Chapter 4
Cumulative Impacts Assessment

4.0 Introduction and Overview of Chapter

The Cumulative Impacts Assessment (CIA) includes an evaluation of both on-site and off-site interactions of the proposed Program practices with the impacts of past and reasonably foreseeable future projects. In conducting the assessment, we distinguish between on-site impacts that are mitigated by application of the Forest Practice Rules and the Program's practices along with the impacts of other past or reasonably foreseen activities, any of which may not be significant when considered alone but when combined could be significant. This assessment is based on information that is reasonably available during the EIR preparation process.

An essential difference between THP's and PTHP's is that an RPF does not need to conduct a CIA when submitting a PTHP — unlike a THP, where such an analysis is required. Instead, the PTHP is tiered to this PTEIR, which contains a CIA for all potential cumulative impacts within the area of potential impacts.

4.1 Methodology

This CIA uses the guidance provided by the Board of Forestry and Fire Protection's Guidance in the Preparation and Review of Program Timberland Environmental Impact Reports (10/06/09) to assess cumulative impacts. This analysis is in part based on the assumption that the Program's practices constitute best management practices that have been evaluated in the resource specific analyses in Chapter 3 above and found unlikely to contribute individual effects at the project/PTHP level.

To know whether or not the Program will meet its goals requires an assessment of the nature and extent of the Program's impacts to public trust resources. To conduct this assessment requires consideration of: 1) current watershed conditions, 2) factors that led to the current condition, and 3) how the current conditions might evolve in the context of anticipated impacts from the Program and those reasonably foreseeable future projects that may occur within the analysis period. With this information, the lead agency and the public can make a reasonable assumption as to the cumulative impacts of the Program and alternatives within the affected area.

The Mattole watershed is very dynamic and its natural range of variability for physical or biological conditions is great. Because the environment is an expression of so many influences and interactions, to understand cumulative watershed impacts sometimes requires relying upon qualitative descriptions and order-of-magnitude estimates. It is necessary to recognize and separate (for analysis purposes) the inherent fluctuations of watersheds due to natural conditions from impacts caused by the Program and other human activities.

In an environmental impact report such as this, the science relating to identifying cause-and-effect relationships for past, present, and future projects is sometimes tenuous. Reasonable judgments must be made based on the quality and quantity of information available. Any

judgment made by an individual will be ultimately based upon their unique values, perspective, formal training, experiences, research and analytical tools at hand.

Natural disturbance, such as that caused by long-term climatic trends, plays a crucial role in determining conditions within the Mattole and also shapes successive conditions. Understanding how natural disturbances influence future environmental conditions and their biologic communities is critical in order to expose and predict cumulative impacts. In addition, people are continuing to modify the ecological processes in the Mattole as they have for thousands of years.

A central objective of the Program is to ensure forest and public trust resource sustainability and resilience in order to maintain the Mattole's ability to recover following disturbance. The Mattole Forest Futures Program aims to encourage landowners toward long-term management and continued sustainability by implementing practices that are designed to ensure that future generations will have the same abundant forests and wildlife that existed historically. The intent of the Program is to integrate the conservation of soil, air, water quality, and wildlife and fish habitat with the careful growing, nurturing and harvesting of trees for useful products and employment. Compliance with the FPR's and the Program practices is intended to maintain and enhance forest and stream conditions.

The methodology for assessing the cumulative effects of implementing the Program follows the "list" approach described in CEQA at 15130 (b)(1). This approach includes "listing" the past, present and probable future projects producing related or cumulative impacts and then describing the severity of the impacts and the likelihood of occurrence. The severity of the impacts and the likelihood of occurrence are described for each of the major resource areas that are required to be addressed in a PTHP per 1092.01(c).

4.2 Description of Assessment Area

Chapter 1 lists the 25 CALWAT hydrologic planning watersheds in the Mattole and the seven subbasins being evaluated in this EIR. As previously noted in Chapter 1, the 25 planning watersheds in the Mattole basin have been grouped into seven subbasins which form the basis for the description of both the direct impacts described in Chapter 3 and the cumulative impacts being described here in Chapter 4. Chapter 3 describes the direct assessment area for each resource area. Generally, the CIA area for watershed impacts (essentially water quality) is the entire Mattole basin. The CIA area for soil productivity is also the entire Mattole basin. The assessment area for biological resources such as fish and other aquatic species, vegetation, and terrestrial wildlife resources is the Mattole basin. The CIA for recreation is the Program area plus an additional 300 feet outside of the Program area. The CIA for traffic is the entire Program area road network and the County road system within the Mattole basin. The CIA for cultural and visual/aesthetic resources, air quality, greenhouse gases and wildland fire is the entire Mattole basin.

4.3 General Description of Program Area

A general description of the Program area has previously been included in Chapter 2 and further detailed in Chapter 3 and is not repeated here.

4.4 Past Activities

Qualitative Description of Subbasin Condition

A narrative description of the condition of each subbasin is included below, which qualitatively describes not only the harvest history but also other actions that may have created significant adverse impacts to public trust resources.

East_1

This subbasin, about 25,900 acres, straddles a long reach of the Mattole River between the community of Honeydew on the North and Grindstone Creek on the South. Its western boundary is Wilder Ridge. Its eastern boundary is the divide between the Mattole and South Fork Eel River Basins for the northern half of the subbasin, and the Mattole Canyon Creek Planning Watershed for the southern half.

The subdivided smaller and residential parcels in this subbasin are mostly in the Dry Creek Planning Watershed and along Wilder Ridge, with some more scattered parcels primarily in the Sholes Creek Planning Watershed and along the upstream western banks of the Mattole River. Private holdings above 160 and greater than 640 acres are mostly in the middle portion of the subbasin, with a few scattered elsewhere, mostly in southern parts of the subbasin. There are important scattered and consolidated BLM holdings that occupy at least a third of the area of the sub-basin, such as the BLM Gilham Butte old-growth reserve, which is incorporated into the "Redwoods to the Sea" corridor, connecting Humboldt Redwoods State Park with the KRNCA.

Aside from extensive more recent residential subdivision, the East _1 subbasin was also subjected to heavy grazing, timberland conversion impacts, the devastating post WW II tractor logging, and an assortment of fires. Gilham Butte is the largest contiguous old-growth legacy forest in the Mattole Valley, with its protection a major public concern since the 1960s and earlier. Although watersheds and stream habitat conditions seem to be improving, the unstable geology, flood exacerbation via human impacts, and unstable private road networks are all existing adverse factors. Some significant work has been done in the subbasin by the Good Roads Clear Creeks program, and more such work is planned.

This subbasin encompasses the widest range of bedrock types and structures in the Mattole Basin, including portions of the Coastal terrane, Yager terrane, and Central Belt mélange, along with the fault zones that form the boundaries between the terranes. Slope stability varies widely. Soft terrain grassland areas are impacted by earthflows, soil creep, and gully erosion. There is a NW to SE band of soft terrane running through the middle of the subbasin. Mapped landslides occupy almost a quarter of the subbasin.

High levels of sediment, cobble embeddedness, lack of canopy and instream cover, and seasonal high water temperatures generally impair the anadromous streams in the subbasin. There are some healthy areas, however, and Chinook and coho Salmon, and steelhead trout are present in the subbasin. According to the NCWAP Assessment Report, the estimated anadromous habitat length (in miles), going from North to South is: Dry Creek 3.0, Middle 2.1, Westlund 3.1, Fourmile 3.1, Sholes 2.0, and Harrow 0.2. Stream bank erosion is a problem, especially in the Dry Creek and Sholes Creek Planning Watersheds. There are significant barren riparian areas, especially in Dry Creek and upstream parts of the Mattole River. Dry channel reaches and toxic spill risks are two other concerns.

The East_1subbasin contains large tracts of recovering forestland that need stewardship. Fortunately, the subbasin also contains many motivated residents, whose individual and cooperative efforts can be coordinated to economically and environmentally carry out appropriate practices for recovery, fuel hazard reduction, and watershed restoration.

East_2

This sub-basin, about 24,937 acres, extends along about 13 miles of the Mattole River, from the river east to the divide between the Mattole and the South Fork Eel River Watersheds. It includes McKee Creek watershed on the South and Grindstone Creek watershed on the North. Most of the land is in ranches and subdivided ranches. Eubank, Blue Slide, and Mattole Canyon Creeks are the major creeks that either are, or have the potential to be, some of the most productive tributaries in the Mattole River watershed.

According to the NCWAP "Assessment Report," the estimated anadromous habitat length (in miles) for the streams in the sub-basin, going from North to South, are: Grindstone 0.3, Mattole Canyon 6.0, Blue Slide 7.0, Eubank 3.2, Painter (tributary of McKee) 1.1, and McKee 2.1. McKee Creek is known to definitely support coho Salmon. Eubank and McKee Creeks maintain the best cold-water temperatures. Eubank and Blue Slide Creeks have the highest quality pools.

It appears that this subbasin is probably the most heavily populated in the Mattole Watershed with two of three of its Planning Watersheds having more than 12 owners per 1000 acres, and the third having between 6 and 12 owners per 1000 acres. Access is mainly over extensive networks of private roads that are connected to the Briceland Road (both within and to the east of the Mattole Watershed), the Telegraph Ridge Road, with some easterly ownerships accessed via the Elk Ridge and Salmon Creek Roads. There are a lot of 'serious' long-term homesteaders that are concerned with road maintenance, fire prevention, water quality & quantity, and forest stewardship. This constitutes a nucleus of persons who, if encouraged and helped with cost shares, can carry out long-term stewardship measures -- and who have already participated strongly with the Good Roads Clear Creeks Program of the MRC. Many roads in the Mattole Canyon and Blue Slide Creek areas have been evaluated and/or had upgrade/corrective measures projects implemented. Other smaller areas in the sub-basin have similar work done -- with significant potential corrective measures still possible and needed throughout the sub-basin.

The forests in the sub-basin are primarily Douglas fir and Tan Oak dominated with significant components of other hardwoods such as Madrone, Black Oak and others. Little logging has been

done for the last 30 years except for some damaging cut & sell development. Typically, damage and impacts from tan barking and very heavy post WW II logging are a legacy that is difficult to adequately address. Needed measures to manage the thick regrowth for fuel hazard reduction and high-value forest stewardship have been very limited -- with fuel hazard reduction measures only around a few homesteads and some ridge top roads.

Steep forested slopes are "locally impacted by historically active debris slides and occasional large, deep seated dormant landslides . . ." (NCWAP, 2002). Certain reaches of streams in the sub-basin continue to be adversely impacted by inner gorge landslides and bank erosion despite a general trend of recovery due to reduction of impacts since the overwhelming logging disturbances. Soft terrain earthflows and gullies are a serious issue in eastern parts of the sub-basin.

North_1

This subbasin, about 34,431 acres, is the northernmost subbasin in the Mattole Valley, bounded on the far southwest by the Pacific Ocean, and on the westerly side from south to north, by the coastal Planning Watersheds of McNutt Gulch, Davis Creek and the South Fork Bear River. On the north and northeast the subbasin is bounded by the Bear River watershed, and on the south, from west to east, by the Mattole River, the divide between Conklin and McGinnis Creeks, and the divide between the Lower North Fork and the Upper North Fork watersheds.

The North_1 subbasin has the largest area of low human population density (less than 3 owners per 1000 acres) in the Mattole Valley. This subbasin, along with the North_2 subbasin has generally 'soft geology' (over 40% of the area) and the most extreme slope stability, erosion, and sedimentation problems. Over 60% of the area has either a high or very high landslide potential. This, coupled with a long history of overgrazing, tan barking, conversion of forestland to grazing land by fire, topped by huge floods during the post WW II tractor logging period has created huge problems for recovery of watershed and forestland-based resources. The subbasin also includes half of the Mattole lagoon/estuary area, which remains substantially and cumulatively impacted by problems in the Lower North Fork watershed. These problems extend from the estuary upstream, and are also caused by adverse impacts from the rest of the Mattole watershed.

There is a clustering of small parcels around the Town of Petrolia, and other areas of under-160-acre parcels, mostly in the Apple Tree and Cow Pasture Opening Planning Watersheds. Almost all of the Petrolia, Joel Flat, Long Ridge and Rainbow Planning Watersheds are in private ownerships of greater than 640 acres. The current large holdings of the Humboldt Redwood Company (formerly Pacific Lumber/Maxxam) in this subbasin are in the Rainbow Planning Watershed, with some in the Long Ridge and Apple Tree Planning Watersheds and in the Conklin Creek watershed. Most if not all of the large ranch and forestland holdings are working ranches, and about a third of the subbasin is in grasslands. This subbasin, along with the North_2 and South subbasin, has had the most 'modern' logging operations (occurring after passage of the 1973 Forest Practice Act) in the Mattole Valley. In the 1980s and ’90s, public controversy reached a 'fever pitch' with logging by PL/Maxxam in the Mattole Valley in areas such as Rainbow Ridge. Litigation and non-violent citizen defense continued for years, involving such places as Sulphur Creek, where older larger firs were planned to be cut in a watershed where numerous scarred, eroding clearcuts were still in evidence.

NCWAP found this area to have "the highest concentration of mapped gullies and length of Negative Mapped Channel Characteristics (NMCCs). The length of gullies more than doubled between 1984 and 2000. Rainbow Planning Watershed NMCCs decreased in length, but increased in the Cow Pasture Opening Planning Watershed.

Fish habitat factors including temperature, large wood, pools, and spawning gravel are generally quite poor through the subbasin. There are some bright spots, such as good canopy and gravels in Sulphur Creek. Also from NCWAP: "…surprisingly few dry channel reaches [were] recorded in late summer surveys..." NCWAP estimated anadromous habitat length in miles: Jim Goff Gulch 0.7, Lower North Fork 8.0, East Mill 1.3, Conklin 2.2, East Branch of the lower North Fork 0.9 (This list seems incomplete as Sulphur Creek has had salmonids observed, and its mouth is further up the East Branch than 0.9 miles). Historically, the Lower North Fork Watershed supported Chinook and coho Salmon and steelhead. Recovery in this subbasin is problematic but foreseeable with suitable intervention and recovery time.

North_2

This subbasin, about 29,157 acres, is comprised of the Upper North Fork watershed and the smaller eastside Mattole tributary watersheds from Honeydew downstream to and including McGinniss Creek watershed. The northeastern boundary is the Bear River watershed and the Bull Creek watershed of the South Fork Eel River basin. The northwestern boundary is the Conklin Creek watershed and the East Branch of the Lower North Fork Mattole watershed. The southeastern boundary is the Honeydew and Dry Creek Planning Watersheds.

The area around the town of Honeydew and the southern half of the Rattlesnake Creek Planning Watershed are primarily small residential parcels. There are a few smaller parcels scattered across the rest of the subbasin, but the northern half of the Rattlesnake Planning Watershed and the Tent City, Camp Mattole and McGinnis Creek Planning Watersheds are almost entirely large ownerships with those over 640 acres dominant. There are two large industrial forestland blocks owned by Humboldt Redwoods Company that together, comprise between a third and a half of the area of the subbasin. The larger of the blocks is mostly in the northeast half of the Upper North Fork watershed, and the smaller is mostly in the McGinniss Creek and Camp Mattole Planning Watersheds.

This subbasin, similar to the North_1 subbasin, is extremely unstable and eroding either through the soil creep and mass movement common to 'soft terrain', or through landslides, debris torrents, and debris slide slopes on harder, steeper terrain. The impacts of overgrazing, post WW II tractor logging, coupled with fires have been especially hard on subbasin North_2, particularly in the Upper North Fork watershed. From NCWAP: "Two fires in 1990 covered 6,700 acres, mostly in the Oil Creek and Camp Mattole Planning Watersheds . . . only seven percent of the forest stands [in North_1 and North_2 subbasins] have average tree diameters greater than twenty-four inches..."

NCWAP estimated anadromous habitat length in miles: McGinnis Creek 3.1, Upper North Fork mainstem 8.0, Upper North Fork tributaries: Oil Creek 3.5 (& Oil Creek tributaries: Green

Ridge Creek 0.6 and Devils Creek 0.8); and Rattlesnake Creek 3.0. NCWAP found that Oil Creek had an increase of 8% in NMCCs between 1984 and 2000. There was locally intensive 'sanitation/salvage' logging in the Oil Creek watershed following the 1990 Rainbow Fire. "The length of gullies increased in all Planning Watersheds between 1984 and 2000." "Approximately 8,200 feet of eroding bank has been mapped in the Rattlesnake PW." Erosion from inner gorges and historically active landslides is also common in this subbasin.

Overall, habitat conditions in the North_2 subbasin are not currently "supportive of the cold beneficial use of water for salmonid habitat." Lack of canopy, gravel embeddedness, lack of pools, and lack of large wood are the common condition of these streams. Steelhead are still found in these streams, but they once supported coho and Chinook Salmon as well. Again, like North_1 subbasin, there needs to be a concerted, cooperative, and organized effort to recover the forest and watershed resources here. The small areas positively affected by the MRC's Good Roads Clear Creeks program need to be increased by orders of magnitude and scope.

South_1

The South_1 subbasin of the Mattole River Watershed is the southern most headwaters area of the Mattole, extending from the Bridge Creek and Van Arken Creek watersheds upstream to Four Corners, an area of about 17,644 acres. The area of this sub-basin coincides with a sub-basin used for the Mattole evaluation done by the state's North Coast Watershed Assessment Program (NCWAP) in the "Mattole River Watershed Assessment Report" of March 2003.

There are two CalWater Planning Watersheds in the Southern Sub-basin: Bridge Creek and Thompson Creek. The sub-basin has a number of tributaries that are very significant for spawning and rearing habitat for salmon and steelhead. They, along with the headwaters mainstem, are considered the largest and most important refugia for salmonids, especially coho, in the Mattole. Bridge, Van Arken, Mill, Baker, and Thompson Creeks are the most prominent of these tributaries, but many smaller tributaries such as Ravasoni, Harris, Gibson, and Stanley are, or are potentially, very significant and important salmonid habitat.

The South_1 subbasin has a number of noteworthy features, including but not limited to, containing almost all of the redwood forest in the Mattole Valley, having a 'hard' geology with relatively stable slopes and a lot of bedrock controls in the stream and river channels, a generally more favorable natural recovery from past adverse logging impacts, a lot of human restoration work over the last quarter century, the largest human population in the Mattole Valley, large areas of modern industrial logging, and significant areas of protected forest remnants.

There is quite a mix of land use and ownership in the South Sub-basin. There are some concentrated areas of small residential parcels -- around 'new' Thorn (Whitethorn), 'old' Thorn (Whitethorn Junction to Bridge Creek), and the Gopherville and Whale Gulch areas in the Mendocino County headwaters. There are a lot of scattered 20, 40, 80 and larger parcels -- some with residents and some not. Most of the industrial timberland in the sub-basin is on the eastern side of the Whitethorn Valley, although there are some significant areas on the westside also, notably Mill Creek. Barnum Timber Company (BTC) is the major industrial owner, although

some other smaller landowners have conducted industrial-type logging on their properties from time to time.

Past cumulative impacts include tanbark extraction and redwood split-stuff manufacture from the 1800s into the 1930s, high impact tractor logging during post WW II boom time, followed by remnant timber cutting under the 1973 Forest Practice Rules. Indigenous, generally low impact, habitation was followed by higher impact settler occupation that reached its peak population during the post-WWII logging boom. This was succeeded by a surge of back-to-the-lander immigration in the 1960s, 70s and later. In this last period, significant remnant forest was protected. Present and future cumulative effects are focused upon excessive human population pressure and water use, along with continuing recovery efforts for Salmon and steelhead in this headwaters refugium. Modern Forest Practice rules and related rules & laws coupled with public vigilance should ensure a lower risk of significant cumulative effects in the future.

West_1

This subbasin, about 25,843 acres, is generally bounded on the North and East by the Mattole River, on the West by the King Range Crest/Mattole River watershed divide and the Pacific Ocean, and on the South by the Honeydew Creek watershed. It is comprised of the Shenanigan Ridge, Squaw Creek, and Woods Creek Planning Watersheds. More than a third of the West_1 subbasin is in the KRNCA, most of it in wilderness designation except for some areas in or close to the Woods Creek watershed, in or close to the Indian Creek watershed, at the mouth of the Mattole River, and a few small scattered parcels.

The rest of the subbasin is in private holdings with quite a range of sizes. There is a large subdivided area from about Mill Creek to the ocean between Prosper Ridge and the Mattole River, with smaller to medium-sized parcels scattered among larger older ranch and forestlands extending next to or accessed by the Mattole Road upstream to (and into) the Honeydew Creek watershed. Most, but not all, of the interior private parcels are quite large, most between 160-640 acres, with a couple larger.

Some fertile, flat agricultural bottom and terrace lands are spaced along the Mattole River in this subbasin. Most of the upland areas have been severely impacted at one time or another over the last 150 years by fires, overgrazing, tan barking, and the devastating impacts of tractor logging after WW II. There is some 'harder' geology on the east slopes of the King Range, but also significant landsliding along with debris slide slopes. There are also "Large deep-seated landslides, historically active earthflows, and gully erosion on grass-covered highlands…mapped in association with soft terrain...” (NCWAP, 2002). About 10% of the subbasin is grassland, with about half of the subbasin in mixed conifer/hardwood, with hardwood forests about twice the area of conifer forests on the remainder.

According to NCWAP, the estimated anadromous habitat length in miles for the creeks in this subbasin, going from North to South, are: Bear 0.3, Stansberry 0.5, Lower Mill 1.4, Clear 0.7, Indian 1.2, Squaw 12.7, Saunders 0.4, and Woods 1.5. NMCCs between 1984 and 2001 generally decreased in the Squaw and Woods Creeks Planning Watersheds, but increased in the Shenanigan Ridge Planning Watershed (though its length of gullies went down). Gravel

embeddedness is a problem in all these streams, but Lower Mill Creek is in better shape in this regard than Squaw Creek, which had 50% or greater embeddedness in over 80% of the reaches sampled. Squaw Creek also ranks low in canopy (about 45% canopy cover) with Woods Creek somewhat better at 65%. Stream temperatures in most of the tributaries are problematic.

Both Chinook and coho Salmon have been found in Squaw and Woods Creeks. Coho have been found in Lower Mill Creek and Clear Creek. Steelhead are present in all of this subbasin's Mattole tributaries. Chinook have been found in Stansberry and Indian Creeks. Fish passage improvements have been made to Bear, Stansberry, Lower Mill, Indian and Saunders Creeks. There are almost unlimited opportunities in this subbasin for silvicultural and watershed recovery efforts–given adequate funding, motivation, and cooperation.

West_2

The West_2 sub-basin, about 32,249 acres, is bounded on the west by the crest of the King Range and on the east (from north to south) by the Wilder Ridge, the Mattole River, and the Bridge Creek watershed. There are four Planning Watersheds in the sub-basin that include all of the Honeydew Creek and Bear Creek watersheds along with some smaller west-side Mattole River watersheds that include Big and Little Finley, and Nooning Creeks. More than 2/3rds of the sub-basin is in the King Range National Conservation Area (KRNCA), which was established in 1970, with close to about half of that being classified as Wilderness in 2006. Honeydew and Bear Creeks are two of the largest and most important anadromous salmonid tributary streams of the Mattole. The NCWAP assessments concluded that the Mainstem Bear Creek had the best salmonid habitat in the Mattole watershed.

According to the NCWAP "Assessment Report" the estimated anadromous habitat length (in miles) for the streams in the sub-basin, going from North to South, are: Honeydew Mainstem 5.9; Honeydew tributaries: Bear Trap 0.1, High Prairie 0.6, East Fork 6.0, and West Fork 0.2; Bear Mainstem 6.5; Bear tributaries: North Fork 4.3, Jewett 2.4, French 0.4, and South Fork 10.7; Little Finley (less than 0.1), Big Finley 0.1, and Nooning Creek 1.5. Most of Honeydew Creek is in the wilderness area with its lower reaches and the East Fork in non-wilderness KRNCA or private holdings. There are some private holdings affecting the North, South Forks, and Mainstem Bear Creek watersheds, but a large portion of, or most of, those watersheds are in non-wilderness KRNCA. The same goes for the Finley Creeks and Nooning Creek watersheds.

Three of the four Planning Watersheds are of "medium low" population density with 3 to 6 owners per 1000 acres. Most of this population is scattered in small parcels along Wilder Ridge, above the East Fork of Honeydew Creek, and along several private roads that connect to the Wilder Ridge Road, as well as some that are similarly situated relative to the Shelter Cove and Chemise Mountain Roads.

Past significant adverse impacts to the Planning Watershed include, heavy grazing, post WW II tractor logging and tan barking. Compared to the extensive subdividing of some of the more populated Planning Watersheds, subdivision here has been limited. Management impacts to the wilderness areas of the KRNCA will be very limited due to exclusion of motorized vehicles. Management impacts to the non-wilderness areas of the KRNCA will be quite limited also, but

more management is likely due to BLM's goal of thinning to accelerate the development of late seral forest characteristics and to reduce the risk of wildfire. Fire is a very large issue and has had an even bigger impact here than in the rest of the Mattole Valley. Large fires such as the 1973 Finley Creek Fire, the 2006 Honeydew Fire, and many others have severely affected the area. BLM and the MRC have cooperated on shaded fuel breaks along the west side of the Planning Watershed and along county and private roads including the Wilder Ridge Road.

This sub-basin has some of the highest rainfall totals in the Mattole Valley because of the orographic impact of the high ridges and peaks of the King Range. Close to 20% of the area is covered by active or dormant landslides. There are abundant debris slide slopes. Despite all this, there is the potential for steady watershed and stream habitat recovery because some of the people in this sub-basin are proactively working to restore stream function.

Past 10 Year Harvest History

Chapter 2.0.3, timber harvest history, describes the acreage of harvest by various periods while Table 2-4 shows the acres harvested by subbasin by silvicultural prescription between 1983 and 2007. Technical Rule Addendum 2 requires a detailed analysis of the past 10 years of timber harvest. Table 4-1 shows the harvest by silvicultural type by subbasin between 1999 and 2010. Figure 4-1 shows the location of the last 10 years of harvest, most of which occurred in the North_1 and North_2 subbasins.

Figure 4-1

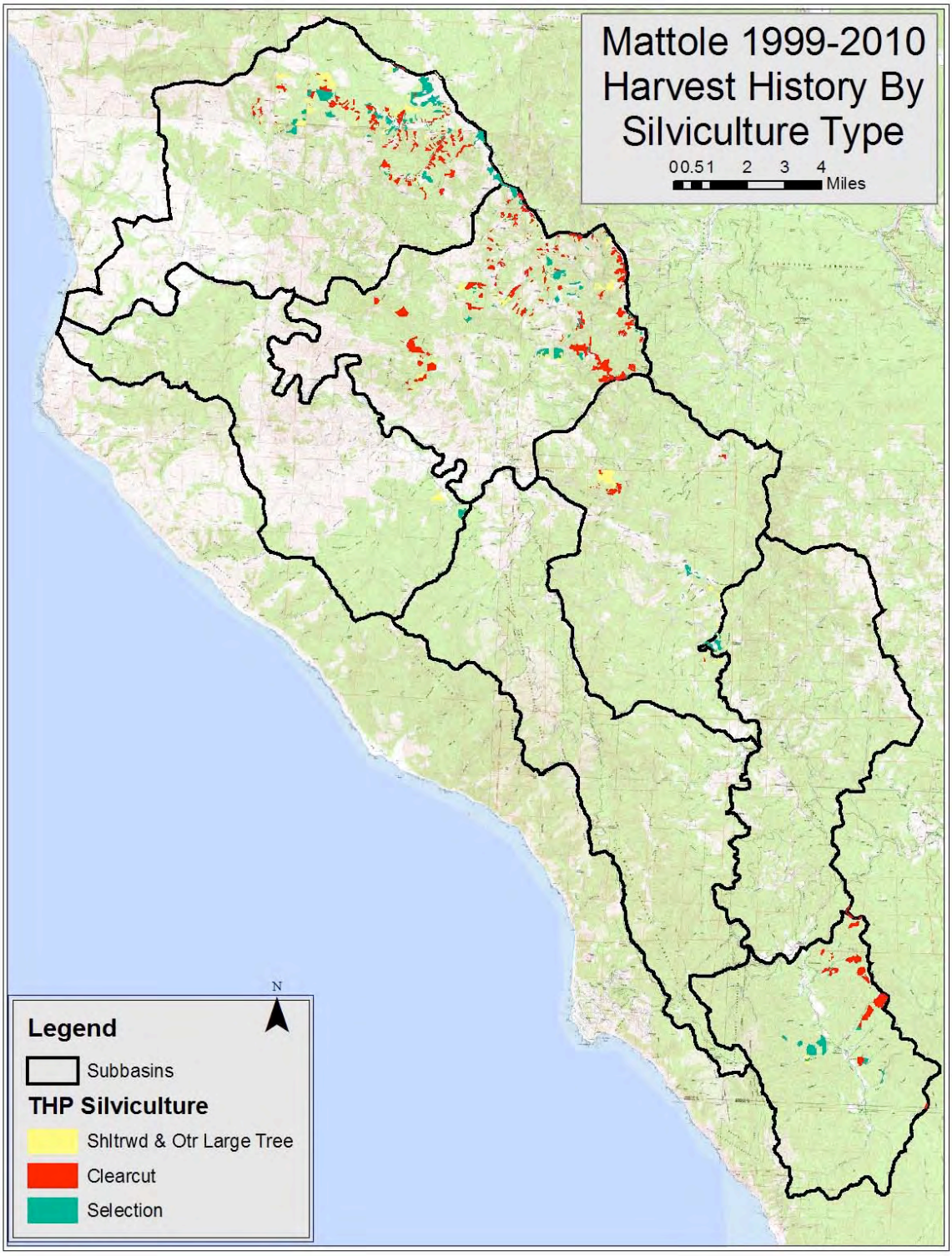

Mattole 1999-2010
Harvest History By
Silviculture Type
00.51 2 3 4
Miles
N
Legend
Subbasins
THP Silviculture
Shltrwd & Otr Large Tree
Clearcut
Selection

Table 4-1
Past THP Harvest 1/ (1999-2010) By Silviculture And By Subbasin

Subbasin	Category 1 2/ Silviculture	Category 2 Silviculture	Category 3 Silviculture	Total
East_1	66	154	34	253
East_2	5	10	40	54
North_1	567	288	590	1,445
North_2	999	210	329	1,537
South_1	288	15	150	453
West_1	0	37	23	60
West_2				
Total	1,924	713	1,166	3,803

1/ All harvest is by THP, no NTMP Harvest during period

2/ Silviculture Category 1 includes even-aged regeneration prescriptions: clear-cut, rehabilitation, seed tree step, shelterwood seed step and road construction. Silviculture Category 2 includes prescriptions that remove most of the largest trees: shelter wood prep step, shelterwood removal step and alternative prescriptions. Silviculture Category 3 includes prescriptions that leave large amounts of vegetation after harvest: selection, group selection, commercial thin, sanitation salvage, transition and seed tree removal step prescriptions.

Barnum Timber Company and PALCO filed the vast majority of the plans listed above. Virtually every plan noted above has a completion status of 'completed.' Because these plans were completed under various versions of the Forest Practice Rules since 1999, they included substantive measures to reduce the adverse impacts of these past projects. Therefore, the past plans noted above are not expected to combine with the Proposed Program to cause cumulative adverse impacts to any resource area. It is likely that many of these projects have a had a net benefit to water quality in the Mattole basin as a result of improvements to drainage structures on both permanent and temporary roads and on skid roads. Since virtually every one of the THP's filed within the past 10 years has a completion status of complete, it is assumed that these projects comply with the FPR's and the THP-specific mitigation measures for any particular THP.

MRC Good Roads Clear Creeks Program

The Mattole Restoration Council's Good Roads Clear Creeks Program treats actively used and abandoned roads to remove potential sediment before road failures deliver this sediment to the already impacted Mattole basin streams. In the 11 years since the Program was founded, about 537,000 yards of sediment has been removed from places where it would be likely to be delivered to streams in the basin. The lion's share of the material removed (250,000 yards) has been in the East_2 subbasin, essentially from Blue Slide to Grindstone Creek. South_1, East_1 and the Eubanks portion of East_2 each have had about 70,000 yards of material removed from crossings on active and abandoned roads.

4.5 Present Activities

Ongoing present activities include road improvement, residential development and livestock grazing. Until 2010, due to depressed market conditions for Douglas-fir and tanoak, most timber harvest was not economical to implement. As such, most landowners with harvestable timber have been waiting for market conditions to improve before committing to timber harvest. No THP has been filed in the Mattole since 2007. All plans were complete as of March 2010.

MRC's Good Roads Clear Creeks program is currently implementing road decommissioning and sediment removal in the Blue Slide and Grindstone Creek areas and in the Petrolia area. Approximately 30,000 yards of material are expected to be removed from the Blue Slide/Grindstone project and about 25,000 yards are expected to be removed in the Petrolia area before the end of 2010. Funding is secure and work is expected to take place in the Upper North Fork (North_1 subbasin) in 2011 to removed about 200,000 yards of material.

4.6 Probable Future Projects

CEQA does not explicitly describe what constitutes a "probable future project", but the CEQA Guidelines describe such things as private projects requiring agency approval, public projects for which money has been budgeted, projects included in a summary of projects in a general plan and projects anticipated as later phases of a previously approved project.

The Forest Practice Rules explicitly define "probable future projects" under the definition of Reasonably Foreseeable Probable Future Projects to mean; "*Projects with activities that may add to or lessen impact(s) of the proposed THP including but not limited to: 1) if the project is a THP on land which is controlled by the THP submitter, the THP is currently expected to commence within but not limited to 5 years, or 2) if the project is a THP on land which is not under the control of the THP submitter, the THP has been submitted or on-the-ground work including THP preparation has materially commenced, or 3) if the project is not a THP, and a permit is required from a public agency, and the project is under environmental review by the public agency, or 4) if the project is one which is [undertaken] by a public agency, the agency has made a public announcement of the intent to carry out the project.*"

Because the FPR's definition of reasonably foreseeable probable future projects mirrors the CEQA description of a probable future project, hereafter, the term reasonably foreseeable probable future project is considered equivalent to the CEQA definition of probable future project.

The reasonably foreseeable probable future activities include implementation of the Proposed Program as well as potential conventional timber harvest that is comprised of landowners submitting standard THP applications. In addition, there is a reasonable expectation that the MRC will continue its Good Roads Clear Creeks Program, and that there will be continued livestock grazing, residential development and road use and upgrading not associated with the MRC Good Roads Clear Creeks Program. Besides these projects, the BLM is expected to continue management under its current Resource Management Plan that includes stand improvement to increase late seral development and maintenance of existing shaded fuel breaks. Several Fire Safe Councils have prioritized projects in the Mattole that are implemented when

funds are available and there are community groups with the expertise and administrative capability to implement such projects. A more complete description of each of these reasonably foreseeable probable future activities is described below.

Program Related Timber Harvest

Chapter 3 describes in detail the project impacts associated with the projected harvest that might result from implementation of the Program. Slightly more than 15,000 acres of timberland within the Mattole basin are projected to be harvested over the next 60 years under the Mattole Forest Futures Program. Harvest by period and by subbasin has been previously described in chapter 2.2 and is not repeated here.

"Conventional Off-Program" Timber Harvest

For this analysis, the reasonably foreseeable probable future timber harvest is assumed to be comprised of harvest by Humboldt Redwood Company, Barnum Timber Company and non-industrial private timberland owners throughout the Mattole. The specific assumptions are described below but essentially are based on the historic trend of past silviculture, discussions with Humboldt Redwood Company and review of Barnum Timber Company's timber age class data based on timber harvest history.

The recent historical trend in silvicultural systems shows that uneven-aged systems have been employed 70% of the time in the Mattole and the remaining 30% of harvests have been comprised of even-aged systems. The assumption is that uneven-aged harvesting which previously would have occurred under a THP would shift into the Program, while the 30% even-aged would continue to operate under THP's. Therefore, the "conventional off-Program" harvest is projected to be comprised of primarily even-aged silvicultural systems, and is estimated at 30% of the total Status Quo harvest acreage over the 50-year projection period.

The Humboldt Redwood Company (HRC) "conventional off-Program" even-aged harvest, which is comprised of variable retention or rehabilitation treatments, is projected to take place solely in the North_1 and North_2 subbasins, where the company's holding are located. This harvest is expected to be about 150 acres/5 year period each in the North_1 and North_2 subbasins for a total of 60 acres/year across both subbasins. All other harvest by Humboldt Redwood Company is assumed to occur under the Program and is already accounted for in the direct environmental impacts described in Chapter 3 above. Table 4-2 below summarizes the projected off-Program harvest expected during the 50-year projection period by subbasin and by alternative. Even if HRC uneven-aged harvests are permitted as regular THPs instead of PTHPs to retain less basal area after harvest, the watershed protection standards to which the firm is committing under its Habitat Conservation Plan and Watershed Analysis are roughly equivalent to those required under the Program, and thus the conclusions regarding cumulative effects will still stand.

Barnum Timber Company is also expected to have reasonably foreseeable probable future timber harvest. All of this harvest is "off-Program", is expected to be even-aged, and takes place solely in the South_1 subbasin. It is not expected to begin until 2030 and is projected at a rate of 285 acres/5 year period. This harvest is expected to continue at that rate into the future.

A portion of the non-industrial private timberland owners are also expected to harvest timber "off-Program". The "off-Program" NIPF harvest is projected at 30% of the Status Quo and is expected to be comprised solely of even-aged harvest or heavy selection that would not meet the requirements of the Program.

BLM King Range National Conservation Area Reasonably Foreseeable Projects

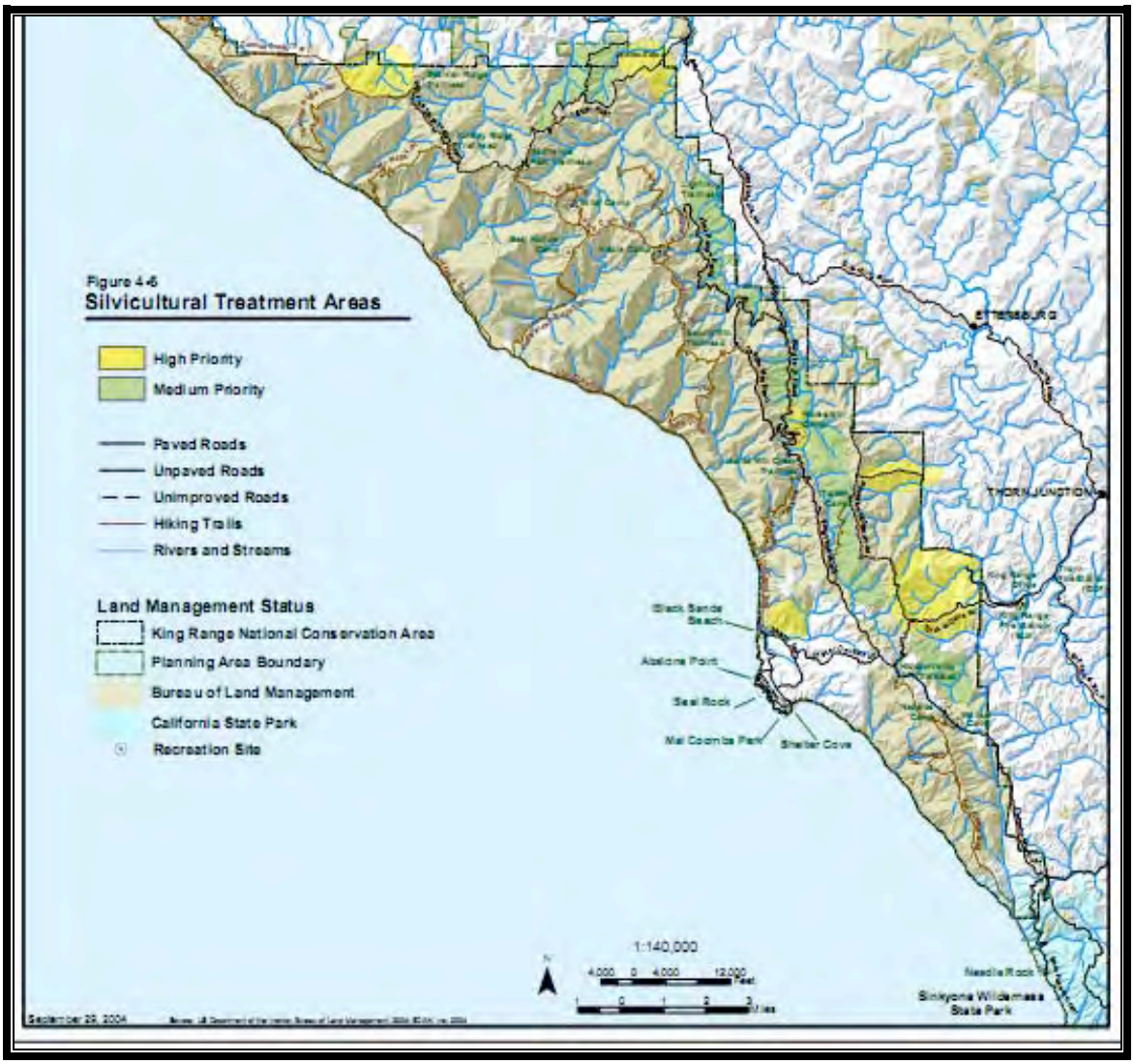
The BLM is not proposing timber harvest within the KRNCA or its other Mattole holdings, and as such, all of the KRNCA forestland will continue to mature at varying rates. For a limited number of stands, the BLM seeks to accelerate (King Range objective FM 1.4) the rate at which second-growth stands achieve old-growth or late-successional characteristics. Previously harvested stands would be treated in the Spanish Ridge, Honeydew, and Paradise Ridge areas and in the Bridge Creek and Eubank Creek areas of South_1 and East_1 respectively. The BLM also has a goal (FM-2) to enhance the development of a more diverse forest structure on approximately 700 acres of the KRNCA particularly in the Nooning Creek and Finley Ridge areas, and in Bear Trap Creek. Implementation of these projects is expected to result in negligible to moderate positive impacts to the amount of late seral forests within the Mattole. Figure 4-2 below shows the likely locations of some of the proposed silvicultural treatment areas.

Table 4-2
Cumulative Impact Analysis Area And
Reasonably Foreseeable Probable Future Timber Harvest, 2010-2060

Subbasin	Total Area	Forestland Area	Commercial Forestland Area	Available* Private Commercial Forestland	Off-Program Harvest Area	Footprint Area of Program or Alt.	Total Area Harvested, including off-Program	Commercial Forestland Area Not Harvested
	Program Acres							
East_1	25,875	23,347	20,351	11,459	487	2,655	3,142	17,209
East_2	24,983	21,555	15,616	11,576	209	1,669	1,878	13,739
North_1	34,401	19,668	15,060	6,755	1,308	4,307	5,615	9,445
North_2	29,123	20,017	15,313	4,744	1,022	2,935	3,957	11,356
South_1	17,637	17,327	13,164	5,354	1,717	631	2,348	10,816
West_1	25,820	19,731	13,734	6,155	62	1,746	1,808	11,926
West_2	31,919	29,360	23,593	6,065	106	1,095	1,201	22,392
Total	189,760	151,005	116,831	52,108	4,912	15,038	19,950	96,882
Alternative I Status Quo Acres								
East_1	25,875	23,347	20,351	11,459	N/a	1,950	1,950	18,402
East_2	24,983	21,555	15,616	11,576	N/a	770	770	14,846
North_1	34,401	19,668	15,060	6,755	N/a	5,330	5,330	9,730
North_2	29,123	20,017	15,313	4,744	N/a	4,292	4,292	11,021
South_1	17,637	17,327	13,164	5,354	N/a	1,717	1,717	11,447
West_1	25,820	19,731	13,734	6,155	N/a	277	277	13,457
West_2	31,919	29,360	23,593	6,065	N/a	379	379	23,214
Total	189,760	151,005	116,831	52,108	N/a	14,715	14,715	102,116
Alternative II Acres								
East_1	25,875	23,347	20,351	11,459	487	2,725	3,212	17,139
East_2	24,983	21,555	15,616	11,576	209	2,083	2,292	13,324
North_1	34,401	19,668	15,060	6,755	1,308	3,973	5,281	9,779
North_2	29,123	20,017	15,313	4,744	1,022	2,441	3,463	11,850
South_1	17,637	17,327	13,164	5,354	1,717	653	2,370	10,795
West_1	25,820	19,731	13,734	6,155	62	2,295	2,357	11,377
West_2	31,919	29,360	23,593	6,065	106	1,230	1,336	22,257
Total	189,760	151,005	116,831	52,108	4,912	15,400	20,311	96,520
Alternative III Acres								
East_1	25,875	23,347	20,351	11,459	487	1,592	2,079	18,272
East_2	24,983	21,555	15,616	11,576	209	1,001	1,209	14,407
North_1	34,401	19,668	15,060	6,755	1,308	3,027	4,335	10,725
North_2	29,123	20,017	15,313	4,744	1,022	2,377	3,399	11,914
South_1	17,637	17,327	13,164	5,354	1,717	611	2,328	10,836
West_1	25,820	19,731	13,734	6,155	62	1,018	1,081	12,653
West_2	31,919	29,360	23,593	6,065	106	602	708	22,885
Total	189,760	151,005	116,831	52,108	4,912	10,228	15,140	101,691

** Available under 2010 FPRs after WLPZ and geology removals. Total available area will be slightly different under the Program and Alternative 3 (57,601 acres) and Alternative II (46,644 acres) because of variation in the widths of riparian buffers and assumptions about how much ground is removed for geologic reasons.*

Figure 4-2
BLM Silvicultural Treatment Areas



The KRNCA also has a goal to maintain its shaded fuel break system. The existing system consists of mostly ridge top road; shaded fuel breaks along the King Peak and Saddle Mountain roads and out the South Etter road to the Northside Peak Trailhead. In addition there is also the Paradise Ridge Road shaded fuel break that extends north out to Horse Mountain and south to the Shelter Cove Road. Maintenance of these shaded fuel breaks is not expected to contribute adverse environmental impacts to vegetation or soils in addition to those projected to be created by the Program in the West_2 and South_1 subbasins. Figure 4-3 below shows the location of the BLM existing or planned fuel break system in or near the KRNCA.

The BLM is not planning on additional road rehabilitation in the KRNCA, as it believes most of the essential road rehabilitation has already been completed (G. Pritchard-Peterson, personal communication 2010). The BLM is proposing to reduce the number of grazing allotments within

the Mattole portion of the KRNCA by making the 654-acre Bear Trap Ridge and 80-acre Lee French allotments unavailable since both were clearcuts that have now developed into densely stocked Douglas-fir plantations. Changing the grazing status of these two allotments is expected to have a negligible positive environmental impact by adding additional acres of conifer forest to the Mattole basin in general and to the West_1 subbasin in particular.

The KRNCA mountain bike trail network is being expanded in the Paradise Ridge area; however, this is not expected to contribute additional environmental impacts to those created by the Program.

Figure 4-3
BLM Existing and Planned Shaded Fuel Break System

Fire Safe Council Projects

The following projects were ranked high priority at the time these Fire Safe Councils prioritized them. Their current and or future status is unknown. Because most of the funding for these projects is not known until each year's state and federal budgets are approved, it would be speculative to include some or all of these projects in the cumulative impacts analysis that follows.

Lower Mattole Fire Plan 2002

a. Shaded fuel break along Fox Springs Road
b. Shaded fuel break along south Panther Gap/Stewart Ridge Rd.
c. Shaded fuel break along Panther Gap/Perimeter Rd.

Upper Mattole Fire Plan 2004

1. Shaded fuel break along Ettersburg-Honeydew Road along Telegraph Ridge (completed)
2. Shaded fuel break along Briceland-Thorne Road from Thorn Junction to Four Corners
3. Dutyville Road shaded fuel break
4. Shaded fuel break along Huckleberry Lane north from Thorn Junction
5. Shaded fuel break along Blue Slide Road
6. Shaded fuel break along Gibson Ridge Road on Barnum Property
7. Shaded fuel break along private roads east of Whitethorn along East Anderson, Harris, Gibson, Stanley and Baker Creeks.

The Humboldt County Fire Safe Council has developed an updated list of projects by working with Fire Safe Councils around the County. For the Mattole-Lost Coast area, the following projects, which are separate from the Lower and Upper Mattole Fire Safe Council projects above have been rated as high priority. However, the Humboldt County Fire Safe Council is "switching gears" to some extent and prioritizing "hardening" rural homes and access routes through education and grants that are tied with the CALFIRE 100' clearing requirements in PRC 4291 rather than implementing some of these larger landscape scale projects.

Humboldt County Fire Safe Council and Master Fire Protection Plan Projects

1. Strawberry Rock/BLM mastication project
2. Demonstration/Pilot project at Petrolia dump
3. Mill Creek-Matthews Ranch Road shaded fuel break
4. Downtown Petrolia-Chambers road eucalyptus grove clearing/cleanup

Shaded fuel breaks are typically located with a County or other major road anchoring the fuel break depending on the actual physical location of the road and the surrounding terrain. Most shaded fuel breaks in the Mattole are approximately 100 feet wide. Small trees and brush are removed, usually by chainsawing, hand piling and burning. The resulting overstory trees are not usually removed, as the goal is to maintain enough dense shade to reduce resprouting of tanoak and other sprouting species.

Implementation of these projects is expected to result in modest positive impacts to the amount of late seral forests within the Mattole, as shaded fuel breaks are designed to remove understory

trees and improve health of the overstory. In addition, there is expected to be a moderate positive impact that should reduce wildfire severity as a result of these projects. Hardening of people's houses and access roads is expected to result in a negligible to moderate positive impact that should improve the health and safety of local residents and reduce wildfire severity as a result of these projects.

Grazing

Within the Mattole, grazing is an on going and reasonably foreseeable probable future activity. The current amount of grazing is not expected to decline or increase precipitously in the reasonably foreseeable future. NCWAP estimated there were 23,332 acres of grazing land in the entire basin, the vast majority of which is North_1 and North_2 (about 16,282 acres combined or about 70% of all grazing land) and a smaller amount in West_1 and West_2 (4,023 acres). The East_1, East_2 and South_1 subbasins have a combined total of about 3,000 acres of grazing land with the vast majority in the East_1 and East_2 subbasins. NCWAP describes grazing as widespread and shifted to cattle from sheep as a result of enactment of predation protection measures. NCWAP also states that stock impacts to streams were not widespread, but watercourse exclusionary fencing is limited.

The KRNCA has about 11,000 acres of currently grazed lands, however many of these are not in the Mattole. The 11,000 acres in the KRNCA supported about 220 cattle. Only a very small amount of the four grazing leases allowed for in the KRNCA Resource Management Plan are located in the Mattole.

Mattole Restoration Council Good Roads Clear Creeks Program

The MRC GRCC program has conducted field-based inventories of controllable sediment sources in various planning watersheds in the Mattole watershed. The results of the inventories conducted thus far but not yet implemented has identified about 1.034 million cubic yards of sediment stored on actively used and abandoned roads that can be removed so as to reduce the potential for delivery during storm events. About 200,000 yards of the 1 million yards is already contracted to be removed in the North_1 subbasin. An additional 500,000 yards has been identified for removal in the North_1 and North_2 subbasins. In addition, 200,000 yards of potential sediment has been identified in the West_1 subbasin, and approximately 50,000 yards has been identified for removal in the East_2 subbasin. Beyond the 500,000 yards slated for removal in the Upper North Fork in the North_1 subbasin, an additional 102,000 yards have been identified for removal in the Petrolia area and on ranches, both in the North_1 subbasin. However, none of these projects is currently funded and it is uncertain whether such removals will take place.

Mattole Restoration Council Fuels Reduction Projects

The MRC administers several programs that implement construction of or maintenance of shaded fuel breaks as well as fire clearance work around people's homes. Recently, the MRC has instituted its FLASH (Fire adapted Landscapes and Safe Homes) program which is a slight change in emphasis from past MRC fuel reduction work in that it strives to "harden" peoples

homes and access routes similar to work being conducted by the Humboldt Fire Safe Council. As of this writing in spring 2011, the MRC is under contract to complete approximately 150 additional acres of fuels reduction in the next 5 years, with a roughly equal area in projects that have been developed but not yet funded.

Residential Development

Chapter three describes the population and housing situation within the Mattole basin. The East_2 subbasin has the highest density of owners, while the North_1 and North_2 subbasins have the lowest density of ownership. Currently and into the foreseeable future, the potential for extensive new residential development is considered low with an estimated two to five new permitted residential buildings being constructed per year (personal communication, John Williams, Humboldt County Planning Department, September, 2010). Population growth is estimated at about 0.3%/year which is equivalent to a net increase of approximately 10 people per year. This estimate is based on information from the Humboldt County Building Department and may underestimate the rate of net-in-migration, as some residential construction occurs without permits.

SOD

Chapter 3 describes the impacts of SOD on tanoak and as a result of Program implementation. SOD has been determined to occur within the Mattole basin, in the Blue Slide drainage in the East_2 subbasin. As stated in Chapter three, the entire Mattole basin is at a high or very high risk for infection. The spread rate of SOD associated tanoak mortality in Southern Humboldt is estimated at 1,000 acres per year based on an increase in extent from “1 acre” to over 10,000 acres in four years within a 74,000 acre area (Y. Valachovic, personal communication, 10/5/10). SOD is estimated to kill over 90% of infested tanoak. Once tanoak is killed, it is estimated that on average, trees remain standing for as long as 10 years, fall over and then quickly decay in another five years into material that is no longer a fire hazard. Once tanoak has died, trees and shrubs are expected to fill the vegetative niche either through release of surrounding conifers and hardwoods, if present, as well as from seedlings taking hold as a result of seedfall from adjacent overstory trees. Shrubs are less likely to seed-in since their seed sources are not likely to be activated by the low disturbance effect of tanoak mortality.

The spread of SOD is too speculative under CCR 15145 to make a determination as to significance. The uncertainty as to significance is due to the fact that:

1. The likely places where SOD might occur are impossible to predict since virtually the entire Mattole basin is listed as at high or very high risk of infection and with few exceptions, tanoak occurs virtually everywhere.

2. SOD is thought to be spread initially through the air and by water but also by vehicles including residential vehicles. Given the pervasiveness of the road system and the stream network, SOD could spread from a single point or from multiple points all at the same time.

3. The spread of SOD is highly dependent on the weather conditions in the spring, something over which landowners have no control and which cannot be predicted with any certainty. As a result, historical spread rates have varied in Humboldt County from 0 acres spread in one year to over 9,000 acres being infected in a year with more favorable weather conditions.

4. Even more speculative is the potential to use herbicides as a treatment for SOD (see Chapter 3, Hazardous Materials for discussion as to why assessing herbicides is speculative).

For this cumulative impacts analysis, it is estimated that if SOD becomes established in the Mattole, at any one time around 15,000 acres will be in some sort of condition where tanoak is either standing or has fallen over and successional trends are replacing the void created by the tanoak mortality with other tree (and occasionally shrub) species. As described in Chapter 2.1(C.6), there are numerous standard BMPs that are required by the Program to reduce the impact of SOD, as well as one additional measure particular to the PTEIR which changes the Program's practices if SOD impacts exceed the threshold of 80% tanoak mortality on 35% or more of the acres in any one subbasin.

Summary of Reasonably Foreseeable Probable Future Projects

The following table summarizes the relative magnitude of the reasonably foreseeable probable future projects:

Table 4-3
Summary Of Reasonably Foreseeable Probable Future Projects

Project or Activity	Magnitude	Time Period
Program Timber Harvest	15,038 Acres	50 year time period
Conventional (Off-Program) Timber Harvest	4,912 Acres	50 year time period
KRNCA Late Seral/Silvicultural Improvement Projects	50 Acres	Per year
KRNCA Shaded Fuel Break Maintenance	2 miles of shaded fuel break or 36 acres	Per year
KRNCA Mountain Bike Trail installation	1 mile of trail	Per year
Fire Safe Council Projects maintained or new	2-3 miles shaded fuel break or ~ 40 acres	Per year
Grazing area	24,000 acres	Per year
# Cattle grazing (10 acres per cow)	2,000 animals	Per year
MRC Good Roads Clear Creeks sediment removal in Upper North Fork and Petrolia*	225,000 yards of sediment removal	2011
MRC Fuel reduction projects	75 acres	Per year
Permitted Residential Development	2-5 new residential buildings	Per year
Population increase	10 people	Per year
SOD	1,000 acres 15,000 acres	Per year At any one time

*The GRCC program protocol collects and reports information using cubic yard units, however the TMDL and Sediment Analysis conducted in Chapter 3 reports units in tons. The conversion rate for cubic yards to tons in the Mattole watershed is 1.4 tons/cubic yard.

4.7 Watershed Cumulative Impacts

This section summarizes the cumulative impacts to the Mattole watershed from implementing the Proposed Program in conjunction with the on-going and reasonably foreseeable probable future projects. The assessment areas for describing the potential cumulative impacts of implementing the Program's practices on the Mattole watershed are the seven Program subbasins which encompass the 25 Cal Wat HUC's in the Mattole basin.

Flow Effects

The methodology used for analyzing potential cumulative impacts to peak flows was the same as that used in Chapter 3.16 for analyzing Program impacts on peak flows. In summary, the cumulative canopy reduction due to timber harvest was summed annually and compared to established values in the literature. As noted in Chapter 3.16, in order for peak flows to be increased by a detectable amount it is necessary to remove 20-40% of the forest canopy in a small watershed (e.g. <1,000 acres).

The highest level of annual canopy removal predicted in Chapter 3.16 occurred in North 1 under Alternative I and was 2.53% averaged over the 50 year analytical time period, with a peak annual value of 3.77%. After accounting for the additional timber harvest that occurred during the 1999 to 2010 time period and the predicted off-Program harvest that would occur during the 2010-2060 time period it was determined that the Program in North 1 would have the highest average annual cumulative canopy removal at 2.94%, with a peak annual value of 4.35%. The other Alternatives and subbasins all had lower annual canopy removal values. North 1 continues to have the highest average annual canopy cover removal values because harvest rates have been and will continue to be amongst the highest in the Mattole watershed due to a high proportion of industrially owned timberland and to a lesser extent large ranches.

The second highest canopy removal values occurred in South 1, at 2.18% for average annual canopy removal and 4.59% for maximum annual canopy removal values. Canopy cover removal values were predicted to increase in South 1 due to the anticipated resumption of widespread, off-Program, even-aged harvesting on Barnum Timber Company lands as their stands reach maturity in the 2030 to 2060 time period.

When considering the combined effects of Program and off-Program activities, the average annual and peak annual canopy removal values fall well below the 20-40% canopy removal values required to cause a detectable effect to peak flows when analyzed at the subbasin scale (10,000-20,000 acre area). Peak flow increases may be considerably larger in smaller headwater catchments (<1,000 acres) that have all or most of their canopy removed with off-Program harvest, but these types of increases are not found when peak flow analysis is conducted at larger scales (i.e., planning watersheds, super planning watersheds, or river basins) (CAL FIRE 2005).

Timber harvest has been associated with minor, short-term increases in summer low flows, which would have a positive effect on aquatic biota. Therefore, this effect did not warrant further analysis (Beschta et al. 1995).

Determination of Significance for Peak Flows

The analysis above shows that there is a less than significant cumulative adverse impact to peak flows or summer low flows when combining the individual Program practices together with reasonably foreseeable probable future projects and activities.

Water Temperature Effects

As described in Chapter 3.16, many reaches of the mainstem Mattole River and low-gradient reaches of large tributaries have high summer water temperatures that do not support cold water fisheries designated uses. The main driver of excessive water temperatures appears to be excessive sediment storage in these reaches, which has altered channel morphology and riparian forest composition. Recent timber harvest did not appear to be having a significant effect on water temperatures in the Mattole.

As described in Chapter 3.16, the recently adopted ASP rules within the FPR's include riparian buffer protection measures designed to protect water temperatures for coho salmon and other listed anadromous salmonids. The ASP rules at minimum apply to all Alternatives and have been found by the BOF to be protective of water temperature. The Program and Alternatives 2 and 3 include riparian buffer measures that are more protective of water temperature than the ASP rules.

Grazing is a common land use in the Mattole watershed. Grazing has the potential to reduce riparian vegetation and thereby decrease stream shade and lead to increased stream water temperatures. Grazing was not mentioned in the Mattole TMDL as a significant factor affecting stream water temperatures (NCRWQCB 2002). Welsh (2005) correlated grassland dominated vegetation types with elevated water temperatures, but did not cite grazing as a causative factor. There does not appear to be evidence that grazing has had a significant effect on stream water temperatures in the Mattole watershed.

Determination of Significance for Water Temperature

The combination of protective rules for riparian buffers (ASP and Alternatives), low harvest and canopy cover removal rates and declining hillslope sediment yield over time all contribute to the finding that there is a less than significant cumulative adverse impact to water temperature when combining the individual Program practices together with reasonably foreseeable probable future projects and activities.

Nutrient Effects

Complete harvest of forests (clearcutting) can lead to increased leaching of nitrogen from forest soils and increased nitrate levels in receiving waters (Dahlgren 1998). In general this effect is short lived, as forest vegetation re-captures the site and resumes nitrogen uptake, resulting in loss rates declining to pre-harvest levels within 5-7 years. In some regions or ecosystems the loss of soil nitrogen and increase in water column nitrate levels can be significant; however this is generally not the case in the Pacific Northwest (Beschta et al. 1995). The effect of partial harvest

on soil nitrogen loss and water column nitrate concentrations is less well known, but is assumed to be less than for clearcutting.

Based on harvest history in the Mattole for the 1984-2008 time periods, the majority of timber harvest on NIPF lands has been uneven-aged, selection style. Although silviculture on industrial lands has historically been dominated by even-aged systems, the change in ownership from PALCO to HRC indicates that uneven-aged forestry will be more common on industrial lands in the future. Thus, the majority of Program and off-Program timber harvest are expected to be uneven-aged, which has a low likelihood of significant nitrogen export and resulting elevated water column nitrate concentrations.

Determination of Significance for Nutrients

Based on the prediction that even-aged harvesting is expected to be a minor component of cumulative harvest techniques in the Mattole and that the PNW ecosystems are relatively resilient to nitrogen losses, there will be a less than significant cumulative adverse impact to water column nutrient levels when combining the individual Program practices together with reasonably foreseeable probable future projects and activities.

Large Wood and Organic Debris Effects

As described in Sections 3.4 and 3.16, the Program (and to a lesser extent Alternatives 2 and 3) is expected to provide increased LWD recruitment potential compared to the status quo (Alternative 1), due to having greater riparian buffer protections, measures that lead to the avoidance of logging on landslide-prone areas, and prohibition of even-aged harvest techniques. The additional off-Program forest harvest considered in this cumulative impacts section would be implemented following the ASP rules in the FPR's and would be primarily even-aged harvesting.

The ASP rules, which govern the off-Program harvest in the entire Mattole watershed, have been found by the BOF to be protective of salmonid habitat, including LWD recruitment levels (BOF 2009). This means that LWD source areas and recruitment mechanisms will be sufficiently protected under standard FPR harvests in areas where the ASP rules apply.

The Mattole Restoration Council and Mattole Salmon Group also have active LWD placement programs to target LWD additions to stream reaches that could benefit from habitat enhancement. The South_1 subbasin in particular has had extensive LWD additions from these two restoration groups.

Regarding small (fine) organic debris levels, the following conclusions were reached at JDSF and are equally applicable in the Mattole watershed (CAL FIRE 2007):

> *Smaller organic debris also can affect beneficial uses of water. Fine organic materials provide food and host sites for benthic macroinvertebrates and microbes. However, decomposition of large amounts of fine organic matter may lead to oxygen depletion that can kill fish and other oxygen-requiring aquatic organisms and can release undesirable*

chemical compounds and odors. The Forest Practice Rules prohibit the deposition of slash or other fine organic materials in Class I or II waters, and require prompt removal if deposition occurs [14 CCR §§ 916.3, 916.3(a), 916.3(b)]. Inventories of Forest Practice Rule implementation and effectiveness related to water quality (Cafferata and Munn 2002) have not found compliance problems with these rule requirements, and the low level of timber operations in Class I and II WLPZ's indicates that there are few opportunities for deposition of fine organic materials into these watercourses.

Determination of Significance for Large Wood and Organic Debris

The analysis above shows that there is a less than significant cumulative adverse impact to LWD and organic debris levels when combining the individual Program practices together with reasonably foreseeable probable future projects and activities.

Sediment Effects

As described in Chapter 3.16, hillslope sediment yields continue to decline across the Mattole watershed. The primary reason for the decline is that sediment yields peaked at such a high level in the 1965-1970 time period due to a combination of destructive logging practices and an extreme storm event. However, as noted in the Mattole TMDL, watershed-wide sediment yield levels as of 2002 were still far above natural background levels (NCRWQCB 2002). The primary reason that hillslope sediment yield values remain above background levels is the extensive network of active and abandoned roads, which continues to be a significant source of chronic and episodic sediment. Secondary to the road network in terms of management-related sediment yield was the ongoing erosion from legacy timber harvest practices, such as diverted stream channels at watercourse crossings and harvest-related mass wasting.

A computer model was developed to analyze sediment yield based on the data and assumptions contained in the Mattole TMDL, the details of which were described in Appendix D. In order to analyze the cumulative impacts of past and reasonably foreseeable future projects described in Table 4-3, the additional projects were included along with the predicted harvest levels for the Program in the computer model. The following off-Program impacts were included in the sediment yield model:

- All sediment sources described in the TMDL, which covered the period from 1983-2002.
- Timber harvest that occurred from 2002-2009
- Good Roads Clear Creeks sediment reductions projects - both those completed as of 2009 and those predicted for the future
- Predicted off-Program timber harvest from 2010-2060
- Natural decline of legacy harvest sediment sources by 75% over the 2002-2060 time period (described in Appendix D).

Grazing-related sediment sources were not included because they were not quantified in the TMDL. New residential development was not included because the predicted activity was very minor and typically makes use of existing roads. KRNCA projects were not included because

they have been designed to produce insignificant quantities of erosion and many are or were conducted outside of the Mattole watershed.

It was established in Chapter 3.16 that the Program and Alternatives were similar in their impacts on net sediment yield, with the Program typically having the greatest beneficial effect. The net sediment yield was negative for all Alternatives and subbasins except the West_1 and West_2 subbasins, where it was slightly net positive. When the cumulative effect of all projects and natural decay of legacy sediment sources was added to Program impacts, the net result was a decline in hillslope sediment yield for all subbasins (Figure 4-4).

The modeled results indicate that the existing road network is the dominant source of anthropogenic sediment and only declines a little over time because only a small portion of the road network was predicted to receive harvest or treatment over the next 50 years. The total area subject to timber harvest, or footprint area, including Program and off-Program harvests ranges from a low of 3.8% in West 2 to a high of 16.3% in North 1 subbasin- thus leaving 83-96% of the poorly maintained road network untreated[1]. New harvest contributes a minor amount to the overall sediment yield, because the area treated is small; the yield is low and decays within 15 years. New roads contribute so little sediment that they do not even show up on the chart, which is largely because there is not much need for new roads to be built when such an extensive road network already exists. Finally, there is the effect of legacy sediment sources from historic harvests, which were predicted to decline steadily over the 58-year analytical time frame (2002-2060). The reason that the decline of legacy sediment sources was predicted to be so significant was that it occurred across the entire watershed, rather than only in areas that received treatment.

There is an important difference between the actively treated sediment sources and natural decline of legacy sediment sources. The actively treated sources (timber harvest or restoration efforts) actually prevent delivery of sediment to the channel network, whereas the decline of sediment yield from legacy sources is partly due to the failure of vulnerable sites which are unable to fail again in the future, e.g. Humboldt crossings or gullies which have reached a relatively stable state. The predicted net sediment savings for the Program and Alternatives due to road upgrades, treatment of legacy sediment sources and new timber harvests and roads calculated in Chapter 3.16 ranged from 1 to 2 million tons over the next 50 years. The Good Roads Clear Creeks (GRCC) program estimated that it has saved approximately 400,000 tons of sediment as of 2009 and plans to save an additional 1.4 million tons in coming years for a total of 1.8 million tons. Thus the GRCC program and the Mattole Forest Futures Program are expected to save roughly the same quantity of sediment over the 50-year analytical period, for a total of approximately 3 to 4 million tons or 60,000 to 80,000 tons per year.

[1] It is likely that the total extent of roads treated may exceed the area contained in the harvest footprint because appurtenant roads are required to be treated in harvest plans. Appurtenant roads are defined in the FPRs as roads "under the ownership or control of the timber owner, timberland owner, timber operator, or submitter of the plan." Unlike large industrial single ownership land bases, in the Mattole much of the private road network that accesses scattered rural parcels is not under the ownership or control of the timber owner, timberland owner, timber operator, or submitter of the plan. Therefore, the conservative assumption was made that only the roads within the harvest plan area would receive road upgrade treatments, as treatment outside of harvest footprint areas was speculative.

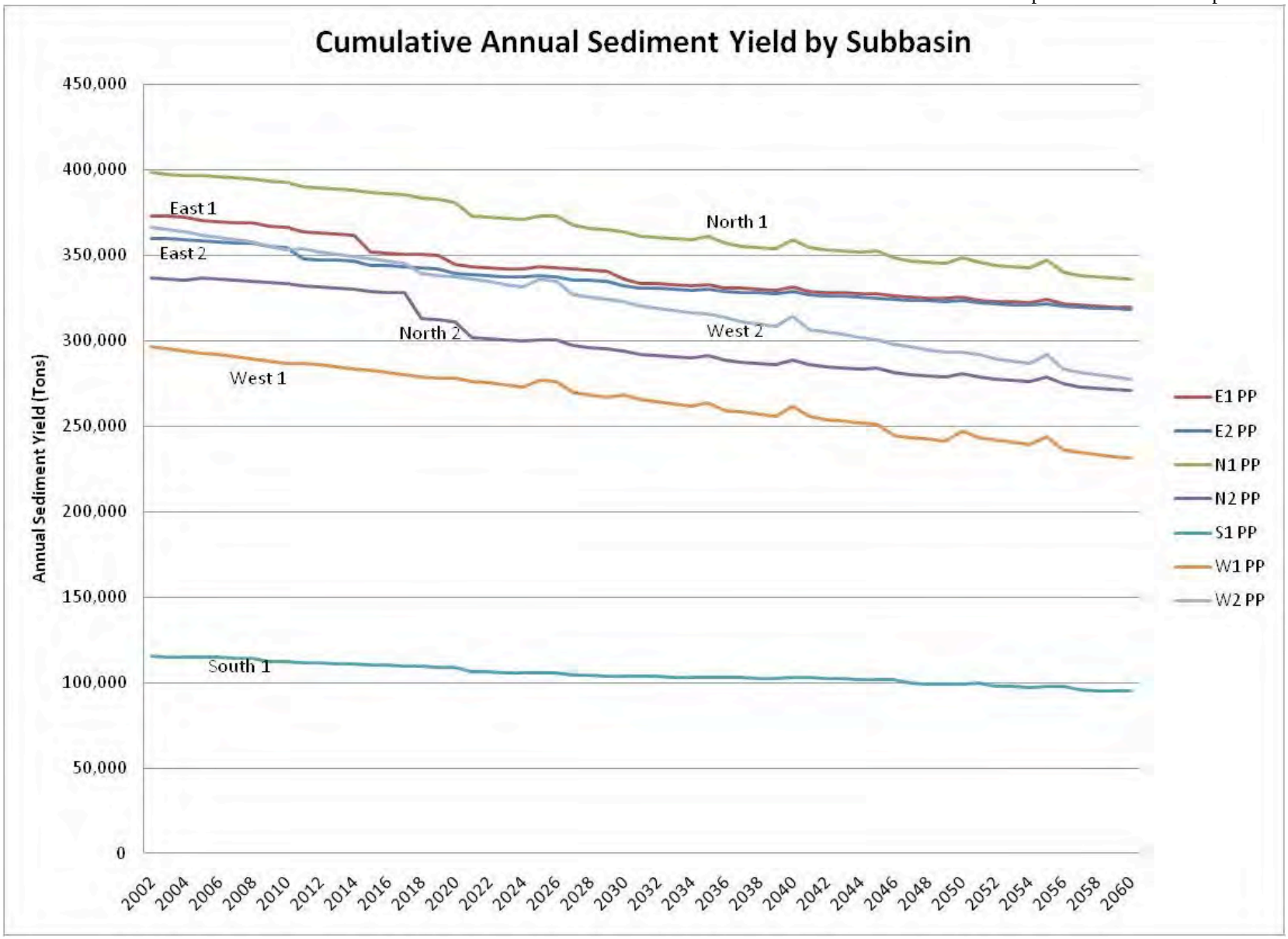
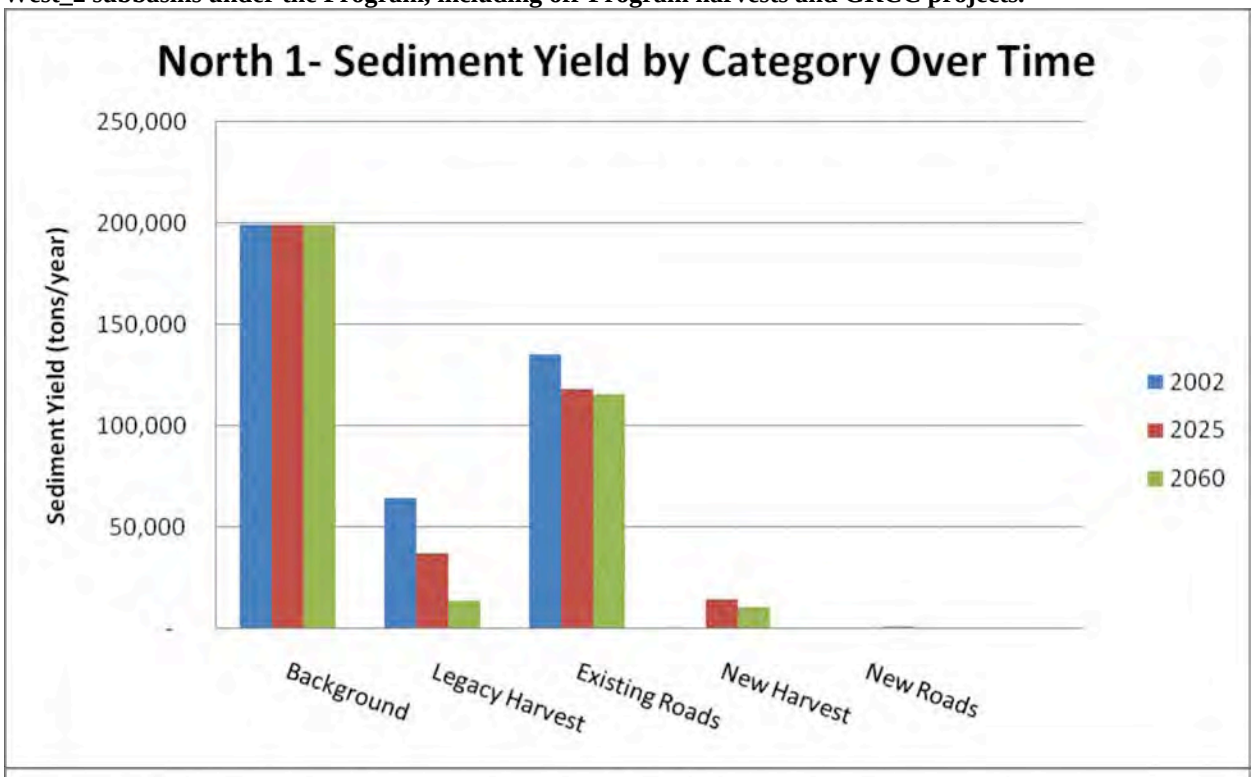
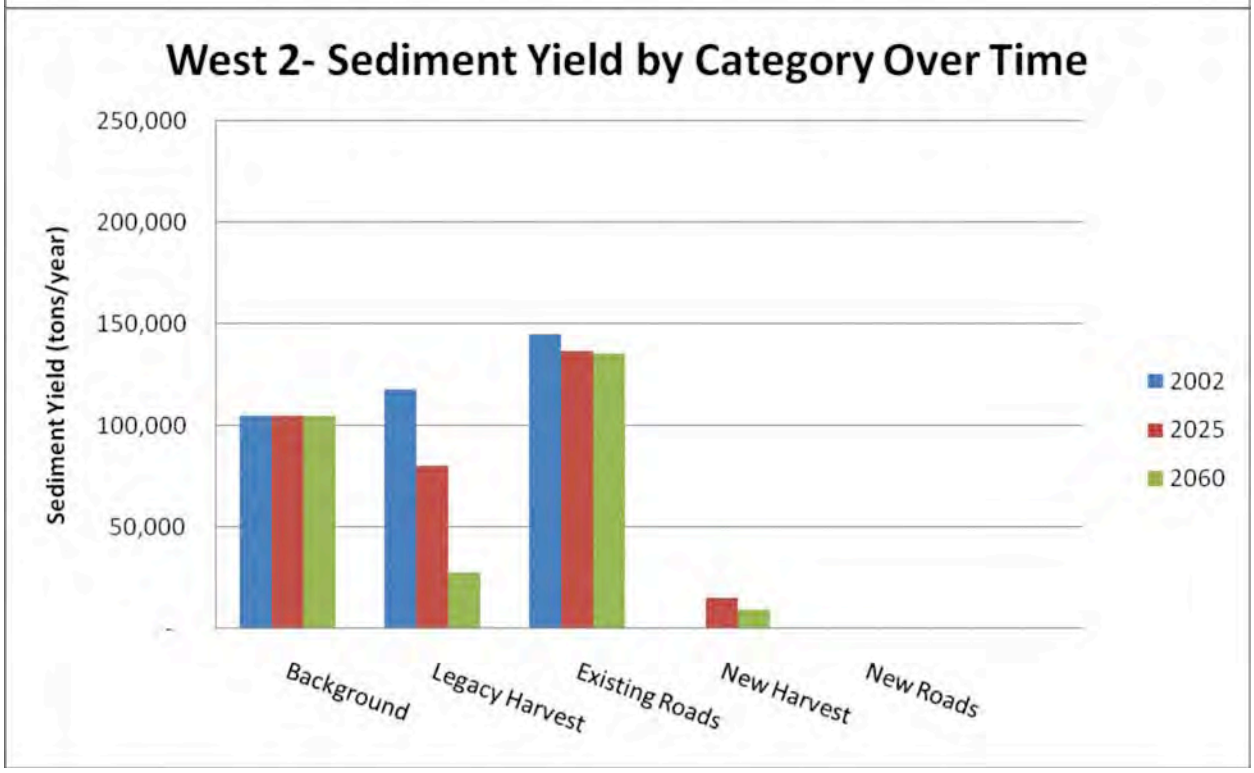


Figure 4-4. Comparison of predicted cumulative annual sediment yields for all subbasins under the Program including off-Program activities.

In order to understand why cumulative sediment yield is predicted to decline across all subbasins it is useful to look at examples of sediment yield by category from North 1 and West 2.

Figures 4-5 and 4-6. Comparison of predicted annual cumulative sediment yield by category for North_1 and West_2 subbasins under the Program, including off-Program harvests and GRCC projects.





The average annual cumulative sediment savings of 60,000 to 80,000 tons per year equates to 200 to 270 tons/mi^2/year. The Mattole TMDL calculated that management-related sediment yield in the Mattole (roads and legacy harvest) contributed 5,100 tons/mi^2/year. The load allocation for the Mattole from management-related sources was set at 700 tons/mi^2/year, which was an 86% reduction from loading as of 2002. The cumulative sediment savings from GRCC, MFFP and off-Program harvests of approximately 200-270 tons/mi^2/year represents a load reduction of about 5% over the next 50 years.

The TMDL estimated that Mattole-wide sediment yield due to legacy harvest was 1,410 tons/mi^2/year. If this sediment source declines by 75% as predicted, the total load will be reduced by about 1,060 tons/mi^2/year by 2060- or 21% of the management-related sediment load. Thus, the total management related sediment load reduction from planned management and natural decay of legacy sediment sources adds up to about 26%, still well short of the 86% load reduction target established in the TMDL.

The main impediment to reaching the TMDL goal of 86% reduction in sediment yield from management related sediment sources is that 80-90% of the 3,000+ mile road network remains untreated by the year 2060.

The cumulative effect of the Program and off-Program harvests on sediment yield in the Mattole basin is estimated to be a reduction in management-related sediment yield of approximately 2-3% over 50 years.

There may be minor, short-term, localized increases in water column turbidity associated with timber harvest and/or road upgrade treatments the year after harvest or treatment. However, as described in Chapter 3.16, the annual rate of harvest even when adding in off-Program harvests is still well below the 1.5% rate established as a threshold above which chronic turbidity impacts were likely to occur (Klein et al. 2008).

Determination of Significance for Sediment

The analysis above shows that there is a less than significant cumulative adverse impact to sediment loading and water column turbidity when combining the individual Program practices together with reasonably foreseeable probable future projects and activities.

Watershed References Cited

Beschta, R.L. et. al. 1995. Cumulative Effects of Forest Practices in Oregon: Literature and Synthesis. Prepared for the Oregon Department of Forestry. Salem, Oregon.

Board of Forestry and Fire Protection (BOF). 2009. Final Statement of Reasons. Anadromous Salmonid Protection Rules 2009. [Adopted by BOF on October 7, 2009] Title 14 of the California Code of Regulations (14 CCR): Sacramento, California.

CAL FIRE. 2005. Appendix 10: Peak flow analysis. Draft Environmental Impact Report for the Draft Jackson Demonstration State Forest Management Plan. December 2005. Prepared by the California Department of Forestry and Fire Protection, Sacramento, CA. 25 p. Available online at:
http://www.fire.ca.gov/resource_mgt/downloads/jdsf_deir_05/DEIR_Appendix_10_PeakFlowAnalysis_12.2005.pdf

CAL FIRE. 2007. RECIRCULATED DRAFT Environmental Impact Report for the Draft Jackson Demonstration State Forest Management Plan Alternative G. Prepared by the California Department of Forestry and Fire Protection, Sacramento, CA.

Klein, R.D, W.J. Trush and M. Buffleben. 2008. Watershed condition, turbidity, and implications for anadromous salmonids in the north coatal California streams. Report to North Coast Regional Water Quality Control Board, Santa Rosa, CA.

North Coast Regional Water Quality Control Board. 2002. Mattole River Watershed Technical Support Document for Sediment and Temperature. North Coast Regional Water Quality Control Board, Santa Rosa, California

Welsh, H., G.R. Hodgson and A.J. Lind. 2005. Ecogeography of the herpetofauna of a northern California watershed: linking species patterns to landscape processes.

4.8 Soil Productivity and Geologic Cumulative Impacts

The section summarizes the cumulative impacts to soils and to geology due to implementing the Program in conjunction with the on-going and reasonably foreseeable probable future projects. The assessment area for describing the potential cumulative impacts on soils and geology is the Mattole basin.

The significance criteria and the determination thresholds have already been previously described in Chapter 3. The determination thresholds are reproduced here since they establish the point at which cumulative impacts might be significant. The Program in conjunction with the reasonably foreseeable probable future projects and activities, when combined might create a significant cumulative impact if they would:

- Substantially increase mass wasting in the form of landslides or other geologic hazards
- Substantially increase soil erosion rates, or
- Substantially reduce soil productivity.

As described in the FPRs, adverse cumulative impacts to soil productivity can occur when the impacts of two or more activities, from the same or different projects, combine to produce a significant increase in soil erosion rates or substantially reduce soil productivity.

<u>Forest Management Impacts</u>

Factors influencing soil productivity that can be affected by timber operations include: organic matter loss, surface soil loss, soil compaction, and growing space loss. Recovery from these impacts is often slow, so mitigation measures must focus on prevention and limits on the extent of impact

Chapter 3 described the impacts to soils and geologically unstable areas resulting from the Program's practices. Generally, the impacts from implementing the Program on 15,038 acres were considered to create a less than significant impact to soils and geologically unstable terrain. These negligible impacts are partly the result of the fact the Program only treats about 13% of the commercial forestland within the Mattole (although as much as 29% of North_1 might be treated). Off-Program harvest adds an additional 4,912 acres of mostly even-aged harvest to the 15,038 acres of "light touch" harvest from the Program. The additional off-Program impact is concentrated in the North_1 and South_1 subbasins as a result of additional HRC even-aged harvest in North_1 and even-aged harvest from Barnum Timber Company in South_1.

Old-growth timber operations typically were conducted with little concern for soil productivity impacts. These activities removed much of the surface organic material and left slopes exposed to erosion. Later tractor logging resulted in large numbers of excavated skid trails, landings, and roads with little erosion control, often directly filling watercourse channels; deeply excavated layouts; extensive slash removal and site preparation by tractors with large amounts of soil movement; and the continued use of hot, broadcast burning for slash removal and site preparation. Through the 1960s, erosion control was rarely provided for roads and skid trails after use and before winter rainfall. This phase of tractor logging resulted in the removal of

much organic matter, large amounts of soil disturbance, displacement, and direct placement into watercourses, the creation of large areas of compacted surfaces, and greatly accelerated surface erosion, gully erosion, and mass wasting.

Organic matter loss can cause a decrease in site productivity due to loss of support for critical soil microbial activity and diminished capability of the soil to store moisture in a form readily available to both plants and soil microorganisms. Organic matter loss can occur by displacement of surface organic materials during skidding, mechanical site preparation, and other land disturbing timber operations and from erosion, burning, or oxidation of exposed fine organic material. Soil productivity is affected by the loss of nutrients stored in organic matter, surface exposure that results in higher temperatures and increased evaporation during the dry season, and reductions in soil porosity from loss of soil organic matter. These impacts can be avoided or reduced by minimizing the use of broadcast burning for slash control and site preparation.

The potential for erosion following logging is largely a function of the area of exposed mineral soils. Soil loss occurs from mechanical displacement during road building, harvesting, or site preparation and by surface erosion or mass wasting on harvest units. Removing the surface soil has a disproportionate impact on soil productivity because the upper layers of soil are the storehouse of organic matter and nutrients that have accumulated from decomposing plant materials and atmospheric sources. As described in Chapter 3, loss of soil by mass wasting (above background rates) from timber operations is prevented by identifying and placing limits on operations in unstable areas. Implementation of the Geologic Flow Chart is a key part of the proposed methods to reduce and avoid soil disturbance and mass wasting. Surface soil erosion is further minimized by the reduced emphasis on use of broadcast burning and other intensive site preparation methods in the Program. Loss of surface soil by mechanical displacement is avoided or reduced by re-use of existing skid trails, and restrictions on the use of yarding systems that create excavation on steep slopes.

Soil compaction leads to loss of soil productivity by reducing pore space for water storage, movement of water, and for the exchange of oxygen, carbon dioxide, and other gases that are required and produced by roots and soil organisms. Compaction also increases soil density and strength, which impedes root penetration. Measures designed to limit compaction produced by timber operations include controlling the location and amount of ground disturbance by ground-based equipment (e.g., through the use of cable yarding, pre-designated skid trails) and suspending operations above specified soil moisture contents (Froehlich and McNabb 1984). .

Growing space loss is most affected by the construction of new roads and landings that take timberland out of production. Minimizing the number of roads, landings, and skid trails used for timber operations can reduce growing space loss along with re-use of existing landings and skid trails. Cable yarding tends to take less ground out of production since no skid roads are constructed. However, multiple stand entries over time can increase soil impacts so that cumulative impacts at the watershed scale can become significant. In addition, uneven-aged silvicultural systems that often involve reentry on a shorter time scale than even-aged systems can also increase soil impacts.

Impacts from Reasonably Foreseeable Probable Future Projects

Off-Program harvest adds an additional 4,912 acres of mostly even-aged harvest to the 15,038 acres of "light touch" harvest from the Program. The additional off-Program impact is concentrated in the North_1 and South_1 subbasins as a result of additional HRC even-aged harvest (e.g. variable retention is considered an even-aged silvicultural technique) in North_1 and even-aged harvest from Barnum Timber Company in South_1. The Chapter 3 impacts analysis of Alternative I (which uses even-aged harvest) shows a potential for a moderate impact in the East_1 and North_1 and North_2 subbasins. As the amount of exposed soil increases, the erosion hazard rating of soils in these subbasins is elevated to a level higher than when the Program's practices are employed.

Chapter 3 described the impacts to soils and geologically unstable areas resulting from the Program's practices. Generally, the impacts from implementing the Program on 15,038 acres were considered to create a less than significant impact to soils and geologically unstable terrain. These negligible impacts are partly the result of the fact the Program only treats about 13% of the commercial forestland within the Mattole (although as much as 29% of North_1 might be treated). The addition of the off-Program harvest of an additional 4,912 acres is not expected to change the impacts to soils except for the North_1 and North_2 subbasins, because the additional harvest amounts to around 1-4% additional acreage harvested in the future.

Other reasonably foreseeable probable future projects are generally so limited in extent, such as the KRNCA shaded fuel break maintenance, residential development and fire safe council projects, that the cumulative impact of these additional projects is not expected to create significant adverse impacts beyond those already described above.

The reasonably foreseeable probable future "project" that might have an impact is the continued impact of cattle grazing. While the Program does not treat grasslands, there may be an adverse impact to soils from cattle that venture into forested areas. The largest accumulation of grazing animals is in the North_1 and North_2 subbasins, where the greatest adverse impacts from the Program and other cumulatively additive projects are located.

The action of animal hooves would cause some disturbance, shearing, and compaction of soil, increasing its susceptibility to both water and wind erosion. These impacts can be severe in heavily grazed areas, but are less so under light and moderate grazing intensities. Severe compaction often reduces the availability of water and air to the roots, sometimes reducing plant vitality. Soil organisms can be negatively affected as grazing animals can cause the loss of surface organic matter, create soil compaction, and create structural habitat alterations. Recovery time from grazing-induced compaction is site-dependent, with recovery observed usually within 1 to 2 years (Wheeler et al. 2002).

Determination of Significance for Soils and Mass Wasting

The analysis above shows that there is a less than significant cumulative adverse impact to soils when combining the individual Program practices together with reasonably foreseeable probable future projects and activities.

For mass wasting, the analysis above shows that there is a less than significant cumulative adverse impact resulting from additional landslides due to the additive impacts of combining the individual Program practices together with the reasonably foreseeable probable future projects and activities.

Soil Productivity and Geologic Reference Cited

Froehlich, H.A. and D.H. McNabb. 1984. Minimizing soil compaction in Pacific Northwest forests. Pgs. 159-192 in: E.L. Stone (ed.) Forest Soils and Treatment Impacts. Proc. of the 6th N. Am. For. Soils Conf. Univ. of Tennessee, Knoxville, TN. June 1983.

Wheeler, Melinda A., M.J. Trlica, Gary W. Frasier, and J.D. Reeder, 2002. Seasonal grazing affects soil physical properties of a montane riparian community. Journal of Range Management 55:49-56, January 2002.

4.9 Biological Cumulative Impacts

Aquatic Resources

The Mattole NCWAP report (NCWAP 2002), MRRP (2009) and MRRP (2010) contain the most recent and relevant descriptions of fisheries populations, trends and habitat conditions for the Mattole and are not repeated here. Welsh at al. (2005) provide the most recent and relevant description of herpetofauna distribution in the Mattole watershed. For a detailed review of the relationship of habitat parameters to aquatic species needs see CAL FIRE (2007).

According to the NCWAP report, the most limiting habitat conditions for each subbasin were as follows;

- Northern subbasin - high water temperatures
- Southern subbasin - low summer water flows/dry reaches
- Eastern subbasin – excess sediment delivery to watercourses
- Western subasin- instream habitat, lack of complexity

As noted in Section 3.4, aquatic habitat conditions in the Mattole have been degraded by excess sediment delivery, much of it delivered during the 1964 flood event. Since 1964 the quantity of sediment delivered to the stream channel via landsliding, which is the dominant sediment delivery mechanism in the Mattole, has declined dramatically (NCRWQCB 2002). As sediment supplies from hillslopes declined, water and gravity carried much of the delivered sediment down the channel network. The result was a 42% decrease in the length of channel reaches with negative mapped channel characteristics[2] between 1984 and 2002 (NCWAP 2002). Essentially, stream channels in the Mattole watershed are recovering from the top down; smaller and higher-gradient channels have largely recovered from the excessive sediment loading experienced post 1964. However, the sediment is still accumulating in low-gradient tributaries and the mainstem of the Mattole, where sediment transport rates have not been sufficient to move the excess sediment out to the ocean. Regardless of current land management practices, a complete recovery to pre-1964 channel conditions in the low-gradient tributaries and the mainstem Mattole will take decades to centuries.

The California Board of Forestry and Fire Protection (BOF) recently adopted regulations to address the situation of poor aquatic habitat common to salmonid-bearing streams across forestland in California, known as the Anadromous Salmonid Protection Rules (FPR 916.9, 936.9, 956.9 and 916.9.1 [936.9.1]). In a formal review of the environmental impacts of adopting these rules the BOF (2009) made the following findings (among others):

- *The Board finds that the adopted regulations are based on the consideration of an extensive review and evaluation of applicable scientific literature. The adopted rules are found to be based upon the science literature review and testimony from scientists*

[2] Negative mapped channel characteristics (NMCC) was a term developed by aerial photo interpreters in the NCWAP Mattole process to refer to channel reaches that appeared to be overly wide due to sediment aggradation and/or had unstable riparian vegetation due to high sediment loads (NCWAP 2002).

and technical experts in the fields of watershed processes, riparian functions, and fisheries biology.

- *The Board finds that the adopted regulations are based on recommendations by the Department of Fish and Game, the California Department of Forestry and Fire Protection, the State Water Quality Control Board and Regional Boards, and numerous individuals.*

- *The adopted regulations are found by the Board to be consistent with goals established in the California Fish and Game Commission, Board of Forestry and Fire Protection, Joint Policy Statement on Pacific Salmon and Anadromous Trout*

- *The Board finds that the adopted regulations will maintain and improve aquatic habitat and contribute to restoration of listed anadromous salmonids. This finding is based on the expected effects on the beneficial uses of water, including cold freshwater habitat , spawning, migration and rare and endangered species…*

All subbasins within the Mattole watershed are subject to the ASP rules, which have been determined to be protective of salmonid habitat. The Program and Alternatives 2 and 3 include additional regulations to further protect salmonid habitat and are therefore even more likely to, "maintain and improve aquatic habitat and contribute to restoration of listed anadromous salmonids."

The Mattole coho Recovery Strategy (MRRP 2010) contains a ranked listing of mainstem and tributary reaches of highest priority for protection and restoration. Most of the high priority habitat occurs in the South _1 subbasin, while very little occurs in the North_1 and North_2 subbasins.

Furthermore, as determined in Chapters 3.16 and 4.2, neither the Program nor will any of the Alternatives in combination with off-Program activities have a significant adverse impact on water quality or LWD recruitment.

Cumulative harvest levels (footprint) over the 50-year analytical period are highest in the North_1, North_2 and South_1 subbasins, at 16.3%, 13.6% and 13.3% respectively. This pattern is driven by the ownership pattern in the Mattole; almost all of the industrially owned lands are located in these three subbasins. Although these three subbasins represent the most intensively managed lands in the Mattole, the annual rate of harvest and average annual cumulative canopy reduction levels are still quite low at less than 1% and 3% respectively (see Section 4.2).

As discussed in Chapter 3.4 amphibians are sensitive to water quality conditions and also to microclimatic conditions. In regards to forest harvest, it appears that increased canopy removal is related to increased change in microclimatic conditions, i.e. warmer and drier. A subset of cool temperature adapted amphibians is very sensitive to warmer, drier climatic conditions and therefore are more often found in older stands with more canopy cover. Thinning of forest stands has less of an effect on amphibians than clearcutting and both had variable responses

observed in studies. Riparian buffers are helpful for protecting amphibians, but linkages across watershed and sub-watershed divides are also important.

The Program clearly provides the best combination of prescriptions to maintain amphibian populations relative to the other Alternatives. First, even-aged harvesting is prohibited, which is an improvement over Alternative 1 and 2 in regards to buffering microclimate impacts. Also, by eliminating even-aged harvesting, forested linkages between subbasins will be maintained at all times. By requiring uneven-aged harvesting and retention of half of the largest trees after each entry, stands managed under the Program will continue to become bigger and older over time, rather than oscillating between zero and 50-70 years of age indefinitely as typically occurs in even-aged managed stands. Old-growth trees, which are a component of habitat types preferred by some amphibians, are prohibited from harvest within the Program and Alternative 3. Within the Program, the riparian buffer widths and protective measures on class I, II and III streams exceed those for Alternatives 1 and 3. Alternative II includes wider no-cut buffers than the Program, but also permits even-aged harvests that offset this benefit to some extent.

The cumulative impact assessment includes an additional 4,912 acres of off-Program, mostly even-aged harvesting beyond the harvest predicted for the Program, or 2.5% of the Mattole watershed over 50 years. The highest concentrations occur in the North_1, North_2 and South_1 watersheds at 3.8%, 3.5% and 9.7% of watershed area respectively. The most concentrated area of even-aged harvesting occurs in South_1, which is a unique subbasin within the Mattole climatically. As noted in Chapter 3.4, despite extensive even-aged harvesting over the 1984-2008-time period on the same industrially owned lands projected for future harvest, stream water temperatures remained suitable for coho. The South_1 subbasin is influenced by coastal fog and contains the only substantial population of redwood trees in the Mattole watershed. The coastal influence of the South_1 subbasin will likely ameliorate the potential adverse impacts to microclimate due to even-aged harvest (Ashton, Marks and Welsh 2005).

Determination of Significance for Aquatic Resources

The analysis above shows that there is a less than significant cumulative adverse impact to aquatic resources when combining the individual Program practices together with reasonably foreseeable probable future projects and activities.

Aquatic Biologic References Cited

Ashton, D.T., S.B. Marks and H.H. Welsh. 2005. Evidence of continued effects from timber harvesting on lotic amphibians in redwood forests of northwestern California. Forest Ecology and Management 221:183-193.

CAL FIRE. 2007. Recirculated Draft Environmental Impact Report for the Draft Jackson Demonstration State Forest Management Plan Alternative G. Prepared by the California Department of Forestry and Fire Protection, Sacramento, CA.

MRRP (Mattole River and Range Partnership: Mattole Restoration Council, Mattole Salmon Group, and Sanctuary Forest) 2009. Mattole Integrated Coastal Watershed Management Plan:

Foresight 2020. Petrolia, Calif. 190 pp.

Mattole River and Range Partnership. 2010. Draft Mattole Coho Recovery Strategy. Petrolia, California.

NCRWQCB, 2002. Mattole River Watershed Technical Support Document for the Total Maximum Daily Loads for Sediment and Temperature. California Regional Water Quality Control Board North Coast Region. Santa Rosa, CA. 2002.

NCWAP, 2002. (Downie, Scott T., C.W. Davenport, E. Dudik, F. Yee, and J. Clements (multi-disciplinary team leads). 2002). Mattole River Watershed Assessment Report. North Coast Watershed Assessment Program, p. 441 plus Appendices. California Resources Agency, and California Environmental Protection Agency, Sacramento, California.

Welsh, H., G.R. Hodgson and A.J. Lind. 2005. Ecogeography of the herpetofauna of a northern California watershed: linking species patterns to landscape processes.

Vegetation Cumulative Impacts

This section summarizes the cumulative impacts to vegetation due to implementing the Program in conjunction with the on-going and reasonably foreseeable probable future projects. Section 3.14 provides a substantial level of cumulative impacts analysis for this topic because it is largely based on an assessment of stand structure classification over time. Also, the description of potential impacts from Sudden Oak Death apply to the whole watershed and could easily be included in both the direct effects and cumulative effects sections. Even though no significant direct impacts to botanical resources were identified in that analysis, there is still the potential for impacts from the Program to combine with those of other reasonably foreseeable future projects or processes to cause significant adverse cumulative impacts.

The significance criteria and the determination thresholds have already been previously described in Chapter 3. The determination thresholds are reproduced here since they establish the point at which cumulative impacts might be significant. The Program in conjunction with the reasonably foreseeable probable future projects and activities, when combined might create a significant impact if cumulatively they would:

a. Threaten to eliminate a plant community;
b. Violate any state or federal wildlife protection law; or
c. Contribute directly (through immediate mortality) or indirectly (through reduced productivity, survivorship, genetic diversity, or environmental carrying capacity) to a substantial, long-term reduction in the viability of any native species or subspecies at the watershed level.

Impacts to Vegetation from Reasonably Foreseeable Probable Future Projects

The cumulative impacts analysis requires identification and analysis of reasonably foreseen projects that could occur within or outside of the Program area, such as off-Program timber operations. In addition to human-initiated projects, impacts from processes such as the spread of sudden oak death (SOD) must also be considered.

Of the reasonably foreseen projects, the off-Program timber operations are the most pertinent to analyzing the cumulative effects to vegetation from all types of timber harvesting combined. Off-Program timber operations would not be tiered to the PTEIR and filed as PTHP's, but would likely be filed as THP's tiered to the FPR's. Off-Program timber operations are assumed to be similar to the status quo prescriptions modeled and are not expected to meet most of the goals of the Program, such as increasing development of mature conifer stands. An assumption of the modeling of off-Program activities is that even with the Program in place, many landowners would not choose to utilize PTHP's but would continue to file THP's (see explanation in section 4.6 earlier in this chapter).

In addition to the off-Program timber operations, other reasonably foreseeable projects and processes which could affect forest habitat and special status species over the 50-year analysis period are shown below.

KRNCA Late Seral Silvicultural Improvement Projects	50 acres/year
KRNCA Shaded Fuel Break Maintenance	1800 acres
MRC Fuel Reduction Projects	120 acres/year
Sudden Oak Death Infestation	possibly up to 1,000 acres/year

Impacts to Vegetation From Sudden Oak Death

The spread of SOD in the Mattole watershed has the potential to have significant effects on forest vegetation in the Mattole regardless of whether the Program is implemented or not. SOD is expected to impact the hardwood vegetation types the most, particularly the non-commercial forestlands where hardwood stocking is the highest. Also, stands managed under the Program that have a substantial hardwood component could potentially suffer from widespread tanoak mortality independent of silvicultural treatments. However, these impacts will not be exacerbated to a significant extent by activities conducted under the Program, largely due to the standard BMPs described in Section 2.1(C.6). Additionally, if SOD kills more than 80% of tanoak on 35% or more of the acres in any one subbasin, then the Program's practices associated with the All Aged prescription will be modified to mitigate for the loss of hardwood canopy and mast. (see section 2.1(C.6) for details)

In general, stands affected by SOD would have a much higher level of tanoak mortality than would occur in even the most intensive Program treatments. The effect to vegetation of Program treatments is extremely different than the effect of SOD infestation and subsequent mortality, particularly the level of standing dead fuel. For these reasons, stands managed to reduce the proportion of hardwood stocking are not expected to add to the acreage of high mortality SOD stands.

Forest Habitat Analysis

The assessment area for describing the potential cumulative impacts on vegetation is the Mattole basin rather than just the Program area itself. This larger area of evaluation for cumulative impacts includes many acres of forestland where timber operations are not projected to occur, such as most public lands; non-commercial timber stands, no-cut buffers within managed areas, and forested properties where no commercial management is anticipated to take place. All these areas contribute to the overall forested landscape of which the Program managed lands are a part.

Therefore, all the commercial forest types were grown forward using the FVS modeling software without any management for the 50-year analysis period. The WHR classification of these stands at each time period was determined as described in Sections 3.14.5. The WHR Classification Key is shown in Table 2-7, and is repeated here below for the facility of the reader. Non-commercial forest (mostly lands classified as MHW4D in the GIS data) was not included in the projections due to a lack of data and the fact that it would not develop any differently under the Program or the Status Quo. However, as explained in chapter 3.19-Timberland Resources, the lands classified as MHC4D in the GIS data had inventory plot data and were included in the projections but were renamed MHW4D based on the inventory data.

In order to develop the WHR charts for the whole watershed, projections for the Program footprint were combined with projections for the off-Program harvests as well as all the unmanaged commercial forest types to create the same type of chart used in the direct impacts analysis in Chapter 3.14. The same thing was done for the Status Quo situation so that the Program impacts at the landscape level could be compared to the distribution of forest types without the Program in place.

Table 4-4 (also 2-7)

WHR Classification Key for Mattole Forestlands

SPECIES		SIZE CLASS avg dbh of overstory		DENSITY Total Canopy Cover %	
DFR	>50% relative overstory cover by conifers (Douglas fir /redwood)	6	> 24" & multi-storied	S	Sparse 10-25%
MHC	Montane Hardwood/Conifer - relative overstory conifer cover between 25 & 50%	5	> 24"	P	Patchy 25-40%
MHW	Montane Hardwood – relative conifer cover < 25%	4	11" – 24"	M	Moderate 40-60%
		3	6" – 11"	D	Dense > 60%
		2	1" – 6"		
		1	< 1"		

Charts showing the progression of WHR classification on all the commercial forestland in the watershed are displayed below for the Program and the Status Quo. The most telling result indicated by these watershed charts is the apparent similarity between the Program and the Status Quo. While the difference between silvicultural treatments and subsequent stand development is great on the actual footprint acres, once all the unmanaged lands are included in the picture, the differences are greatly diluted. However, there are still some important differences to highlight. Under the Program there are significantly more acres in the 'M' density class (shown as the patterned series in the charts) than in the Status Quo due to the much greater amount of uneven-aged management occurring, even though this still represents a very small proportion of the landscape.

The same metrics utilized in analyzing the footprint area – late seral habitat change and transition from hardwood to conifer classification – are important to point out on the landscape scale as well. As of 2010 the watershed is estimated to have 9,440 acres of size class 5 or 6 forest. By the end of the projection, the area of potentially late succession forest stands will have increased to about 85,000 acres in the Status Quo and 88,000 acres with the Program in place. All of the increase in class 5 & 6 under the Status Quo is the result of unmanaged stands growing into this classification, whereas under the Program some of the managed lands develop into class 5 & 6 in addition to the unmanaged lands. While the increase in late succession habitat in the watershed by 3,000 acres under the Program could be considered moderately beneficial, this is only 4% more of an increase than occurs in the Status Quo. However, there is significantly more size class 6 beginning earlier in the projection under the Program, since stand structure becomes multi-storied much sooner under Program selection than it would with no management.

Generally, WHR class 6 has much greater late seral habitat value than class 5 due to its diverse stand structure. Under the Status Quo no class 6 stands occur until 2055, but with the Program in place they begin to develop 15-20 years earlier. By 2060 there are projected to be 15,900 acres of WHR class 6 forest compared to 8,200 acres projected in the Status Quo scenario – nearly twice as much.

The gradual transition of hardwood-dominated stand types to conifer is characterized in the same charts. Under both the Program and Status Quo scenarios the proportion of the commercial forest landscape in MHC and MHW types goes from 53% in 2010 to about 19% in 2060. The vast majority of these acres go unmanaged in both scenarios, but stands generally have sufficient conifer stocking to eventually grow into a conifer classification without management. Treatments in hardwood dominated stands tend to accelerate the successional change from hardwood to conifer dominated, but these treatments represent only 37% of the total harvested acres under the Program and thus an even smaller portion of the cumulative effects area. These treatments would likely occur on too small a portion of the landscape to detect the changes at the watershed level.

Figure 4-7

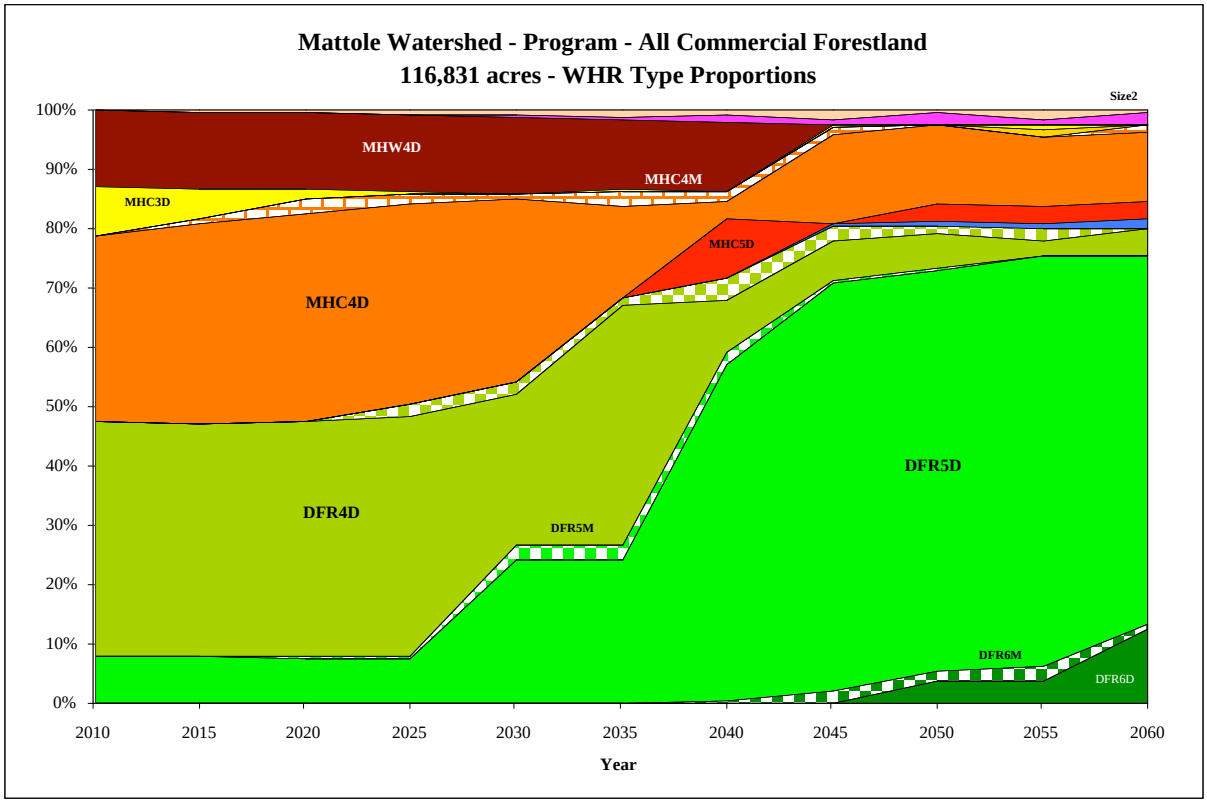
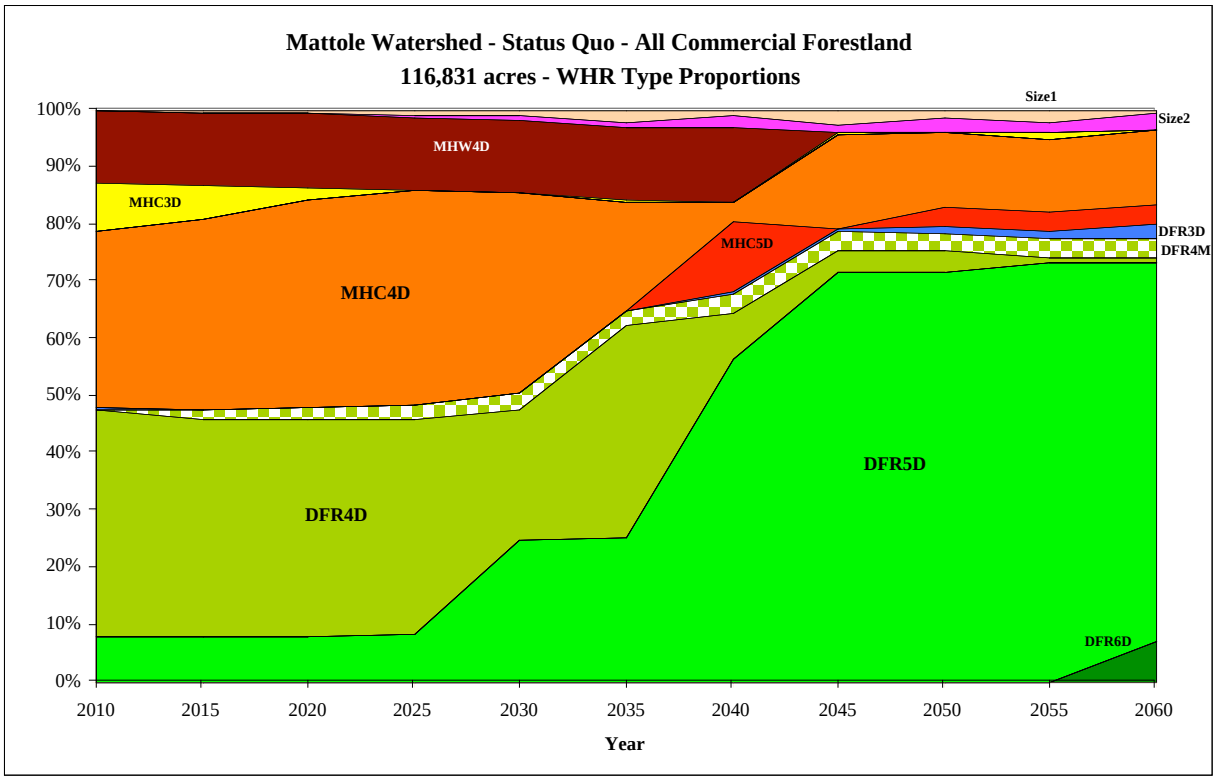


Figure 4-8



Invasive Species

Under California law, certain invasive non-native plants are designated as noxious weeds (California State-listed Noxious Weeds) because they are, or are likely to be:

> "troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species, and difficult to control or eradicate" (Title 3 CCR, FAC 5004).

These noxious weeds are ranked by the State Department of Food and Agriculture as A, B, C, or Q (refer to http://www.cdfa.ca.gov/phpps/ipc/noxweedinfo/noxweedinfo_hp.htm for most current list) that denotes the appropriate action (eradication, containment, etc.) to be taken when such species are detected.

In addition to designated noxious weeds, there are invasive non-native plants, termed "non-noxious invasive weeds", that may have a significant negative impact on natural ecosystems. The nonprofit California Invasive Plant Council (Cal-IPC), in its "California Invasive Plant Inventory, Feb 2006", maintains a database of these weeds. More information on invasive plants and levels of concern can be found at www.cal-ipc.org/inventory/weedlist.php

Adverse impacts are those where invasive non-native plants are able to either successfully invade or reinvade treatment areas and establish viable populations, either because the treatments prepared hospitable site conditions or left viable populations of invasive non-native plants intact and able to increase in extent. A significant adverse impact would be a major increase in a population sufficient to enable invasive non-native plants to dominate the natural plant community within the short-term (2-5 years).

The list of invasive plants relevant to the Mattole and their rankings can be found in the table in Section 3.14.1. A discussion of their current status in the watershed and potential for spread is also found there so does not need to be repeated here.

At the watershed scale, the potential for cumulative effects would exist if conditions were being created conducive to the spread of invasives at a much greater level than would occur in the absence of the Program. On the contrary, there is much more even-aged treatment projected in the Status Quo than under the Program. Exposed ground along roads is the primary conduit for the spread of invasives and would be more prevalent in even-aged harvesting. Even though uneven-aged management often utilizes more of the extensive road network, it does not leave as much exposed ground with minimal canopy cover. The data in the WHR charts indicates that by 2060 there would be approximately 60% more forestland in size classes 1&2 (average diameter < 6") under the Status Quo than under the Program.

Determination of Significance for Vegetation Resources

- Special Status Species

Potential direct impacts to special status plant species at the project level have been addressed in Section 3.14. These are avoided by compliance with the DFG scoping and survey requirements. Also, the maintenance or improvement of beneficial habitat conditions in the watershed will help ensure the long-term viability of plant populations. Since no significant effects are expected to occur at the project level, none would be expected at the cumulative effects level unless one or more of the reasonably foreseeable future projects could have at least a moderate level of adverse effects.

Although some herbaceous species can serve as SOD hosts, there is no evidence that SOD has a negative impact on herbaceous species such as those Special Status plants on the list in Table 2-8, and none of these plants has a particular known association with habitat types most likely to be heavily affected by SOD. Stand improvement activities conducted by KRNCA would presumably be subject to the same kind of scoping requirements for special status plant species, as would the fuel reduction projects conducted by the MRC.

Therefore, cumulative impacts are predicted to be less than significant from Program activities and would not, in combination with Program treatments,

a. Threaten to eliminate a plant community;
b. Violate any state or federal wildlife protection law; or
c. Contribute directly (through immediate mortality) or indirectly (through reduced productivity, survivorship, genetic diversity, or environmental carrying capacity) to a substantial, long-term reduction in the viability of any native species or subspecies at the watershed level.

- Late Succession Forest Stands

The cumulative impact from Program treatments in combination with the reasonably foreseeable future projects is determined to be moderately beneficial, largely due to the increased amount of WHR class 6 habitat created compared to the Status Quo. There will be no significant adverse impacts to late succession forest stands in the watershed as a result of implementing the Program.

- Invasive Species

The results of analysis indicate that the spread of non-native invasive species in the Mattole watershed will not be increased to a significant extent by activities conducted under the Program. While some of the Reasonably Foreseeable Probable Future Projects could facilitate the spread of invasives, Program treatments would not exacerbate these conditions to a level that would cause significant adverse impacts.

Terrestrial Wildlife

This section summarizes the cumulative impacts to wildlife from implementing the Proposed Program combined with impacts from reasonably foreseeable projects or processes. The assessment area for describing the potential cumulative impacts of implementing the Program's practices on wildlife, including threatened and endangered species, is the Mattole basin. However, many of the impacts described below are analyzed against the commercial forest landbase in the basin for two reasons: first, they apply largely to impacts to wildlife habitat in forested ecosystems, such as percent canopy cover; and second, because the analysis would be more likely to identify adverse impacts within a smaller landbase than the entire basin, which contains many non-commercial forest stands and non-forested areas.

Section 3.18 provides a substantial level of cumulative impacts analysis for this topic because it is largely habitat-based and examines habitat and its wildlife implications across the assessment area. Even though no significant impacts to terrestrial wildlife resources were identified in the direct affects analysis, there is still the potential for impacts from the Program to combine with those of other reasonably foreseeable future projects or processes to cause significantly adverse cumulative impacts.

- Terrestrial Wildlife Significance Criteria

The Program and Alternatives would have a significant cumulative effect to wildlife resources if impacts from the Program or any alternative, combined with those of reasonably foreseen projects or processes would:

a) Violate any state or federal wildlife protection law; or
b) Contributes directly (through immediate mortality) or indirectly (through reduced productivity, survivorship, genetic diversity, or environmental carrying capacity) to a substantial, long-term reduction in the viability of any native species or subspecies at the state level.

- Direct Impacts to Terrestrial Wildlife from the Program or Alternatives

The cumulative impacts analysis requires identification and analysis of reasonably foreseen projects that could occur within or outside of the Program area, such as off-Program timber operations. In addition to human-initiated projects, impacts from processes such as the spread of sudden oak death (SOD) must also be considered.

Of the reasonably foreseen projects, impacts from off-Program timber operations are indistinguishable from those for Alternative I as described in 3.18. Off-Program timber operations would not be tiered to the PTEIR and filed as PTHP's, but would likely be filed as THP's tiered to the FPR's. Off-Program timber operations are not expected to meet most of the wildlife goals of the Program, such as favoring the development of mature conifer stands. An assumption in modeling off-Program activities is that even with the Program in place many landowners would not choose to utilize PTHP's, but would continue to file THP's. As noted, since Alternative I is entirely off-Program it contains no additional acreage of off-Program

operations for analysis; while for the Program and Alternatives 2 and 3, the impact of each is combined with that of expected off-Program timber operations for the cumulative impacts analysis. Off-Program operations are predicted to occur on approximately 4,912 acres over the analysis period under implementation of the Program and Alternatives 2 or 3.

In addition to the off-Program timber operations, other reasonably foreseeable projects and processes, which could affect terrestrial wildlife species over the 50-year analysis period are shown below.

KRNCA Late Seral Silvicultural Improvement Projects	2500 acres
KRNCA Shaded fuel break maintenance	1800 acres
KRNCA mountain bike trail installation	50 miles of trail
Livestock Grazing	2,000 animals/ 24,000 acres
MRC Good Roads Clear Creeks Program	Removal of 225,000 yards of sediment (year 2011)
MRC Fuel Reduction Projects	6000 acres
Residential Development	100-250 new dwellings
Population Increase	500 people
Sudden Oak Death Infestation	50,000 acres

- <u>Cumulative Impacts from the Program, Alternatives, and Reasonably Foreseen Projects/Processes</u>

The methodology utilized in Section 3.18 to predict direct impacts to terrestrial wildlife from implementation of the Program and alternatives is to analyze the projected changes in WHR type over the analysis period, as illustrated in the charts in that section. This section utilizes the same methodology to determine cumulative impacts to terrestrial wildlife from Program-related activities and reasonably foreseen non-Program activities. WHR charts for the whole watershed are shown in the previous section.

As shown in the figure for the Program-treated area in Section 3.18, treatments conducted under the Program have the effect of substantially increasing the proportion of multi-storied, maturing conifer-dominated stands (DFR 6M&D) over the next 50 years. However, as shown in Figures 4-7 and 4-8 in the Vegetation section above, the effects of implementing the Program have a far greater relative impact within the Program area compared to the impacts across the 116,831 acres of commercial forestland in the basin.

However, examination of Figure 4-7 against Figure 4-8, which shows the development of WHR types under implementation of the status quo (Alt. 1) across the same area of commercial forestland, indicates only minor differences: the Program area shows a slightly higher proportion of DFR4D stands (young growth Douglas-fir stands ranging from 12 to 24 inches in diameter) and of DFR6M&D stands (multi-storied Douglas-fir stands over 24” diameter). But the remarkably similar feature of both is the vast increase in DFR5D stands. These stands occupy a relatively small proportion of the overall Program area at the beginning of the analysis period but increase to well over 60% of the landscape after 50 years under both the Program and status quo. The primary source of the increase appears to be natural maturation of younger, well-stocked

DFR4D stands into DFR5D stands; the implication being that conifer stocking and dominance is likely to increase over the analysis period primarily because younger stands are not being harvested but are allowed to mature, and that timber harvest, as modeled for both the Program and status quo, has a fairly minor effect to vegetation type development over time, because of the low proportion of the commercial timberland being harvested.

The 87% of commercial timberland that is not modeled for harvest includes conservation lands, such as Sanctuary Forest, government lands such as the KRNCA, and private lands that have too low a volume of commercial stocking to support a harvest. It is possible that the predicted increase in the acreage of commercially valuable DFR5D stands will stimulate an increase in demand and trigger another logging boom; but rather than speculate on future trends, the PTEIR models future harvest on recent past patterns of timber harvest activity, including periods of available and abundant timber and far fewer regulations

- Summary of Cumulative Impacts to Terrestrial Wildlife

The analysis of cumulative impacts to wildlife must consider impacts to special-status species and to particular wildlife habitat elements that the FPR's consider important for maintenance of wildlife habitat within managed forestlands. Many of the special-status species (as discussed in detail in Section 3.18) prefer mature, multi-storied, well-developed timber stands, and these features are enhanced by implementation of Program practices over time. Table 4-5 below compares cumulative impacts from the Program, off-Program timber operations, and the reasonably foreseen impacts noted above, against the important habitat elements recognized in Appendix Technical Rule Addendum #2 of the FPR's. (Of the seven critical habitat elements analyzed in this document, only higher road density is determined to have a negative effect to wildlife, whereas the other habitat elements are presumed to have a more beneficial effect with greater presence on the landscape.)

The following table summarizes the evaluation of the potential for the Program or other reasonably foreseen activities to cause significant adverse impacts to any of the Critical (Wildlife) Habitat Elements identified in Technical Addendum 2 of the FPR's.

TABLE 4-5
Cumulative Impacts[1/] to Critical Habitat Elements from Program Activities and Reasonably Foreseen Projects and Processes Across Commercial Timber Strata in the Mattole Basin

	Snags/Den Trees	Road Density	Large Woody Debris	Multistory Canopy	Hardwood Cover	Late Seral Characteristics	Late Seral Continuity
Program Timber Harvest	LS	LS	LS	LS	LS	LS	LS
Off-Program Timber Harvest	LS	LS	LS	LS	LS	LS	LS
KRNCA Late Seral Silvicultural Improvement	LS	LS	LS	LS	LS	LS	LS
KRNCA Shaded fuel break maintenance	LS	LS	LS	LS	LS	LS	LS
KRNCA mountain bike trail installation	LS	LS	LS	LS	LS	LS	LS
Basin-wide livestock Grazing	LS	LS	LS	LS	LS	LS	LS
MRC Good Roads Clear Creeks Program	LS	LS	LS	LS	LS	LS	LS
MRC Fuel Reduction Projects	LS	LS	LS	LS	LS	LS	LS
Residential Development	LS	LS	LS	LS	LS	LS	LS
Population Increase	LS	LS	LS	LS	LS	LS	LS
Sudden Oak Death Infestation	LS	LS	LS	LS	PS2/	LS	LS

1/ Key to impacts: **PS = Potentially Significant Adverse Impact; LS = Less than Significant Adverse Impact**: Adverse impacts are those effects which degrade the diversity, structure, size, integrity, abundance or number of; or are outside the natural range of variability, for the resource at issue. Beneficial effects are those effects that improve the diversity, structure, size, integrity, abundance or number of; or are within the natural range of variability, for the resource at issue.

2/ The impact to hardwood cover from SOD is potentially significant, however, the direct effect is estimated to be less than significant because, as described in Chapter 3, the impacts from SOD are highly speculative. In addition, one of the SOD mitigation measures would change the Program's practices if SOD were to kill more than 80% of tanoak on more than 35% of any subbasin. The cumulative effect of all of the reasonably foreseeable future projects, other than SOD, is not likely to reduce hardwood cover by any more than a negligible amount, so that the cumulative impacts are mostly the result of the direct effects. As such the cumulative effect is essentially the direct effect, which, as previously stated in chapter 3 is both highly speculative and together with the mitigation measures is considered as less than significant. The cumulative impact would be significant without the mitigation measure.

The impacts to the Critical Habitat Elements from implementation of the Program are discussed in detail in Section 3.18. Likewise Off-Program timber operations are indistinguishable from those described for Alternative I in Section 3.18, because they employ the same treatments. The other reasonably foreseen actions are analyzed below:

The KRNCA late seral improvement project is beneficial to many critical habitat elements because its primary purpose is to increase late seral conditions within the conservation area. Because this project does not overlap physically with the Program or alternatives, any impacts would affect other areas of the Mattole basin. Because of its purpose, the The KRNCA late seral improvement project is considered to be beneficial to snags and den trees, large woody debris, and development of a multistory canopy. It should have little if any impact to road density, as there is no information that it affects the extent of the road system. It could have a slight adverse impact to hardwood cover, as the intent of the project is to hasten the development of late seral conifers stands; and because it is designed to increase late seral conditions it has a beneficial impact to late seral characteristics and continuity within its area of operation.

KRNCA shaded fuel break maintenance is expected to create a slight adverse impact to most of the critical habitat elements because it tends to simplify stand structures and remove fuels (e.g., down woody material, snags) within the fuel break areas. There is no evidence that it affects the extent of the road system.

The KRNCA mountain bike trail installation should have little effect to elements related to stand structure. It could have a moderately adverse impact to road density because although a bike path creates fewer impacts than a well-traveled road, it still fragments habitat for some wildlife species and introduces human presence into their habitats.

Livestock grazing should have little adverse impact to the critical habitat elements because it largely occurs outside of forested areas where the critical habitat elements exist. There is no evidence to suggest that road use related to grazing would increase road density over its current level.

The MRC Good Roads Clear Creeks Program should have little to no impact to most critical habitat elements because its purpose is to remove sediment and improve road conditions. It is expected to create a beneficial impact to road density because some roads will be decommissioned and others hydrologically disconnected and rendered undriveable, removing barriers to wildlife passage.

The MRC fuel reduction projects are expected to create a slight adverse impact to most of the critical habitat elements because they tend to simplify stand structures and remove fuels that make up critical habitat elements such as the understory canopy and large down woody material. There is no information that these projects affect the extent of the road system.

Residential development and population increase are expected to have a slight adverse impact to all of the critical habitat elements because they will likely be mostly removed by clearing for home construction; and many elements that may remain nearby are not compatible with human uses of the immediate dwelling area. As snags are removed for safety purposes, the understory cleared for visibility and defensible space, etc.. Residential development is expected to cause a slight adverse impact across the basin in terms of road density through construction of driveways and access roads. This impact is not considered significant due to the projected low rate of residential development.

Sudden oak death infestation is rated as significantly adverse to snags and den trees because it will likely kill thousands of mature tanoaks that would eventually become snags or den trees. Wildfire intensity and rate of spread could also be exacerbated if these stands are affected by wildfire as discussed in Section 4.15, Wildland Fire. SOD is also rated significantly adverse to multistory canopy because of projected mortality of much of the current overstory, and to hardwood cover because SOD is expected to destroy substantial amounts of hardwood cover across the basin. It is rated moderately adverse to late seral conditions and continuity, because although it could destroy many hardwoods that contribute to late seral structures, it has little effect to the mature conifer stands that currently comprise most of the late seral stands in the assessment area; in addition, SOD would not delay maturation of most stands to late seral conditions given the diversity of tree species in the Mattole and their ability to colonize forest openings. It is expected to have a slight adverse impact to road density because some now brushed-over roads could be opened to better combat SOD infestations. It would have a short term benefit to large woody debris as dead trees fall, which would be relatively short lived due to the rapid decay rates of down hardwood logs.

- Cumulative Impacts to Special-Status Terrestrial Species

In the following table, each of the special-status species that were discussed in detail in Section 3.18 is listed, along with the rating of direct impact from the Program as discussed in Section 3.18. The next column to the right rates the cumulative impact from implementation of the Program as well as from all the reasonably foreseen projects discussed above. The final column summarizes reasons for the determination. (It should be noted that although sudden oak death has an impact on many habitat elements, including mast production, few of the species listed below are known to be highly dependent on the presence of extensive stands of tanoak (the most likely species to be decimated by SOD), even though tanoak represents 1/3 of all trees by basal area within forest stands of the basin.

Table 4-6
Cumulative Impacts to Special Status Species from Program Activities and Reasonably Foreseen Projects and Processes Across Commercial Timber Strata in the Mattole Basin

Special-Status Species	Direct Impacts From Program	Cumulative Impacts	Reason for Determination (Cumulative Impacts)
Cooper's hawk	LS	LS	Creation of suitable habitat through forest stand management. Slight adverse impacts from small acreage of homesite conversion, population increase, decline in squirrel prey base as a result of tanoak mortality from SOD.
Golden eagle	LS	LS	No likely impact to habitat from timber operations
Great egret	LS	LS	No impact expected to very limited habitat
White footed tree vole	LS	LS	Slight adverse impact from disturbance to habitat from logging & development on relatively small proportion of analysis area
Red tree vole	LS	LS	Somewhat increased disturbance to habitat from off-Program projects and processes
Great blue heron	LS	LS	No impact to very limited habitat
Ruffed grouse	LS	LS	Slight increased disturbance to habitat
Marbled murrelet	LS	LS	Beneficial impact due to increased habitat from Program, some habitat loss from other projects
Vaux's swift	LS	LS	
Olive sided flycatcher	LS	LS	
Townsends big eared bat	LS	LS	No impact to very limited habitat
Hermit warbler	LS	LS	Increased habitat from Program, some loss from other projects
Pacific slope flycatcher	LS	LS	
Little willow flycatcher	LS	LS	Increased habitatfrom Program area, no expected loss from other projects
Peregrine falcon	LS	LS	No expected impacts to limited habitat. Legal protections mitigate against impacts
Bald eagle	LS	LS	
Osprey	LS	LS	
Purple martin	LS	LS	Beneficial impact due to increased habitat from Program, some loss of habitat from other projects
Pacific fisher	LS	LS	
Humboldt marten	LS	LS	
Northern spotted owl	LS	LS	

1/ Key to impacts: **PS = Potentially Significant** Adverse Impact**; LS = Less than Significant** Adverse Impact.

As indicated in the table above there appears to be little likelihood for the cumulative effects of the Program along with the reasonably foreseen projects and processes to cause significant cumulative impacts to any particular special-status terrestrial wildlife species in the Mattole basin. For many of these species impacts from the program are considered beneficial due to projected increases over time in late seral habitat; this is also true of the KRNCA late seral

improvement project. On the other hand a slight adverse cumulative impact is expected from many of the reasonably foreseen projects (with the exclusion of the KRNCA late seral improvement project) as they tend to diminish rather than improve late-successional habitat.

- Summary of Cumulative Impacts to Terrestrial Wildlife

The analysis above shows that there is a less than significant cumulative adverse impact to terrestrial wildlife when combining the individual Program practices together with reasonably foreseeable probable future projects and activities.

4.10 Recreation Cumulative Impacts

This section summarizes the cumulative impacts to recreation from implementing the Proposed Program in conjunction with the on-going and reasonably foreseeable probable future projects. The assessment area for describing the potential cumulative impacts of implementing the Program's practices on recreation is the Program area plus 300 feet

As described in Chapter 3.10 the primary potential impact to recreational use of the Mattole watershed would be occasional, mid-week use of public camping facilities by logging crews. Although this hypothetical effect has never been described by public resource agencies, the potential exists. The addition of off-Program harvests to the Program harvests analyzed in Chapter 3.10 would add approximately one more logging crew per year so rather than 2-3 crews there could be 3-4 crews.

It is highly unlikely that this additional influx of workers would significantly impact the 49 public camping sites available in the Mattole.

As described in Chapters 3.4 and 4.2 impacts to fisheries resources are highly unlikely and effects on deer habitat are likely to be positive. Due to the low harvest rates and predominance of uneven-aged silviculture methods it was determined in Chapter 3.15 that impacts to scenic resources would also be minimal, which are a key component of the recreational appeal of the Mattole watershed.

<u>Determination of Significance for Recreational Resources</u>
The analysis above shows that there is a less than significant cumulative adverse impact to recreational resources when combining the individual Program practices together with reasonably foreseeable probable future projects and activities.

4.11 Visual and Aesthetic Cumulative Impacts

This section summarizes the cumulative impacts to visual and aesthetic resources from implementing the Proposed Program in conjunction with on-going and reasonably foreseeable probable future projects or processes. The assessment area for describing the potential cumulative impacts of implementing the Program's practices on visual resources is the Mattole basin rather than the FPR prescribed area that is within three miles of the logging area, as explained in Section 3.15. Even though no significant direct impacts to visual and aesthetic resources were identified in the analysis in Section 3.15, the less than significant impacts from the Program could combine with those of other reasonably foreseeable future projects or processes (e.g., sudden oak death, population increase) to cause significantly adverse cumulative impacts. Reasonably foreseen projects are shown in Table 4-5 above and listed and discussed below.

Significance Criteria

The Program and Alternatives would have a significant cumulative impact to visual and aesthetic resources if impacts from the Program or any alternative combined with those of reasonably foreseen projects would:

a) Have an adverse impact on a scenic vista;
b) Damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway; or
c) Degrade the existing visual character or quality of the site and its surroundings.

Cumulative Impacts to Visual and Aesthetic from the Program, Alternatives, or Reasonably Foreseen Projects/Processes

Impacts to visual and aesthetic resources are discussed in detail in Section 3.15. These impacts are related to the magnitude of disturbance to the landscape and the visibility of the disturbance from public roads or lands. The analysis of direct impacts to these resources in Section 3.15 equates 'adverse visual impacts' to even-aged management, and considering the rugged terrain of the Mattole, it is estimated that 50% of the projects would likely be visible in most of the subbasins (excluding the North_1 subbasin), including fleeting views, from public roads or lands.

The reasonably foreseen project with the most similarity to the Program is timber harvest that occurs outside of the Program, or 'off-Program' timber operations, which is predicted to occur on approximately 4,912 acres over the analysis period. Table 4-7 below compares estimated areas of adverse impact to visual resources from Program and off-Program timber operations against those of the Program and alternatives using the methodology used in Section 3.15 and described briefly in the footnotes to the table.

Table 4-7
Potential Visually Adverse Footprint Harvest Acres by Program/Alternative[1/]

Subbasin	Off-Program[6/]	Program[2/]	Alternative I[3/]	Alternative 2[4/]	Alternative 3[5/]
East_1	73	133	293	409	0
East_2	31	83	116	312	0
North_1	196	215	800	596	0
North_2	153	147	644	366	0
South_1	258	32	258	98	0
West_1	9	87	42	344	0
West_2	16	55	57	185	0
TOTAL	737	752	2207	2310	0

1/Harvest acreage likely to have a negative impact to visual resources/aesthetics based on amount of primary canopy layer removed (acreage of even-aged vs. uneven-aged management) and estimated 50% visibility of treatment acreage from public roads or public lands.
2/Program acres = Footprint acres x 0.10 (estimated group selection openings x 0.50 (estimated visible acres)
3/Alternative 1 = Footprint acres x 0.30 (estimated even-aged prescriptions) x 0.50 (estimated visible acres)
4/Alternative 2 = Footprint acres x 0.30 (estimated even-aged prescriptions) x 0.50 (estimated visible acres)
5/Alternative 3 = Estimated at 0 adversely affected acres because no even-aged management and no group selection, plus mandatory 60% canopy retention
6/Off-Program = Footprint acres x 0.30 (estimated even-aged prescriptions) x 0.50 (estimated visible acres)

Off-Program timber operations are similar in the acreage of adverse visual impact they create to the Program at 737 vs. 752 acres; however, the openings created in the Program are never more than 2.5 acres in size, while the disturbances created by off-Program harvest could be made up of clearcuts and other even-aged harvest units of many sizes.

In Section 3.15, Table 3-45 rates estimated visual effects from the Program and alternatives by subbasin. Impacts to all subbasins from Alternative 3 were rated as less than significant. Impacts to the North_2 and South_1 subbasins from Alternative I, and to the North_2 and West_1 subbasins from Alternative 2 were expected to be moderately adverse but still less than significant. Impacts to all the remaining subbasins by Program and alternatives were rated as less than significant. (As noted in Chapter 3, although the North_1 subbasin shows the most adversely affected acres, the visual impact is largely negated by the fact that this subbasin is essentially not visible from public roads and lands, and visual impacts in the subbasin are considered to have at the most a slight adverse impact.

Table 4-8 below compares the acreage of commercial timberland in the Program area that is potentially visible from public roads or lands (using the same methodology as in the table above) against the total impacted acres from the Program and alternatives plus the impacted acreage of the off-Program harvest. Percentage of the potential impacted commercial forestland is also shown.

Table 4-8
Acres Of Potential Cumulative Impact To Visual/Aesthetic Resources By Acreage From Program And Off-Program Timber Harvest By Subbasin

Sub-basin	Prog.+ off-Prog.	Alt 1 + off-Prog.	Alt 2 + off-Prog.	Alt 3 + off-Prog.	Commercial Forest in Program. Area	Percentage of Commercial Forestland Adversely Impacted[1/]			
						Prog.	Alt 1	Alt 2	Alt 3
East_1	206	366	482	73	20351	1.01	1.80	2.37	0.36
East_2	115	147	344	31	15616	0.94	0.94	2.20	0.20
North_1	412	996	792	196	15060	6.61	6.61	5.26	1.30
North_2	300	797	519	153	15313	5.21	5.21	3.39	1.00
South_1	289	515	356	258	13164	3.91	3.91	2.70	1.96
West_1	97	51	354	9	13734	0.37	0.37	2.57	0.07
West_2	71	73	200	16	23593	0.31	0.31	0.85	0.07
TOTAL	1489	2944	3047	737	116,831	2.52	2.52	2.61	0.63

1/Includes off-Program impacts.

Section 3.15.1, Determination Threshold for impacts to visual and aesthetic resources, concludes that impacts would be considered significant if the acreage of treatments

- caused adverse and long term impacts exceeding more than 10% of the scenic vistas or the existing visual quality,
- caused damage to 10% or more of the scenic resources within the Program area, or
- degraded more than 10% of the visual character of the operations sites of a PTHP and its surroundings in any 10-year period.

Such impacts would be considered particularly significant if they occurred within the Coastal Commission Special Treatment Area in the Mattole basin (as discussed in 3.15).

Examination of Table 4-8 above indicates that far less than 10 percent of the commercial forestland in any one subbasin is affected over the analysis period by the Program or any of the alternatives combined with additional impacts from off-Program timber operations. It is assumed that in most of the subbasins the scenic vistas and other aesthetic values are directly related to the acreage of commercial forestland, as that is the landscape context in which they occur; however, in terms of cumulative impacts to the Mattole basin as a whole, it should be remembered that commercial forestlands only make up slightly over 60% of the acreage of the entire basin. Non-commercial forestlands occupy 34,174 acres of the basin and non-forested acres occupy 38,755 acres, so the impact to visual resources to scenic values from Program and off-Program activities would be an even smaller fraction of the threshold of significance to visual resources across the basin, making these impacts fall even further below the determination threshold percentages.

The extreme western portions of the West_1 and North_1 subbasins lie within the Coastal Commission Special Treatment Area (See discussion in Section 3.15.2). The Special Treatment Areas in the Mattole basin are recognized (as per the FPR definition of Special Treatment Areas)

for being *B. Site[s] of significant scenic value,* and *C. Wetlands, lagoons, streams, estuaries, and marine environments.* It is possible that a direct view from the mean high tide mark looking east could take in some private lands that might be impacted by Program-related or off-Program effects from timber operations. However, any impacts to this special treatment area must be disclosed during the timber plan preparation process, as noted in the Regulatory Setting Section, 3.15.2, and mitigated as guided by the FPR's. Because of this regulatory emphasis, no significant cumulative impacts are expected to the BOF special treatment area from operations conducted under the FPR's, including on- and off-Program timber operations.

Implementation of Alternatives 1, 2, or 3, although they affect slightly different landbases and acreages, is also expected to have at most a slightly adverse cumulative impact when combined with the other reasonably foreseen impacts noted above, for the same rationale as that discussed for the Program.

Table 4-3 above lists several reasonably foreseen ground-disturbing projects and processes that have potential to impact visual and aesthetic resources over the 50-year analysis period, including:

KRNCA Late Seral Silvicultural Improvement Projects	250 acres
KRNCA Shaded fuel break maintenance	36 acres/year
KRNCA mountain bike trail installation	50 miles of trail
Livestock Grazing	2,000 animals/ 24,000 acres
MRC Good Roads Clear Creeks Program	Removal of 225,000 yards of sediment (year 2011)
MRC Fuel Reduction Projects	6000 acres
Residential Development	100-250 new dwellings
Population Increase	500 people
Sudden Oak Death Infestation	50,000 acres

KRNCA Late Seral Silvicultural Improvement Projects : Figure 4-2 above shows the areas within the Mattole basin where the BLM intends to implement late seral improvement projects. This is estimated to occur on 50 acres a year, which projected over 50 years could total 250 acres. As with timber operations, these projects would impact visual resources to the extent that they could be viewed from public roads or lands inside the basin or impact the other visual resource evaluation criteria noted in Section 3.15. However, given the relatively low-impact nature of the KRNCA projects and the small acreage they are projected to impact, they should have no significant adverse visual impact when combined with Program and off-Program timber operations.

<u>Livestock Grazing</u>: Impacts from livestock grazing to visual and aesthetic resources are addressed by the USFS in General Technical Report PSW-035 (Brown and Kissel 1979), which notes that:

> *"The visual impacts of grazing systems are associated with range conditions. That is to say, how livestock are grazed in a certain allotment affects the perceived visual patterns of the landscape. The perceived patterns are affected by the following factors and*

> *conditions: The existing vigor and condition of the vegetation, soil fertility, erosion potential, the availability and spacing of water sources, the number of livestock being grazed and the length of time they are grazed. All these factors and more combine to determine the degree of visual impacts associated with grazing systems.* [and]
>
> *As described in this paper, the visual impacts of range management vary in degree depending on how the specific actions are planned, designed and implemented in the various characteristic landscape types. A project in one landscape type may look totally different in another landscape type. There are many variables involved when evaluating any type of visual impact. Most impacts are noticeable in the foreground and middleground viewing zones. The more varied the landscape the less impacting they become. The visual impacts of range management activities vary in degree over the life of the project. The visual impact of site construction for example, will probably diminish over time. Vegetative manipulations are most noticeable within the first five years after implementation. The longest visual impact occurs with grazing practices themselves. Overgrazed rangeland takes a long time to recover and the effects go far beyond visual impacts. Because of the historical significance associated with cattle ranching, range management activities are not considered a major visual impact nationally. However, as people are becoming more aware of their environment, they are objecting to adverse visual changes caused by highly competitive land uses. It, therefore, becomes more important to consider how range management activities "fit" the landscape in order to reduce negative visual impacts."*

During review of documents related to the Mattole basin in regard to this project none have surfaced that are critical of the visual or aesthetic impacts from grazing. Livestock can keep prairies open by suppressing invasive shrubs and trees, and intact prairies add to the visual variety characteristic of the region. Many persons appreciate the aesthetic values of such a landscape, as illustrated by Brown (2008), who notes that grazing land can confer a

> *"…strong appreciation of nature, especially its visual qualities and even the colour green. Related attraction to the idea of living in [such areas] with associated attraction to pastoralism and farming, livestock and a country life in which humans are part of nature…scenes preferred are virtually devoid of development and have a high natural content, even if this is essentially visual and/or aesthetic, as opposed to 'real'…"*

From the above considerations, it appears that livestock grazing can have a beneficial visual impact as long as its various impacts are well managed, particularly the avoidance of overgrazing. Livestock grazing as a stand-alone activity in the Mattole is considered to have a less than significant adverse impact to visual resources when combined with Program and off-Program timber harvesting.

<u>The MRC Good Roads Clear Creeks</u> project affects only already-constructed roads. In that its goals are to help avoid road failures and associated stream pollution, this project should have a moderately beneficial and less than significant impact on visual and aesthetic resources.

<u>The MRC Fuels Reduction</u> projects will create a minor disturbance to established vegetation in the short term, but over the longer term will likely create a pleasing visual effect as more park-like conditions are created by the construction of shaded fuel breaks. Effective fuel breaks can

also help mitigate the effects of wildfire, the blackened landscape of which is considered an adverse visual impact, as discussed in Section 3.5. These treatments are estimated to occur on 120 acres a year, which projected over 50 years could total 6000 acres. The MRC fuel reduction projects, combined with the Program or alternatives or other expected impacts should not create a significant cumulative adverse impact to visual resources due to the long term positive visual impacts and the slow rate of implementation of the project.

Residential Construction: Construction of 100-250 dwellings over the 50-year assessment period would have a variable impact to visual resources depending on the dwelling site and type of dwelling. In many circles, well-designed buildings are considered to complement visual resources; however, people who prefer bucolic landscapes generally have a strong aversion to even small occurrences of urban-type development (Brown 2008). If the dwellings are constructed on undeveloped land, other buildings such as garages, shops, etc., would no doubt follow, and the area of visual impacts could total at least 1 acre per homesite. Of course, these impacts tend to be permanent in effect rather than transitory, compared to the rather transitory impacts caused by on and off-Program timber operations and most of the other reasonably foreseen projects. But even if each homesite created adverse visual impacts by itself, the overall impacts in terms of adversely affected acres could still not reasonably be considered significantly adverse to visual resources, given that the greatest impact would be no more than 5 acres per year over 50 years.

Sudden Oak Death

Another factor that is reasonably foreseen is the likely spread of sudden oak death (SOD) into the Mattole basin. This is predicted at 1000 acres per year, or 50,000 acres over the analysis period, which clearly exceeds the significance thresholds noted above. At any one time it is estimated that up to 14,000 acres could be heavily impacted (e.g., most tanoak trees killed) at any one time across the basin (Valachovic, pers. comm.. 2010). Because as tanoak makes up approximately 50% of the tree stocking in the Mattole and SOD largely kills tanoaks, this mortality could heavily impact visual resources in some areas, However, observation of SOD-infected stands in the Redway-Briceland area indicates that the mixture of species (many of which are not affected by SOD) in most stands and the ability of vegetation to quickly restock open areas can mitigate visual effects to a fair degree and over time. If SOD spreads quickly into the Program area, it is likely that it would have a significant adverse impact on visual resources and aesthetics.

Some stand manipulation treatments as envisioned under the Program or off-Program timber harvest could help mitigate the effects of SOD since they have the potential to remove dead and dying trees and break up the potentially large areas of negative visual impacts, especially as these areas would be regenerated with conifers. There could also be adverse effects to visual resources if large areas were treated by removing trees within and around infected areas in a sanitation treatment; however, if this happened it would likely be only on industrial timberland in the North_1 watershed, where visual effects are limited. It is considered unlikely that a coordinated program to treat all infected sites would be applied to the patchwork of private parcels in the watershed.

Determination of Significance for SOD

As discussed in Section 4.6, the anticipated infestation of SOD into the Mattole basin is so unpredictable that impacts to even almost pure tanoak stands are too speculative under CCR 15145 to make a determination of cumulative significance. The possible use of herbicides as a control to SOD is even more speculative, as described in Section 3.11.

Environmental Clearance for Reasonably Foreseen Projects

Environmental clearance for the reasonably foreseen projects to visual resources would depend on the funding source of the projects. Federal KRNCA projects would be addressed through NEPA, while the MRC projects would likely be state-funded and addressed via CEQA. Both CEQA and NEPA require evaluation of impacts to visual and aesthetic resources.

In terms of new dwelling construction, the primary regulatory responsibility would rest with the Humboldt County Planning and Building Departments. If a permit is obtained for an existing parcel, the environmental review is conducted by a building inspector who fills out a Pre-Site Investigation Checklist. This checklist contains no requirements related to visual or aesthetic resources. On the other hand, if a residential subdivision is planned, it is subject to a CEQA analysis, which follows a similar review to a timber harvest plan, whereby the proponent must consider views from public roads and lands, visual screening, etc., before being permitted A CEQA review can also be generated if a landowner files for a special permit (for instance, to decrease the setback from a stream for a building site), in which case visual impacts could be investigated (Estlow, pers. comm. 2010).

Determination of Cumulative Significance on Visual and Aesthetic Resources

Over the 50-year analysis period implementation of the Program along with reasonably foreseen projects is not likely to create a cumulative significant adverse impact to visual resources.

However, with the addition of up to 14,000 acres of dead or dying hardwoods being present on the landscape at any one time, if even half of these were visible the effects from SOD plus the Program and reasonably foreseen impacts would be considered significantly adverse.

Mitigation Measures

Section 2.1(C.6) contains state-mandated best management practices designed to impede the infestation of SOD into the Mattole basin, and/or to control the spread of the infestation. It is hard to measure the effects of these BMPs (which are already in place) against the spread of SOD as documented and predicted; but they represent the best thinking of experts at this state of the infestation. Given the relatively small impact of the combined Program and reasonably foreseen projects, further modifying the Program or the projects to reduce the overall visual impacts to a landscape in order to mitigate against SOD as well is too speculative to consider given the unpredictable nature of impacts from SOD.

Literature Cited

Brown, Bruce R. and David Kissel. 1977. USDA Forest Service, Pacific Southwest Resarch Station General Technical Report 035-01.

Brown, Stephen R. 2008. Project Central Wind: Assessment of Landscape and Visual Amenity Effects. Stephen Brown Environments. New Zealand.

Estlow, Trevor. 2010. Humboldt County Planning Department. Eureka.

Valachovic, Yana. Personal Communication October 2010. Forest Advisor, University of California Extension Service.

4.12 Cumulative Impacts to Traffic and Transportation

This section summarizes the cumulative impacts to traffic and transportation from implementing the Proposed Program in conjunction with the on-going and reasonably foreseeable probable future projects. The assessment area for describing the potential cumulative impacts of implementing the Program's practices on transportation is the public road system, in particular the Humboldt County road system. Because the location of possible Program implementation is unknown at this time, singling out the first road not part of the logging area, as the FPR's require, is not possible. As a result, for CWE purposes, the impacts from implementing the Program are limited to the impacts to the County's road system.

The significance criteria and the determination thresholds have already been previously described in Chapter 3. The determination thresholds are reproduced here since they establish the point at which cumulative impacts might be significant. The Program in conjunction with the reasonably foreseeable probable future projects and activities, when combined, might create a significant impact if cumulatively they would result in impacts to traffic and transportation that result in:

a) An increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections).
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways.

As described in the FPR's, cumulative impacts to traffic and transportation can occur when the impacts of two or more activities, from the same or different projects, combine to produce a significant increase in traffic which is defined as traffic increases in excess of 10% of the ADT of the capacity of roads that serve residential and/or commercial areas near project areas.

Program Impacts Analysis

The direct impact of the Program and alternatives on traffic and transportation is evaluated in Chapter 3. The findings suggest that the direct Program impacts are likely to have a negligible adverse impact to traffic patterns and on transportation within the Program area. Although the Program only takes place on 13% of the Mattole basin acreage, all of the traffic generated by the Program eventually utilizes the main county roads serving the Mattole. In spite of this, total traffic associated with the Program is expected to increase by only about 175 vehicle trips per year which is just a 0.23% increase in ADT assuming that all of the traffic associated with implementation of the Program occurs between June and October of each year.

Cumulative Impacts Analysis

The cumulative additive impact of the reasonably foreseeable probable future projects together with implementation of the Program results in a slightly increased ADT above that projected for the Program. Cumulative traffic impacts would occur if traffic from the Program either makes existing traffic problems significantly worse or is combined with existing traffic to create a

significant adverse impact. There is no indication that there are currently any existing traffic cumulative impacts within the assessment area.

Log truck traffic in the project area has declined in recent years proportionately with the decline in timber harvesting activity. However log hauls are now longer, due to the recent closure of the Harwood Company mill in Branscomb. These closures have increased the potential amount of log truck traffic traveling north on highway 101, since some loads from the Mattole would likely have gone to Branscomb but now have to travel north to Eureka.

The log truck traffic levels resulting from implementation of the Program or any of the alternatives will vary with the alternative and also will vary over time and space and seasonally. However, none of the alternatives would result in significant ongoing increases in log truck traffic beyond the historic levels that have resulted from timber harvest in the Mattole.

Further, sources of traffic growth in the area are minimal, resulting in little or no traffic growth over time. The evaluation of traffic impacts in Chapter 3 considered the overall effect of traffic increases from the proposed Program on existing traffic levels, and concluded that there were no substantial impacts causing a level of service standard established by the county congestion management agency for designated roads or highways to be exceeded. Therefore, the proposed alternatives will not add to or create significant, adverse cumulative impacts to traffic.

All of the reasonably foreseeable probable future projects are associated with traffic increases that are so small as to be un-detectable at the Programmatic level. Many of the reasonably foreseeable probably future projects such as recreation, cattle ranching, home building, implementation of the MRC Good Roads Clear Creeks program etc, are already accounted for in the ADT for the basin.

Determination of Significance for Traffic and Transportation

The cumulative impact to transportation/traffic from treatments under the Proposed Program in conjunction with the on-going and reasonably foreseeable probable future projects are such that they will neither, a) cause a substantial increase in traffic nor, b) will it individually or cumulatively exceed the level of service for designated roads or highways. The combined impact of the Program and the reasonably foreseeable probable future projects only slightly increases ADT such that this increase will have a less than significant cumulative adverse impact to traffic.

4.13 Air Quality Cumulative Impacts

This section summarizes the cumulative impacts to air quality from implementing the Proposed Program in conjunction with the on-going and reasonably foreseeable probable future projects. The assessment area for describing the potential cumulative impacts of implementing the Program's practices on air quality is the Mattole basin

The significance criteria and the determination thresholds have already been previously described in Chapter 3. The determination thresholds are reproduced here, since they establish

the point at which cumulative impacts might be significant. The Program in conjunction with the reasonably foreseeable probable future projects and activities, when combined might create a significant impact if cumulatively they would result in emissions that exceed the California Violation Thresholds described in Chapter 3.3.

As described in the FPR's, cumulative impacts to air quality can occur when the impacts of two or more activities, from the same or different projects, combine to produce a significant increase in emissions.

Program Impacts Analysis

The direct impact of the Program and alternatives on air quality is evaluated in Chapter 3. The findings suggest that the direct Program impacts are likely to have a negligible adverse impact to air quality on the Program acres. Because the Program only takes place on 13% of the commercial forest acres within the Mattole, and only a small percentage of those will be treated with fire, any change in air quality would likely be minimal.

The NCUAQMD is in attainment for all criteria air pollutants except for PM10. As chapter 3 points out, production of exhaust-related PM, SOX, NOX and TOG generated by the Program's practices or the Alternatives is insignificant compared to total emissions within the district. Total production of exhaust-related particulate matter from the Program is about 0.012% of the total exhaust-related particulate matter generated in any year within the NCUAQMD. Particulate matter production from prescribed fire is estimated at 1% of district totals from managed burning, while particulate matter production from wildfires burning in areas treated under the Program where slash is assumed not to have been treated, represents an extremely low proportion of total emissions from wildfires burning in the NCUAQMD area, generally on the order of between 0.07% to 0.08% of total emissions.

Cumulative Impacts Analysis

The cumulative additive impact of the reasonably foreseeable probable future projects results in a mixed set of both beneficial impacts and adverse impacts depending on the type of project being considered.

The air quality impacts associated with the reasonably foreseeable probable future projects are virtually undetectable compared to emissions throughout the district. Given the rural nature of the Mattole basin with no point-source emitters and with the vast majority of the basin not likely to be harvested, the role of other projects in PM10 production is negligible save for the impacts from the off-Program harvest. Impacts to air quality from maintenance of shaded fuel breaks, construction of 2 to 5 houses per year as well as daily traffic of around 2,500 vehicle trips per day along with other reasonably foreseeable probable future projects is not likely to result in significant increases to PM10.

If every acre that is treated through off-Program harvest were to be burned by wildfire, in a worst-case scenario, it would be expected to emit about 9 tons of PM10 per year if every acre were burned by wildfire, which is about 0.013% of total wildfire PM10 emissions in the

NCUAQMD, an amount that is negligible. Total off-Program PM10 emissions from operation of heavy equipment exhaust emissions and dust from log trucks operating on unpaved roads is estimated to be about 1/3 of Program emissions, which were estimated at 0.012% of total district exhaust and dust emissions. Emissions of PM10 from off-Program prescribed fire are expected to be negligible since most off-Program harvest is not expected to be treated with prescribed fire.

Determination of Significance for Air Quality Resources

Based on the projected emissions from prescribed fire, wildfire and from use of heavy equipment, the Program and on-going and reasonably foreseeable probable future projects would:

a. Not conflict with or obstruct implementation of any NCUAQMD air quality plans and air quality regulations
b. Not exceed the California Violation Threshold for criteria air pollutants and thus would not violate any air quality standard or contribute to an existing or projected air quality violation;
c. Not result in a cumulatively considerable net increase of any criteria pollutant for which the region is in non-attainment under an applicable federal or state ambient air quality standard since emissions of PM10 from the Program and on-going and reasonably foreseeable probable future projects are not “considerable”.
d. Not expose sensitive receptors to substantial pollutant concentrations, generally since operations under the Program and on-going and reasonably foreseeable probable future projects do not take place adjacent to such receptors,
e. Not create objectionable odors affecting a substantial number of people;
f. Not otherwise degrade the atmospheric environment since emissions would not exceed the California Violation Thresholds for criteria air pollutants; and
g. Not expose workers or the public to hazardous toxic emissions or substantial pollutant concentrations in excess of the California Violation Thresholds

As a result, the Proposed Program, together with the on-going and reasonably foreseeable probable future projects, will have a less than significant cumulative adverse effect on air quality.

4.14 Greenhouse Gas Cumulative Impacts

The section summarizes the cumulative impacts to greenhouse gas emissions from implementing the Program in conjunction with the on-going and reasonably foreseeable probable future projects. The assessment area for describing the potential cumulative impacts on greenhouse gas emissions is the Mattole basin.

The significance criteria and the determination thresholds have already been previously described in Chapter 3. The determination thresholds are reproduced here since they establish the point at which cumulative impacts might be significant. The Program in conjunction with the reasonably foreseeable probable future projects and activities, when combined might create a significant impact if cumulatively they would emit more than 6.6 metric tonnes of carbon dioxide equivalent per "service population"/year (the service population is the sum total of all residents plus outside employees within the district). Using such guidance, the threshold of determination would be whether the Program would generate an annual total of approximately 13,200 tons of CO2 equivalent per year.

Program Impacts Analysis

The direct impact of the Program and alternatives on greenhouse gas emissions is evaluated in Chapter 3. The findings suggest that the direct Program impacts are likely to have a negligible beneficial impact on greenhouse gas emissions on the Program acres. However, the Program only takes place on 13% of the commercial forest acres within the Mattole. As the findings in Chapter 3 state, the Program is likely to sequester about 2,200 metric tons of CO2 equivalent per year.

Cumulative Impacts Analysis

The cumulative additive impact of the reasonably foreseeable probable future projects results in a mixed set of both beneficial impacts and adverse impacts depending on the type of project being considered.

There are negligible adverse impacts from greenhouse gas emissions in the Mattole basin created by the implementation of KRNCA (King Range National Conservation Area) shaded fuel break installations and maintenance projects, since such projects improve forest health and growth rates, which leads to additional carbon being sequestered, and reduce the risk of widespread wildfire, thus avoiding wildfire GHG emissions. Thus, the work by Fire Safe Councils to maintain or install shaded fuel breaks along with the MRC FLASH program is also expected to improve greenhouse gas sequestration. Negligible adverse impacts are expected to greenhouse gas concentrations associated with MRC's Good Roads Clear Creeks program from heavy equipment operation associated with removing the 225,000 yards of sediment over the next several years. In addition, residential development and increased in-migration are likely to create negligible adverse impacts from the emission of carbon dioxide from vehicles.

The off-Program emission of GHG's is likely to be approximately 1/3 of the GHG's given off (sequestered) by the Status Quo. As a result, the amount of GHG's sequestered each year is expected to be around 822 metric tons of CO2 equivalents.

While the Program and off-Program activities sequester carbon along with several of the reasonably foreseeable probable future projects, the role of cattle in emitting methane, which is a potent greenhouse gas with over 15 times the warming impact of CO2, could be substantial. Cattle produce about 75 Kg of methane per head per year, which is the equivalent of about 1 metric ton of CO2 equivalent per year or, based on the estimated number of cattle in the Mattole approximately 2,000 metric tons of CO2 equivalent per year. The amount of cattle-Produced GHG's essentially is equivalent to the amount of GHG's sequestered by the Program.

The 116,831 acres of commercial forestland in the Mattole that is not projected to be harvested over the next 50 years is sequestering about 7.8 metric tons of CO2 per acre/year, which is approximately 900,000 tons of CO2/year.

Determination of Significance for Greenhouse Gases

Overall, the combination of Program practices, off-Program harvest, other reasonably foreseeable probable future projects such as fuel break maintenance along with no harvest across the vast majority of the Mattole's commercial forests, results in an annual sequestration of around 903,000 tons of CO2 equivalent per year, which far exceeds the determination threshold. As a result, there is a less than significant cumulative adverse effect on GHG emissions from the additive impacts of combining the individual Program practices together with reasonably foreseeable probable future projects and activities.

4.15 Wildfire Cumulative Impacts

The section summarizes the cumulative impacts to wildfire behavior from implementing the Program in conjunction with the on-going and reasonably foreseeable probable future projects. The assessment area for describing the potential cumulative impacts from wildfire behavior is the Mattole basin.

The significance criteria and the determination thresholds have already been previously described in chapter three. The determination thresholds are reproduced here since they establish the point at which cumulative impacts might be significant. The Program in conjunction with the reasonably foreseeable probable future projects and activities, when combined might create a significant impact if cumulatively they would:

a. Increase tree mortality by 50% or more between 2011 and 2060:

As described in the FPR's, cumulative impacts from a change in wildfire behavior can occur when the impacts of two or more activities, from the same or different projects, combine to produce a significant increase in tree mortality.

Program Impacts Analysis

The direct impact of the Program and alternatives on Wildfire severity is evaluated in Chapter 3. The findings suggest that the direct Program impacts are likely to have a less than significant impact on wildfire behavior on the Program acres. As noted in Chapter 3, up to 29% of the North_1 subbasin might be treated with flame lengths increasing from 1.5' to 3.5' between 2010 and 2035 and then falling to less than 3.5' by 2060.

Cumulative Impacts Analysis

The cumulative additive impact of the reasonably foreseeable probable future projects results in a mixed set of both beneficial impacts and adverse impacts depending on the type of project being considered.

There are moderate benefits to the environment in the Mattole basin by reasonably foreseeable probable future shaded fuel break installation and maintenance projects, particularly those being pursued by the Lower and Upper Mattole Fire Safe Councils, and the Southern Humboldt Fire Safe Council. There are additional additive cumulative benefits to the Mattole basin by projects being implemented by the KRNCA to maintain shaded fuel breaks and to increase the rate at which late seral stand conditions are achieved from timber harvest undertaken 15-30 years ago. KRNCA slash treatment requirements in the late seral silvicultural projects require lopping slash to 12" and pruning limbs on all remaining small trees up 6'. These two practices in particular should easily reduce flame lengths to less than 2' in these treated areas. The Humboldt Fire Safe Council goal to "harden" homesites and access roads is also likely to reduce wildfire behavior in these treated areas. The impacts to wildfire behavior from implementation of fuel hazard abatement work and installation or maintenance of fuel breaks are not expected to cumulatively

add more than a negligible beneficial impact beyond those already described for the Program, since these efforts are at such a small scale compared to the basin as a whole.

Actions that reduce vehicle access tend to reduce the potential for ignition, thus the MRC Good Roads Clear Creeks program which removes abandoned roads has the potential to reduce access and thus to reduce ignitions. However the projected increase in population and residential buildings increases the potential for new ignition sources, particularly from backyard debris burning and from increased vehicle usage within the basin. The impacts to wildfire behavior from sediment removal, residential development and population increase are not expected to cumulatively add more than a negligible beneficial or adverse impact beyond those already described for the Program.

Grazing in and of itself is not likely to cumulatively impact wildfire behavior, other than the potential that vehicle access associated with tending cattle potentially results in a limited number of ignitions in the Mattole. As a result, cattle grazing in the commercial forest, along with the Program specific impacts are not expected to result in anything more than a negligible adverse impact to wildfire behavior beyond those already described resulting from implementation of the Program itself.

The largest cumulatively additive adverse impact to wildfire behavior is the projected off-Program harvest of almost 5,000 acres within the Mattole basin using even-aged silvicultural prescriptions. Analysis of the direct impacts to wildfire behavior from implementing Alternative I show that these even-aged treatments could result in significant adverse impacts as a result of an increase in mortality during moderate fire weather conditions. Percent mortality increases from around 15% from fires burning in untreated stands today to 50% mortality in stands, which have even-aged silvicultural treatments today through the next 50 years. For these specific 4,912 acres, the direct impacts would be significant, particularly in the North_1 and North_2 subbasins. However, the cumulatively additive combination of the Program fire impacts, the off-Program fire impacts and the 83% of the Mattole commercial forestland that is never harvested results in an actual decline in percent mortality over time. Stands that are never harvested improve in terms of fire behavior over time with mortality under moderate fire weather conditions dropping from an average of 17% mortality to 9% mortality when averaged across all commercial vegetation types. The change in mortality occurs even as moderate fire weather flame lengths increase from an average of 1.6’ today to 4.2’ in 50 years. Increased tree size accounts for the majority of the beneficial change in mortality rates. As a result, the cumulatively additive impact of the off-Program harvest, Program harvest and the 83% of stands that are never cut results in a moderate beneficial impact to wildland fire behavior across the entire Mattole basin.

The cumulatively additive impact of the spread of SOD on wildland fire behavior is difficult to predict. SOD is almost certain to advance into the Mattole, particularly given the high risk of SOD infection throughout the basin. At an infection rate of 1,000 acres/year (average of the low infection spread rate in the Southern Humboldt area), the spread of SOD is likely to create a cumulatively additive substantial adverse impact to fire behavior over time. Within 15 years, at the spread rates above, SOD could easily have a greater impact on the environment than either the Program or the Status Quo. Predicted flame lengths increase from 2.7’ to 6.5’ in moderate fire weather conditions after tanoak is killed by SOD. Mortality from simulated wildfire is

projected to increase from 18% to approximately 45% as a result of SOD mortality. In severe fire weather conditions, SOD-affected stands could see a projected increase in flame lengths from 5' to 13' along with a projected mortality increase from 55% mortality pre SOD to 85% post SOD infestation. Over time, killed tanoaks fall over and decay, such that their contribution to fuel loading declines at some point after the trees die from SOD. A rough estimate might be that tanoak killed by SOD remains standing for 5-10 years, then falls over and decays at a relatively fast rate. At any one time, there might be as many as 15,000 SOD acres that are likely to have increased wildland fire behavior.

Climate Change

Chapter 3 discusses the role of climate change in relation to wildfire frequency and is not repeated here other than the concluding paragraph, which is summarized below.

> "*The findings from Chapter 3 suggest that predictions about wildland fire behavior in the Program area over the next 100 years due to global climate change vary since such predictions are highly sensitive to the assumptions made including the choice of GCM. Amazingly, give the large scale nature of GCM's, there are at least two studies which focus on northern California, including Fried's 2004 study which focused on the Humboldt Del Norte Ranger Unit. Fried's 2004 work suggests only a minor change in the number of escaped fires due to global climate change, however Fried's 2004 work used a GCM not used by other researchers. Other work by Fried, and Westerling and Bryant, … predicted increases in wildland fire behavior and change in the number of escaped fires due to global climate change. Both pieces of work predicted global climate change would likely result in more escaped fires in grassland and brushland types, and only a minor increase in forestland fire types. Fried's 2006 work also noted that there would probably be a slight reduction in wind speed due to global climate change. However, with a longer fire season, more ignitions due to more people in the Program area and with most escaped fires occurring during severe fire weather conditions, it can be concluded that there is likely to be a greater number of escaped fires during the next 100 years due to climate change than would be the case without climate change.*"

Given the conclusion above, it seems likely that the Program together with the reasonably foreseeable probable future projects and activities is not likely to be significantly adversely impacted by climate change in terms of wildfire behavior.

Determination of Significance for Wildfire

Overall, the combination of Program practices, off-Program harvest, other reasonably foreseeable probable future projects such as fuel break maintenance along with no harvest across the vast majority of the Mattole's commercial forests results in wildfire-induced mortality that declines through time and certainly never increases by 50% to create a significant adverse impact.

As a result, the analysis above shows that there is a less than significant cumulative adverse impact on wildfire behavior from the additive impacts of combining the individual Program practices together with reasonably foreseeable probable future projects and activities including the effects on wildfire behavior from SOD.

4.16 Population and Housing Cumulative Impacts

This section summarizes the potential for cumulative impacts to Population and Housing from implementing the Program in conjunction with the on-going and reasonably foreseeable probable future projects. The assessment area for describing the potential cumulative impacts from to population and housing is the Mattole basin.

The significance criteria and the determination thresholds have already been previously described in Chapter 3. The determination thresholds are reproduced here, since they establish the point at which cumulative impacts might be significant. The Program in conjunction with the reasonably foreseeable probable future projects and activities, when combined might create a significant impact if cumulatively they would induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure).

As described in the FPR's cumulative impacts from a change in population or housing as a result of implementing the Program can occur when the impacts of two or more activities, from the same or different projects, combine to produce a significant increase in population or housing

As stated in section Chapter 3, there is no accepted threshold for evaluating a significant change in population so the following threshold was used: Population increases less than 0.5% were considered negligible.

Program Impacts Analysis

The direct impact of the Program and Alternatives on population and housing are evaluated in Chapter 3. The findings suggest that the direct Program impacts are likely to have a negligible adverse impact to population and housing.

Cumulative Impacts

There is no growth inducing impact associated with the Program. The only changes to population and housing, as discussed in Chapter 3, are temporary increases associated with workers traveling into an area to complete timber harvest operations.

Determination of Significance for Population and Housing

Based on the analysis above, there is a less than significant cumulative adverse impact to population and housing expected from the additive impacts of combining the individual Program practices together with reasonably foreseeable probable future projects and activities..

4.17 Cultural, Archaeological, and Historic Resources Cumulative Impacts

This section summarizes the cumulative impacts to cultural, archaeological and historic resources from implementing the Program in conjunction with on-going and reasonably foreseeable probable future projects. As noted in Section 3.15, under the FPR's each PTHP must be evaluated separately for potential effects to cultural resources. For the purpose of this analysis the assessment area for describing the potential cumulative impacts to cultural, archaeological and historic resources is the Mattole basin, because it offers a defined boundary to the Program area and, at least in historical times, is considered a discrete community of place, as evidenced by the many groups, such as MRC, which have identified the basin as their working circle.

Even though no significant direct impacts to cultural, archaeological, and historic ('cultural') resources were identified in the analysis in Section 3.5, there is still the potential for impacts from the Program or alternatives to combine with those of other reasonably foreseeable future projects or natural processes to bring about significantly adverse cumulative impacts.

Determination Threshold

The Program and Alternatives would have a significant cumulative effect to cultural resources if impacts from implementation of treatments in the Program or any alternative combined with those of reasonably foreseen projects or processes ultimately results in:

a) A substantial adverse change in the characteristic(s) contained in that resource which qualify it as being significant;
b) An adverse change to locations associated with the traditional beliefs of Native Americans, including areas used or assumed to be used for ceremonial activities; or
c) An adverse change to locations and or resources used by Native Americans to carry out or support economic, artistic, or other cultural practices

Cumulative Impacts from the Program or Alternatives

Effects on cultural resources are directly tied to acreage potentially impacted by operations and the potential for cultural resources to be present within the any area of impacts. Although intensity of the impact also is a factor, any ground disturbance can potentially create an adverse impact and therefore area of potential disturbance equates to project area.

The Program is estimated to implement logging across a 15,038-acre 'footprint.' Because uneven-aged management is utilized, 12,549 of the approximately 15,000 acres are projected to be re-entered for harvest at least once more during the 50-year analysis period, for a total area of ground disturbance of 41,718 acres. The 15,038-acre Program footprint represents approximately 13% of the 116,831 acres of commercial forestland in the basin. Alternative I, the status quo, is estimated to have a footprint of 14,715 acres and Alternative 2, 15,400 acres, each equivalent to about 13% of the commercial forestland in the basin. Alternative 3 is projected to impact 10,228 acres, or about 9% of the commercial forestland in the basin.

The reasonably foreseen project with the most similarity to the Program is timber harvest that occurs outside of the Program, or 'off-Program' timber operations, which is predicted to occur on approximately 4,912 acres over the analysis period. The total cumulative footprint acres affected by timber operations after adding the off-Program acreage is 19,950 acres for the Program, 20,311 for Alternative 2, and 15,140 under Alternative 3. Alternative I, which occurs without the Program in place, is projected to impact a total of 14,715 acres over the 50-year analysis period (also ~13% of the commercial timberland).

Off-Program timber operations would be conducted consistent with FPR regulations and under CAL FIRE oversight, and the effects would basically be to add additional acres having similar impacts to those discussed in Section 3.5, including soil disturbance, increased erosion and sedimentation and removal of vegetation, all of which could cause damage to cultural resources. These projects are projected to occur on private timberlands; no commercial logging is projected to occur on federal lands in the basin (Bureau of Land Management 2005), although there are expected to be federal ground-disturbing projects, as shown below.

Table 4-3 above lists several reasonably foreseen ground-disturbing projects that have potential to impact cultural, archaeological, and historical resources over the 50-year analysis period, including:

KRNCA Late Seral Silvicultural Improvement Projects	2500 acres
KRNCA Shaded fuel break maintenance	1800 acres
KRNCA mountain bike trail installation	50 miles of trail
Livestock Grazing	2,000 animals/ 24,000 acres
MRC Good Roads Clear Creeks Program	Removal of 225,000 yards of sediment (year 2011)
MRC Fuel Reduction Projects	6000 acres
Residential Development	100-250 new dwellings
Population Increase	500 people
Sudden Oak Death Infestation	50,000 acres

Environmental clearance for projects expected to occur in the basin, including their impacts to cultural resources, would depend on the funding source of the projects or the permits required. Federal KRNCA projects would likely be addressed through NEPA, while the MRC projects would likely be state-funded and addressed via CEQA. Both CEQA and NEPA require evaluation of cultural, archaeological and historical resources, including, as appropriate, a field survey and/or consultation with the State Historic Preservation Office.

Environmental Clearance for Reasonably Foreseen Projects

Many of the reasonably foreseen projects would require additional environmental review outside of the PTEIR process, as noted below.

Residential Construction: For residential construction the primary regulatory responsibility would rest with the Humboldt County Planning and Building Departments. If a permit is obtained for an existing parcel, a building inspector, who fills out a Pre-Site Investigation

Checklist, conducts the environmental review. This checklist contains no requirements related to cultural resources. On the other hand, if a residential subdivision is planned, it is subject to a CEQA analysis, which follows a similar review to a timber harvest plan, where the proponent must consider cultural resources and apply mitigation measures to avoid significant impacts to them. The North Coast Information Center is consulted for all proposed subdivision developments, and archaeological studies may be conducted, according to the recommendations of the NCIC. A CEQA review can also be generated if a landowner files for a special permit (for instance, to decrease the setback from a stream for a building site), in which case impacts to cultural resources could be investigated (Estlow, pers. comm. 2010).

Sudden Oak Death: Infestation by the sudden oak death fungus of 50,000 acres over 50 years will be limited to stands containing substantial amounts of hardwoods. There is likely no direct effect to cultural resources from the infestation and killing of affected trees, although there could be ground-disturbing effects from control measures such as tree felling and slash burning. Presumably, however, control activities would be funded by the state and covered by CEQA, under which project-scale impacts to cultural resources would have to be evaluated.

Cattle grazing: Cattle grazing appears to be the only reasonably foreseen ground-disturbing land use for which there is no overt permitting or regulatory oversight. The effects of herbivory on cultural resources can include trampling, artifact breakage, soil compaction (which can disturb soil profiles and affect dating), reduced ground cover, and destabilization of stream banks, leading to erosion and displacement of artifacts (USDA 2009). Grazing animals, especially large, heavy animals such as cattle, can dislodge and damage cultural resources (Osborn et al. 1987). However, the Mattole basin has been used for livestock grazing for over 100 years, so it can be somewhat safely assumed that many of the possible impacts to cultural resources from grazing have already occurred and are not likely to increase during the analysis period. While there could be some slight negative impact from maintenance of grazing at its current rate, cattle grazing is estimated to create at most a slight adverse impact to cultural resources, as a stand-alone activity.

Determination of Significance for Cultural, Archaeological, and Historic Resources

The analysis above shows that there is a less than significant cumulative adverse impact to cultural, archaeological, and historic resources resources when combining the individual Program practices together with reasonably foreseeable probable future projects and activities.

Literature Cited

Estlow, Trevor. 2010. Humboldt County Planning Department. Eureka

Osborn, Alan J. and S.K. Hartley. 1987. Adverse Effects of Domestic Livestock Grazing on the Archaeological Resources of Capitol Reef National Park, Utah. National Park Service. Lincoln, Nebraska

USDA Forest Service. 2009. Rube and Powder Magazine Grazing Environmental Assessment. Sequoia National Forest, Tulare County, CA

Valachovic, Yana. Personal Communication October 2010. Forest Advisor, University of California Extension Service.

4.18 Cumulative Impact Summary

The foregoing analysis has considered the effects of the proposed Program in combination with past, present, and reasonably foreseeable probable future projects, and found that no significant impacts are reasonably expected to occur as a result of the Program and those other projects.

Table 4-9
Cumulative Impacts by Resource Area: Significance Summary

Resource Subject	Yes, After Mitigation (a)	No, after Mitigation (b)	No reasonably potential significant impacts (c)
Watershed effects			
Peak flows			X
Water temperatures			X
Nutrients			X
Large Wood and Organic Debris			X
Sediment loading and turbidity			X
Soils and Mass Wasting			X
Biological			
Aquatic resources			X
Vegetation [1]		X	
Terrestrial wildlife			X
Recreation			X
Visual and aesthetic			X
Traffic and transportation			X
Air quality			X
Greenhouse gases			X
Wildfire			X
Population and housing			X
Cultural, archaeological and historic resources			X

[1] The effect of the possible spread of Sudden Oak Death is considered in this EIR, with a mitigation measure described on page 2-38. This is a conditional mitigation that would become effective in the event that Sudden Oak Death kills more than 80% of tanoak on 35% or more of the acres in a subbasin.

Appendix A: Methods and Procedures Used to Establish the Footprint of the Mattole Forest Futures Program and Alternatives

Most landscape level timber management planning documents (Habitat Conservation Plans (HCPs), Sustained Yield Plans (SYPs), USFS Forest Plans, etc.) are developed for single ownerships where the owner is able to state what they intend to do, where and how. In contrast, the Mattole Forest Futures Program could theoretically include all of the approximately 900 private forestland landowners in the Mattole watershed that choose to participate. Therefore, evaluating the environmental effects that may occur due to implementation of the Mattole Forest Future Program (and the alternatives required by CEQA) necessitates developing predictions (estimates) of how many acres will be harvested, where the harvests will occur and which treatments will be used.

The Procedure to develop the Program and Alternatives footprints included the following approach:

1. Identify Commercial Timber Landbase

The assessment area for analyzing the direct impacts from implementing the Program's practices on timber resources is the Program footprint area— those forest stands that are actually harvested under the PTEIR. It is likely that the majority of the forested area in the Mattole would meet the technical definition of 'timberland' even though much of it could not be managed economically in the foreseeable future. For the purposes of analysis in this EIR, land cover in the watershed is divided into four broad categories of vegetation: commercial forest types, non-commercial forest types, grasslands, and other non forested vegetation types not proposed for treatment under the Program. The first step in the timber analysis was to stratify the commercial forestland into types homogenous enough to apply appropriate silvicultural simulations. These strata are derived from the GIS data (CALVEG 1998) previously described in section 2.0.5 above. The 1998 vegetation data are based on remotely sensed information using satellite imagery and subsequent "ground-truthing" for verification and slight modification. Based on remote sensing data, there are estimated to be approximately 86,671 acres of private commercial forestland within the basin. This is used as the potentially commercial landbase and is not projected to change significantly over the analysis period.

The assessment of current and future forest conditions in the Program area relies upon the Wildlife Habitat Relationship (WHR) classification system developed by CA DFG. The following table shows the classification system categories for forestlands found in the Mattole. Forest type designations are based on predominant species, size class by average overstory tree diameter, and density by total canopy cover.

Table A-1 (From Tables 3-61 (also 2-7))
WHR Classification Key for Mattole Forestlands

SPECIES		SIZE CLASS Avg. dbh of overstory		DENSITY Total Canopy Cover %	
DFR	>50% relative overstory cover by conifers (Douglas fir/redwood)	6	> 24" & multi-storied	S	Sparse 10-25%
MHC	Montane Hardwood/Conifer - relative overstory conifer cover between 25 & 50%	5	> 24"	P	Patchy 25-40%
MHW	Montane Hardwood – relative conifer cover < 25%	4	11" – 24"	M	Moderate 40-60%
		3	6" – 11"	D	Dense > 60%
		2	1" – 6"		
		1	< 1"		

The stratification of the program area began with the CALVEG 1998 WHR classification of the vegetation of the Mattole, which was obtained in GIS format from the Mattole Restoration Council who obtained it from Region 5 of the USDA Forest Service. The GIS data contained numerous classification systems within it. For purposes of this analysis, the WHR classification system as to the type of vegetation and the size of the vegetation was combined with the CALVEG classification of density to arrive at a WHR classification of the vegetation of the basin. The WHR density classification was not used, because it classified virtually everywhere as dense based on the crown cover of all layers of vegetation compared to the CALVEG density classification, which only classified the overstory density.

This dataset was intersected in ARCMAP with the Humboldt County GIS assessor parcel data so that each individual landowner in the basin had their ownership classified into specific vegetation types according to the WHR type and size classification system and the CALVEG density classification.

The CALVEG 1998 classification indicated that nearly 80% of the private commercial forestland belonged to the DFR type. This classification appeared to be at odds with the actual conifer-hardwood balance in the watershed, as most stands within the basin appear to have regenerated into more tanoak-dominated stands after the initial old-growth logging.

Fortunately, these remotely sensed GIS data were supplemented with inventory information provided by private landowners within the basin. Approximately 470 timber inventory plots measured between 1993 and 2005 were utilized to determine the final description of the vegetation within the basin and to model growth and harvest over time. Because the plot data included species-specific inventory information, it was possible to assign each plot to its actual WHR category. Since the locations of the plots were known, the actual WHR category of each plot could be compared with its remotely sensed WHR classification. The conclusion was that much of the remotely sensed Douglas-fir type (DFR) has substantially lower conifer stocking than this label indicates, and actually should have been classified as Montane Hardwood-Conifer (MHC). Some plots, however, did reflect the majority conifer overstory that characterizes the DFR vegetation type. Because of the heterogeneity within the DFR classes, clusters of plots were grouped for purposes of silvicultural modeling into two or three strata, each representing a

level of conifer stocking within that WHR class— high, low, and in some cases medium. The plot data were used to calculate average stand metrics for each of ten strata — three each for remotely sensed DFR3 and DFR4, two for remotely sensed DFR5, and one each for remotely sensed MHC5 and MHC4.

The plot analysis allowed adjustments to the overall proportion of the landbase ascribed to each WHR type — an analysis that is explained in fuller detail in Section 3.14-Vegetation. The proportional area of each stratum within a remotely sensed WHR class in a given sub-basin was estimated from the density classes found in the CALVEG GIS data for that subbasin. Growth and harvest projections for all ten strata were used in developing the projections of overall harvest under the program. This section presents in detail the results of modeling for five of those strata that comprised the great majority of the Program Area landbase. Table A-2 below lays out the correspondence between remotely sensed WHR classes, levels of conifer stocking, and actual WHR classes.

Table A-2 (also Table 3-62)
Correspondence of Timber Strata To WHR Type

Remotely sensed WHR category	Conifer Stocking	Actual WHR category
DFR 5	high	DFR 5D
DFR 5	low	MHC 4D
DFR 4	high	DFR 4D
DFR 4	med	
DFR 4	low	MHC 4D
DFR 3	high	DFR 3D
DFR 3	med	MHC 3D
DFR 3	low	
MHC 5	low	MHC 4D
MHC 4	low	MHW 4D

These 3 strata all fall into the MHC4D WHR classification.

Overall, analysis results indicate that only about 38,000 acres of the private commercial forest is true Douglas-fir type (meaning that more than 50% of the overstory canopy cover is Douglas-fir) and nearly 35,000 acres of the private commercial forestland is Montane Hardwood/Conifer type (MHC), where 50 to 75 percent of the overstory canopy cover is comprised of hardwoods, principally tanoak. This finding essentially confirms one of the hypotheses behind the Program goals outlined in chapter 1: that much of the forestland has become hardwood-dominated following the removal of valuable Douglas-fir from stands which previously had a minor tanoak component. The Program Area includes six WHR types. Their areas were calculated after shifting some of the strata acreages into the more appropriate WHR classes and are shown in the following table. Stand characteristics presented represent a weighted average of the inventory data for each of the strata comprising the WHR type.

Table A-3 (also Table 3-40)
Vegetation Type Condition Summary 2010

Actual WHR Type	Private Acres	Trees/ acre	Trees/ acre	Avg. diam. (inches)	Avg. diam. (inches)	Basal Area (ft2/acre)	Basal Area (ft2/acre)
		Conifer	HW	Conifer	HW	Conifer	HW
DFR3D	2,565	289	147	11.9	9.0	272	69
DFR4D	28,915	226	48	12.5	8.7	200	32
DFR5D	6,681	117	11	20.1	10.0	297	5
MHC3D	5,345	175	439	11.1	10.3	116	205
MHC4D	29,562	155	328	11.2	10.9	96	171
MHW4D	13,603	71	488	12.0	11.2	61	207
Total	86,671	168	237	12.4	10.0	147	116

Certain non-commercial types, such as Coastal Oak Woodland and Montane Hardwood, were eliminated from further analysis due to their lack of occupancy by commercial species. Other types were eliminated because of low stocking and/or low size class. After these areas were eliminated, approximately 86,671 acres within the Program landbase were considered occupied by vegetation types containing trees of the size, species, and density of stocking that potentially could support a commercial timber harvest during the 50-year planning horizon (potentially commercial types were "grown forward" in time using computer growth models to estimate their future merchantability). The number of acres of potential commercial vegetation type, once-determined, is not projected to change over the analysis period, although stocking by acre does vary due to stand growth and maturation, as well as from stand treatments including projected harvest removals.

2. Identify Available Landbase

Eliminating areas designated as no-harvest zones by either state regulation or to meet the goals of the Program or alternatives as described above then reduced the pool of potential acres based on timber type. No-harvest watercourse buffers and (for some alternatives) unstable slopes of certain classifications made up the bulk of the excluded acreage. After elimination of no-harvest areas, an available landbase was calculated for the Program and each alternative. For the proposed Program, the available landbase is estimated at 57,601 acres.

The procedure to accomplish the identification of the available landbase took the GIS database of combined WHR types and landownership and intersected these data with GIS shapefiles of the stream network obtained from NCWAP and the GIS shapefiles of the NCWAP landslide hazard. Depending on the requirements in each alternative, Class I or II watercourses were buffered to eliminate "no-harvest" areas. For landslide hazard, the NCWAP GIS landslide hazard shapefile was combined with the ownership, stream buffer, and vegetation type information to create a shapefile with each acre classified according to landowner name, vegetation type, no harvest stream buffer and whether the area was classified as extreme or high landslide potential. Total acres available were comprised of those areas that were designated as harvestable stream buffers, and 65% of all landslide areas classified as extreme and 80% of all landslide areas classified as

high hazard. The resulting data table for determining how much of the Program area was available for harvest comprised around 24,000 lines of data.

3. Identify Feasible Landbase

The identified available landbase was then subjected to a financial feasibility analysis to determine if particular landowners could likely conduct a viable economic timber harvest operation, considering the size of their timbered landbase, volume of harvestable timber, accessibility, etc. This analysis was conducted on a landowner-by-landowner basis using the available landowner dataset that was combined with timber volume estimates of stocking and harvest projected through time using the plot data described above.

Plots were grown forward from the time of initial measurement to 2010 in the US Forest Service's Forest Vegetation Simulator (FVS) program using the Klamath Mountains variant, which includes reference data from stands of similar species composition to much of the Mattole. Because the Mattole plot data was compiled from a variety of past projects, including an unsystematically selected assortment of landowners, the plot distribution is not a statistically valid sample. However, plots were located on sites throughout the basin, including lands in the extreme southern, northern and middle portions of the basin. These data provide a good representation of stand conditions within the primary WHR types, but should not be used to predict actual volumes that would be harvested. The per acre stand metrics in the tables below can serve to demonstrate that the Program prescriptions can achieve the target parameters from a variety of forest conditions, even though individual landowners filing PTHPs may or may not have stands that match those modeled for this EIR.

Each stratum has a site index determined by that particular set of inventory data. During growth and yield modeling, variations in site class within a stratum are accounted for since FVS growth is driven by the plot-specific site index. The resulting strata averages reflect a range of site indices from low site 2 to middle site 4. Strata with greater proportions of hardwood stocking in 2010 generally have more site 4 plot data.

Growth and harvest were simulated in each stratum for at least 60 years applying the most appropriate prescription based on the vegetation information. Simulations were extended beyond 60 years if necessary to demonstrate that the stand would reach the target conditions under the planned regime. The prescriptions were designed to achieve the goals of the Program in regard to increasing conifer stocking and size class and /or increasing the proportion of conifers to hardwoods, depending on the starting condition of each stratum. The selection prescription was modeled for all the strata included in WHR types DFR3D, DFR4D, and DFR5D. The all-aged prescription was modeled for all the strata included in types MHC3D, MHC4D, and MHW4D.

Assumptions and parameters of the silviculture modeling in FVS include:

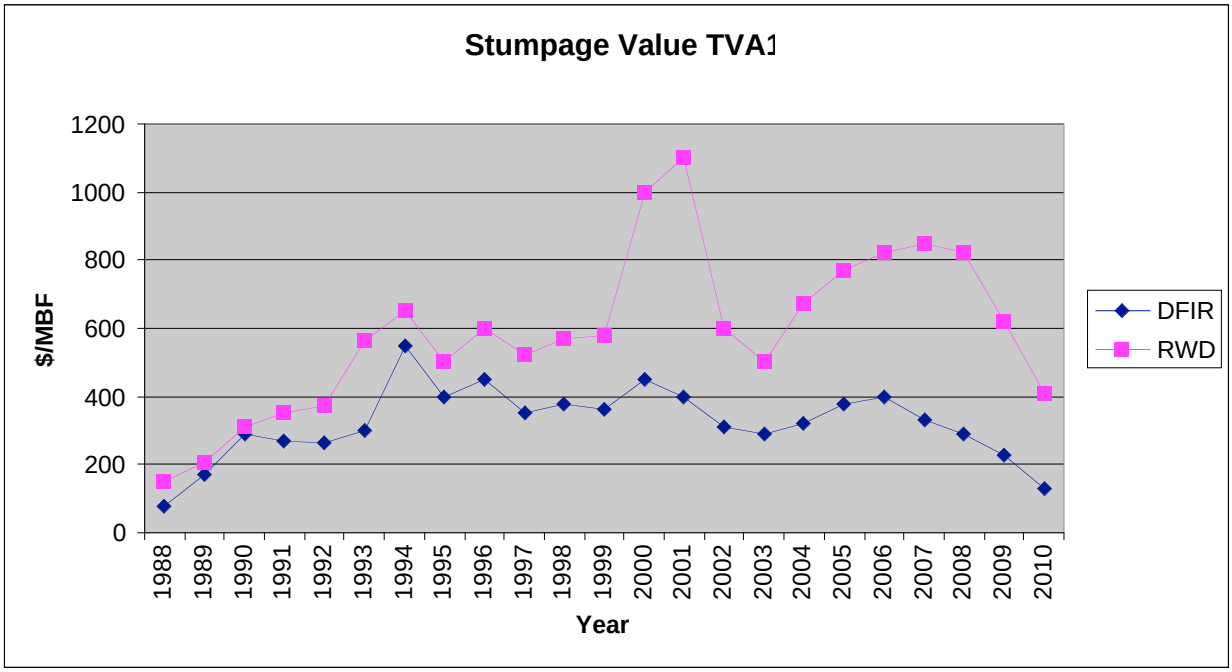
- Target conditions considered to meet Program goals are 150 ft^2 conifer stocking and >60% conifer composition by basal area.
- "Maximum harvest" means that the simulation represents the most intensive harvesting realistically allowed under the requirements of the PTEIR prescriptions.

- At each entry the maximum number of large trees allowed to be harvested under the PTEIR prescriptions would be harvested – stand data was carefully examined to create prescriptions that ensured FVS was retaining 1/2 the largest conifers in the diameter class representing the upper 30% of the basal area distribution.
- Stands were projected for 60 years or longer if necessary to achieve the target conditions.
- Group openings in the All-aged prescription are simulated separately from the individual tree selection occurring in the rest of the stand.
- Stocking data in the all-aged tables are weighted averages of the group openings and the individual tree selection areas of the stand.
- Initial stand entry occurs when there is sufficient volume to allow an economically feasible harvest – generally at least 20,000 board feet per acre of conifer stocking.
- Cutting cycle is 15 years for Selection and 20 years for the All-aged prescription.
- Group Openings: retain 15 ft^2 of basal area in large trees; 350 DF trees/acre are planted; natural sprouting of hardwoods is simulated in proportion to their presence in the pre-harvest stand; 50% of the tanoak sprouts are killed 5 yrs after harvest in a release treatment; and the regenerated stand is commercially thinned at age 40 and 60.
- Individual Tree Selection area: natural regeneration is simulated after each harvest with 100 trees/acre of DF and tanoak sprouting turned on.

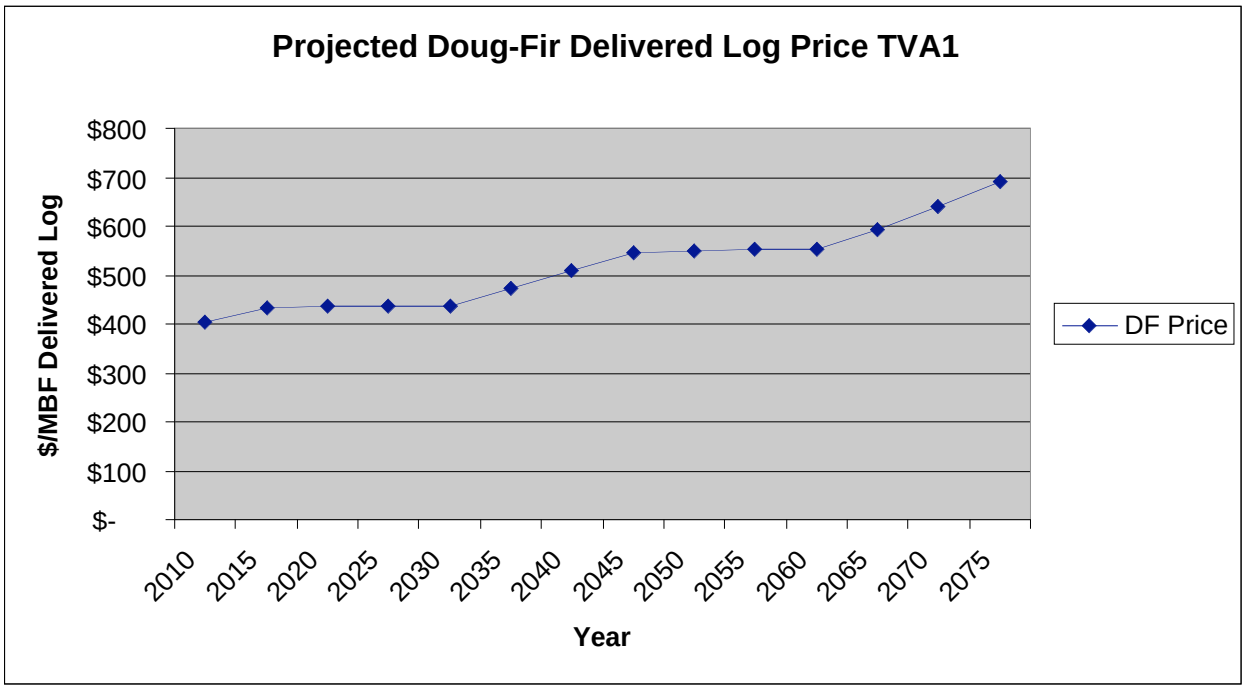
Once all of the modeling was complete, the FVS output of stand stocking and harvest volume classified according to conifer or hardwood volume was assigned to each of the 24,000 discrete available landowner polygons.

To determine feasibility of harvest required assessing the value of the harvest and cost of harvest over time. Variables that were considered in this analysis included timber prices and volumes projected over the planning horizon, logging systems appropriate to terrain, silvicultural systems assigned to various timber types, and variability in treatments between alternatives. Also at this time in the analysis, large landowners with more than 300 acres of commercial timber types were subdivided into tracts of around equal size, each no larger than 300 acres so that from a regulatory standpoint, a large landowner would not be modeled as filing one permit on 2,000 acres, for instance. Thus, every “harvest operation” required that a “new” permit be obtained for each tract of an ownership. For small ownerships less than 300 acres, no subdivision was required.

Prices were extrapolated through time based on an analysis of historic timber pricing in Humboldt County between 1988 and 2010. The stumpage price of Douglas-fir and redwood during the subject time frame for Timber Value Area 1(TVA1 - Humboldt County) is shown below:



Based on the trend line above, there is an approximate six-year periodicity between two highs (or two lows), e.g. a low in 2003 is followed by three up years and then three down years. This trend was modeled for Douglas-fir only by taking the past trend between 1988 and 2010, adding in logging costs and trends to produce a potential delivered log price through time. The graph below has been smoothed, eliminating the peaks and valleys in each 6-year cycle.



Logging costs were trended at a historic consumer price appreciation rate of 1%/year. Tractor logging costs in partial cuts started at $225/MBF and cable yarding costs at $275/MBF. Stump-to-landing hardwood falling and skidding costs were started at $289 and $354/MBF for cat and yarder, respectively. Haul costs were based on $75/hour for a log truck hauling 4.6 MBF/load for conifers and 3.6 MBF/load for hardwoods with a round trip time of 6 hours per load. Thus, haul costs started at around $97/MBF for conifers and $125/MBF for hardwoods. Costs for slash treatment, plan preparation, hardwood treatment costs, etc. were calculated separately for the Program or Alternatives depending on the suite of prescriptions likely to be applied. For example, logging costs for the Program and Alternative III were set higher than for Alternative I or II where production rates and volumes per acre were expected to be higher leading to lower logging costs. Hardwood stumpage prices all reflect skidding logs to the landing only and no trucking costs, which presumes that logs are not hauled to a biomass or other processing plant. However, only a portion of the hardwood logs were assumed to be skidded to the landing – in the case of the Program, 50%. In the case of Alt 1 and 2, no hardwood logs were skidded to the landing, in the case of Alternative III, 80% of logs were required to be skidded to the landing.

For the Program the various cost centers on a per acre or per landowner/tract were as follows:

Table A-4
Costs Per Acre Or Per Tract For Program Through Time

	Conifer stumpage	Hardwood stumpage	Road cost per acre	Hardwood treatment cost per acre	Cost of THP, per ownership	Cost of PTHP per ownership
P1_2010	$ 53	$ (311)	$ 185	$ 75	$ 25,000	$ 18,000
P2_2015	$ 81	$ (322)	$ 192	$ 78	$ 25,887	$ 18,639
P3_2020	$ 71	$ (333)	$ 198	$ 80	$ 26,806	$ 19,300
P4_2025	$ 60	$ (345)	$ 205	$ 83	$ 27,758	$ 19,985
P5_2030	$ 47	$ (357)	$ 213	$ 86	$ 28,743	$ 20,695
P6_2035	$ 66	$ (370)	$ 220	$ 89	$ 29,763	$ 21,429
P7_2040	$ 88	$ (383)	$ 228	$ 92	$ 30,819	$ 22,190
P8_2045	$ 113	$ (397)	$ 236	$ 96	$ 31,913	$ 22,978
P9_2050	$ 100	$ (411)	$ 245	$ 99	$ 33,046	$ 23,793
P10_2055	$ 86	$ (426)	$ 253	$ 103	$ 34,219	$ 24,638
P11_2060	$ 70	$ (441)	$ 262	$ 106	$ 35,433	$ 25,512
P12_2065	$ 95	$ (457)	$ 272	$ 110	$ 36,691	$ 26,418
P13_2070	$ 123	$ (473)	$ 281	$ 114	$ 37,993	$ 27,355
P14_2075	$ 154	$ (490)	$ 291	$ 118	$ 39,342	$ 28,326

Income and expenses on either a per acre or per tract basis were then calculated using the volumes per acre of harvest and the acres by timber type for each landowner/tract to arrive at total income.

A floor for economic feasibility for conducting a timber harvest operation was set at $30,000 net profit, which was considered the minimum economic gain a landowner would require in order to engage and comply with the harvest regulation process.

After elimination of non-commercial operations, a feasible landbase was calculated for each alternative. For the proposed project, the feasible landbase as of the beginning of the Program is 22,465 acres. Over time, more acres will grow into feasibility as they develop greater stocking. However, for many landowners, especially small landowners, their harvest does not start out positive. If a landowner did not have a positive harvest of $30,000 in the first period, then feasibility was ascertained in the second, third, or fourth period until a harvest became feasible. If a landowner's operation became feasible in any period, that landowner was then assigned that particular prescription and the growth and yield stream was then "hard-wired" to that landowner for the balance of the projection time span. If a landowner's operation did not become feasible by the fourth period, then it was assumed not to enter the pool of feasible acres, as a way of balancing out acreage that may drop out of the Program due to changes in ownership or landowner objectives.

4. Identify "Footprint" Landbase

In order to assess the landscape effects of implementing the program, the feasible landbase was reduced in accordance with the propensity of landowners to engage in timber harvest activities, as identified in the landowner opinion survey conducted during early PTEIR preparation. The "propensity to harvest" was estimated as a percentage of each landowner size class (e.g., 25% of landowners with <160 acres were estimated as likely to file a PTHP within the next 20 years, while 47% of larger landowners were likely to file PTHP's). In the survey, landowners also indicated how soon they were apt to harvest. For each of the first four five-year harvest periods, the "dice were rolled" for each feasible landholding to determine whether it would be modeled as being logged. The probabilities were calibrated to the survey results, so that over the first twenty years, an appropriate percentage of the landowners in each size class would be modeled as having logged. Additional variables included in projecting the non-industrial private forestland (NIPF) owner harvest included timing (larger landowners are more likely to conduct periodic harvests compared to smaller ones) and the fluctuation of projected future timber prices.

The process of rolling the dice was accomplished by assigning each landowner a random number between one and the total number of landowners in the simulation (e.g. in the Program or Alternatives). For each period the appropriate percentage of landowners likely to harvest was multiplied times the total number of landowners to arrive at a number of landowners who might harvest. This number was then set as the ceiling against which all landowners with a lower random number could be selected, but only if they had a feasible harvest value. Once a landowner was selected in period X, it was removed from the simulation and assumed to harvest at the hardwired rate described in section 3 above. Simulations were carried out for the first four periods, at which point landowners who had previously harvested in period one were beginning to harvest in the fifth period.

After the initial 20-year pool of landholdings likely to harvest was calculated, land that had not been "logged" was left out of the program, for purposes of this modeling. Although land would change hands and some new landowners would choose to enter the program later (and some younger forest would grow into feasibility), it was assumed in the model that these would be balanced out by land dropping out of the program as it was purchased by owners with different predilections. The landbase footprint for the proposed program is estimated at 15,038 acres.

5. Identify Projected Landbase

The final step involved calculating the total number of acres projected to be impacted by timber harvest over the entire period of analysis. While the footprint landbase represents each individual landholding projected to take part in the Program and harvested at least once, the projected landbase includes the total acres entered for harvest including multiple entries on the same property. The rationale for double- or triple-counting the same acres in order to analyze environmental effects is based on the recognition that each harvest entry results in impacts to resources. A primary goal of the Program is to establish silvicultural treatment regimes on acres harvested under the program such that it would be to the landowner's benefit to continue to apply the treatments over time, as the treated stands build volume and value from growing larger trees and increasing conifer stocking over time, consistent with Program goals. For NIPF landowners the Projected Landbase over the 50-year analysis period was estimated at 34,718 acres.

In addition to the NIPF data collected in the survey, Humboldt Redwood Company (HRC) provided an estimate of their likely harvest volume within the basin as well as their acreage by timber type. This information was used to derive an estimated HRC harvest of approximately 200 acres/year in the near future, of which approximately 70%, or 140 acres/year, could be filed as PTHP's. Over the 50-year analysis period, the total estimated acres HRC may potentially harvest under the program is therefore 7,000 acres, while their footprint acreage logged during the first 20 years is estimated at 2,800 acres. It is possible that HRC may choose instead to file some of its selection harvests as THPs instead, and this will represent a conservatism in projecting the environmental impacts of the Program, which in that case would include fewer acres than modeled.

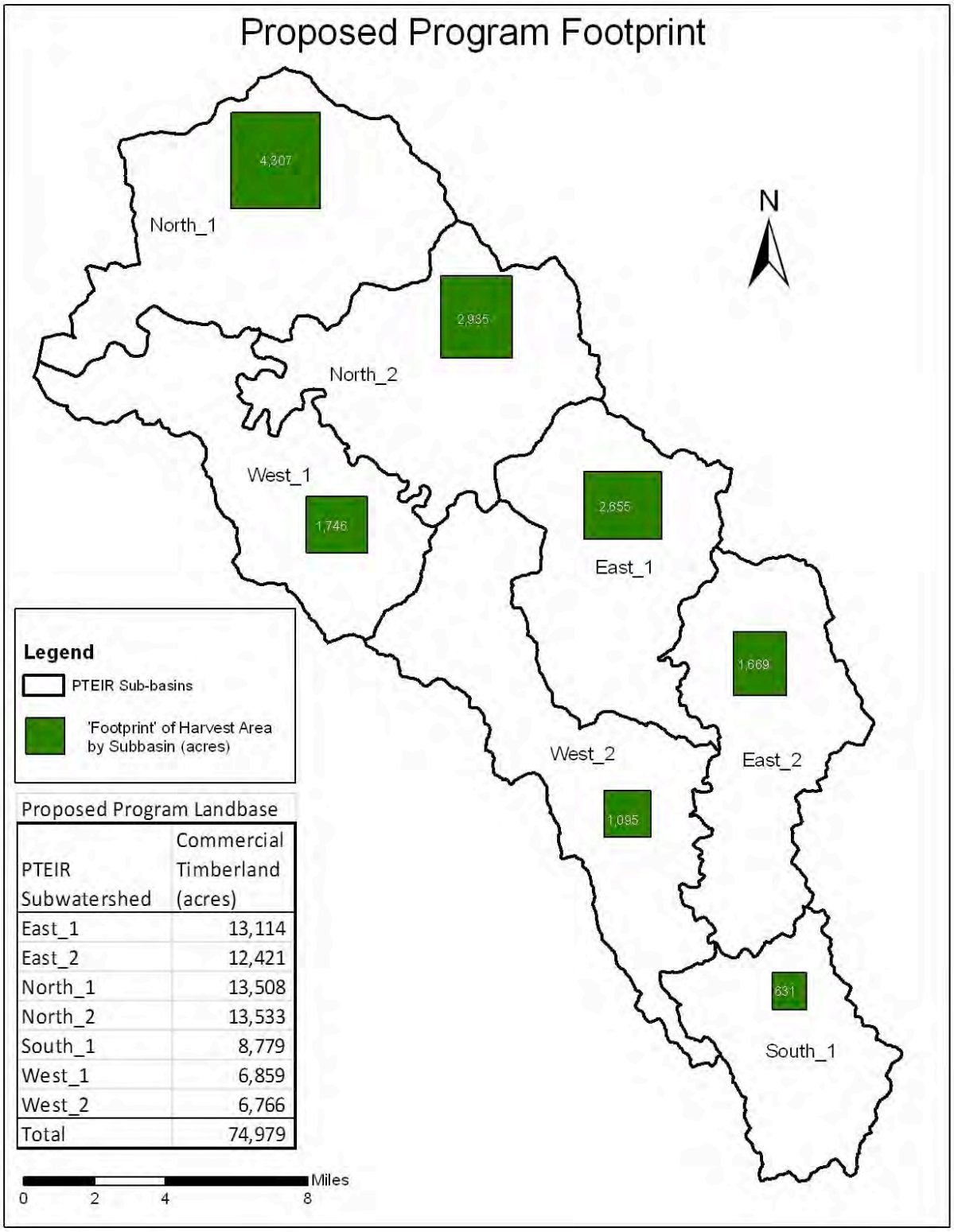
Combining NIPF and HRC data as discussed above, the projected extent of harvest over the 50-year planning horizon of the Program is 41,718 acres, including two to three harvests on most footprint acres during the planning horizon.

Table 2-2 below shows the breakdown by acres of landbases identified by application of the methodology described above, for the proposed project while Figure 2-1 shows the location of the potentially harvestable area in 2010.

To further determine the environmental effects of proposed treatments, the operational harvest landbase was further subdivided into areas projected for harvest using one of the allowed silvicultural prescriptions and related treatments (e.g., slash treatments, road crossing repair). These acres by treatment were analyzed over the 50-year planning horizon and include multiple harvest entries, regeneration and growth, and variability in timber prices projected over time.

Table A-5 (also Table 2-2) **Breakdown of Program Landbase by Acreage**	
Landbase	**Area (acres)**
Private land in watershed	156,484
Commercial Timberland (commercial forest type + adequate stocking)	86,671
Commercial Timberland outside of riparian buffers	74,979
Available Landbase (minus areas excluded from harvest because of geologic instability)	57,601
Feasible Landbase (commercial harvest >=$30,000 net profit)	22,465
Program "footprint" – Estimated harvest acres enrolled in program during analysis period	15,038* **Includes only first-time entries, and does not re-count acres that are reentered during the analysis period (see projected acreage below).*
Projected total acreage of harvest, based on propensity-to-harvest data from public survey). Acres harvested twice are counted twice.	41,718* ** Total acreage of harvest, counting acres with multiple harvests multiple times.*

Figure A-1 (also Figure 2-1)



Proposed Program Landbase

PTEIR Subwatershed	Commercial Timberland (acres)
East_1	13,114
East_2	12,421
North_1	13,508
North_2	13,533
South_1	8,779
West_1	6,859
West_2	6,766
Total	74,979

6. Distribution of Program Harvest Acres by Subbasin by Landowner Type

The distribution of likely harvest across the Mattole during the analysis period was allocated based on the amount of operationally harvestable land in each Program subbasin, and is shown in Table 2-3, for the proposed project.

Table A-6 (also Table 2-3)
Total Acres Projected to be Harvested and Harvest "Footprint"
By PTHP's 2011-2060
Under The Proposed Program
Acres By Ownership Type By Subbasin

	NIPF	Industrial	Total	"Footprint" 1/
East_1	8,094		8,094	2,655
East_2	5,149		5,149	1,669
North_1	7,594	3,500	11,094	4,307
North_2	3,492	3,500	6,992	2,935
South_1	1,777		1,777	631
West_1	5,007		5,007	1,746
West_2	3,605		3,605	1,095
	34,718	7,000	41,718	15,038

1/ See definition of footprint in Table A-5 above.

The total NIPF landbase in the proposed program is comprised of 57,601 acres. Out of this, it is projected that logging plans will total 34,718 acres during the 50-year analysis period. It should be noted, however, that many of these acres will represent re-entry harvests on the same acres and not previously unharvested acres brought into the program. The analysis recognizes that some landowners who employ the Program will not conduct subsequent harvests, but that some additional landowners who have not participated will enter the program during the analysis period; these effects are assumed to balance out over the analysis period.

In order to predict the future acreage of THPs and PTHP's, the 1993-2007-time period was used to estimate the acreage of each silviculture type for Non-Industrial Forest Landowners (NIPFs). NIPFs used even-aged methods on approximately 30% of the acres and uneven-aged or thinning methods on 70% of acres during this period. For analysis of the program it was assumed that all uneven-aged methods would convert over to PTHP's, while the 30% of even-aged harvests would still use THPs. (As noted, for HRC, data obtained directly from the company was used to estimate harvest for that ownership.)

Based on these assumptions, the 2011-2060 projected harvest level represents a 74% increase in harvest levels compared to the '93-'07 time period. This harvest acreage is projected to increase over time due to increased volume on WHR size class 4 and 5 stands (generally stands with diameters > 11" DBH). However, the projection also recognizes that some landowners who employ the Program will not conduct subsequent harvests; therefore, for analysis purposes the additional new acres and non-repeated PTHP acres are estimated to balance each other out, so

that the 11,239 acres harvested by 2034 is carried over as the analyzed landbase through the remainder of the analysis period (2060).

The projected NIPF harvestable acreage represents 71 ownerships that can support a feasible harvest, which were chosen randomly based on the propensity of landowners of their size class to conduct a timber harvest. Fifteen of these landowners own 160 acres or less and 56 own more than 160 acres. Table 2-4 below shows estimated harvest by subbasin by NIPF landowner class across the 50-year analysis period. *(Note: Wide fluctuations in totals by period shown in the table are related to the estimated volume of mature timber per modeled parcel combined with the estimated price of timber per period. Minor variations in numbers are caused by rounding).*

Table A-7 (also Table 2-4)
Projected PTHP Harvest 2011-2060
For The Proposed Program
NIPF Owners By Size Of Ownership By 5-Year Period

Analysis Period	Acres Harvest NIPF =<160 Acres	Acres Harvest NIPF >160 Acres	Total
2011-15	638	4,242	4,880
2016-20	145	1,196	1,341
2021-25	182	2,462	2,664
2026-30	598	4,178	4,776
2031-35	135	2,538	2,673
2036-40	143	2,052	2,196
2041-45	781	5,782	6,562
2046-50	0*	265	265
2051-55	134	3,395	3,528
2056-60	744	5,108	5,852
TOTAL	3,500	31,217	34,718

*Projected timber harvest prices for this period, based on past fluctuations in the log market, are too low to support commercial harvest. This 5-year period did not include one of the every-six-years peaks in timber prices used in the financial modeling.

**Please note that the acres projected to be treated under the Program (and Alternatives 2 and 3) are not directly comparable to treatment acres for Alternative 1 (see Table 2-5), since the Program includes 'off-Program' harvest, but Alternative 1, being entirely 'off-Program' includes no additional off-Program acres.

Appendix B.

Geologic Review Flow Charts

For use with
the Mattole
Program Timberland
Environmental Impact Report
(PTEIR)

Prepared by
Gary Simpson,
SHN Engineering, Eureka
Oct. 14, 2008

in consultation with

BBW Associates,

California Geological Survey

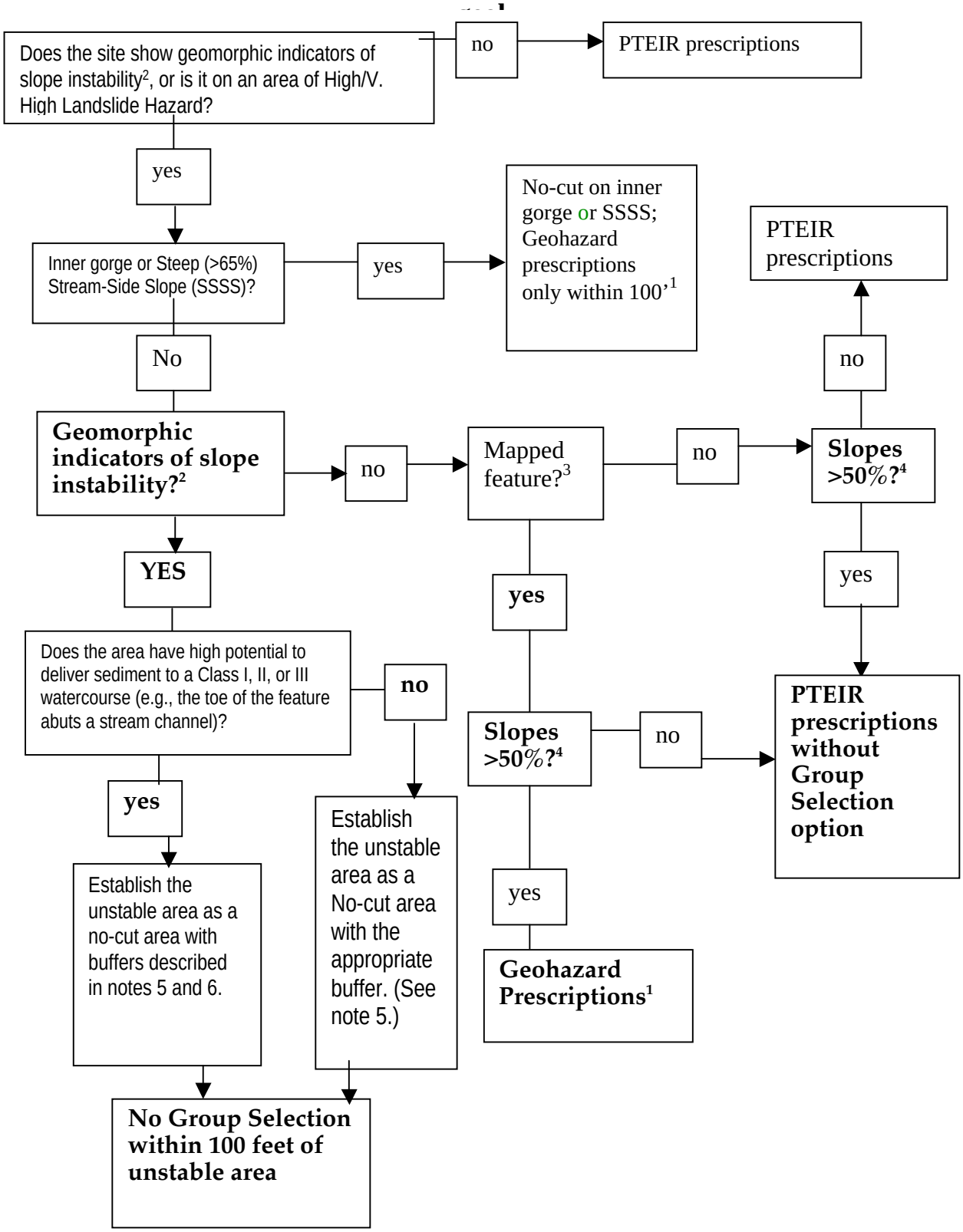
and

the Mattole Restoration Council

Revised May 2010
in consultation with the Mattole Technical Advisory Committee

Silviculture Flow Chart

Any operations outside these prescriptions must be justified by a geologist's report.



If the prescription derived at the end of a path is unsatisfactory, retain a licensed geologist to consider whether a more aggressive prescription is warranted. If so, submit a suitable report explaining and justifying the proposed deviation.

Explanation of the Silviculture Landslide Hazard Flow Chart

- The Landslide Hazard Flow Chart is intended to provide RPF's with the means to determine an appropriate course of action regarding THP layout relative to potential unstable areas. It is the intent of this process that the RPF can develop appropriate silviculture to mitigate unstable areas within the THP without the need to retain a licensed geologist. By nature, because the process must account for all imaginable outcomes, a high level of conservatism is incorporated. Should the outcome of this flow chart be unacceptable to a landowner, they always have the option of hiring a licensed geologist to justify exceptions to the flow chart outcome.

- The Landslide Hazard Flow Chart should be applied to the largest area within a THP or individual THP unit to which it can be applied. Variables that modify the outcome of the flow chart for any one location are geology, presence or absence of mapped landslide features, and slope. Therefore, as an RPF lays out a THP, he/she must be aware of these three variables at all times; as they change, so may the appropriate silvicultural prescription.

- The mapped slope stability features noted on the flow chart are based on the North Coast Watershed Assessment Program's (NCWAP's) landslide mapping for the Mattole watershed (California Geological Survey, 2002). Pertinent maps within this series include the "geologic and geomorphic features related to landslides map", the geologic map, and the landslide hazard map. The RPF may petition CalFire to utilize another more specific map series.

Footnotes:

[1] **Geohazard Prescriptions**: For this PTEIR, "geohazard prescriptions" include Commercial Thinning and Individual Tree Selection options with a minimum of 100 sq. ft. ba/ac retention for both options.

[2] Were geomorphic indicators of unstable areas identified in the field? See the attached list of geomorphic indicators of unstable areas or refer to the CLFA Checklist.

[3] Mapped landslides are shown on the NCWAP geologic and geomorphic features maps.

[4] Slope gradient should be an average over an area, and should not be influenced by small topographic deviations of less than .25 acre.

[5] If the unstable area is 1 acre or less, establish a 75 foot buffer at the top of the slide and 50 foot buffers along the lateral margins; or extend it to the hydrologic divide, whichever is less. If the unstable area is larger than 1 acre, establish a 100 foot buffer at the top of the slide and 50 foot buffers along the lateral margins. The Geohazard Prescription (note 1) may be applied within the buffer, and all buffer zones should be established as Equipment Exclusion Zones per the Forest Practice Rules.

6 Additional measures: Retain all trees around the edge of the feature whose roots visibly contribute to the stability of the scarp. Within 50 feet of the edge, retain 75% canopy closure post-harvest.

Geomorphic Indicators of Unstable Areas (All Flow Charts)

The following list was modified after the California Licensed Foresters Association checklist of August 1999 (that is, the "Guide to Determining the Need for Input from a Licensed Geologist During THP Preparation"). This list is not exhaustive — other indicators may be present in the field.

- Hillslopes greater than 65%, including inner gorge slopes

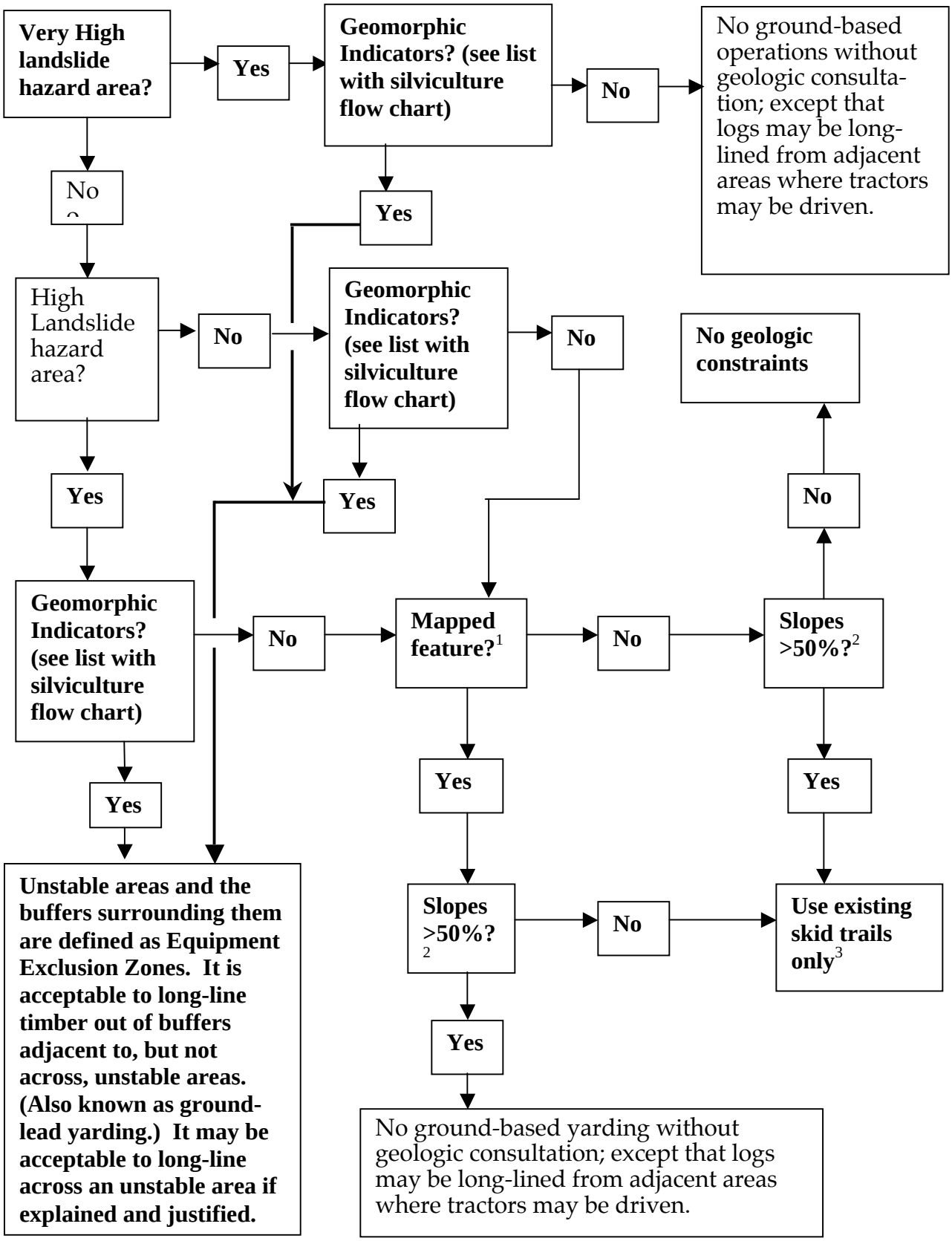
- Irregular topography
    1. Scarps
    2. Benches (usually located adjacent to and below a scarp)
    3. Hummocky ground (typical of prairie ground; in forested setting, hummocky ground associated with active mass wasting is typically coincident with leaning or deformed trees)
    4. Surface cracks, fissures (typically parallel or subparallel to slope contour; distribution pattern is more regular than shrinkage cracks, which are typically more chaotic)
    5. Bowl-shaped depressions
    6. Headwall swale/convergent slope areas
    7. Linear chutes leading out of headwall areas

- Vegetative indicators (if associated with landsliding, these indicators will typically be coincident with an irregular topographic feature listed above)
    1. Groups or concentrations of leaning conifer trees
    2. Hydrophytes
    3. Isolated patches of anomalous vegetation or abrupt contrast in timber type (especially where coincident with geomorphic indicators such as bowl-shaped depressions, etc.)

- Disorganized drainage (if associated with landsliding, these indicators will typically be coincident with an irregular topographic feature listed above)
    1. Sag ponds
    2. Seeps
    3. Watercourses diverted by geologic activity
    4. Concentrations of closely spaced Class III watercourses (e.g., "turkey foot" pattern)

- Concentrations of road cut-bank failures
- Road or landing fill failure

YARDING FLOW CHART



Explanation of the Yarding Flow Chart

- The Yarding Flow Chart is intended to provide RPFs with the means to determine an appropriate course of action regarding THP layout relative to potential unstable areas. It is the intent of this process that the RPF can develop appropriate yarding methods to mitigate unstable areas within the THP without the need to retain a licensed geologist. By nature, because the process must account for all imaginable outcomes, a high level of conservatism is incorporated. Should the outcome of this flow chart be unacceptable to a landowner, they always have the option of hiring a licensed geologist to justify exceptions to the flow chart outcome.

- The mapped slope stability features noted on the flow chart are based on the North Coast Watershed Assessment Program's (NCWAP's) landslide mapping for the Mattole watershed (California Geological Survey, 2002). Pertinent maps within this series include the "geologic and geomorphic features related to landslides map", the geologic map, and the landslide hazard map. The RPF may petition CalFire to utilize another more specific map series.

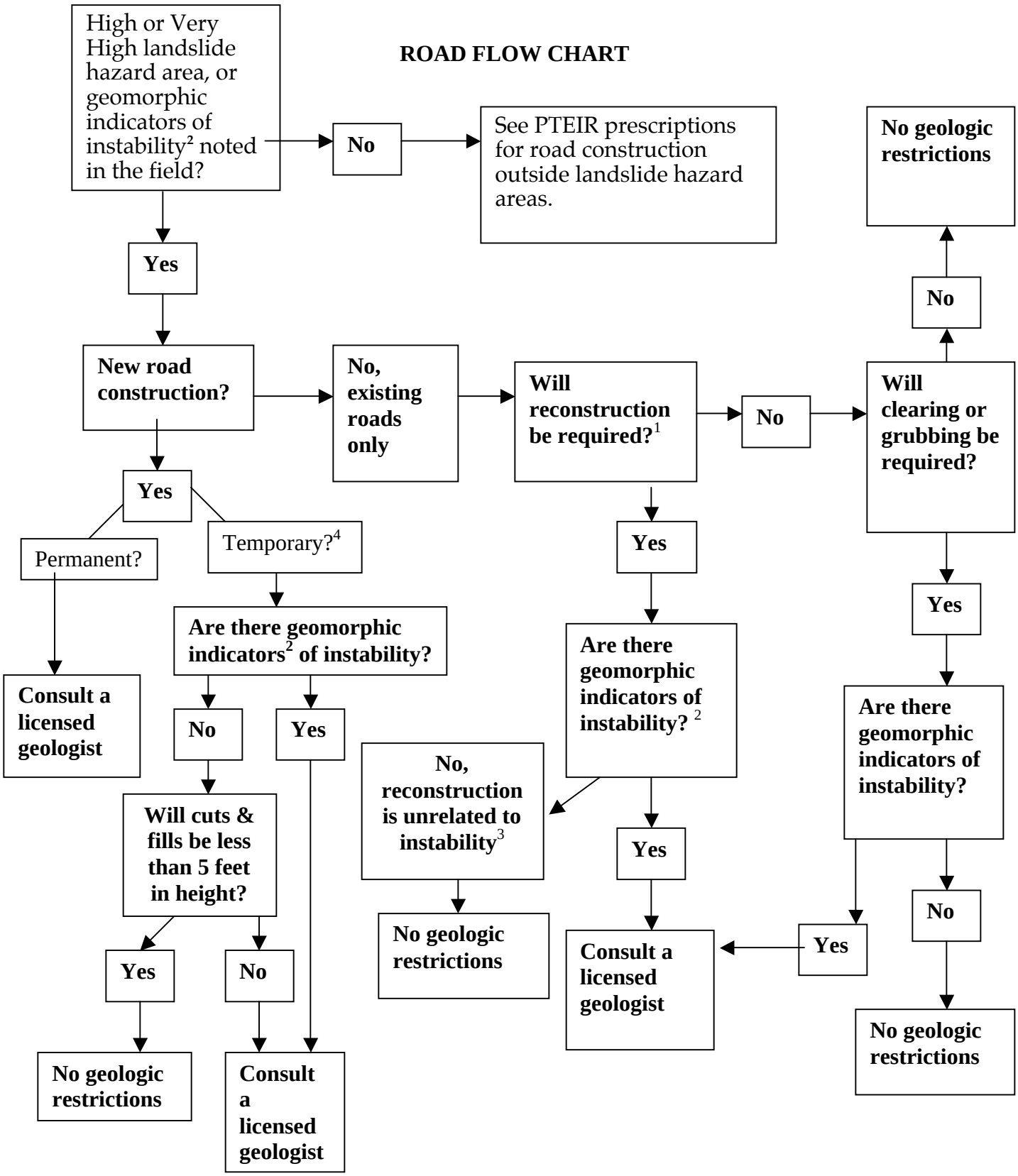
Footnotes:

[1] **Mapped landslides are shown on the NCWAP geologic and geomorphic features maps.**

[2] **Slope gradient should be an average over an area, and should not be influenced by small topographic deviations of less than .25 acre.**

[3] "Existing skid trails" are defined as those with in intact running surface adequate for use by heavy equipment after minor clearing and grubbing.

ROAD FLOW CHART



Explanation of the Roads Flow Chart

Footnotes:

[1] **"Reconstruction" is defined as cutting or filling involving >50 cu. yds/0.25 linear road miles.**

[2] **See the list of geomorphic indicators included with the Silviculture flow chart.**

[3] **This is intended to allow for upgrade or reconstruction of failed watercourse crossings unrelated to instability without necessitating geologic consultation.**

[4] **"Temporary" for this purpose applies to roads to be removed prior to the next rainy season; that is, they will not be allowed to persist through a wet weather cycle. The decommissioning of a temporary road will entail removal of watercourse crossings, outsloping of the road surface, and installation of water bars/breaks per the site's Erosion Hazard Rating.**

1.

Appendix C
Stand delineation and within-stand differentiation

A **stand** is a geographically identifiable contiguous group of trees that are sufficiently uniform in age class distribution, composition and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit. Forestry practices are carried out on a stand-by-stand basis, since the characteristics of a stand determine where specific silvicultural practices can logically be applied and where compliance with stocking regulations will be assessed. Because a forest stand represents the basic unit for silvicultural planning, care should be taken to ensure that each stand represents a uniform ecological unit, so that silvicultural opportunities and constraints are properly identified and addressed.

Delineation of forest stands across an ownership must be completed through the use of aerial photographs, forest reconnaissance, inventory sampling, and assessment of site factors. Unique **strata**, identified for silvicultural treatment purposes, may be comprised of a single geographically identifiable stand polygon <u>or</u> multiple polygons geographically distributed across an ownership, which, when appraised collectively in acreage terms, accounts for 15% or more of the total PTHP area. The RPF shall evaluate stand conditions and develop a silvicultural prescription which is specific to the strata and is designed to meet the goals and objectives of the Mattole Forest Futures Program. Aerial photographs utilized for stand and strata delineation shall be of sufficient quality and at a scale at which the stands and strata can be easily identified as described in this appendix.

The RPF shall designate stands down to a scale that is appropriate to the overall PTHP area and that results in an accurate portrayal of the major stand types that exist on the PTHP. When delineating polygons, it is important to consider that future PTHPs tiered to the PTEIR must be tied to conditions reported in previous PTHPs applied to the same stand. For this reason it is recommended that, whenever feasible, identifiable features such as roads, streams, ridges and property lines be used as polygon boundaries.

PTHPs which present inventory data from multiple stands proposed to be combined for treatment purposes, but which have individual compositions and/or structures dissimilar enough so that inventory data may compromise development of an accurate inventory estimate now and into the future, cannot be accepted into the Mattole Forest Futures Program. Coalescing minor stand types into larger types may be acceptable, provided that the inventory data from the minor type(s) does not compromise development of an accurate inventory estimate of the major type.

As an example of expectations for participants in the Mattole Forest Futures, basal area density is one of the more significant factors in a stand-typing key. Typically, with all other factors being equal, when average basal area density measures from two potentially different stands vary by 20% or more based on the higher density stand, planned silvicultural regimes and their corresponding growth and harvest levels will likely be sufficiently different such that combining both stands to reflect a single entity would not be justified. However, practical considerations such as terrain, logging systems, and road networks may occasionally justify inclusion of stands with differing basal areas into a single treatment unit.

Within-stand differentiation and the group selection prescription

Even within a stand of trees as defined above, variation in individual growth rates allows some trees to achieve competitive advantage and encroach upon the growing space of other trees. This redistribution of growing space is referred to as **differentiation** and is generally manifested first in diameter differences and then in height differences, since diameter growth has lower priority for allocation of photosynthate.

As some trees achieve various degrees of dominance or relative suppression the stand's appearance changes. Trees that do not achieve dominance, and are therefore smaller and less vigorous than their competitors, may persist as a size class of trees within a stand that can cursorily appear to represent a younger age class than the more dominant trees (Oliver, Chadwick; Larson, Burce. 1990. Forest Stand Dynamics, page #209. McGraw-Hill. New York. 467 p).

The intent of a group selection prescription is to create openings within a stand, within which trees of a younger age class are managed toward eventual harvest. These trees may be planted or naturally seeded in, or in some cases may be comprised of existing understory trees that are retained within the opening after harvest. If residual trees within the group opening are not actually young and vigorous but instead are weaker trees of the same age class as those harvested, they are unlikely to respond to release as desired for stand growth and future management. RPFs prescribing group selection prescriptions should make sure that any residual trees being counted for stocking within group openings have the potential to respond vigorously to removal of the overstory.

Appendix D: Methods Used to Predict Sediment Yield

Sediment Loading

Predicting the potential impacts of the Mattole Forest Futures Program for sediment related parameters in the Mattole River Watershed is considered to be one of the most important resource areas. This is due to the fact that the Mattole River is impaired by excess sediment and is currently on the 303(d) list of impaired watersheds for sediment. The primary sediment parameter associated with the TMDL listing is delivery of sediment to the watercourse, i.e. sediment yield. Thus, the analysis is necessarily structured around estimating the potential impacts to this parameter. The primary management related question that must be addressed in this analysis is: what is the net effect of decreasing sediment yield by upgrading roads and fixing legacy sediment sources as compared to the increasing sediment yield by installing new timber harvests and building new roads? The data and assumptions contained in the Mattole River TMDL were the basis for addressing this question.

A challenge inherent in the Mattole Forest Futures Program is that the exact timing, number and location of potential timber harvest activities expected to occur as a result of this project is unknown. This uncertainty is due to the fact that the Project is not a management plan for a defined landbase, but an optional permit that may be invoked by private landowners if they choose to do so. We have developed a methodology for predicting the approximate acreage of participating landowners for each sub-basin over the next 50 years, but it is not possible to predict which particular landowners will harvest which particular acres.

The lack of spatial specificity in defining the potentially effected environment provides a unique challenge for the analysis of potential impacts to sediment yield. Methods that rely on spatially specific information such as slope steepness, road location and configuration, landslide hazard, proximity to watercourses, etc. are all limited by lack of information in this particular analysis. The analysis must therefore rely on a generalized analysis of average conditions found in each sub-basin. Numerous analytical methods were reviewed in order to determine which method would be best suited for use in the Mattole Forest Futures Program, see below.

Summary of Methods That Were Evaluated

There are many methods and models that can be used to predict sediment loading. A method developed by the USFS known as Equivalent Roaded Area (ERA) is widely used. The ERA methodology is a “lumped, conceptual model that quantifies total disturbance in the watershed through the use of empirical coefficients and recovery curves for each activity (MacDonald and Coe 2004)”. The primary limitations of the ERA model are: 1) it does not separate impacts on sedimentation from peak flows, 2) evaluation of recovery time is linked to causes of the impacts rather than the impacts themselves, 3) results are not spatially explicit (location of the project in the watershed is not accounted for) and 4) ERA describes a level of risk due to management activities but does not offer an index of actual impacts (Menning et.al. 1996, MacDonald and Coe 2004). Despite these shortcomings, ERA has proven to be a useful index of watershed activity (Reid 2010, McGurk and Fong 1995, USDA Forest Service 2003, USDA Forest Service 2005, USDA Forest Service 2007).

The North Coast Regional Water Quality Control Board suggested the use of the Disturbance Index (DI), which was used by Gualala Redwoods Inc. (GRI) in the Garcia River Watershed. The DI method is very similar to the ERA method but includes some additional terms to describe distance from stream, soil detachability and landslide risk for sediment sources. Like ERA, the DI method produces an abstract index of disturbance with relatively few data inputs. Interpretation is limited to comparison of relative disturbance indexes between sub-basins and/or analysis Alternatives. It is not possible to directly compare DI or ERA values with physical estimates of erosion and sediment transport in terms of actual rates or volumes (tons/sq. mile/year). The DI approach does not include background sediment production (earthflows, landslides, streambank erosion, etc.) in its current form (as described by GRI). Finally, the DI method, as well the methods described below, all require spatially specific information on the physical location of each harvest area, which is not available for the Mattole Forest Futures Program.

Of the many quantitative models that were considered (SEDMODL, WEPP, etc.), the one that appeared to be the most promising for the Mattole was NetMap. NetMap has the advantage of already having been applied to part of the Mattole watershed as part of a Pacific Lumber Company (PALCO) watershed analysis. NetMap uses a sophisticated GIS-based approach to determine sediment production for each area in which it is applied. We discussed the use of NetMap in the Mattole with one of its designers, Lee Benda, and reviewed the information produced by NetMap for the Mattole. We also reviewed the use of NetMap as applied to the Mad River TMDL (US EPA 2007). Based on this review we determined, in consultation with Lee Benda, that NetMap might not work well for the PTEIR in the Mattole for the following reasons.

First, there is no standardized way to model different sediment production rates from various silviculture and yarding techniques within NetMap, which is an essential component of the Mattole Forest Futures Program. Sediment production rates for various silviculture and yarding techniques were developed in the Mad River TMDL for each geologic type through extensive site-specific field work (see Appendix B of the Mad River TMDL). However, there is no budget to conduct this level of fieldwork within the Mattole Forest Futures Program. Second, in order for NetMap to accurately predict sediment loading from various parts of each sub-watershed, it would be necessary to measure or estimate sediment load values at multiple flow levels for each sub-watershed in order to give NetMap a reference value for total load expected to flow out of each sub-watershed. Again, this was done through extensive fieldwork in the Mad River TMDL but was not feasible in the Mattole. Third, NetMap produces estimates of fish habitat suitability for each stream segment, and this was done as part of the PALCO watershed analysis. Knowledgeable members of the Mattole Salmon Group reviewed the predicted habitat suitability maps and determined them to be of poor accuracy relative to what is known based on fish surveys that have been conducted in the Mattole. Finally, as with other methods, NetMap relies on spatially specific information to predict potential impacts. Based on these factors, we decided that NetMap was not suitable for use in the Mattole Forest Futures Program.

After consideration of ERA, DI, NetMap and others, we decided that a hybrid approach that utilized the existing data collected for the Mattole TMDL and modeled this into the future would be best. The hybrid approach used the sediment yield values estimated waste load allocations described in the TMDL as the basis for assessing future sediment loading in the Mattole using DI-type

multipliers for each silviculture and yarding type. The main advantages to this method are that the estimates of disturbance are produced in interpretable units of tons/sq. mile/year and the erosion estimates are based on data collected in the Mattole. Predicted sediment loading from various modeled activities may then be compared directly to sub-basin sediment yields generated in the TMDL and interpreted as a percentage of the total. Sediment loading estimates could then also be compared to sediment transport capacity of receiving waters in order to estimate potential impacts to channel condition. In particular, CGS has mapped aggradation/incision over time in various channels in the Mattole. It may be possible to use estimated sediment yields from management activities as the basis for predicting the sediment flux status of the channel, e.g. will harvest cause this channel to move from a condition where the amount of sediment in the channel is limited by supply, to a condition in which the level of sediment is limited by the channel's capacity to transport it onward to downstream reaches?

The primary limitation of the hybrid approach is that it is only as accurate as the TMDL data upon which it is based. Nineteen watersheds on the north coast of California have had rapid sediment budgets prepared as a part of the TMDL process (NCRWQCB 2009). The rapid sediment budget process is based upon aerial photographic analysis, GIS digital terrain models and limited field investigation. Due to these types of methods, in general, rapid sediment budgets can produce estimates only within a factor or two of actual sediment yield (Reid and Dunne 1996). Although the rapid sediment budgets upon which TMDL's are based have limited accuracy, they have been publically and peer reviewed and are the basis for regulation of landuse, e.g. Action Plan for the Garcia River Watershed Sediment TMDL (RWQCB 2001) and the Categorical Waiver (NCRWQCB 2009).

Despite the shortcomings of the Mattole TMDL analysis (and other TMDLs) it contains the only estimate of watershed wide sediment yield and is therefore the best available information from which to base an analysis of potential impacts on sediment yield due to management. Another advantage to using the TMDL sediment budget as the departure point for analysis of future activities is that the TMDL already includes a complete analysis of all past sediment sources, i.e. it is a cumulative watershed impacts analysis for sediment that is current through the year 2002.

Description of Approach used in Mattole Forest Futures Program

The overall method of the hybrid approach is to develop mini-sediment budgets for each harvest area evaluated in the PTEIR, then account for these within the larger status quo sediment yield values described in the TMDL (Table 1). Conceptually the method is to clip out Harvest Area polygons from TMDL sediment budgets, modify the numbers to simulate road upgrades and new timber harvest and re-insert them into the overall sediment budget, then review the results at the subbasin scale.

Table D-1.
Sediment Yield Values From the Mattole River TMDL by Subbasin*

	Tons/acre/year			
Budget item	**North**	**East**	**South**	**West**
Natural Mass Wasting	5.78	2.50	2.50	3.28
Stream Bank Erosion	1.23	0.42	0.27	0.56
Other Harvest Related Delivery	0.94	0.22	0.23	2.34
Skid Trail Related Erosion	0.92	1.09	1.19	1.33
Road Related Gullying	0.16	0.30	0.45	0.31
Road Related Mass Wasting	3.13	9.22	0.70	3.28
Road Related Surface Erosion	0.56	1.05	1.22	0.88
Road Stream Crossing Failures	0.08	0.06	0.25	0.06

***Sediment yield values in the TMDL were originally calculated on a per square mile basis, but were converted to an acreage basis to facilitate analysis of future timber harvest, which occurs on an acreage basis.**

The only quantitative studies of sediment yield from roads and harvest areas that have been carried out in the Mattole watershed are the TMDL from 2002 and the PALCO Watershed Analysis (WA) for the Northern subbasin (NCRWQCB 2002, PALCO 2006). The TMDL is the only *watershed wide* sediment budget that exists for the Mattole watershed. The TMDL is based on a combination of field investigations and aerial photo interpretation and has been publicly and scientifically reviewed. The sediment budget period for the TMDL was 1984 to 2002. The Watershed Analysis (WA) completed by PALCO in 2006 examined only commercial timberlands owned by PALCO in the Northern sub-basin. The sediment budget period for the WA was from 1988 to 2003. The WA was also subject to public and scientific review.

In order to make comparisons of potential changes in sediment yield values at the subbasin scale that may be expected to occur as a result of implementing each Alternative within the Mattole Forest Futures Program the following steps were performed:

1. An estimate of the acreage that is likely to be harvested within each subbasin within each Alternative was generated. The methods for estimating potential harvest are described in Chapter 2 of the PTEIR.

2. New, smaller subbasins were defined for the PTEIR. The sub-basins used in the PTEIR were divisions of the 4 sub-basins used in the TMDL and NCWAP analyses. Specifically the Northern, Eastern and Western sub-basins were split approximately in half, so that there were 7 PTEIR sub-basins, each approximately 20-30,000 acres in size. CALFIRE recommended this as an appropriately sized analytical unit.

3. The appropriate mixture and proportion of silviculture types was assigned to each Alternative. It was *not* necessary to define the actual location of each harvest area in each subbasin, as the TMDL sediment values were based on average yield values for each subbasin. Each PTEIR subbasin was assigned the average sediment yield values assigned to them the original, larger TMDL sub-basins (North, East, South, West).

4. Activities that occur outside of Alternatives were added to the sediment yield values estimated for each Alternative. The primary, non-program cumulative impacts analyzed were THPs and other harvest types that occur outside of the harvest activities analyzed within each Alternative.

5. For each Alternative analyzed within the PTEIR, an estimate of the annual sediment yield (SY) over the next 50 years for each subbasin was developed using a Microsoft Access database, which employed the same basic methodology used in the TMDL (essentially summing road, harvest and natural sediment yields for each subbasin). For each subbasin, there is an estimate of the number of acres that will be harvested in 5 year blocks for the next 50 years (see Chapter 3), for each harvest area the following assumptions were employed to simulate potential changes to the sediment yield of that harvest area:

   a. **Roads:** Reductions of the sediment yield originating from existing roads for each new harvest area based on the following assumptions:
      i. Landowners filing PTHPs, THPs or NTMPs (collectively "harvest plans") will be required to upgrade roads as necessary to meet standards described in the Anadromous Salmonid Protection Rules (ASP), as described within the 2010 Forest Practice Rules (FPRs). In addition, PTHPs and those THPs seeking a waiver of the NCRWQCB's wastewater discharge permit requirements will be required to stay within limits described in RWQCB Order No. R1-2009-0038.
      ii. Road upgrades implemented under harvest plans are capable of meeting the TMDL load reduction targets, which range between 80 and 95% for road related parameters (NCRWQCB 2002).
      iii. Assume that all roads within each harvest plan area will be upgraded during the life of the plan during the first entry.
      iv. Assume that 25% of those filing PTHPs will opt to construct the maximum amount of new road permissible, 1,000 feet. Newly constructed road will be assumed to meet TMDL reduction targets. The forested areas of the Mattole were roaded extensively in the first round of logging in the watershed from 1950 to 1990. Thus, relatively little new road construction is expected. Most new roads that would be constructed would likely be on ridges and away from streams.
      v. No decay of sediment yield over time, as roads are constant sediment sources.
      vi. For uneven-aged silviculture harvests the road upgrades were assumed to occur during the first entry and the decreased sediment yield from the newly upgraded roads was effective at that point; for subsequent re-entries it was assumed that roads were maintained and would continue to produce lower sediment yields attained during the first entry, but no additional decreases in sediment yield were assumed to occur. For even-aged harvests, there is only one entry during the analysis period (2010-2060) and road upgrades were assumed to occur every time an even-aged harvest occurred. The result of these assumptions is that more acres of roads are upgraded using even-aged

silviculture than uneven-aged silviculture, because every even-aged harvest encounters un-upgraded roads whereas in uneven-aged silviculture the harvest only encounters un-upgraded roads on the first entry, re-entries occur on upgraded roads.

b. **New Harvest Areas:** For each simulated harvest area a new component was added to the sediment budget to account for additional sediment generated by the harvest. The sediment yield from new harvest was assumed to persist for 15 years.

c. Legacy Harvest Areas: Assume that each harvest plan filed will identify and fix legacy sediment sources, such as diverted streams, unstable landing fills, failing inner-gorge roads, etc. (see details, next section) during the life of the plan. As explained above (item a.(xi)) every acre of even-aged harvest was assumed to occur on land that had no previous efforts to fix legacy sediment sources ('new' ground), whereas uneven-aged harvest only fixed legacy sediment sources on the first entry and no further fixes were assumed on re-entries. Areas where no new management occurs over the next 50 years were assumed to have a sediment yield that declined by 75% over the next 50 years.

d. Background Sources: Natural rates of mass wasting and streambank erosion were assumed to persist at levels estimated in the TMDL for harvested and un-harvested areas.

6. **Status Quo and non-PTHPs (Cumulative Impacts)**
   a. All areas not-explicitly within a post 2010 harvest plan were assumed to generate sediment yields based on TMDL figures for each sub-basin.
   b. The acreage of standard harvest permits (THPs, NTMPs, etc.) were estimated for each sub-basin 50 years into the future. A distribution of silviculture types were estimated for these other permit types. These non-program harvest plans were be added to the impacts estimated for in-program impacts in each Alternative to arrive at an estimate of Cumulative Impacts for sediment yield.

7. PTEIR Sub-Basin Analyses
   a. Sum sediment yield values from each Alternative for each sub-basin and compare to total annual sediment yields for each sub-basin to determine magnitude of effect. Total sub-basin sediment yield was estimated based on likely harvest acres assumed for each sub-basin under PTEIR and non-PTEIR harvest scenarios. Sediment yield values for each sub-basin were calculated annually over the next 50 years in order to estimate cumulative changes in sediment yield due to implementing each Alternative over time.

8. PTEIR Planning Watershed Analyses
   a. Within each sub-basin, the planning watersheds (PWS) that are likely to receive the greatest harvest impacts under either the PTEIR or normal THP process will be identified. A combination of available timber volume, extent of private land base, harvest feasibility and parcel size among other variables will be used to identify areas where harvest is most likely. Also, PWS specific factors such as fish habitat abundance or geologic stability will be considered to determine where harvest impacts would be most likely to negatively influence existing conditions. The PWS's that are most

sensitive or most likely to be impacted will be singled out for greater analysis, particularly using PWS specific qualitative information, where available.

Comparison of TMDL and PALCO WA Sediment Budgets

A unique and valuable (from the perspective of available data) situation has occurred within the Mattole Watershed. The Northern subbasin has had two, recent, independently prepared, rapid sediment budgets developed. The first was developed by the NCRWQCB for the TMDL and the other was prepared by the Pacific Lumber Company (PALCO) for its ongoing watershed analysis (WA) efforts. The WA focused on the lands covered by the Company's Habitat Conservation Plan (HCP) and included approximately 2,900 acres of forests that were subject to timber harvest within the past 20 years. The PALCO WA area was located in the Northern subbasin area as analyzed in the TMDL. The sediment budget for the TMDL was focused on the time period from 1984 to 2002, while the WA covered the entire photo record from 1947-2003. However, the WA did report sediment values from two distinct time periods; 1947-1987 and 1988-2003 in order to separate out legacy from recent harvest and management related activities. The TMDL sediment budget from 1984-2002 and the WA sediment budget from 1988-2003 are temporally comparable. In general, the PALCO WA was a more focused effort on a smaller landbase with a greater proportion of field verification and review of aerial photographs than the TMDL.

The TMDL calculated a total sediment budget for the Northern sub basin of 8,200 tons/mi^2/year, of which 54% was derived from natural sources. The PALCO WA calculated a total sediment budget of 6,723 tons/mi^2/year, of which 85% was derived from natural sources (Table 2). An independent review of the TMDL by Bedrossian and Custis (2002) also came to the conclusion that the TMDL underestimated the natural/background rates of sediment yield.

Essentially, the TMDL reported higher values for all management related categories (roughly four times as high, in aggregate) and the PALCO WA reported higher values for natural categories (about 25% higher). The differences in surface erosion values for roads and harvest areas were particularly high.

A potentially significant difference between the TMDL and the WA is that the landbase in the WA was exclusively industrially managed timberland, while the TMDL also includes lands managed as ranches, rural sub-divisions and public lands. It is possible that the lower rates of road and harvest related erosion reported in the PALCO WA (73-94% lower) were due to conducting the study on roads and harvests that have been subject to recent regulatory requirements in terms of road upgrades and post harvest erosion control measures. Despite the differences, both sediment budgets reported that road and harvest related mass wasting were the dominant management related sediment sources.

Table D-2. Comparison of TMDL and PALCO Sediment Budgets for Northern Subbasin*

	Road Density (mi/mi2)	Road Surface Erosion Yield (tons/road mile/year)	Road Surface Erosion Yield (tons/mi2/year)	Road related Stream Crossing Washouts and Road Gullies (tons/mi2/year)	Natural Mass Wasting (tons/mi2/year)	Mass Wasting-Road Related (tons/mi2/year)	Mass Wasting-Harvest Related (tons/mi2/year)	Surface Erosion-Harvest Area (tons/mi2/year)	Legacy Mass Wasting (tons/mi2/year)	Skid Trail Related Erosion (tons/mi2/year)	Harvest Related Sediment Yield (tons/mi2/year)
TMDL North Subbasin	2.3	156	360	150	3,700	2,000	600	10	**	590	1,200
PALCO HCP Area	3.4	8.6	29	31	5,664	526	207	2.3	395	***	604

* The Analysis period for the TMDL was 1984-2002, the PALCO WA period was 1988-2003.

** The TMDL included surface erosion from large un-revegetated landslides from the pre-1984 time period into the category titled “Mass Wasting- Harvest Related”, whereas PALCO separately categorized landslides that originated prior to the sediment budget time period as “Legacy” sediment sources.

*** The PALCO WA included skid trail related erosion in the “Surface Erosion-Harvest Area” field whereas the TMDL included landslides originating from skid trails in the “skid trail related erosion” category

Sediment Yield Reductions Expected due to Road Upgrading and Modified Harvest Practices

Road Surface Erosion

The Mattole TMDL (NCRWQCB 2002) estimated that reductions of 90-95% for road surface sediment delivery were possible using current road upgrade techniques, which would result in values of 36 tons/mi^2/year from upgraded roads in the Northern subbasin (Table 2). The estimates of sediment yield from road surface erosion reported in the PALCO WA were 94% less than those reported in the TMDL at 29 tons/mi^2/year (Table 2). The estimates of sediment yield from road surface erosion in the WA were derived from Water Erosion Prediction Project (WEPP) model runs of roads upgraded/constructed to modern standards – including outsloping, adequate drainage, rock surfacing, etc.

K. Sullivan and B. Weaver both described their own unpublished studies of the effectiveness of hydrologically disconnecting road networks from stream networks using road upgrade techniques such as outsloping road surfaces, installing rolling dips, increasing cross-drain frequency, etc. Weaver noted that for private roads on average, approximately 50% of the road surface is hydrologically connected prior to road upgrade practices. After road upgrades are completed hydrologic connectivity is typically reduced to about 10-15%, which is approximately a 70- 80% reduction in road connectivity. K. Sullivan described the exceptional practices underway on Humboldt Redwood Company (HRC) to disconnect road surfaces, which includes additional rock surfacing at all stream crossing locations and noted that she has observed that many upgraded road reaches on HRC property are only 2-5% hydrologically connected.

A study was recently conducted in Washington State on forestlands that have been undergoing widespread road upgrade practices as a result of regulatory requirements to reduce hydrologic connectivity of roads (Martin 2009). Martin found that approximately 12% of the surveyed road network was hydrologically connected following road upgrade treatments. Martin's results are consistent with Weaver's observations (see above).

The results from Martin, Weaver and Sullivan all corroborate the 90% estimate of potential reductions in sediment loading from road surface erosion due to road upgrading contained in the TMDL. <u>Therefore we will assume that upgraded roads will attain the 90% reduction in sediment yield from road related surface erosion described in the TMDL.</u>

Road-Related Mass Wasting

The Mattole TMDL (NCRWQCB 2002) estimated the potential reduction in road related mass wasting due to road upgrading as follows, "Other road-related mass wasting features, which are greatly influenced by their geologic terrane, may be more difficult to control, so a loading reduction of 80-85 percent may be a more realistic target." The PALCO WA estimated road-related mass wasting values that were 73% lower than those reported in the TMDL (Table 2).

Results from comparing roads constructed in the 1970s to those constructed in the 1990s in Caspar Creek indicates that modern roads tend to produce fewer and smaller road associated landslides than those constructed prior to implementation of the California Forest Practices Act (Cafferata and Spittler 1998). However, this study did not directly address the potential sediment yield reductions

that would occur due to upgrading existing roads that were originally constructed in the 1950s through 1970s.

In nearby Bear Creek watershed Pacific Watershed Associates characterized the occurrence of road related mass wasting as follows (PWA 1998),

> *Road-related landsliding* - Road-related landslide frequency peaked in the 1966 aerial photo period and has continued to diminish over time (Figure 5). The 1966 storm generated 23 identifiable landslides along roads in the basin, whereas the 1996/97 storm produced only three new road-related landslides. Four factors are likely responsible for this: 1) the 1964 storm, by all accounts, was of greater magnitude than the 1996/97 event, and thereby produced a larger number of failures, 2) a large number of roads had recently been constructed (and had not been storm tested) by 1964, and these susceptible sites failed in the 1964 event, 3) prior to the 1964 storm harvesting and yarding practices were not protective of water quality or slope stability, and 4) roads built following the 1964 storm were confined to upland areas and ridge-top hillslopes which are less susceptible to debris landsliding. With time, as unstable fills and hillslope areas fail, the number of potentially unstable areas which remain along the road system diminish in number. Likewise, much of the pre-1966 road network was upgraded during the 1990s, and this may have contributed to the reduction in landslide risk and sediment production during the 1996/97 storm.

Therefore we will assume that upgraded roads will attain the 80% reduction in sediment yield for road related mass wasting described in the TMDL.

Road-Related Crossing Failures

The Mattole TMDL (NCRWQCB 2002) estimated the potential reduction in road related crossing failures due to road upgrading as follows, “Estimates that 95 percent of road-stream crossing failures are controllable (Hagans, et al. 1986), are reflected by a reduction of 90-95% from the current estimated loading rate.” The PALCO WA estimated road related “stream crossing washouts and road gullies” were 80% lower than those reported in the TMDL.

Cafferata and Munn (2006) reported that 18 percent of crossings inspected after completion of THPs had minor or major deviations from the Forest Practice Rules, most commonly regarding insufficient treatment of diversion potential. While there is no data regarding the actual performance of upgraded crossings in terms of frequency or magnitude of failure relative to un-upgraded crossings, Hagans, et al. (1986) estimated that 95% of road-steam crossings failures are controllable.

Therefore we will assume that upgraded roads will attain the 90% reduction in sediment yield for road related crossing failures described in the TMDL.

Road-Related Gullies

The Mattole TMDL (NCRWQCB 2002) estimated the potential reduction in sediment yield originating from road related gullies due to road upgrading as follows, “techniques are available to greatly reduce sediment delivery from roads (Weaver and Hagans, 1994); therefore, the load allocation for road-related sediment (including road-related gullying, and surface erosion) reflects a reduction of about 90-95 percent from the estimate of the current loading rate.” The PALCO WA

estimated road related "stream crossing washouts and road gullies" were 80% lower than those reported in the TMDL.

Therefore we will assume that upgraded roads will attain the 90% reduction in sediment yield from road related gullying described in the TMDL.

Legacy Harvest Impacts

The Mattole TMDL (NCRWQCB 2002) estimated the potential reduction in sediment yield originating from harvest areas as follows, "The best conservation and land management measures to control sediment associated with landsliding in timber harvest areas are expected to be about as effective as those to control road-related sediment. Therefore, the load allocations for sediment delivery from timber harvest, such as skid trail related erosion and other harvest-related delivery reflect 85-90 percent reductions from the estimate of current loading."

Fixing legacy sediment problems such as diverted stream channels, filled crossings, non-water-barred skid trails, etc. is a requirement of modern timber harvest in California. Therefore it is reasonable to expect that sediment yields originating from legacy harvest impacts will be addressed when land is subject to timber harvest for the first time since the original, pre-FPR logging occurred.

Based on this rationale, it is assumed that for each acre subject to new harvest there will be an 85 percent reduction in legacy harvest related sediment yield compared to current conditions described in the TMDL. The reduction will be achieved during the life of the harvest plan.

Future Harvest Impacts

This component of the sediment budget was difficult to estimate based on the TMDL data alone because the sediment yield originating from harvest (Table 1) was calculated as an average value across each subbasin (including harvested and un-harvested areas), rather than per harvested acre. It is necessary to calculate sediment yield per harvested acre in order to predict sediment yield from a specified rate of future timber harvest. The sediment yield on a per harvested acre basis was approximated from the Mattole TMDL data as follows, using the Northern subbasin data as an example:

1. Annual sediment yield values from the two sediment budget categories in the TMDL (Table 1) related to harvest ("skid trail related erosion" and "other harvest") were summed to estimate total annual sediment yield from timber harvest, 590 and 600 tons/sq. mile/year, respectively. This equates to a harvest related sediment yield of 1,190 tons/sq. mile /year for the sediment budget period of 1984 to 2002. Both categories of harvest related erosion were used because each category included a mass wasting a component and mass wasting was the largest contributor to sediment yield from harvest units (NCRWQCB 2002).

2. The annual sediment yield from harvest areas was then multiplied by the duration of the TMDL sediment budget period of 18 years and the watershed area of the North subbasin of 99 square miles, which equaled 2,120,580 tons delivered during the sediment budget period form harvest related sources.

3. The next step was to identify the total harvested acreage that contributed to the sediment yield for the sediment budget period. The 1941, 1965, 1984, 1996 and 2000 aerial photos were used in the TMDL analysis to identify landslides from harvested areas. The greatest number of landslides occurred in the 1965 and 1984 photo years, though only landslides from the 1984 and more recent photo years were included in the 1984 to 2002 sediment budget period (NCRWQCB 2002). The common practice in aerial photo interpretation is to include landslides from areas that were harvested 15 years prior and more recently into the 'management' related sediment yield component, which in this case would be harvests beginning in 1970. This is based on the concept that root strength in harvested units declines to its minimum 10-15 years after harvest and landslide risk peaks at this point (O'Louglin 1974). Based on this same root strength concept it is conservative not to include harvests that are less than 10 years old, because their susceptibility to landslide risk has not peaked yet. Since the last photo set used was from the year 2000, no harvests after 1990 were included in the acreage assumed to contribute to the sediment yield for the sediment budget period. So, the harvest years 1970 to 1990 were used to approximate the harvested acres that contributed to the sediment yield estimated in the TMDL sediment budget.

4. The total acreage harvested from 1970 to 1990 for each subbasin was derived from a harvest history analysis performed by the Mattole Restoration Council for CAL FIRE (MRC 2001). The acreage harvested, mostly by clearcut and tractor yarding, for each subbasin was as follows:

Table D-3 Estimate of Harvest Acreage for TMDL Sediment Budget Period

TMDL Subbasin	Acres harvested 1970-1990
North	5,435
East	6,471
South	1,263
West	3,592

5. The total volume delivered during the sediment budget period (2,120,580 tons) was then divided by the number of acres of timber harvest that would have produced the sediment yield, which for the North subbasin was 5,435 acres. The result of this division equals 391 tons/acre for the 5,435 acres that were harvested from 1970-1990.

6. Dividing this value sediment budget period of 18 years equals a sediment yield rate of 21.7 tons/harvested acre/year for the Northern subbasin from timber harvest.

7. Finally, the TMDL Load Allocation included an estimate that future timber harvest could be expected to produce sediment yields that were 85-90% lower than current loading estimates contained in the TMDL (RWQCB 2002), which would result in an expected sediment yield of **2.2 to 3.3 tons/acre/year** for the North subbasin from future timber harvest. The preceding calculations carried out for all subbasins yields the following results (Table 4):

Table D-4 Estimate of Sediment Yield From Each Harvested Acre, Derived from Mattole TMDL Data

Subbasin	Sed yield for 1970-1990 era harvest (tons/acre/year)	TMDL reduction 85%	TMDL reduction 90%
North	21.7	3.3	2.2
East	10.3	1.5	1.0
South	19.9	3.0	2.0
West	59.0	8.9	5.9

As expected, the estimated sediment yield values for each harvested acre (Column 2, Table 4) are much higher than the sediment yield values presented in Table 1, which are values averaged across each subbasin including harvested and non-harvested areas.

The Mattole TMDL (NCRWQCB 2002) estimated the potential reduction in sediment yield originating from newly harvested areas as follows, "The best conservation and land management measures to control sediment associated with landsliding in timber harvest areas are expected to be about as effective as those to control road-related sediment. Therefore, the load allocations for sediment delivery from timber harvest, such as skid trail related erosion and other harvest-related delivery reflect 85-90 percent reductions from the estimate of current loading." Therefore the per harvested acre sediment yield values that can be expected for new timber harvests in the Mattole watershed that utilize, "the best conservation and land management measures" are included in Table 4, and **range from 1.0 to 8.9 tons/acre/year.**

Comparison of Mattole Harvest SY to Other Regional Values

In order to determine if the estimates of future sediment yield from timber harvest made in the TMDL were reasonable, other studies were reviewed as follows.

The North Fork of Caspar Creek was 50% clearcut from 1985-1990 in order to study the impacts of modern timber harvest on sediment yield. The harvested areas were subject to the 1996 storm event and in 1998 it was reported that the North Fork of Caspar Creek yielded 25.2 cubic yards per acre from the 1,169-acre watershed (Cafferata and Spittler 1998). In order to convert these data into values comparable to Table 4 it was necessary to convert cubic yards to tons using a rate of 1.4 tons/cubic yard and divide the total sediment yield by the time period over which the sediment was delivered (1985-1998), which resulted in a value of 1.9 tons/acre/year from a 50% clear cut watershed. To account for the fact that half of the watershed was not harvested that sediment yield value could be doubled to estimate sediment yield that originated only from the harvested area,

which would result in a value of 3.8 tons/acre/year. The range of sediment yield values from **Caspar Creek was (1.9-3.8 tons/acre/year)**.

The Critical Sites Erosion Study conducted by Rice and Lewis (1991) calculated the sediment yield from Timber Harvests Plans (THPs) conducted in 1978 and 1979. They conducted their fieldwork approximately 10 years after the harvests were installed and reported an average sediment yield from harvested areas of 3.2 cubic yards/acre. As with the Caspar Creek data it was necessary to convert these values into tons/acre/year required converting cubic yards to tons and dividing by the time period over which sediment was delivered. These calculations resulted in a value of **0.42 tons/acre/year from harvested acres in Northern California**.

A sediment budget prepared for the Bear Creek Watershed on Pacific Lumber Company property in Humboldt County provided another reference point for per harvested acre sediment yield values (Pacific Watershed Associates 1998). PWA reported that 228,500 cubic yards of sediment were delivered to the stream from landslides originating from 1,900 acres of land that had been harvested within the previous 15 years. Converting these data into values comparable to Table 4 resulted in a per harvested acre sediment yield rate of **11.2 tons/acre/year for the Bear Creek watershed**.

The PALCO Watershed Analysis for their privately owned lands within the North Fork of the Mattole River developed an analysis of mass wasting that separated the impacts of recent logging (post 1974) from legacy harvest practices (pre-1974). The sediment budget time period of 1988-2003 was chosen as the time period that reflected current harvest practices. The mass wasting analysis defined "management related" landslides as follows:

1. landslides occurring on hillslopes that have been clear cut harvested (>50% canopy removal) less than 20 years prior (typically relative to the air photo date);
2. Landslides occurring on hillslopes partially harvested (<50% canopy removal) less than 15 years prior;
3. Road-related landslides associated with any roads subject to the 1999 PALCO Habitat Conservation Plan (HCP) (generally any roads within PALCO's GIS system).

The WA relied on the 1997 and 2003 aerial photos for their analysis of mass wasting from 'recent' harvest practices. Using the similar methods as described above under "Future Harvest Impacts" to derive a per harvested acre sediment yield required development of an estimate of the harvest area over which the observed landslides originated from; twenty years prior to 1997 was 1977 and ten years prior to 2003 is 1993, so the time period 1977 to 1993 was established as the harvest window. For the 1977-1993 time period 2,178 acres of harvest occurred on PALCO land in the study area. During the 16-year sediment budget period (1988 to 2003) 61,773 cubic yards of sediment were delivered to watercourses from non-road related, management (harvest) sources, which equates to 94,512 tons (using a 1.53 tons/cy bulk density value cited in Simpson 2006). So dividing the landslide volume (94,512 t) by the acreage harvested (2,178 acres) equals 43 tons/acre/16 years, which results in an estimate of **2.7 tons/acre/year** due to mass wasting from recent harvest units.

There has been one recent effort by PALCO to develop rates of expected sediment yield from upgraded roads, newly constructed roads and modern timber harvest practices for the Elk River Watershed. The effort is based on sediment budgeting principles similar to those used in the

Mattole TMDL and N. Fork Mattole WA, also done by PALCO. The Report of Waste Discharge (ROWD) Elk River (PALCO 2004) analyzed sediment yield from a range of recent timber harvests and upgraded road segments and developed a detailed rate of expected future sediment yield that is used by PALCO to calculate the necessary sediment offsets required to compensate for any increases in sediment yield originating from planned timber harvests. This ROWD is very similar to the analysis being prepared for this PTEIR for the Mattole Forest Futures Program, in that it quantitatively predicted how future timber harvest activities along with sediment source treatments would affect net sediment yield.

The ROWD estimated that the sediment yield from each harvested acre due to elevated rates of mass wasting and associated in-unit roads would be 0.0613 cubic yards/acre/year **(0.0858 tons/acre/year)**[1]**.** In order to calculate future sediment yield from new harvest these rates were assumed to persist for 15 years post harvest for hillslope features and 5 years post harvest for in-unit roads, the product of these sediment rates multiplied by the time periods were then multiplied by 1.2 to account for a margin of safety and the final, total landslide rate offset for harvested acres was 0.408 cy/acre (~0.57 tons/acre). This value is lower than the other values cited above by two orders of magnitude. PALCO asserted that the reported rates were an accurate reflection of their post HCP land management style and represent the best estimate of expected sediment delivery from future timber harvest conducted under recently enacted, very stringent rules.

The ROWD also addressed the issue of stream bank erosion originating from headward extension and enlargement of low order streams caused by timber harvest (Lewis 1998). PALCO used two independent methods to calculate potential sediment yield from this source and chose the higher of the two results, which was **0.117 cy/acre/year (~0.164 tons/acre/year).** The impacts were assumed to persist for 15 years post harvest and yield 1.76 cy/acre/15 years.

Table D-5 Comparison of Per Harvested Acre Sediment Yield Rates reported for Northern California

Study Location (Author)	Description	Sediment Yield Rate (tons/acre/year)
Mattole TMDL (NCRWQCB 2002)	Derivation of sediment yield per harvested acre from logging conducted 1970-1990	**10.3-59.0**
Mattole TMDL (NCRWQCB 2002)	Estimated sediment production from future harvest activities (85-90% reduction)	**1.0-8.9**
Caspar Creek (Cafferata and Spittler 1998)	Sediment yield from 50% clearcut watershed 1985-1990	**1.9-3.8**
Bear Creek (PWA 1998)	Sediment budget for harvest related mass wasting from harvests that occurred in 1980s and 1990s	**11.2**

[1] The bulk density of soil in the Elk River Watershed was assumed to be 1.4 tons/cubic yard (Stillwater Sciences 2007).

North Coastal California (Rice and Lewis 1991)	Critical Sites Erosion Study of harvest conducted in 1978-1979	**0.42**
North Fork Mattole Watershed Analysis (Simpson 2006)	Sediment yield due to non-road related mass wasting for harvest conducted 1977-1993	**2.7**
Elk River ROWD (PALCO 2004)	Estimate of sediment yield per harvested acre for future timber harvest	0.0858 mass wasting + 0.164 channel enlargement =**0.2498**

The only source of information in Table D-5 that included an estimate of sediment yield from future timber harvest governed by current forest practice rules (plus additional HCP regulations) was the PALCO ROWD report for Elk River (PALCO 2004). In order to gauge the comparability of the Elk River ROWD sediment yield estimates to the Mattole TMDL estimates it was useful to compare their total sediment budgets, using the North subbasin as an example. The Mattole TMDL calculated a total sediment budget for the Northern sub basin of 8,200 tons/mi^2/year, of which 54% was derived from natural sources (Table 2). The Sediment budget for Elk River from the time period of 1988-1997 for all sources was 924-tons/ mi^2/year (using 1.4 tons/cubic yard bulk density estimate), of which 48% originated from natural sources. The total sediment yield in the North subbasin as calculated in the TMDL was 8.9 times higher than sediment yield in Elk River, and the estimate of sediment yield from future timber harvest in the Northern subbasin of the Mattole (Table 4) was 8.8 to 13.2 times higher than the estimate of future timber harvest sediment yield calculated in the Elk River ROWD. So the estimate of sediment yield from future timber harvest in the North subbasin of the Mattole River represents approximately the same proportion of the sediment budget as the value calculated for the Elk River ROWD.

The NCRWQCB (2002) did not explicitly define the terms of "best conservation and land management measures" when they made their estimate that sediment loading from harvested areas could be reduced by 85-90% from historic levels. However, it seems reasonable to assume that the provisions governing timber harvest included in the 2009 Categorical Waiver (Order No. R1-2009-0038) would be consistent with "best conservation and land management measures" cited in the Mattole TMDL (NCRWQCB 2009) since item 15 of the Order includes the following statement, "This Order furthers the objectives defined in the TMDL Implementation Policy and Work Plan". All timber harvests conducted under the Mattole Forest Futures Program will meet the terms of the Categorical Waiver and should therefore achieve the sediment yield reduction targets established in the TMDL.

For Alternatives analyzed under the Mattole Forest Futures Program PTEIR a Disturbance Index approach will be used to increase the expected sediment yield that would occur from standard THPs using the full range of silvicultural options. Adjustment factors in North Coast Regional Water Quality Control Board Order No. R1-2006-0039 (North Coast Regional Water Quality Control Board, 2006), were used, where each clearcut, right-of-way, and rehabilitation cut acre was accounted for on a one-to-one basis but acreages with lighter silvicultural methods were reduced by the factors given (e.g., 0.75 for shelterwood and seed tree removal, 0.5 for selection, commercial thin, etc.). Timber harvests conducted under the Mattole Forest Futures Program are limited to selection, group selection or commercial thinning type harvests and will therefore be expected to

produce the per acre sediment yield values under the 85% reduction column of Table 4. And based on the Disturbance Index factors contained in Table D-6, we will assume that sediment yields from clearcut areas would be double those in selection harvested areas (DI factor of 1.0 versus 0.5).

Table D-6: Disturbance Index Factors for Various Silvicultural Prescriptions

Silviculture Type and GIS Code	Adjustment Factor
CLCT = Clearcut	1.00
CMTH = Commercial Thin	0.50
GSLN = Group Selection	0.50
REHB = Rehabilitation of Understocked Areas	1.00
ROAD = Road Right of Way	1.00
SASV = Sanitation Salvage	0.75
SHPC = Shelterwood Preparation Cut	0.75
SHRC = Shelterwood Removal Cut	0.75
SHSC = Shelterwood Seed Cut	0.75
SLCN = Selection	0.50
STRC = Seed Tree Removal Cut	0.75
STSC = Seed Tree Seed Cut	0.75
ALPR = Alternative Prescription	*0.75*
NHRV = No Harvest Area	*0.00*
OUT = Not Part of THP	*0.00*
TRAN = Transition	*0.25*
VRTN = Variable Retention	*0.50*

Table D-6. Silvicultural Disturbance Index Factors from NCRWQCB 2006

A caveat to modeling sediment yield for future timber harvest in the Mattole Forest Futures Program is that the particular types of light touch silvicultural prescriptions that are proposed have not been quantitatively evaluated for sediment yield anywhere, let alone in the Mattole watershed. Most studies of sediment yield (and other resource areas) are derived from studies that compare uncut forests to clear-cut forests, or unroaded areas to those with a road network (e.g. Cafferata and Spittler 1998, Grant and Wolf 1991). However the approach typically used in the ERA and DI methods of assigning ‘factors’ to various silviculture and yarding techniques will be used as an approximation. The light touch silviculture options contained in the Mattole Forest Futures Program are most similar to Selection or Commerical Thinning.

Rate of Decay for Future Harvest Related Sediment Yield

The dominant components of sediment yield that originate from harvested areas reported in the Mattole TMDL were (apart from roads) mass wasting, surface erosion and gully and rill erosion; with landslides contributing the vast majority of harvest related sediment (NCRWQCB 2002). The primary causal mechanism for increased landsliding rates after clear cut timber harvest is the loss of root strength in the soil (O'Loughlin 1974). The loss of root strength is greatest 3-15 years after harvest, before the regenerated stand is able to re-establish a dense network of roots to stabilize the soil. Surface and rill erosion are strongly correlated with the amount of vegetation on the site, which recovers quickly after harvest and thus these impacts are not expected to persist for more than 1-5 years post harvest (Larson and Sidle 1980). In a study of landslide rates in harvested stands after the 1996 storms in Oregon Robison (1999) found that the rate of landslides/acre occurred in stands 0-9 years old, the next highest frequency was found in stands >100 years old and was lowest in stands in 30-100 years of age. In summary, consider the following statement from Beschta et. al. (1995), "Recovery of vegetative cover is generally considered a sufficient condition for the recovery from surface erosion and leaching, and to a lesser extent, mass movement. This recovery typically occurs rapidly, often within 5-10 years, if site conditions and disturbance are not too severe."

Based on the concepts summarized above, a value of 15 years is often used as a recovery period for modeling sediment yield after logging from hillslope sources. Two recent approaches to modeling the sediment yield due future timber harvest used a value of 15 years as the time period over which sediment yield originating from timber harvest declines to zero; the PALCO ROWD (PALCO 2004) and the Gualala Redwood Company's Watershed Wide Waste Discharge Report. Menning et al. (1996) described a modified Equivalent Roaded Area (ERA) model that used a recovery rate that varied by practice, but generally showed 90%+ decline in cumulative watershed impacts (including sediment yield) 15 years after logging.

Based on the research and modeling efforts cited above, we made the assumption that the vast majority of sediment yield was delivered within 15 years after harvest and therefore applied the calculated per acre sediment yield values (Table 4) at a constant rate for 15 years to each harvested acre. We used the more conservative estimate of 85% reduction in sediment yield contained in the TMDL for estimates of future erosion and DI values from Table D-6 for various silvicultural styles. For example, in the North subbasin of the Mattole each clearcut acre is expected to produce 6.6 (3.3 times 2 because of clear cut silviculture) tons/acre/year for 15 years or a total of 99 tons/acre per harvest.

The recovery period of 15 years for harvest related sediment yield is only meant to characterize average annual delivery of sediment to watercourses, not gauge impacts within the stream channel. There is evidence that elevated levels of sediment transport and suspended sediment loads in the stream channel may persist after timber harvest for 10-30+ years (Keppeler et al. 2003, Grant and Wolf 1991). For example, the Mattole River mainstem and larger tributaries have still not recovered to their pre-management channel form 50+ years after the 1965 storm event.

It is also important to note that the average sediment yield values predicted for future timber harvest in this analysis are only an index to relative impacts of timber harvest in the Mattole. Actual

sediment yields will depend on the size and number of large storm events that occur 10-15 years after harvest and sediment yield is likely to be episodic, rather than evenly distributed as an average annual value.

Rate of Decay for Legacy Harvest Related Sediment Yield

The Mattole TMDL calculated a value of 1,410 tons/mi^2/year for sediment yield from non-road, harvest related sources across the entire watershed (NCRWQCB 2002). This was an average value for the 1984-2002 time period, but cannot be expected to continue undiminished for the next 50 years. Though not precisely quantified in the TMDL, the vast majority of sediment from legacy harvests appears to have originated from mass wasting. Surface erosion from non re-vegetated landslides was quantified at 9% of the sediment yield from harvested areas (Table 3.14 "soil erosion"), thus the other 91% percent is presumed to have originated from landslides or perhaps gullies and rill erosion, though it was not mentioned directly in the TMDL for harvest related impacts. The TMDL contains descriptions of ongoing surface erosion from non re-vegetated landslides that originated from harvest conducted in the 1950-1970 time period and, "many legacy problems associated with management practices pre-dating the Z'Berg-Nejedly Forest Practices Act" (NCRWQCB 2002).

Data from the TMDL on landslide frequency indicate that rates have continuously declined since 1965 (See Figure 3.8, from the TMDL).

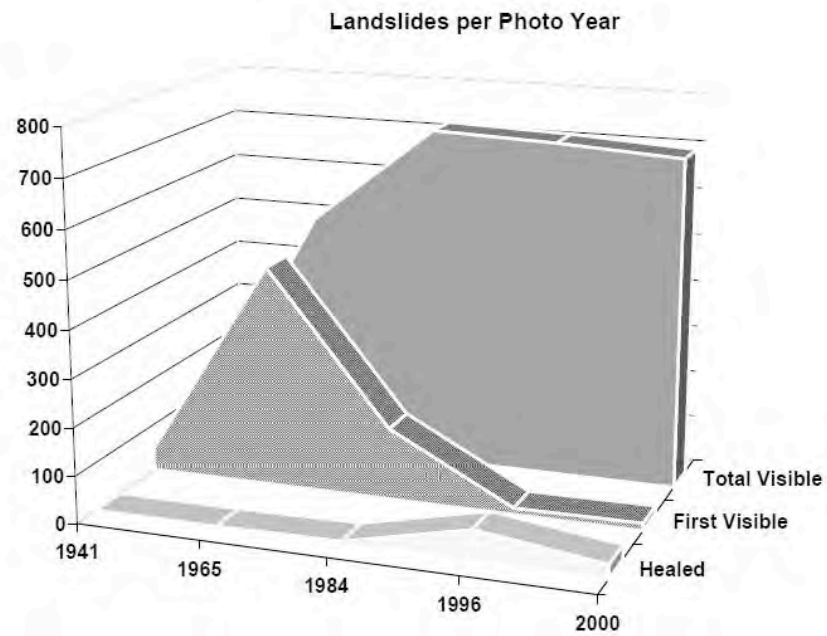


Figure 3.8 Total number of landslides per photo year analyzed in the Rainbow Ridge, Squaw Creek, Bridge Creek, Dry Creek, and Cow Pasture Opening planning watersheds combined.

Final Estimates of Sediment Yield for New Harvest Areas

The TMDL sediment budget includes mass wasting events observed on the 1984 aerial photographs, which appear to be the vast majority of landslides accounted for the in 1984-2002 sediment budget period (see Figure 3.8). The landslides observed on the 1984 photo set likely originated from harvests conducted during the 1970-1984 time period. Very few additional landslides were detected in the 1996 and 2000 aerial photo sets indicating that the landslide rate originating from the 1970's era harvest has declined dramatically. And since landslides observed in the 1984 photo set constituted the majority of sediment yield for the category of harvest related sediment yield in the TMDL, we will assume that total sediment yield for legacy harvest will decline significantly over the next 50 years as well.

Table D-2
Sediment Yield Values for New Harvest Areas
(Tons/acre/year)

General Category	Sediment Budget Item	TMDL Subbasin			
		North	East	South	West
Natural	Natural Mass Wasting	5.78	2.50	2.50	3.28
	Stream Bank Erosion	1.23	0.42	0.27	0.56
Legacy Harvest	Other Harvest Related Delivery	0.14	0.16	0.18	0.20
	Skid Trail Related Erosion	0.14	0.03	0.04	0.35
New Harvest*	New Harvest- Selection	3.30	1.50	3.00	8.90
	New Harvest- Clear Cut	6.60	3.00	6.00	17.80
Upgraded Roads	Road Related Gullying	0.02	0.03	0.05	0.03
	Road Related Mass Wasting	0.63	1.84	0.14	0.66
	Road Related Surface Erosion	0.06	0.10	0.12	0.09
	Road Stream Crossing Failures	0.01	0.01	0.03	0.01
New Roads (tons/linear mile)	Road Related Gullying	3.33	3.17	3.19	3.23
	Road Related Mass Wasting	133.33	196.67	9.89	67.74
	Road Related Surface Erosion	12.00	11.17	8.57	9.03
	Road Stream Crossing Failures	1.67	0.67	1.76	0.65

Given that the TMDL analysis reported evidence of ongoing erosion from the legacy harvested areas we will not assume that sediment yield will decline as rapidly as for future timber harvests (see above). In the cumulative watershed impacts analysis for sediment yield we will assume that, in the absence of active treatment of legacy sediment sources, a conservative estimate of the rate of decline in sediment yield from timber harvests conducted in the 1970-1990 time period is 75% over the next 50 years.

As with the discussion above regarding sediment yield from future timber harvest, our assumption that sediment yield from legacy harvest will decline dramatically over the next 50 years does not mean that the impacts of the sediment that has already been delivered to the channels will decline at the same rate. Hillslope sediment yield from legacy harvests is likely to decline dramatically over the next 50 years, however in-stream stored sediment from these historic sediment delivery episodes may take decades to centuries to move through the channel network.

Sensitivity Analysis

The North_1 sub basin (34,414 acres) will be used as the subject of a sensitivity analysis of the hybrid modeling approach used to predict sediment yield due to timber harvest in this PTEIR analysis. The North_1 sub basin was selected for the following reasons:

1. It has abundant, recent and intensive timber harvest and road upgrading activity,
2. It is amongst the least stable areas geologically within the Mattole watershed,
3. There are two recent independent sediment budgets for this sub basin, and;
4. Future timber harvest is projected to be high within the Mattole Forest Futures Program.

The base scenario used for this sensitivity analysis was Mattole Forest Futures Program projected harvest using data and assumptions contained in the Mattole TMDL as described above. The sensitivity analysis will be used to explore the assumptions inherent in this base scenario. The following questions will be tested using the sensitivity analysis:

1. What is the effect of the Mattole Forest Futures Program on the net sediment budget from management related sources using TMDL data and assumptions (base scenario)?
2. What if road upgrading and treating legacy harvest related sediment sources was 20% less effective than estimated in the TMDL (-20%)?
3. What if future harvest related sediment yields were 20% higher than those estimated in Table 4 (+20%)?
4. What if 50% of new harvests constructed maximum road extent (1,000 ft.) rather than 25%?
5. What if the silviculture used in the Program were clear-cut rather than selection?

The metric used to evaluate the various scenarios in the sensitivity analysis was net sediment yield due to management activities expressed in tons/50 years/subbasin. In order to gain some context the net sediment values were also expressed as a percentage natural sediment yield for the basin, based on TMDL values (NCRWQCB 2002).

Answers to the sensitivity analysis questions:

Table D-7 Sensitivity Analysis of Modeling Assumptions for North 1 Subbasin Proposed Program						
	Sediment Production (tons/50 years)		**Sediment Savings (tons/50 years)**		**Net Effect (tons/50 years)**	**Change as % of Natural Erosion Total (tons/50 years)**
Scenario	New Harvest	New Roads	Fix Legacy Harvest Sources	Upgrade Roads	All Harvest and Roads	12,098,250
Proposed Program	516,767	18,428	(286,244)	(583,146)	(334,195)	-2.76%
Roads Upgrades and Legacy Harvest -20%	516,767	36,204	(203,655)	(410,247)	(60,931)	-0.50%
Future Harvest +20%	620,120	17,128	(266,300)	(542,502)	(171,554)	-1.42%
Roads and Legacy -20% and New Harvest +20%	620,120	36,204	(203,655)	(410,247)	42,422	0.35%
New Roads 50% of plans	516,767	34,256	(266,300)	(542,502)	(257,779)	-1.16%
Program Footprint with Clear Cuts	408,095	18,424	(286,244)	(583,146)	(442,871)	-3.66%

* Sediment yield from Natural Erosion (Natural Mass Wasting and Stream Bank Erosion) for the North subbasin was estimated at 4,500 tons/mi^2/year X 53.8 mi^2 X 50 years = 12,098,250 tons

Sediment Yield data was estimated for the 1984-2002 time period in the Mattole TMDL (NCRWQCB 2002), all values were assumed to be constant for the next 50 years for the calculations shown above.

Sensitivity Analysis Results

According to the modeled results based on TMDL data and assumptions, the Proposed Program results in a net decrease in sediment yield over a 50-year time frame. Essentially fixing bad roads and legacy harvest related sediment sources 'saves' more sediment than new harvest produces. If the assumptions in the TMDL regarding the effectiveness of road upgrades and fixing legacy sediment sources were low by 20%, the net effect would still be a decrease in sediment yield. Similarly, if the assumptions contained in the TMDL regarding the sediment yield from future timber harvest underestimate future sediment yield by 20%, the net effect would still be a decrease in sediment yield. It would be necessary for the assumptions in the TMDL to be off by 20% in both directions for new harvest to have a net positive effect on sediment yield.

Due to the high density of existing roads in the Mattole our best estimate was that only 25% of landowners filing PTHPs would opt to construct 1,000 feet of road. Even if this estimate was doubled to 50% of landowners, the net effect of the Program would still be a decrease in sediment yield.

Finally, the impacts of silvicultural choice were explored. The Program requires the use of uneven-aged, Selection style silviculture. After initial harvest Selection silviculture was expected to produce about half as much sediment as if Clear-Cut style silviculture were employed (see above for discussion of DI values). However, Selection silviculture requires re-entry about every 10-20 years, whereas Clear-Cut silviculture typically ranges from 50-80 years between re-entries. Thus, if each silviculture type were practiced on the same 4,307 acre 'footprint', the model results indicate that over the 50 year analytical period the sediment yield reductions due to road upgrading were the same while the increases in sediment yield due new harvest were greater for selection because of the re-entries required to practice selection silviculture.

A fundamental weakness of the comparison of silviculture types is the lack of data from experimental watersheds on the impacts modern selection silviculture on sediment yield. The 'modern' logging implemented in the North Fork of Caspar Creek only included clearcutting (except for higher retention in the buffers) (Ziemer 1998). The assumption that canopy cover is approximately linearly related to changes in hydrology and sediment yield is what has given rise to the use of Disturbance Index and Equivalent Clearcut Area coefficients like those used in this analysis and contained in PALCO (2004) and Menning (1996). Given this assumption, it may be reasonable to assume that sediment yields from the type of selection silviculture prescribed in the Program are in fact only 20-30% of those of clear-cutting rather than the 50% assumed for this analysis. The reason the lower sediment yield values may be more accurate is that average canopy cover across PTHP harvest areas will not be less than 70% in most cases.

Assumptions for Alternatives

All even-aged acres harvested are first entries (Alt 1 and 2), with associated road upgrading and new road construction. Off program harvests (Alt 1) assume that 50% of landowners install 1,000 of road per harvest rather than the 25% assumed for Program harvests and Alts II and III.

Alternative II which has bigger buffers and more restricted MW avoidance also has all silvicultural options in the FPRs available so we assumed 30% install even-aged harvest and 70% go uneven-aged; which is the same assumption as the Status Quo based on harvest history.

Road upgrades for Program and non-Program harvests are assumed to meet the 85-90% sediment yield reduction targets described in the TMDL because the regulations governing both are very similar. Program harvests are subject to the Waiver requirements (NCRWQCB 2008) and status-quo harvests are subject to the GWDR requirements- and both are subject to the Anadromous Salmonid Protection Rules (ASP Rules) described in the Forest Practice Act. All harvests (Program and non-Program) are required to produce an inventory of controllable sediment sources and a timeline for fixing them for every acre harvested and the appurtenant road network. It is possible that non-Program road upgrade and legacy sediment source treatments would be less effective than Program related road upgrades, but there is no data to test this assumption. For an estimate of what the potential impacts would be see the "Sensitivity Analysis" section in Appendix D, where an estimate of road upgrades being 20% less effective is analyzed.

References For Water Quality/Quantity Section and Appendix D

Bedrossian, T.L. and K. Custis. 2002. Review of July 2002 EPA Analysis of Impacts of Timberland Management on Water Quality. Memorandum dated November 22, 2002 and sent to Mr. Ross Johnson, California Department of Forestry and Fire Protection. California Geological Survey. Sacramento, CA. 23 p.

Beschta, R.L. et.al. 1995. Cumulative Impacts of Forest Practices in Oregon: Literature and Synthesis. Prepared for the Oregon Department of Forestry. Salem, Oregon.

Cafferata, P. and J. Munn. 2006. Modified Completion Report Monitoring Program. Monitoring Study Group California State Board of Forestry and Fire Protection, Sacramento California.

Cafferata, P. and T. Spittler. 1998. Logging impacts of the 1970's vs. the 1990's in the Caspar Creek Watershed. USDA Forest Service Gen. Tech. Rep. PSW-GTR-168.

CalFire. 2007. RECIRCULATED DRAFT Environmental Impact Report for the Draft Jackson Demonstration State Forest Management Plan Alternative G. Prepared by the California Department of Forestry and Fire Protection, Sacramento, CA.

Elliot, W.J. and S. Miller. 2002. Estimating Erosion Impacts from Implementing the National Fire Plan. ASAE Meeting Paper No. 02-5011. St. Joseph, Michigan: ASAE.

Grant, Gordon E.; Lewis, Sarah L.; Swanson, Frederick J.; Cissel, John H.; McDonnell, Jeffrey J. 2008. Impacts of forest practices on peak flows and consequent channel response: a state-of-science report for western Oregon and Washington. Gen. Tech. Rep. PNW-GTR-760. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 76 p.

Grant, G.E. and A.L. Wolff. 1991. Long-Term Patterns of Sediment Transport After Timber Harvest, Western Cascade Mountains, Oregon, USA. Sediment and Stream Water Quality in a Changing Environment: Trends and Explanation. Proceedings of the Vienna Symposium, August 1991, IAHS Publ. No. 203, 1991.

Grant, G., W. Megahan, and R. Thomas. 1999. A re-evaluation of peak flows: do forest roads and harvesting cause floods? Paper presented at the 1999 NCASI West Coast Regional Meeting, Portland, OR. National Council for Air and Stream Improvement. P. 5

Gucinski, H., M.J. Furniss, R.R. Ziemer, M.H. Brookes. 2001. Forest roads: A synthesis of scientific information. Gen. Tech. Rep. PNW-GTR-509. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 103 p.

Hatchet, B., M. Grismer and M. Hogan. 2004. Impacts of Mechanical Mastication on Soil Compaction and Runoff in the Lake Tahoe Basin. Integrated Environmental Restoration Services, Inc.

Hope, D. 2008. Personal Communication at Mattole Restoration Council Technical Advisory Committee Meeting. Eureka, California.

Keppeler, E.T., J. Lewis, and T.E. Lisle. 2003. Impacts of forest management on streamflow, sediment yield, and erosion, Caspar Creek Experimental Watersheds. In: Renard, Kenneth G.; McElroy, Stephen A.; Gburek, William J.; Canfield, H. Evan; Scott, Russell L., eds. First Interagency Conference on Research in the Watersheds, October 27-30, 2003. U.S. Department of Agriculture, Agricultural Research Service; 77-82. Available at: http://www.fs.fed.us/psw/publications/keppeler/Keppeler_Lewis_Lisle_ICRW.pdf

Klein, R.D, W.J. Trush and M. Buffleben. 2008. Watershed condition, turbidity, and implications for anadromous salmonids in the north coatal California streams. Report to North Coast Regional Water Quality Control Board, Santa Rosa, CA.

Larson, K.R. and R.C. Sidle. 1980. Erosion and sedimentation data catalog of the Pacific Northwest. *In* R6-WM-050-1981. USDA Forest Service Pacific Northwest Region. Portland, Oregon 64.p

Lewis, J. (1998). Evaluating the impacts of logging activities on erosion and suspended sediment transport in the Caspar Creek watersheds. Conference on coastal watersheds: the Caspar Creek Story, Albany, CA, Pacific Southwest Research Station.

MacDonald, L.H., D. Coe and S. Litschert. 2004. Assessing cumulative watershed impacts in the central Sierra Nevada: Hillslope measurements and catchment scale modeling. USDA Forest Service General Technical Report. PSW-GTR-193

MacDonald, L.H. and J.D. Stednick. 2003. Forests and Water: a state-of-the-art review for Colorado. Colorado Water Resources Research Institute Rep. No. 196, Fort Collins, CO: Colorado State University, 65 p.
Martin, D. 2009. Forest Road Runoff Disconnection Survey of Private Timberlands inWashington. *Unpublished report.* Washington Forest Protection Association 724 Columbia Street NW, Suite 250 Olympia, WA.

Mattole Restoration Council. 2001. Report to the California Department of Forestry (CDF) Digitization of Forest Harvest History maps from Elements of Recovery. Petrolia, California.

Mattole River and Range Partnership. 2010. Draft Mattole Coho Recovery Strategy. Petrolia, California.

McGurk, B.J. and D.R. Fong. 1995. Equivalent Roaded Area as a measure of cumulative effect of logging. Environmental Management, 19(4), 609-621

Megahan, W.F., J.G. King. 2004. Erosion, sedimentation and cumulative impacts in the Northern Rocky Mountains, In: Ice, G.G., J.D. Stednick (eds.) A Century of Forest and Widland Watershed Lessons. Bethesda, MD: Society of American Foresters, Chapter 9, 201-222

Menning, K.M., D.C. Erman, K.N. Johnson and J. Sessions. 1996. Modeling aquatic and riparian systems, assessing cumulative watershed impacts and limiting watershed disturbance. Sierra Nevada Ecosystem Project: Final report to Congress, Addendum. Davis: University of California, Centers for Water and Wildland Resources. pp. 33-50

Moser, E. 2007. Personal Communication. USFS Hydrologist TEAMS member, Oregon.

Mount, J. 1995. California rivers and streams: the conflict between fluvial process and land use. Berkeley: University of California Press.

Murphy, M.L. 1995. Forestry impacts on freshwater habitat of anadromous salmonids in the Pacific Northwest and Alaska- requirements for protection and restoration. Decision Analysis Series No. 7. National Oceanographic and Atmospheric Administration. Silver Springs, MD.

North Coast Regional Water Quality Control Board. 2002. Mattole River watershed Technical Support Document for Sediment and Temperature. North Coast Regional Water Quality Control Board, Santa Rosa, California.

North Coast Regional Water Quality Control Board. 2009. Order No. R1-2009-0038 Categorical Waiver of Waste Discharge Requirements For Discharges Related to Timber Harvest Activities on Non-Federal Lands in the North Coast Region.

Pacific Lumber Company (PALCO). 2004. Report of Waste Discharge Elk River. *Submitted to the North Coast Regional Water Quality Control Board.* Scotia, California.

Pacific Watershed Associates. 1998. Sediment Source Investigation and Sediment Reduction Plan for the Bear Creek Watershed, Humboldt County, California. prepared for the Pacific Lumber Company Scotia, California. Pacific Watershed Associates, Arcata, California. April, 1998.

O'Louglin, C.L. 1974. A study of tree root strength deterioration following clearfelling. Canadian Journal of Forest Research. 4:107-113

Reid, L.M. and T. Dunne, 1996. Rapid evaluation of sediment budgets. Reiskirchen: Germany, Catena Verlag (GeoEcology paperback). 164 p.

Reid, L.M. 2010. Understanding and evaluating cumulative watershed impacts. Pgs. 277-298 in: W.J. Elliot, and L.J. Audin (editors), CWE for fuels management in the Western U.S. USDA Forest Service RMRS-GTR-231. Available online at: http://www.fs.fed.us/rm/pubs/rmrs_gtr231/rmrs_gtr231_277_298.pdf

Regional Water Quality Control Board. 2001. ACTION PLAN FOR THE GARCIA RIVER WATERSHED SEDIMENT TMDL. http://www.swrcb.ca.gov/northcoast/water_issues/programs/tmdls/garcia_river/

Rice and Lewis. 1991. Estimating Erosion Risks Associated with Logging and Forest Roads in Northwestern California. Water Resources Bulletin vol. 27 no. 5. American Water Resources Association.

Robichaud, P.R., L.H. MacDonald and R.B. Foltz. 2007. Fuel Management and Erosion. Cumulative Watershed Impacts of Fuels Management: A Western Synthesis. RMRS….

Robichaud, P.R., J.L. Beyers and D.G. Neary. 2000. Evaluating the effectiveness of post fire rehabilitation treatments. USDA Forest Service General Technical Report. RMRS-GTR-63

Robison, E.G., K. Mills, J.T. Paul, L. Dent, and A. Skaugset. 1999. Oregon Department of Forestry 1996 Storm Impacts Monitoring Project: Final Report. Forest Practices Technical Report # 4. Oregon Department of Forestry, Salem, Oregon. 141 pp.

Simpson, G. 2006. Mattole River Watershed Analysis Mass, Wasting Assessment, Signatory Review Team Draft Report. SHN Consulting Engineers and Geologists, Eureka California.

Spence, B.C., G.A. Lomnicky, R.M. Huges, and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. Mantech Environmental Research Services Corp., Corvallis, OR.

Stednick, J.D. 1996. Monitoring the impacts of timber harvest on annual water yield. Journal of Hydrology. Vol. 176(79-95)

Stillwater Sciences. 2007. Landslide hazard in the Elk River Basin, Humboldt County, California. Prepared for the North Coast Regional Water Quality Control Board by Stillwater Science, Arcata, California.

Tiedemann, A. R., and D. A. Higgins. 1989. Impacts of management strategies on water resources. In: T. M. Quigley, H. R. Sanderson, and A. R. Tiedemann, Managing interior Northwest rangelands: The Oregon Range Evaluation Project. USDA Forest Serv. Gen. Tech. Rep. PNW-GTR-238. p. 56-91.

USDA Forest Service. 1988. Chapter 20 – Cumulative Off-Site Watershed Impacts Analysis. Soil and Water Conservation Handbook. USDA Forest Service Region 5

USDA and USDI. 1994. Record of decision for amendments to forest service and bureau of land management planning documents within the range of the northern spotted owl. April 1994.

USDA Forest Service. 2003. Herger-Feinstein Quincy Library Group Final Supplemental Environmental Impact Statement. USDA Forest Service, Plumas National Forest. Quincy, California

USDA Forest Service. 2005. Final Supplemental Environmental Impact Statement: Empire Fuels Management Project. USDA Forest Service, Plumas National Forest. Quincy, California

USDA Forest Service. 2007. Environmental Assessment, North Fork of the San Jacinto Healthy Forest Project. San Jacinto Ranger District, San Bernadino National Forest. Riverside County, California.

US Environmental Protection Agency. 2007. Mad River Total Maximum Daily Loads for Sediment and Turbidity. US Environmental Protection Agency, Region IX. San Francisco, California.

US EPA. 1993. Grazing Management Measures, section E. *in* Guidance specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. EPA 840-B-92-002, January 1993.

Welsh, H.H., G.R. Hodgson and N.E. Karraker. Influences of the vegetation mosaic on riparian and stream environments in a mixed forest-grassland landscape in “Mediterranean” northwestern California.

Appendix E: Mattole Planning Documents

1. Upper Mattole Fire Plan, 2004 – prepared by Mattole Restoration Council and ForEverGreen Forestry Consultants

The Upper Mattole Fire Plan was drafted in 2004 and contains guidance regarding PRC 4291 on fire safe clearing distances and on SB 1369 requirements which require that land owners obtain a certificate of compliance from a local building official in order to obtain homeowner's insurance when the structure is located in very high fire hazard locations (as determined by CAL FIRE and FRAP). In addition, the Fire Plan contains a map of the local CAL FIRE protection districts, a list of priority projects including creation of defensible space around structures and creation of shaded fuel breaks, increasing water supply/storage for fire fighting purposes, education and continued community meetings. The Plan also contains a map of existing shaded fuel breaks.

2. Lower Mattole Fire Plan, 2002– prepared by Mattole Restoration Council

The Lower Mattole Fire Plan was drafted in 2002 (before the requirements of SB 1369) and contains guidance regarding PRC 4291 fire safe clearances among other suggestions. A list of priorities for the area includes 1) increasing water supply, 2) fuels reduction, 3) education, and 4) continued neighborhood meetings.

3. Humboldt County Master Fire Protection Plan (MFPP), 2006 – prepared by Humboldt Fire Safe Council.

On August 16, 2006, the Humboldt County Board of Supervisors approved the Humboldt County Master Fire Protection Plan and certified that it met the requirements for a Community Wildfire Protection Plan (CWPP). The MFPP is intended to serve as the guiding document for reducing the risk of fire to Humboldt County communities. Policy recommendations from the MFPP will supplement the Natural Resources and Hazards Report that supports the preparation of the Humboldt County General Plan, thus influencing future development patterns. Additionally, the MFPP is designed to meet Healthy Forest Restoration Act criteria for Community Wildfire Protection Plans (CWPP) by engaging in a collaborative process, prioritizing fuel reduction activities, and recommending treatments for reducing structural ignitability, by

- Incorporating wildland fire safety measures, fire hazard mitigations, accessible roads data, emergency water supply locations, flammable vegetation clearance for defensible space techniques, and other fire safety techniques, into local community planning
- Updating Humboldt County Fire Safe Standards to identify specific hazard zones and improve fire safe measures

A high priority finding and recommendation applicable to the Mattole is the recommendation on risk reduction to, "*Develop a biomass utilization program to develop commercially-viable*

markets for fuel reduction project wood byproducts and residue such as slash, small diameter logs, foliage, wood chips, etc."

4. Humboldt County General Plan Update – 2008 – prepared by Humboldt County Planning Department

A draft of the Humboldt County General Plan Update was provided to the Humboldt County Planning Commission on 11/20/08. Within the 331-page plan are proposed policies regarding forest land use in the Natural Resource Element of the Plan and fire hazard mitigation in the Safety Element of the plan. Several policies in the Safety Element are applicable in the Mattole including:

- Subdivisions within SRA high and very high fire severity classification areas shall explicitly consider designs and layout to reduce the risks of fire and improve defensibility; for example, through clustering of lots in defensible areas.
- Proposed development within SRA high and very high fire severity classification areas shall be serviced by adequate water supplies for fire protection consistent with state or local CAL FIRE protection agency requirements.
- Development shall conform to Humboldt County SRA Fire Safe Regulations.
- Encourage the use of prescribed burning as a management tool for hazardous fuels reduction, timber management purposes, livestock production, and enhancement of wildlife habitat

Several policies in the Natural Resources Element are applicable in the Mattole including:

- Defer to CAL FIRE on timber harvest reviews; comment only where county land-use patterns have significantly contributed to use conflicts at issue and where the County can assist in dispute resolution.
- Support fewer, more effective and lower cost timber management regulations as a strategy to maintain timber production as the primary use of forestlands. Coordinate county policies so they are compatible with the State Forest Practice Act and State Forest Practice Rules.
- Parcels of Timber Site Quality III or higher shall be planned to maintain timber production as the primary use.
- Require continued viability of timber production on TPZ zoned parcels containing residences by mitigating the impacts of residences on timber harvesting, water resources, biological resources, wildland fire potential and public services.
- The County shall provide incentives to maintain large-scale land ownerships for commercial timber production.

5. Humboldt Del Norte Fire Plan, 2005 – prepared by CAL FIRE

The Humboldt Del Norte Fire Plan contains a list of the communities at risk within the Unit Plan boundaries which includes the Mattole watershed communities of Petrolia, Ettersburg, Honeydew, Briceland and Whitethorn. In addition, the plan describes completed fuel reduction projects within the Unit including the Mattole Valley/Prosper Ridge/Wilder Ridge

fuel break, which was completed in 2003. The Unit Plan indicates several projects in Southern Humboldt were planned for 2004-2006 but withdrawn for various reasons.

6. Resource Management Plan for the King Range Resource Area, 2005, prepared by USDI Bureau of Land Management (hereafter KRNCA) USDI BLM, 2005.

The King Range Conservation Area Resource Management Plan Record of Decision (ROD) was signed on May 17, 2005, which approved management standards and guidelines for about 62,000 acres of BLM lands within the King Range and for grazing and campground use at a limited number of acres outside of the King Range. A large portion of the King Range Conservation Area lands lies within the Mattole Watershed. Although this PTEIR affects only the management of private lands, the management of KRNCA holdings in the Mattole affects the foreseeable cumulative effects of timber harvest elsewhere in the watershed. The KRNCA standards and objectives include:

- Maintain and restore habitat necessary to support healthy riparian, aquatic and wetland ecosystems. This ROD clarifies that watershed restoration activities will be focused on Mattole River tributaries containing federally listed species and critical habitat (coho and Chinook salmon and steelhead trout). Restoration activities in other watersheds are not precluded by the RMP, but will not be the management focus.
- Establish sufficient northern spotted owl habitat to support 20 breeding pairs within the King Range NCA.
- Manage migratory bird, herpetofauna, and game species habitat to host natural population levels of these species.
- Manage vegetation types to produce a mosaic of plant communities that existed prior to the era of mechanized logging and exclusion of fire regimes in the region (approximately 1945).
- Maintain and develop forest vegetation based on historical conditions prior to 1945 (approximately 60 percent late successional, 20 percent mid mature, and 20 percent early successional stands).
- Maintain undisturbed late-successional forest habitat by keeping those stands intact.
- Backcountry Zone: Manage fuels to allow various intensity wildfires and to create a landscape resistant to damages associated with large high intensity wildfires.
- Front country and Residential Zones: Use prescribed fire and mechanical fuel reduction to reduce potential for high intensity fires.
- Develop a shaded fuel break system to provide a defensible perimeter around the Backcountry Zone and minimize the need for construction of bulldozer lines during fire events.

7. Mattole River Watershed Assessment Report, 2003. North Coast Watershed Assessment Program, 441 p. plus Appendices, prepared by California Resources Agency, and California Environmental Protection Agency, Sacramento, California.

The North Coast Watershed Assessment Program's (NCWAP, 2002) Mattole River Watershed Assessment Report was an interagency effort between the California Resources Agency and Cal EPA, established to provide a consistent body of information on North Coast

watersheds (in this case the Mattole) for use by landowners, stakeholders, and collaborative watershed groups. The Assessment was completed in March of 2003.

Each of the NCWAP's participating departments developed data collection and analysis methods used in their basin assessments. This information provided guidance for developing restoration, management, and conservation recommendations. Of the five participating agencies:

- CDFG compiled, developed, and analyzed data related to anadromous fisheries habitat and populations.
- CAL FIRE compiled, developed, and analyzed data related to historical land use changes in the watersheds. It also led preparation of reports that synthesize information, findings, and recommendations, and developed a framework for assessing cumulative impacts.
- DOC/California Geologic Service (CGS) compiled, developed, and analyzed data related to the production and transport of sediment. Tasks included baseline mapping of landslides, landslide potential, and instream sediment, as well as an analysis of stream geomorphology and sediment transport.
- NCRWQCB compiled, collected, and analyzed water quality data for the assessment. The assessment included comparison of recently collected and past available information comprised predominately of a robust water temperature data set, and some limited sediment data.
- DWR installed and maintained stream monitoring gages where needed to develop and analyze stream flow information.

The Mattole Assessment reached conclusions about a number of issues including the following, which relate directly to the proposed program described in this PTEIR:

- Land use, including road construction and use, timber harvesting, and grazing, have added excess sediment to the fluvial system. Many of the effects from these activities are spatially and temporally removed from their upland sources. Excess sediment remains in the Mattole mainstem despite decades of low timber harvesting activity;
- Currently, roads are a major land use contributor of sediment (CAL FIRE, 2002). Large storms or other catastrophic events combined with poor road location and construction practices have the potential to deliver large and adverse amounts of sediment into stream systems;
- Large woody debris recruitment potential is limited by the low percentage of near-stream forest stands containing trees in large diameter classes;

Based on available information for the Mattole Basin, the NCWAP team found that salmonid populations are currently being limited by:

- Impacted estuarine conditions;
- General basin-wide lack of habitat complexity;
- High instream sediment levels;
- High summer water temperatures;
- Reduced basin-wide coho and Chinook meta-populations.

The Assessment Team made the following recommendations, which apply basin-wide:

- Reduce sediment deposition to the estuary by supporting a basin-wide road and erosion assessment/control program such as the Mattole Restoration Council's Good Roads Clear Creeks effort. Continue to conduct and implement road and erosion assessments such as the ongoing efforts in the Dry and Westlund planning watersheds in the Eastern Subbasin. Expand road assessment efforts because of the potential for further sediment delivery from active and abandoned roads, many of which are in close proximity to stream channels, especially in the Bridge and Thompson planning watersheds in the Southern Subbasin;
- Consider the nature and extent of naturally occurring unstable geologic terrain, landslides and landslide potential (especially Categories 4 and 5, page 89) when planning potential projects in the subbasin;
- At stream bank erosion sites, encourage cooperative efforts to reduce sediment yield to streams. CGS mapping indicates eroding banks are not a significant basin wide issue, but may be of localized importance. They occur in isolated, relatively short reaches distributed throughout the Mattole Basin;
- Based on the high incidence of unstable slopes in the Northern Subbasin, any future sub-division development proposals should be based on an existing county-imposed forty acre minimum parcel sub-division ordinances;
- Encourage the use of appropriate Best Management Practices for all land use and development activities to minimize erosion and sediment delivery to streams. For example, low impact yarding systems should be used in timber harvest operations on steep and unstable slopes to reduce soil compaction, surface disturbance, and resultant sediment yield.
- Where current canopy is inadequate and site conditions, including geology, are appropriate, initiate tree planting and other vegetation management to hasten the development of denser and more extensive riparian canopy, especially in the Northern Subbasin;
- Landowners and managers in the Northern and Western subbasins should work to add more large organic debris and shelter structures to streams in order to improve channel structure, channel function, habitat complexity, and habitat diversity for salmonids;
- Ensure that stream reaches with high quality habitat in the Mattole Basin are protected from degradation. This is especially important in the Southern Subbasin. The best stream conditions as evaluated by the stream reach EMDS (Ecological Management Decision Support tool, NCWAP 2002) were found in the South Fork of Vanauken Creek, Mill Creek - at Mattole river-mile 56.2 (RM 56.2), Stanley Creek, Thompson Creek, Yew Creek, and Lost Man Creek Tributary in the Southern Subbasin, and in Harrow Creek in the Eastern Subbasin. Refugia investigation criteria, which include biological parameters, indicated Bear Creek was the best stream evaluated in the Mattole Basin.

8. Mattole Watershed Plan Landscape Conservation Strategy by Eric Goldsmith, Sanctuary Forest, 2/4/05.

This plan, which is a portion of a larger document, describes priorities for conserving each of the subbasins, generally from a fisheries and old growth habitat standpoint. Priorities for each of the subbasins include:

- Estuary subbasin – protecting and enhancing salmonid fisheries
- Northern subbasin – protect remaining old-growth forests, 2) protection of salmonid refugia in priority tributary subbasins; 3) maintaining ranchland; 4) protecting native grasslands; and 5) conserving open space.
- Eastern subbasin - 1) protection of remaining unconserved old-growth forests; 2) protection of salmonid refugia in priority tributary sub -basins; 3) enhancing conservation connectivity and open space; and 4) maintaining ranchland.
- Southern subbasin - 1) maintaining summertime flows, with particular attention to the relationship of river flows to subdivision and rural residential development; 2) maintaining or enhancing connectivity of high quality fisheries habitat; 3) maintaining or enhancing connectivity of habitat for wide-ranging species, by connecting with SWSP and KRNCA; and 4) maintaining or enhancing the scenic road corridor.
- Western subbasin - protecting salmonid refugia, especially in coho streams; 2) protecting old-growth forest habitat; 3) enhancing connectivity within high-quality refugia tributaries, and externally with the Redwoods to the Sea Corridor and the Upper Mattole River and Forest Cooperative; and 4) conserving ranchlands.

9. Upper Mattole River and Forest Cooperative Coordinated Resource Management Plan, prepared by Sanctuary Forest, 4/27/06.

The Upper Mattole River and Forest Cooperative was created in 1999 through signing an MOU between Sanctuary Forest, Save the Redwoods League, Restoration Forestry, California State Parks, California Coastal Conservancy, CA Departments of Forestry and Fire Protection and Fish and Game, and the USDI Bureau of Land Management. The purpose of the MOU is to coordinate management of conserved lands in the Mattole headwaters as old growth forest and salmonid refugia across ownerships. The parties to the MOU own approximately 5,277 acres and there is an additional 713 acres that are conserved by cooperating landowners including Redwoods Monastery and the Northcoast Regional Land Trust.

The primary forestry goals for these lands are shown below. Projects to be implemented to achieve these goals include thinning to promote late seral characteristics, monitoring the spread of sudden oak death (SOD), implementing the Upper Mattole Fire Plan system of fuel breaks, and promoting a demonstration prescribed burning project.

- Protect ecological functioning of existing old-growth

- Promote development of old-growth forest characteristics.
- Restore native species diversity.
- Promote development of riparian shade
- Promote projects demonstrating ecologically compatible forestry practices.
- Promote projects supporting local capacity to produce sustainable forest products
- Protect surrounding communities from threat of wildfire
- Promote reintroduction of fire as an essential ecosystem element.

The primary watershed and fisheries goals for these lands include, 1) restoring, maintaining and enhancing the ecological health of watersheds, protecting and restoring native runs of coho, chinook and steelhead and maintaining and enhancing healthy water flows and high water quality to benefit aquatic species.

The primary wildlife habitat goals for these lands include; 1) protecting and restoring native biodiversity and sustaining natural processes, 2) protecting and conserving habitat of all rare, threatened and endangered species, 3) containing and removing non-native invasive species, and 4) promoting the abandonment of homesteads in important wildlife areas. Projects to implement these goals include updating wildlife surveys of sensitive species to determine current status, implement the Mattole Watershed Plan invasives species control projects and identify and designate critical wildlife habitat areas.

10. Foresight 2020: Mattole Integrated Coastal Watershed Management Plan, prepared by MRC, Mattole Salmon Group, and Sanctuary Forest, 8/31/09.

Since the late 1970s, local citizens have worked to remediate environmental damage in an attempt to restore the Mattole's salmon runs and forests. These efforts have coalesced into a team of three nonprofit conservation organizations which together lead watershed management and restoration in the Mattole, where there are no municipalities and limited government agency presence. The three nonprofits are the Mattole Restoration Council, Mattole Salmon Group, and Sanctuary Forest, together known as the Mattole River and Range Partnership (MRRP). Each organization takes responsibility for different aspects of watershed management and recovery, working closely with County, State and Federal government partners.

Foresight 2020 describes MRRP's plan for watershed restoration and water quality management in the Mattole between 2010 and 2020. It identifies eight specific goals to be achieved during the decade. These goals are approached through eight Key Management Areas, or program types. For each management area, the plan identifies a series of strategies, each of which lead to a number of specific tasks for implementation by the MRRP. Additionally, the Plan describes prioritization and monitoring approaches to enhance management and restoration actions. MRRP's ultimate goals for the Mattole are abundant, native salmon runs along with healthy, productive upslope ecosystems and sustainably integrated human communities.

This Plan builds upon previous Mattole watershed planning documents including the North Coast Watershed Assessment Program, Mattole Basin Plan and the 2005 Mattole Watershed

Plan, as well as broader planning documents such as the California Ocean Plan, North Coast Integrated Water Management Plan, and California's Sediment Master Plan.

Despite the relatively short time since the 2005 Plan, there were a number of reasons to create another. Based on feedback received on *Mattole Watershed Plan*, MRC identified several areas in need of further planning including monitoring, interim goal-setting, and coverage of recently developed or improved programs such as grassland restoration, working lands stewardship support, estuary restoration, riparian forestry, and stream flow enhancement.

Forestry management goals outlined in the plan that are relevant to this PTEIR are listed in section 3.4.4, and include:

- Conserve remaining old-growth and mature forests on the scattered industrial and private lands in the watershed.
- Promote the development of late successional forest characteristics in second growth forests.
- Reduce forest densities to improve forest health, reduce fire hazard, improve ecological resiliency to disturbance and pathogens, and improve habitat.
- Support the development of a light touch forestry and value added forest products industry.
- Improve forest practices throughout the watershed with the eventual goal of reducing clear cutting and herbicide use watershed wide.
- Promote carbon sequestration for Mattole landowners by pursuing relationships with groups such as California Climate Action Registry (CCAR).

According to the authors, "Implementing the actions described in this plan can be expected to accelerate the recovery of the Mattole watershed and protect its regionally important contributions to salmonid habitat and the conservation of California's biodiversity."

Appendix F:

Contents of a Sediment Prevention Plan (SPP) and Erosion Control Plan (ECP)

The following definitions and descriptions were taken directly from the document titled:

California Regional Water Quality Control Board
North Coast Region
ORDER NO. R1-2009-0038
Categorical Waiver of Waste Discharge Requirements
For
Discharges Related to Timber Harvest Activities
On Non-Federal Lands in the
North Coast Region

Sediment Prevention Plan -SPP

Definition:

"Sediment Prevention Plan" (SPP) means a plan designed and implemented to prevent and minimize the creation of new sites that discharge sediment to waters of the State. The Sediment plan is submitted by a discharger seeking coverage for a Project under Categorical Waiver F: Other Projects (THPs and Other Timber Harvesting Projects). The SPP must be developed by a qualified professional. The Sediment Prevention Plan (SPP) must include, but not be limited to, a map clearly showing the location(s) of the site(s) that could discharge sediment, and site-specific designs and/or management measures to prevent and minimize the discharge of sediment.

Description:

A Sediment Prevention Plan must be designed and implemented to prevent and minimize the discharge of sediment to waters of the State and submitted as part of a Project seeking coverage under the Categorical Waiver. A Sediment Prevention Plan differs from an Erosion Control Plan in that it is intended to prevent and minimize creation of *new* sources of sediment discharge from operations conducted under the current Project, while an ECP is intended to prevent and minimize sediment discharge from *existing* sources.

The Sediment Prevention Plan (SPP) shall be developed by a qualified professional. The Sediment Prevention Plan (SPP) shall include site specific measures that can reasonably be expected to prevent and minimize creation of new sediment discharge sources from proposed timber harvest activities. The sediment prevention plan must include a map clearly showing the location(s) of the site(s) where prevention and minimization measures described in the plan will be implemented.

Erosion Control Plan- ECP

Definition: "Erosion Control Plan" (ECP) means a plan designed and implemented to prevent and minimize the discharge of sediment from existing sites to waters of the state in violation of water quality requirements or other conditions of this Order and submitted with the Project seeking coverage under the Categorical Waiver E: Nonindustrial Timber Management Plans (NTMPs) and Categorical Waiver F: Other Projects (THPs and Other Timber Harvesting Projects). The Erosion Control Plan (ECP) must be developed by a qualified professional. The ECP must include but is not limited to, a map clearly showing the location(s) of the site(s) that could discharge sediment, site specific designs and/or management measures to prevent and minimize the discharge of sediment, and a time schedule for implementation of site specific designs and/or management measures. Specific instructions to complete an ECP are included in below (originally Appendix B of ORDER NO. R1-2009-0038).

Contents of an Erosion Control Plan (ECP)

An Erosion Control Plan, must be developed and implemented for timber harvesting, including the logging area, roads and skid trails used to access or haul timber harvesting materials that are owned by or under the control of the Discharger. The ECP must be designed to prevent and minimize the discharge or threatened discharge of sediment from existing Controllable Sediment Discharge Sources into waters of the state in violation of water quality requirements or other provisions of this Order. The Discharger must develop and submit an ECP for coverage under the Categorical Waiver E: Nonindustrial Timber Management Plans (NTMPs) and Categorical Waiver F: Other Projects (THPs and Other Timber Harvesting Projects) as follows:

CSDS are defined as sites or locations, within the Project area that meet all the following conditions:

1. is discharging or has the potential to discharge sediment to waters of the state in violation of water quality requirements or other provisions of these General WDRs,
2. was caused or affected by human activity, and
3. to the maximum extent practicable may feasibly and reasonably, respond to prevention and minimization management measures.

Controllable sediment discharge sources include, but are not limited to, failing or failed watercourse crossings, road failures, road surfaces, landslides, unstable features discharging to or near watercourses, unstable watercourse banks, soil stockpiles, storage of waste, skid trails, landings, exposed harvest units, or any other location discharging or threatening to discharge waste or earthen materials. The ECP shall be amended and revised, when necessary, to meet this standard. No Project may conduct activities that can reasonably be expected to create new sediment discharge sources where none previously existed.

The ECP may be included with the initial submittal of a project, in which case it can be reviewed concurrently with the project, or separately as part of the application for a Categorical Waiver.

Contents of an ECP

a) An Inventory and Treatment of Controllable Sediment Discharge Sources within the logging area.

The inventory must identify controllable sediment discharge sources and inform the development of a time schedule for implementation of prevention and minimization management measures. The inventory must include an on-the-ground survey and site evaluations, and may be Order No. R1-2009-0038 -30- Categorical Waiver augmented by additional information sources such as aerial photographs or previously prepared reports. Any method or model used to develop the inventory must be briefly described and must be reasonably expected to detect sediment discharge sources and to effectively prevent and minimize sediment discharge. The inventory must include:

i. A brief description of the method(s) used to conduct the inventory. This description provides the reviewer with an understanding of the thoroughness of the survey method and the likelihood that CSDSs have been identified. For example, the description identifies any aerial photographs used, and whether the Discharger inventoried all watercourses and skid trails,

ii. A description of each site, including sufficient information to provide the reviewer with an understanding of current conditions and why the site meets the definition of a CSDS,

iii. i. A topographic map, at a scale of 1:12000 or greater (e.g. 1:6000) with no greater than 80’ contours, showing the logging area and the location of all controllable sediment discharge sources included in the inventory,

iv. An estimate of the potential deliverable sediment volume for each inventoried site. The potential deliverable sediment volume represents an estimate of the maximum volume of sediment that could discharge to waters of the state in the event of complete failure of a site,

v. narrative description of the site-specific prevention and minimization management measure(s) prescribed for each controllable sediment discharge source identified in the inventory. Prevention and minimization management measures must be reasonably expected to effectively prevent and minimize specific sediment discharge sources in the logging area. The description must provide sufficient design and construction specifications, including but not limited to diagrams, minimum rock size, or performance standards as needed, to allow on site personnel to implement prevention and minimization measures as intended,

vi. Priority for implementation of prevention and minimization measures. The priority must be used to develop the time schedule for implementation and must be based on the potential impacts to the beneficial uses of water. The priority must consider at a minimum the estimate of the deliverable volume of sediment, the imminence of failure,

and the sensitivity of beneficial uses of water in receiving streams. In general, the highest priority is assigned to sites with large sediment discharge sources that show an imminent risk of failure and that will discharge to waters that support domestic water supplies or fish. Priority may be indicated as low, medium, or high,

vii. A time schedule for implementation of prevention and minimization management measures contained in the ECP that provides for timely implementation to prevent and minimize sediment discharge from sites in the order of priority. For THPs, implementation must be during the time an individual THP is active, or during the NTO covering the area in which a CSDS is located, unless an alternative time schedule is agreed to in writing by the Executive Officer. The schedule may specify a time range for implementation, for example the plan may state that a site shall be completed during the first two years of operations on the plan, as long as the schedule includes a final completion date. The time schedule for implementation may be revised as warranted by changed conditions if agreed to in writing by the Executive Officer.

b) Inspection Plan and Reporting Requirements

For each Project enrolled in Categorical Waivers E and F, Dischargers must follow the Inspection Plan detailed below for evaluating the implementation and effectiveness of the management measures in the Erosion Control Plan, to determine if any new controllable sediment discharge sources have developed within the Project area, and to ensure that all drainage facilities and erosion control structures are functioning properly in order to prevent sediment discharge to waters of the state.

The Inspection Plan must include a narrative discussion of the program to inspect and maintain all identified management measures designed to prevent and minimize sediment discharge throughout the duration of the Project. A site map that depicts the inspection locations to be visited before and after the winter period must be included in the Inspection Plan. Inspections must include, at a minimum, logging area roads that could discharge sediment, sites and locations addressed in the sediment prevention plan, and controllable sediment discharge sources contained in the ECP.

Each CSDS must be inspected during each required inspection. Additionally, inspectors should strive to inspect all accessible portions of the road system that have the potential to discharge sediment to watercourses to ensure roads are draining adequately and watercourse crossings are functioning properly and indentify any new CSDS sites that may have developed. Inspectors must note the conditions of CSDS sites and any failures or ineffectiveness of management measures.

Inspections conducted prior to the winter period must be designed to assure that management measures are properly installed and maintained. Post-winter period inspections must be designed to assure that the management measures have functioned adequately and to determine whether any new controllable sediment discharge sources have developed. Management measures must be evaluated for adequacy and proper implementation and

whether additional management measures are required in accordance with the terms of this Order.

Landowners and Qualified professionals must conduct all specified inspections of the Project site to identify areas causing or contributing to a violation of applicable water quality requirements or other provisions of the Categorical Waiver. The name(s) and contact number(s) of the assigned inspection personnel must be listed in the Inspection Plan.

The following inspection requirements begin once the startup of timber harvest activities begin within Project areas:

i. Inspections must be conducted as follows:
   - By November 15 to assure Project areas are secure for the winter; and
   - After April 1 and before June 15 to assess the effectiveness of management measures designed to address controllable sediment discharges and to determine if any new controllable sediment discharge sources have developed.
   - For THPs and other non-NTMP projects, inspections must be conducted each year according to the schedule specified above until the Project has been completed and the Discharger has submitted a Notice of Termination.

ii. Projects for which Timber Harvest Activities have not yet Commenced: No inspections are required.

iii. If any new controllable sediment discharge sources are identified during inspections, prevention and minimization measures must be implemented as soon as is feasible. New controllable sediment discharge sources shall be evaluated and addressed in accordance with the provisions described above, and included in a revised ECP. The revised ECP must be submitted to Regional Board staff with the annual summary inspection report.

iv. Equipment, materials, and workers must be available for rapid response to failures and emergencies, and implement, as feasible, emergency management measures depending upon field conditions and worker safety for access.

c) Reporting Requirements

Discharger must submit an inspection summary report to the Executive Officer by June 30th for each year of coverage under these Categorical Waivers and upon termination of coverage. The inspection summary report must include the following information, at a minimum:

- the date of each inspection,
- the inspector's name,
- the location of each inspection,
- the title and name of the person submitting the summary report,
- a brief narrative description of observed conditions,
- a description of any new controllable sediment discharge sources identified during inspections or throughout the course of routine timber harvest activities, a description of any corrective action taken to prevent and minimize sediment

discharge as a result of observations made during the inspections, as well as the date the corrective action was taken,

- a description of prevention and minimization measures contained in the ECP implemented up to the date of submission of the report, the date those measures were implemented, and an evaluation of the effectiveness of those measures,
- a description of where management measures have been ineffective and when the Discharger will implement repairs or design changes to correct management measure failures.

A final inspection summary report shall be submitted with the final Certification Notice.

Appendix G: EIR Preparers

Name	Organization	Education and qualifications	Years Experience	Chapters
Greg Blomstrom	Baldwin, Blomstrom, Wilkinson and Associates, Inc., Consulting Foresters, Arcata, Calif.	Registered Professional Forester (RPF). B.S., Forest Management, Humboldt State University	36 years, forestry and consulting forestry experience	Air Quality, Green House Gases, Geology and Soils, Noise, Population and Housing, Utilities, Transportation, Wildfire, modeling of feasibility and footprint
Jared Gerstein	Baldwin, Blomstrom, Wilkinson and Associates, Inc., Consulting Foresters	RPF. B.A. from UC Santa Cruz and an M.S. from Oregon State University	16 years forestry and consulting forestry experience	Aquatic Resources, Water Quality, Hazards and Hazardous Materials, GIS including available landbase
Paul Harper	Baldwin, Blomstrom, Wilkinson and Associates, Inc., Consulting Foresters	RPF. B.A. from Duke University and an M.S. from UC Berkeley	14 years forestry and consulting forestry experience	Vegetation, Timberland Resources, FVS modeling of prescriptions, volumes, GHG's and wildfire
Bill Wilkinson	Baldwin, Blomstrom, Wilkinson and Associates, Inc., Consulting Foresters	RPF. M.S. in Forest Resources from the University of Idaho and a B.S. in Forestry from the University of Tennessee	38 years forestry and consulting forestry experience	Cultural/Archaeological Resources, Visual/Aesthetics, Recreation, Wildlife
Gary Simpson	SHN Engineering, Eureka, Calif.	Registered Geologist, Certified Engineering Geologist. B.A. and M.S. in Geology from Humboldt State University	20 years experience in forestry-related geological analysis	Geologic Flow Chart