Chapter 12

Potential Impacts and Assessment of Take

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12 POTENTIAL IMPACTS AND ASSESSMENT OF TAKE

12.1 Introduction

Chapter 12 addresses 2 of the basic requirements of an HCP/NCCP, namely that

1. Landowners show what adverse impacts to covered species might result with implementation of their HCP/NCCP.
2. Landowners assess the *take*, i.e., the number of animals or plants that might be adversely impacted.

The Environmental Impact Study/Program Timberland Environmental Impact Report (EIS/PTEIR), prepared for the wildlife agencies with the assistance of Stillwater Sciences, will address a broader array of potential impacts by examining various alternatives to our HCP/NCCP, as required under NEPA and CEQA.

12.1.1 Covered activities

MRC recognizes that our covered activities, taken in total, will have a greater effect on ecosystems in the plan area than a single PTHP. However, our conservation measures, while targeted toward covered species and their habitat, indirectly benefit the ecosystems of which these species are a part. By protecting and recruiting wildlife trees, for example, we provide habitat for cavity nesters, as well as for bats that build maternity colonies in basal hollows. Protections for salmonids and their aquatic habitat produce benefits for aquatic insects and amphibians, even apart from the red-legged frogs and coastal tailed frogs covered by our HCP/NCCP.

The management goal of our HCP/NCCP is to grow and conserve a functional redwood forest that sustains native ecosystems. In some cases, a covered activity may alter occupied habitat and result in harm or death to an individual of a species. Such results, though possible, should be uncommon because (1) conservation measures limit certain activities (e.g., by setting up buffer areas) and (2) some species are rarely in harvest areas where impacts are likely (e.g., coastal tailed frogs do not move more than a few meters from streams).

Finally, in assessing the impact of our HCP/NCCP, we have compared our proposed conservation measures and monitoring programs to our current operational practices, driven by 3 key documents:

1. MRC Management Plan (2010).
2. California Forest Practice Rules (CDF 2010).
3. FSC-US Forest Management Standard (v1.0, 2010).

12.2 Effects of MRC Covered Activities

12.2.1 Assessment of effects

Assessing the effects of MRC covered activities is difficult because of the widespread and diverse forests that make up the plan area. Several factors come into play:[1]

- Large number of potentially affected resources.
- Numerous ways by which covered activities can affect resources.
- Synergy which produces an effect greater than the sum of individual effects.
- Difficulty of defining recovery rates.
- Uncertainty about spatial and temporal scales for assessment.
- Unpredictability of future events (both management and natural events).

[1] Reid 1993, MacDonald 2000, Dunne et al. 2001

- Impact of land use beyond property boundaries.

12.2.2 Watershed analysis

There are recognized shortcomings in the various methods for identifying, predicting, or avoiding significant cumulative effects at the watershed level (Beschta et al. 1995, Berg et al. 1996, Reid 1998a, MacDonald 2000, Dunne et al. 2001). A report by the Science Review Panel, co-sponsored by the California State Resources Agency and NMFS, recommended watershed analysis as the best tool for (1) evaluating existing and potential cumulative effects, and (2) identifying methods to avoid, minimize, or mitigate adverse cumulative effects on anadromous salmonid and their habitat (Ligon et al. 1999).

Watershed analysis, conducted as part of our HCP/NCCP,

- Assists in reducing non-point source pollution.
- Evaluates current and past land management practices relevant to aquatic habitat and aquatic species.
- Establishes a baseline for monitoring watershed conditions over time.

This analysis helps MRC management to develop conservation measures which reduce impacts to aquatic resources as well as restore or improve aquatic habitat.

12.2.3 PTHP requirements

Programmatic Timber Harvest Plans (PTHPs) provide project-specific or site-specific assessments of the impact of covered activities as detailed in the California Forest Practice Rules (CFPR). However, there are issues that MRC must consider in a larger context than a single PTHP, namely

- Peak flow.
- Landslide risk.
- Sediment transport.
- Status of stream reaches and habitat conditions.
- Road systems.
- Rates of harvest over time.

This chapter assesses the effects of MRC covered activities at the planning watershed scale and at the regional scale as well.

In the future, each MRC PTHP will reference information and assessment from our HCP/NCCP and the wildlife agencies' EIS/PTEIR. For example, when addressing impacts to aquatic habitat, a PTHP will incorporate (1) the findings of watershed analysis regarding past and current problem areas and sensitive resources, (2) HCP/NCCP conservation measures, and (3) the assessment of potential impacts and take contained in our HCP/NCCP.

12.2.4 Spatial and temporal scales

The scales of analysis vary by the problem at hand. For fish, the spatial scale may be a watershed or sub-watershed. For wildlife, the spatial scale may cut across several watersheds.

The cumulative effects assessment of our HCP/NCCP focuses on landscape-level effects at several spatial scales:

- Planning watersheds.
- Watershed analysis units (WAU).
- River basins.

- Inventory blocks.
- Region of Mendocino County.

Planning watersheds are the basic spatial unit in the assessment of fish and aquatic resources. Such watersheds may be too small, however, for some types of assessment. In those cases, planning watersheds may be aggregated into larger units, such as WAUs. WAUs may also be aggregated into inventory blocks or river basins to provide a broader, more regional context for assessment.

The time scales in the assessment generally focus on the first 40 years of our HCP/NCCP and the expected duration of the ITP (80 years). Assessment of current and past impacts incorporates similar time scales, with some discussions focused on the past 10 years, others on the past 20 or 50, and still others focused on the first wave of logging activity over 100 years ago. Likewise, MRC will use projections about future timber harvests to predict future resource trends under HCP/NCCP implementation.

12.2.5 Land uses and actions considered

12.2.5.1 MRC neighbors

The lands surrounding or adjacent to the plan area are state-owned commercial timberland and parks, as well as privately-owned forests.

Jackson Demonstration State Forest (JDSF) is 50,200 ac (20,315 ha) managed by the state of California for purposes of forestry research (CDF 2001). JDSF has created a plan for managing its forest that includes timber harvest and recreation.

State parks adjacent to or near the plan area include Lower Big River, Navarro Redwoods, Hendy Woods, and Montgomery Woods. No commercial timber management occurs in these state parks.

In addition to MRC, there are 6 privately-owned forests in Mendocino County that are over 2500 ac:

1. Hawthorne Timber Co., LLC (The Campbell Group).
2. Coastal Ridges, LLC.
3. Soper-Wheeler Co.
4. Gualala Redwoods, Inc.
5. Redwood Forest Foundation, Inc. (Usal Redwood Forest).
6. Conservation Fund / The Nature Conservancy.

12.2.5.2 WAUs within the plan area

The plan area is located across 12 WAUs that cover approximately 532,045 ac (215,311 ha). It comprises about 40% of the total WAU acreage. The amount of acreage that MRC owns within a WAU varies. In the Elk Creek watershed, MRC owns the largest slice—78%. In the Upper Russian River watershed, MRC owns only about 14% of the land. For 5 of the 12 WAUs, MRC owns between 53-78% of the land.

Table 12-1 WAUs in Plan Area

WAUs in Plan Area		
WAU	**WAU Acres**	**% Plan Area**
Albion River	50,828	29%
Alder Creek/Schooner	57,762	22%
Big River	75,261	44%
Cottaneva Creek	10,569	75%
Elk Creek	18,059	78%
Garcia River	68,292	19%
Greenwood Creek	16,440	58%
Hollow Tree Creek	44,443	46%
Navarro River	103,084	53%
Noyo River	43,990	44%
Rockport Coastal Streams	17,255	59%
Upper Russian River	26,062	14%

12.2.5.3 TMDL

The plan area is within several watersheds that have undergone development of Total Maximum Daily Loads (TMDL) by the Environmental Protection Agency (EPA) under the authority of the Clean Water Act. A TMDL identifies all sediment sources and recommends corrective action for problems. Watersheds that have TMDL allocations within the plan area are

- Albion River.
- Eel River (South Fork).
- Gualala River.
- Navarro River.
- Noyo River.
- Big River.
- Russian River.
- Garcia River.

After the EPA completes a TMDL, the state is responsible for producing an action plan to implement the recommendations in the TMDL. Currently, only Garcia River has an action plan. Landowners in the Garcia River basin have 3 options:

1. Comply with the waste discharge prohibitions.
2. Comply with an approved Erosion Control Plan and approved site-specific management plan.
3. Comply with an approved Erosion Control Plan and the Garcia River Management Plan.

The wastewater discharge prohibitions include controllable discharge of soil, silt, bark, slash, sawdust, or other organic and earthen material from any logging, construction, gravel mining, agriculture, grazing or other activity into waters of the State within the Garcia River watershed. For the foreseeable future and until there are implemented action plans for all the watersheds within the plan area, negative impacts from lands outside MRC property may continue to adversely affect aquatic resources within the plan area.

12.2.6 Cumulative effects in the plan area

12.2.6.1 Past, present, and future

Most of the plan area was clear-cut from the mid-to-late 1800s and well into the 1900s. Logging usually was conducted watershed by watershed. After all or most trees were removed, operations moved on to the next watershed. During first-cycle logging, technology and management practices were not as developed as in later years. Removal of old-growth redwoods and Douglas fir resulted in increased ground and stream disturbances. Logs were transported down river via splash-dams or dragged into and across streams. These early practices required repeated burning to reduce slash (Sawyer et al. 2000a, p. 27). Frequent burns favor Douglas-fir and redwoods. Stands that underwent these early harvest practices are even-aged, very dense stands. As technology improved, harvest practices concentrated on removing the highest merchantable timber.

California passed its first Forest Practices Act (FPA) in 1945. The FPA required 25-49 seed trees per ac (10-20 seed trees per ha) to remain following timber harvest (Sawyer et al. 2000a). Most companies aerially seeded Douglas-fir and left 25-49 redwoods/ac (10-20 redwoods/ha). After 20 years, this resulted in dense Douglas-fir stands—2023 to 4047 trees/ac (5100 to 10,000 trees/ha)—with few or no redwoods (Sawyer et al. 2000a). The practice of aerial seeding was not a frequent occurrence in the plan area.

As second-growth harvesting started, there was clear-cutting with and without planting; this included limited post-harvest vegetation management. Selective regeneration harvests (selection, group selection, or transition) and intensive even-aged management, along with post-harvest vegetation management to restore hardwood dominated stands, started approximately 10 years ago. The proportion of uneven-aged regeneration has grown ever since and will continue to grow; even-aged management will likely be phased out in the plan area.

MRC employs either uneven-aged silviculture or silviculture necessary to phase timber stands into uneven-aged structure, such as variable retention. Currently, MRC applies variable retention only to poorly stocked, tanoak-dominated stands, keeping 10-40% or more of the original stand in rolling and permanent pockets of untouched trees. This method allows MRC to plant conifer trees in the openings created by harvest and quickly restore tanoak-dominated stands back to conifer-dominated stands. Since December 1999, MRC has planted over 7 million redwood and Douglas-fir seedlings (Table 12-2).

Overall, MRC harvests timber at a current rate of less than 2% of our inventory per year; this will double our inventory in 50 years. MRC proposes within the PTEIR that conifer harvest levels will not exceed Long-Term Sustainable Yield (LTSY) in any decade. Moreover, we are evaluating and adjusting management practices, such as use of herbicides, to decrease negative impacts on the environment.

In addition to adopting more sustainable harvest practices, MRC will continue to sell conservation easements, such as the 87-acre parcel near Comptche in the Albion watershed.

Reforestation Process

1. A forester snips a sprout from a redwood stump and sends it to a lab.

2. A lab technician takes shavings from the sprout and grows redwood cultivars in a petri dish.

3. Cultivars are placed in styrofoam containers to continue growth at a nursery.

4. Yearling redwood trees at the nursery are sent to MRC.

5. Some of the yearling redwoods (100 per cultivar) are planted at the Navarro Hedge Farm which is a repository for each MRC cultivar.

6. Forestry crews plant most of the yearling redwoods in harvested stands to optimize spacing of new growth.

7. Cycle begins again: sprouting from a redwood stump becomes a source for new cultivar material or, in most cases, natural reforestation.

Table 12-2 Tree Planting

MRC Tree Planting	
Year	**Trees Planted**
1999	610,670
2000	619,000
2001	740,826
2002	707,538
2003	625,012
2004	541,995
2005	609,845
2006	782,830
2007	665,515
2008	769,007
2009	487,430
2010	360,780
2011	288,084*
Total	**7,808,532**

TABLE NOTE
***Planting for Jan/Feb 2011 only

In the future and for the life of our HCP/NCCP, MRC plans to further develop and improve our sustainable forest practices to decrease impacts and to enhance aquatic and terrestrial wildlife and habitat. Some of these practices include

- Commercial thinning.
- High retention selection.
- Single-tree selection.
- Group selection.
- Variable retention.
- Transition.

12.2.6.2 Impact of timber industry on fisheries

CDFG initiated the Sports Fish Restoration Program (funded by Dingle-Johnson legislation) in the 1950s to facilitate rehabilitation of many fisheries impacted by timber, land use, and water use practices. One of the objectives of the program was to restore access to anadromous fish streams that were blocked by accumulations of woody debris from logging operations.

The enormity of the LWD problem caused by logging practices in the timber boom of the 1940s and 1950s led to a focus on LWD removal. This emphasis on LWD removal was not without merit. Maps and tables contained in proposal documents describe 51 migration barriers out of 835 logjams which totaled an estimated 336,791 ft^3 (9,537 m^3) of woody debris. For example, on Hayworth Creek in the headwaters of the Noyo River, biologists documented the presence of 17 logjams over a 2-mile reach. Of these, 10 were considered to be upstream passage barriers up to 15 ft (4.6 m) high. One of the largest jams was estimated to be 100 ft (30.5 m) long x 100 ft (30.5 m) wide x 8 ft (2.4 m) high, containing approximately 40,000 ft^3 (1,133 m^3) of wood.

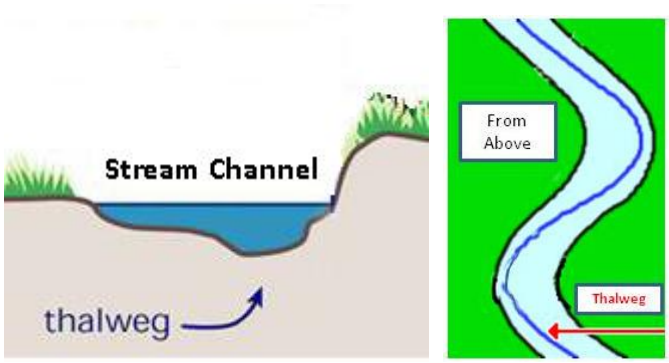
Inmate crews of CAL FIRE carried out much of the LWD removal work. They cleared significant portions of the streams of all debris that could accumulate to form a migration barrier

Surveying for the thalweg—a line defining the deepest points of a stream

or act as a sediment trap. From 1959-1969, there were 5 proposals for LWD clearance projects in Mendocino County. The proposals documented the miles of streams that were accessible to anadromous fish and the miles that would be accessible upon clearance completion. In many instances, the proposals presented the "extremes" for viable anadromous fish spawning and rearing habitat upstream. Typically, fisheries biologists would walk the streams, noting the location and size of debris jams on topographic maps. The proposals included traced copies of many of these maps. Proponents calculated the required effort for clearance by classifying the streams and estimating the number of stream miles needing clearance. Often, they noted the level of scattered debris between major logjams so that their estimates could be adjusted accordingly.

Subsequent floods in these areas cleared away woody debris and removed large accumulations of fine sediment. With stream channels damaged by timber harvest and stream structure altered by log removal, floods scoured the channel and lowered the thalweg elevation in some stream sections by as much as 10-20 ft (3-6 m).

As a result of stream clearance projects, the importance of LWD for the maintenance of channel structure and fish habitat—particularly coho salmon—is widely recognized. The Stream and Lake Improvement Program initiated by CDFG now evaluates the need for any LWD removal. Debris jams that are documented barriers to upstream migration can currently be modified to allow passage, but there is no longer any large scale removal of woody debris from channels. Woody debris that enhances fish habitat and provides channel structure and stability is left in place. Moreover, restoration projects now place LWD in streams to improve fish habitat.



12.2.7 Watershed and fisheries

Past forest practices have left a legacy of impacts on the aquatic and riparian habitats in the plan area, including

- Simplified stream channels.
- Adverse levels of stream sediments.

- Degraded riparian function.
- Channels and riparian areas depleted of LWD.
- Roads poorly planned and constructed.

Our conservation measures will improve aquatic and riparian habitats in the plan area and reduce cumulative effects on these habitats. Improvements should result from

- Maintaining or increasing the density of large trees in riparian zones.
- Maintaining or increasing the canopy density within the riparian zone.
- Limiting timber harvests on potentially unstable hillslopes.
- Reducing the adverse impacts of roads and stream crossings.

By restricting the type and amount of harvesting that can take place in a watershed, MRC will minimize the potential adverse impacts of timber harvest on peak flows, runoff, and water yield. These measures, together with site-specific guidelines in individual PTHPs, should maintain natural hydrologic regimes and protect the quality of water in MRC streams. This, in turn, should ensure that populations of salmonids remain stable or increase in the plan area even though timber harvests continue.

12.2.8 Hydrology

In forested landscapes, such as the plan area, timber harvests and roads may alter a catchment's hydrology by affecting the timing, volume, and rate of runoff. Removal of tree canopy increases the amount of precipitation that reaches the forest floor; since there is less vegetation to catch the precipitation, it evaporates before reaching the ground (Dunne and Leopold 1978).

12.2.8.1 Rain-on-snow

In areas where precipitation may fall as either rain or snow, timber harvests can increase the amount of snow that accumulates in logged areas; this also increases the likelihood of floods from rain-on-snow conditions. The plan area does not receive any significant snow accumulations that could contribute to rain-on-snow events.

12.2.8.2 Fog

A reduction in forest canopy may also decrease fog interception and fog drip; this would reduce soil moisture and stream flow in portions of the plan area that experience substantial summer fog (Harr 1982, Ingwersen 1985; as cited in Keppeler 1998). The removal of trees and other vegetation during timber harvests decreases the amount of water removed from the soil by roots and dissipated through evapotranspiration. Therefore, in harvested areas, soil moisture levels are higher during the growing season; the first (usually small) storm-flow peaks in the fall are increased (Ziemer 1998). Removal of more forest vegetation from a basin can increase the potential for peak flows (Hibbert 1967, as cited in Keppeler 1998).

12.2.8.3 Peak flow

Observations of increased peak flows at the watershed scale due to logging roads or other compacted surfaces (skid trails, landings, cable-yarding corridors, or fire-lines) have been inconclusive. Some hydrologic studies associate logging and road construction with a significant increase in peak flows (Harr et al. 1979; Jones and Grant 1996); other studies do not (Ziemer 1981a; Wright et al. 1990; Duncan 1986; Lewis et al. 2000). However, drainage from roads or other compacted surfaces can alter the stream-flow at localized sites. Roads and skid trails have the capacity to channel surface runoff and route water to stream channels; this increases hydrologic connectivity, as well as runoff and peak flows within a basin (Wemple et al. 1996).

Roadside ditches and drainage culverts channel runoff and intercept subsurface flow, routing water to stream channels more quickly and directly than in an undisturbed landscape (Murphy 1995). The failure of drainage structures, such as culverts, at stream crossings can also reroute surface runoff from one channel to another, potentially altering peak flow magnitude and timing (Furniss et al. 1998).

Long-term research suggests that peak flows in the Caspar Creek Experimental Watershed, which is a gauged stream, were not substantially affected by roads, soil compaction, or overland flow (Ziemer 1998). However, because the approximate road density of the MRC plan area (6.9 mi/mi^2) is greater than the road density in the Caspar Creek Experimental Watershed (5.7 mi/mi^2), this may impact peak flows in the plan area during the short term In time, the MRC road plan should reduce road density in the plan area to a value similar to that in the Caspar Creek Experimental Watershed. We designed our road management plan to minimize possible adverse impacts from hydrologic changes and erosion due to human intervention. The road management plan will use state-of-the-art technology and science to

- Inventory all roads.
- Develop a long-term road system plan.
- Provide road and landing design.
- Provide construction and reconstruction standards for
  - Road inspection and maintenance.
  - Road and landing closure and abandonment.
  - Road use.
- Provide standards for water drafting and skid trails.

Peak flow response to timber harvests in the Caspar Creek Experimental Watershed appears to be primarily influenced by reduced vegetative cover (Ziemer 1998). The primary effect of logging on peak flow is an increase in the size of the smallest peaks during the driest antecedent conditions (i.e., in the fall before the onset of heavy winter rains, when soils are driest). This effect appears to diminish as the amount of rainfall and the initial wetness of the watershed increases (Ziemer 1998). In Caspar Creek Experimental Watershed, peak flow increases from early season storms averaged 35% for tributary watersheds that were entirely clearcut and 16% in partially clearcut watersheds. Ziemer (1998) concluded that these were relatively benign hydrologic increases in terms of their channel forming processes. Over the period of our HCP/NCCP, median peak flow increase during years of average wetness in MRC planning watersheds is estimated at 6.8% as compared to average flow conditions in a fully forested, second growth watershed (see section 8.4.3.1).

12.2.8.4 Low flow

Most studies, including those conducted in the Caspar Creek Experimental Watershed, show increases in low flows following timber harvests (Keppeler and Ziemer 1990, Ziemer et al. 1996, Keppeler 1998). Research in the Caspar Creek Experimental Watershed indicates that stream-flow changes due to logging are most evident during the summer. Substantial increases lasting 7 years followed selection harvest; potentially longer time periods could follow clearcuts (Keppeler 1998). Data from Caspar Creek Experimental Watershed show that the potential loss of fog drip following logging did not reduce stream-flow (Keppeler 1998). Any decreases in soil moisture due to reduced fog drip are apparently balanced by reduced evapotranspiration as a result of vegetation removal. With forest re-growth, flow diminishes, returning to pre-harvest flow conditions after about 12 years (Keppeler et al. 2003).

Throughout the term of our HCP/NCCP, MRC does not expect timber harvests to threaten aquatic resources or other beneficial uses of water. For watercourses within the plan area, our timber harvests should result in little if any short-term increases in summer flow relative to current conditions. Low flows in summer potentially benefit salmonids by temporarily increasing habitat available for juvenile rearing (Hetherington 1988).

12.2.8.5 Water drafting

Water drafting involves the siphoning of stream flow into a water truck. Periodically, the siphoned water is sprayed or applied to road surfaces to minimize dust production and maintain a hard, compact road surface. Gravity systems may also provide water directly to storage reservoirs or tanks for later use in dust abatement or fire suppression. MRC does not expect water drafting to threaten incubating or rearing salmonids because of the restrictions and monitoring associated with lowering flows.

12.2.9 Soils and geology

Soil productivity

Soils in the assessment area will continue to be subject to erosion from both natural and anthropogenic causes during the term of our HCP/NCCP. Timber harvests can cause substantial soil disturbance, including compaction and scarification (Spence et al. 1996). The effects of soil compaction, which include reduced infiltration capacity and increased surface runoff, may alter hydrologic response and increase sediment delivery to streams. Cafferata (1992) found that tractor yarding can result in the compaction of 10-40% of a harvested area; these effects may persist for several decades.

Surface erosion and mass wasting, which can have detrimental effects on water quality and aquatic habitat, should decrease as we minimize sediment delivery to streams and implement our road plan.

12.2.10 Water quality and human uses

12.2.10.1 Suspended sediment and turbidity

Timber harvests that increase inputs of fine sediment to streams can degrade water quality and threaten aquatic species. Fine sediment, created from surface erosion, mass wasting, and bank erosion, can increase suspended sediment concentrations and turbidity; this may have detrimental effects on aquatic species and water quality. Lewis (1998) reported increased suspended sediment concentrations following logging in the Caspar Creek Experimental Watershed; he determined the concentrations were closely correlated with increased storm-flows. Municipal and domestic uses of water occur both within and downstream of the plan area; fine sediment inputs from timber harvests and road construction could affect these water sources. The City of Fort Bragg has identified turbidity caused by fine sediment as a primary water quality concern for its drinking water supply (SHN 1995).

Our HCP/NCCP will minimize the impacts of suspended sediment primarily through our strategies for mass wasting, sediment, and road maintenance. Habitat conservation strategies for riparian function provide additional protection. The following practices protect water quality by reducing fine sediment delivery to streams:

- Restrictions on timber harvest, as well as on construction of roads, landings, and stream crossings in Terrain Stability Units (TSUs) with the greatest potential for mass wasting.

- Proper design, location, construction, and maintenance of roads to reduce (a) mass wasting from road failures and (b) surface erosion from the construction, use, and maintenance of roads.
- Identification and closure or abandonment of improperly closed roads to reduce their sediment contribution.
- Regular road inspections to (a) identify problem sources of sediment and (b) prioritize maintenance.
- Designation of over 50% of the MRC road network to temporary use only.
- Prescriptions for improved skid trail, cover, soil management, and silviculture to reduce surface erosion and mass wasting from timber harvests.
- Restrictions on heavy equipment use in the AMZs to minimize soil compaction, bank instability, and surface erosion.
- Restrictions on site preparation and burning in the AMZs and on steep slopes adjacent to watercourses to (a) minimize surface erosion and removal of understory vegetation and (b) maintain LWD for sediment storage.

Estimates suggest that approximately 60% of sediment inputs in the plan area during the last 30-40 years have been from landslides. Road use and timber management contribute to the remaining 40%. MRC will limit timber management in high hazard terrains (TSUs 1-3) to 5% over a 10-year period within each CalWater planning watershed. Our intent is to reduce sediment delivery due to mass wasting and retain at least 50% of the overstory canopy in these managed units.

To date, MRC has identified 16,000 sources of controllable erosion, 38% of which have high or moderate potential for sediment delivery. As of 2011, the MRC road inventory is 90% complete. Completion should occur in 2012. We will control 1,302,000 yd^3 of controllable erosion over the first 30 years of our HCP/NCCP (O§8.3.2-6). In addition, in the first 20 years of our HCP/NCCP, MRC will treat controllable erosion at sites designated high and moderate priority and at road-related restoration sites in coho core areas (see Tables 8-18 and 8-19). Abandonment of roads will also substantially decrease the number of stream crossings. Based on current road inventory, there are 2300 miles of roads in the plan area. Less than 3% of these roads are paved; roughly 78% of them have only a native surface. Reducing the length of riparian roads and the number of stream crossings will reduce the potential for sediment delivery to streams and improve water quality. MRC estimates that new road construction over the first 10 years of our HCP/NCCP will outpace road decommissioning. However, the plan area will only end up with roughly 20 net miles of new roads. New roads will meet more stringent guidelines to reduce sediment input. Decommissioning will focus on roads in the worst condition. In addition, MRC will designate about 50% of the road network in each planning watershed for temporary use; currently about 25-30% of MRC roads are for temporary use. This change will reduce road activity, maintenance, and potential erosion. Temporary road use will also reduce the number of permanent features (e.g., culverts and stream crossings) in each planning watershed to the benefit of covered fish species.

Harm to covered fish species will still occur under our HCP/NCCP as a result of sediment delivery; local habitat conditions will continue to impair the ability of individual fish to grow, rear, migrate, or spawn. However, our HCP/NCCP will likely result in substantially less sediment delivery than current management practices and subsequently improve aquatic habitat conditions.

12.2.10.2 Nutrients

The effects of forest management on nutrient cycling in coastal northern California are not clear (Dahlgren 1998). While some researchers have identified nutrient losses from leaching, erosion, and loss of plant biomass following timber harvest (Likens et al. 1970, Johnson et al. 1982, 1988, Hornbeck et al. 1987; all as cited in Dahlgren 1998), short-term nitrogen increases have resulted from reduced nutrient uptake, increased subsurface flow, increases in leachable forms of nitrogen compounds, and increases in decaying organic material (Reid 1993). Many evaluations of nutrient changes after logging have focused on nitrogen (Dahlgren 1998, Reid 1993), apparently a limiting factor in many west coast forest ecosystems (Dahlgren 1998).

In the Caspar Creek Experimental Watershed, Dahlgren (1998) examined the effects of clearcut (even-aged) logging on nitrogen in stream water. Dahlgren found that the release of nutrients from organic matter increased nitrate concentrations and reduced nutrient uptake by vegetation following timber harvests. Nitrate levels in stream water were highest during high stream flows following storms; downstream, there were near reference levels due to dilution and possibly instream immobilization. Although substantial amounts of nitrogen were lost from harvested vegetation, nutrient losses were low relative to the total site nutrient capital and input mechanisms. This is due in part to rapid re-growth and nutrient uptake by redwood stump sprouts, shrubs, and herbaceous plants.

Based on the Caspar Creek study, increased nitrogen levels are not likely to occur in streams draining harvested watersheds in the plan area. MRC will rely more and more on uneven-aged management. Short-term minor increases in stream nutrients associated with rehabilitation or other intensive silvicultures will be very limited because MRC does not rely on broadcast burning for site-preparation purposes. Uneven-aged management appears to have a minimal effect on stream nitrogen concentration when compared to other types of timber harvests. This management prescription should ensure that timber harvests in the plan area do not result in adverse impacts to water quality as a result of nutrient loading.

12.2.10.3 Dissolved oxygen

Dissolved oxygen in streams draining steep, forested watersheds is generally maintained at or near saturation levels by re-aeration of flowing water (Murphy 1995). Depletion of dissolved oxygen relative to timber management can result from algal blooms. The cause is increased nutrient inputs and increased oxygen consumption by decaying organic materials (Kopperdahl et al. 1971, Ringler and Hall 1975, Reid 1993). Large increases in stream water temperature may also reduce dissolved oxygen concentrations.

Forest management practices that include riparian zone protections should not deplete dissolved oxygen in stream water under normal circumstances (MacDonald et al. 1991). Reduced concentrations of dissolved oxygen following logging apparently return rapidly to pre-harvest levels (Ringler and Hall 1975). MRC does not expect timber harvests under our HCP/NCCP to decrease dissolved oxygen and cause detrimental impacts to downstream water quality.

12.2.10.4 Pollutants

Chemicals used for forest management have the potential to introduce pollutants into the soil, groundwater, and stream network. This can cause direct or indirect effects to aquatic systems (Spence et al. 1996, Norris et al. 1991). Herbicides, insecticides, fertilizers, and fire retardants are the most commonly used chemicals for forest management. Herbicides and insecticides are highly variable in their chemical properties and potential effects on aquatic resources. Fire

retardants may have lethal consequences to rainbow trout if not highly diluted (Buhl and Hamilton 2000).

Currently there is no information to indicate that any herbicides are contaminating surface water in the plan area. Nitrogen, in the form of urea, is the most commonly used forest fertilizer; it has the potential to increase production of aquatic resources under certain conditions or create various levels of toxicity to aquatic biota (Norris et al. 1991). Fire retardants have the potential to affect aquatic ecosystems, although the impacts have not been extensively studied (Buhl 2006). Potential impacts of forest chemicals on aquatic systems depend on many variables including chemical properties, method of application, and local conditions such as soil and weather.

Petroleum products, including fuels and oil that may be used or discharged (e.g., spills and leaks) during timber harvest operations, have the potential to create pollution concerns. The use of heavy equipment and gas-powered tools creates the potential for petroleum products to be introduced into soils, groundwater, and streams. Numerous state and federal regulations, such as the Clean Water Act., address restrictions and measures to reduce the potential for petroleum pollution.

The potential effects of chemical pollutants on terrestrial and aquatic biota depend on the movement and toxicity of the chemical, as well as its fate and persistence in the environment (Norris et al. 1991). The MRC Management Plan (2010) sets restrictions on the introduction and application of chemicals in the aquatic environment.

MRC does not expect our HCP/NCCP to increase the potential for pollutants to affect water quality or aquatic resources in the plan area. In addition, to reduce potential impacts to aquatic environments, we have limited the use of herbicides. We will continue to experiment with a variety of alternatives—manual methods, vinegar, corn gluten, eucalyptus oil, neem tree oil, and others—and monitor experimental sites for impacts to water quality.

12.2.11 Water supply

Impacts to water supply may include the amount and quality of water available for municipal and domestic use. Erosion from timber harvests and roads may produce sediment and turbidity in municipal and domestic water supply (section 12.2.10.1). MRC does not expect implementation of our HCP/NCCP measures to substantially influence local water supply. The most likely hydrologic response to timber harvest would be short-term increases in peak flow and low flow.

12.2.12 Water temperature

12.2.12.1 Impacts of management activities

The effects of timber harvests on stream water temperatures have been well-documented (e.g., Burns 1972, Ringler and Hall 1975, Beschta et al. 1987, Beschta et al. 1995). Loss of canopy shading following logging increases the amount of solar radiation reaching the stream; this causes increased maximum temperatures and greater diel fluctuations (Beschta et al. 1995). Temperature increases are typically greatest during the summer (MacDonald et al. 1991), when stream temperatures are naturally at their peak due to maximum incident radiation. These effects tend to be greatest in small streams (Beschta et al. 1995, Spence et al. 1996), because the influence of solar radiation diminishes with increasing stream depth and discharge

Long-term effects of timber management on stream temperatures depend on a number of interrelated factors, including the spatial distribution of harvesting, the amount of over-story

canopy removed, and the management of riparian vegetation following harvesting (Beschta et al. 1995, Spence et al. 1996). Cafferata (1991) measured a mean increase of 3.4ºF (1.9ºC) in maximum summer stream temperature downstream of a 6-year-old clearcut at JDSF in the South Fork Noyo River watershed. In this study, riparian shading was reduced by 14% as a result of harvesting. Other studies of coastal watersheds in the Pacific Northwest have shown increases in average summer maximum stream temperatures of up to 14ºF (8ºC) following clearcut logging (Beschta et al. 1987) and average diel temperature fluctuations of 6.7ºF (3.7ºC) (Holtby and Newcombe 1982, as cited in Spence et al 1996). The orientation of a stream (e.g., north-south vs. east-west), the steepness of adjacent hillslopes, and the amount of groundwater and subsurface flow can also affect the magnitude of temperature increase following riparian canopy removal (Cafferata 1990, Beschta et al. 1995, Murphy 1995).

12.2.12.2 Effects on habitat suitability

Elevated water temperatures can affect stream biota in a variety of ways. The growth and productivity of many aquatic organisms may increase as a result of higher water temperatures following timber harvests (Beschta et al. 1987). Greater light levels after removal of riparian vegetation can stimulate primary and secondary productivity (Erman et al. 1977, Hawkins et al. 1982). As a result, populations of vertebrate predators, including salmonids, have increased (Hawkins et al. 1982, Murphy and Hall 1981, Murphy and Meehan 1991). Further abundance of primary producers and benthic macroinvertebrates, however, is generally accompanied by reduced species diversity (Bilby and Bisson 1992, Beschta et al. 1995); increased fish production is usually short-lived (Sedell and Swanson 1984). High water temperatures have adverse impacts on the growth and development of early anadromous salmonid and amphibian life stages and can reduce habitat suitability for adults as well (Spence et al. 1996). Egg incubation rates, emergence timing, and growth patterns are among the life history traits of anadromous salmonid influenced by increased water temperatures following logging (Hartman et al. 1987). Scrivener and Anderson (1984) found that elevated temperatures induced early emergence of coho salmon; the effects of early emergence included increased susceptibility to high winter flows, earlier outmigration, and reduced densities.

12.2.12.3 Resource trends and effectiveness of conservation strategies

Prescriptions for canopy retention in our HCP/NCCP should maintain cool stream temperatures by ensuring adequate streamside shading. Standards for AMZ width and canopy closure should limit adverse site-specific and downstream impacts on sensitive aquatic biota that could otherwise result from deleterious increases in maximum summer stream temperatures. By protecting riparian ecosystem integrity, these measures should maintain other key functions of riparian forests, such as LWD input, streambank stabilization, organic matter input, and terrestrial wildlife habitat (Spence et al. 1996).

Louisiana-Pacific, the previous owner of the MRC lands, initiated summer temperature monitoring in 1989 at a limited number of sites. Currently, MRC is monitoring approximately 100 sites. These monitoring sites are primarily on Class I watercourses, with additional Class II watercourse sites to be added. We monitor most watercourses with 1 station. However, on larger streams, we use multiple stations. Temperatures at some locations have occasionally exceeded maximum weekly average temperature (MWAT) thresholds for juvenile coho salmon. For the most part, the highest summer stream temperatures were recorded in watercourses in the eastern portions of the plan area. MRC has recommended riparian buffers of varying widths to protect stream water temperatures for salmonids.

Murphy (1995) cites Johnson and Ryba (1992) in recommending a width of 80 ft (25 m) to provide adequate stream shading. Spence et al. (1996) review various recommendations and conclude that a buffer width equal to 3/4 the height of 1 site-potential tree is sufficient to fully protect stream shading, litter inputs, and nutrient regulation. Depending on slope, MRC will establish 130 to 190-ft AMZs on Class I streams (3/4 to 1 site-potential tree height adjusted to slope distance) and 100 to 150-ft AMZs on Large Class II streams (1/3 to 4/5 site-potential tree height). Buffers for stream shading can be smaller on small Class II and Class III watercourses as there is no surface flow that can be heated by solar isolation during summer. Shade is unnecessary because these small watercourses do not deliver surface-exposed water to Class I and Large Class II watercourses during the summer when temperatures are a concern. MRC riparian conservation measures include 50 to 100-ft wide AMZs on small Class IIs (1/3 to 3/4 site-potential tree height) and 25–50 ft on Class IIIs (1/6 to 1/3 site-potential tree height).

The effectiveness of riparian buffers for providing stream shading and maintaining cool water temperatures also depends on the density of canopy closure within the buffer. The site-specific conservation measures for riparian areas will maintain high levels of streamside shade along Class I and Class II streams; there will be 85% over-story canopy in the inner zone and 70% in the middle zone of Class I and large Class II AMZs.

12.2.12.4 Fish habitat

Within watersheds, physical and biological processes influence habitats for aquatic species. In the Pacific Northwest, freshwater habitat for salmonids is particularly susceptible to the types of disturbances created by forest management (Beschta et al. 1987, 1995; Reid 1993, Murphy 1995, Spence et al. 1996). Coho salmon, Chinook salmon, and steelhead are the anadromous salmonids that occur in MRC streams and for which MRC is seeking coverage under the incidental take permit. The analysis presented in this section, therefore, focuses on the potential impacts of forest management on habitat for these species in MRC streams. Some key habitat requirements are summarized below to provide background for this analysis.

While in fresh water, anadromous salmonids require specific habitat requirements during spawning, incubation, summer rearing, and winter rearing (Everest et al. 1985, Bjornn and Reiser 1991). Adults returning to spawn need access to spawning riffles, that are comprised of relatively silt-free gravel of adequate size (Platts et al. 1979), and nearby cover such as deep pools, overhanging vegetation, or LWD (Bjornn and Reiser 1991). Spawning also requires suitable water depth and velocity, as well as adequate space and gravel for construction of redds (Bjornn and Reiser 1991). The amount of fine sediment in the spawning gravels of redds and the amount of dissolved oxygen available to the eggs influences the survival from egg to emergence (Cloern 1976, Mason 1976a, Shirazi and Seim 1981). Spawning salmonids need relatively cold water temperatures; juvenile coho salmon and steelhead also require cold temperatures for growth and survival (Bjornn and Reiser 1991).

Juvenile rearing success is closely related to the availability of food and cover (Chapman and Bjornn 1969). Substrate heterogeneity, water temperature, oxygen levels in the water, and nutrients, all influence the production of invertebrate food resources (Minshall 1984). LWD is an important source of cover for rearing salmonids; it is also crucial to the formation of pools and the retention and spatial distribution of sediment (Fausch and Northcote 1992, Cederholm 1994). Juvenile and adult salmonids use pools as cover in summer and winter (Tschaplinski and Hartman 1983, Bjornn and Reiser 1991, Meehan and Bjornn 1991). They can serve as cold-water refugia when water temperatures are high elsewhere in the stream (Nielsen et al. 1994). Important sources of cover also include coarse substrates, overhead vegetation, undercut banks, and

backwater or off-channel areas; the latter are especially important during high winter flows (Nickelson et al. 1992).

12.2.12.5 Impacts of forest management

Timber harvests and roads have the potential to substantially influence the input of water, sediment, heat, and wood to streams. These inputs are the major determinants of stream-channel geomorphology; together with food and water quality, they constitute the key components of salmonid habitat.

Timber harvests can increase inputs of fine and coarse sediment to streams by accelerating the rates of mass wasting and surface erosion (Hicks et al. 1991a). Increased mass wasting in response to timber harvests primarily occurs due to localized changes in soil hydrology and decreased root strength (Beschta et al. 1995). Loss of root strength is likely of lesser importance in the redwood and mixed redwood/Douglas-fir forests that occur in the plan area since the root system of redwoods often remains alive after harvesting. In an Oregon study, clearcutting approximately tripled hillslope failure rates relative to undisturbed conditions (Swanson and Dyrness 1975, as cited in Beschta et al. 1995). In contrast, research in Caspar Creek Experimental Watershed suggests that the incidence of shallow landsliding in cable-yarded clearcut units without midslope roads did not increase significantly relative to unlogged areas (Cafferata and Spittler 1998). This indicates that current timber and road management may reduce the impacts of logging on mass wasting.

Surface erosion in harvested areas generally occurs where the soil surface is disturbed or compacted by yarding and other ground-based activities (Hicks et al. 1991b, Reid 1993, Murphy 1995). Loss of the organic surface layer of the soil and formation of a hydrophobic layer following fire can further increase susceptibility to surface erosion (Spence et al. 1996). Compared to tractor yarding, which involves extensive road and skid trail systems and ground-based heavy equipment, cable and helicopter yarding produce less soil disturbance; as a result, they have less potential for erosion (Beschta et al. 1995).

Increases in sediment delivery to streams may also result from accelerated erosion of stream banks caused by harvesting in riparian areas (Hicks et al. 1991b). Physical disturbance and loss of root strength increase the susceptibility of banks to stream erosion. The impacts of increased sediment production on aquatic habitats depend on the amount of sediment that is actually delivered to the stream (Spence et al. 1996). Therefore, harvesting in riparian areas or inner gorges generally presents a greater risk of aquatic habitat degradation than harvesting elsewhere in a watershed. Moreover, timber harvests usually involve the construction of roads, ditches, and skid trails; these can channel sediment to streams and exacerbate the effects of upslope management activity on anadromous salmonid habitat.

The total sediment contribution from roads can be greater than from all other management activities in a watershed combined (Gibbons and Salo 1973, as cited in Furniss et al. 1991, May 2002). Road construction can increase slope failure rates by 25 to 400 times relative to undisturbed conditions (Sidle et al. 1985, as cited in Beschta et al. 1995). Road systems affect slope stability primarily by modifying natural drainage patterns (Reid 1993, Sidle et al. 1985, as cited in Beschta et al. 1995). Roads, skid trails, and landings can often contribute large amounts of fine sediment to streams via surface erosion (Chamberlin et al. 1991). If the road network is in close proximity or hydrologically connected to the channel network, this will greatly increase sediment delivery (Rice et al. 1979, Furniss et al. 1991, Ketcheson and Megahan 1996, Flanagan et al. 1998). Stream crossings, culverts, and other drainage structures can be chronic sources of

erosion. Catastrophic failure of stream crossings input large amounts of sediment to streams (Flanagan et al. 1998). Best et al. (1995) found that 80% of all road-related erosion in a Humboldt County (CA) watershed was from stream crossing locations; the cause was diversions from plugged culverts and failed road fills.

Road surfaces are susceptible to sheetwash erosion and channelized runoff from compacted surfaces (Chamberlin et al. 1991, Spence et al. 1996). Road surfacing and traffic can also affect erosion potential. Reid and Dunne (1984) found that nearly all sediment from road surface erosion originated from the travel surface (tread). Paved roads produced only 0.4% as much sediment as heavily used gravel roads; the latter produce over 130 times more sediment than lightly used gravel roads. The design, construction, use, and maintenance of the road network are, therefore, important determinants of how much sediment reaches streams.

Harvesting in riparian areas reduces the potential for recruitment of LWD to channels (Bisson et al. 1987, Hicks et al. 1991b). These effects can be long-term, especially if harvests remove all recruitment sources of LWD. Recruitment of key pieces of LWD from second-growth forests may take many decades, depending on the size of the channel (Murphy 1995). Key pieces of LWD (a) are independently stable in the stream channel; (b) retain other debris or sediment; (c) substantially influence bed scour or deposition; and (d) provide complex habitat for anadromous salmonid. As existing pieces in the channel decay, LWD can decline for a period of nearly 100 years and may not recover fully for more than 250 years (Murphy and Koski 1989). If harvesting converts riparian stands to non-conifer species, stable, key LWD, which creates aquatic habitat, could remain low for even longer (Chan 1993, as cited in Murphy 1995). Woody debris from hardwood trees is generally less stable in stream channels and decays more rapidly than that from conifers (Beschta et al. 1995). Redwood LWD can reside in stream channels for centuries (Keller et al. 1995). LWD is important for storing sediment, including spawning gravel, and organic material in stream channels (Murphy 1995). Depletion of LWD, therefore, diminishes the capacity of streams to retain fine sediment; less fine sediment means less spawning gravel for salmonids and less organic debris used by invertebrates and other stream biota for food and cover. Salvage logging and stream clearing, which removes pieces directly from channels, may deplete LWD and destabilize remaining pieces (Bilby and Ward 1989, Murphy 1995).
LWD greatly diversifies channel morphology and hydraulic conditions (Keller and Swanson 1979, as cited in Sullivan et al. 1987, Keller et al. 1995). Loss of LWD decreases pool scour potential and channel stability, thereby simplifying channel morphology (Bisson et al. 1987, Hicks et al. 1991b). Loss of LWD also reduces the amount of instream cover and pool habitat available for fish (Tschaplinski and Hartman 1983, Bisson et al. 1987).

12.2.12.6 Effects on habitat suitability

Land management that increases sediment inputs and bed scour while reducing LWD abundance, riparian vegetation, and stream flow can decrease available habitat, food, and survival for rearing salmonids. Fine sediment can reduce the suitability of spawning habitat by filling gravel interstices; this, in turn, reduces intragravel flow and dissolved oxygen for incubating eggs and developing alevins (McNeil and Ahnell 1964, Peters 1965, Moring and Lantz 1975). Reductions in dissolved oxygen can cause mortality, delayed hatching and emergence, smaller fry size, and increased incidence of developmental abnormalities (Alderdice et al. 1958, Coble 1961, Silver et al. 1963, Shumway et al. 1964, Mason 1976a, Shirazi and Seim 1981). Fine sediment may also form a seal or cap in the upper layers of redds (Einstein 1968), impeding or obstructing the emergence of alevins in a process known as "entombment" (Phillips et al. 1975). A reduction in stream flow can decrease rearing habitat, dewater redds, or impede migration.

Reach-scale aggradation and reduction of average bed substrate particle size from increases in surface erosion and mass wasting can reduce pool quantity, pool quality, and availability of suitably-sized spawning gravels (Everest et al. 1987, Sullivan et al. 1987). Such changes to the channel-bed generally reduce the number of pool-riffle transition areas (pool tailouts) preferred as spawning locations. Filling of pools with coarse and fine sediments can reduce the carrying capacity of rearing habitats for juveniles (Bjornn et al. 1977, Lisle and Hilton 1991). In watersheds where past forest management created large fluctuations in sediment input to streams, previously aggraded channels may be down-cut. This reduces connectivity between the channel and its floodplain, as well as the availability of off-channel habitat. Increased loading of fine sediment may reduce aquatic invertebrate diversity and production, along with food availability (Crouse et al. 1981, Minshall 1984). Increased sedimentation from land management may also reduce habitat suitability by filling in the interstitial spaces in the substrate which juvenile salmonids use as cover from predators or as refugia during high flows or low temperatures (Hillman et al. 1987).

Researchers often cite LWD as the single most important habitat element that provides cover for anadromous salmonids (McMahon and Reeves 1989, Fausch and Northcote 1992, Cederholm 1994). LWD creates pools used for rearing, provides velocity refuge and cover from predators, and may moderate late summer temperature extremes (Keller et al. 1995).

Land management that results in loss of LWD tends to increase the amount of riffle area in streams and decrease pool area (Bisson and Sedell 1984). Removal of LWD results in fewer deep pools and less refuge from predation, high flows, and high summer water temperatures (Beschta et al. 1987, Bisson et al. 1987). LWD also plays an important role in nutrient dynamics by retaining carcasses of spawned salmonids (Cederholm and Peterson 1985).

12.2.12.7 Resource trends and effectiveness of conservation strategies

The habitat conservation measures of our HCP/NCCP should avoid or minimize the potential impacts of forest management on salmonid habitat. There is insufficient data to link forest management to effects on aquatic and riparian habitat and trends in salmonid populations across the plan area. MRC will evaluate the effectiveness of our HCP/NCCP in maintaining or improving salmonid habitat based on the adequacy of our conservation measures to minimize impacts and promote or accelerate natural recovery. MRC monitoring will focus on watersheds and attempt to establish causal linkages between salmonid survival at specific life stages and plan area management. This information will improve our conservation measures through the adaptive management plan.

Over 100 years of forest management has influenced salmonid habitat in MRC streams. Although this influence continues, some aspects of aquatic habitat in MRC streams appear to be recovering from past impacts. Recruitment of LWD to stream channels has likely increased since the mid-1970s compared to previous decades when CDFG called for removal of wood from streams. The CDFG intent was to clean out large debris jams left over from logging operations. Still LWD loading generally remains low in MRC streams. MRC watershed analysis has evaluated sediment inputs to streams in the plan area with initial estimates summarized by CalWater planning watershed. Research in the Caspar Creek Experimental Watershed indicates that the implementation of modern timber harvest practices has reduced sediment inputs to streams compared to previous practices (Cafferata and Spittler 1998).

Many of the most severe or chronic impacts should continue to influence stream habitat across the plan area. Accelerated mass wasting in inner gorges, initially instigated by splash dam

logging, may continue to occur in some areas, potentially causing ongoing channel-bed aggradation. The surface erosion analysis conducted for watershed analysis indicates that roads continue to be a major source of fine sediment in streams. Removal of LWD in recent decades appears to have released sediment stored in channels and facilitated scour of some alluvial channels to bedrock. LWD loading is substantially lower in MRC streams than in streams draining unmanaged forests; as a result many streams have low pool frequency and depth, reduced habitat heterogeneity, and lack of significant sediment storage capacity.

MRC will base our efforts at road abandonment on results of watershed analysis. Our focus will be streamside roads, with an overall goal to decrease road miles in the plan area. We will remove road-stream crossings concurrent with road abandonment. MRC will follow our road management plan in abandoning, designing, constructing, using, and maintaining roads in the plan area. These best management practices should minimize road-related erosion.

By reducing the amount of sediment delivered from roads, the prescriptions of our HCP/NCCP should substantially benefit aquatic habitat in MRC streams. A reduction in fine sediment loading from road-related sources will potentially increase the quality of spawning gravel and incubation success; it will also increase the amount of rearing habitat by reducing pool filling and increasing interstitial space between bed substrates. Moreover, the removal of culverts at road-stream crossings on fish-bearing streams will help ensure unimpeded passage for migrating salmonids. Table 8-20 shows the decommissioned roads, crossings, and culverts in the plan area as of 2009, while Table 8-21 provides estimates for road work within the first 10 years of HCP/NCCP implementation.

Limiting the amount of tractor yarding, especially in inner gorges, should minimize sediment production from hillslopes in most erosion-prone areas. MRC will use cable yarding, which results in less ground disturbance and lower post-logging erosion rates, as the primary yarding method in steeper terrain. In the areas where slopes are generally not as steep (i.e., typically less than 50%), use of tractor yarding will equal or surpass cable yarding.

Density of large trees in MRC riparian zones should increase throughout HCP/NCCP implementation. Our habitat conservation measures for riparian areas retain a percentage of the largest trees, based on channel sensitivity (C§8.2.3.1.4-1). Minimum basal area retention ensures that large trees are abundant in riparian habitat and recruitment of LWD improves (C§8.2.3.1.3-1 to C§8.2.3.1.3-3). By maintaining or increasing LWD recruitment, our HCP/NCCP should increase LWD loading in MRC streams over current levels. This will accelerate recovery from the depleted conditions of stream cleaning. As more LWD is recruited to streams, pool formation and sediment storage will increase; this should enhance the habitat complexity for rearing coho, Chinook salmon, and steelhead. By retaining spawning gravel and organic matter as well as providing rearing habitat, LWD will increase spawning success and cover from predators during the summer rearing period. The deeper pools scoured by LWD could potentially serve as cold water refugia during periods of high water temperature; these deep pools, together with velocity refugia provided directly by pieces of LWD, may increase over-winter survival during periods of high flow. Throughout the term of our HCP/NCCP, such changes will gradually increase production potential and habitat suitability for salmonids within the plan area.

12.2.12.8 Conservation measures to protect salmonid habitat

Strategies in our HCP/NCCP designed to protect salmonid habitat include habitat conservation measures targeted at riparian areas and mass wasting, our road plan, and other management

practices that are part of individual PTHPs. The following measures—all discussed in Chapter 8—will minimize the impacts of timber harvests and roads on salmonid habitat:

- Restrict timber harvests and road construction on potentially unstable hillslopes, including inner gorge areas, to minimize mass wasting potential and episodic delivery of large amounts of sediment to streams.
- Reduce mass wasting from road failures and surface erosion from construction, use, and maintenance of roads.
- Restrict road use to minimize sediment production, including during wet weather.
- Identify, re-close, or abandon improperly closed roads to reduce their sediment contribution.
- Inspect roads regularly to identify problem sources of sediment and prioritize maintenance.
- Restrict use of heavy equipment in AMZs to minimize soil compaction, bank instability, and surface erosion.
- Restrict timber harvest in inner and middle bands of AMZs to minimize effects on water temperature and LWD recruitment.
- Restrict site preparation and burning in AMZs and steep slopes adjacent to watercourses to (a) minimize surface erosion and removal of understory vegetation and (b) maintain LWD for sediment storage.
- Recruit LWD to stream channels to (a) maintain channel stability, pool habitat, instream cover, and sediment storage, and (b) help meter the delivery of sediment to downstream reaches.
- Restrict silvicultural treatments in the inner, middle and outer bands of the AMZ to ensure high levels of canopy shading, tree volume, and basal area.
- Implement standards for the installation of culverts on fish-bearing, Class I streams to ensure unobstructed upstream and downstream fish passage.

12.2.13 Vegetation and wildlife habitat

In some cases, MRC will manage sensitive and rare ecosystems and ecosystem components to ensure continuous functioning across the plan area; snags fall in this category. In other cases, MRC will protect such ecosystems and components to maintain hard-to-replace values for wildlife, such as Type I old-growth stands and rocky outcrops. By altering the distribution and relative abundance of the forest seral stages, we expect timber harvests in conifer and conifer/hardwood stands to mimic early successional stages. MRC will maintain protected conservation areas, such as old growth groves, as late successional stages. To limit disturbance, we will implement habitat conservation measures for wildlife trees, downed wood, old-growth trees and stands, pygmy forest, and rocky outcrops. We will enhance sensitive resources (e.g., by providing screen trees for old growth trees and snags) and rare ecotypes (e.g., by permitting prescribed burning in oak woodlands to mimic natural processes). While some timber harvests will occur within mid and outer bands of AMZs and adjacent forest, MRC will minimize impacts to stream and riparian habitat.

12.2.14 Old-growth and late-successional forest

MRC will protect the remaining old-growth trees in the plan area. The retention of individual old-growth conifer trees and old-growth groves will provide old-growth habitat elements in high and low densities across much of the plan area. In other areas, where we will only schedule limited harvest or no harvest (e.g., unstable areas and AMZs), we expect to maintain or enhance a network of late successional forest features.

Moreover, MRC will continue to manage our matrix forest for ecological values such as those from old growth trees, wildlife trees, and snags which provide wildlife habitat and ecological function. These matrix forests, managed with the proper care, will provide connective tissue between patches of old growth, AMZs, unstable areas, and other important habitat. Over the term of this plan, our AMZ forest stands and unstable areas are likely to develop more characteristics of late successional forest. This increasing trend of late successional forest features should provide beneficial outcomes for species such as the marbled murrelet, northern spotted owl, Vaux's swift, and silver-haired bat.

12.2.15 Forest structural stage diversity

While MRC has relatively few acres of old growth or mature forest, our long term use of uneven-aged management will allow stands to develop late-successional characteristics, such as tall tree height and large diameter, similar to old-growth stands. In general, large diameter classes (>24 in. dbh) will continue to increase in the plan area throughout the plan period. Stands with dominant diameter classes greater than 16 in. will make up most of the plan area over the term of our HCP/NCCP. By the end of that term, we expect the smaller size classes (<16 in. dbh) to decrease from the current estimate of 48% of the plan area to about 5%. The trend toward large trees will be most dramatic in watercourses that have been heavily harvested. In watercourses currently stocked with large trees, the trend will be more gradual.

12.2.16 Habitat elements

Wildlife relies on an abundance and diversity of habitat structural elements, such as large trees, snags, and LWD. MRC computer models allow for projected trends in density of large trees, but not of snags and LWD. According to these models, MRC expects the density of large trees (i.e., > 24 in. dbh) within AMZs of the plan area to increase substantially over the term of our HCP/NCCP. This will allow for a concomitant increase in large snags and LWD as well. The habitat conservation measures for riparian function, which include retaining a percentage of the largest trees per acre in the AMZ at each harvest entry, will ensure that (a) large trees are abundant in riparian habitat and (b) recruitment of large snags and LWD will continue throughout the term of our HCP/NCCP.

Projected patterns in large tree density differ somewhat among WAUs. MRC will generally promote large conifer stands with some very large trees and some very small recruitment trees. Hardwood stands capable of growing conifers will slowly trend toward a condition of conifer-domination. In watersheds that are already well stocked with large conifers and with few hardwood-dominated stands, the pattern of vegetation change will gradually trend toward even larger conifer stands. Where young conifer stands dominate, along with substantial hardwood competition, the pattern of vegetation change will be more dramatic.

With the habitat conservation measures for snags, the density of snags should reach a forest-wide goal of 1 to 2 snags per acre. MRC will retain existing snags across the plan area except where they pose a safety hazard. Snag densities should be highest in AMZs and old-growth management areas. The retention and recruitment of snags, which eventually fall to become LWD, along with the retention guidelines in the habitat conservation measures for downed wood, will provide for the distribution of LWD across the plan area over the term of our HCP/NCCP. Current levels of LWD across the plan area vary somewhat by watershed. There are approximately 6.4 logs per acre with an average diameter ≥ 16 in.

12.2.17 Rare habitats and habitat diversity

MRC expects to maintain the diversity of wildlife habitat in the plan area. We will protect rare habitat features, such as pygmy forest, seeps, springs, rocky outcrops, and natural meadows from disturbance. In addition, we will retain a portion of the hardwood component of conifer/hardwood forest stands during timber harvests, including the diversity of hardwood species and tree sizes that occur under pre-harvest conditions. Retaining islands of hardwood types during rehabilitation harvests across the plan area should allow this now common stand condition (seral-stage) to persist in the plan area but drastically reduce its dominance. Retention and enhancement of the diversity of vegetation types and ecosystem elements in the plan area will provide a diversity of habitat types for wildlife over the term of our HCP/NCCP.

12.2.18 Conservation easements and carbon credits

DEFINITION

A **conservation easement** is a legal agreement between a landowner and a government or non-profit organization that permanently limits use of the land in order to protect its natural, scenic, or historic value. The land is still privately owned and no public access is implied.

MRC currently maintains 2 conservation easements within the plan area:

- NAVARRO RIVER

  Save the Redwoods League holds the conservation easement to an area by the mainstem and north fork of the Navarro River. The easement is 225 ac, along 10 miles of river, immediately adjacent to Navarro River Redwoods State Park. MRC retains ownership of the land, while *Save the Redwoods* retains the harvest rights to the trees on the land.

- COMPTCHE HILL

  MRC completed an easement with Pacific Forest Trust (PFT) that provides “forever wild” protection to approximately 90 ac of mature redwood forest southwest of Comptche. The “forever wild” easement allows for (a) limited harvesting of hazard trees; (b) fuels management; and (c) response to catastrophic events. These allowances require consultation with PFT and maintenance of the property’s conservation value.

MRC is evaluating easement strategies for larger portions of the plan area to ensure permanent protection of old growth, oak woodlands, pygmy forest, the Lower Alder Creek Management Area (LACMA), marbled murrelet enhancement areas, and other special habitats. In addition, we are assessing "working forest" conservation easements to ensure light touch, restoration, and exemplary forestry practices near stream zones throughout the plan area.

12.2.19 Biodiversity

MRC will maintain the diversity of plants and animals in the plan through

- Protection of rare habitat types (O§9.6.2.2-2).
- Conservation strategies for riparian areas (section 8.2.3).
- Preservation and enhancement of late-seral and old-growth forest and habitat elements (O§9.4.2-1 to O§9.4.2-3).

- Ongoing presence of a variety of forest seral stages (O§9.6.1.2-2)
- Control efforts aimed at invasive species and introduced pests (O§9.7.2-1 to O§9.7.2-3).
- Minimization of interference with natural processes (O§9.6.1.2-1 to O§9.6.1.2-3)
- Establishment and maintenance of conservation easements (C§9.4.3.1-2 and Table 7-1).

Our HCP/NCCP will ensure that aquatic, riparian, and terrestrial ecosystems support the biological diversity that occurs in coastal Mendocino County.

12.3 Assessment of Take

For each covered species in the plan area, this section estimates the amount of take from covered activities. The specific method for estimating takes varies by species. In general, the bases for assessments of take are (a) field surveys; (b) observational data; (c) computer modeling of habitat impacts due to harvests; and (d) estimates of the effects of management activities. MRC typically conducted impact assessments by overlaying GIS maps showing the locations of covered activities with computer models of species habitat or natural communities. The basis for the location and distribution of the covered species in the region and in the plan area is survey data and historical information. MRC assessed activities within the plan area and possible effects on covered species qualitatively or quantitatively, depending on the data available. For the most part, estimates assume a "reasonable worst-case scenario" in which covered activities occur over the maximum area and intensity possible. As a result, we typically **overestimated** the amount of take that will actually occur during the term of our HCP/NCCP. Analyses may also assume that all suitable habitat is occupied, which will overestimate direct effects on covered species.

12.3.1 Coho salmon

12.3.1.1 Location and distribution in the plan area

Chapter 4 (section 4.2) provides a detailed species account of coho salmon, including geographic distribution, local distribution in the plan area, population trends, life history, and habitat requirements.

12.3.1.2 Suitable habitat in the plan area

Table 3-8 provides historical data on aquatic habitat conditions for major streams and rivers in the plan area from 1998 to 2008. This data is the basis for designating *potential suitable habitat* for coho salmon. This potential suitable habitat includes all Class I streams and associated riparian habitat within a 300-ft wide AMZ (150 ft on either bank) up to the natural limit of anadromy (i.e., the most downstream naturally-occurring fish passage barrier) where there is documented historical occurrence of coho salmon.

For Southern Oregon/Northern California Coasts coho salmon, a combined total of 44.8 stream miles and 5578.42 ac of known occupied and potential suitable habitat may be present in the plan area (Table 12-4); likewise, for the Central California Coast coho salmon, a combined total of 335 stream miles and 41,598.47 ac (Table 12-5).

12.3.1.3 Covered activities adjacent to suitable habitat

Coho salmon depend on the condition of surrounding forests and rangelands. The condition of the watersheds that drain these forests and rangelands controls the physical structure and chemical composition of the streams in which fish migrate, spawn, and rear. While there have been many studies on the effects of land use, including forest management, on aquatic ecosystems, the relationships between land use and stream productivity are complex.

MRC covered activities with the most potential to adversely affect coho salmon and their habitat are

- Timber harvest (harvesting, yarding, loading, and hauling).
- Construction, reconstruction, and maintenance of landings and skid trails.
- Construction and maintenance of roads.
- Construction and maintenance of stream crossings and culverts.

These activities can (a) alter natural hydrology; (b) lead to an increase in sediment input and turbidity; (c) reduce stream bank stability and input of LWD to streams; (d) reduce stream shade and floodplain connectivity; and (e) degrade water quality.

Changes in the distribution of precipitation reaching the ground, evaporation rates, the amount of precipitation intercepted by vegetation, and the amount of precipitation stored in the soil may impact runoff (Meehan 1991). Changes in natural flow regimes may, in turn, impact coho salmon. The timing and magnitude of stream flows, for example, provide the environmental cues for adult and juvenile migrations. This timing may cause dewatering of redds, displacement of fry or juveniles, or scouring of spawning gravels. Because juvenile coho salmon rear in freshwater for a year before emigrating to the ocean, potential changes to summer flows could affect the productivity of coho salmon.

Timber operations and road construction or maintenance that results in ground-disturbance could alter the rate and pathways of water movement resulting in erosion, road failures, landslides, sediment transport, and ultimately delivery to streams. Increases in sedimentation and turbidity affect fish physiology, behavior, and habitat. Physiological effects of turbidity on salmonids include gill trauma, altered blood sugar levels, and osmoregulatory function. Behavioral effects include avoidance of high turbidity, changes in foraging ability, increased predation risk, and reduced territoriality. Fine sediment may reduce salmonid spawning and rearing habitat quality and quantity. Deposition of excessive fine sediment on the stream bottom could (a) eliminate habitat for aquatic insects; (b) reduce density, biomass, number, and diversity of aquatic insects and vegetation; (c) reduce permeability of spawning gravel; and (d) block the interchange of surface and subsurface waters. Increases in fine sediments in low velocity stream reaches could also cover spawning gravel or reduce the number, volume, and depth of pools. Increases in fine sediments in low velocity stream reaches could also cover spawning gravel or reduce the number, volume, and depth of pools. Existing and future road crossings can result in the creation of barriers to fish migration. Barriers could reduce the amount of available habitat for spawning and rearing; this might lead to increases in predation of adults.

Substantial sediment input and deposition could (a) cause channel braiding; (b) increase width-to-depth ratios; (c) increase incidence and severity of bank erosion; (d) reduce pool volume and frequency; and (e) increase subsurface flow. In general, these actions tend to reduce habitat values by reducing the structural and hydraulic complexity of natural channels and preventing channel processes that sustain these values.

Despite conservation measures in place to reduce sediment inputs (section 8.3.3), harm to coho salmon will still occur under our HCP/NCCP; local habitat conditions will continue to impair the ability of individual fish to grow, rear, migrate, or spawn. However, MRC will substantially reduce sediment delivery within the plan area by (a) reducing the potential for mass wasting; (b) upgrading the road network; (c) decommissioning roads; (d) applying stringent conditions to the development of new roads; and (e) designating 50% of our road network to temporary use. All of these actions will reduce impacts to coho salmon and improve habitat conditions which currently

may impair the survival rates of coho eggs and juveniles. Through monitoring and adaptive management, MRC will ensure, at a minimum, that

- Stream gravel permeability will, on average, approach or exceed 10,000 cm/hr across stream reaches.
- Percent of fine material < 0.85 mm will, on average, approach < 7% across stream reaches (using dry sieve techniques).
- Proportion of fine sediment in pools will, on average, approach < .21 across stream reaches (using V-Star methodology).

The removal of streamside vegetation during timber operations and road construction can reduce the number of trees available for recruitment to streams and affect the coverage and health of vegetation. Vegetation provides structural stability to stream banks. A reduction in vegetation could lead to a reduction in structural complexity in channels and cover within streams. Large wood is an important component of salmonid habitat in streams. Canopy removal that increases exposure of streams to solar radiation can increase water temperatures and the magnitude of daily temperature fluctuations. Temperature change can have direct and indirect effects on the growth, survival, and reproduction of fish.

The use of heavy equipment could result in accidental spills or inadvertent discharges of petroleum products (i.e., fuels, lubricants, and hydraulic fluids). The spill or accidental discharge of these materials adjacent to, or in a water body, could potentially affect the water quality of a stream, river, or wetland and thereby directly affect fish or their prey.

Water drafting has the potential to adversely affect coho salmon through (a) excessive withdrawal rates that reduce available water; (b) high intake velocities that entrain fish; and (c) inadequately-sized intake screens that allow fish to pass through. Withdrawing water from Class I streams with coho salmon present from April 1 to November 15 could interrupt smolt migration, de-water redds, and reduce juvenile rearing habitat for up to 24 hours, depending on the water recovery rate.

Water drafting demonstrably affects flow 450 ft or more downstream of the water drafting site (MRC 2002). All use of water drafting sites is episodic. MRC may not use a waterhole for several years, next use it for its allowed maximum capacity for 1-2 years, and then leave it alone for several more years. We use some drafting sites along mainline roads annually.

Other covered activities with the potential to adversely affect coho salmon include stream habitat improvement, as well as research and monitoring activities. Habitat improvement can lead to short-term increases in turbidity and sedimentation. However, the magnitude of these effects would be much less than those incurred with timber operations. Moreover, habitat improvement would ultimately benefit fish.

Research and monitoring activities could result in direct and indirect effects on fish. Fish surveys requiring the capture or handling of fish (e.g., electrofishing, trapping, and netting) may affect the growth or survival of juvenile coho salmon. Stream surveys could interfere with migration and spawning of fish; they could also result in the crushing and trampling of eggs in redds. Moreover, improper stream classification could trigger reduced protections to stream reaches (e.g., reduced buffer widths), thereby adversely impacting fish.

12.3.1.4 Mitigation that offsets the effects of forest management

MRC protects and conserves all 3 covered salmonids (coho salmon, Chinook salmon, and steelhead) and their respective life stages by focusing on their aquatic habitat. We have adopted standard conservation measures for all Class I streams because all salmonid life stages may be present in all fish-bearing streams at any time. AMZs support, in one way or another, the unique habitat requirements of each of the salmonid species. Our approach avoids the problems of single-species management. Overall, our conservation measures include

- Stream buffers.
- Improvements to riparian areas and enhancement of riparian functions.
- Equipment exclusion zones and restricted harvest in AMZs.
- Reduction of sediment input to streams from roads and timber harvests.
- Monitoring stream flows during water drafting.
- Culvert upgrades.
- Enhancement of stream habitat.
- Monitoring surveys.

Combined, these measures will reduce sediment input to streams, avoid creating barriers to fish migration, and enhance riparian function while at the same time minimizing impacts in AMZs. This will ensure that take of Central California Coast coho salmon is also minimized or avoided. In addition, the proposed and ongoing survey and monitoring efforts will ensure that MRC identifies occupied and suitable habitat for coho salmon. If future surveys result in the designation of additional Class I streams or determine new reaches where suitable habitat for coho salmon exist, MRC will afford these streams and reaches the conservation measures adopted for the 3 covered salmonids.

12.3.1.5 Level of expected take

MRC conservation measures should minimize the incidental take of Southern Oregon/Northern California Coast and Central California Coast coho salmon because they protect (a) water quality (e.g., from turbidity, increased water temperature, and pollutants); (b) spawning substrate (e.g., by avoidance or reduction in anthropogenic sediment loading); (c) flow disruption (e.g., by following water drafting guidelines); and (d) habitat complexity (e.g., through bank stability, increased pool depth, improved riparian function, and recruitment of LWD). In addition, implementation of habitat improvements, such as replacement of instream structures, channel realignment, and bedload reduction should benefit coho salmon, especially in areas that have not yet recovered from the impacts of historical logging practices.

If MRC does not accurately designate stream classes, this could result in reduced protections and habitat quality for coho salmon. However, we believe this potential risk of take is low. MRC will ensure accurate classification of stream channels and identification of key habitat through watershed analysis, biological monitoring (fish and habitat surveys), and other related riparian strategies.

Some direct take of coho salmon (Central California Coast ESU) may occur as a result of water drafting. An MRC study (2002) of water drafting recorded the time it took 52 waterholes to fully recover from pumping and how far downstream flow was affected. MRC staff measured flow downstream at intervals of 43 ft, 95 ft, 220 ft, 330 ft, and 450 ft. They observed flow reduction up to 450 feet downstream of the drafting site.

For coho salmon (Southern Oregon /Northern California Coast ESU), there are 7 water drafting sites in Hollow Tree Creek. MRC classified 5 sites as recovering fast (in less than 6 hours) and 1

site as slow to recover (in 24 hours). For coho salmon (Central California Coast ESU), there are 55 water drafting sites in potential coho habitat. MRC classified 26 of these sites as recovering fast, 13 as recovering slowly, and 9 as undetermined. Water drafting could result in direct take of coho eggs by dewatering redds or indirect take of juvenile or smolt coho salmon by reducing rearing or migratory habitat for up to 24 hours. In our HCP/NCCP *Atlas*, MAPS 22A-C show the water drafting sites in the plan area and MAPS 23A-C show the waterhole recovery rate for coho salmon.

MRC proposes to minimize impacts of water drafting by not

- Withdrawing more than 10% of the daily above-surface flow.
- Reducing maximum pool depth by more than 10%.
- Drafting in watercourses that have less than 1 cfs of surface flow.

To address intake velocities and screen size, MRC will follow water drafting guidelines prepared by NMFS (1997). We will also follow other guidelines described in Appendix E, section E.7, *Standards for Water Drafting*.

In the plan area, the take of coho salmon (Southern Oregon/Northern California Coast ESU and Central California Coast ESU) will most likely occur at waterholes when there is a reduction in the flow of water. We decided to capture the effect of drafting both at the waterhole and 200m downstream from the waterhole. In order to quantify take, we averaged the width of drafting holes across the property; this came out to be 4m. We then multiplied the average waterhole width (4m) by the selected downstream length (200m). Fish densities across the plan area vary annually as well as site-to-site. Based on MRC data for the plan area, the average of mid-to-high densities is 1 coho/m^2. The amount of waterholes which MRC will use per year will vary depending on the number and location of projects across the plan area. We estimated that in years of heavy activity, we may use approximately 4 sites in the SONCC ESU and 8 sites in the CCC ESU. Incorporating all this information, the equation for the number of CCC coho potentially harassed is: 1 coho/m^2*(4m*200m) *8 sites = 6400 coho per year. Similarly, the equation for the number of SONIC coho potentially harassed is: 1 coho/m^2*(4m*200m) *4 sites = 3200 coho per year. Table 12-3 shows the potential take of coho from water drafting for the 80-year term of our HCP/NCCP. Tables 12-4 and 12-5 show the potential impacts for coho habitat for that same time period.

Table 12-3 Potential Take of Coho from Water Drafting

Potential Take From Water Drafting in the Plan Area								
Decades								
1	2	3	4	5	6	7	8	Total
Central California Coast (CCC) Coho Salmon								
64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	512,000
S. Oregon/N. California Coasts (SONCC) Coho Salmon								
32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	256,000

Table 12-4 Coho Salmon - SONCC

Total Stream Miles, Habitat Acres, and Habitat Harvested in the Plan Area for Southern Oregon/Northern California Coasts (SONCC) Coho Salmon										
WAU	**Miles of Class I Streams**	**Total Acres of Class I Habitat (AMZs)**	**Potential Acres Harvested Within Class I Habitat By Decade**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
* Hollow Tree Creek	44.8	5,578.42	-	-	57	251	673	748	861	788
Total	**44.8**	5,578.42	0	0	57	251	673	748	861	788
			****Total Acres Harvested = 3378**							

TABLE NOTES
* Indicates a known occurrence of the species. The species may not currently occupy all Class I streams in the watershed.
** Total Acres Harvested is the total number of acres harvested by decade and can include the same area previously harvested. Because of the overlap, the actual amount of newly harvested habitat may be less than the estimate.

Table 12-5 Coho Salmon - CCC

Total Stream Miles, Habitat Acres, and Habitat Harvested in the Plan Area for Central California Coast (CCC) Coho Salmon										
WAU	**Miles of Class I Streams**	**Total Acres of Class I Habitat (AMZs)**	**Potential Acres Harvested Within Class I Habitat By Decade**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
*Cottaneva Creek	12.8	1,607.49	-	-	16	59	194	132	242	151
Rockport Small Coastal Streams	17.3	2,098.76	-	-	-	-	81	168	183	334
*Noyo River	34.8	4,510.82	-	24	86	186	252	418	520	565
*Big River	71.8	8,500.61	-	10	191	387	350	732	904	1056
*Albion River	31	3,955.54	21	55	113	225	357	464	486	501
*Navarro River	106.3	13,422.42	40	81	336	550	834	1174	1138	1464
Greenwood Creek	19.9	2,490.81	-	-	196	173	321	227	355	250
*Elk Creek	20.3	2,394.51	5	10	144	343	453	417	487	428
*Garcia River	20.8	2,617.51	17	50	78	133	132	222	210	270
WAU Total	335.00	41,598.47	83	230	1160	2056	2974	3954	4525	5019
* WAU Total	**297.80**	**37,008.90**	****Total Acres Harvested = 20,001**							

TABLE NOTES
* Indicates a known occurrence of the species. The species may not currently occupy all Class I streams in the watershed.
** Total Acres Harvested is the total number of acres harvested by decade and can include the same area previously harvested. Because of the overlap, the actual amount of newly harvested habitat may be less than the estimate.

Research and monitoring activities, such as fish distribution and abundance monitoring as well as fish habitat surveys, could result in mortality, injury, or harassment to individual salmonids. This result would stem from capture and handling, as well as subsequent interference with feeding,

migration, or spawning. Electrofishing and out-migrant trapping have the greatest potential for mortality or injury to salmonids. However, MRC will reduce the potential for mortality of individuals by limiting electrofishing to periods when water temperatures are no warmer than 18 degrees C. Moreover, MRC research will increase information about the distribution of salmonids in the plan area. This new data will improve the accuracy of stream class designations and decrease the risk of potential take of coho salmon from forest management.

MRC uses out-migrant trapping to estimate the number of Central California Coast coho moving from Little North Fork Navarro and South Fork Albion to the ocean. Later in the year, we monitor how many of them return from the ocean to these same rivers to spawn. Over the term of our HCP/NCCP, potential take from out-migrant trapping may result from capturing, anesthetizing, handling, fin clipping, and releasing coho juveniles. Table 12-6 provides an estimate of potential take based on our current permit allowances prior to implementation of our HCP/NCCP. Future projections assume a modest increase in capture rates due to increased levels of monitoring and increases in population size. The estimates in Table 12-6 (row 1) refer to the number of coho juveniles that MRC is legally permitted to temporarily capture for the purposes of monitoring. Incidental mortality of juveniles from such capture must not exceed 2% of this number. Occasionally, adult coho are incidentally caught in an out-migrant trap. The estimates in Table 12-6 (row 2) show the potential number of coho adults that might be caught in a trap and released throughout the term of the HCP/NCCP.

Table 12-6 Coho Salmon—Central California Coast (CCC)

Potential Take from Out-migrant Trapping of Adult and Juvenile Stages of Coho Salmon (CCC)											
Little North Fork Navarro and South Fork Albion											
Species	**ESU**	**Pre-NCCP/HCP**	**Years Post HCP/NCCP Implementation**								
			10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**Total**
Coho Salmon (juvenile)	CCC	45,000*	45,000	45,000	50,000	50,000	55,000	55,000	60,000	60,000	420,000
Coho Salmon (adult)	CCC	0**	20	20	20	20	20	20	30	30	180
Totals		45,000	45,020	45,020	50,020	50,020	55,020	55,020	60,030	60,030	420,180

TABLE NOTES

* Denotes current allowed annual take for pre-HCP/NCCP monitoring and research multiplied by 10 years for comparison.

**Denotes adult life stages incidentally captured. Pre-HCP/NCCP numbers are based on actual data (averages) multiplied by 10 years for comparison.

Table 12-7 provides an estimate of potential take from Annual Salmonid Monitoring Basins (M§13.6.1.1-1) and Anadromous Salmonid Distribution monitoring (M§13.6.1.1-2). The estimate of potential take is based on our current permit allowances prior to implementation of our HCP/NCCP. Potential take may result from capturing, anesthetizing, handling, and releasing coho juveniles. Based on the number of survey sites (roughly 500 survey sites maximum per year) and the tendency to avoid harassment (by ceasing surveys after MRC staff detect 1 individual of each species), the current take allotment would be sufficient throughout the term of our HCP/NCCP. If populations expand and our ability to detect salmonid species improves over time, the overall take of covered salmonids due to monitoring may actually decline, based on proposed non-invasive sampling.

Table 12-7 Coho Salmon – SONCC and CCC

Potential Take from ASMB and Salmonid Distribution Monitoring of Coho Salmon (SONCC and CC) Juvenile Life Stages											
Species	**ESU**	**Pre-NCCP/HCP**	**Years Post HCP/NCCP Implementation**								
			10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**Total**
Coho Salmon (juveniles)	SONCC	10,000*	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	80,000
Coho Salmon (juveniles)	CCC	10,000*	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	80,000
Total		20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	160,000

TABLE NOTES
* Denotes current allowed take for pre-HCP/NCCP monitoring and research multiplied by 10 years for comparison.

Fine sediment delivery from MRC covered activities will continue to impair the emergence success of coho fry, but at a lesser rate than currently experienced. As a result of HCP/NCCP improvements in gravel permeability, pool quantity, and pool quality, we expect increases in coho egg survival-to-emergence and juvenile abundance.

Migration barriers due to stream crossings will continue under HCP/NCCP implementation. However, MRC will decommission roads and remove stream crossings. Decommissioning roads will decrease sediment delivery to streams and removal of stream crossings will facilitate increased migration.

12.3.2 Chinook salmon

12.3.2.1 Location and distribution in the plan area

Chapter 4 (section 4.3) provides a detailed species account of Chinook salmon, including geographic distribution, local distribution in the plan area, population trends, life history, and habitat requirements.

12.3.2.2 Suitable habitat in the plan area

Table 3-8 provides historical data on aquatic habitat conditions for major streams and rivers in the plan area from 1998 to 2008. This data is the basis for designating *potential suitable habitat* for Chinook salmon. This potential suitable habitat includes all Class I streams and associated riparian habitat within a 300-ft wide AMZ (150 ft on either bank) up to the natural limit of anadromy (i.e., the most downstream naturally-occurring fish passage barrier) where there is documented historical occurrence of Chinook salmon.

For California Coastal fall-run Chinook salmon, a combined total of 203 stream miles and 25,162.9 ac of known occupied and potential suitable habitat may be present in the plan area (Table 12-10). MRC assumes that suitable habitat for Chinook salmon is in the creek reaches that historically supported the species or currently do so.

12.3.2.3 Covered activities adjacent to suitable habitat

Chinook salmon depend on the condition of surrounding forests and rangelands. The condition of the watersheds that drain these forests and rangelands controls the physical structure and chemical composition of the streams in which fish migrate, spawn, and rear. While there have been many studies on the effects of land use, including forest management, on aquatic ecosystems, the relationships between land use and stream productivity are complex.

MRC covered activities with the most potential to adversely affect Chinook salmon and their habitat are

- Timber harvest (harvesting, yarding, loading, and hauling).
- Construction, reconstruction, and maintenance of landings and skid trails.
- Construction and maintenance of roads.
- Construction and maintenance of stream crossings and culverts.

These activities can (a) alter natural hydrology; (b) lead to an increase in sediment input and turbidity; (c) reduce stream bank stability and input of LWD to streams; (d) reduce stream shade and floodplain connectivity; and (e) degrade water quality.

Changes to the distribution of precipitation reaching the ground, evaporation rates, the amount of precipitation intercepted by vegetation, and the amount of precipitation stored in the soil may impact runoff (Meehan 1991). Changes in natural flow regimes may, in turn, impact Chinook salmon. The timing and magnitude of stream flows, for example, provide the environmental cues for adult and juvenile migrations. This timing may cause dewatering of redds, displacement of fry or juveniles, or scouring of spawning gravels. Because juvenile Chinook salmon typically emigrate to the ocean before summer, potential changes to summer flows tend to have minimal effect on the productivity of Chinook salmon.

Timber operations and road construction or maintenance that results in ground-disturbance could alter the rate and pathways of water movement resulting in erosion, road failures, landslides, sediment transport, and ultimately delivery to streams. Increases in sedimentation and turbidity affect fish physiology, behavior, and habitat. Physiological effects of turbidity on salmonids include gill trauma, altered blood sugar levels, and osmoregulatory function. Behavioral effects include avoidance of high turbidity, changes in foraging ability, increased predation risk, and reduced territoriality. Fine sediment may reduce salmonid spawning and rearing habitat quality and quantity. Deposition of excessive fine sediment on the stream bottom could (a) eliminate habitat for aquatic insects; (b) reduce density, biomass, number, and diversity of aquatic insects and vegetation; (c) reduce permeability of spawning gravel; and (d) block the interchange of surface and subsurface waters. Increases in fine sediments in low velocity stream reaches could also cover spawning gravel or reduce the number, volume, and depth of pools. Existing and future road crossings can result in the creation of barriers to fish migration. Barriers could reduce the amount of available habitat for spawning and rearing, and lead to increases in predation of adults.

Substantial sediment input and deposition could (a) cause channel braiding; (b) increase width-to-depth ratios; (c) increase incidence and severity of bank erosion; (d) reduce pool volume and frequency; and (e) increase subsurface flow. In general, these actions tend to reduce habitat values by reducing the structural and hydraulic complexity of natural channels and preventing channel processes that sustain these values.

Despite conservation measures in place to reduce sediment inputs (section 8.3.3), harm to Chinook salmon will still occur under our HCP/NCCP; local habitat conditions will continue to impair the ability of individual fish to grow, rear, migrate, or spawn. However, MRC will substantially reduce sediment delivery within the plan area by (a) reducing the potential for mass wasting; (b) upgrading the road network; (c) decommissioning roads; (d) applying stringent conditions to the development of new roads; and (e) designating 50% of our road network to temporary use. All of these actions will reduce impacts to Chinook salmon and improve habitat conditions which currently may impair the survival rates of Chinook eggs and juveniles. Through monitoring and adaptive management, MRC will ensure, at a minimum, that

- Stream gravel permeability will, on average, approach or exceed 10,000 cm/hr across stream reaches.

- Percent of fine material < 0.85 mm will, on average, approach < 7% across stream reaches (using dry sieve techniques).
- Proportion of fine sediment in pools will, on average, approach < .21 across stream reaches (using V-Star methodology).

The removal of streamside vegetation during timber operations and road construction can reduce the number of trees available for recruitment to streams and affect the coverage and health of vegetation. Vegetation provides structural stability to stream banks. A reduction in vegetation could lead to a reduction in structural complexity in channels and cover within streams. Large wood is an important component of salmonid habitat in streams. Canopy removal that increases exposure of streams to solar radiation can increase water temperatures and the magnitude of daily temperature fluctuations. Temperature change can have direct and indirect effects on the growth, survival, and reproduction of fish.

The use of heavy equipment could result in accidental spills or inadvertent discharges of petroleum products (i.e., fuels, lubricants, and hydraulic fluids). The spill or accidental discharge of these materials adjacent to, or in a water body, could potentially affect the water quality of a stream, river, or wetland and thereby directly affect fish or their prey.

Water drafting has the potential to adversely affect Chinook salmon through (a) excessive withdrawal rates that reduce available water; (b) high intake velocities that entrain fish; and (c) inadequately-sized intake screens that allow fish to pass through. Withdrawing water from Class I streams with Chinook salmon present from April 1 to November 15 could interrupt juvenile migration and reduce juvenile rearing habitat for up to 24 hours, depending on the water recovery rate.

Other covered activities with the potential to adversely affect Chinook salmon include stream habitat improvement, as well as research and monitoring activities. Habitat improvement can lead to short-term increases in turbidity and sedimentation. However, the magnitude of these effects would be much less than those incurred with timber operations. Moreover, habitat improvement would ultimately benefit fish.

Research and monitoring activities could result in direct and indirect effects on fish. Fish surveys requiring the capture or handling of fish (e.g., electrofishing, trapping, and netting) may affect the growth or survival of juvenile Chinook salmon. Stream surveys could interfere with migration and spawning of fish; they could also result in the crushing and trampling of eggs in redds. Moreover, improper stream classification could trigger reduced protections to stream reaches (e.g., reduced buffer widths), thereby adversely impacting fish.

12.3.2.4 Mitigation that offsets the effects of forest management

MRC protects and conserves all 3 covered salmonids (coho salmon, Chinook salmon, and steelhead) and their respective life stages by focusing on their aquatic habitat. We have adopted standard conservation measures for all Class I streams because all salmonid life stages may be present in all fish-bearing streams at any time. AMZs support, in one way or another, the unique habitat requirements of each of the salmonid species. Our approach avoids the problems of single-species management. Overall, the MRC conservation measures include

- Stream buffers.
- Improvements to riparian areas and enhancement of riparian functions.
- Equipment exclusion zones and restricted harvest in AMZs.
- Reduction of sediment input to streams from roads and timber harvests.

- Monitoring stream flows during water drafting.
- Culvert upgrades.
- Stream habitat enhancement.
- Monitoring surveys.

Combined, these measures will reduce sediment input to streams, avoid creating barriers to fish migration, and enhance riparian function while at the same time minimizing impacts in AMZs. All this, along with the protections for coho salmon and steelhead, will ensure that take of California Coastal fall-run Chinook salmon is also minimized or avoided. In addition, the proposed and ongoing survey and monitoring efforts will ensure that MRC identifies occupied and suitable habitat for fall-run Chinook salmon.

12.3.2.5 Level of expected take

MRC conservation measures should minimize the incidental take of California Coastal Chinook salmon because they protect (a) water quality (e.g., from turbidity, increased water temperature, and pollutants); (b) spawning substrate (e.g., by avoidance or reduction in sediment loading); and (c) habitat complexity (e.g., through bank stability, increased pool depth, improved riparian function, and recruitment of LWD). In addition, implementation of habitat improvements, such as replacement of instream structures, channel realignment, and bedload reduction should benefit Chinook salmon, especially in areas that have not yet recovered from the impacts of historical logging practices.

If MRC does not accurately designate stream classes, this could result in reduced protection and habitat quality for Chinook. However, we believe this potential risk of take resulting from inaccurate designation of stream classes is low because MRC will ensure accurate classification of stream channels and identification of key habitat through watershed analysis, biological monitoring (fish and habitat surveys), and other related riparian strategies.

Some direct take of California Coastal Chinook salmon may occur as a result of water drafting. For Chinook salmon, there are 7 water drafting sites in Hollow Tree Creek and the Albion River (*HCP/NCCP Information Atlas*, MAPS 24A-B). We classified 6 sites as recovering fast (in less than 6 hours) and 1 site as slow to recover (in 24 hours). However, we identify these sites based on habitat present, not current distribution. Impacts from water drafting on Chinook would not be as great as on coho or steelhead. To minimize impacts to Chinook salmon, we propose measures similar to those for coho salmon. The amount of take of Chinook salmon would be less than coho salmon because of their limited habitat in the plan area and the timing of their spawning and juvenile migration; Chinook leave the streams for more estuarine habitat early in the spring when MRC is typically not water drafting. Some take may occur as a result of water drafting activities, but we cannot quantify the take.

Research and monitoring activities, such as fish distribution and abundance monitoring as well as fish habitat surveys, could result in harm to individual salmonids. This could stem from capture, handling, and subsequent interference with feeding, migration, or spawning. Electrofishing and out-migrant trapping would have the greatest potential for harm. However, MRC will reduce the potential for mortality of individuals by only using electrofishing when water temperatures are 18 degrees C or less. Moreover, MRC research will increase information about the distribution of salmonids in the plan area. This data will improve the accuracy of stream class designations and decrease the risk of potential take of Chinook salmon from forest management.

Table 12-8 provides an estimate of potential take of California Coastal Chinook salmon from out-migrant trapping. Potential take could be due to capturing, anesthetizing, handling, and releasing Chinook juveniles. Currently Chinook salmon are not included in the MRC permit for out-migrant trapping because, so far, we have not confirmed their presence at the trapping locations in Little North Fork Navarro or South Fork Albion. If they do occur during the permit term, the numbers stated should remain accurate given the episodic nature of the species. Of the two locations, Chinook are most likely to occur in South Fork Albion.

Table 12-8 California Coastal (CC) Chinook Salmon

Potential Take from Out-migrant Trapping of California Coastal (CC) Chinook Salmon											
Little North Fork Navarro and South Fork Albion											
Species	**ESU**	**Pre-NCCP/ HCP**	**Years Post HCP/NCCP Implementation**								
			10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**Total**
Chinook Salmon	CC	0*	500	1000	1000	1000	1500	1500	1500	2000	10,000

TABLE NOTES
* Denotes current allowed annual take for pre-HCP/NCCP monitoring and research multiplied by 10 years for comparison.

Table 12-9 provides an estimate of potential take from Annual Salmonid Monitoring Basins (M§13.6.1.1-1), Chinook Salmon Monitoring Reaches (M§13.6.1.1-3), and Anadromous Salmonid Distribution monitoring (M§13.6.1.1-2).

Table 12-9 California Coastal (CC) Chinook Salmon

Potential Take from ASMB, CSMR, and Salmonid Distribution Monitoring of Chinook (CC) Juvenile Life Stages											
Species	**ESU**	**Pre-NCCP/ HCP**	**Years Post HCP/NCCP Implementation**								
			10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**Total**
Chinook Salmon **	CC	100*	2000	2000	3000	3000	4000	4000	5000	5000	28,000

TABLE NOTES
* Current allowed take for pre-HCP/NCCP monitoring and research multiplied by 10 years.
**Categories for proposed snorkel surveys for Chinook salmon are (a) observe or harass and (b) no capture.

MRC cannot precisely determine the number of covered salmonids that will be harmed or harassed during our forest management activities. We have chosen to use management disturbance within 150 ft of Class I streams as a surrogate for such harm or harassment. Harm to covered species may result from degradation to aquatic habitat (e.g., harvested acres, loss of LWD recruitment, and sediment inputs) and harassment from elevated levels of turbidity in the streams, as well as other factors. Covered activities could impact 10 to 1056 ac per decade of riparian habitat in the California Coastal Chinook salmon ESU (Table 12-10). Over the course of the permit term, covered activities could impact up to 12,393 ac of riparian habitat for that ESU (Table 12-10). However, our conservation measures will ensure higher densities of larger trees in Class I streams which in turn will provide higher rates of LWD recruitment and water quality benefits. If MRC conservation measures prove to be unsuccessful, take of an undetermined number of Southern Oregon/Northern California Coast coho salmon and Central Coast coho salmon could result. However, we do not expect them to be unsuccessful. Instead we anticipate that our conservation measures will improve the aquatic habitat for all life stages of salmonids.

All Chinook salmon in the plan area are in Class I streams (i.e., fish bearing streams). MRC estimates that there are 409.5 miles of Class I streams within the plan area (see *HCP/NCCP Atlas*, MAPS 18A-C). The total length of Class I streams for watersheds where Chinook salmon could potentially occur is 110.6 miles (Table 12-10).

Table 12-10 California Coastal (CC) Chinook Salmon

California Coastal Chinook Salmon										
Total Stream Miles, Habitat Acres, and Habitat Harvested										
WAU	Miles of Class I Streams	Total Acres of Class I Habitat (AMZs)	Potential Acres Harvested Within Class I Habitat							
			By Decade							
			1	2	3	4	5	6	7	8
*Hollow Tree Creek	44.8	5,578.42	-	-	57	251	673	748	861	788
*Noyo River	34.8	4,510.82	-	24	86	186	252	418	520	565
Big River	71.8	8,500.61	-	10	191	387	350	732	904	1,056
*Albion River	31	3,955.54	21	55	113	225	357	464	486	501
Garcia River	20.8	2,617.51	17	50	78	133	132	222	210	270
WAU Total	203.2	25,162.90	38	139	525	1182	1764	2584	2981	3180
* WAU Total	**110.6**	**14,044.78**	****Total Acres Harvested = 12,393**							

TABLE NOTES
* Indicates a known occurrence of the species. The species may not currently occupy all Class I streams in the watershed.
** This is the total number of acres harvested by decade and can include areas previously harvested. Because of this overlap, the actual amount of harvested habitat may be less than the estimate.

Fine sediment delivery from covered activities will continue to impair the emergence success of Chinook fry, but at a lesser rate than currently experienced. As a result of HCP/NCCP improvements in gravel permeability, pool quantity, and pool quality, we expect increases in coho egg survival-to-emergence and juvenile abundance.

Migration barriers due to stream crossings will continue under HCP/NCCP implementation. However, MRC will decommission roads and remove stream crossings. Decommissioning roads will decrease sediment delivery to streams and removal of stream crossings will facilitate increased migration.

12.3.3 Steelhead

12.3.3.1 Location and distribution in the plan area

Chapter 4 (section 4.4) provides a detailed species account of steelhead, including geographic distribution, local distribution in the plan area, population trends, life history, and habitat requirements.

12.3.3.2 Suitable habitat in the plan area

Table 3-8 provides historical data on aquatic habitat conditions for major streams and rivers in the plan area from 1998 to 2008. For purposes of this analysis, potential suitable habitat for steelhead

includes all Class I streams within the plan area and associated riparian habitat up to the natural limit of anadromy (i.e., the most downstream naturally-occurring fish passage barrier).

For Northern California steelhead, a total of 401 stream miles and 49,902.77 ac of known occupied and potential suitable habitat may be present in the plan area (Table 12-14); likewise, for Central California Coast steelhead, a total of 8.5 stream miles and 1004.10 ac (Table 12-15).

12.3.3.3 Covered activities adjacent to suitable habitat

Steelhead trout depend on the condition of surrounding forests and rangelands. The condition of the watersheds that drain these forests and rangelands controls the physical structure and chemical composition of the streams in which fish migrate, spawn, and rear. While there have been many studies on the effects of land use, including forest management, on aquatic ecosystems, the relationships between land use and stream productivity are complex.

MRC covered activities with the most potential to adversely affect steelhead trout and their habitat are

- Timber harvest (harvesting, yarding, loading, and hauling).
- Construction, reconstruction, and maintenance of landings and skid trails.
- Construction and maintenance of roads.
- Construction and maintenance of stream crossings and culverts.

These activities can alter natural hydrology; lead to an increase in sediment input and turbidity; reduce stream bank stability and input of LWD to streams; reduce stream shade and floodplain connectivity; and degrade water quality.

Changes to the distribution of precipitation reaching the ground, evaporation rates, the amount of precipitation intercepted by vegetation, and the amount of precipitation stored in the soil may impact runoff (Meehan 1991). Changes in natural flow regimes may, in turn, impact steelhead trout. The timing and magnitude of stream flows, for example, provide the environmental cues for adult and juvenile migrations. This timing may cause dewatering of redds, displacement of fry or juveniles, or scouring of spawning gravels. Because juvenile steelhead trout typically emigrate to the ocean before summer, potential changes to summer flows tend to have minimal effect on the productivity of steelhead.

Timber operations and road construction or maintenance that results in ground-disturbance could alter the rate and pathways of water movement resulting in erosion, road failures, landslides, sediment transport, and ultimately delivery to streams. Increases in sedimentation and turbidity affect fish physiology, behavior, and habitat. Physiological effects of turbidity on salmonids include gill trauma, altered blood sugar levels, and osmoregulatory function. Behavioral effects include avoidance of high turbidity, changes in foraging ability, increased predation risk, and reduced territoriality. Fine sediment may reduce salmonid spawning and rearing habitat quality and quantity. Deposition of excessive fine sediment on the stream bottom could eliminate habitat for aquatic insects; reduce density, biomass, number, and diversity of aquatic insects and vegetation; reduce permeability of spawning gravel; and block the interchange of surface and subsurface waters. Increases in fine sediments in low velocity stream reaches could also cover spawning gravel or reduce the number, volume, and depth of pools. Existing and future road crossings can result in the creation of barriers to fish migration. Barriers could reduce the amount of available habitat for spawning and rearing; this might lead to increases in predation of adults.

Substantial sediment input and deposition could (a) cause channel braiding; (b) increase width-to-depth ratios; (c) increase incidence and severity of bank erosion; (d) reduce pool volume and frequency; and (e) increase subsurface flow. In general, these actions tend to reduce habitat

values by diminishing the structural and hydraulic complexity of natural channels and preventing channel processes that sustain these values.

Despite conservation measures in place to reduce sediment inputs (section 8.3.3), harm to steelhead will still occur under our HCP/NCCP; local habitat conditions will continue to impair the ability of individual fish to grow, rear, migrate, or spawn. However, MRC will substantially reduce sediment delivery within the plan area by (a) reducing the potential for mass wasting; (b) upgrading the road network; (c) decommissioning roads; (d) applying stringent conditions to the development of new roads; and (e) designating 50% of our road network to temporary use. All of these actions will reduce impacts to steelhead and improve habitat conditions which currently may impair the survival rates of steelhead eggs and juveniles. Through monitoring and adaptive management, MRC will ensure, at a minimum, that

- Stream gravel permeability will, on average, approach or exceed 10,000 cm/hr across stream reaches.
- Percent of fine material < 0.85 mm will, on average, approach < 7% across stream reaches (using dry sieve techniques).
- Proportion of fine sediment in pools will, on average, approach < .21 across stream reaches (using V-Star methodology).

The removal of streamside vegetation during timber operations and road construction can reduce the number of trees available for recruitment to streams and affect the coverage and health of vegetation. Vegetation provides structural stability to stream banks. A reduction in vegetation could diminish structural complexity in channels and cover within streams. Large wood is an important component of salmonid habitat in streams. Canopy removal that increases exposure of streams to solar radiation can increase water temperatures and the magnitude of daily temperature fluctuations. Temperature change can have direct and indirect effects on the growth, survival, and reproduction of fish.

The use of heavy equipment could result in accidental spills or inadvertent discharges of petroleum products (i.e., fuels, lubricants, and hydraulic fluids). The spill or accidental discharge of these materials adjacent to, or in a water body, could potentially affect the water quality of a stream, river, or wetland and thereby directly affect fish or their prey.

Juvenile Steelhead

Water drafting has the potential to adversely affect steelhead through (a) excessive withdrawal rates that reduce available water; (b) high intake velocities that entrain fish; and (c) inadequately-sized intake screens that allow fish to pass through. Withdrawing water from Class I and Class II streams with steelhead present from April 1 to November 15 could

- Interrupt juvenile rearing and smolt migration.
- Dewater redds.
- Reduce habitat for up to 24 hours, depending on the water recovery rate.

Other covered activities with the potential to adversely affect steelhead include stream habitat improvement, as well as research and monitoring activities. Habitat improvement can lead to

short-term increases in turbidity and sedimentation. However, the magnitude of these effects would be much less than those incurred with timber operations. Moreover, habitat improvement would ultimately benefit fish.

Research and monitoring activities could result in direct and indirect effects on fish. Fish surveys requiring the capture or handling of fish (e.g., electrofishing, trapping, and netting) may affect the growth or survival of juvenile steelhead. Stream surveys could interfere with migration and spawning of fish; they could also result in the crushing and trampling of eggs in redds. Moreover, improper stream classification could trigger reduced protections to stream reaches (e.g., reduced buffer widths), thereby adversely impacting fish.

12.3.3.4 Mitigation that offsets the effects of forest management

MRC protects and conserves all 3 covered salmonids (coho salmon, Chinook salmon, and steelhead) and their respective life stages by focusing on their aquatic habitat. We have adopted standard conservation measures for all Class I streams because all salmonid life stages may be present in all fish-bearing streams at any time. AMZs support, in one way or another, the unique habitat requirements of each of the salmonid species. Our approach avoids the problems of single-species management. Overall, the MRC conservation measures include

- Stream buffers.
- Improvements to riparian areas and enhancement of riparian functions.
- Equipment exclusion zones and restricted harvest in AMZs.
- Reduction of sediment input to streams from roads and timber harvests.
- Monitoring stream flows during water drafting.
- Culvert upgrades.
- Stream habitat enhancement.
- Monitoring surveys.

Combined, these measures will reduce sediment input to streams, avoid creating barriers to fish migration, and enhance riparian function while at the same time minimizing impacts in AMZs. All this, along with the protections for coho salmon and Chinook salmon, will ensure that take of Northern California and Central California Coast steelhead is also minimized or avoided. In addition, the proposed and ongoing survey and monitoring efforts will ensure that MRC identifies occupied and suitable habitat for steelhead. If future surveys result in the designation of additional Class I streams, or determine new reaches where suitable habitat for steehead exist, MRC will afford these streams and reaches the conservation measures adopted for the 3 covered salmonids.

12.3.3.5 Level of expected take

MRC conservation measures should minimize the incidental take of Northern California and Central California Coast steelhead because they protect (a) water quality (e.g., from turbidity, increased water temperature, and pollutants); (b) spawning substrate (e.g., by avoidance or reduction in sediment loading); and (c) habitat complexity (e.g., through bank stability, increased pool depth, improved riparian function, and recruitment of LWD). In addition, implementation of habitat improvements, such as replacement of instream structures, channel realignment, and bedload reduction should benefit steelhead trout, especially in areas that have not yet recovered from the impacts of historical logging practices.

If MRC does not accurately designate stream classes, this could result in reduced protection and habitat quality for steelhead. However, we believe this potential risk of take resulting from

inaccurate designation of stream classes is low because MRC will ensure accurate classification of stream channels and identification of key habitat through watershed analysis, biological monitoring (fish and habitat surveys), and other related riparian strategies.

Some direct take of Northern California and Central California Coast steelhead may occur as a result of water drafting. In the plan area, there are a total of 78 water drafting sites in potential steelhead habitat. MRC classified 47 sites as recovering fast (less than 6 hours), 20 sites as recovering slowly (24 hours), and 11 sites as undetermined (*HCP/NCCP Atlas*, MAPS 25A-C). MRC proposes measures to minimize impacts to steelhead similar to those for coho salmon. The take of steelhead may be more than coho salmon because steelhead occurs more widely in the plan area.

In the plan area, the take of steelhead will most likely occur at waterholes when there is a reduction in the flow of water. We decided to capture the effect of drafting both at the waterhole and 200m downstream from the waterhole. In order to quantify take, we averaged the width of drafting holes across the property; this came out to be 4m. We then multiplied the average waterhole width (4m) by the selected downstream length (200m). Fish densities across the plan area vary annually as well as site-to-site. Based on MRC data for the plan area, the average of mid-to-high densities is 1 steelhead/m^2. The amount of waterholes which MRC will use per year will vary depending on the number and location of projects across the plan area. We estimated that in years of heavy activity, we may use approximately 3 sites in the CCC ESU and 10 sites in the NC ESU. Incorporating all this information, the formula for number of CCC steelhead potentially harassed = 1 steelhead/m^2*(4m*200m) *3 sites = 2400 steelhead per year. Similarly, the formula for number of NC steelhead potentially harassed = 1 steelhead/m^2*(4m*200m) *10 sites = 8000 steelhead per year. Table 12-11 shows the potential take of steelhead from water drafting during the 80-year term of the HCP/NCCP.

Table 12-11 Potential Take of Steelhead from Water Drafting

Potential Take of Steelhead During Water Drafting Plan Area								
Decades								
1	2	3	4	5	6	7	8	Total
Central California Coast (CCC) Steelhead								
24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	192,000
Northern California (NC) Steelhead								
80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	640,000

Research and monitoring activities, such as fish distribution and abundance monitoring as well as fish habitat surveys, could result in harm to individual salmonids. This would stem from capture and handling, as well as subsequent interference with feeding, migration, or spawning. Electrofishing and out-migrant trapping would have the greatest potential for harm. However, MRC will reduce the potential for mortality of individuals by only using electrofishing when water temperatures are 18 degrees C or less. Moreover, MRC research will increase information about the distribution of steelhead in the plan area. This data will improve the accuracy of stream class designations and decrease the risk of potential take of steelhead from forest management.

MRC uses out-migrant trapping to estimate the number of Northern California steelhead moving from Little North Fork Navarro and South Fork Albion to the ocean. Later in the year, we monitor how many of them return from the ocean to these same rivers to spawn. Over the term of our HCP/NCCP, potential take from out-migrant trapping may result from capturing, anesthetizing, handling, fin clipping, and releasing steelhead juveniles. Table 12-12 provides an

estimate of potential take based on our current permit allowances prior to implementation of our HCP/NCCP. Future projections assume a modest increase in capture rates due to increased levels of monitoring and increases in population size. The estimates in Table 12-12 (row 1) refer to the number of steelhead that MRC is legally permitted to temporarily capture for the purposes of monitoring. Incidental mortality of juveniles from such capture must not exceed 2% of this number. Occasionally, adult steelhead are incidentally caught in an out-migrant trap. The estimates in Table 12-12 (row 2) show the potential number of steelhead adults that might be caught in a trap and released throughout the term of our HCP/NCCP.

Table 12-12 Northern California (NC) Steelhead

Potential Take from Out-migrant Trapping of NC Steelhead (Adult and Juvenile Stages)											
Little North Fork Navarro and South Fork Albion											
Species	**ESU**	**Pre-NCCP/HCP**	**Years Post HCP/NCCP Implementation**								
			10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**Total**
Steelhead	NC	50,000*	50,000	50,000	55,000	55,000	60,000	60,000	65,000	65,000	460,000
Steelhead (adult)	NC	50**	50	50	80	80	100	100	120	120	700
Total			50,050	50,050	55,080	55,080	60,100	60,100	65,120	65,120	460,700

TABLE NOTES
* Denotes current allowed take for pre-HCP/NCCP monitoring and research multiplied by 10 years for comparison
**Denotes adult life stages incidentally captured. Pre-HCP/NCCP numbers are based on actual data (averages) multiplied by 10 years.

Table 12-13 provides an estimate of potential take from Annual Salmonid Monitoring Basins (M§13.6.1.1-1) and Anadromous Salmonid Distribution monitoring (M§13.6.1.1-2). Estimates are based on our current permit allowances prior to implementation of our HCP/NCCP. Potential take may result from capturing, anesthetizing, handling, and releasing steelhead juveniles. Based on the number of survey sites (roughly 500 survey sites maximum per year) and the tendency to avoid harassment (by ceasing surveys after MRC staff detect 1 individual of each species), the current take allotment would be sufficient throughout the term of our HCP/NCCP. If salmonid populations expand and our ability to detect them improves, overall take of covered salmonids due to monitoring may actually decline as we use non-invasive sampling.

Table 12-13 CCC and NC Steelhead

Potential Take from ASMB and Salmonid Distribution Monitoring of Steelhead (CCC and NC) Juvenile Life Stages											
Species	**ESU**	**Pre-NCCP/HCP**	**Years Post HCP/NCCP Implementation**								
			10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**Total**
Steelhead	CCC	2,000*	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	16,000
Steelhead	NC	30,000*	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	240,000
Total			32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	256,000

TABLE NOTE
* Current allowed take for pre-HCP/NCCP monitoring and research multiplied by 10 years.

Take may occur in the form of acreage disturbance and harvest within the 150-ft wide buffers along Class I streams. MRC covered activities could impact 83 to 6242 ac per decade of riparian habitat of Northern California steelhead (Table 12-14). Over the course of the permit term, MRC covered activities could impact up to 25,243 ac of riparian habitat for the Northern California steelhead (Table 12-14). During that same time period, MRC covered activities could impact up

to 2 ac of the riparian habitat for the Central California Coast steelhead (Table 12-15). However, MRC conservation measures will ensure higher densities of larger trees in Class I streams which in turn will provide higher rates of LWD recruitment and water quality benefits. If MRC conservation measures prove to be unsuccessful, an undetermined number of Northern California steelhead and Central California Coast steelhead would be taken.

All steelhead in the plan area are found in Class I Streams (i.e., fish-bearing streams). MRC estimates that there are 409.5 miles of Class I streams within the plan area (see *HCP/NCCP Atlas*, MAPS 19A-C). The total length of Class I streams for watersheds where Northern California steelhead are known to occur is 401 miles (Table 12-14); for Central California Coast steelhead, 8.5 miles (Table 12-15).

Table 12-14 Northern California (NC) Steelhead

Total Stream Miles, Habitat Acres, and Habitat Harvested in the Plan Area for Northern California Steelhead										
WAU	**Miles of Class I Streams**	**Total Acres of Class I Habitat (AMZs)**	**Potential Acres Harvested Within Class I Habitat**							
			By Decade							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
*Albion River	31	3,955.54	21	55	113	225	357	464	486	501
*Alder Creek/Schooner Gulch	21.2	2,725.88	-	-	104	259	296	419	351	435
*Big River	71.8	8,500.61	-	10	191	387	350	732	904	1,056
*Cottaneva Creek	12.8	1,607.49	-	-	16	59	194	132	242	151
*Elk Creek	20.3	2,394.51	5	10	144	343	453	417	487	428
*Garcia River	20.8	2,617.51	17	50	78	133	132	222	210	270
*Greenwood Creek	19.9	2,490.81	-	-	196	173	321	227	355	250
*Hollow Tree Creek	44.8	5,578.42	-	-	57	251	673	748	861	788
*Navarro River	106.3	13,422.42	40	81	336	550	834	1,174	1,138	1,464
*Noyo River	34.8	4,510.82	-	24	86	186	252	418	520	565
*Rockport Small Coastal Streams	17.3	2,098.76	-	-	-	-	81	168	183	334
TOTAL	**401.0**	**49,902.77**	83	230	1321	2566	3943	5121	5737	6242
			****Total Acres Harvested = 25,243**							

TABLE NOTES

* Indicates a known occurrence of the species. The species may not currently occupy all Class I streams in the watershed.

** Total Acres Harvested is the total number of acres harvested by decade and can include the same areas previously harvested. Because of this overlap, the actual amount of harvested habitat may be less than the estimate.

Table 12-15 Central California Coast (CCC) Steelhead

Total Stream Miles, Habitat Acres, and Habitat Harvested in the Plan Area for Central California Coast Steelhead										
WAU	Miles of Class I Streams	Total Acres of Class I Habitat (AMZs)	Potential Acres Harvested Within Class I Habitat By Decade							
			1	2	3	4	5	6	7	8
*Upper Russian River	8.5	1004.10	-	-	-	-	-	-	-	2
TOTAL	**8.50**	**1004.10**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
									Total Acres Harvested = 2	

TABLE NOTE
* Indicates a known occurrence of the species. The species may not currently occupy all Class I streams in the watershed.

Fine sediment delivery from MRC covered activities will continue to impair the emergence success of steelhead fry, but at a lesser rate than currently experienced. As a result of HCP/NCCP improvements in gravel permeability, pool quantity, and poor quality, we expect increases in steelhead egg survival-to-emergence and juvenile abundance.

Migration barriers due to stream crossings will continue under HCP/NCCP implementation. However, MRC will decommission roads and remove stream crossings. Decommissioning roads will decrease sediment delivery to streams and removal of stream crossings will facilitate increased migration. Table 12-13 indicates that 2000 Central California Coast steelhead juveniles may be taken per decade from annual surveys. This number may also apply to new stream crossings.

12.3.4 Red-legged frog

12.3.4.1 Location and distribution in the plan area

Chapter 4 (section 4.5) provides a detailed species account of the northern and California red-legged frog, including geographic distribution, local distribution in the plan area, population trends, life history, and habitat requirements.

12.3.4.2 Suitable breeding habitat in the plan area

Section 4.5.7 details the requirements, summarized here, for red-legged frog habitat. Northern red-legged frogs use a variety of habitat types: aquatic sites for breeding; riparian and mesic upland forests during the post-breeding season; and upland habitats during overwintering at low elevations (Gomez and Anthony 1996, Nussbaum et al. 1983, Licht 1969).

Red-legged frogs are associated with deep pool habitat. Licht (1969) reported that northern red-legged frogs usually call underwater from a depth of at least 92 cm (3 ft). Hayes and Jennings (1988) found California red-legged frogs in Central Valley drainages almost exclusively (99%) at sites with some water at least 70 cm (27.5 in) deep.

Red-legged frogs breed in coastal lagoons, permanent or temporary pools, marshes, ponds or backwater portions of permanent or intermittent streams, and artificial impoundments (Stebbins 1985, Jennings and Hayes 1994, USFWS 1997a). Larval red-legged frogs use both mud and

vegetation for cover (Calef 1973, as cited in USFWS 1980). Optimal habitat includes emergent willow, stems, grasses, cattails, submerged weed stems, and filamentous algae (Wiens 1970).

Metamorphosed red-legged frogs may be found far from water during the non-breeding season, particularly in moist or humid habitats (Nussbaum et al. 1983). During the non-breeding season, California red-legged frogs reportedly use small mammal burrows and moist leaf litter up to 25.9 m (85 ft) from water in dense riparian vegetation for estivation (USFWS 1997a).

Haggard (2000) found that the average distance that northern red-legged frogs moved from their breeding sites was 149 m. Recent movement studies indicate that the percentage of California red-legged frogs moving away from breeding habitat varies; 66% of females and 25% of males dispersed in one study (Fellers and Kleeman 2007) while less than 50% in another (Tartarian 2008). Bulger et al. (2003) found that 90% of non-dispersing California red-legged frogs stayed within 60 m of their aquatic sites, with a maximum distance of up to 130 m recorded after summer rain. Fellers and Kleeman (2007) found that the median distance California red-legged frogs dispersed was 150 m, generally moving to the nearest available non-breeding habitat. Dispersing frogs can move great distances, with 1 record of a 2.8 km straight-line map distance in a single season (Bulger et al. 2003).

There are a total of 11 sites where red-legged frogs are known to occur in the plan area, based on both surveys and incidental observations. Survey data collected for these sites included water temperature, canopy cover, and maximum water depth. Temperatures at known locations ranged from 8.3^{o} C to 14.5^{o} C (46.9^{o} F to 58.1^{o} F), with an average temperature of 10.5^{o} C (50.9^{o} F). Canopy closure ranged from 0% to 60%, with 9 sites having canopy coverage of 25% or less. Average canopy cover of occupied sites was 21%. Ten occupied sites had a maximum water depth of at least 3 ft, with 5 sites having a maximum depth of at least 6 ft.

MRC has not mapped all potential breeding habitat for red-legged frogs; we have defined criteria for mapping sites based on depth and persistence of water (Table 10-2). Within the plan area, wetland habitat is most likely to be found adjacent to larger stream classes. The definition of potentially suitable habitat, for the purposes of this analysis, is all Class I and Large Class II streams, as well as the area within 150 m of these streams. The basis for this definition is (a) known habitat associations of red-legged frogs; (b) the probability that breeding habitat would be located within riparian areas of larger streams; and (c) the recognition that there has been incomplete mapping of potential breeding habitat in the plan area. This definition should encompass the majority of potential habitat but is also likely to greatly overestimate the amount of habitat available in the plan area because it assumes that suitable breeding is evenly distributed in all Class I and Large Class II streams, which is unlikely. Suitable breeding habitat is likely to be more unevenly (or “patchily”) distributed but still associated with Class I and Large Class II streams. Based on this analysis, Table 12-16 shows the amount of suitable habitat available in the plan area. Since red-legged frogs are not likely to use all Class I and Large Class II streams and all ponds, and most red-legged frogs move less than 150 m from aquatic habitats, these habitat estimates are overstated.

Table 12-16 RLF Habitat

Red-legged Frog Suitable Habitat in Plan Area	
Inventory Block	**Acres**
Albion	4797
Big River	10,997
Garcia River	4603
Navarro East	9172
Navarro West	7683
Noyo	5462
Rockport	11.576
South Coast	10.991
Ukiah	1367
Total	**66,626**

12.3.4.2.1 Covered activities adjacent to suitable habitat

Covered activities that are likely to occur in or adjacent to occupied or suitable habitat during the permit term primarily include (a) timber management; (b) road construction, reconstruction, maintenance, and use; (c) research and monitoring; and (d) heavy equipment use in ELZs.

Timber management includes timber harvest operations and silvicultural activities. Timber harvest operations include harvesting, yarding, loading, and hauling timber. Silvicultural activities include stand improvement and regeneration, specifically tree planting, seeding, site preparation, brush removal, broadcast burning, and fire control. Road construction, reconstruction, maintenance, and use includes (a) construction, reconstruction, and maintenance of roads, landings, and skid trails; (b) closure of both temporary and permanent roads and skid trails; (c) construction and maintenance of stream crossings; (d) water drafting; (e) development and use of rock pits; (f) maintenance and fueling of equipment; and (g) use of roads by outside parties under right-of-way agreements. Research and monitoring include fish and fish habitat sampling, amphibian surveys, and distribution and abundance monitoring.

Timber management activities, particularly canopy removal, can decrease shading and cause changes to microclimates in the aquatic and riparian areas. Microclimate changes include water temperature, water temperature fluctuation, humidity, and wind velocity (Ledwith 1996; Chen et al. 1995, 1999). Increased stream temperatures can affect reproduction and development or survival of embryonic and larval stages (Licht 1971, Nussbaum et al. 1983). Removal of riparian vegetation can cause a decrease in humidity in riparian zones, due to increased sunlight and wind. This can affect survival of frogs because they rely on high humidity levels and low wind velocity to prevent dehydration and allow respiratory functions. Modification of riparian canopy could result in a change in riparian plant species which in turn could alter the composition and production of algae. This could result in the alteration of food sources available to tadpoles and, potentially, adult red-legged frogs. Timber management activities in riparian habitat could also lead to direct mortality of individuals from crushing by equipment, falling trees, or humans walking through the area.

By reducing the number of recruitment trees available, timber management and road-related activities within a riparian area can result in a decrease in the amount of LWD in a stream (Bryant 1980, Andrus et al. 1988, Murphy and Koski 1989, Ralph et al. 1994) or cause a change in the timing of LWD input (Reid and Hilton 1998). Decreased LWD levels can reduce structural complexity and pool habitat (Keller and Swanson 1979, Sullivan et al. 1987, Montgomery et al.

1995, Beechie and Sibley 1997, Dominguez and Cederholm 2000). This could lead to a decrease in survival of red-legged frogs that use LWD and deep pools for cover (Licht 1969, Gregory 1979, as cited in Davidson 1993).

Timber management and road-related activities can also result in an increase in fine sediment in streams and ponds (Furniss et al. 1991). This could (a) interfere with attachment of eggs to substrates; (b) adversely affect embryo development; (c) reduce production of algae and macroinvertebrates; (d) reduce foraging success; and (e) cause direct mortality. Embryonic and tadpole stages would be most affected.
Timber management and road-related activities can reduce streambank stability; this could result in increases in fine sediment in the stream and a loss of streambank features used by amphibians for cover (FEMAT 1993, Sedell and Bescheta 1991, Swanson et al. 1982). This, in turn, could lead to a reduction in the amount of breeding and foraging habitat available and could decrease the survival, foraging, and reproductive success of red-legged frogs. Equipment and vehicles operating in riparian areas increase the risk of gas and oil pollution, which could harm or kill frogs.

Vegetation removal can (a) influence the hydrology of wetlands, seeps, and springs; (b) change vegetation abundance and diversity; and (c) affect physical attributes such as shade, microclimate, prey availability, and cover. This could reduce habitat quality for red-legged frogs.

Timber management activities can create barriers to movement. Practices such as removal of understory vegetation, removal of downed wood, and even-aged stand management can fragment habitats, creating physical barriers to movement. This could decrease the ability of red-legged frogs to move between metapopulations across the landscape and to access upland habitat during the non-breeding season, leading to an overall decrease in survival and breeding success (Welsh et al. 1998).

Broadcast burning, changes in hydrology, and wildlife or fish surveys could also impact red-legged frogs. Broadcast burning could cause direct mortality to red-legged frogs and could affect their habitat by eliminating downed wood, decreasing canopy cover and structural complexity, increasing delivery of fine sediment to water bodies, and changing microclimates. Changes in hydrology attributable to water drafting or to changes in peak flows from improperly drained roads could (a) affect frog reproduction by scouring eggs from the water body or (b) lead to direct mortality of frogs from water drafting equipment. Conducting surveys could potentially cause harm through handling or interference with feeding, migration, or breeding. Sampling of fish populations with methods such as electrofishing and out-migrant trapping could cause direct harm to frogs or interfere with their feeding, migration, or breeding.

12.3.4.2.2 Mitigation that offsets the effects of forest management

MRC has developed mitigation measures to specifically offset or minimize effects on red-legged frogs (C§10.2.2.3-1 to C§10.2.2.3-15). The conservation measures for red-legged frogs focus on protecting habitat and maintaining occupancy at breeding sites in the plan area. Conservation measures for red-legged frogs will (a) enhance aquatic habitat; (b) minimize disturbance to wet areas, wet meadows, and breeding habitats; (c) control non-native species (bullfrogs); and (d) ensure that breeding habitat is available throughout the plan area.

MRC will minimize disturbance in potential and documented red-legged frog breeding habitat by (a) using vegetation management techniques; (b) maintaining equipment limitation or exclusion zones; (c) limiting the amount of water drafting, particularly during the early summer; and (d)

employing water drafting techniques designed to minimize impacts on aquatic organisms. We will also implement a bullfrog control plan to prevent bullfrogs from establishing populations in red-legged frog habitat.

To offset or minimize the effects of forest management, MRC has proposed conservation measures for red-legged frogs (C§10.2.2.3-1to C§10.2.2.3-15); for sediment inputs (section 8.3.3); and for hydrologic change (section 8.4). In addition, we will follow the standards in *Roads, Landings, and Skid Trails* (Appendix E) and comply with the *Master Agreement for Timber Operations* (Appendix T).

Wetland and riparian conservation measures that would offset or minimize potential impacts on red-legged frogs are primarily those developed to protect wetlands, wet meadows, wet areas, seeps, and springs. Conservation measures for wetlands, wet areas, and wet meadows include

- Maintaining equipment exclusion zones (EEZs) around wetlands.
- Avoidance of artificial wetlands.
- Retention of basal area.
- Felling hazard trees away from habitat and leaving the downed tree in place.
- Retention of old-growth and LWD.
- Avoidance of salvage.
- Surveying ponds prior to water drafting.

Conservation measures for seeps and springs include

- Protection of springs or seeps within AMZ boundaries.
- Extension of AMZ boundaries to encompass seeps and springs.
- Maintenance of EEZs.
- Felling of hazard trees away from habitat and leaving the downed tree in place.
- Management with uneven-aged silviculture.
- Retention of old-growth and LWD.
- Avoidance of salvage.
- Surveying of ponds prior to water drafting.

Implementation of the conservation measures for sediment input could minimize potential impacts from forest management that can increase the incidence of mass wasting and delivery of sediment to streams and ponds. MRC will analyze mass wasting and propose protection measures based on watershed analysis units. Conservation measures to address hydrologic change due to forest management incorporate conservation measures and policies designed or proposed for protection of other resources in the plan area. Measures include (a) uneven-aged management to produce forest canopy that minimizes stream flow changes; (b) increases in LWD recruitment; and (c) implementation of road design standards to minimize concentrated drainage. These measures will reduce erosion of channels and banks and benefit red-legged frogs by reducing sediment delivery to streams.

MRC has established standards for road management. Proper design of roads and landings prior to construction or reconstruction can eliminate many potential erosion problems and environmental impacts. An efficient road system will minimize hydrologic connectivity; point source and surface erosion; mass wasting; and maintenance and construction requirements and costs. MRC follows standards in all road and landing designs, which will minimize potential impacts to red-legged frogs.

The conservation measures for red-legged frogs will benefit the species by protecting preferred breeding and overwintering habitat, reducing the potential for direct mortality, minimizing the potential for increased sediment delivery to aquatic habitat, and minimizing potential impacts from water drafting.

12.3.4.2.3 Level of expected take

Table 12-17 shows impacts to known and potential red-legged frog habitat by decade over the term of the permit. More specifically, Table 12-17 shows the acreage and percent of the suitable habitat in the plan area that is impacted inside and outside of the AMZs, as well as the total impact on suitable habitat in the entire plan area. Table 12-18 breaks down this same data for individual inventory blocks.

Because MRC will enter a given stand multiple times over the term of the permit to conduct a variety of silvicultural activities, their operations may impact the same areas on the ground one or more times during the term of the permit. As a result, it would be inaccurate to simply add up individual acres to produce an overall impact acreage. For this reason, we calculated the percentage of impacted suitable habitat in each inventory block to show the relative level of impact expected in each decade.

Red-legged frogs use different habitat elements during different life phases. Breeding occurs in aquatic habitat. During the breeding season, most adult frogs would be found in or near breeding habitat; eggs and larval red-legged frogs are dependent on aquatic habitat. Only metamorphosed adult frogs are found in upland habitat outside the AMZ; the density of frogs decreases with distance from aquatic habitat because of a finite number of individuals within a larger area.

Over the 80-year term of the permit, a variety of silvicultural activities would occur in each inventory block in the plan area; impacts to individual sites would be about every 20-30 years, although this varies by site. Because silvicultural activities would occur both inside and outside AMZs, habitat degradation would also occur in both these areas. However, the amount of habitat disturbance that would occur inside AMZs is much less than outside AMZs. Conservation measures for red-legged frogs, in conjunction with maintenance of canopy cover and basal area within AMZs, would minimize impacts inside of AMZs.

Table 12-17 Suitable Habitat

		Red-legged Frog Suitable Habitat in the Plan Area							
		Potential Impacts By Decade							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Within AMZ	Total Acres	645	958	2633	4257	6194	7781	8862	9481
	% of Available	1%	1%	4%	6%	9%	12%	13%	14%
Outside AMZ	Total Acres	15,655	16,924	18,166	19,685	18,975	20,095	19,536	20,403
	% of Available	23%	25%	27%	30%	28%	30%	29%	31%
Combined	Total Acres	16,312	17,889	20,811	23,957	25,180	27,891	28,416	29,907
	% of Available	24%	27%	31%	36%	38%	42%	43%	45%
Total Acres of Suitable Red-legged Frog Habitat Available in the Plan Area = 66,626									

Table 12-18 RLF Habitat Impacts by Inventory Block

Red-legged Frog Suitable Habitat in the Plan Area									
Inventory Block	**Impact**	**Potential Impacts by Decade (Total Acres and % of Available Acres)**							
		1	2	3	4	5	6	7	8
Albion	In AMZ	72 1%	122 3%	195 4%	324 7%	505 11%	632 13%	667 14%	670 14%
	Outside AMZ	1042 22%	1050 22%	1239 26%	1339 28%	1264 26%	1352 28%	1326 28%	1376 29%
	Total	1114 23%	1172 24%	1434 30%	1663 35%	1769 37%	1984 41%	1993 42%	2046 43%
Big River	In AMZ	50 <1%	63 1%	400 4%	577 5%	634 6%	1034 9%	1499 14%	1561 14%
	Outside AMZ	2404 22%	2838 25%	3196 29%	3226 29%	3357 31%	3267 30%	3446 31%	3290 30%
	Total	2454 22%	2901 26%	3595 33%	3803 35%	3991 36%	4301 39%	4945 45%	4851 44%
Garcia River	In AMZ	67 1%	126 3%	214 5%	361 8%	406 9%	564 12%	525 11%	626 14%
	Outside AMZ	1167 25%	1420 31%	1193 26%	1476 32%	1238 27%	1573 34%	1309 28%	1587 34%
	Total	1233 27%	1549 34%	1407 31%	1840 40%	1644 36%	2141 47%	1840 40%	2225 48%
Navarro East	In AMZ	61 1%	143 2%	349 4%	421 5%	872 10%	1163 13%	1243 14%	1505 16%
	Outside AMZ	2371 26%	2520 27%	2625 29%	2962 32%	2782 30%	3097 34%	2822 31%	3135 34%
	Total	2431 27%	2663 29%	2974 32%	3383 37%	3654 40%	4260 46%	4065 44%	4641 51%
Navarro West	In AMZ	111 1%	160 2%	323 4%	324 8%	557 7%	796 10%	782 10%	973 13%
	Outside AMZ	1393 18%	1624 21%	1562 20%	2100 27%	1636 21%	2164 28%	1749 23%	2170 28%
	Total	1515 20%	1788 23%	1896 25%	2735 36%	2204 29%	2971 39%	2543 33%	3155 41%
Noyo	In AMZ	34 1%	83 2%	169 3%	315 6%	397 7%	641 12%	760 14%	837 15%
	Outside AMZ	1279 23%	2292 24%	1507 28%	1742 32%	1556 28%	1755 32%	1608 29%	1795 33%
	Total	1313 24%	1374 25%	1677 31%	2056 38%	1953 36%	2396 44%	2369 43%	2632 48%
Rockport	In AMZ	138 1%	112 1%	265 2%	556 5%	1351 12%	1482 13%	1763 15%	1765 15%
	Outside AMZ	3105 27%	3395 29%	3407 29%	3575 31%	3579 31%	3 630 31%	3646 31%	3744 32%
	Total	3243 28%	3507 30%	3672 32%	4131 36%	4929 43%	5112 44%	5409 47%	5509 48%
South Coast	In AMZ	113 1%	148 1%	715 7%	1067 10%	1469 13%	1447 13%	1617 15%	1509 14%
	Outside AMZ	2740 25%	2620 24%	3294 30%	3031 28%	3395 31%	3048 28%	3455 31%	3060 28%
	Total	2853 26%	2768 25%	4009 36%	4098 37%	4864 44%	4495 41%	5072 46%	4569 42%

Red-legged Frog Suitable Habitat in the Plan Area									
Inventory Block	**Impact**	**Potential Impacts by Decade (Total Acres and % of Available Acres)**							
		1	2	3	4	5	6	7	8
Ukiah	In AMZ	1 <1%	0 0%	2 <1%	13 1%	4 <1%	21 2%	5 <1%	35 3%
	Outside AMZ	154 11%	165 12%	145 11%	234 17%	167 12%	210 15%	175 13%	246 18%
	Total	155 11%	165 12%	147 11%	247 18%	171 13%	231 17%	181 13%	280 21%

Our conservation measures will minimize impacts to habitat with the highest concentration of red-legged frogs, particularly breeding habitat. Habitat alteration would occur within the AMZs but retention of canopy cover and basal area would minimize the impact of this alteration. Take of an unknown number of adult red-legged frogs could occur within the AMZs, particularly outside of EEZs or ELZs, in the form of direct mortality from use of equipment or falling trees. Disturbance to red-legged frogs in areas with ongoing silvicultural activities is also likely. However, direct mortality from habitat alteration is expected to be rare in the AMZs due to implementation of our conservation measures including retention of canopy cover and basal area. Take due to habitat alteration inside AMZs would vary by decade; the amount of impacted habitat would increase each decade (Table 12-17). In the AMZs, take would be associated with 645 ac of impacted habitat (i.e., 1% of all suitable habitat in the plan area) in Years 1-10 of HCP/NCCP implementation, and 9481 ac of impacted habitat (i.e., 14% of all suitable habitat in the plan area) in Years 70-80. Although the acreage of impacted habitat increases with each decade, the take from habitat disturbance should decrease as MRC continues to identify areas of occupied habitat through surveys conducted prior to silvicultural activities.

Direct mortality of an unknown number of adult red-legged frogs is also possible in suitable habitat outside of AMZs, where the majority of habitat impacts would occur. Mortality could result from equipment use or falling trees, as well as habitat alteration, particularly timber harvests, if changes in microclimate and cover lead to desiccation or increased predation. Areas outside of AMZs should have the lowest concentration of red-legged frogs because they are farther away from breeding habitat. Within the plan area, take from habitat alteration outside AMZs would vary by decade; the trend increases after the first decade. Outside of AMZs, take would be associated with 15,655 ac of impacted habitat (i.e., 23% of the total suitable habitat available in Years 0-10 of HCP/NCCP implementation) and with 20,403 ac (i.e., 31% of the total suitable habitat available in Years 70-80). Overall, take would be associated with 16,312 ac of habitat impact (i.e., 24% of total available habitat in Years 0-10 of HCP/NCCP implementation) and 29,907 ac (i.e., 45% of total habitat available in Years 70-80).

In addition to take related to timber management, which may include injury, death, harm, and harassment, some additional take in the form of harm or harassment of red-legged frogs will occur during research and monitoring. The basis for the MRC estimates are historic levels of field sampling and expectations of increases in sampling effort once the plan is in place. We estimate that, over the permit term, research and monitoring may result in harm or harassment to 2000 egg masses, 24,000 larval life stages, and 3200 post-metamorphic life stages (Table 12-19). MRC property is at the northern limits of a hybrid zone where California red-legged frogs and northern red-legged frogs are inter-breeding. We are cooperating with University of California (Davis) in a DNA sampling project to determine the extent of this hybridization. Biologists from both MRC and Davis are involved in the research and monitoring. We anticipate a greater need for DNA tissue sampling during the initial period of plan implementation given the current uncertainties

about the boundaries and intergradation zone of the California and northern red-legged frog species. DNA sampling during the first 10 years of HCP/NCCP implementation could harm or harass as many as 5750 frogs. Take from research and monitoring may increase toward the later years of the permit term if the red-legged frog population increases and expands and MRC intensifies our monitoring efforts. The take estimates are maximum levels. In most cases, we can avoid handling red-legged frogs (i.e., avoid harm or harassment).

Table 12-19 Potential Take of Red-legged Frogs

Potential Take from Monitoring of Northern Red-legged Frogs									
Life Stage	**Years Post HCP/NCCP Implementation**								
	10[1]	**20[1]**	**30[1]**	**40[1]**	**50[2]**	**60[2]**	**70[3]**	**80[3]**	**Total**
Embryonic (numbers of egg masses)	1000*	100	100	100	150	150	200	200	2000
Larval	4000*	2000	2000	2000	3000	3000	4000	4000	24,000
Post-Metamorphic	750*	250	250	250	350	350	500	500	3200

TABLE NOTES
*Denotes time periods with likelihood of increased sampling for DNA data to inform MRC and UC (Davis) biologists about species range boundaries and hybrid zones. Annual estimate: 100 egg masses, 40 larva, 75 post-metamorphs.

[1]Annual estimate: 1 egg mass, 20 larva x 10 sites; 25 post-metamorphs
[2]Annual estimate: 1 egg mass, 20 larva x 15 sites; 35 post-metamorphs
[3]Annual estimate: 1 egg mass, 20 larva x 20 sites; 50 post-metamorphs

12.3.5 Coastal Tailed Frogs

12.3.5.1 Location and distribution in the plan area

Chapter 4 (section 4.6) provides a detailed species account of the coastal tailed frog, including geographic distribution, local distribution in the plan area, population trends, life history, and habitat requirements.

12.3.5.1.1 Suitable habitat in the plan area

Section 4.6.6 details the requirements, summarized here, for coastal tailed frog habitat. Coastal tailed frogs generally occur in streams in forested habitat with high canopy closure and, in lower abundance, in areas lacking canopy cover such as clearcuts (Hayes 1996, Metter 1964a, Bury and Corn 1988, Bury et al. 1991b). Adults also use moist, dense forested habitat adjacent to streams (Bury et al. 1991b). In the redwood zone of northwestern California, Diller and Wallace (1999) found that the following habitat variables were related to the presence of coastal tailed frogs:

- Landscape level – geologic formation.
- Reach level – percent fines, stream gradient, and water temperature.
- Microhabitat.

The Diller and Wallace study encountered tailed frog larvae more often in streams where cobble, boulder, and gravel substrates had low embeddedness, and less often in streams with fine substrates. Likewise, the study detected larvae more often in high gradient riffles and less often in pools and runs. The association of stream temperature appeared minimal in this study, however, that may be attributed to little variation being observed (Diller and Wallace 1999).

A study conducted in Douglas-fir and hardwood forests of northern California and southwestern Oregon found that the relative abundance of tailed frogs varied significantly between forest age

classes, with greater abundance in older forests (Welsh and Lind 1991). Forest structure may be a more important factor than stand age in predicting the occurrence of tailed frogs; high canopy closure, low ambient temperatures, downed woody debris, and a deep duff layer are key attributes of that structure (Welsh 1990, Welsh et al. 1993).

Tailed frogs inhabit perennial streams, not ephemeral streams, because they commonly spend more than 1 year in the stream in their larval form (Brown 1990). Coarse substrates with low levels of fine sediment (low embeddedness) provide interstitial spaces for foraging and cover (Diller and Wallace 1999, Hawkins et al. 1988, Corn and Bury 1989). Tailed frogs are found in streams having a wide of range of gradients, with a range of 2% to 60% reported (Sutherland et al., as cited in Wahbe et al. 2001). They are less likely to occur in stream reaches with gradients greater than 50%, where bedload is probably mobilized more frequently (Dupuis et al. 2000).

Water temperatures in streams inhabited by tailed frogs are usually between 5° and 16° C (41° and 61° F) (Marshal et al. 1996). Cool water temperature is critical to tailed frog reproduction, and streams with water temperatures above 15° C (59° F) for extended periods are not suitable for reproduction (Hays 1996).

Adult tailed frogs use forest habitat adjacent to streams for foraging. Wahbe et al. (2004) found most tailed frogs stayed within 25 m of aquatic habitats; some frogs were 100 m out, which was the maximum distance from aquatic habitat that they sampled. Nussbaum et al. (1983) indicated that tailed frogs may forage up to 25 m (82 feet) from water, but are usually much closer.

MRC knows of 75 sites where coastal tailed frogs occur in the plan area, based on both surveys and incidental observations. From these sites, we collect data on stream temperature, canopy cover, stream gradient, and substrate embeddedness. [2]

Stream temperatures at known locations ranged from 11.0^{o} to 15.9^{o} C (51.8^{o} to 60.6^{o} F), with an average temperature of 13.1^{o} C (55.6^{o} F). Canopy closure was between 50 and 100%, with an average canopy cover of 84% for occupied sites. Stream gradient was recorded in ranges: 66 occupied sites (88%) had a stream gradient of 0 to 10%; 8 (11%) had a gradient of 10 to 25%; and 1 (1%) had a gradient of 40 to 50%. Table 12-20 shows substrate embeddedness also recorded in ranges.

Table 12-20 Stream Substrate Embeddedness

Stream Substrate Embeddedness Known Coastal Tailed Frog Sites		
Plan Area		
Embeddedness (%)*	**Number of Sites**	**% of Sites**
None reported	1	1%
0-25	18	24%
0-50	1	1%
25-50	47	63%
25-75	2	3%
50-75	6	8%
Total	75	100%

TABLE NOTE
*There is overlap in the ranges, due to differences in the way data was collected.

[2] Embeddedness is the degree to which fine sediment surrounds coarse substrate on the surface of the streambed.

Stream temperatures were within the expected range for occupied sites, and average canopy closure was high, as expected. Stream gradients of most sites were relatively low, but were within the range of 2 to 60%. Substrate embeddedness was below 50% for 88% of sites. Based on the known habitat associations of tailed frogs, potentially suitable habitat for this species has been defined, for the purposes of this analysis, as all Class I and Large Class II streams and the area within 300 ft of these streams. Table 12-21 shows the amount of coastal tailed frog habitat available in the plan area.

Table 12-21 Coastal Tailed Habitat

Suitable Coastal Tailed Frog Habitat in the Plan Area	
Inventory Block	**Acres**
Albion	2952
Big River	6780
Garcia River	2795
Navarro East	5601
Navarro West	4632
Noyo	3266
Rockport	7027
South Coast	6786
Ukiah	851
Total	**40,689**

12.3.5.2 Covered activities adjacent to suitable habitat

Covered activities that are expected to occur in or adjacent to occupied or suitable habitat during the permit term include timber management; road construction, reconstruction, maintenance, and use; stream habitat improvement; research and monitoring; and other HCP/NCCP activities.

Timber management includes timber harvest operations and silvicultural activities. Timber harvest includes harvesting, yarding, loading, and hauling timber. Silvicultural includes stand improvement and regeneration, specifically tree planting, seeding, site preparation, brush removal, broadcast burning, and fire control.

Road construction, reconstruction, maintenance, and use includes construction, reconstruction and maintenance of roads, landings, and skid trails; closure of both temporary and permanent roads and skid trails; construction and maintenance of stream crossings; drafting and use of water; development and use of rock pits; maintenance and fueling of equipment; and use of roads by outside parties under right-of-way agreements.

Stream habitat improvement projects include instream structure replacement, channel realignment, and bedload reduction. Research and monitoring include fish and fish habitat sampling, amphibian surveys, and distribution and abundance monitoring.

Timber management activities, particularly canopy removal, can decrease stream shade and cause changes to microclimates in the aquatic and riparian areas. Microclimate changes include changes in stream temperatures, stream temperature fluctuation, humidity, and wind velocity (Ledwith 1996; Chen et al. 1995, 1999). Increased stream temperatures can affect reproduction and development or survival of embryonic and larval forms (Zweifel 1955, Duellman and Trueb 1986, Balustein et al. 1994, both as cited in Asheton et al. 1999; Kupferberg 1996).

Removal of riparian vegetation can cause a decrease in humidity in riparian zones due to increased sunlight and wind. This can affect survival of frogs because they rely on high humidity levels and low wind velocity to prevent dehydration and allow respiratory functions. Modification of riparian canopy could result in a change in riparian plant species which in turn could alter the composition and production of algae. This could result in the alteration of food sources available to tadpoles and, potentially, adult coastal tailed frogs. Timber management activities in riparian habitat could also lead to direct mortality of individuals from crushing by equipment, falling trees, or humans walking through the area.

Timber management activities and road-related activities within a riparian area can result in a decrease in the amount of LWD in a stream by reducing the number of recruitment trees available (Bryant 1980, Andrus et al. 1988, Murphy and Koski 1989, Ralph et al. 1994). These activities could cause a change in the timing of LWD input, with large amounts potentially entering the system as a result of windfall of trees left in a buffer strip, followed by periods of little or no input as stands recover (Reid and Hilton 1998). Reduced LWD levels have been associated with reduced structural complexity and pool habitat (Keller and Swanson 1979, Sullivan et al. 1987, Montgomery et al. 1995, Beechie and Sibley 1997, Dominguez and Cederholm 2000). Coastal tailed frogs prefer channels and cascades; however, pools trap sediment and a reduction in pools could increase sediment delivery to preferred tailed frog habitat.

Timber management and road-related activities can also result in an increase in fine sediment in stream channels (Furniss et al. 1991). This can inhibit reproduction and foraging by coastal tailed frogs; inhibit attachment of eggs to substrate; fill interstitial spaces used by coastal tailed frogs; alter prey base by reducing algal and macroinvertebrate production; and reduce foraging success (Jennings and Hays 1994). Direct mortality may occur as a result of reduced foraging success, suffocation, and flushing of populations from habitat by debris torrents.

Timber management and road-related activities can reduce streambank stability, which can also result in increases in fine sediment in the stream and a loss of streambank features used by coastal tailed frogs for cover (FEMAT 1993, Sedell and Bescheta 1991, Swanson et al. 1982). Equipment and vehicles operating in riparian areas increase the risk of gas and oil pollution, which could harm or kill frogs.

Stream habitat improvement projects would generally benefit coastal tailed frogs in the long term; however, in the short term, site preparation can disturb soils and cause an increase in fine sediment in the stream. Broadcast burning could result in direct mortality of adults and alter riparian vegetation, causing changes in microclimate or sediment delivery.

Surveys for coastal tailed frog could potentially cause harm from handling or interfere with feeding, migration, or breeding. Likewise, sampling of fish populations with methods such as electrofishing and out-migrant trapping could directly harm frogs or interfere with feeding, migration, or breeding.

12.3.5.3 Mitigation that offsets the effects of forest management

To offset or minimize the effects of forest management, MRC has proposed conservation measures for coastal tailed frogs (C§10.2.3.3-1 to C§10.2.3.3-9); for wetland and riparian areas (C§8.2.3.5.1-1 to C§8.2.3.5.1-12); for sediment inputs (section 8.3.3); and for hydrologic change (section 8.4). In addition, we will follow the standards in *Roads, Landings, and Skid Trails* (Appendix E) and comply with the *Master Agreement for Timber Operations* (Appendix T).

MRC may designate basins as Large Class II due to the presence of coastal tailed frogs; as a result, these basins would receive increased protection. This would result in wider AMZs and increased protection of riparian habitat.

The conservation measure for wetland riparian areas that would most benefit coastal tailed frogs is the establishment of AMZs around Class I and Large Class II streams. AMZs will have 3 bands, and the band widths will vary by stream class and the slope class (percent) of the adjacent riparian area (C§8.2.3.1.1-1). Total AMZ widths for Class I streams would range from 130 ft to 190 ft. Total AMZ widths for Large Class II streams would range from 100 ft to 150 ft. Within AMZs, MRC will maintain large trees and overstory canopy and limit equipment disturbances. There will be a 10-ft no-harvest zone adjacent to Class I, Class II, and Class III streams for non-sprouting species, with limited harvest allowed within redwood clumps (see section 8.2.3.1); in the remaining AMZ areas, there will be selective harvest consistent with retaining canopy cover (C§8.2.3.1.2-1), basal area (C§8.2.3.1.3-1 to C§8.2.3.1.3-3), and largest tree retention (C§8.2.3.1.4-1 to C§8.2.3.1.4-5).

Forest management can potentially increase the incidence of mass wasting and delivery of sediment to streams; conservation measures for sediment inputs (section 8.3.3) would minimize these impacts. MRC will analyze mass wasting and propose protection measures based on watershed analysis units. Our strategy emphasizes high protection near watercourses where the risk for sediment delivery from mass wasting is critical. This is especially true for inner gorge terrain and steep streamside slopes. We will promote the upslope integrity of hydrologic processes and tree-root strength through default conservation measures for specific terrain. Furthermore, MRC will retain larger trees to provide LWD to stream channels if a hill-slope failure does occur. Within each CalWater planning watershed across our timberlands, MRC will also retain at least 50% average overstory canopy to mitigate the effects of timber harvest on hydrologic changes at the watershed scale.

Conservation measures to address hydrologic change due to forest management would not be unique but would incorporate conservation measures and policies designed or proposed for protection of other resources in the plan area. Uneven-aged management which provides forest canopy to minimize peak and low stream flow changes, increases in LWD recruitment, and implementation of road design standards to minimize concentrated drainage will reduce erosion of channels and banks. This would benefit coastal tailed frogs by reducing sediment delivery to streams.

MRC has established standards for road management (*Appendix E*) from which MRC will not deviate without first obtaining approval of the appropriate regulatory agencies for explicit alternatives. Proper design of roads and landings prior to construction or reconstruction can eliminate many potential erosion problems and environmental impacts. An efficient road system will minimize hydrologic connectivity; point source and surface erosion; the probability of mass wasting; and maintenance and construction requirements and costs. This, in turn, will minimize potential impacts to coastal tailed frogs.

AMZs would provide protection for coastal tailed frog habitat by maintaining high canopy cover to minimize potential stream temperature and microclimate changes; maintaining a 10-ft no harvest buffer to minimize the risk of fine sediment input into streams ; maintaining stream bank integrity; and limiting ground disturbance caused by equipment. Limiting the use of equipment

within the AMZs would also reduce the potential for direct mortality of coastal tailed frogs by crushing.

12.3.5.4 Level of expected take

Table 12-22 shows the projected impacts to known and potential coastal tailed frog habitat, inside and outside AMZs, for each decade of our HCP/NCCP. Table 12-23 breaks down the same data by inventory block. Because MRC will enter a given stand multiple times over the term of the permit to conduct a variety of silvicultural activities, the same areas on the ground may be impacted one or more times during the term of the permit; therefore, impact acres cannot be added to produce an overall impact acreage. For this reason, the percentage of suitable habitat in each inventory block that would be impacted by decade was calculated to show the relative level of impact expected in each decade.

Table 12-22 CTF Suitable Habitat

		Coastal Tailed Frog Suitable Habitat in the Plan Area							
		Potential Impacts By Decade							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Within AMZ	Total Acres	417	673	2,252	3,833	5,758	7,318	8,394	9,010
	% of Available	1%	2%	6%	9%	14%	18%	21%	22%
Outside AMZ	Total Acres	6,745	7,322	7,850	8,484	8,168	8,649	8,399	8,776
	% of Available	17%	18%	19%	21%	20%	21%	21%	22%
Combined	Total Acres	7,168	8,000	10,108	12,326	13,931	15,977	16,803	17,799
	% of Available	18%	20%	25%	30%	34%	39%	41%	44%
Total Acres of Suitable Coastal Tailed Frog Habitat Available in the Plan Area = 40,689									

Table 12-23 CTF Suitable Habitat by Inventory Block

Coastal Tailed Frogs Suitable Habitat in the Plan Area									
Inventory Block	**Impact**	**Potential Impacts by Decade (Total Acres and % of Available Acres)**							
		1	2	3	4	5	6	7	8
Albion	In AMZ	49 2%	97 3%	167 6%	289 10%	469 16%	594 20%	629 21%	631 21%
	Outside AMZ	451 15%	465 16%	541 18%	589 20%	552 19%	595 20%	578 20%	605 20%
	Total	500 17%	562 19%	707 24%	879 30%	1021 35%	1188 40%	1207 41%	1236 42%
Big River	In AMZ	34 <1%	38 1%	352 5%	523 8%	580 9%	978 14%	1439 21%	1505 21%
	Outside AMZ	1050 15%	1358 19%	1413 21%	1430 21%	1471 22%	1448 21%	1509 22%	1458 21%
	Total	1084 16%	1296 19%	1766 26%	1953 29%	2051 30%	2426 36%	2949 43%	2962 44%
Garcia River	In AMZ	50 2%	101 4%	190 7%	332 12%	377 13%	534 19%	496 18%	595 21%
	Outside AMZ	504 18%	607 22%	518 19%	639 23%	536 19%	675 24%	566 18%	679 21%
	Total	554 20%	711 25%	708 25%	974 35%	913 33%	1212 43%	1068 38%	1282 46%
Navarro East	In AMZ	35 1%	89 2%	293 5%	346 6%	803 14%	1075 19%	1171 21%	1414 25%
	Outside AMZ	1040 19%	1077 19%	1164 21%	1286 23%	1223 22%	1339 24%	1239 22%	1358 24%

Coastal Tailed Frogs Suitable Habitat in the Plan Area									
Inventory Block	**Impact**	**Potential Impacts by Decade (Total Acres and % of Available Acres)**							
		1	2	3	4	5	6	7	8
	Total	1075 19%	1167 21%	1457 26%	1632 29%	2026 36%	2415 43%	2410 43%	2771 49%
Navarro West	In AMZ	86 2%	130 3%	277 6%	568 12%	505 11%	734 16%	725 16%	910 20%
	Outside AMZ	574 12%	669 14%	642 14%	836 18%	667 14%	861 19%	709 15%	862 19%
	Total	666 14%	801 17%	925 20%	1411 30%	1178 25%	1602 35%	1440 31%	1779 38%
Noyo	In AMZ	21 1%	65 2%	141 4%	286 9%	367 11%	611 19%	721 22%	805 25%
	Outside AMZ	542 17%	551 17%	637 19%	721 22%	656 20%	726 22%	678 21%	743 23%
	Total	563 17%	616 19%	777 24%	1007 31%	1023 31%	1337 41%	1399 43%	1548 47%
Rockport	In AMZ	76 1%	62 1%	179 3%	486 7%	1255 18%	1407 20%	1665 24%	1689 24%
	Outside AMZ	1315 19%	1474 21%	1448 21%	1555 22%	1519 22%	1577 22%	1546 22%	1627 23%
	Total	1391 2%0	1535 22%	1627 23%	2041 29%	2775 39%	2984 42%	3211 46%	3316 47%
South Coast	In AMZ	66 1%	91 1%	651 10%	994 15%	1399 21%	1371 20%	1545 23%	1433 21%
	Outside AMZ	1202 18%	1145 17%	1431 21%	1327 20%	1474 22%	1334 20%	1500 22%	1339 20%
	Total	1268 19%	1235 18%	2083 31%	2321 34%	2873 42%	2705 40%	3045 45%	2773 41%
Ukiah	In AMZ	1 <1%	0 0%	1 <1%	9 1%	2 <1%	14 2%	3 <1%	28 3%
	Outside AMZ	67 8%	76 9%	56 7%	100 12%	70 8%	94 11%	73 9%	105 12%
	Total	68 8%	76 9%	57 7%	109 13%	72 8%	108 13%	76 9%	133 16%

Coastal tailed frogs use different habitat elements during different life phases. Breeding occurs in aquatic habitat. During the breeding season, most adult frogs would be found in or near breeding habitat; eggs and larval coastal tailed frogs are also dependent on aquatic habitat. Only metamorphosed adult frogs are found in upland habitat; one would expect the density of frogs to decrease with distance from aquatic habitat.

Over the 80-year term of our permit, a variety of silvicultural activities will occur in each inventory block in the plan area; individual sites will generally be impacted every third decade, although this will vary by site. Because silvicultural activities will occur both inside and outside of the AMZs, habitat degradation will occur in both areas. However, there will be fewer disturbances inside the AMZs than outside, as shown in Table 12-23. Conservation measures for coastal tailed frog (C§10.2.3.3-1 to C§10.2.3.3-9), in conjunction with maintenance of canopy cover and basal area within AMZs, will minimize impacts inside AMZs.

Take of an unknown number of adult coastal tailed frogs could occur within the AMZs in the form of direct mortality from use of equipment or falling trees. Disturbance to coastal tailed frogs in areas with ongoing silvicultural activities is also likely; however, direct mortality from habitat alteration is not expected in the AMZs. Take from habitat alteration inside AMZs would vary by decade, with the amount of habitat impacted increasing each decade (Table 12-23). In

the AMZs, take would be associated with 417 ac of habitat impacts, representing 1% of all suitable habitat in the plan area, during the first decade and would be associated with 9010 ac of habitat impact, 22% of suitable habitat in the plan area, in the eighth decade (Table 12-22). In the seventh and eighth decades, habitat impacts inside and outside of AMZs would be similar. Although the acreage of impacted habitat increases with each decade, the take from habitat disturbance is expected to decrease as MRC continues to identify areas of occupied habitat through surveys conducted prior to silvicultural activities.

Direct mortality of an unknown number of adult coastal tailed frogs is also possible in suitable habitat outside of the AMZs. In this area, where the majority of habitat impacts would occur, mortality could result from use of equipment or falling trees and also from habitat alteration, particularly timber harvests, if changes in microclimate and cover lead to desiccation or increased predation. Silvicultural activities such as thinning would be expected to have less impact than clearcut harvesting; therefore, the amount of take that would occur in a given site would vary depending on the type of activity conducted. Take from habitat alteration outside the AMZ would vary by decade, with an increasing trend from the first to the eighth decade. Outside of AMZs, take would be associated with 6745 ac of habitat impact, 17% of the total suitable habitat available, in the first decade and with 8776 ac, or 22% of the total suitable habitat available, in the eighth decade (Table 12-22). In the seventh and eighth decades, habitat impacts inside and outside of AMZs would be similar. Overall, in the first decade, take would be associated with 7168 ac of habitat impact, representing 18% of total available habitat in the plan area; 17,799 ac of habitat impact, i.e., 44% of total habitat available in the plan area, could occur in the eighth decade.

In addition to take related to timber management, which will include injury, death, harm, and harassment, some additional take in the form of harm or harassment will occur during research and monitoring. The basis for the MRC estimate of take was the historic capture rate at 10 sites. MRC assumed that harm and harassment from research and monitoring would increase over time as the number of coastal tailed frogs increases due to the beneficial effects of the plan. Over the permit term, we estimate that research and monitoring may harm or harass 67,000 larval life stages and 3000 post-metamorphic life stages of coastal tailed frogs (Table 12-24). The take numbers are maximum levels and MRC does not expect to approach the maximum levels with regularity.

Table 12-24 Potential Take of Coastal Tailed Frogs

Potential Take from Monitoring of Coastal Tailed Frogs										
Life Stages	**Pre-NCCP/HCP**	**Years Post HCP/NCCP Implementation**								
		10[1]	**20[1]**	**30[1]**	**40[1]**	**50[2]**	**60[2]**	**70[3]**	**80[3]**	**Total**
Larval	5000*	6000	6000	6000	10,000	10,000	10,000	12,000	12,000	72,000
Post-Metamorphic	300*	300	300	300	400	400	400	600	600	3300

TABLE NOTE
*Reflects the maximum number of animals captured at a relative abundance site (pre-HCP) and multiplied by 10 years
[1]Annual estimate: 60 larva, 3 post-metamorphs x 10 sites
[2]Annual estimate: 100 larva, 4 post-metamorphs x 10 sites
[3]Annual estimate: 120 larva, 6 post-metamorphs x 10 sites

12.3.6 Northern spotted owl

12.3.6.1 Location and distribution in the plan area

Chapter 5 (section 5.2) provides a detailed species account of the northern spotted owl, including geographic distribution, local distribution in the plan area, population trends, life history, and habitat requirements.

12.3.6.2 Suitable habitat in the plan area

Habitat suitability is based on tree type, dominant size class, and minimum canopy (Table 10-8). According to our 2007 baseline assessment for northern spotted owls, the plan area has 209,148 ac of forested land that could potentially grow into nesting/roosting habitat; 139,973 ac of foraging habitat; and 25,037 ac of non-suitable habitat (Figure 12-1).

Annual surveys conducted over a period of several years located 167 spotted owl territories in or adjacent to the plan area (Table 10-5). Under the HCP/NCCP, all spotted owl territories will receive some level of protection. The basis for protection is territory productivity, categorized as Level 1 through Level 5. Of the 167 territories, 28 are Level 1, 67 Level 2, 29 Level 3, 22 Level 4, and 21 Level 5 (Table 10-5). At HCP/NCCP commencement, Level-1 territories will receive high protection (C§10.3.1.3.1-1 to C§10.3.1.3.1-19); Level-2, moderate protection (C§10.3.1.3.1-20 to C§10.3.1.3.1-37); Level-3, limited protection (C§10.3.1.3.1-38 to C§10.3.1.3.1-41). Of the Level-4 territories, 17 will receive moderate protection and 5 limited protection. All Level-5 territories will receive moderate protection.

12.3.6.3 Covered activities adjacent to suitable habitat

Timber operations can alter the distribution of suitable habitat and cause forest fragmentation. They can affect spotted owl abundance and distribution by altering habitat structure and tree species composition. Forest fragmentation can isolate populations, provide clearings where spotted owls are subject to increased predation, and create habitat for competing species such as the barred owl (Gutièrrez 1985, Dark et al. 1998). Timber operations may result in the removal of 34 of the 167 territories in or adjacent to the plan area, as well as “excess” Level-1 and Level-2 territories; by excess we mean the number of territories that exceed our population objectives (O§10.3.1.2-1 and O§10.3.1.2-2). Timber operations may also result in the removal of spotted owls in areas where there were false negative surveys (i.e., an owl was present even though the surveys indicated the owl was absent). Inaccurate designation of habitat could increase involuntary direct and indirect take of northern spotted owls.

Forest management can lead to the modification or removal of nesting and roosting habitat, including removal of trees around nests, reduced canopy cover, or altered tree species composition. This may result in a reduction of nest and roost trees; changes in over- and understory vegetation composition and abundance; and changes in microclimate, including diurnal temperature fluctuation. Spotted owls prefer nest sites that are shaded and cool, such as sites in riparian areas. Changes in microclimate, including increases in temperature due to canopy removal, can increase physiological stress of the spotted owl and reduce its survival and reproductive success (Wasser et al. 1997).

Under the 50-11-40 rule of the Draft Recovery Plan of the Northern Spotted Owl (USFWS 2007), 50% of a land base should be in dispersal habitat provided by trees of 11 in. or greater with 40% canopy cover to sustain spotted owls. The description of dispersal habitat is approximately equivalent to foraging habitat within our HCP/NCCP. Forest practices can lead to the modification or removal of foraging and dispersal habitat. Timber harvest and subsequent seral-

stage conversion could reduce or displace prey populations or alter prey species composition; other harvest activities, such as group selection, could increase prey species populations. . Alterations to foraging habitat can reduce prey availability or accessibility and, subsequently, foraging success (Sakai and Noon 1993, Ward et al. 1998). Reductions in dispersal habitat can decrease the chances that dispersing fledglings will reach vacant territories. Changes in prey availability may affect breeding success, establishment of activity centers, or fledging of young by owls of all productivity levels.

Noise disturbance can occur from timber management, construction of roads and landings, and rock pit activities. Noise-related impacts can be especially detrimental during the breeding season. This can potentially result in decreased reproductive success due to physiological stress, abandonment of the nest and young, or both.

Research and monitoring activities may lead to disturbance. Capturing and banding as well as other disturbances caused by researchers could adversely affect northern spotted owls by increasing stress and reducing nesting success. Surveys and monitoring for other covered species may cause disturbances to northern spotted owls. Mousing owls to determine reproductive status or to attempt banding may increase an owl's tameness and attraction to vehicle stimulus. Inaccurate designation of nesting, roosting, or foraging habitat may result in reduced protections and habitat benefits.

Relaxing the owl prior to banding

Banding the owl

12.3.6.4 Mitigation that offsets the effects of forest management

To minimize effects of fragmentation, MRC will

- Provide long-term maintenance and enhancement of spotted owl habitat through landscape planning and conservation measures for old growth, wildlife trees, downed wood, and riparian areas.
- Minimize adverse impacts to spotted owl habitat from timber operations.
- Rehabilitate tanoak-dominated stands to conifer or mixed-conifer stands.
- Maintain our "no clearcut" policy, as well as other habitat and species conservation measures that recruit high-quality habitat for spotted owls.
- Monitor all spotted owl territories for 3 years after they have been targeted for potential removal.

NOTE
Of the 34 territories initially subject to potential removal, many may remain despite harvesting.

- Survey areas scheduled for harvest following the protocol in Appendix K, *Northern Spotted Owl Data and Protocol*, in order to eliminate any false negative surveys.
- Identify activity centers prior to harvest and mark and retain all spotted owl nest trees.
- Protect spotted owl activity centers located along streams with additional conservation measures for riparian areas, salmonids, and amphibians.
- Manage for increased nesting/roosting habitat across the plan area so that the acreage of nesting/roosting habitat trends upwards to meet specified numeric objectives (Table 10-10).

To minimize effects on foraging and dispersal habitat, MRC will

- Maintain and recruit old growth, wildlife trees, downed wood, and dense canopy cover to minimize adverse impacts to the prey base of owls and allow for successful foraging and dispersal of spotted owl fledglings.
- Retain at least 500 ac of suitable habitat within 0.7 miles of activity centers with high and moderate protection.
- Manage our forests so that the amount of dispersal habitat on our land (i.e., foraging and nesting/roosting habitat) does not drop below 60% during the term of our HCP/NCCP, as our landscape model currently predicts.
- Retain mixed conifer stands that are preferred habitat of owl prey through conservation measures for riparian areas and hardwoods.

To minimize effects of noise, MRC will establish disturbance buffers during the breeding season to reduce noise impacts for all nesting owls. No-harvest buffers and restrictions on some harvest are expected to minimize noise around owl activity centers with high, moderate, and limited protection during the breeding season.

In addition, our proposed survey and monitoring will ensure that occupied and suitable habitat are identified. Spotted owls will benefit from our increased understanding of its habitat requirements, use patterns, reproductive biology, response to disturbance, and ecological interactions. By reducing uncertainties and increasing knowledge of spotted owl threats and requirements, MRC will improve management effectiveness. To minimize effects of monitoring, MRC will

- Use researchers approved by the wildlife agencies to capture and band owls.
- Monitor owls with high or moderate protection in the current year, as well as some owls with limited protection.
- Monitor only to determine the location of an activity center and the reproductive status of a northern spotted owl, so direct harm to an owl is unlikely, unless we band owls within a territory.
- Limit non-emergency vehicles from stopping within 1000 ft of any currently active nest site.

12.3.6.5 Level of expected take

For northern spotted owls, we define take in 3 ways:

1. Removal of habitat within 1000 ft of a spotted owl activity center (harm).
2. Reduction of nesting, roosting, or foraging habitat within 0.7 miles of the most current activity center to less than 500 ac (harm).
3. Disturbance within 1000 ft of a territory during the breeding season (harassment).

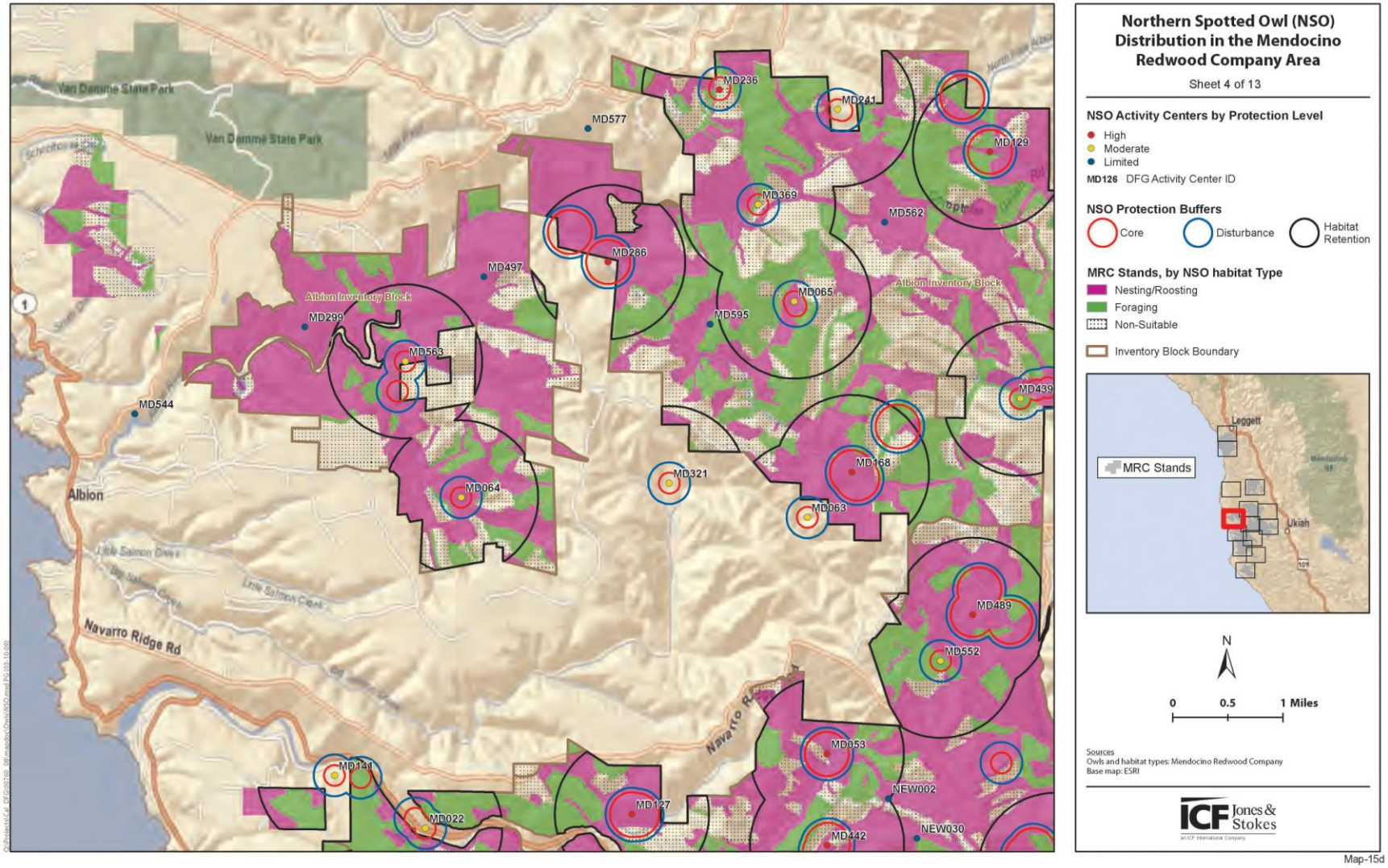


Figure 12-1 NSO Activity Centers by Protection Level

Direct injury or mortality should be very rare. It would occur when direct impacts result from false-negative surveys, i.e., surveys which fail to detect owls present. A total of 34 territories with limited protection (both inside and immediately outside the MRC property line) will be subject to take as defined above in #1 and #2. This will include 29 Level-3 territories and 5 Level-4B territories. Despite habitat removal, the level of actual mortality of spotted owls in these territories should be low, because (a) the territories already exhibit little if any productivity and (b) reduction of the habitat buffer is unlikely to result in spotted owl mortality. For 133 spotted owl territories in the plan area with moderate and high-level protection, covered activities will not result in take as defined above in #1 and #2 (see section 10.3.1.3).

Figure 12-1 shows one of several maps in our HCP/NCCP *Atlas* (MAPS 15A-N) that depict the spotted owl activity centers by protection level. Over the term of our plan, there may be a total of 1324 disturbances from covered activities resulting in degradation of 6754 ac within 34 territories with limited protection (Table 12-25). MRC based these calculations on the number of acres within 1000 ft of territories with some level of projected impact due to covered activities. Degradation of the 6754 ac could result in take through loss of habitat and indirect mortality, accompanied by changes in susceptibility to predation or availability of prey. Again, the level of actual mortality of spotted owls in these territories should be low, because (a) the territories already exhibit no or low productivity and (b) noise disturbance is unlikely to result in mortality of spotted owls.

Table 12-25 Potential Impacts to NSO Territories

Potential Disturbance Events and Impacts to Acreage in NSO Territories During the Term of HCP/NCCP		
Inventory Block	**Number of Silviculture Events**	**Acres[1]**
Albion Inventory Block	184	946
Big River Inventory Block	88	422
Garcia River Inventory Block	121	676
Navarro East Inventory Block	215	1194
Navarro West Inventory Block	115	641
Noyo Inventory Block	135	682
Rockport Inventory Block	350	1616
South Coast Inventory Block	116	578
Total	**1324**	**6754**

TABLE NOTE
[1]Based on the number of acres impacted per territory per event within a 1000-ft buffer. Numbers are rounded.

During the breeding season, all spotted owl territories will have disturbance buffers of at least 500 ft. Territories with moderate and high protection will have 1000-ft disturbance buffers. MRC conservation measures permit use of mainline roads and other existing roads which are no closer to an activity center than a public road. There will be no creation of new roads and no tailhold and cable work in spotted owl territories and their associated buffers. As a result, MRC conservation measures will minimize the potential for disturbance or harassment, during the breeding season, to northern spotted owls in the 133 territories with high and moderate protection. Noise and other disturbance from covered activities during the breeding season may affect the 34

spotted owl territories with limited protection because these activities could occur within 500 ft of breeding sites.

The MRC goal for spotted owls is to increase their population in the plan area by 20%, from 95 Level-1 and Level-2 territories to 114. In order to accomplish this, MRC will manage 25% of the plan area to provide suitable nesting habitat. This is an increase of 8150 ac (18%), from the current 44,137 ac to 52,287 ac (Table 10-10). The expected increase in nesting/roosting habitat and population size will offset the expected take of spotted owls by habitat degradation.

12.3.7 Marbled murrelet

12.3.7.1 Location and distribution in the plan area

Chapter 5 (section 5.3) provides a detailed species account of the marbled murrelet, including geographic distribution, local distribution in the plan area, population trends, life history, and habitat requirements.

12.3.7.2 Suitable habitat in the plan area

Potential suitable habitat for marbled murrelets is based on known occurrences and habitat characteristics. Potential suitable habitat includes the LACMA site with known occurrences (Figure 12-2), Type I and Type II old-growth stands, and individual trees based on diameter and presence of platform branches. The tree diameter at breast height (dbh) must equal or exceed 48 in. for redwood trees and 36 in. for Douglas firs. The tree must also have at least 1 large limb (9 in. or more in diameter). For the purposes of this analysis, any tree with the required dbh and with branches identified by a forester as large was considered a potential murrelet tree.

Only a portion of the plan area has been surveyed for potential murrelet habitat: of the 83,088 ac of THP lands surveyed over the last 10 years (40% of plan area), 404 potential habitat trees have been identified. To determine the number of potential murrelet trees within the un-surveyed portion of the plan, we extrapolated based on the frequency of tree occurrence and the proportion of each inventory block surveyed. Based on this extrapolation, another 600 murrelet trees may be present within the plan area.

12.3.7.3 Covered activities adjacent to suitable habitat

Covered activities that may affect murrelets include timber operations (harvesting, yarding, loading and hauling timber), silviculture, and stand improvement. Timber activities can alter the distribution of suitable habitat and cause forest fragmentation, transforming large continuous forest patches into 1 or more smaller patches surrounded by disturbed areas. Forest fragmentation is a primary threat to marbled murrelets (Miller et al. 1995). This species uses contiguous patches of old-growth coastal coniferous forest for nesting (Hamer and Nelson 1995, Miller et al. 1995). Reduced canopy closure, an aftermath of fragmentation, allows for increased predation of murrelets (Nelson and Hamer 1995, as cited in Cooperrider et al. 2000). In addition, forest fragmentation increases available habitat for avian predators, allowing for further increases in predation (Ehrlich et al. 1988, Shuford 1993, Miller et al. 1995). Timber operations during the dry summer season may result in increased fire risk to murrelet habitat. Fire could reduce nesting habitat, decrease canopy cover, and increase predation risk.

Timber harvests can reduce forest canopy. Marbled murrelets use dense multi-storied canopies of old growth within coastal areas as nesting habitat (Miller et al. 1995, Miller and Ralph 1996) and for predator avoidance (Hamer and Nelson 1995). Reductions in canopy cover can result in

increased predation and decreased nesting success. Helicopter operations close to nest trees during non-breeding season may remove vegetation, such as old branches, moss, etc. Removal of tree structures could reduce murrelet nesting habitat (Miller et al. 1995).

Silvicultural management for new marbled murrelet habitat growth in LACMA, including basal area and canopy closure requirements, could result in noise disturbance and changes in composition of vegetation. Noise during the breeding season could result in decreased reproduction from physiological stress and abandonment of the nest and young (Marshall 1988, Miller et al. 1995). Decrease in canopy cover can lead to increased predation and decreased nesting success (Hamer and Nelson 1995). Regeneration could affect marbled murrelet habitat due to changes in vegetation, canopy cover, and noise levels. Regeneration activities, including tree planting and seeding, site preparation and brush removal, broadcast burning and fire control may impact murrelets.

Covered activities that may create noise levels disturbing to murrelets include

- Timber operations.
- Forest regeneration.
- Stand improvement.
- Road, landing, and skid trail construction, reconstruction, and maintenance.
- Stream crossing construction and maintenance.
- Water drafting development and use.
- Rock pit development and use.
- Equipment maintenance and fueling.

Noise can be potentially detrimental during the breeding season, resulting in decreased reproductive success due to physiological stress, abandonment of the nest and young, or both.

Research and monitoring activities could result in direct and indirect effects on marbled murrelets. Invasive research and its associated disturbance could have adverse impacts on marbled murrelet due to increased stress and reductions in nesting success (Marshall 1988, Miller et al. 1995). Disturbances from research and monitoring are expected to have only minor impacts on marbled murrelets since no direct handling or invasive methods will occur.

All marbled murrelet habitat may not be located because of the difficulty in surveying. Determining occupied marbled murrelet habitat and identifying occupied areas based on habitat suitability is difficult. MRC conducted 271 ground surveys for murrelets from 1994-2007 and established 2007 as our baseline for assessment of take. From all the surveys, 22 resulted in detections of murrelets—all in Lower Alder Creek with the exception of 1 area in Greenwood Creek.[3] Using these numbers, MRC assumes approximately 8% (i.e., 22/271) of un-surveyed stands may be occupied. However, this percentage is biased since most detections occurred in Lower Alder Creek. Moreover, detections generally did not result in a determination that murrelets were occupying the area.

Retention of potential murrelet trees and increased surveys are unlikely to result in any detriment to murrelet populations. However, any harvest or additional surveys near potential habitat trees could increase predator abundance. Inaccurate classification of habitat could cause involuntary direct or indirect take of breeding marbled murrelets and their young. Retention of potential marbled murrelet trees will provide additional habitat and potential colonization areas. In limited

[3] In 2008, there was one ground detection for murrelets in the Marsh Gulch area. Further surveys suggested that murrelets were unlikely to actually occupy the area.

protection areas where there is no survey requirement, murrelets may occupy potential trees and experience greater predation rates. Increasing the intensity and extent of surveys as well as decreasing the time surveys remain valid will reduce the possibilities for harvest in areas occupied by murrelets.

12.3.7.4 Mitigation that offsets the effects of forest management

Outside the Lower Alder Creek area, MRC has proposed protocols for murrelet surveys, as well as protections in lieu of surveys. If MRC decides not to survey an area with potential habitat trees, we must still follow protection measures. In addition, MRC will not harvest any tree that has a high likelihood of being a potential habitat tree for murrelets.

Our HCP/NCCP will contribute to the conservation efforts for marbled murrelet in California. The core of our plan protects the existing murrelet population in the Lower Alder Creek watershed. Barring unforeseen circumstances, our protections will maintain this population and give it the opportunity to increase even more as surrounding areas produce potential murrelet habitat and nest trees. At that point, MRC will offer the wildlife agencies the chance to purchase some of these forested stands. In discussions with the wildlife agencies, we have designated 6 Murrelet Habitat Recruitment Stands (see section 10.3.2.3). Additionally, MRC will retain all trees that have a high potential to become murrelet nest trees even if our surveys indicate that a tree or stand is currently not occupied by murrelets.

Through our conservation measures, MRC will

- Provide long-term maintenance and enhancement of murrelet habitat through landscape planning and conservation measures for old-growth, wildlife trees, downed wood, and riparian areas.
- Protect 1237 ac of existing habitat in Lower Alder Creek, the only drainage in the plan area where occupied behavior has been observed.
- Provide increased protection stands outside of the Lower Alder Creek drainage with special restrictions to promote growth of murrelet habitat at an accelerated pace.
- Rehabilitate tanoak-dominated stands to become conifer or mixed conifer stands; such stands are more likely to become high quality murrelet habitat.
- Enforce a “no-clearcut” policy to reduce forest fragmentation.
- Maintain and enhance multi-storied canopy characteristic of old-growth forests required by murrelets for nesting.
- Restrict helicopter operations in the vicinity of nesting trees to minimize removal of vegetation and change habitat structure.
- Report fires or potential fire dangers to CDF.
- Provide buffers around occupied areas and potential habitat to reduce the likelihood of a fire reaching these locations.
- Allow only limited road-use in the vicinity of murrelet habitat with high and moderate protection during breeding season.
- Provide disturbance buffers to reduce noise from harvest and logging operations; the buffer sizes for high and moderate protection will meet or exceed U.S. Fish and Wildlife Service take avoidance criteria.
- Monitor marbled murrelet with radar and ground surveys that do not include handling of marbled murrelets; trained biologists will conduct the ground surveys.

  NOTE
  Marbled murrelets will benefit from surveys which increase our understanding of local population cycles and trends and allow us to detect occupied areas currently unknown.

- Limit survey and operational crews in LACMA to reduce the likelihood of increased predation rates.

For the LACMA area, protection levels during the breeding season are 0.25 miles, 0.5 miles, and 1 mile, respectively, for general, helicopter, and blast activities. Protection levels during the non-breeding season are a 300-ft and 500-ft buffer, respectively, for general and helicopter activities. For marbled murrelet trees currently identified as outside of LACMA, MRC based protection levels on the zone of the stand. We grouped trees based on number of potential murrelet trees within 100 ft. Following the criteria in Table 10-16, we will survey and protect these individual murrelet trees or groups of trees. Since areas with limited protection are unlikely to harbor murrelets, take at these locations is unlikely to cause direct mortality of murrelets. Table 12-26 shows protections for areas outside LACMA.

Table 12-26 Protections for Areas outside LACMA

Breeding Season		
Activity	Prescription	
	High and Moderate Protection	Limited Protection
General Silvicultural	Follow USFWS guidance per Table 12-26.	Retain murrelet trees and screen trees.
Helicopter	0.25 mile buffer	
Blasting	1 mile buffer	
Non-breeding Season		
Activity	Prescription	
	High Protection	Moderate Protection
General Silvicultural	100-ft buffer	75-ft buffer
Helicopter	300-ft buffer	200-ft buffer

12.3.7.5 Level of expected take

For marbled murrelets, we define take in 2 ways:

1. Habitat degradation or removal within 300 ft of marbled murrelet trees (i.e., harm in the form of habitat loss).
2. Disturbance which exceeds criteria listed in Table 10-17 and 10-18 (i.e., harassment of individuals).

MRC does not expect take in the form of direct injury or mortality of marbled murrelets to occur due to our protection of occupied habitat in Lower Alder Creek, i.e., core areas, habitat areas, and buffer areas. Moreover, we will protect other areas occupied by marbled murrelets with a ¼ mile disturbance buffer and a 300-ft habitat buffer. Although highly unlikely, it is possible that direct mortality of marbled murrelets could occur in areas where surveys return a false-negative result or where murrelets colonize after surveys.

The primary form of murrelet take will be habitat degradation or removal within 300 ft or more of murrelet trees. Un-surveyed areas given high and moderate protection will have 100- and 75-ft "no harvest" buffers, respectively. This is less than the standard 300-ft buffer for occupied stands. Limited protection areas have no buffer. Habitat degradation could adversely affect marbled murrelets within areas of limited protection. This would occur outside LACMA in habitat areas

consisting of individual murrelet trees. In areas of limited protection, MRC only protects individual murrelet trees.

MRC began surveying for individual wildlife tree in 1999 as part of THPs. In the field, we painted each identified wildlife tree with a "W" and recorded their individual characteristics on a data sheet as well as marking their location on a map. Next, we used this wildlife tree data to filter out all trees that did not meet the criteria as potential murrelet trees (section 10.3.2.3.4). We then determined which wildlife trees were individual trees and which were part of a clump of 2 or more trees within 100 ft of each other. We assigned limited protection to individual wildlife trees and either high or moderate protection to wildlife trees in a clump.

Table 12-27 shows potential take from disturbance of murrelets. Since our murrelet habitat with high and moderate protection are equivalent to 2009 take-avoidance standards, we only assessed take for operations adjacent to habitat assigned limited protection. We used 2 different buffer distances, namely, 500 ft, a typical disturbance buffer, and 1320 ft, the disturbance distance associated with felling large trees, yarder whistles, and rock blasting (Table 10-18). We believe that 25% of operations near these individual trees would require a 1320 ft buffer under take-avoidance guidelines. According to our assessment, a total of 306 known murrelet trees are further than 100 ft from another murrelet tree. Because this is a rough assessment, we have allowed for sampling error by increasing the estimate 10% to 337 trees. Since we surveyed roughly 40% of covered lands for wildlife trees, we project that the remaining covered lands could result in 506 additional murrelet trees. This would amount to 843 individual murrelet trees in the plan area.

Table 12-28 shows potential take from degradation or removal of murrelet habitat. Since the current take-avoidance guidelines require a 300-ft "no harvest" buffer, all levels of MRC protection (high, moderate, and limited) will result in potential take as result of habitat degradation or removal. Because there is no habitat buffer for limited protection, operations within 300 ft of individual murrelet trees is take. There are 75- and 100-ft "no-cut" buffers for murrelet trees with moderate and high protection, respectively. To address take for murrelet trees with moderate or high protection, MRC subtracted the acreage of a 300-ft buffer (6.5 ac) from the acreage for the 75-ft (0.41 ac) or 100-ft buffer (0.72 ac) and then multiplied by the number of occurrences of each protection type.

To minimize murrelet harassment, MRC established disturbance buffers for the anticipated sound levels of various activities (Table10-18). Take as a result of disturbance may impact 37,751 ac over the term of the plan (Table 12-27). Take as a result of habitat degradation may occur in 5480 ac with limited protection, 944 ac with moderate protection, and 136 ac with high protection (Table 12-28).

These estimates are the worst case scenario for potential take of marbled murrelets. The assumption for this assessment was that murrelets actually occupy all habitat trees given high, moderate, and limited protection. In actual fact, we have only detected marbled murrelets during about 1% of our surveys; these detections are often not indicative of occupied behavior. Multiplying 1% of 37,751 ac equals only 377 ac. This much smaller number better represents the acreage potentially occupied by murrelets and subject to impact from disturbance. Moreover, MRC biologists will survey a portion of the 377 ac (25-50%) to determine murrelet occupancy; this will further reduce the possibility that take might occur within those 377 ac.

To minimize murrelet harassment, MRC established disturbance buffers for the anticipated sound levels of various activities (Table10-18). Take as a result of disturbance may impact 37,751 ac over the term of the plan (Table 12-27). Take as a result of habitat degradation may occur in 5480 ac with limited protection, 944 ac with moderate protection, and 136 ac with high protection (Table 12-28).

Table 12-27 Potential Take of Marbled Murrelet from Disturbance

Buffer	# Known Trees	Known Acres of Disturbance Take	Predicted # Trees	Predicted Acres of Disturbance Take	Total Trees	Total Acres of Take
500-ft buffer	253	4554	379	6822	632	11,376
1320-ft buffer	84	10,500	127	15,875	211	26,375
Total	337	15,054	506	22,697	843	37,751

Table 12-28 Table Potential Habitat Take of Marbled Murrelet

Protection Level	Known # Individual Locations	No-cut Buffer (ft)	Habitat Take Acreage*	Predicted # Individual Locations	Habitat take Acreage*	Total Individual Locations	Total Acres of Take
Limited	337	0	2191	506	3289	843	5480
Moderate **	62	75	378	93	566	155	944
High**	9	100	55	14	81	23	136
Total	448	NA	2624	613	3936	1021	6560

TABLE NOTES

*Habitat acreage = (Acreage 300 ft buffer [6.5] – acreage no-cut buffer) x number of locations)

** Our assessment did not include Type I and II old growth because MRC protection for these stands exceeds take avoidance standards.

These estimates are the worst case scenario for potential take of marbled murrelets. The assumption for this assessment was that murrelets actually occupy all habitat trees given high, moderate, and limited protection. In actual fact, we have only detected marbled murrelets during about 1% of our surveys; these detections are often not indicative of occupied behavior. Multiplying 1% of 37,751 ac equals only 377 ac. This much smaller number better represents the acreage potentially occupied by murrelets and subject to impact from disturbance. Moreover, MRC biologists will survey a portion of the 377 ac (25-50%) to determine murrelet occupancy; this will further reduce the possibility that take might occur within those 377 ac.

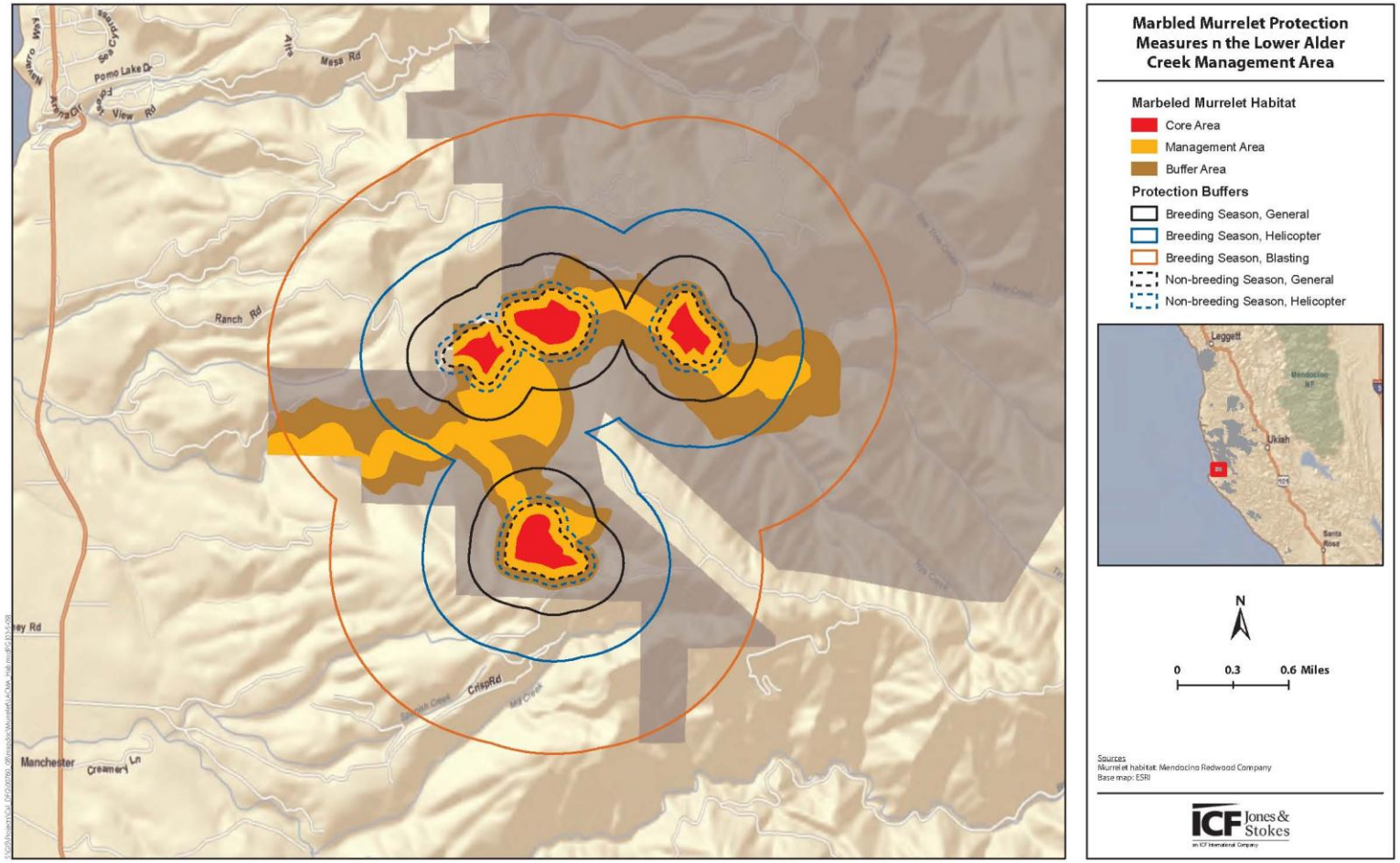


Figure 12-2 LACMA Habitat

12.3.8 Point Arena mountain beaver

12.3.8.1 Location and distribution in the plan area

Chapter 5 (section 5.4) provides a detailed species account of the Point Arena mountain beaver, including geographic distribution, local distribution in the plan area, population trends, life history, and habitat requirements.

12.3.8.1.1 Known burrow locations for assessment analysis

There are approximately 262 known sites of Point Arena mountain beavers; however, some reported sites may be part of the same burrow system.[4] Data on distribution of sites in the plan area is sparse but Point Arena mountain beavers have been observed in the watersheds of Mallo Pass Creek/ Mills Creek and Alder Creek (USFWS 1998a and MRC data, 2007) (Figure 12-3). Mountain beaver presence in these watersheds is known to occur at 14 burrow systems, although burrows 8 and 10 are likely one system.[5] One additional burrow system, adjacent to Point Arena Creek, is outside the plan area. The burrow systems are at small disjunctive sites generally separated by unsuitable habitat.

In the plan area, burrow systems of Point Arena mountain beaver are generally in riparian forests and at locations where there are freshwater seeps and brush. Burrow sites are rarely in conifer stands. Most of the known burrow systems in the plan area (i.e., 64% of burrow systems and 60% of their acreage) are within the inner or middle bands of the riparian buffers for Class I or Large Class II streams. This puts them within 130 ft of the streams. However, 1 burrow system (1) is above a small Class III Stream; 2 burrow systems (11 and 12) are outside the buffer of a Class I stream but in close association with several other burrow systems within the riparian buffer; and 2 burrows (3 and 4) are 250 and 400 ft, respectively, from a Class I stream.

The known burrow systems in the plan area, based on GIS data, total 1.87 ac. However, 3 of the burrow sites are currently point locations; MRC has not surveyed or mapped the areal extent of the burrow system. Information suggests that the sizes of the burrow systems are from 0.06 ac to 0.57 ac. Using the largest burrow system size, i.e. 0.57 ac, to estimate the acreage of the 3 point locations, MRC concludes that all known burrow systems in the plan area total approximately 3.58 ac.

Our HCP/NCCP assessment area for the Point Arena mountain beaver extends up and down the coast for approximately 20 miles and inland for 5 miles in the Garcia River and South Coast inventory blocks. MRC has surveyed 33 THPs for mountain beaver burrow systems since 2004. In the assessment area, there are approximately 2877 ac within 200 ft of Class I and Class II streams. MRC has surveyed about 691 of these acres to determine whether or not Point Arena mountain beavers occupy any areas scheduled for harvest under THPs. Therefore, 2186 ac of potential mountain beaver habitat remain un-surveyed. MRC discovered 1 of the 14 known burrow systems (14) during the pre-harvest THP surveys; the rest were discovered prior to THP surveys. Figures 12-3 through 12-6 show the known locations of burrow systems. Although 1 burrow system occurs along Point Arena Creek, which is outside the plan area, surveys of other areas in the Garcia inventory block have not resulted in any detection of Point Arena mountain beaver burrow systems.

[4] Email to Craig Hansen (ICF J&S) from John Hunter (USFWS) on 01/08/09
[5] Telephone conversation between Sarah Billig (MRC) and Craig Hansen (ICF J&S) on 02/28/08

MRC will conduct pre-harvest THP surveys and long-term monitoring to protect potential breeding sites of mountain beaver. By increasing information about the mountain beaver, these surveys will decrease the potential risk of *take*.

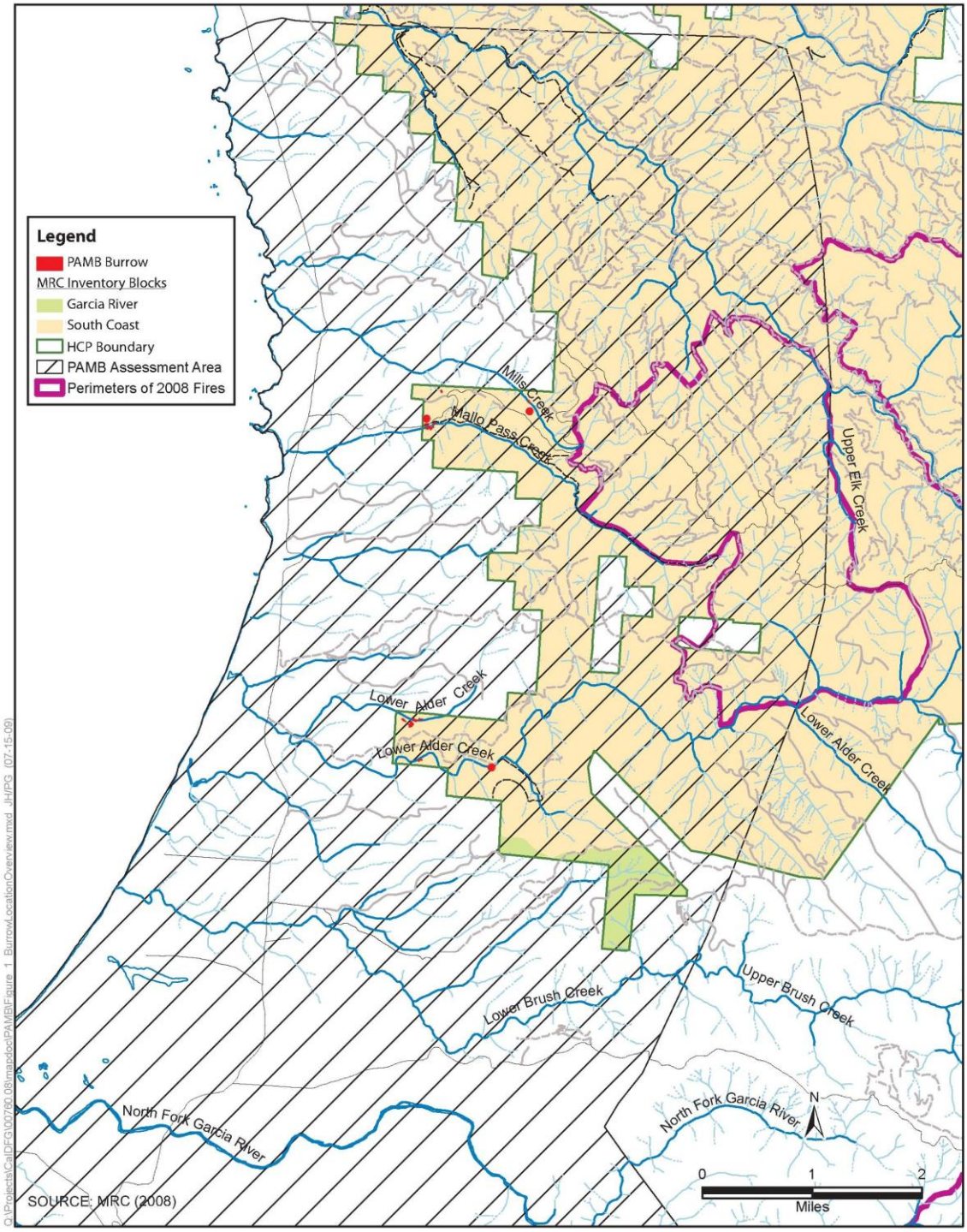


Figure 12-3 Burrow Locations of Point Arena Mountain Beaver (PAMB)

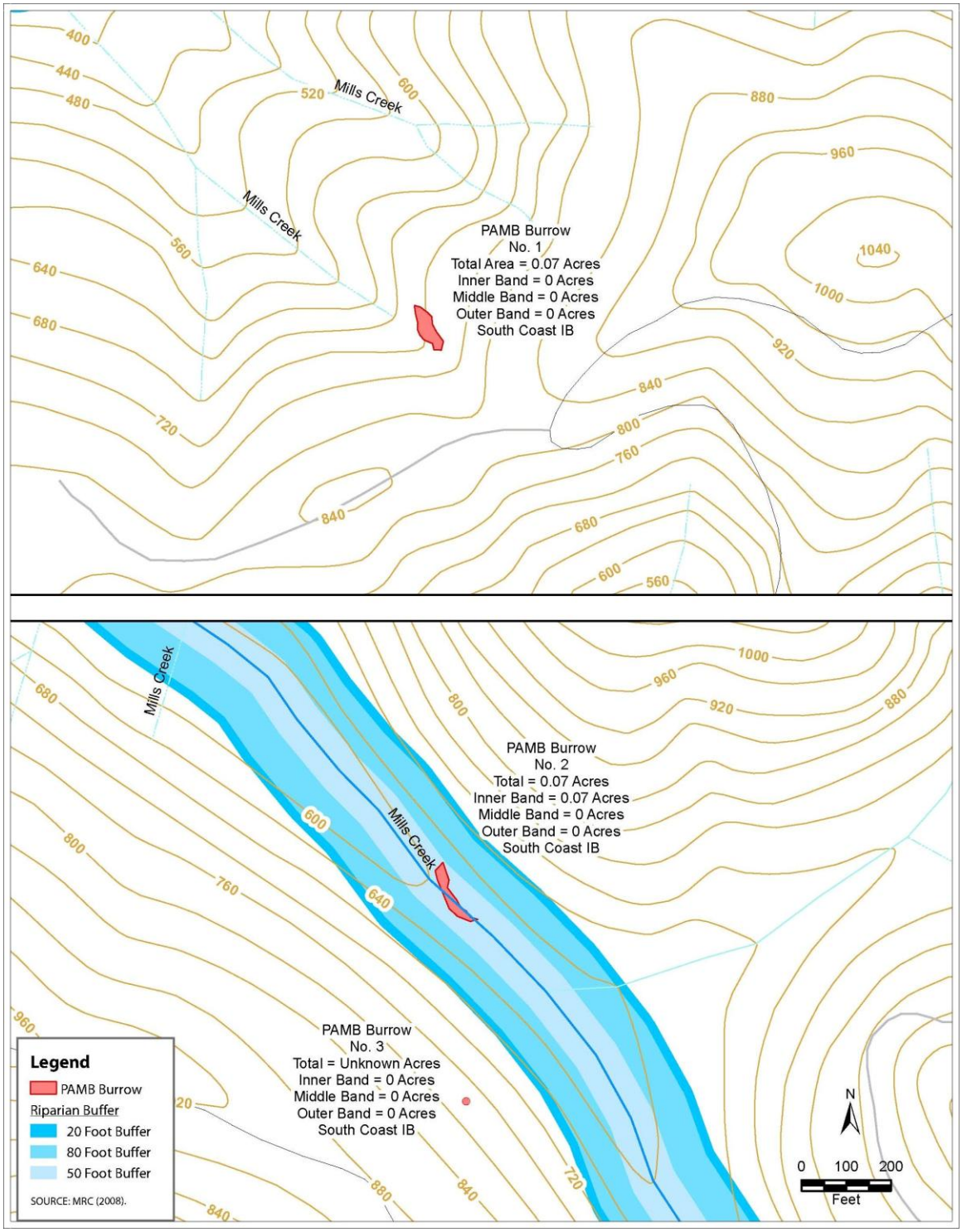


Figure 12-4 PAMB Burrow Locations 1, 2, and 3

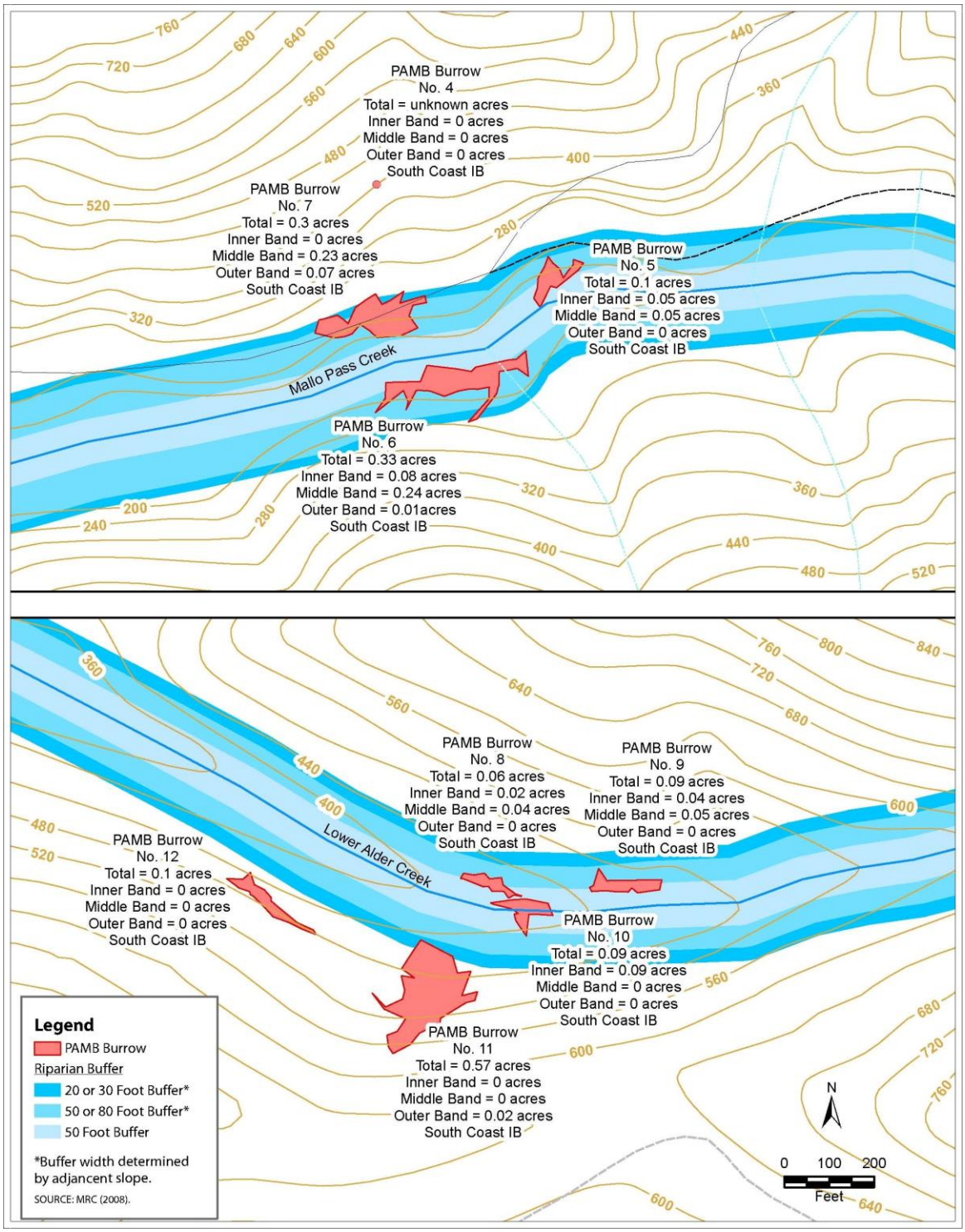


Figure 12-5 PAMB Burrow Locations 4 through 12

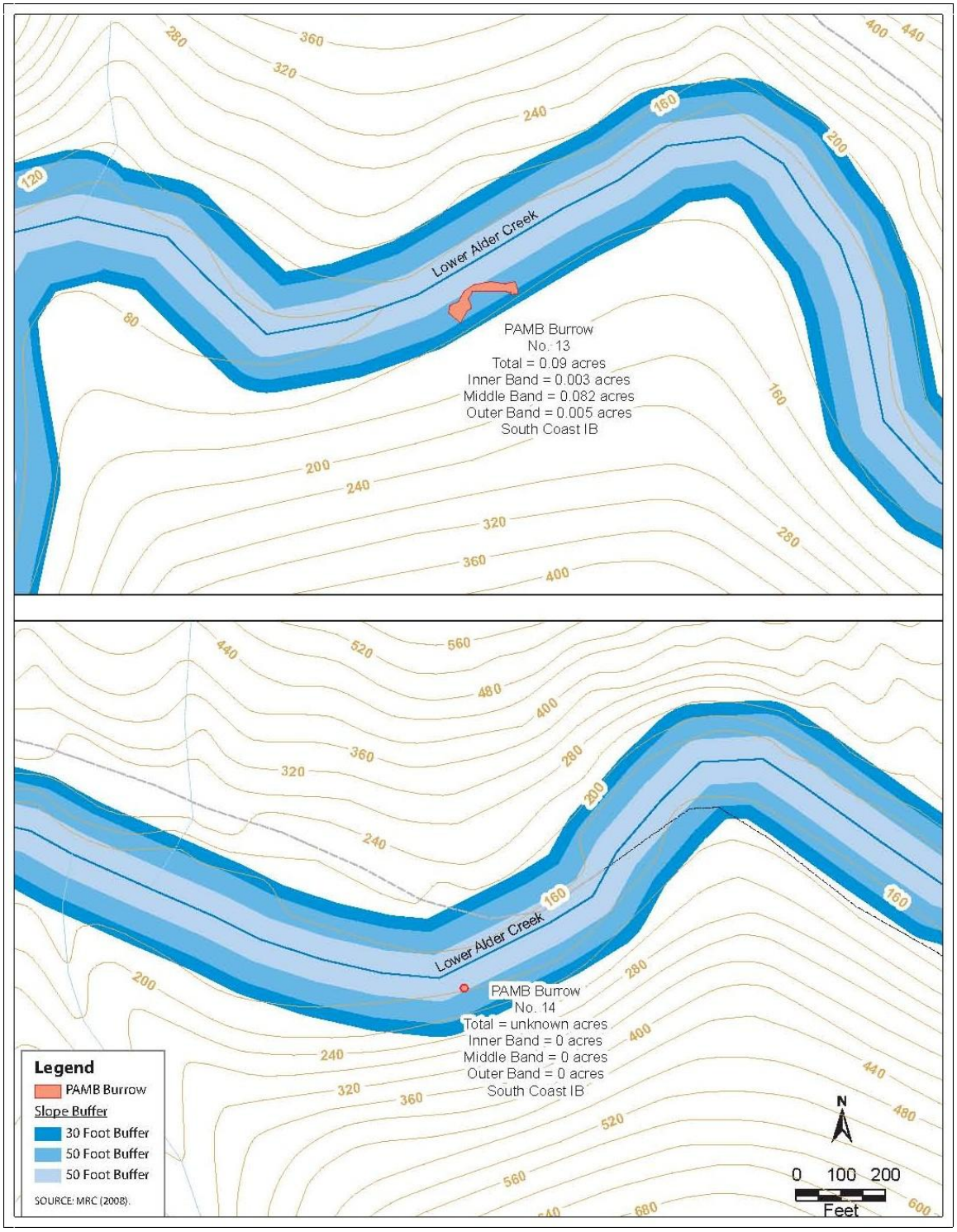


Figure 12-6 PAMB Burrow Locations 13 and 14

12.3.8.2 Suitable habitat in the plan area

Potential suitable habitat for the Point Arena mountain beaver is any area with herbaceous or brushy ground vegetation (excluding grasses) within 5 miles of the Pacific coast in the South Coast and Garcia inventory blocks. The likelihood of encountering mountain beavers in areas solely comprised of redwoods and Douglas fir, however, is very low. Since most known mountain beaver sites in the plan area are, based on GIS analysis, within approximately 130 ft of a stream, we estimate that potential habitat could occur within 200 ft of any stream in watersheds that currently have Point Arena mountain beaver. For sub-basins with known occupancy, i.e., Mallo Pass Creek/Mills Creek and Lower Alder Creek in the South Coast inventory block, and Garcia River in the Garcia inventory block, the amount of potential habitat may be 927 ac, 611 ac, and 1339 ac respectively. Based on the percentage of potential habitat surveyed—Mallo Pass Creek/Mills Creek (34%), Alder Creek (11%), and Garcia River (25%)—and on the known burrow systems along the creeks in each of the sub-basins, Table 12-29 shows the MRC estimates on potential occupied habitat. To arrive at the amount of potential occupied habitat by mountain beavers in Mallo Pass Creek/Mills Creek, for example, we made the following calculation:

EXAMPLE
Mallo Pass Creek/Mills Creek

suitable PAMB habitat	927 ac
% habitat surveyed	34%
surveyed habitat	315 ac
known burrow systems	.87

Potential occupied habitat = .87:315::x:927
315x=.87*927
315x= 806
x=2.5 ac (Table 12-29, row 1)

Table 12-29 Potential Occupied PAMB Habitat

Watersheds	Potential Habitat (ac)	% Potential Habitat Survey	Know Burrow Systems (ac)*	Potential Occupied PAMB Habitat (ac)
Mallo Pass Creek/Mills Creek	927	34	.87	2.5
Lower Alder Creek	611	11	1.00	9.1
Garcia River	1339	25	none**	4.0
			Total	15.6

TABLE NOTES
*Sum of "Total" burrow acres in each watershed (Figures 12-4 to 12-6)
**We used 1 ac in our calculations for Garcia River Watershed.

The Mendocino Lightning Complex of 2008 burned over 282 ac of potential Point Arena mountain beaver habitat in Mallo Pass Creek. It is unclear if the fire created new habitat or destroyed potential habitat. No known mountain beaver burrow systems were within the perimeter of the fire.

12.3.8.3 Covered activities and suitable habitat

Little is known about the sensitivity of mountain beavers to disturbance (USFWS 1998a). Because of their clumped and fragmented distribution, the subspecies is very vulnerable to catastrophic disturbances (natural or anthropogenic), such as storms, fire, flooding, landslides, disease, or prolonged drought (USFWS 1998a).

Cattle and sheep grazing have resulted in the loss and degradation of coastal scrub habitat used by mountain beavers (Steele 1989). Cattle may also adversely impact mountain beaver habitat by trampling burrows and crushing runways (i.e., travel pathways that rodents use in grassy or herbaceous areas), as observed at Alder Creek (Steele 1989). Livestock grazing could be an important factor limiting the expansion of existing sites of Point Arena mountain beaver (USFWS 1998a). However, MRC will not graze livestock in the plan area.

Urban development has been an important factor in the loss and degradation of coastal scrub habitat within the range of the Point Arena mountain beaver. Predation by feral and non-feral dogs and cats likely increases near areas of human habitation and may be affecting some sites (USFWS 1998a). Rodent and pest control by residents of urban development could result in negative effects on the Point Arena mountain beaver. The construction of private and county roads and the existence of State Highway 1 within the distribution of the Point Arena mountain beaver probably prevents or impedes dispersal between sites or into potentially suitable, unoccupied habitat (Steele 1989), as well as causing direct mortality (USFWS 1998a). Housing developments planned for the Irish Gulch area of Mendocino County may result in additional indirect and direct effects on Point Arena mountain beaver (USFWS 1998a). MRC is not proposing housing and infrastructure development in the plan area.

Gopher control programs have resulted in Point Arena mountain beaver mortality because mountain beavers were mistaken for gophers (USFWS 1998a). Trapping and poison baiting of rodents is common along the Mendocino County coast (Steele 1986). Use of other chemicals, such as pesticides and herbicides, may also result in mortality (USFWS 1998a). MRC has restrictions on chemical use, especially in areas where mountain beavers are known to occur.

Crushing of vegetation and burrows by campers and hikers may adversely affect sites of Point Arena mountain beavers (USFWS 1998a). Closure of sensitive areas to recreation has resulted in an increase in activity by mountain beavers (USFWS 1998a). In the plan area, there are no recreation sites near burrow systems of Point Arena mountain beaver.

Mountain beavers may respond relatively well to habitat changes precipitated by logging. Dense vegetation typically increases as overstory is removed (Sleeper 1997). Evidence indicates that mountain beavers may use openings in conifer stands and colonize areas where conifers have been removed (Scheffer 1929, Hooven 1973, Neal and Borrecco 1981). After logging occurs, mountain beavers seem to select sites where coarse woody debris remains (Hacker and Coblentz 1993). Falling trees and yarding may result, however, in direct injury or mortality to mountain beavers; logging may also damage their burrow systems.

The most likely MRC covered activities with the potential to adversely affect mountain beavers are timber harvest, road maintenance, and construction. These activities have the potential to directly affect mountain beavers by removing or degrading occupied burrows or suitable habitat, or causing disturbance or mortality to individuals in occupied burrow systems. Surveys might yield false negative results as well that could potentially result in impacts to mountain beavers

and their habitat. Indirectly, timber harvest, road maintenance, and construction could eventually cause road failures that adversely affect mountain beavers and their burrow systems.

12.3.8.4 Mitigation that offsets the effects of forest management

The MRC conservation strategy for Point Arena mountain beaver is primarily a take-avoidance approach (C§10.3.3.3-1 to C§10.3.3.3-18). In brief, the combination of stream buffer protections, restrictions on road building near burrow systems, noise and disturbance buffers, and daily and seasonal restrictions on activities near occupied burrow systems will likely result in little, if any, *take* of mountain beaver from MRC forest management.

Survey efforts in areas likely to contain suitable habitat will ensure that MRC identifies both suitable and occupied habitat. If MRC discovers new burrow systems during surveys, we will protect them as occupied burrow systems. Moreover, MRC prohibits dogs in areas being surveyed. These measures should result in no *take* of Point Arena mountain beavers.
Under adaptive management provisions of our HCP/NCCP, MRC may experimentally harvest trees or manipulate downed log abundance and distribution within protective buffers to determine if such management within short distance of a burrow system will negatively impact the mountain beaver. Other mountain beaver species have responded positively to forest management activities[6]. Adaptive management has the potential to adversely or positively affect the mountain beaver or, perhaps, result in little or no effect.

12.3.8.5 Level of expected take

MRC does not expect our conservation measures to result in incidental *take* of Point Arena mountain beaver because they are a take-avoidance strategy. We will protect known occupied mountain beaver sites as well as newly discovered sites.

Road or landing failures could affect mountain beavers but the possibility is remote. MRC will implement management practices to prevent such failures and will restrict road-building near streams, an area where burrow systems routinely occur. These actions, coupled with the sparse distribution of mountain beaver burrow systems and their typical location within stream buffers, should result in a very low risk of *take*.

False negative surveys could impact mountain beavers. However, it is difficult to quantify the accuracy of surveys. MRC believes the risk of *take* from false negative surveys is low. Our biologists are trained in the proper protocol. They understand what constitutes suitable mountain beaver habitat. Their survey protocols are similar to those developed by USFWS. In following these protocols, surveyors have very little probability of concluding beavers are absent when, in fact, they are present.

Take may occur when MRC chooses to implement the adaptive management provisions relative to Point Arena mountain beaver. The *take* would be the acreage of the experimental burrow system and any individuals associated with the burrow system. MRC projects that we will implement the adaptive management provisions near 2 burrow systems per decade, with little or no adverse impacts to the burrow systems. If adaptive management does result in adverse impacts, we would desist.

The acreage of known burrow systems in the plan area ranges from 0.06 ac to 0.57 ac. Thus, the acreage of burrow systems that could be impacted by adaptive management, i.e. 2 burrow

[6] Email to Craig Hansen (ICF J&S) from Brad Valentine (CDFG) on 01/07/09

systems, ranges from 0.12 to 1.14 ac per decade. However, for purposes of determining the level of *take*, we assume that 2 of the largest burrow systems might be taken, which is 1.14 ac. If the adaptive management provisions prove to be unsuccessful, an undetermined number of Point Arena mountain beaver within the 1.14 acres of occupied habitat could be taken.

12.3.9 Covered rare plants

12.3.9.1 Level of expected take

Our take analysis was limited to the known occurrences of rare plants within the plan area. Due to insufficient data, we were unable to assess take for suitable habitat of covered species. In order to assess take for suitable habitat, a strong habitat model is needed to accurately predict locations where the species could occur. An essential component of a habitat model is a clear understanding of the habitat requirements for the species being modeled. Unfortunately, very little is known about the key microclimate conditions associated with the majority of the species covered by this plan. Therefore, no habitat models were developed for the covered species.

It is estimated that 10% of the plan area has been inventoried for covered plant species. MRC anticipates that new occurrences of species currently found in the plan area and new species not yet documented in the plan area will be discovered as pre-harvest surveys are conducted in areas not yet inventoried. Since our analysis lacked the capability to accurately predict the location of likely occurrences, it was not possible to account for take in these undiscovered occurrences. Therefore, we recognize that our analysis could under estimate the amount of take likely to occur from project activities carried out during the permit term, even with implementation of our conservation measures.

There are 31 plant species covered by our plan. Eleven of the species have been documented within the plan area and these are addressed in the take analysis (Table 12-30). The concept behind this analysis was to view the location and extent of plant occurrences and then overlay project activities to identify areas where they intersect. For plants in the forested environment, the conservation measures are designed to result in take avoidance. Plant locations elsewhere in the plan area may be affected by activities associated with roads, landings, and rock pits. These features were buffered: roads (buffered to match the existing road base); landings (buffered with .25 ac); and rock pits (buffered with .50 ac). The areas of intersection between the core occurrence areas and the buffered road, landing, and rock pit features represent potential take. One challenge we faced in running this process was that no data was available for the aerial extent of the plant occurrences. In order to give spatial extent to plant locations, we assigned a core occurrence area to each species. For species in management categories MC1 through MC3, we used the buffer sizes prescribed in their actual conservation measures, namely circles with a 150-ft radius for MC1 species and a 50-ft radius for MC2 and MC3 species (section 11.5). Generally, these buffers will be larger in the field than our conceptual geometry suggests. On the other hand, MC4 species and the 2 species for which MRC will apply species-specific conservation measures (Humboldt milk-vetch and long-beard lichen) do not have protective buffers. In the case of Humboldt milk-vetch, a MRC forester will mark the outer limits of the core occurrence area at least 5 ft beyond any of its visible parts (C§11.8.2-3). For long beard lichen, MRC will protect up to 10 source trees in any PTHP area (C§11.8.1-3). However, in order to quantify take for our analysis, we assumed that MC4 species, as well as Humboldt milk-vetch and long-beard lichen, had 50-ft buffers (Table 12-30). In this way, we could generate an estimate of take similar to our estimates for species in MC1-MC3.

Table 12-30 Take Analysis for Covered Plants

Potential Take of Covered Plants with Known Occurrences in the Plan Area								
Common Name	**Scientific Name**	**MC**	**Core Area Radius (ft)**	**Est. Take (ac)**	**Activities Associated with Take**			
					Timber Harvest	**Road**	**Landing**	**Rock Pit**
Humboldt milk-vetch	*Astragalus agnicidus*	na	50	51.1	X	X	X	X
Small ground-cone	Kopsiopsis hookeri	1	150	.1		X	X	
Swamp harebell	*Campanula californica*	3	50	1.68	X	X	X	
Oregon goldthreads	*Coptis laciniata*	2	50	.25	X	X	X	
Pygmy cypress	Hesperocyparis pygmaea	4	50	0.76		X	X	
Coast lily	*Lilium maritimum*	1	150	0.59		X		
Bolander's beach pine	*Pinus contorta* ssp. *bolanderi*	4	50	.1		X	X	
White-flowered rein orchid	*Piperia candida*	2	50	0.07		X		
North Coast semaphore grass	*Pleuropogon hooverianus*	1	150	2.77		X	X	
Maple-leaved checkerbloom	*Sidalcea malachroides*	4	50	1.4		X		
Long-beard lichen	*Usnea longissima*	Na	50	1.68	X	X	X	

TABLE NOTES
MC = management category
na = not assigned

A draw-back to assigning a core occurrence area in this way is that it does not reflect the actual size of the occurrence. This can be problematic in the take analysis by either over or under estimating take. As an example, consider a small occurrence (5 individuals) of species 'A', which is in MC2 and located along the roadside. This occurrence would be assigned a core occurrence area with a 50-ft radius, which likely over represents the actual area that the 5 individuals occupy (Figure 12-7).

For the take analysis, road related activities intersect the core occurrence area and a value of take is calculated. In our example, none of the individuals are actually affected by the road activities

and take is over estimated. For occurrences with high numbers if individuals, the assigned core area will likely under represent the actual area the plants occupy and project activities could result in a larger amount of take than the analysis calculated (Figure 12-7).

With these potential problematic situations in mind, we analyzed take for the 11 covered species documented within the plan area. A summary of take for each species is presented below, specifically noting situations where take may be over or under estimated.

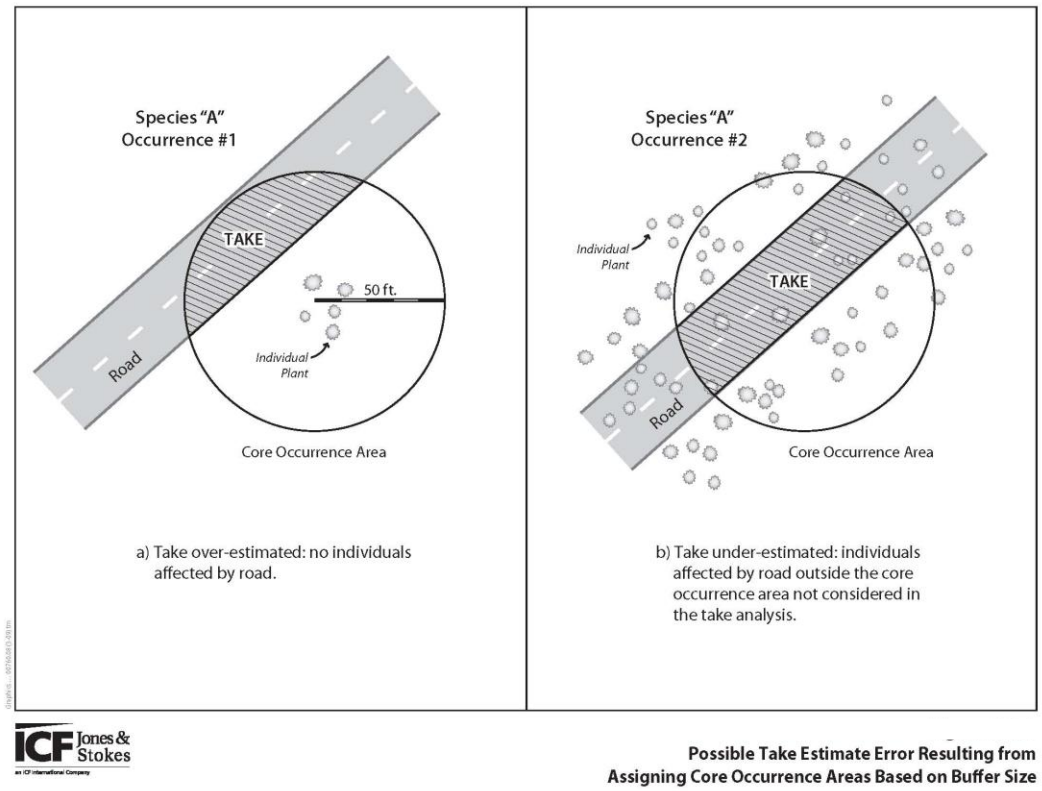


Figure 12-7 Possible Take Estimate Error

12.3.9.2 Humboldt Milk-vetch (*Astragalus agnicidus*)

12.3.9.2.1 Location and distribution in the plan area

There are 23 documented occurrences of Humboldt milk-vetch in the plan area (see our HCP/NCCP *Atlas*, MAPS 16A-C). The majority of the occurrences are in the Rockport inventory block. However, there are reports of several occurrences from each of the following inventory blocks: Noyo, Big River, Navarro East, South Coast, and Garcia. Occurrences in South Coast and Garcia inventory block have not been mapped and do not appear in our HCP/NCCP *Atlas*. Thirteen of the occurrences reported 100 individuals or less, 5 of the occurrences reported numbers ranging from 100-1000 individuals, and 5 occurrences reported >1000 individuals. The largest occurrence comprised 8195 individuals in 2001, when it was first documented.

All occurrences were reported along roads, skid trails, and landings. Humboldt milk-vetch is typically found in North Coast coniferous forests and broadleaved upland forest at sites with soil disturbance and an open forest canopy.

12.3.9.2.2 Current condition of occupied habitat

The 2008 Mendocino Lightning Complex fires burned large portions of the Rockport inventory block, including almost all of the Humboldt milk-vetch occurrences located in that region. Approximately 88% of the Humboldt milk-vetch known in the plan area was located in the Rockport inventory block. In addition to disturbance from burning, the occurrences also experienced disturbance from vehicle traffic, staging activities, and construction of fire breaks. The effect of fire on these occurrences is not yet known. Future surveys will be needed to document conditions. It is possible that Humboldt milk-vetch will respond positively to the disturbance based on the following characteristics of the species: it thrives in open areas with disturbed soil, the seeds remain viable in the soil for long periods of time, and seed germination is stimulated by fire.

12.3.9.2.3 Forest management adjacent to occupied habitat

The forest matrix surrounding Humboldt milk-vetch occurrences is predominantly redwood/Douglas fir and conifer hardwood forest. The initial harvest prescription for most of the stands is rehabilitation, variable retention, or transition harvest. Harvest rotation is on a 20-year cycle with subsequent prescriptions calling for selection harvest. Additional harvest-related activities that will occur in the vicinity of Humboldt milk-vetch include the use and maintenance of roads, landings, and rock pits.

12.3.9.2.4 Mitigation that offsets the effects of forest management

Humboldt milk-vetch typically occurs in areas with active timber management. Since this species may actually benefit from timber harvest activities, MRC proposes species-specific conservation measures, rather than category-based conservation measures, to meet the biological objectives for the species as well as the intent of the take provisions. With this strategy, conservation objectives will be the same as for MC 2 while allowing timber operations to proceed without unreasonable constraints. Conservation measures include clearly marking the boundary of the core occurrence area and felling trees away from it when possible. However, limited activities will be permitted in the core occurrence area, including use of existing roads, landings, and rock pits.

12.3.9.2.5 Level of expected take

Conservation measures for Humboldt milk-vetch are sufficient to protect most individual plants from take. However, take of 51.1 ac of Humboldt milk-vetch may occur from use and maintenance of roads, landings, and rock pits, with very minor take from tree felling and yarding operations (Table 12-30). After reviewing the numbers of individuals in each occurrence, it is likely that 56% of the occurrences factored into the take calculation over estimate take and 22% of the occurrences under estimate take. The amount by which take was over or under estimated is unknown; therefore, the accuracy of the calculated acreage for take is uncertain.

12.3.9.3 Small Ground-Cone (*Kopsiopsis hookeri*)

12.3.9.3.1 Location and distribution in the plan area

One occurrence of small ground-cone is known within the plan area. It is located in the Albion inventory block and in 2002, when first documented, consisted of 5 plants growing along the roadside. This species typically occurs in open and shrubby areas within North Coast coniferous forest and close-cone coniferous forest.

12.3.9.3.2 Current condition of occupied habitat

A site description for the occurrences is currently not available.

12.3.9.3.3 Forest management adjacent to occupied habitat

The forest matrix surrounding small ground-cone occurrences is predominantly pygmy forest where MRC is not proposing harvests.

12.3.9.3.4 Mitigation that offsets the effects of forest management

Small ground-cone belongs to MC1 and receives a core occurrence area buffer with a 150-ft radius. All harvest-related activities are excluded from the core occurrence area. Limited activities are permitted within the buffer, including use of existing roads, landings, and rock pits.

12.3.9.3.5 Level of expected take

Conservation measures for small ground-cone are sufficient to protect individual plants from take. MRC does not expect take of the 1 known occurrence of ground-cone during the term of our HCP/NCCP; it is well away from a road and will be clearly marked during future operations. However, there may be minor take (.1 ac) from road and landing use in areas still un-surveyed for ground-cone (Table 12-30).

12.3.9.4 Swamp Harebell (*Campanula californica*)

12.3.9.4.1 Location and distribution in the plan area

The 6 occurrences of swamp harebell known in the plan area were located in the South Coast and Garcia inventory blocks. Two of the occurrences contain low numbers of individuals (< 6), while the remaining occurrences contain > 600 individuals. One occurrence in the Garcia inventory block had > 40,000 individuals in 2007. Many of the occurrences were reported from stream crossings (culverts), roadside ditches, and mesic locations on roads and landings. This species is typically associated with wetland habitats within coastal prairie, closed-cone coniferous forest, and North Coast coniferous forest.

12.3.9.4.2 Current condition of occupied habitat

A site description for the occurrences is currently not available.

12.3.9.4.3 Forest management adjacent to occupied habitat

The forest matrix surrounding swamp harebell occurrences is redwood/Douglas fir forest. The initial harvest prescription for most of the stands is transition harvest. Harvest rotation is on a 20-year cycle with subsequent prescription calling for selection harvest. Additional harvest-related activities that will occur in the vicinity of swamp harebell include the use and maintenance of roads and landings.

12.3.9.4.4 Mitigation that offsets the effects of forest management

Swamp harebell belongs to MC3 and receives a core occurrence area buffer with a 50-ft radius. Conservation measures include clearly marking the boundary of the core occurrence area and felling trees away from it when possible. Additionally, activities causing take will be restricted to the period between seed set and the breaking of dormancy, if feasible. Limited activities are permitted within both the core occurrence area and the buffer, including use of existing roads, landings, and rock pits.

12.3.9.4.5 Level of expected take

Conservation measures for swamp harebell are sufficient to protect most individual plants from take. However, take of 1.68 ac of swamp harebell may occur from use and maintenance of roads and landings, with very minor take from tree felling and yarding operations (Table 12-30).

12.3.9.5 Oregon goldthread (*Coptis laciniata*)

12.3.9.5.1 Location and distribution in the plan area

Seven occurrences of Oregon goldthread have been documented within the plan area, located in the following inventory blocks: Rockport, Albion, South Coast, and Big River. The number of individuals for the occurrences ranges from 25-65, and all were reported growing on stream banks. In addition to growing on stream banks, this species can typically be found in other mesic sites including meadows and seeps in coniferous forests.

12.3.9.5.2 Current condition of occupied habitat

A site description for the occurrences is currently not available.

12.3.9.5.3 Forest management adjacent to occupied habitat

The forest matrix surrounding Oregon goldthread occurrences is predominantly redwood/Douglas fir forest. Oregon goldthread occurs primarily in riparian areas. The main silvicultural prescription in the adjacent forests is high retention selection with entry into the stands once every 20 years beginning in the fourth decade of our HCP/NCCP.

12.3.9.5.4 Mitigation that offsets the effects of forest management

Oregon goldthread belongs to MC2 and receives a core occurrence area buffer with a 50-ft radius. Conservation measures include clearly marking the boundary of the core occurrence area and felling trees away from it when possible. When feasible, activities will be restricted to the period between seed set and the breaking of dormancy. Spoils from road maintenance will not be transported more than 100 ft from their plant population unless other requirements take precedence. Limited activities are permitted within the periphery of the core occurrence area and the buffer, including use of existing roads, landings, and rock pits.

12.3.9.5.5 Level of expected take

Conservation measures for Oregon goldthread are sufficient to protect individual plants from take. MRC does not expect take for existing occurrences. However, since we have only surveyed 10% of the plan area, minor take (.25 ac) may occur from timber harvest as well as road and landing use during the term of our HCP/NCCP in areas still un-surveyed for Oregon goldthread.

12.3.9.6 Pygmy Cypress (*Hesperocyparis pygmaea*)

12.3.9.6.1 Location and distribution in the plan area

All 4 occurrences of pygmy cypress in the plan area were located in the Albion inventory block. Three of the occurrences were in the pygmy forest, where covered activities will rarely take place. The fourth occurrence comprised 300 individuals and was located in pygmy transitional forest along roads, landings, and skid trails.

12.3.9.6.2 Current condition of occupied habitat

A site description for the occurrences is currently not available.

12.3.9.6.3 Forest management adjacent to occupied habitat

Forest management activities are not expected to affect the occurrences located in pygmy forest. The occurrence located in pygmy transitional forest is expected to experience impact from project activities. The dominant species in this transitional forest is redwood. The stand is scheduled for rotational harvest every 20 years with the first prescription calling for rehabilitation harvest and subsequent selection harvest. Additional harvest-related activities that will occur in the vicinity of pygmy cypress include the use and maintenance of roads and landings.

12.3.9.6.4 Mitigation that offsets the effects of forest management

Pygmy cypress belongs to MC4 and receives the lowest level of protection from conservation measures. The boundary of the core occurrence area will be clearly marked and impacts to individual plants will be avoided to the degree necessary to meet conservation objectives.

12.3.9.6.5 Level of expected take

Conservation measures outlined for pygmy cypress are sufficient for protecting individual trees from take during activities associated with felling trees. However, 0.76 ac of take for pygmy cypress is expected to occur from activities associated with using and maintaining roads and landings (Table 12-30). This expectation likely underestimates the amount of take that could occur from project activities during the life of the plan. The occurrence that will be affected by project activities comprises 300 trees, which undoubtedly occupy more area than the core area assigned to it.

12.3.9.7 Coast Lily (*Lilium maritimum*)

12.3.9.7.1 Location and distribution in the plan area

Four occurrences of coast lily were reported from the South Coast and Garcia inventory blocks. All occurrences reported low numbers of individuals, ranging from 1-10 plants. Several of the occurrences documented plants growing alongside roads. This species typically occurs in mesic sites in a variety of habitat types within 1-2 miles from the coast.

12.3.9.7.2 Current condition of occupied habitat

The 2008 Mendocino Lightning Complex fires burned 2 of the 4 occurrences. Both occurrences were in the Lower Alder Creek watershed in the South Coast inventory block. The impact of the fire on the plants is currently unknown.

12.3.9.7.3 Forest management adjacent to occupied habitat

The forest matrix surrounding coast lily occurrences is redwood/Douglas fir forest. The harvest prescription for the stands is selection harvest on a 20-year rotation cycle. Additional harvest-related activities that will occur in the vicinity of coast lily include the use and maintenance of roads.

12.3.9.7.4 Mitigation that offsets the effects of forest management

Coast lily belongs to MC1 and receives a core occurrence area buffer with a 150-ft radius. All harvest-related activities are excluded from the core occurrence area. Limited activities are permitted within the buffer, including use of existing roads, landings, and rock pits.

12.3.9.7.5 Level of expected take

Conservation measures outlined for coast lily are sufficient for protecting individual plants from take during activities associated with felling trees. However, 0.59 ac of take for coast lily is expected to occur from activities associated with using and maintaining roads (Table 12-30). This estimate of take likely over estimates the amount of take that will occur at these sites. The numbers of individuals per occurrence for coast lily were $\leq$ 10 plants and those plants probably occupy an area much smaller than the core area assigned to them for the analysis.

12.3.9.8 North Coast Semaphore Grass (*Pleuropogon hooverianus*)

12.3.9.8.1 Location and distribution in the plan area

Seven occurrences of North Coast semaphore grass have been documented in the plan area, all within the Upper Ackerman Creek watershed in the Ukiah inventory block. Two of the occurrences had 10 or fewer individuals, 1 occurrence had 200 individuals, and the remaining 4 occurrences had numbers ranging from 1,500 to >10,000 individuals. Plants were documented growing along roadsides, in mesic grasslands and seeps, and near streams. This species is typically associated with broadleaved upland forests and North coast coniferous forests.

12.3.9.8.2 Current condition of occupied habitat

A site description for the occurrences is currently not available.

12.3.9.8.3 Forest management adjacent to occupied habitat

The forest matrix surrounding North Coast semaphore grass occurrences is Douglas fir forest and conifer hardwood forest. The predominant harvest prescription in these stands is selection harvest scheduled on a 20-year rotation cycle. A number of stands don't receive their first harvest until Year 60 of the plan. Additional harvest-related activities that will occur in the vicinity of North Coast semaphore grass include the use and maintenance of roads and landings.

12.3.9.8.4 Mitigation that offsets the effects of forest management

North Coast semaphore grass belongs to MC1 and receives a core occurrence area buffer with a 150-ft radius. All harvest-related activities are excluded from the core occurrence area. Limited activities are permitted within the buffer, including use of existing roads, landings, and rock pits.

12.3.9.8.5 Level of expected take

Conservation measures outlined for North Coast semaphore grass are sufficient for protecting individual plants from take during activities associated with felling trees. However, 2.77 ac of take for North Coast semaphore grass is expected to occur from activities associated with using and maintaining roads and landings (Table 12-30).

12.3.9.9 Bolander's Beach Pine (*Pinus contorta* ssp. *bolanderi*)

12.3.9.9.1 Location and distribution in the plan area

All 4 occurrences of Bolander's beach pine were located in pygmy forest in the Albion inventory block. Numbers of individuals for these occurrences were low; reports documented several individuals at each location.

Bolander's beach pine is one of the few covered species for which we understand the key habitat requirements and can predict suitable habitat with a certain degree of accuracy. This species is restricted to the acidic, shallow soils within closed-cone pygmy forests at elevations from 225-750 ft. The plan area consists of 719 ac (0.3%) of potentially suitable habitat for Bolander's beach pine.

12.3.9.9.2 Current condition of occupied habitat

A site description for the occurrences is currently not available.

12.3.9.9.3 Forest management adjacent to occupied habitat

All occurrences of Bolander's beach pine occur in pygmy forest. No project activities are scheduled in the vicinity of any known occurrence during the permit term.

12.3.9.9.4 Mitigation that offsets the effects of forest management

Bolander's beach pine belongs to MC4 and receives the lowest level of protection from conservation measures. The boundary of the core occurrence area will be clearly marked and impacts to individual plants will be avoided to the degree necessary to meet conservation objectives.

12.3.9.9.5 Level of expected take

MRC has not scheduled PTHPs near any known occurrence of Bolander's beach pine. However, there is currently light road use near known populations and there will be future road use in areas still un-surveyed for Bolander's beach pine. As a result, .1 ac of take may occur for this species.

12.3.9.10 White-Flowered Rein Orchid *(Piperia candida)*

12.3.9.10.1 Location and distribution in the plan area

Two occurrences of white-flowered rein orchid have been documented in the plan area—1 in the Garcia inventory block and 1 in the Rockport inventory block. Both occurrences reported low numbers of individuals. This species prefers open-to-shaded sites within broadleaved upland forests, lower mountain coniferous forests, and North Coast coniferous forests.

12.3.9.10.2 Current condition of occupied habitat

A site description for the occurrences is currently not available.

12.3.9.10.3 Forest management adjacent to occupied habitat

The forest matrix surrounding white-flowered rein orchid occurrences is conifer hardwood forest. The harvest prescription in these stands is selection harvest scheduled on a 20-year rotation cycle with the first entry into the stands occurring in Year 60 of the permit term. Additional harvest-related activities that will occur in the vicinity of white-flowered rein orchid include the use and maintenance of roads.

12.3.9.10.4 Mitigation that offsets the effects of forest management

White-flowered rein orchid belongs to MC2 and receives a core occurrence area buffer with a 50-ft radius. Conservation measures include clearly marking the boundary of the core occurrence area and felling trees away from it when possible. When feasible, activities will be restricted to the period between seed set and the breaking of dormancy. Spoils from road maintenance will not be transported more than 100 ft from their plant population unless other requirements take precedence. Limited activities are permitted within the periphery of the core occurrence area and the buffer, including use of existing roads, landings, and rock pits.

12.3.9.10.5 Level of expected take

Conservation measures outlined for white-flowered rein orchid are sufficient for protecting individual plants from take during activities associated with felling trees. However, 0.07 ac of take for white-flowered rein orchid is expected to occur from activities associated with using and maintaining roads (Table 12-30).

12.3.9.11 Maple-Leaved checkerbloom *(Sidalcea malachroides)*

12.3.9.11.1 Location and distribution in the plan area

Maple-leaved checkerbloom is known from 6 occurrences in the plan area, all within a relatively short distance from the coast. It occurs in the following inventory blocks: Rockport, Albion, Navarro West, and South Coast. Numbers of individuals range from 1-80. This species prefers disturbed areas within broadleaved upland forest, coastal prairie, coastal scrub, and North Coast coniferous forests. All documented occurrences were reported along roadsides and landings.

12.3.9.11.2 Current condition of occupied habitat

The 2008 Mendocino Lightning Complex fires burned through the Juan Creek watershed in the Rockport inventory block. One occurrence of maple-leaved checkerbloom with 70 individuals was documented along the roadside in this drainage in 2007. Fire suppression activities including road grading and widening occurred in the vicinity of this occurrence. Surveys are needed to determine the extent of the impact. This is a perennial species and the majority of the individuals are thought to have been destroyed by road grading. However, the occurrence may persist since it is a disturbance-oriented species capable of regenerating from remnant seeds in the soil.

12.3.9.11.3 Forest management adjacent to occupied habitat

The forest matrix surrounding maple-leaved checkerbloom occurrences include redwood/Douglas fir forest, conifer hardwood forest, and mixed hardwood forest. The initial harvest prescription for most of the stands is transition or variable retention harvest. Harvest rotation is on a 20-year cycle with subsequent prescription calling for selection harvest. Additional harvest related activities that will occur in the vicinity of maple-leaved checkerbloom include the use and maintenance of roads.

12.3.9.11.4 Mitigation that offsets the effects of forest management

Maple-leaved checkerbloom belongs to MC4 and receives the lowest level of protection from conservation measures. The boundary of the core occurrence area will be clearly marked and impacts to individual plants will be avoided to the degree necessary to meet conservation objectives.

12.3.9.11.5 Level of expected take

Conservation measures outlined for maple-leaved checkerbloom are sufficient for protecting individual plants from take during activities associated with felling trees. However, 1.4 ac of take for maple-leaved checkerbloom is expected to occur from activities associated with using and maintaining roads (Table 12-30).

12.3.9.12 Long-Beard Lichen *(Usnea longissima)*

12.3.9.12.1 Location and distribution in the plan area

Long-beard lichen is found in all inventory blocks except the Noyo and Ukiah blocks. Sixteen occurrences have been reported with numbers of host trees ranging from several to 50. The majority of the occurrences are along ridge tops and reported host trees include Douglas fir, redwood, and madrone. Long-beard lichen is typically associated with North Coast coniferous forests and broadleaved upland forests up to 2000 ft in elevation

12.3.9.12.2 Current condition of occupied habitat

A site description for the occurrences is currently not available.

12.3.9.12.3 Forest management adjacent to occupied habitat

The forest matrix surrounding long-beard lichen occurrences is redwood/Douglas fir forest. The harvest prescription for these stands is selection harvest on a 20-year rotation schedule. Additional harvest related activities that will occur in the vicinity of long-beard lichen include the use and maintenance of roads and landings.

12.3.9.12.4 Mitigation that offsets the effects of forest management

MRC proposes species-specific conservation measures for long-beard lichen (C§11.8.1-1 to C§11.8.1-8), including protecting up to 10 source trees in any PTHP area (C§11.8.1-3). Additionally, old growth trees and snags will be protected as habitat for long-beard lichen colonization (C§11.8.1-6).

12.3.9.12.5 Level of expected take

Conservation measures for long-beard lichen are sufficient to protect up to 10 individual source trees per PTHP. If more than 10 source trees exist in a PTHP area, MRC may fell source trees. As a result, 1.68 ac of take may occur for this species from tree felling, yarding, and use and maintenance of roads during the term of our HCP/NCCP (Table 12-30).

Chapter 13

Monitoring and Adaptive Management

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13 MONITORING AND ADAPTIVE MANAGEMENT

13.1 Introduction

Chapter 13 describes how our monitoring and adaptive management program will

- Ensure compliance to HCP/NCCP prescriptions.
- Assess the status of species and natural communities on MRC covered lands.
- Evaluate the effectiveness of our conservation measures in meeting HCP/NCCP goals and objectives.
- Determine if conservation measures need to be changed.

The adaptive management component of the program will determine how MRC collects, analyzes, and uses information to improve the environmental conditions for covered species and natural communities within our forestlands. The monitoring component of the program will evaluate whether our management actions comply with our HCP/NCCP and yield the expected benefits. Both management and monitoring must adapt to change—in the environment, in scientific research, and in technological advances—as MRC learns to improve our conservation efforts and the relevance of our data collection.

13.2 Types of Monitoring

Recent guidelines for regional conservation planning define monitoring as the "systematic and usually repetitive collection of information typically used to track the status of a variable or system" (Atkinson et al. 2007). In accordance with these guidelines, MRC implements 3 types of monitoring: compliance monitoring, effectiveness monitoring, and validation monitoring.[1]

DEFINITION	**Compliance monitoring** determines whether MRC is conforming to the regulatory provisions of our HCP/NCCP.
	Effectiveness monitoring tests whether MRC conservation measures, individually or in sum, meet the stated goals and objectives of our HCP/NCCP.
	Validation monitoring examines the validity of the assumptions upon which the MRC conservation measures are built.

While our definitions emphasize distinct differences, in reality, these 3 types of monitoring may overlap and interact. If MRC determines through effectiveness monitoring, for example, that we are not meeting our objectives for covered species, we may change our conservation measures. Changing our conservation measures would, in turn, impact compliance monitoring.

13.2.1 Compliance monitoring

By tracking the status of plan implementation, compliance monitoring establishes whether MRC is meeting our regulatory commitments under our HCP/NCCP. In effect, compliance monitoring is implementation monitoring. In addition, there is a correlation between compliance monitoring and effectiveness monitoring. Without compliance monitoring, our ability to interpret results from effectiveness monitoring becomes very limited.

[1] Section 13-10, *Monitoring Rare Plants*, uses "focused studies" synonymously with validation studies.

13.2.1.1 Compliance under the Programmatic Timber Harvest Plan (PTHP)

At a minimum, the PTHP process will consists of the following:

1. An MRC RPF will prepare a PTHP in accordance with our HCP/NCCP.
2. The MRC operations coordinator will review the plan and ensure that it complies with our HCP/NCCP.
3. The MRC operations coordinator, if necessary, will consult with the wildlife agencies prior to submitting the PTHP.
4. The MRC operations coordinator will include any results from consultations with the wildlife agencies in the PTHP.
5. The PTHP will include maps and the following information, where relevant, as enforceable language in section 2 of the PTHP:
    - Northern spotted owl
        - Previous 3 activity centers per territory within 0.7 mi. of the PTHP area and within 0.5 mi. of appurtenant roads.
        - Protection level of each activity center.
        - Pre- and post-harvest habitat maps and acreages for territories within 0.7 miles the THP area.
    - Marbled murrelet
        - Indication if the PTHP is in the Lower Alder Creek Management Area (LACMA).
        - Outcome of any assessment for marbled murrelet habitat and designation of the Murrelet Habitat Zone (MHZ) of the PTHP (section 10.3.2.3.3).
        - Protection levels provided for marbled murrelet habitat or a survey plan for murrelet habitat.
        - Indication if (a) MRC has completed ongoing radar monitoring in additional drainages (13.9.2.2-3); (b) trees will be assessed as primary and secondary murrelet trees; and (c) MRC will harvest secondary murrelet trees which our surveys indicate are not occupied.
    - Point Arena mountain beaver
        - Indication if the PTHP is within the Point Arena mountain beaver assessment area.
        - Potential habitat of the Point Arena mountain beaver in or adjacent to the PTHP area.
        - Occupied habitat of the Point Arena mountain beaver in or adjacent to the PTHP area.
    - Coastal tailed frog
        - Indication if there are watercourses occupied by coastal tailed frogs in the PTHP area and confirmation that MRC is treating occupied watercourses as Large Class II streams.
        - Indication if MRC proposes heavy equipment in a buffered area around any wet features (seeps, springs, wet areas, wet meadows, or wetlands) and if pre-project surveys are required.
    - Red-legged frog
        - Indication if there are potential or documented breeding sites in the PTHP area and confirmation or descriptions of pertinent conservation measures.
        - Indication if MRC proposes heavy equipment in a buffered area around any wet features (seeps, springs, wet areas, wet meadows, or wetlands) and if pre-project surveys are required.
    - Mass wasting
        - Field observations and mapping of TSUs.

- Aquatic management zones (AMZs)
  - Proposed AMZ restoration.
  - Alternatives for restoration treatments in AMZ (AC§8.2.3.4-1 to AC§8.2.3.4-22).
  - Proposed harvest within the AMZ.
  - Water drafting guidelines (Appendix E, section E.7, *Standards for Water Drafting*; Appendix T, *Master Agreement for Timber Operations*).
- Snags, wildlife trees, recruitment trees, and LWD
  - Process for marking, tracking, and mapping silvicultural units to ensure compliance to our HCP/NCCP.
  - Report on number of snags, wildlife trees, and recruitment trees in sample area.
- Hardwoods
  - Indication if the basal area of hardwoods in silvicultural units prior to harvest is $\geq$ 15 ft^2/ac or, if not, statement included of the actual basal area.
  - Indication if the stands covered in the harvest plan are Type I, Type II, or Type III hardwoods stands or are hardwood representative sample areas.
- Plants
  - Survey compliance
    - Date of survey effort; size and location of areas surveyed; communities and habitats covered by the survey; number of person-hours to complete the survey.

      NOTE
      A survey may not be completed at the time the PTHP is submitted for approval. MRC may amend a survey to an already approved PTHP. CDFG will have 15 days to review the survey results prior to commencement of operations.
    - List and map showing all occurrences of rare plant species, including an identification code or number and specific location (USGS quadrangle, watershed, and inventory block) for each occurrence.
    - Number of rare plant individuals (or alternative measure of abundance or cover) for each occurrence detected during the survey.
  - Conservation compliance
    - Management category of each covered rare plant species known in the PTHP area.
    - Approved variances to the standard conservation measures.
    - Description of how MRC will implement standard and alternative conservation measures.
- Additional species
    - Additional seasonal restrictions for any species not listed above.
    - Location of any habitat or disturbance buffers, retention areas, EEZs, or ELZs.
- Allowable deviations or alternatives to standard conservation measures (Chapters 8-11).
- Natural communities
    - Indication if the PTHP occurs in uncommon natural communities.
    - Map showing the area covered by PTHP and the proposed activities within the uncommon natural communities.

6. MRC will

- Submit to CAF FIRE, per State law and in accordance with the CFPR, the PTHP, and any major PTHP amendments subsequent to submission.
- Notify the wildlife agencies as described within our HCP/NCCP.

7. CAL FIRE will review the PTHP as follows:
    - There will be an initial office review of the PTHP to determine if the plan is within the scope of the PTEIR.
    - A pre-harvest inspection, if necessary, will occur in the field; the MRC coordinator will notify the wildlife agencies of the scheduled date so that they can attend.
    - There may be active inspections during conduction of the PTHP to ensure that operations are in compliance with our HCP/NCCP.
    - CAL FIRE will prepare and file the inspection reports in the PTHP record.
8. The MRC operations coordinator will prepare a PTHP completion report and submit it to CAL FIRE and the wildlife agencies.
9. CAL FIRE may request, post-harvest, a completion inspection; in that case, the MRC coordinator will notify the wildlife agencies of the scheduled date so they can attend.
10. The wildlife agencies may request a status on operations of a PTHP and schedule a field inspection with MRC.
11. The MRC operations coordinator will conduct field reviews, within the first 3 years of HCP/NCCP implementation, of up to 25 PTHPs, starting with all PTHPs with active operations in the initial year of our HCP/NCCP; this process will continue until 25 PTHPs have been reviewed or 3 years have elapsed, whichever comes first.
12. The MRC operations coordinator will submit a PTHP compliance report with compiled information on the annually reviewed PTHPS to CDF, NMFS, USFWS, and CDFG, as requested, prior to December 31 of the year in which MRC completed the PTHPs.

13.2.1.2 Non-PTHP compliance monitoring

MRC will submit annual reports for operations that are not directly related to a PTHP. These reports include annual sediment control and LWD placement (see Appendix D, *HCP/NCCP Report Timelines and Samples,* D.2.4).

13.2.2 Effectiveness and validation monitoring

Effectiveness monitoring assesses the biological success of our HCP/NCCP; specifically, it evaluates whether MRC is meeting our biological goals and objectives. Validation monitoring, or in some cases focused studies, tests hypotheses to determine whether the assumptions under which MRC is conducting operations are correct. Table 13-1 lists all our HCP/NCCP monitoring programs. Each monitoring program has a unique code. For example, in the code M§13.5.2.1-2, M indicates this is a monitoring program, 13.5.2.1 indicates the section number within our HCP/NCCP where there is a description of this specific monitoring program, and 2 indicates it is the second monitoring program in that section.

Table 13-1 HCP/NCCP Monitoring Programs

HCP/NCCP Monitoring Programs		
Monitoring Code	**Type**	**Description**
M§13.5.1.1-1	E	Timber Inventory: Riparian Stands
M§13.5.1.1-2	E	Timber Inventory: Riparian Canopy
M§13.5.1.1-3	E	Watershed Analysis: LWD Conditions
M§13.5.1.1-4	E	Watershed Analysis: Shade Conditions
M§13.5.1.1-5	E	Stream Temperature
M§13.5.1.2-1	V	Long-term Channel Monitoring: LWD
M§13.5.1.2-2	V	Focus Watersheds: Riparian Function
M§13.5.1.2-3	V	Watershed Size: Small Class II Watercourses
M§13.5.2.1-1	E	Watershed Analysis: Mass Wasting
M§13.5.2.1-2	E	Focus Watersheds: Mass Wasting
M§13.5.2.2-1	V	Forensic Monitoring: Landslide Observations
M§13.5.3.1-1	E	Road Inventory: Sediment Prevention
M§13.5.3.1-2	E	Watershed Analysis: Sediment Prevention
M§13.5.3.2-1	V	Focus Watersheds: Sediment Prevention
M§13.5.4.1-1	V	Focus Watersheds: Sediment Budget
M§13.5.4.1-2	V	Long Term Channel Monitoring: Stream Sediment
M§13.5.4.1-3	V	Focus Watersheds: Stream Sediment
M§13.5.5.1-1	E	Water Drafting
M§13.5.5.2-1	V	Water Drafting
M§13.6.1.1-1	E	Anadromous Salmonid Presence: Annual Salmonid Monitoring Basins (ASMB)
M§13.6.1.1-2	E	Anadromous Salmonid Distribution
M§13.6.1.1-3	E	Chinook Salmon Monitoring Reaches (CSMR)
M§13.6.1.2-1	V	Smolt Abundance
M§13.6.2.1-1	E	Baseline Distribution and Habitat Quality of Red-legged Frog Breeding Sites
M§13.6.2.1-2	E	Occupancy of Red-Legged Frogs in Documented Breeding Sites
M§13.6.2.1-3	E	Re-evaluate Habitat Quality and Species Presence within RLF Breeding Sites
M§13.6.3.1-1	E	Baseline Distribution of Coastal Tailed Frogs
M§13.6.3.1-2	E	Distribution and Relative Abundance of Coastal Tailed Frogs
M§13.8.1-1	E	Snags, Wildlife Trees, Recruitment Trees, and Downed Wood
M§13.8.1-2	E	Basal Area of Hardwoods in Timber Stands
M§13.8.1-3	E	Post-Harvest Follow-up on Hardwood Representative Sample Areas
M§13.8.1-4	E	Acreage and Number of Hardwood Representative Sample Areas
M§13.8.1-5	E	Acreage and Number of Old Growth Stands and Trees
M§13.8.1-6	E	Distribution and Area of Rocky Outcrops
M§13.8.2-1	E	Common Natural Communities
M§13.8.2-2	E	Uncommon Natural Communities
M§13.8.3-1	E	Invasive Species Control
M§13.9.1.3-1	E	Northern Spotted Owls: Level-1 and Level-2 Territories
M§13.9.1.3-2	E	Northern Spotted Owls: Distribution and Acreage of Nesting/Roosting Habitat
M§13.9.1.4-1	V	Population Trends of Northern Spotted Owls
M§13.9.1.4-2	V	Identification of Nesting/Roosting Habitat for Northern Spotted Owls
M§13.9.1.4-3	V	Benefits of High Protection for Northern Spotted Owls and Their Territories

HCP/NCCP Monitoring Programs		
Monitoring Code	**Type**	**Description**
M§13.9.1.4-4	V	Effect of Harvest within 1000 ft of NSO Territories with Limited Protection
M§13.9.1.4-5	V	Effect of Habitat on Productivity of Northern Spotted Owls
M§13.9.1.4-6	V	Effect of Hardwood Density on Northern Spotted Owls
M§13.9.1.4-7	V	Effect of Barred Owl Control on Northern Spotted Owls
M§13.9.2.1-1	V	Activity Level of Marbled Murrelets in Lower Alder Creek
M§13.9.2.1-2	V	Murrelet Occupancy in Navarro, Greenwood Creek, Albion River Watersheds
M§13.9.2.2-1	E	Murrelet Habitat Distribution in LACMA
M§13.9.2.2-2	E	Methods for Accelerating Growth of Murrelet Habitat
M§13.9.2.2-3	V	Radar Monitoring in Additional Drainages
M§13.9.3.1-1	E	Spatial Extent of Known Burrow Systems of Point Arena Mountain Beaver
M§13.9.3.1-2	E	Creating Habitat with Timber Harvest within Dispersal Distance of Existing PAMB Burrow Systems
M§13.9.3.2-1	V	Defining Habitat for Point Arena Mountain Beavers
M§13.9.3.2-2	V	Creating Potential Habitat in or Adjacent to Existing PAMB Burrow Systems
M§13.10.3-1	E	Status and Trend of Covered Rare Plant Species

TABLE NOTES

E = effectiveness monitoring
V= validation monitoring

13.2.2.1 Conservation measures, contingencies, and definitions subject to change

Individual conservation measures target different biological goals and objectives. Some of these conservation measures are static. MRC can only change them through an amendment process outlined in the *Implementing Agreement*. Other conservation measures are dynamic. MRC may change them in response to data collected under the adaptive management program. Section 13.3.6 describes the allowable limits of change for these dynamic conservation measures. When a change is within these allowable limits, MRC can make it with approval of the wildlife agencies; however, when a change is outside the allowable limits, MRC may need to propose an amendment or minor modification to the HCP/NCCP, as described in section 1.13. Table 13-2 describes, in general, the conservation measures subject to change. Table 13-3 has the contingency for barred owls that is subject to change. In addition, some of the definitions surrounding specific conservation measures are also subject to change; Table 13-4 shows those definitions and the monitoring programs that determine what those changes may be. Finally, MRC will monitor the population trends of all northern spotted owls in the plan area (M§13.9.1.4-1) to determine if their total numbers increase, decrease, or remain stable.

Table 13-2 General Conservation Measures Subject to Change

General Conservation Measures Subject to Change		
Conservation Measure Code	**Monitoring Program**	**Monitoring Code**
Mass Wasting		
C§8.3.3.1.2-1 to C§8.3.3.1.7-3 C§8.3.3.1.8-1 to C§8.3.3.1.8-9	Focus Watersheds: Mass Wasting	M§13.5.2.1-2
	Watershed Analysis: Mass Wasting	M§13.5.2.1-1
	Forensic Monitoring: Landslide Observations	M§13.5.2.2-1
Road Upgrades and Abandonment		
C§8.3.3.1.2-1 to C§8.3.3.1.7-3	Focus Watersheds: Mass Wasting	M§13.5.2.1-2
	Focus Watersheds: Stream Sediment	M§13.5.4.1-3
	Road Inventory: Sediment Prevention	M§13.5.3.1-1
	Watershed Analysis: Mass Wasting	M§13.5.2.1-1
	Long Term Channel Monitoring: Stream Sediment	M§13.5.4.1-2
AMZ Canopy and Large Tree Retention		
C§8.2.3.1.2-1 C§8.2.3.2.2-1 C§8.2.3.3.2-1 C§8.2.3.1.4-1	Focus Watersheds: Riparian Function	M§13.5.1.2-2
	Timber Inventory: Riparian Stands	M§13.5.1.1-1
	Timber Inventory: Riparian Canopy	M§13.5.1.1-2
	Watershed Analysis: Shade Conditions	M§13.5.1.1-4
	Stream Temperature	M§13.5.1.1-5
AMZ Retention Standards		
C§8.2.3.1.4-1 C§8.2.3.1.3-1 to C§8.2.3.1.3-3 C§8.2.3.1.7-1 -4	Focus Watersheds: Riparian Function	M§13.5.1.2-2
	Timber Inventory: Riparian Stands	M§13.5.1.1 -1
	Timber Inventory: Riparian Canopy	M§13.5.1.1-2
Northern Spotted Owl		
C§10.3.1.3.1-34	Effect of Harvest within 1000 ft of NSO Territories with Limited Protection	M§13.9.1.4-4

General Conservation Measures Subject to Change		
Conservation Measure Code	**Monitoring Program**	**Monitoring Code**
C§10.3.1.3.1-5 C§10.3.1.3.1-21	Effect of Habitat on Productivity of Northern Spotted Owls	M§13.9.1.4-5
C§9.3.3.1-1 to C§9.3.3.1-3 C§9.3.3.2-1 to C§9.3.3.2-12 C§9.3.3.3-1 to C§9.3.3.3-3	Effect of Hardwood Density on Northern Spotted Owls	M§13.9.1.4-6
	Marbled Murrelet	
C§10.3.2.3.1-3	Methods for Accelerating Growth of Murrelet Habitat	M13.9.2.2-2
C§10.3.2.3.11-9 C§10.3.2.3.12-9	Radar Monitoring in Additional Drainages	M§13.9.2.2-3
	Point Arena Mountain Beaver	
C§10.3.3.3-1	Creating Potential Habitat in or adjacent to Existing PAMB Burrow Systems	M§13.9.3.2-2
	Rare Plants	
C§11.7.1-11 C§11.7.2-8 C§11.7.3-8	Status and Trend of Covered Rare Plant Species	M§13.10.3-1

Table 13-3 Contingency Subject to Change

Contingency	Monitoring Program	Monitoring Code
	Northern Spotted Owl	
Barred Owls SECTION 10.3.1.2.5 Y§10.3.1.2.5-6	Effect of Barred Owl Control on Northern Spotted Owls	M§13.9.1.4-7

Table 13-4 Definitions Subject to Change

Definitions Subject to Change		
Definitions	**Monitoring Program Name**	**Monitoring Code**
Small Class II watercourses	Watershed Size: Small Class II Watercourses	M§13.5.1.2-3
NSO nesting/roosting habitat	Identification of Nesting/Roosting Habitat for Northern Spotted Owls	M§13.9.1.4-2
Mapped boundaries of LACMA	Murrelet Habitat Distribution in LACMA	M§13.9.2.2-1

Definitions Subject to Change		
Definitions	**Monitoring Program Name**	**Monitoring Code**
Potential habitat of Point Arena Mountain Beaver	Defining Habitat for Point Arena Mountain Beavers	M§13.9.3.2-1

13.2.2.2 Objectives and hypotheses

Sections 13.4 through 13.11 detail our effectiveness and validation monitoring programs. The objectives in the effectiveness monitoring programs link directly to one or more stated objectives in Chapters 8 through 11, where we propose our conservation measures. Except for physical processes, the hypotheses in the validation monitoring programs link directly to "key uncertainties" stated in Chapter 4 (*Covered Aquatic Species*), Chapter 5 (*Covered Terrestrial Species),* and Chapter 6 *(Covered Plant Species)*.

There are 8 monitoring programs for physical processes, shown in Table 13-5, with various parameters such as instream canopy and LWD, drainage areas of Small Class II watercourses, mass wasting observations, road inventory, and conditions of instream channels and sediment. MRC is already implementing most of these monitoring programs within watershed analysis. In the future, we may (a) continue the same frequency and survey effort; or (b) alter survey frequency and incorporate improved technologies or habitat models after HCP/NCCP commencement. For other physical monitoring programs, such as those for Small Class II watercourses or mass wasting forensics, MRC will need to plan new protocols prior to HCP/NCCP implementation.

Table 13-5 Validation Monitoring Programs for Physical Processes

Validation Monitoring	
Program Code	**Monitoring Program Description**
M§13.5.1.2-2	Focus Watersheds: Riparian Function
M§13.5.1.2-3	Watershed Size: Small Class II Watercourses
M§13.5.2.2-1	Forensic Monitoring: Landslide Observations
M§13.5.3.2-1	Focus Watersheds: Sediment Prevention
M§13.5.4.1-2	Long Term Channel Monitoring: Stream Sediment
M§13.5.4.1-3	Focus Watersheds: Stream Sediment
M§13.5.4.1-1	Focus Watersheds: Sediment Budget
M§13.5.5.2	Water Drafting

13.2.2.3 Testing assumptions

Many of the assumptions behind our conservation measures were based on research in locations different from the plan area or on information only indirectly related to a specific species or habitat. These assumptions and scientific sources must be sorted out and examined.

Effectiveness and validation monitoring are not mutually exclusive. While validating a hypothesis, one can evaluate the effectiveness of a conservation measure as well. Appropriate levels of LWD in fish-bearing streams, for instance, may be the objective of a conservation measure. Validation monitoring examines the assumption that abundance of anadromous salmonid will increase with LWD. An actual increase in abundance of anadromous salmonid may validate the assumption and show that LWD recruitment has been effective at meeting conservation objectives.

MRC will use various programs to assess habitat and species populations and test the performance of our conservation measures. We anticipate that most, if not all, of the monitoring programs will be implemented for the full term of our HCP/NCCP.

13.2.2.4 Use of statistics in monitoring programs

DEFINITION

Mean is the arithmetic average of a set of numbers; for example, the mean of 33 19 47 84 12 is 39

Median is the middle number in an ordered sequence of numbers; for example, the median of 12 19 33 47 84 is **33**. If there are an even number of numbers, then the median is the average of the two middle numbers; for example, the median of 12 19 **33 47** 84 92 is 40.

The basic function of statistics is to produce knowledge from raw data and allow for informed decisions. In applying statistics, one begins with a *population*. In our case, this might be, for example, a population of northern spotted owls or red-legged frogs. MRC routinely collects data in observational or experimental settings about various populations on our land. For practical reasons, we study a subset of a population, called a *sample*. If the sample is representative of the population, then inferences and conclusions made from the sample can be extrapolated to the population as a whole. A major problem lies in determining the extent to which the sample is representative. Results can be difficult to interpret and may not agree with intuition or expectation. Statistics help us to estimate randomness or uncertainty in our sample and in our data collection procedure.

Many of our monitoring programs compare 2 different sets of numbers, for example, the number of murrelet detections in the Lower Alder Creek Management Area (LACMA) during 2008 and 2009. Say, for example, the mean number of detections in 2008 and 2009 were 20 and 25 respectively. Intuitively, we might conclude that these mean numbers are different. Intuition, however, can be incorrect. To conclude with some level of certainty that there was, in fact, an increase in the number of murrelet detections between 2008 and 2009, we must look at the variability of our samples for both years. The difference in means may simply be due to the variability of our samples. In 2008, our detections may have varied wildly (0, 0, 100, 0, 0) for a mean of 20. In 2009, our detections continued to be erratic (20, 85, 0, 20, 0) for a mean of 25. In light of this variation in our detections, there is no statistical basis for concluding that the difference in the mean number of murrelet detections from 2008 to 2009 equates to an increase in murrelet detections.

DEFINITION

Null hypothesis is a basic statistical hypothesis to be tested, generally stated as 2 populations having equivalent parameters.

Alpha level is the probability of rejecting a hypothesis when it is, in fact, true.

Power is the probability of rejecting a hypothesis when it is, in fact, false.

Power analysis is the ability to find a statistically significant difference when a real difference exists.

As the above example shows, we test whether the mean number of murrelet detections from one year to the next is different by assessing the means and the variation in the surveys that generate those means in each year. To compare the means, we set up a *null hypothesis*, such as "The mean number of murrelet detections is equal in 2008 to 2009." The *alpha level* is the probability that we will reject the null hypothesis when the hypothesis is true. The *power* is the probability we will reject the null hypothesis when the hypothesis is false, i.e., we will make a correct decision. In terms of statistical tests, the higher the power, the more likely the test will detect a difference when there is an actual difference. In designing monitoring studies to compare means or medians, we are trying to balance power against alpha level so that we are more likely to detect a difference when there is one and less likely to mistakenly detect a difference when none exists.

The concepts of power and alpha level also relate to the statistical concepts of Type I and Type II error. A Type I error occurs when a researcher rejects the null hypothesis even though it is true; therefore, a lower alpha level means a decreased chance for a Type I error. A Type II error occurs when a researcher should have rejected a null hypothesis but instead fails to reject it. The power is the probability that a Type II error will not occur; consequently, a higher power means a decreased chance of a Type II error.

Because null hypotheses are usually stated as 2 equal populations, a Type I error can lead to the mistaken conclusion that a difference exists and precipitate an unnecessary action. On the other hand, a Type II error can overlook a difference when one occurs. A Type II error can be more important than a Type I if the missed difference is a serious decline in a covered species population. Power can be increased by increasing the acceptable alpha level, increasing the minimum detectable change, increasing the number of sampling units, or reducing the standard deviation.

We cannot, in our HCP/NCCP, lay out the statistical details of our study designs—most of which have not yet been developed. However, our intention, going forward, is to use existing monitoring programs or design new programs early in the plan implementation that incorporate the necessary statistical rigor for specific applications. As MRC develops each monitoring program, we will work with the wildlife agencies to ensure there is minimal statistical error.

MRC recognizes several principles of experimental design that are important to our monitoring programs. Replicates in space and time can help assure that findings can be extrapolated across the plan area. Random allocation of treatments is also important, but difficult to apply in a land management scenario. The BACI (Before-After-Control-Impact)[2] design is a powerful design that MRC will apply whenever feasible in developing effectiveness and validation monitoring programs (see rightmost columns of Figure 13-2).

13.2.2.5 Spatial scales for monitoring

Monitoring must evaluate effects at both small and large scales. MRC is using different spatial scales for effectiveness and validation monitoring (see Table 13-6). Some monitoring will be at a project or site-specific scale. Aquatic monitoring will often be at major tributary or river-reach scale. For many cumulative effects, the large basin or watershed scale is an appropriate size.

[2] BACI is a method for measuring the potential impact of an event on an ecological resource (e.g., fish distribution in a stream after removal of a fish passage barrier). One measures conditions *before* a planned activity and then compares the results to conditions after the activity. The comparison is done with a control site that remains the same before and after the activity.

Data on spotted owls and marbled murrelets will be collected at the inventory block scale since owls can move across basins and watersheds.

MRC has designed some of our monitoring programs to evaluate conditions at the planning watershed scale. In consultation with the wildlife agencies, we determined the most appropriate scale for each monitored parameter. Each objective has a monitoring program which balances the need for a representative sample with the intensity of effort required to achieve that representation. MRC conducts LWD monitoring, for example, at numerous watercourse segments within a planning watershed; we can rapidly conduct this monitoring throughout an area. In the case of long-term channel monitoring for stream morphology, however, we track changes at a single stream reach within a planning watershed; this is a labor-intensive program. By monitoring the most downstream reach within the planning watershed, we obtain vital information.

! MRC may or may not implement optional monitoring programs during the term of our HCP/NCCP. Only validation monitoring programs are optional.

Table 13-6 Spatial Scales of Effectiveness and Validation Monitoring

Spatial Scales of Effectiveness and Validation Monitoring			
Spatial Scale	**Description**	**Monitoring Program**	**Program Code**
Silvicultural unit	• Silvicultural unit	• Basal Area of Hardwoods in Timber Stands	M§13.8.1-2
Project level	▪ Small-scale, site-specific issues or projects, e.g., individual PTHPs and roads	• Forensic Monitoring: Landslide Observations	M§13.5.2.2-1
		• Post-Harvest Follow-up on Hardwood Representative Sample Areas	M§13.8.1-3
		• Water Drafting	M§13.5.5.1
		• Occupancy of Red-Legged Frogs in Documented Breeding Sites	M§13.6.2.1-2
		• Re-evaluate Habitat Quality and Species Presence within RLF Breeding Sites	M§13.6.2.1-3
Major stream or river reach	• Class I watercourse typically with a hydrologic watershed smaller than a planning watershed	• Stream Temperature	M§13.5.1.1-5
		• Anadromous Salmonid Distribution	M§13.6.1.1-2

Spatial Scales of Effectiveness and Validation Monitoring			
Spatial Scale	**Description**	**Monitoring Program**	**Program Code**
	• Major stream or segment of river within a planning watershed	• Distribution and Relative Abundance of Coastal Tailed Frogs	M§13.6.3.1-2
		• Long-term Channel Monitoring: LWD	M§13.5.1.2-1
Lower Alder Creek Murrelet Area	• Sub-planning watershed management area dedicated to retention of murrelet activity and habitat	• Activity Level of Marbled Murrelets in Lower Alder Creek	M§13.9.2.1-1
		• Murrelet Habitat Distribution in LACMA	M§13.9.2.2-1
		• Methods for Accelerating Growth of Murrelet Habitat	M§13.9.2.2-2
CalWater planning watersheds	• Planning unit between 5000-10,000 ac designated by the State of California	• Baseline Distribution and Habitat Quality of RLF Breeding Sites	M§13.6.2.1-1
		• Baseline Distribution of Coastal Tailed Frogs	M§13.6.3.1-1
		• Anadromous Salmonid Presence: ASMB	M§13.6.1.1-1
		• Timber Inventory: Riparian Stands	M§13.5.1.1-1
		• Focus Watersheds: Sediment Budget Stream	M§13.5.4.1-1
		• Distribution and Area of Rocky Outcrops	M§13.8.1-6
		• Long Term Channel Monitoring: Stream Sediment	M§13.5.4.1-2
		• Focus Watersheds: Stream Sediment	M§13.5.4.1-3
		• Water Drafting	M§13.5.5.2-1
Watershed analysis unit (WAU)	• Plan area within a large basin	• Watershed Analysis: Mass Wasting	M§13.5.2.1-1
		• Road Inventory: Sediment Prevention	M§13.5.3.1-1

Spatial Scales of Effectiveness and Validation Monitoring			
Spatial Scale	**Description**	**Monitoring Program**	**Program Code**
		• Murrelet Occupancy in Navarro, Greenwood Creek, Albion River Watersheds	M§13.9.2.1-2
		• Radar Monitoring in Additional Drainages	M§13.9.2.2-3
		• Watershed Analysis: Shade Conditions	M§13.5.1.1-4
Inventory block	• Geographical separation of plan area into distinct management units	• Northern Spotted Owls: Level-1 and Level-2 Territories	M§13.9.1.3-1
		• Northern Spotted Owls: Distribution and Acreage of Nesting/Roosting Habitat	M§13.9.1.3-2
Point Arena mountain beaver assessment area	• Areas up to 5 miles inland bounded by Cliff Ridge to the north and the southern edge of the Garcia inventory block to the south	• Spatial Extent of Known Burrow Systems of Point Arena Mountain Beaver	M§13.9.3.1-1
		• Creating Habitat with Timber Harvest within Dispersal Distance of Existing PAMB Burrow Systems	M§13.9.3.1-2
		• Defining Habitat for Point Arena Mountain Beavers	M§13.9.3.2-1
		• Creating Potential Habitat in or Adjacent to Existing PAMB Burrow Systems	M§13.9.3.2-2
Covered lands	• Plan area	• Snags, Wildlife Trees, Recruitment Trees, and Downed Wood	M§13.8.1-1
		• Acreage and Number of Old Growth Stands and Trees	M§13.8.1-5
		• Population Trends of Northern Spotted Owls	M§13.9.1.4-1
		• Identification of Nesting/Roosting Habitat for Northern Spotted Owls	M§13.9.1.4-2
			M§13.9.1.4-3

Spatial Scales of Effectiveness and Validation Monitoring			
Spatial Scale	**Description**	**Monitoring Program**	**Program Code**
		• Benefits of High Protection for Northern Spotted Owls and Their Territories	M§13.9.1.4-4
		• Effect of Harvest within 1000 ft of NSO Territories with Limited Protection	M§13.9.1.4-5
		• Effect of Habitat on Productivity of Northern Spotted Owls	
		• Effect of Hardwood Density on Northern Spotted Owls	M§13.9.1.4-6
		• Effect of Barred Owl Control on Northern Spotted Owls	M§13.9.1.4-7
		• Acreage and Number of Hardwood Representative Sample Areas	M§13.8.1-4
		• Common Natural Communities	M§13.8.2-1
		• Uncommon Natural Communities	M§13.8.2-2
		• Invasive Species Control	M§13.8.3-1

13.2.2.6 Elements of a monitoring plan

In developing our monitoring plans, MRC will follow guidelines from Oakley et al. (2003) and Elzinga et al. (1998). The basic elements of a monitoring plan are as follows:

- Introduction stating species, needs, and management conflicts.
- Ecological model identifying sensitive attributes to be measured and describing relationships between species biology and management activities.
- Management objectives and rationale for choice of attributes and amount of change that will be considered biologically significant.
- Monitoring design.
- Sampling objective and rationale for choice of precision and error rates.
- Sampling design, including description of sampling unit, size, distribution, and number, as well as proposed Quality Assessment (QA) and Quality Control (QC).
- Field measurement methods, including everything that someone would need to take-over a project and continue it.
- Timing (seasonal and phenological), frequency, and duration.
- Location, including maps and aerial photos to enable location of the sampling units.

- Data analysis approach.
- Sample data sheet(s).
- Responsible parties.
- Funding.
- Management response to results.

MRC will work with the wildlife agencies in developing our monitoring plans and obtain their approval before implementing them. Chapter 13 simply presents high level concepts for each monitoring program; this is not the substantive detail that must go into the actual monitoring plan. After commencement of our HCP/NCCP, the wildlife agencies, in addition to scheduling field inspection, may conduct monitoring in the plan area on their own initiative and with their own funding, as long as they adhere to MRC access rules.

13.2.2.7 Monitoring programs subject to harvest levels

The source of funding for MRC monitoring programs is primarily revenue from our timber harvest. Over the 80-year term of our HCP/NCCP, we expect our projected harvest levels to increase as our forests continue to recover. When this occurs, MRC will increase our milling capacity and customer base, and, in turn, increase capital improvements in our production facilities.

By the same token, a market downturn, as we experienced in 2009, will impact harvest levels and programs funded by harvest revenue. MRC will curtail many of our monitoring efforts if timber harvest drops below 37% of our allowable harvest level.[3] We chose 37% as the benchmark since levels below this number would result in possible reductions in both staff and milling capacity. Harvest levels are set within 5-year periods. Therefore, if our average allowable harvest level for a year was 40 mmbf, we would curtail monitoring efforts if harvests dropped below 15 mmbf. In no case, however, will MRC curtail the monitoring programs described in Table 13-6 for more than 10 years. If harvests remain lower than the average allowable harvest levels for a period exceeding 10 years, our monitoring programs will kick in again.

Harvest cutbacks may not affect all monitoring programs. In some cases, however, MRC will conduct monitoring less frequently or discontinue it altogether until harvest levels rebound. MRC may curtail monitoring in the same year of the reduced harvest or in the year following the reduced harvest. In either case, the HCP/NCCP monitoring coordinator will send written correspondence to the wildlife agencies within 1 week of our decision to limit monitoring. The coordinator will send the letter by July 1st of the year in which the curtailed harvest will occur.

Table 13-7 outlines the potential impact of low harvest levels on proposed monitoring programs. Table 13-8 sets the allowable harvest, as determined by the MRC growth-and-yield model. MRC will adjust harvest volumes as land purchases or sales change the size of the plan area. Our HCP/NCCP is for a term of 80 years. The actual date of HCP/NCCP commencement will determine the starting and ending “Harvest Year” in Table 13-8. We project that the HCP/NCCP will commence in 2012 and conclude in 2092.

[3] Rounded to the nearest whole number

Table 13-7 Monitoring Programs Subject to Harvest Levels

Harvest Falls Below 37% of Allowable Harvest Level		
Monitoring Program	**Monitoring Code**	**Potential Impacts**
Stream Temperature	M§13.5.1.1-5	• Skip no more than 3 years in a row and leave no more than 6 data gaps.
Watershed Analysis: LWD Conditions	M§13.5.1.1-3	• Discontinue monitoring in non-operational areas until harvest levels exceed 37% of allowable harvest.
Watershed Size: Small Class II Watercourses	M§13.5.1.2-3	• No change.
Timber Inventory: Riparian Canopy	M§13.5.1.1-2	• Discontinue monitoring in non-operational areas until harvest levels exceed 37% of allowable harvest.
Focus Watersheds: Riparian Function	M§13.5.1.2-2	• Discontinue monitoring until harvest reaches 75% of allowable harvest levels.
Focus Watersheds: Mass Wasting	M§13.5.2.1-2	• Discontinue monitoring until harvest reaches 75% of allowable harvest levels.
Watershed Analysis: Sediment Prevention	M§13.5.3.1-2	• Discontinue monitoring in non-operational areas until harvest levels exceed 37% of allowable harvest.
Long Term Channel Monitoring: Stream Sediment	M§13.5.4.1-2	• No change.
Timber Inventory: Riparian Stands	M§13.5.1.1-1	• Discontinue monitoring in non-operational areas until harvest levels exceed 37% of allowable harvest.
Long-term Channel Monitoring: LWD	M§13.5.1.2-1	• No change.
Watershed Analysis: Mass Wasting	M§13.5.2.1-1	• Discontinue monitoring in non-operational areas until harvest levels exceed 37% of allowable harvest.
Forensic Monitoring: Landslide Observations	M§13.5.2.2-1	• No change.
Road Inventory: Sediment Prevention	M§13.5.3.1-1	• Discontinue monitoring in non-operational areas until harvest levels exceed 37% of allowable harvest.

Harvest Falls Below 37% of Allowable Harvest Level		
Monitoring Program	**Monitoring Code**	**Potential Impacts**
Focus Watersheds: Sediment Prevention	M§13.5.3.2-1	• Discontinue until harvest reaches 75% of allowable harvest levels.
Focus Watersheds: Stream Sediment	M§13.5.4.1-3	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Water Drafting	M§13.5.5.1-1	• No change
Water Drafting	M§13.5.5.2-2	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Baseline Distribution and Habitat Quality of RLF Breeding Sites	M§13.6.2.1-1	• No change.
Occupancy of Red-Legged Frogs in Documented Breeding Sites	M§13.6.2.1-2	• No change.
Re-evaluate Habitat Quality and Species Presence within RLF Breeding Sites	M§13.6.2.1-3	• No change.
Baseline Distribution of Coastal Tailed Frogs	M§13.6.3.1-1	• No change.
Distribution and Relative Abundance of Coastal Tailed Frogs	M§13.6.3.1-2	• Discontinue for 3 years
Anadromous Salmonid Presence: ASMB	M§13.6.1.1-1	• No change.
Anadromous Salmonid Distribution	M§13.6.1.1-2	• Discontinue monitoring for 3 years (1 cohort[4]), if low harvest levels occur when the distribution survey is scheduled to begin; otherwise, continue monitoring if the 3-year survey is already in progress.
Chinook Salmon Monitoring Reaches (CSMR)	M§13.6.1.1-3	• No change.
Smolt Abundance	M§13.6.1.2-1	• No change.
Snags, Wildlife Trees, Recruitment Trees, and Downed Wood	M§13.8.1-1	• No change.
Basal Area of Hardwoods in Timber Stands	M§13.8.1-2	• No change.

[4] A cohort is a group of animals of the same species, identified by a common characteristic, which are studied over a period of time as part of a scientific investigation.

Harvest Falls Below 37% of Allowable Harvest Level		
Monitoring Program	**Monitoring Code**	**Potential Impacts**
Post-harvest Follow-up on Hardwood Representative Sample Areas	M§13.8.1-3	• No change.
Acreage and Number of Old Growth Stands and Trees	M§13.8.1-5	• No change.
Distribution and Area of Rocky Outcrops	M§13.8.1-6	• No change.
Common Natural Communities	M§13.8.2-1	• No change.
Uncommon Natural Communities	M§13.8.2-2	• No change.
Invasive Species Control	M§13.8.3-1	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Northern Spotted Owls: Level-1 and Level-2 Territories	M§13.9.1.3-1	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Northern Spotted Owls: Distribution and Acreage of Nesting/Roosting Habitat	M§13.9.1.3-2	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Population Trends of Northern Spotted Owls	M§13.9.1.4-1	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Effect of Harvest within 1000 ft of NSO Territories with Limited Protection	M§13.9.1.4-4	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Effect of Hardwood Density on Northern Spotted Owls	M§13.9.1.4-6	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Effect of Barred Owl Control on Northern Spotted Owls	M§13.9.1.4-7	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Activity Level of Marbled Murrelets in Lower Alder Creek	M§13.9.2.1-1	• Continue if MRC has already initiated the study.
Murrelet Occupancy in Navarro, Greenwood Creek, Albion River Watersheds	M§13.9.2.1-2	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Spatial Extent of Known Burrow Systems of Point Arena Mountain Beaver	M§13.9.3.1-1	• No change.
Creating Habitat with Timber Harvest within Dispersal Distance of Existing PAMB Burrow Systems	M§13.9.3.1-2	• Continue if MRC has already initiated the study.

Harvest Falls Below 37% of Allowable Harvest Level		
Monitoring Program	**Monitoring Code**	**Potential Impacts**
Status and Trend of Covered Rare Plant Species	M§13.10.3-1	• Discontinue monitoring in non-operational areas until harvest levels exceed 37% of allowable harvest.

Table 13-8 Harvest Triggers to Reduce Monitoring

Harvest Triggers to Reduce Monitoring			
Harvest Year	**Allowable Harvest Volume Per Year (mbf)**	**37% of Allowable Harvest per Year (mbf)**	**75% of Allowable Harvest per Year (mbf)**
2011-2015	57,954	21,443	43,466
2016-2020	62,669	23,188	47,002
2021-2025	64,382	23,821	48,287
2026-2030	62,008	22,943	46,506
2031-2035	62,976	23,301	47,232
2036-2040	73,552	27,214	55,164
2041-2045	87,011	32,194	65,258
2046-2050	90,201	33,374	67,651
2051-2055	90,573	33,512	67,930
2056-2060	91,780	33,959	68,835
2061-2065	95,407	35,301	71,555
2066-2070	107,037	39,604	80,278
2071-2075	106,885	39,547	80,164
2076-2080	106,484	39,399	79,863
2081-2085	109,110	40,371	81,833
2086-2090	118,427	43,818	88,820
2091-2095	119,410	44,182	89,558

13.3 Adaptive Management

"Nothing is permanent but change." Heraclitus gave us that wise insight into the world over 2500 years ago. Adaptive management—a term that was coined in the 1970s and much later adopted by the conservation community—is the process of improving management policies and practices as things change. Our information about the natural world is never complete and too often it is simply wrong. As Figure 13-1 shows schematically, what we "know" is re-examined and tested, knowledge is corrected and extended, and management is adjusted. In other words, we are continually learning how to manage and we are managing in order to continually learn.

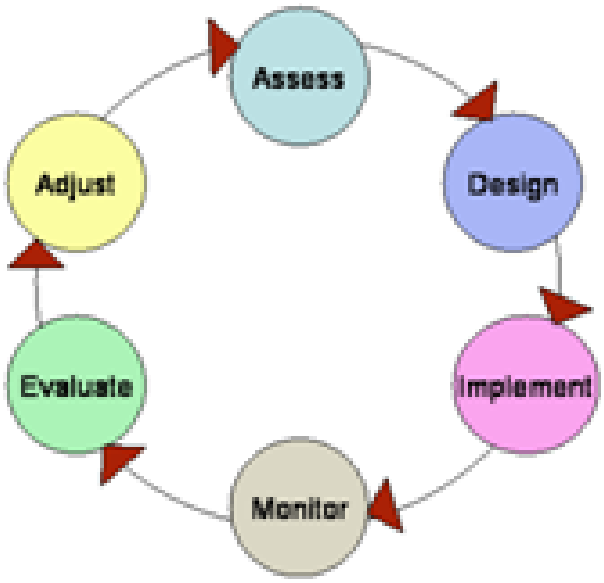


Figure 13-1 Adaptive Management Process

13.3.1 Inherent uncertainty in conservation effort

Our HCP/NCCP primarily uses a habitat-based approach to conserve covered species and natural communities in the plan area. However, our knowledge of covered species, their habitats, and the ecological systems that support them is incomplete. Lack of data introduces uncertainty into the effectiveness of HCP/NCCP conservation measures. Uncertainty is also an inherent component of ecological systems because of natural variation (e.g., rainfall, climate, species behavior, and species response). Ecosystems are complex, which makes predicting species and habitat responses to management actions difficult. Finally, future changes in land use outside the plan area also introduce uncertainty. To address such uncertainties, MRC enlists principles of adaptive management, which allow us to adjust conservation measures based on results of monitoring and experimentation. This approach provides greater assurance that we will achieve our biological goals and objectives for covered species and natural communities.

13.3.2 Definitions of adaptive management

DEFINITION	"Adaptive management is the process whereby management is initiated, evaluated, and refined (Holling 1978, Walters 1986). It differs from traditional management by recognizing and preparing for the uncertainty that underlies resource management decisions. Adaptive management is typically incremental in that it uses information from monitoring and research to continually evaluate and modify management practices. It promotes long-term objectives for ecosystem management and recognizes that the ability to predict results is limited by knowledge of the system. Adaptive management uses information gained from past management experiences to evaluate both success and failure, and to explore new management options." (Kershner 1997)

> Adaptive management "is a method for examining alternative strategies for meeting measurable biological goals and objectives, and then if necessary, adjusting future conservation management actions according to what is learned." (USFWS, Five-Point Policy for HCPs, 65 FR 106, 1 June 2000)

> Adaptive management uses "the results of new information gathered through the monitoring program of the plan and from other sources to adjust management strategies and practices to assist in providing for the conservation of covered species." (California NCCPA of 2003, CDFG Code 2805a)

MRC has designed our adaptive management program to be consistent with the above definitions. Our program incorporates the 4 adaptive management strategies that USFWS recommends for an HCP (65 FR 35252):

1. Identify uncertainties and the questions that need to be addressed to resolve the uncertainties.
2. Develop alternative strategies and determine which experimental strategies to implement.
3. Integrate a monitoring program that is able to detect the necessary information for strategy evaluation.
4. Incorporate feedback loops that link implementation and monitoring to a decision-making process.

Our HCP/NCCP also incorporates the concepts of passive and active adaptive management advocated and defined by USFWS for HCP implementation (65 FR 35250–35257). Through passive adaptive management, MRC will learn how to attain our biological goals and objectives based on the results of effectiveness monitoring. Through active adaptive management, we will resolve uncertainties about the best approaches for achieving specific objectives. Specifically, we will test hypotheses about covered species, covered natural communities, and physical processes; in addition, we will conduct studies to validate assumptions about covered plants.

13.3.3 Adaptive approach

Monitoring the outcomes of management is the foundation of an adaptive approach; thoughtful monitoring can both advance scientific understanding and modify management actions iteratively (Williams et al. 2007).

Adaptive management is necessary because of the degree of uncertainty and natural variability associated with ecosystems and their management. Based on the best scientific information currently available, MRC expects our conservation measures to achieve our biological objectives. However, there is uncertainty about management techniques, conditions within the permit area, regional habitat conditions, and the status of covered species and natural communities; any of these may change in unexpected ways during the course of HCP/NCCP implementation. Results of validation monitoring may indicate that some of our conservation measures are less effective

than anticipated. To address these uncertainties, MRC will use an adaptive management approach, based on validation monitoring, to inform our decisions.

The cornerstone of our monitoring and adaptive management program is experimentation (Figure 13-2). MRC will use information collected through validation monitoring to manage habitat and protect covered species and natural communities. Moreover, MRC will share results from our monitoring, as appropriate, with other regional restoration and management programs. Where feasible, we will use standardized protocols and methodologies to obtain monitoring data that can be coordinated regionally. A monitoring program design that is well-coordinated and scalable will enable MRC and others to measure and evaluate changes in resources as well as threats across the entire permit area and within the eco-region.

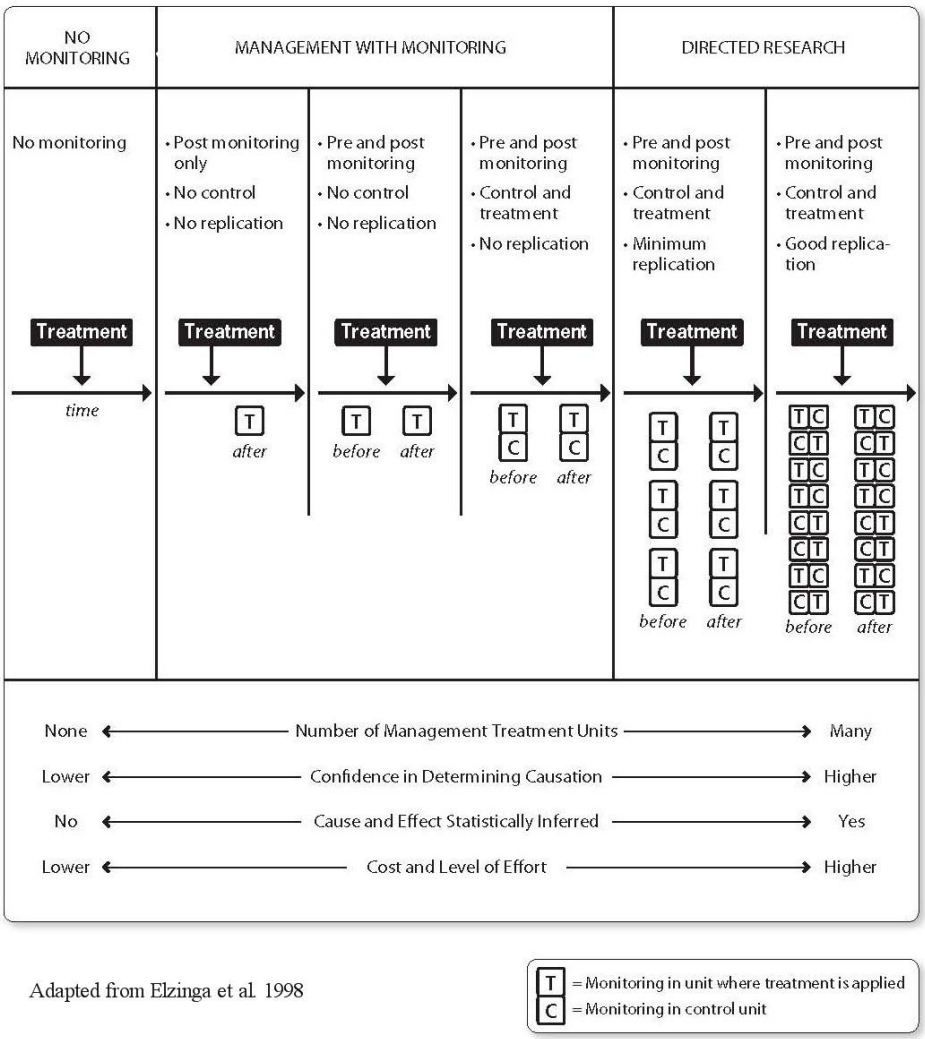


Figure 13-2 Continuum of Experimental Management

13.3.4 Integration of monitoring and adaptive management

There is a direct correlation between validation monitoring and adaptive management. Validation monitoring is the basis for adaptive management and adaptive management is dependent on

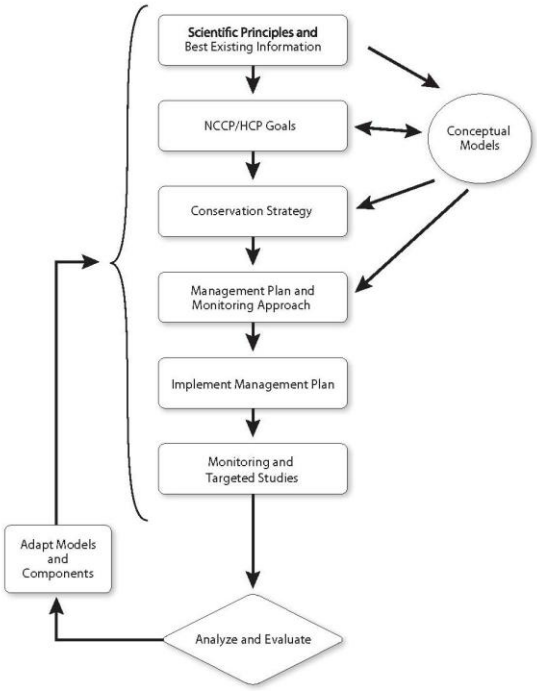
results from validation monitoring. Our HCP/NCCP integrates these 2 components into a single program. Such integration is critical to the successful implementation of our conservation strategies.

Our validation monitoring and adaptive management program will reveal the effectiveness of our conservation measures. We will revise conservation measures which do not achieve the goals and objectives of our HCP/NCCP. Moreover, we may revise conservation measures which exceed those goals and objectives, dialing down their prescriptions a bit. In effect, validation monitoring provides the impetus to change conservation measures as needed. Moreover, some conservation measures come with their own defined limits of allowable change (Table 13-9 through Table 13-12).

13.3.5 Conceptual models

Conceptual models are a useful tool that document HCP/NCCP assumptions about natural communities and covered species. MRC will follow recommended steps for developing conceptual ecological models (Atkinson et al. 2004):

1. Complete conceptual models for each covered species.
2. Identify critical uncertainties for covered species.
3. Identify pressures on natural community types including species-specific, local, regional, and global pressures.
4. Develop conceptual models for natural communities and include their relationships to covered species.
5. Cross-check the monitoring variables selected and described in our HCP/NCCP; monitor species groups or indices where applicable.



Excerpted from Atkinson et al. 2004

Figure 13-3 Adaptive Management Feedback Loop

During plan implementation, conceptual models will guide our monitoring and adaptive management (Figure 13-3). Using monitoring to provide information for adaptive management will require a framework for measuring responses. The process is as follows:

1. Identify threats to the species or natural community.
2. Identify the objectives of the conservation strategy.
3. Evaluate the effectiveness of the objective in meeting a goal.
4. Evaluate the effectiveness of the conservation measure against the expected outcome.

The adaptive management program allows for the adjustment of the conservation measures if the expected outcome fails to match the conservation objective or exceeds the conservation objective. One then adjusts the conservation measures as needed to achieve the expected outcomes and reduce the threats to the natural community.

13.3.6 Limits of allowable change

13.3.6.1 Conservation measures

Our conservation measures fall into categories: riparian, terrestrial species, and rare plants. In some cases, we have also included limits of allowable change. Limits ensure the wildlife agencies, MRC, and the public that changes to our HCP/NCCP will not be open-ended but must be within a specified range.

The results of validation monitoring may support modification of a conservation measure within the limits of allowable change. Generally, MRC will change only 1 conservation measure at a time. In some cases, however, MRC and the wildlife agencies may conclude, based on validation monitoring, to change more than one measure. MRC may adjust conservation measures within the limits of allowable change with the concurrence of the wildlife agencies; adjustments outside those limits require either a minor modification or major amendment to our HCP/NCCP. Table 13-9 through Table 13-11 document the limits of allowable change for conservation measures applicable to riparian function, terrestrial species, and rare plants.

Table 13-9 Riparian Conservation Measures Subject to Change

Riparian Conservation Measures Subject to Change						
Topic	**Habitat Process**	**Monitoring Code**	**Conservation Measure and Code**	**Limits of Allowable Change**		
				Initial	**Low**	**High**
watercourse shade Class I AMZ	Stream water temperature	M§13.5.1.1-5	Inner band canopy retention C§8.2.3.1.2-1	85%	75%	95%
watercourse shade Large Class II AMZ	Stream water temperature	M§13.5.1.1-5	Inner band canopy retention C§8.2.3.1.2-1	85%	75%	95%
Class I AMZ basal area	Instream LWD recruitment	M§13.5.1.1-3 M§13.5.1.2-1 M§13.5.1.2-2	Floodprone/CMZ AMZ inner and middle band C§8.2.3.1.3-1 (trigger for harvest)	300 ft^2	260 ft^2	350 ft^2

Riparian Conservation Measures Subject to Change						
Topic	**Habitat Process**	**Monitoring Code**	**Conservation Measure and Code**	**Limits of Allowable Change**		
				Initial	**Low**	**High**
			Site 2 & 3 AMZ inner and middle band C§8.2.3.1.3-2 (trigger for harvest)	200 ft^2	160 ft^2	260 ft^2
			Site 4 AMZ inner and middle band C§8.2.3.1.3-3 (trigger for harvest)	160 ft^2	120 ft^2	200 ft^2
Class I AMZ largest tree retention	Instream LWD recruitment	M§13.5.1.1-3 M§13.5.1.2-1 M§13.5.1.2-2	High LWD sensitivity, inner band C§8.2.3.1.4-1	30%	10%	50%
			High LWD sensitivity, middle band C§8.2.3.1.4-1	15%	10%	30%
			Moderate LWD sensitivity, inner band C§8.2.3.1.4-1	20%	10%	40%
			Moderate LWD sensitivity, middle band C§8.2.3.1.4-1	10%	5%	30%
			Low LWD sensitivity, inner band C§8.2.3.1.4-1	10%	5%	30%
			Low LWD sensitivity, middle band C§8.2.3.1.4-1	5%	5%	20%
AMZ restoration harvest	Stream water temperature; sediment inputs	M§13.5.1.1-5 M§13.5.3.2-1 M§13.5.4.1-2 M§13.5.4.1-3	Percent of linear distance of Class I and Large Class II AMZ within CalWater planning watershed per decade AC§8.2.3.4-9	0-15% (varies by site specifics)	0	15%
bank stability	Sediment inputs; stream habitat	M§13.5.3.2-1 M§13.5.4.1-2 M§13.5.4.1-3 M§13.5.1.1-3 M§13.5.1.1-2 M§13.5.1.2-2	No harvest distance from bankfull channel except for 50% of redwood clumps. AC§8.2.3.4-1	10 ft or greater (varies by site specifics)	5 ft	25 ft

Table 13-10 Terrestrial Conservation Measures Subject to Change

Terrestrial Conservation Measures Subject to Change					
Monitoring Program	**Monitoring Code**	**Conservation Measure and Code**	**Limits of Allowable Change**		
			Initial	**Low**	**High**
Benefits of High Protection for Northern Spotted Owls and Their Territories	M§13.9.1.4-3	80 ac core area C§10.3.1.3.1-1	80 ac	72 ac	90 ac
Effect of Harvest within 1000 ft of NSO Territories with Limited Protection	M§13.9.1.4-4	500 ft breeding season buffer C§10.3.1.3.1-39	500 ft	400 ft	600 ft
Effect of Habitat on Productivity of Northern Spotted Owls	M§13.9.1.4-5	Amount of suitable habitat required within 0.7 miles C§10.3.1.3.1-5 C§10.3.1.3.1-25	500 ac	450 ac	550 ac
Effect of Hardwood Density on Northern Spotted Owls	M§13.9.1.4-6	15 ft^2/ac retained C§9.3.3.2-1	15 ft^2/ac	5 ft^2/ac	25 ft^2/ac
Methods for Accelerating Growth of Murrelet Habitat	M§13.9.2.2-2	Submit all PTHPs within LACMA for approval of the wildlife agencies C§10.3.2.3.1-4; C§10.3.2.3.1-23	Silvicultural prescriptions agreed upon by wildlife agencies and MRC	NA	NA
Creating Potential Habitat in or Adjacent to Existing PAMB Burrow Systems	M§13.9.3.2-2	Conduct timber operations, including felling, yarding, and enhancements of downed wood, at least 100 ft (30.48 m) away from active burrow systems or un-surveyed potential habitat. C§10.3.3.3-1	100 ft	No buffer	100 ft
Radar Monitoring in Additional	M§13.9.3.2-3	Allow harvest of secondary murrelet trees	Allow harvest of secondary	No harvest of secondary	Allow ongoing harvest of

Terrestrial Conservation Measures Subject to Change					
Monitoring Program	**Monitoring Code**	**Conservation Measure and Code**	**Limits of Allowable Change**		
			Initial	**Low**	**High**
Drainages		C§10.3.2.3.11-9 C§10.3.2.3.12-9	murrelet trees if radar monitoring completed	murrelet trees	secondary murrelet trees

Table 13-11 Rare Plant Conservation Measures Subject to Change

Conservation Measure Description	Management Category (MC)	Conservation Measure Code	Limits of Allowable Change		
			Initial	**Low**	**High**
buffer area width	MC1	Buffer width (ft) C§11.7.1-11	Forest[a] - 150 Other[b] – 50	Forest - 50 Other - 25	Forest - 200 Other - 75
	MC2	C§11.7.2-8	50	25	100
	MC3	C§11.7.3-8	50	25	75

TABLE NOTES
[a] Forest = Coastal redwood/Douglas fir; mixed hardwood-conifer/hardwood/broadleaf upland; and pygmy transition forest
[b] Other = Other vegetation and habitat types, including pygmy forest

13.3.6.2 Contingencies

Table 13-12 Contingency Measures Subject to Change

Monitoring Program	Monitoring Code	Contingency Measures and Section #	Limits of Allowable Change		
			Initial	**Low**	**High**
Effect of Barred Owl Control on Northern Spotted Owls	M§13.9.1.4-7	Barred owl contingencies Section 10.3.1.2.5	20% contingency trigger	No change	30% contingency trigger

13.4 Overview of Aquatic Monitoring

MRC will implement effectiveness and validation monitoring through 10 aquatic programs, shown in Table 13-13. Moreover, we will develop a review process to determine whether or not we are meeting the objectives outlined in Chapter 8, *Conservation Measures for Aquatic Habitat*. The schedules for this review process will depend upon the timing of the individual monitoring programs.

MRC chose to focus a significant portion of our efforts on monitoring elements of aquatic habitat (LWD, stream temperature, sediment, canopy cover, etc.) rather than on monitoring aquatic

species. Monitoring aquatic species across the entire plan area is time consuming, labor intensive, and expensive. Nevertheless, we do monitor the distribution of aquatic species with surveys for presence or absence, along with more focused efforts on species abundance.

Every aquatic monitoring program in Chapter 13 cross-references to an objective in Chapter 8. MRC designed a monitoring program for each objective in consultation with government agencies; our aim is to achieve the greatest amount of landscape coverage without overextending our resources.
Table 13-13 outlines the timing for aquatic monitoring efforts. Each monitoring program balances the need for a representative sample with the intensity of required effort required to achieve that representation. Processes such as wood transport in streams or mass wasting occur on very long (or indeterminable) time scales, typically coinciding with stochastic events. Other processes vary annually or seasonally, such as stream temperature or species distribution. MRC chose the sampling intervals listed below in order to monitor each objective.

Table 13-13 Aquatic Effectiveness and Validation Monitoring Programs

Aquatic Effectiveness and Validation Monitoring Programs		
Monitoring Program Description	**Monitoring Code**	**Timing**
Timber Inventory: Riparian Stands	M§13.5.1.1-1	• Every 10 years
Timber Inventory: Riparian Canopy	M§13.5.1.1-2	• Every 10 years
Watershed Analysis: LWD Conditions	M§13.5.1.1-3	• On average[5] once every 20 years
Watershed Analysis: Shade Conditions	M§13.5.1.1-4	• On average once every 20 years
Long-term Channel Monitoring: LWD	M§13.5.1.2-1	• At least once every 6 years
Focus Watersheds: Riparian Function	M§13.5.1.2-2	• Every 3 years
Stream Temperature	M§13.5.1.1-5	• Annually
Watershed Size: Small Class II Watercourses	M§13.5.1.2-3	• Initial examination in first 5 years
Watershed Analysis: Mass Wasting	M§13.5.2.1-1	• On average once every 20 years

[5] In the first 4 years of our HCP/NCCP, MRC will complete our initial effort at watershed analysis. Watershed analysis takes many years to complete. On average, we will start the process over again in 20 years, although in any given watershed the process may occur earlier or later.

Aquatic Effectiveness and Validation Monitoring Programs		
Monitoring Program Description	**Monitoring Code**	**Timing**
Forensic Monitoring: Landslide Observations	M§13.5.2.2-2	• Episodic
Focus Watersheds: Mass Wasting	M§13.5.2.1-2	• Every 3-5 years or after storms with at least a 5-year return interval, as determined by monitoring equipment at Caspar Creek
Road Inventory: Sediment Prevention	M§13.5.3.1-1	• Every 10 years
Focus Watersheds: Sediment Prevention	M§13.5.3.2-1	• Every 3-5 years or after storms with at least a 5-year return interval
Watershed Analysis: Sediment Prevention	M§13.5.3.1-2	• On average once every 20 years
Long Term Channel Monitoring: Stream Sediment	M§13.5.4.1-2	• At least once every 6 years
Focus Watersheds: Stream Sediment	M§13.5.4.1-3	• Every 10 years
Water Drafting	M§13.5.5.1-1	• Annually
Water Drafting	M§13.5.5.2-1	• Annually
Baseline Distribution and Habitat Quality of RLF Breeding Sites	M§13.6.2.1-1	• Complete initial distribution study for red-legged frogs within 2 years of HCP/NCCP implementation.
Occupancy of Red-Legged Frogs in Documented Breeding Sites	M§13.6.2.1-2	• Monitor documented red-legged frog breeding sites annually.
Re-evaluate Habitat Quality and Species Presence within RLF Breeding Sites	M§13.6.2.1-3	• Revisit all potential sites identified during the initial distribution study, as well as other new sites identified, every 5 years to assess which species are present and if red-legged frogs are expanding in range. • Monitor habitat quality of potential red-legged frog breeding sites every 5 years.

Aquatic Effectiveness and Validation Monitoring Programs		
Monitoring Program Description	**Monitoring Code**	**Timing**
Baseline Distribution of Coastal Tailed Frogs	M§13.6.3.1-1	• Complete distribution study for coastal tailed frogs within 2 years of HCP/NCCP implementation.
Distribution and Relative Abundance of Coastal Tailed Frogs	M§13.6.3.1-2	• Monitor for the presence, probable absence, and relative abundance of coastal tailed frogs at 10 sites annually. • Monitor all occupied streams about every 8 years.
Anadromous Salmonid Distribution	M§13.6.1.1-2	• Assess distribution annually for 3 consecutive years and, thereafter, every 12 years—throughout 450 sites.
Chinook Salmon Monitoring Reaches (CSMR)	M§13.6.1.1-3	• Monitor for the presence and relative abundance of Chinook salmon in 4 Chinook Salmon Monitoring Reaches (CSMR) annually.
Smolt Abundance	M§13.6.1.2-1	• Collect data on smolt abundance annually, rotating between 2 focus watersheds every 3 years.

13.4.1 Watershed analysis within aquatic monitoring

Watershed analysis provides baseline information for many of our conservation measures. An initial watershed analysis will not change or alter proposed conservation measures; however, future watershed analyses that feed data into the adaptive management process may bring about changes in both the conservation measures and monitoring programs of our HCP/NCCP. If such changes are outside of the limits of allowable change, they will require either a major amendment or minor modification to our HCP/NCCP, depending on the magnitude of the change.

MRC will re-visit watershed analysis, in its entirety, approximately every 20 years. There will be a total of 4 watershed analyses per watershed analysis unit—1 initial watershed analysis and 3 re-visits over the life of our HCP/NCCP. When proposing new methods, MRC will ensure their comparability with previous watershed analyses.

MRC will provide the agencies with module methods, hypotheses to be tested, and level of sampling. In consultation with the wildlife agencies, MRC may adapt priorities for road repair, determine new restoration actions, and alter monitoring or conservation measures through watershed analysis. Conservation measures revised through monitoring efforts, such as watershed analysis, will provide the same protection as standard conservation measures. This includes conservation measures with limits of allowable change (Table 13-9 through Table 13-11 13-12).

MRC may update watershed analysis components at any time as we identify information on aquatic species, habitat conditions, and the effects of management. We can perform this update through individual modules or through technical reports on specific conservation measures, restoration, or monitoring. MRC will notify the wildlife agencies when an update occurs and give them the opportunity to review methods and objectives. The following situations can affect a watershed analysis update:

- Development of new analytical techniques or research that may improve interpretations of existing information.
- Significant storms (> 25-year flood) that trigger significant watershed changes.
- Earthquake activity that triggers large volumes of sediment input from mass wasting.
- Social or regulatory changes requiring updated analysis.

In the future, MRC will conduct monitoring at the watershed scale by

1. Reviewing air photos, field observations, and other data collection activities according to watershed analysis protocols (see Appendix G, *Watershed Analysis: Background and Methods*).
2. Compiling, summarizing, and synthesizing watershed information produced by other MRC monitoring programs (Figure 13-4).

In a watershed analysis, for example, MRC will survey many stream segments in a watershed for the number and distribution of key LWD pieces, including LWD information from long term channel segments.

Future watershed analyses will summarize and synthesize information from each monitoring program within a watershed analysis unit. Data from watershed analyses may test hypotheses developed during focus watershed studies or "scale up" results from a sub-watershed scale to a watershed scale.

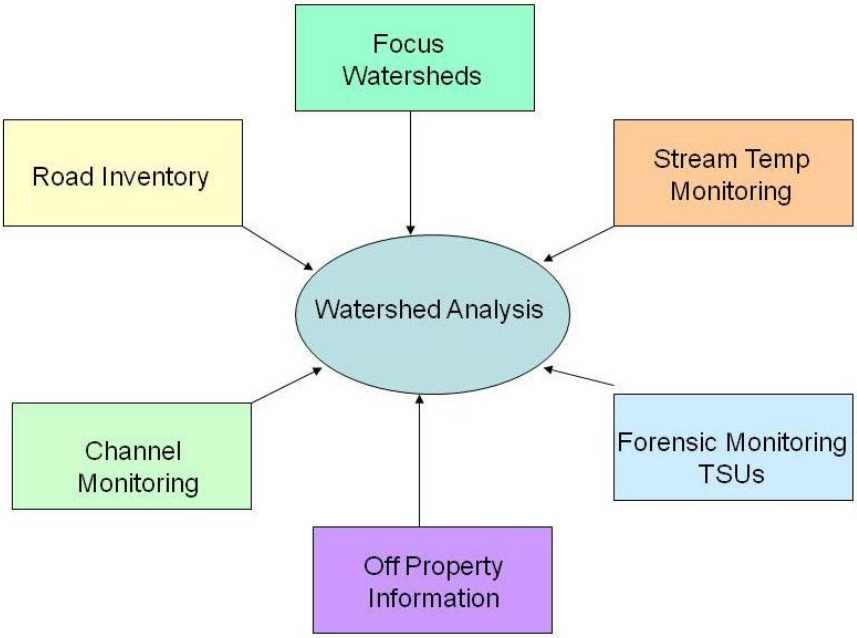


Figure 13-4 Programs Contributing Data to Watershed Analysis

13.4.2 Focus watershed studies

By monitoring focus watersheds, MRC can evaluate water quality and species response at the site scale and the watershed scale. After assessing management impacts in the focus watersheds, we can apply lessons learned to other areas of our land where property-wide monitoring programs indicate similar conditions and problems occur. Experiential knowledge will come from watershed analysis, long term channel monitoring, suspended sediment and turbidity monitoring, road inventory, timber inventory, distribution studies of anadromous salmonid, and stream temperature monitoring.

At first, we will assume that our proposed conservation measures will improve water quality and species habitat. This may not be the case; watershed conditions may remain the same or even degrade. Controlling all the erosion from culverts in a sub-watershed, for example, may not result in measurements of reduced fine sediment in spawning gravel. The reasons could be in our assumptions, such as duration of lag effects, or in our implementation of the conservation measures. Studies in the focus watersheds, such as those for suspended sediment monitoring, need to determine (1) the relationship between land management practices and water quality responses and (2) how we measure that relationship. MRC will create detailed protocols for the focus watershed studies within 1 year of the signing of our HCP/NCCP so that studies are repeatable and verifiable. The format for the protocols will follow the guidelines developed by Oakley et al. (2003) in *Guidelines for Long-term Monitoring Protocols*. Of course, as new knowledge and methods arise within the scientific community, MRC will ask new questions and design new studies within the monitoring programs—all with the assistance of the wildlife agencies and the North Coast Regional Water Quality Control Board.

Within 40 years of HCP/NCCP implementation, MRC will meet our commitments for all of the controllable erosion associated with high and moderate sites based on the initial road inventory. In addition, we will improve watershed conditions through stream and upslope restoration such as road maintenance and reconstruction; LWD placement; riparian restoration harvests; road decommissioning; and upslope canopy retention. Results from focus watershed studies will show us which, if any, of these restoration activities enhances or degrades watershed conditions. Armed with that information, we can, as we said earlier, apply these restoration activities to areas outside of the focus watersheds based on the data collected there from watershed analysis.

MRC has designated 4 areas for focus watershed studies that represent a range of topographic, environmental, and regulatory conditions on our land (Table 13-14). Each represents both a large proportion of the plan area and a range of conditions; as a result, we can ensure that monitoring evaluates the effects of our management decisions and practices. All of the focus watersheds are also CalWater planning watersheds—Cottaneva Creek, South Fork Albion River, Little North Fork Navarro, and Upper Elk Creek. Located within the Franciscan geologic region of the coastal belt, these 4 areas consist of a complex mixture of terrains and rock types with no single component dominating the landscape. From a geological perspective, therefore, the focus watersheds are not easily distinguishable from each other and from other watersheds in the plan area.

Two of the focus watersheds, Little North Fork Navarro and South Fork Albion, will receive intensive monitoring. Both areas are within watersheds listed as “sediment impaired” by Section 303(d) of the Clean Water Act; Little North Fork Navarro is also in a watershed that is “temperature impaired.” The two watersheds provide contrasting forest and climate conditions. South Fork Albion is closer to the Pacific Ocean, with cooler air and water temperatures; it has forest stand conditions that would be desirable across the plan area. On the other hand, Little

North Fork Navarro has warmer air and water temperatures and is a younger forest. Little North Fork Navarro also has a moderate amount of hardwood stands; they will require more intense rehabilitation harvests in the short term, i.e., variable retention or transition treatments. All the focus areas are convenient for personnel with equipment to perform studies.

Upper Elk Creek and Cottaneva Creek represent, respectively, the southern and northern portions of the plan area. Upper Elk Creek has forest type, climate, and topographic environment of coastal watersheds in the southern portion of the plan area. MRC completely owns Cottaneva Creek, which has coho salmon, steelhead, and coastal tailed frogs. The forest stands in South Fork Cottaneva Creek are a mix of young forests with conditions similar throughout much of the plan area. This area receives, on average, much higher amounts of rainfall than the remainder of MRC forests and contains streams with suitable water temperatures for the aquatic species present.

Table 13-14 Focus Areas for Aquatic Monitoring

Focus Area	Watershed (ac)	Plan Area (ac)	% Plan Area	Covered Aquatic Species Present	Regulatory Issues
Designated Areas					
South Fork Albion River	5830	4696	80.5%	Coho salmon, steelhead, red-legged frog	Central ESU, Sediment TMDL
Little North Fork Navarro	7085	6423	90.6%	Coho salmon, steelhead, red-legged frog	Central ESU, Sediment TMDL, Temperature TMDL
Upper Elk Creek	9894	9136	92.3%	Coho salmon, steelhead, red-legged frog, coastal tailed frog	Central ESU
South Fork Cottaneva	3425	3425	100%	Coho salmon, steelhead, coastal tailed frog	Central ESU

13.4.3 Additions and deletions of land

At the commencement of the HCP/NCCP, the plan area consists of 213, 244 ac and 4 designated focus watersheds (Table 13-14). In the ensuing years, additions and deletions of land to the plan area may adjust both these numbers. If the plan area expands to 240,000 ac or more, MRC will add 1 additional focus watershed. If the plan area shrinks to 186,000 ac or less, MRC will subtract 1 focus watershed. During the entire term of our HCP/NCCP, the maximum number of focus watersheds in the plan area will be 5; the minimum number, 3. MRC will consult with the wildlife agencies and Water Quality if land purchases or sales necessitate the addition or deletion of a focus watershed. The decision to locate a new focus watershed within the plan area will weigh how well the proposed area “fits” within the study profile outlined above.

13.4.4 Long term channel monitoring

The long term channel monitoring program has essentially the same protocol as the focus watershed studies for LWD, canopy, stream channel profiles, permeability, V-star, and pebble counts. In long term channel monitoring, however, there is a longer period between sampling and a broader coverage across the plan area. The purpose of its data collection is to

- Draw conclusions about long-term processes through the monitoring of permanent stations.

- Supplement watershed analysis data.
- Track, across the plan area, the status of watershed" health" with knowledge from the focus watershed studies.

13.4.5 Timeline for aquatic monitoring

During the first 2 years of our HCP/NCCP, MRC will determine the initial distribution of amphibians, refining detailed protocols for the monitoring programs and completing our first watershed analysis. MRC will then start the focus watershed studies. These will continue for several years with interruptions for anadromous salmonid distribution, long-term channel monitoring, and amphibian monitoring. Throughout this whole process, we will conduct pre-project (or baseline) monitoring in areas designated for restoration harvests. After approximately 20 years, MRC will weigh the results and re-evaluate the timing of the monitoring programs in consultation with the wildlife agencies. All of the aquatic monitoring programs require significant resources for implementation, including personnel and equipment. Table 13-15 provides an estimated timeline for the first 20 years of the aquatic monitoring programs. Generally, monitoring programs in subsequent years of the plan will recycle through this initial 20-year schedule.

13.5 Monitoring aquatic habitat

MRC has proposed and developed some of the study designs for monitoring aquatic habitat under our HCP/NCCP. During the first 3 years of our HCP/NCCP, we will complete all outstanding study designs for aquatic monitoring.

Habitat monitoring falls into 4 major categories: (1) riparian function; (2) mass wasting; (3) surface erosion; and (4) instream sediment. Within these categories are monitoring programs or portions of programs that measure specific goals and objectives.

The term *segment* appears in 3 of our aquatic monitoring programs—watershed analysis, long-term channel monitoring, and focus watershed studies. A segment is typically 20-30 bankfull widths in length, i.e., roughly 300-1500 ft for most streams in the plan area.

In selecting segments for field observation, the GIS and science staff at MRC first stratify the watercourses within each planning watershed (more specifically, within each watershed analysis unit to be analyzed) by confinement and slope. They then choose segments for field observation based on numerous factors, including location within the watershed, potential fish habitat, stream temperature monitoring locations, and level of effort. MRC does not select segments for field observation that are over 20% in gradient. While we assume such segments do not provide fish habitat, we occasionally sample them for amphibians. Each planning watershed will have anywhere from 3 to 30 field-observed segments, depending upon how much of the planning watershed MRC owns. Segments for long-term channel monitoring and focus watershed studies are typically selected from the field observed segments in watershed analysis. Appendix G, *Watershed Analysis: Background and Methods*, provides details on MRC sampling efforts and intensity.

Table 13-15 Estimated Timeline for Aquatic Monitoring

Estimated Timeline for Aquatic Monitoring																					
Monitoring Code	**Monitoring Program**	**Years Since Start of HCP/NCCP**																			
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
M§13.5.1.1-1	Timber Inventory: Riparian Stands																				
M§13.5.1.1-2	Timber Inventory: Riparian Canopy																				
M§13.5.1.1-3	Watershed Analysis: LWD Conditions																				
M§13.5.1.1-4	Watershed Analysis: Shade Conditions																				
M§13.5.1.2-1	Long-term Channel Monitoring: LWD																				
M§13.5.1.2-2	Focus Watersheds: Riparian Function																				
M§13.5.1.1-5	Stream Temperature																				
M§13.5.1.2-3	Watershed Size: Small Class II Watercourses																				
M§13.5.2.1-1	Watershed Analysis: Mass Wasting																				
M§13.5.2.2-1	Forensic Monitoring: Landslide Observations																				
M§13.5.2.1-2	Focus Watersheds: Mass Wasting																				
M§13.5.3.1-1	Road Inventory: Sediment Prevention																				
M§13.5.3.2-1	Focus Watersheds: Sediment Prevention																				
M§13.5.3.1-2	Watershed Analysis: Sediment Prevention																				
M§13.5.4.1-2	Long Term Channel Monitoring: Stream Sediment																				

Estimated Timeline for Aquatic Monitoring																					
Monitoring Code	**Monitoring Program**	**Years Since Start of HCP/NCCP**																			
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
M§13.5.4.1-3	Focus Watersheds: Stream Sediment																				
M§13.5.4.1-1	Focus Watersheds: Sediment Budget																				
M§13.6.2.1-1	Baseline Distribution and Habitat Quality of Red-legged Frogs Breeding Sites																				
M§13.6.2.1-2	Occupancy of Red-Legged Frogs in Documented Breeding Sites																				
M§13.6.2.1-3	Re-evaluate Habitat Quality and Species Presence within Red-legged Frogs Breeding Sites																				
M§13.6.3.1-1	Baseline Distribution of Coastal Tailed Frogs																				
M§13.5.5.1-1	Water Drafting																				
M§13.5.5.2-1	Water Drafting																				
M§13.6.3.1-2	Distribution and Relative Abundance of Coastal Tailed Frogs																				
M§13.6.1.1-1	Anadromous Salmonid Presence: ASMB																				
M§13.6.1.1-3	Chinook Salmon Monitoring Reaches (CSMR)																				
M§13.6.1.1-2	Anadromous Salmonid Distribution																				
M§13.6.1.2-1	Smolt abundance																				

TABLE NOTES

Most monitoring programs are on-going (i.e., occurring every year), but the shaded cells indicate the years that the program will re-visit the same location.

13.5.1 Riparian function

MRC will use 7 monitoring programs to determine if our biological goals and objectives for riparian function are being met: (1) riparian stand; (2) riparian canopy; (3) watershed analysis of LWD conditions; (4) LWD conditions in long-term monitoring segments; (5) riparian function in focus watershed studies; (6) stream temperature; (7) watershed size for Small Class II watercourses.

13.5.1.1 Effectiveness monitoring

Riparian stands

Effectiveness Monitoring	
Timber Inventory: Riparian Stands	
PROGRAM CODE	M§13.5.1.1-1
O§8.2.2-1	• Develop and maintain Class I and Large Class II AMZs with large, dense conifer trees based on targets for basal area and size distribution.
MONITORING APPROACH	• MRC conducts inventory on a continuous basis. At any point in time, MRC will sample about 10% of our forested acres. Once a sample plot is 10 years old, we archive the existing data and acquire new data. We will incrementally sample more AMZs stands over the term of our HCP/NCCP because of their unique vegetation strata and other monitoring requirements. All the sample data on basal area, trees per acre, board foot volume, and habitat conditions, we incorporate into our landscape model. See Appendix U, *Inventory Strategy*, for further details.
MEASUREMENT CRITERIA	• Tables 8-5 through 8-8 show the targets for basal area and tree height. • More than 45% of vegetation strata in AMZs should be conifer/hardwood or conifer-dominated within 40 years of HCP/NCCP initiation, followed by non-decreasing percentages. • More than 90% of vegetation strata in AMZs should be conifer/hardwood or conifer-dominated 80 years after HCP/NCCP initiation.
ADAPTIVE MANAGEMENT	• MRC will review the status of riparian stands at Years 30 and 70 of HCP/NCCP implementation to determine if we are meeting our targets on schedule. • MRC will examine the causes of deviation if we are not meeting our targets for AMZ characteristics. • MRC may re-vegetate certain areas with poor AMZ conditions such as abandoned landings or streamside roads. • MRC has defined the AMZ conservation measures subject to change through the adaptive management process (Table 13-8).

Riparian canopy

Effectiveness Monitoring	
Timber Inventory: Riparian Canopy	
PROGRAM CODE	M§13.5.1.1-2
O§8.2.2-2	• Achieve, per planning watershed, at least 70% canopy averaged across the entire Class I and Large Class II AMZ. ▪ More than 75% of the stands sampled during timber inventories will meet this canopy requirement within 30 years of HCP/NCCP initiation. ▪ More than 90% of the stands sampled during timber inventories will meet this canopy requirement within 80 years of HCP/NCCP initiation.
MONITORING APPROACH	• MRC conducts inventory on a continuous basis. At any point in time, MRC will sample about 10% of our forested acres. Once a sample plot is 10 years old, we archive the existing data and acquire new data. We will incrementally sample more AMZs stands over the term of our HCP/NCCP because of their unique vegetation strata and other monitoring requirements. All the sample data on basal area, trees per acre, board foot volume, and habitat conditions, we incorporate into our landscape model. See Appendix U, *Inventory Strategy*, for further details.
MEASUREMENT CRITERIA	• More than 75% of Class I and Large Class II AMZs will have at least 70% canopy cover across the inner, middle, and outer AMZ bands within 30 years of HCP/NCCP initiation. • More than 90% of Class I and Large Class II AMZs will have at least 70% canopy cover across the inner, middle, and outer AMZ bands within 80 years of HCP/NCCP initiation.
ADAPTIVE MANAGEMENT	• MRC will review the status of riparian stands at Years 30 and 70 of HCP/NCCP implementation to determine if we are meeting our targets on schedule. • MRC will examine the causes of deviation if we are not meeting our canopy targets for riparian stands. • MRC may re-vegetate certain areas with poor riparian conditions such as abandoned landings or streamside roads. • MRC has defined the AMZ conservation measures subject to change through the adaptive management process (Table 13-9).

Watershed analysis of LWD conditions

Effectiveness Monitoring	
Watershed Analysis: LWD Conditions	
PROGRAM CODE	M§13.5.1.1-3
O§8.2.2-7	• Achieve *on-target* ratings for both stream shade and LWD at the planning watershed scale.
MONITORING APPROACH	• MRC will use information on riparian function from watershed analysis to ▪ Evaluate the condition of riparian stands for the recruitment of LWD throughout response and transport stream segments (< 20% gradient). ▪ Evaluate current and past LWD loading in a sample of response

Effectiveness Monitoring	
Watershed Analysis: LWD Conditions	
	and transport stream segments. ▪ Rate watercourse LWD quality, tracked by planning watershed. • MRC describes the methods for evaluating LWD recruitment in Appendix G, *Watershed Analysis: Background and Methods* (section G.3.3.2).
MEASUREMENT CRITERIA	• See Appendix S, *Targets for LWD and Effective Shade*.
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if we are not meeting our LWD targets. • MRC may place LWD in streams or increase large tree retention within AMZ and mass wasting areas, if we are not meeting our targets for LWD recruitment rates. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

Watershed analysis of shade conditions

Effectiveness Monitoring	
Watershed Analysis: Shade Conditions	
PROGRAM CODE	M§13.5.1.1-4
O§8.2.2-7	• Achieve *on-target* ratings for both stream shade and LWD at the planning watershed scale.
MONITORING APPROACH	• MRC will use information on riparian function from watershed analysis to ▪ Determine the average percent shade (measured with a solar pathfinder) for selected streams within each planning watershed ▪ Assess effective shade conditions at the planning watershed level based on the number of stream segments that meet the effective shade targets.[6] • MRC describes the methods for evaluating stream shade in Appendix G, *Watershed Analysis: Background and Methods* (section G.3.3.3).
MEASUREMENT CRITERIA	• See Appendix S, *Targets for LWD and Effective Shade.*
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if we are not meeting our instream canopy targets. • MRC may re-vegetate certain areas with poor riparian conditions such as abandoned landings or streamside roads. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

[6] Effective shade is dependent upon bankfull width and includes analysis of instream water temperature.

Stream temperature

Effectiveness Monitoring	
Stream Temperature	
PROGRAM CODE	M§13.5.1.1-5
OBJECTIVE O§8.2.2-6	• Decrease summer water temperatures, where possible, to manage for temperatures at or below MWMT targets for covered species (see the *Water Quality Control Plan for the North Coast Region*, i.e., the Basin Plan).
MONITORING APPROACH	• MRC will monitor stream temperatures, from approximately May to October, in 139 sites (*HCP/NCCP Atlas* MAPS 3A-C). • MRC will monitor all watercourses on our land where coho salmon are known to be present. • MRC will monitor at least 1 Large Class II watercourse in each CalWater planning watershed with coastal tailed frogs present. • MRC will attempt to capture a range of Class II stream sizes and locations across our land when selecting Large Class II monitoring sites. • MRC will monitor air temperature at 1 or more monitoring sites in every inventory block to assist in interpretation of stream temperatures. • MRC will monitor the effects of restoration harvests on stream temperatures in the focus watersheds using 2 sources: (1) annual stream temperatures collected at permanent monitoring sites; and (2) stream temperatures collected at restoration harvests. • MRC will phase in restoration harvests based on monitoring results and consultation with the wildlife agencies.
MEASUREMENT CRITERIA	• MRC will use MWMT and MWAT derived from continuous electronic temperature recorders with measurements taken at least every 30 minutes. We will place the stream temperature recorders in shallow pools (< 1 m in depth) directly downstream of riffles and out of direct sunlight. Placement of temperature recorders will be in locations where water is adequately mixed and unlikely to evaporate during the annual monitoring period. Each data recorder will be held in place with a piece of rebar, or concrete reinforcing rod, driven into the substrate. • MRC will perform accuracy tests on all temperature data recorders for pre- and post-data recording activities. We will test the accuracy of the temperature data recorders by placing the equipment in an ice and room temperature bath for at least 4 hours. Temperature readings recorded by the data recorder will be compared with temperature readings from a certified reference thermometer placed in the same medium in the bucket. MRC will interpret results using the manufacturer's suggested allowable error for the instrument. • MRC will monitor stream temperatures both upstream (or nearby) and downstream of AMZ restoration harvests, in ▪ Streams where MRC predicts direct shade to be lower than pre-harvest conditions by more than 10%. ▪ Streams that do not meet stream temperature targets. ▪ Streams that contribute flow to other streams that exceed the targets. • MRC will make the following observations while monitoring restoration

Effectiveness Monitoring	
Stream Temperature	
	harvests: ▪ Average canopy before and after harvest in each AMZ band and on both sides of the watercourse. ▪ Estimated average tree height of the canopy before and after harvest in each AMZ band. ▪ Stream shading measured with a solar pathfinder before and after treatment. The shade measurement will be the average of at least 10 observations taken in the middle of the active channel and evenly spaced along the restoration treatment area. MRC will take 2 measurements (equidistant from the banks) at each of the 10 locations (i.e., 20 observations in total) for streams with active channels greater than 30 ft in width. ▪ Azimuth of the watercourse pointing downstream and aspect of each AMZ. If there are multiple aspects and azimuths, we will include the distance of each. ▪ Stream flow data for at least 1 season before and after treatment. MRC will take the observations at the upstream and downstream ends of the AMZ restoration treatment. • MRC will collect air temperatures to adjust and interpret stream temperature observations, if we use before and after observations.
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if we are not meeting our targets for stream temperatures. • MRC may re-vegetate certain areas with poor riparian conditions such as abandoned landings or streamside roads. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

13.5.1.2 Validation monitoring

LWD in long-term channel monitoring segments

Redwood or Douglas-fir trees can take decades to become mature and fall into stream channels. Plus, the input of LWD to stream channels is infrequent in response to episodic disturbances, such as wind, bank erosion, or mass wasting. All in all, the response and recovery of stream channels to disturbances can be very slow. MRC believes surveying for LWD in long term channel monitoring segments once per decade is appropriate given the slow response of LWD inputs and stream channels to management.

Validation Monitoring	
Long-term Channel Monitoring: LWD	
PROGRAM CODE	M§13.5.1.2-1
HYPOTHESIS SECTION 8.2.2	• Stream channels will respond to increases in LWD loading through increases in pool frequency, residual water depth, or residual pool volumes.
MONITORING APPROACH	• MRC will monitor at least 60 long-term channel monitoring segments a minimum of once every 6 years to evaluate the effectiveness of LWD inputs to streams across our land. • MRC has provided further details in Appendix G, *Watershed Analysis:*

Validation Monitoring	
Long-term Channel Monitoring: LWD	
	Background and Methods (section G.3.4).
MEASUREMENT CRITERIA	• Determine if LWD demand meets or exceeds mean LWD recruitment rates for northern California (section 8.2.4.8). • Assess active placement of LWD. • Evaluate, at the stream reach scale, stream channel response to LWD recruitment through changes in pool frequency, residual pool depth, or residual pool volumes.
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if there are no increases in pool frequency, residual pool depth, or residual pool volumes. • MRC may place LWD in streams or increase large tree retention within AMZ and mass wasting areas, if we are not achieving the desired conditions for pool frequency, residual pool depth, or residual pool volumes. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

Riparian function in focus watersheds

Validation Monitoring	
Focus Watersheds: Riparian Function	
PROGRAM CODE	M§13.5.1.2-2
HYPOTHESES SECTIONS 8.2.4.7-10	• Stream channels will respond to increases in LWD loading through increases in pool frequency, residual pool depth, or residual pool volumes. • Shade over streams will increase in response to riparian conservation measures.
MONITORING APPROACH	• MRC will determine the following, in observations taken every 3 years: ▪ Effectiveness of the riparian zone at shading the watercourses and maintaining appropriate stream temperatures in the focus watersheds. ▪ Long-term relationships between stream channel habitat, riparian conditions, and LWD recruitment rates. • MRC will provide protocol details for the focus watershed studies within 1 year of HCP/NCCP acceptance and signing.
MEASUREMENT CRITERIA	• MRC will track, in each of the focus watersheds, the timing and extent of upslope or AMZ forest management and compare results with monitored riparian functions of LWD and canopy closure. 1. MRC will conduct LWD surveys, in each of the focus watersheds, at 5-7 stream-monitoring segments covering a distribution of stream channel types (morphologies, gradients, location within network). We will initially select the stream monitoring segments by stratified random sampling based on the proportion desired within target stream channel types. The monitoring segments will be at least 20-30 bankfull widths in length. 2. MRC will measure, every 3 years, LWD in stream channel monitoring segments; refer to Appendix G, *Watershed Analysis:*

Validation Monitoring	
Focus Watersheds: Riparian Function	
	Background and Methods, section G.3.3.1. MRC will also document current riparian stand conditions along the monitoring segment, including basal area, vegetation strata, and canopy. The combination of AMZ stand conditions and stream channel LWD observations will help determine LWD recruitment rates within the focus watersheds. MRC can compare these rates to published LWD recruitment rates. In addition, we can use these detailed observations of LWD to interpret information from annual surveys. • MRC will monitor, in each of the focus watersheds, stream canopy closure and associated shade: 1. MRC will measure instream shade using a solar pathfinder. We will develop a sampling protocol for assessing shade in the focus watershed segments. These will be the same 5-7 stream monitoring segments used for LWD observations. We will monitor stream water temperatures annually throughout the focus watersheds. The surveys of instream shade in varying stream channel types should detect spatial and temporal changes in canopy across the plan area. 2. MRC will measure AMZ canopy, tree heights, and stand characteristics in conjunction with stream shading measurements throughout all the monitoring segments of the focus watersheds. The observations will include distribution of topography, aspect, and stream channel sizes. We will make observations infrequently—every decade—because canopy and tree height increases relatively slowly. Finally, we can use these detailed observations of riparian areas, shade, and canopy closure to interpret information from annual surveys.
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation, if there are no increases in pool volume, frequency, and residual depth. • MRC will examine the causes of deviation if we are not meeting our targets for instream shade. • MRC may place LWD in streams or increase large tree retention within AMZ and mass wasting areas, if we are not achieving our targets for LWD recruitment rates or instream shade. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

Watershed size

Validation Monitoring	
Watershed Size: Small Class II Watercourses	
PROGRAM CODE	M§13.5.1.2-3
HYPOTHESIS SECTION 8.2.4.3	• 100 ac or less is the appropriate watershed size to characterize most Class II watercourses that do not flow during the warm summer period.
MONITORING APPROACH	• MRC will initially designate Class II watercourses as Small Class II watercourses if they are 100 ac or less in drainage area. We must then

Validation Monitoring	
Watershed Size: Small Class II Watercourses	
	determine if this is the appropriate watershed size so that AMZ management does not increase water temperature (MWMT). We will address the watershed size at which a significant number (i.e., > 20%) of Small Class II watercourses retain year-round surface water. • MRC will determine watershed size for Small Class II watercourses with year-round surface water by evaluating adjacent and upslope areas post-harvest to determine if watershed size needs to be adjusted because of increased surface flows. • MRC will complete its initial examination of Small Class II watersheds for significant surface water within the first 5 years of our HCP/NCCP, depending on annual flow conditions.
MEASUREMENT CRITERIA	• MRC will map all watersheds to identify the point at which Small Class II watercourse size is ≤ 150 ac. From these maps, MRC will randomly select 20% of the watercourses that have not experienced recent upslope timber harvest (i.e., within the last 10 years) for observation within each CalWater planning watershed. • MRC will monitor the selected watercourses in July to determine if there is significant surface water. Significant surface water covers at least 25% of channel length in 100 ft sections with water depth ≥ 0.05 ft (.02m). We will measure the extent of significant surface water when both the first and second 100-ft section furthest upstream fails to meet this definition. This criterion is dependent upon natural water sources and not anthropogenic sources of flow such as ditch relief culverts. • MRC will map the extent of significant surface water within a watershed and record the date. ▪ MRC recognizes that observations of significant surface water flow will likely vary based on the amount of precipitation. In very wet years, streams that do not flow in dry years may flow all year in small watersheds. ▪ MRC will not attempt to map significant surface water in Small Class II watersheds in years with high or low summer stream flow. Low or high summer stream flow is a 33% deviation from the average stream flow observation at the South Fork Caspar Creek stream-flow gage on July 1. In 2005 based on observations from 1963-1995, the average stream flow for July 1 for the South Fork Caspar Creek was 0.34 ft^3 per second. Based on this average value, in years with less than 0.23 cfs or more than 0.44 cfs of stream flow, MRC will not conduct monitoring. If observations cannot be made in successive years, MRC may extend the length of time needed to complete the initial examination of Small Class II watersheds—estimated at 5 years—by the number of years measurements could not be taken. • MRC will re-evaluate the sites sampled in the initial 5-year effort to determine if the extent of significant surface flow has increased; this will take place in late summer, at approximately the same date as the pre-project sampling and following the first winter after harvest. ▪ If there is significant surface water, MRC will map its extent within the Small Class II watershed and record the date. ▪ If there is not significant surface water, MRC will note the date of observation and watershed size.

Validation Monitoring	
Watershed Size: Small Class II Watercourses	
	• MRC will survey 20% of Small Class II watercourses to determine their appropriate watershed size.
ADAPTIVE MANAGEMENT	• MRC will increase the upper size limit for Small Class II watercourses if significant surface water does not occur in watersheds between 100 and 150 ac. • MRC will decrease the designated watershed size for Small Class II watercourses if data indicates that significant surface water occurs in watersheds of an average size of less than 100 ac. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

13.5.2 Mass wasting

MRC will address sediment delivery from mass wasting through

- Observations in watershed analysis.
- Incidental landslide observations by MRC foresters.
- Forensic monitoring by a forensic geologist after forest harvest operations.
- Focus watershed studies.

13.5.2.1 Effectiveness monitoring

Mass wasting observations in watershed analysis

Effectiveness Monitoring	
Watershed Analysis: Mass Wasting	
PROGRAM CODE	M§13.5.2.1-1
OBJECTIVES O§8.3.2-1 O§8.3.2-2	• Reduce, by year 40 of our HCP/NCCP, sediment delivery from mass wasting unrelated to roads by at least 10% of the rate (tons/mi^2/year) determined in the initial watershed analyses or established in TMDL load allocation reductions. • Reduce, within the 80-year timeframe of our HCP/NCCP, sediment delivery from mass wasting unrelated to roads by at least 20% of the rate (tons/mi^2/year) determined in the initial watershed analyses or established in TMDL load allocation reductions.
MONITORING APPROACH	• MRC will establish baselines using the initial data from watershed analysis (see Appendix G, G.2.1.10, *MRC methods for estimating sediment input from mass wasting*). • MRC will update ▪ Landslide inventory to show the magnitude and location of mass wasting events within each watershed analysis unit. ▪ Boundaries of terrain stability units to improve the accuracy of our knowledge of terrain with greater risk for sediment delivery from mass wasting.
MEASUREMENT CRITERIA	• MRC will view a series of aerial photographs—at least 1 set per decade. Observations will focus on identifying the types of mass wasting processes active in the basin, the link between mass wasting and forest management

Effectiveness Monitoring	
Watershed Analysis: Mass Wasting	
	related activities, and the concentration of mass wasting processes. This will ensure that MRC partitions the plan area into the appropriate zones of relative mass wasting potential based on the likelihood of future mass wasting and sediment delivery to stream channels (see Appendix G, section G.2.1.4, *Landslide inventory*).
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if we are not meeting our targets for sediment prevention. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

Mass wasting in focus watersheds

Effectiveness Monitoring	
Focus Watersheds: Mass Wasting	
PROGRAM CODE	M§13.5.2.1-2
OBJECTIVES O§8.3.2-4 O§8.3.2-2	• Reduce, within the 80-year timeframe of our HCP/NCCP, sediment delivery from mass wasting related to roads by at least 60% of the rate (tons/mi^2/year) determined in the initial watershed analyses or established in TMDL load allocation reductions. • Reduce, within the 80-year timeframe of our HCP/NCCP, sediment delivery from mass wasting unrelated to roads by at least 20% of the rate (tons/mi^2/year) determined in the initial watershed analyses or established in TMDL load allocation reductions.
MONITORING APPROACH	• MRC will maintain an inventory of mass wasting features within each of the focus watersheds through watershed analysis assessments. • MRC will ensure the inventory observations are more frequent and more comprehensive than those for a watershed analysis in order to allow MRC to examine the effect of our forest management on mass wasting.
MEASUREMENT CRITERIA	• MRC will view the most recent available set of aerial photographs and conduct field observations of the entire focus watershed every 3-5 years. • MRC will make field observations to capture greater detail than the aerial photos (see Appendix J, *CLFA Checklist and Landslide Form*).
ADAPTIVE MANAGEMENT	• MRC will review the status of mass wasting sites at Years 30 and 70 of HCP/NCCP implementation to determine if we are meeting our targets on schedule. • MRC will determine the causes of deviation if we are not meeting our targets for sediment prevention. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

13.5.2.2 Validation monitoring

Forensic monitoring and field observations of landslides

Validation Monitoring	
Forensic Monitoring: Landslide Observations	
PROGRAM CODE	M§13.5.2.2-1
HYPOTHESES SECTION 8.3.3.1	• MRC conservation measures for mass wasting will decrease the incidence of management-related landslides.
MONITORING APPROACH	• MRC will use forest managers to update the watershed analysis inventory database of mass wasting events and improve its accuracy. Our foresters spend a significant amount of time doing pre-project planning and post-project assessment. During these extended periods in the forest, they will document landslides with the incidental landslide observation form and add this information to our watershed analysis inventory database. Increasing the sample size of this database will provide, in turn, more accurate information for assessing the landslide incident rate. • MRC will observe mass wasting events during follow-up inspections of forest harvest areas and roads, typically after storm events[7] when the likelihood of mass wasting is greatest.
MEASUREMENT CRITERIA	• MRC will train forester managers to systematically collect data on landslides (see Appendix J, *CLFA Checklist and Landslide Form*). • MRC will conduct forensic investigations of landslides each year on 10 to 20% of the PTHPs to observe site conditions and document causative evidence. • MRC will use a professional geologist licensed in the State of California to supervise all forensic investigations of landslides (see Appendix J, *CLFA Checklist and Landslide Form*).
ADAPTIVE MANAGEMENT	• MRC will determine the causes of deviation if we are not meeting our targets for sediment prevention. • MRC has defined the conservation measures for sediment control that are subject to change through adaptive management (Table 13-9).

13.5.3 Surface erosion

MRC will monitor surface erosion from road and skid trails by

- Comprehensive road inventory.
- Focus watershed studies.
- Watershed analysis.

[7] This will generally be every 3-5 years or after storms with at least a 5-year return interval as determined by monitoring equipment at Caspar Creek.

13.5.3.1 Effectiveness monitoring

Sediment prevention through road inventory

Effectiveness Monitoring	
Road Inventory: Sediment Prevention	
PROGRAM CODE	M§13.5.3.1-1
OBJECTIVE O§8.3.2-6	• Control 1,302,000 yd^3 of controllable erosion within the first 30 years of the HCP/NCCP.
MONITORING APPROACH	• MRC will inventory roads with permanent structures (culverts or bridges) every 10 years and update a database with information on road improvements, road decommissioning, and erosion control (see Appendix F, *Road Inventory Protocol*). • MRC will complete an initial inventory of all controllable erosion sites from skid trails via aerial photo analysis and field observations as described in section 8.3.3.2.11 *Skid trail system plan*.
MEASUREMENT CRITERIA	• MRC will use our database of road observations and road work to ▪ Provide information on the amount of controllable erosion controlled by upgrading and decommissioning roads. ▪ Document conditions of individual roads to allow MRC to monitor improvements. ▪ Set priorities for controllable erosion work (see section 8.3.3.2.1 to 8.3.3.2.3) • MRC will compare successive 10-year periods for how successful MRC was in repairing sources of controllable erosion and for the quality of individual road features.
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if we are not meeting our targets for reducing erosion from roads and skid trails. • MRC may decide to increase road surface improvements (rocking); limit traffic usage (by time, quantity, or type); or decrease road density. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

Sediment prevention through watershed analysis

Effectiveness Monitoring	
Watershed Analysis: Sediment Prevention	
PROGRAM CODE	M§13.5.3.1-2
OBJECTIVE O§8.3.2-7	• Reduce point source erosion from roads, skid trails, or landings and sediment delivery associated with surface erosion by 50% within the first 30 years of our HCP/NCCP (i.e., from 4000 to 2000 yd^3 per mi^2 per year) and 70% within the initial 70 years of our HCP/NCCP (i.e., from 4000 to 1200 yd^3 per mi^2 per year).
MONITORING APPROACH	• MRC will analyze sediment inputs from roads and skid trails during each watershed analysis.
MEASUREMENT CRITERIA	• MRC discusses in Appendix G, G.2.2.3 and G.2.2.4 how we analyze sediment delivery from roads and skid trails respectively. The initial watershed analysis used a combination of field observations of point

Effectiveness Monitoring	
Watershed Analysis: Sediment Prevention	
	source erosion and estimates from a surface erosion model from the Standard Methodology for Conducting Watershed Analysis (WFPB 1995). Future watershed analysis efforts may use this model or other methods depending on the state of the technology at the time and information generated from focus watershed studies.
ADAPTIVE MANAGEMENT	• MRC will examine the cause of deviation if we are not meeting our targets for prevention of sedimentation from roads and skid trails. • MRC may decide to increase road surface improvements (rocking), change road classifications (traffic usage), or decrease road density. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

13.5.3.2 Validation monitoring

Sediment prevention through focus watersheds

Validation Monitoring	
Focus Watersheds: Sediment Prevention	
PROGRAM CODE	M§13.5.3.2-1
HYPOTHESIS SECTION 8.3.3.2	• MRC conservation measures for roads, skid trails, and landings will measurably reduce the amount of sediment entering stream channels, as compared with the sediment amounts documented in the baseline road inventory survey.
MONITORING APPROACH	• MRC will monitor roads and skid trails within each of the focus watersheds and record quantity and timing of sediment inputs at least twice per decade or after storms with a 5-year or more recurrence interval. In addition, we will collect data from road inventory monitoring at the beginning and end of every decade (Appendix F, *Road Inventory Protocol*).
MEASUREMENT CRITERIA	• MRC will collect post-winter observations of all potentially deliverable controllable erosion sites (crossings, culverts, landings, road slides, erosion features, and skid trail erosion sites) to better examine site characteristics and impacts from conservation measures. • MRC will not survey sites unless they were designated a priority on the baseline surveys.
ADAPTIVE MANAGEMENT	• MRC will examine the cause of deviation if we are not meeting our targets for prevention of sedimentation from roads and skid trails. • MRC may decide to increase road surface improvements (rocking); limit traffic usage (by time, quantity, or type); or decrease road density. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

13.5.4 Instream sediment

MRC will monitor stream sediment by

- Long term channel monitoring.

- Focus watershed studies.
- Sediment budget.

13.5.4.1 Validation monitoring

Section 13.2 distinguishes effectiveness monitoring from validation monitoring. Sometimes, however, effectiveness monitoring and validation monitoring overlap. In the case of the validation monitoring programs discussed in this sub-section, namely M§13.5.4.1-1, M§13.5.4.1-2, and M§13.5.4.1-3, the focus watershed studies for sediment budget, long term channel monitoring, and stream sediment will help MRC draw conclusions about O§8.3.2-8:

O§8.3.2-8 Demonstrate an improving trend in the following parameters over the life of the HCP/NCCP based on MRC conducting (a) watershed analyses at least every 20 years, (b) long-term channel monitoring every 10 years, and (c) focus watershed studies every 3-5 years:

- Quality of stream gravel as measured by increased permeability and percent of fine particles < 0.85 mm.
- Stream-reach complexity as measured by residual pool depths and standard deviation of residual pool depths within long-term stream monitoring reaches.
- Proportion of fine sediment in pools (V-star).
- Decreased sediment inputs to the sediment budget for focus watersheds.

Sediment budget within focus watersheds

Validation Monitoring	
Focus Watersheds: Sediment Budget	
PROGRAM CODE	M§13.5.4.1-1
HYPOTHESIS SECTIONS 8.3.3.1 AND 8.3.3.2	• Conservation measures for mass wasting, roads, skid trails, and landings will measurably reduce the amount of sediment entering stream channels, as compared with the sediment amounts documented in baseline road inventory and mass wasting surveys.
MONITORING APPROACH	• MRC will maintain a sediment budget within each of the focus watersheds. A sediment budget is represented by the equation: Sediment Input + Change in Storage = Sediment Output.
MEASUREMENT CRITERIA	• MRC will generate sediment budget estimates at the end of every decade. • MRC will measure and update *Sediment Input* from assessments of mass wasting, prevention of sedimentation from road and skid trails, and stream sediment monitoring. • MRC will determine *Change in Storage* through field surveys documenting quantities of stored sediments. We will calibrate the observations to the stream monitoring reaches that have longitudinal and cross-section profiles surveyed. Our intent is to use changes within longitudinal, cross-section profiles, and installed bank pins to assess changes in sediment storage. • MRC will determine *Sediment Output* from *Sediment Input* and *Change of Storage*, as well as observations of suspended sediment. We will only collect output information in a few of the focus watersheds and within limited timeframes. Our intent is to improve the accuracy of the sediment budget.
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if we are not meeting our

Validation Monitoring	
Focus Watersheds: Sediment Budget	
	targets for sediment prevention. • MRC may decide, based on the causes of deviation, to alter conservation measures related to sediment inputs.

Long term channel monitoring: stream sediment

Validity Monitoring	
Long Term Channel Monitoring: Stream Sediment	
PROGRAM CODE	M§13.5.4.1-2
HYPOTHESIS SECTIONS 8.3.3.1, 8.3.3.2 AND 8.3.3.3	• Conservation measures for mass wasting, roads, skid trails, and landings will measurably improve instream habitat for covered aquatic species.
MONITORING APPROACH	• MRC will monitor 60 or more long-term channel monitoring segments at least once every 6 years using longitudinal profiles, cross sections, stream bed size distribution, V* observations, and gravel permeability observations; the channel monitoring segments will be identical to those in which LWD observations are made.
MEASUREMENT CRITERIA	**Longitudinal Profiles** • MRC, working upstream, will survey the stream elevation at the thalweg along the stream segment (Appendix G, section G.3.4, *Module: stream channel condition*). The following, all sensitive to sediment inputs, can be interpreted from the longitudinal profile: ▪ Changes in residual-pool depth. ▪ Proportion of riffle and pool habitat by length. ▪ Elevation fluctuations of the stream bed. ▪ Density of habitat-providing pools. **Cross Sections and Stream Bed Size Distribution** • MRC will mark with a permanent monument, within the long-term channel monitoring segment, the location for cross-section surveys and record this in the longitudinal profile survey. We will place the cross sections along relatively straight reaches of channel on riffles. Approximately 3-5 cross-section profiles will be taken along each monitoring segment. • MRC will establish rebar pins at both ends of the cross section—well above the flood-prone channel—to mark the cross section location. We will measure the elevation and the distance from the left bank pin at least every 5 ft or at any topographic changes visually apparent along the cross section. • MRC will identify the bankfull channel in the survey. At each cross section, we will characterize the size distribution of stream bed particles by a pebble count (Appendix G, section G.3.4, *Module: stream channel condition*). • Cross-section surveys provide information on stream channel response to sediment. Comparison between subsequent years provides information on changes to channel form. MRC will gather indications of sediment supply

Validity Monitoring	
Long Term Channel Monitoring: Stream Sediment	
	and stream channel response from ▪ Changes in bed elevation. ▪ Width-to-depth ratio of the stream channel. ▪ Size distribution of the stream bed. When combined with a longitudinal profile, the cross-section profiles give management insight into changes in habitat conditions within long-term channel monitoring segments. **Gravel Permeability** • MRC will take a total of 26 permeability measurements in each monitoring segment at a depth of 25 cm to assess the quality of habitat for spawning and survival of anadromous salmonid. Refer to Appendix H, H.3.1, *Determining adequate sample size*. **V*[8] Observations** • MRC will take V* observations in pools within the long term channel monitoring segment. The V* observations will follow the methods outlined in Hilton and Lisle (1993).
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if we are not meeting our targets for sediment prevention. • MRC may decide, based on the causes of deviation, to alter conservation measures related to sediment inputs.

Focus watershed studies: stream sediment

Validation Monitoring	
Focus Watersheds: Stream Sediment	
PROGRAM CODE	M§13.5.4.1-3
HYPOTHESIS SECTIONS 8.3.3.1, 8.3.3.2 AND 8.3.3.3	• Conservation measures for mass wasting, roads, skid trails, and landings will measurably reduce sediment amounts affecting instream habitat for covered aquatic species as compared with sediment amounts from baseline instream sediment measurements.
MONITORING APPROACH	• MRC will determine ▪ Stream channel response to stream sediments with longitudinal profiles, residual pool depths, cross sections, stream bed size distribution, V* observations, gravel permeability observations, bank erosion observations, and bulk gravel samples in multiple stream monitoring reaches covering a distribution of stream channel types (morphologies, gradients, location within network). **NOTE** MRC will make their observations in 3 to 5-year intervals per decade within the same channel segments used for observations of riparian function.

[8] The objective of V* is to track sediment transport, represented by the portion of pool filled with fine sediments.

Validation Monitoring	
Focus Watersheds: Stream Sediment	
	▪ Turbidity, suspended sediment, and stream-flow for interpretation of annual loads, discrete sediment, and turbidity events.
MEASUREMENT CRITERIA	• MRC will track the timing and extent of upslope or AMZ forest management to compare with monitored stream sediment observations. **Channel Monitoring** • MRC will conduct longitudinal profiles, residual pool depths, cross sections, stream bed size distribution, V* observations, gravel permeability observations, and bulk gravel samples in 5-7 stream-monitoring segments covering a distribution of stream channel types (morphologies, gradients, and location within network). • MRC will initially select the stream monitoring segments by stratified random sampling based on proportion desired within target stream channel types. The segments, identical to those monitored in riparian function, will be at least 20-30 bankfull widths in length. • MRC will measure longitudinal profiles, cross sections, stream bed size distribution, V* observations, gravel permeability observations, and bulk gravel samples in the stream channel-monitoring segments twice during 3-5 year time blocks per decade— specifically, during the first year and last year of a time block. Methods will be the same as the long term channel monitoring discussed previously, with the addition of bulk gravel sampling. • MRC will install bank erosion pins in varying cross sections, within the channel monitoring segments in focus watersheds, with varying vegetation or silvicultural treatments, bank exposure (height and cover), root depth, and shear stress. This will allow us to observe the level of sediment contribution from bank erosion and the effectiveness of MRC conservation measures for bank stability. **Suspended sediment and turbidity** • MRC will install and maintain, at or near the outlet of South Fork Albion and Little North Fork Navarro watersheds, an automated sampling station for turbidity and suspended sediment. • MRC will use collected data to generate accurate estimates of annual suspended sediment load, as well as turbidity duration and stream flow relationships. NOTE ▪ MRC will collect data at the continuous stations with programmable data loggers, pressure transducers, continuous turbidity meters, and automated pump samplers, operated by battery or solar panels. ▪ MRC will augment this data with frequent manual sediment samples and manual discharge measurements. ▪ MRC will correlate continuous stage data to manual discharge measurements made at different points along the hydrograph. ▪ MRC expects that, given a good correlation between turbidity and suspended sediment, over time sampling for suspended sediment will become unnecessary to establish a rating curve for suspended sediment to turbidity. ▪ MRC will install staff plates and continuous turbidity meters and periodically collect grab samples at major tributaries during storm events to measure changes in turbidity and suspended sediment due to changes in land management (roads, skid trails, etc.).

Validation Monitoring	
Focus Watersheds: Stream Sediment	
	• MRC will conduct continuous, automated sampling for turbidity and manual sampling for suspended sediment and discharge in the Cottaneva Creek focus watershed. • MRC will install a staff plate in the same location as the continuous turbidity samplers. **NOTE** ▪ MRC will periodically collect grab samples at continuous stream flow stations during storm events to measure turbidity and suspended sediment. ▪ MRC will also periodically collect grab samples at major tributaries during storm events to measure turbidity and suspended sediment. ▪ MRC will depend heavily on available resources for our sampling effort in the watersheds. If sampling is infrequent, detailed analysis of data may be limited; however, comparisons with data from nearby automated sampling stations may provide supplementary information. Our goal is to observe long-term trends in discrete suspended sediment loads. • MRC will allow the North Coast Regional Water Quality Control Board and the wildlife agencies to conduct turbidity, suspended sediment, and stream flow observations in the Noyo River and Big River and will assist with monitoring of these stations, if time permits.
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if sediment observations do not show a trend toward reduced suspended sediment and turbidity as well as increased stream channel complexity, pool depths, V*, fine sediment percentage, and permeability. • MRC may decide, based on the causes of deviation, to alter conservation measures related to sediment inputs.

13.5.5 Water drafting

13.5.5.1 Effectiveness monitoring

Effectiveness Monitoring	
Water Drafting	
PROGRAM CODE	M§13.5.5.1-1
OBJECTIVE O§8.4.1-3	• Maintain equivalent temperatures downstream and upstream and limit the reduction of the wetted width of the 1st downstream riffle as well as pool volume.
MONITORING APPROACH	• MRC will monitor annually a percentage of active water drafting sites to determine their adherence to the guidelines in the *Master Agreement for Timber Operations* (Appendix T) and their impacts to aquatic habitat. • MRC will monitor, during the entire drafting period and according to plans approved by the wildlife agencies, stream stage and stream temperature with continuous data-loggers. • MRC will conduct, as necessary, periodic measurements of residual pool depth, channel dimensions, and stream flow within any area impacted by water drafting, along with nearby control areas.
MEASUREMENT CRITERIA	• MRC will use digital recorders and flow meters to measure temperature,

Effectiveness Monitoring	
Water Drafting	
	riffle crest, residual pool depths, channel dimensions, and flow in order to assess aquatic habitat. • MRC will review monitoring reports on water drafting compliance for supplemental data (Appendix D, section D.2.11, *Water drafting*).
ADAPTIVE MANAGEMENT	• MRC will review the water drafting guidelines of MATO with the wildlife agencies every 4 years, as well as at Years 30 and 70 of HCP/NCCP implementation, to determine if we are meeting our objectives on schedule. • MRC will investigate to determine causes if we fail to meet our targets for suitable aquatic habitat adjacent to water drafting sites. • MRC may decommission water drafting sites or adjust their intake rates, if we do not meet our targets for aquatic habitat adjacent to water drafting sites.

13.5.5.2 Validation monitoring

Validation Monitoring	
Water Drafting	
PROGRAM CODE	M§13.5.5.2-1
HYPOTHESIS SECTION 8.2.2	• Aquatic organisms will respond to moderations in drafting rates, i.e., increases in residual water depths and decreases in water temperatures.
MONITORING APPROACH	• MRC will evaluate, within each focus watershed, drafting operations, aquatic habitat conditions, and condition of aquatic species (e.g., density and condition indices) to determine impacts to sensitive aquatic plants and animals.
MEASUREMENT CRITERIA	• MRC will determine response variation of salmonids, amphibians, rare plants, and benthic macroinvertebrates to treatment and controls.
ADAPTIVE MANAGEMENT	• MRC will investigate to determine causes if there are no improvements in the conditions of aquatic species. • MRC may adjust the water drafting guidelines in the *Master Agreement for Timber Operations* (Appendix T).

13.6 Monitoring covered aquatic species

13.6.1 Anadromous salmonid monitoring

MRC will update information on the presence of anadromous salmonids using annual spot checks in large basins. We will conduct more extensive distribution surveys throughout each watershed in 3-year cycles and collect annual estimates of the number of out-migrating salmon, particularly coho salmon. MRC will also survey Chinook Salmon Monitoring Reaches (CSMR) annually to evaluate the status of the species and the effectiveness of HCP/NCCP conservation measures.

The state and federal governments are working on a regional salmonid monitoring program in core areas which will overlap the MRC plan area. As more information becomes available, MRC and the wildlife agencies will evaluate both programs for compatibility and commonality. If we can mesh our monitoring program with the agencies' program without exceeding our anticipated monitoring costs for our HCP/NCCP or diminishing the plan's effectiveness, we may do so.

13.6.1.1 Effectiveness monitoring

Presence of anadromous salmonid in ASMB

Each year, MRC will conduct surveys for anadromous salmonid presence in our Annual Salmonid Monitoring Basins (ASMB). We selected basins in which we own all or most of the land to ensure that results reflect our own practices as opposed to activities outside our control. Using these criteria, we identified the following as ASMB:

- Hollow Tree Creek.
- Cottaneva Creek.
- Hardy Creek.
- Juan Creek.
- Howard Creek.
- North Fork Noyo River.
- Big River (above South Fork Big River).
- South Fork Big River.
- Albion River.
- South Fork Albion River.
- North Branch North Fork Navarro River.
- South Branch North Fork Navarro River.
- Greenwood Creek.
- Elk Creek.
- Mallo Pass Creek.
- Alder Creek.
- South Fork Garcia River.
- Ackerman Creek.

We may conduct surveys in main-stem segments or in tributaries of these basins.

A species is considered *present* in a watershed if it is detected at least once during 3 consecutive annual surveys. We selected a 3-year time period to recognize the distinct cohorts of coho salmon that result from its life cycle. That life cycle ideally might proceed as follows: (1) eggs in stream gravel (September–December); (2) alevin in stream gravel (January–June); (3) fry in fresh water (few months to 2 years). If MRC does not detect coho salmon, for example, in years 2010 and 2011 but does observe them in 2012, we will consider coho salmon *present* at the site for the time survey period of 2010-2012.

MRC surveyed all of the watersheds on our land during 2000-2002; the previous landowner surveyed these same sites from 1994-1996. This provides 2 monitoring cycles to serve as baseline data on species diversity and distribution within each watershed. Baseline data indicates that coho salmon are present in 10 of the monitored drainage basins: Hollow Tree Creek, Cottaneva Creek, North Fork Noyo River, Big River (upstream of South Fork Big River), South Fork Big River, Albion River (upstream of South Fork Albion River), South Fork Albion River, North Branch North Fork Navarro River, South Branch North Fork Navarro River, and South Fork Garcia River. Steelhead are present in all 18 drainage basins identified for annual monitoring.

Chinook salmon migrate to sea during their first year of life—typically within 3 months of emergence from spawning gravels—and spend most of their lives in coastal ocean waters (Healy 1991, Mills et al 1997, Moyle et al 1989). Due to their rapid migration after emergence from spawning gravels, we suspect that Chinook salmon are less sensitive than coho salmon to timber management. Monitoring their presence, however, can be difficult. The life cycles of coho salmon are easier to monitor. As a result, the status of coho salmon provides a more convenient

metric to evaluate the over-all effectiveness of MRC conservation measures on salmonid habitat. Nevertheless, Chinook salmon is a covered species in our HCP/NCCP and its habitat needs differ from the other covered salmonids. Therefore, MRC will monitor the status of Chinook salmon in the Chinook Salmon Monitoring Reaches (CSMR).

Effectiveness Monitoring	
Anadromous Salmonid Presence: Annual Salmonid Monitoring Basins (ASMB)	
PROGRAM CODE	M§13.6.1.1-1
OBJECTIVE O§10.2.1.2-1	• Maintain covered salmonids within major drainage basins. ▪ Maintain steelhead in 100% of the ASMB where baseline data and new surveys indicate their presence. ▪ Maintain coho salmon in 100% of ASMB, where baseline data and new surveys indicate their presence.
MONITORING APPROACH	• MRC will assess anadromous salmonid presence annually within the 18 major drainage basins identified.
MEASUREMENT CRITERIA	• MRC considers anadromous salmonid species *present* if we detect them once during 3 annual consecutive surveys in an ASMB. • MRC will conclude that a basin is supporting new fish species not present in previous surveys if we detect them on 2 or more occasions in a continuous 6-year time period. • MRC will use snorkeling or single-pass electro-fishing to determine if anadromous salmonid species are present; a survey site will consist of at least 20 pools within each major drainage basin identified. • MRC will consider the survey complete, if we detect coho and steelhead before sampling 20 pools. • MRC will collect data on "catch per unit effort" and correlate the time for first detection with fish abundance.
ADAPTIVE MANAGEMENT	• MRC will examine the probable causes of deviation including formation of temporary barriers to fish passage, low discharge, status of regional trends, and physical habitat data. • MRC will meet and confer with the wildlife agencies regarding possible solutions and adjustments to conservation measures, such as remediation of barriers.

Anadromous salmonid distribution

Surveys for anadromous salmonid distribution will take place over a 3-year time period. In the first year of the survey, MRC will visit approximately 450 sites across our watersheds to examine the extent and distribution of juvenile anadromous salmonids. In the second and third years, we will sample all sites in which a species was known to be historically present, but remains undetected. If, during a 3-year time period, MRC does not observe a species known to be present from baseline data, we will consider it absent for survey statistics.

Effectiveness Monitoring	
Anadromous Salmonid Distribution	
PROGRAM CODE	M§13.6.1.1-2
OBJECTIVES O§10.2.1.2-2 O§10.2.1.2-3	• Maintain steelhead in 90% of sampling sites throughout the plan area, where baseline data and new information indicates their presence. • Maintain coho salmon in 85% of sampling sites throughout the plan area, where baseline data and new information indicates their presence. **NOTE** MRC set objectives for coho salmon and steelhead distribution at less than 100% to account for natural variations in flow and temporary barriers, such as log jams, which may impede accessibility. When we detect new fish species in a sampling site, we will consider that sampling site able to support the new species only if we detect them.
MONITORING APPROACH	• MRC will assess anadromous salmonid distribution annually over a 3-year period repeating the assessment every 12 years.
MEASUREMENT CRITERIA	• MRC will visit all major watercourses with fish. • MRC will use a hierarchical framework to select the initial locations of survey sites in each stream. Major streams are divided into lower, middle, and upper reaches. Smaller streams are divided into lower and upper reaches. • MRC will survey 1 site in each reach, or 3 sites in major streams and 2 sites in smaller streams. We will add other sites directly downstream and upstream of potential migration barriers to determine which anadromous salmonid species these barriers are impacting. • MRC will use snorkeling or single-pass electrofishing to determine if aquatic species are present. A survey site will contain a minimum of 2 consecutive habitat sequences (pool-riffle sequences) and have a minimum length of 90 ft. If future research improves methods to determine the probability that a species is absent, MRC will incorporate these methods into the distribution surveys. • MRC will collect data on "catch per unit effort" (i.e., the number of fish captured per unit effort of time). • MRC will conclude that a sampling site is supporting fish species not present in previous surveys if we detect them on 2 or more occasions.
ADAPTIVE MANAGEMENT	• MRC will examine the probable causes of deviation including formation of temporary barriers to fish passage, low discharge, status of regional trends, and physical habitat data. • MRC will meet and confer with the agencies regarding possible solutions and adjustments to conservation measures, such as remediation of barriers.

Presence and relative abundance of Chinook salmon

Chinook salmon were historically present or are currently present in the following watersheds within the plan area:

- Hollow Tree Creek.
- North Fork Noyo River.
- Big River.
- Albion River.
- Garcia River.

Moreover, MRC believes that some streams are potential habitat for Chinook salmon. These potential streams are

- Cottaneva Creek.
- South Fork Big River.
- North Fork Navarro River.
- South Fork Albion River.
- Elk Creek.

MRC will identify 1 Chinook Salmon Monitoring Reach (CSMR) in each of the streams listed above, for a total of 10 CSMRs. By locating CSMRs in streams with historical evidence of Chinook salmon presence as well as in streams with no observations at all, MRC hopes to observe expansions in Chinook distribution and relative abundance over time as conditions for freshwater habitat improve.

MRC has identified 2 streams where we have encountered Chinook salmon most often during monitoring: Hollow Tree Creek and North Fork Noyo River. Every year, we will monitor 1 CSMR in Hollow Tree Creek and 1 in North Fork Noyo River for the presence and relative abundance of juvenile Chinook salmon. We will also randomly select 2 other CSMRs to monitor every year. This amounts to a total of 4 CSMR surveys per year, rotating through all the CSMRs roughly every 4 years. If MRC determines that Chinook salmon are occupying a CRMS for 2 consecutive monitoring cycles, we will survey that CSMR annually from that point forward.

MRC will monitor the habitat elements of Chinook salmon by selectively locating new Long Term Channel Monitoring (LTCM) segments within areas frequented by Chinook. Several other monitoring programs, such as those for stream temperature, sediment, and LWD, will also indirectly asses the quantity and quality of habitat available to Chinook salmon.

Effectiveness Monitoring	
Chinook Salmon Monitoring Reaches (CSMR)	
PROGRAM CODE	M§13.6.1.1-3
OBJECTIVE OS10.2.1.2-4	• Maintain Chinook salmon in the Chinook Salmon Monitoring Reaches (CSMR) currently identified for annual monitoring: Hollow Tree Creek and North Fork Noyo River (see *HCP/NCCP Atlas*, MAPS 3A-3C).
MONITORING APPROACH	• MRC will assess the presence and relative abundance of Chinook salmon juveniles annually within the 2 CSMRs most frequented by Chinook salmon, i.e., Hollow Tree Creek and North Fork Noyo River. • MRC will establish 8 additional CSMRs in streams which are currently unoccupied by Chinook salmon or which Chinook salmon may have occupied in the past, i.e., Cottaneva Creek, Big River, South Fork Big River, Albion River, South Fork Albion River, North Fork Navarro River, Elk Creek, and Garcia River. • MRC will randomly select 2 CSMRs from the list above to survey annually, in addition to Hollow Tree Creek and North Fork Noyo River. • MRC will survey a total of 4 CSMRs each year, rotating through all CSMRs every 4 years. • MRC will use snorkel surveys within each CSMR in early spring when juveniles are most likely to be present. • MRC will collect data on the relative abundance of Chinook salmon juveniles within each CSMR by surveying the same reaches over time.

Effectiveness Monitoring	
Chinook Salmon Monitoring Reaches (CSMR)	
	• MRC will monitor a CSMR annually, if we detect Chinook salmon there during 2 consecutive monitoring cycles. • MRC will ensure that each CSMR is similar in size (0.5 to 1.0 mi. long) and choose its location based on suitable habitat as well as accessibility and proximity to major landmarks.
MEASUREMENT CRITERIA	• MRC considers Chinook salmon *present* if we detect them once during 5 annual consecutive surveys in a CSMR. **NOTE** MRC selected a 5-year time period to determine *presence* in order to account for the lifespan of most fall-run Chinook salmon. The 5-year time period also provides MRC some flexibility in addressing the episodic nature of the species occurrence within the plan area. • MRC will collect data on the number of juveniles observed within the entire extent of a CSMR from at least 2 independent surveys per year. • MRC surveyors will snorkel the same CSMR and collect independent estimates of the number of juveniles observed on the same day; we will derive a mean number of fish observed from all surveys to represent the relative abundance for each CSMR in a given year. • MRC surveyors will target the best habitats when the width of a channel is too large to observe the entire wetted width. • MRC surveyors will embark on a survey at least 15 minutes apart and each surveyor will wait until another surveyor has departed a habitat unit (pool, riffle, glide, etc.) before entering it.
ADAPTIVE MANAGEMENT	• MRC will examine the probable causes of deviation including ▪ Formation of temporary barriers to fish passage. ▪ Low discharge. ▪ Status of regional trend. ▪ Physical habitat data. • MRC will meet and confer with the wildlife agencies about possible solutions and adjustments to conservation measures, such as remediation of fish barriers.

13.6.1.2 Validation monitoring

Smolt abundance

Out-migrating juvenile coho salmon and steelhead (smolts) are a preferred life stage to monitor since they have resided in a freshwater environment for at least 1 year and have been exposed to seasonal variation in habitat quality and availability.

The number of adult salmon who return to their natal streams to spawn is important in determining the abundance of smolts within a watershed. Salmon generally spend at least half their lives residing in the ocean; MRC has little or no control over the number of adults who return to spawn. Upon their return, however, the condition of their freshwater aquatic habitat largely determines the number of salmon eggs that will survive to become smolts. We hypothesize that the number of smolts will increase over time as freshwater habitat conditions improve. Testing of this hypothesis will occur in the focus watersheds where we will closely monitor both smolt abundance and habitat conditions.

MRC will not extrapolate data collected in the focal watersheds on smolt abundance and habitat conditions to other watersheds without agreement from the wildlife agencies that such extrapolation is appropriate. We will use information on smolt abundance to monitor trends in out-migrating smolts. With this trend data, we can make comparisons to measurements of suspended sediment or turbidity collected in these focus watersheds or to habitat conditions. In addition, we can use the data for controlled before-and-after experiments to assess the effectiveness of various land management applications.

Validation Monitoring	
Smolt Abundance	
PROGRAM CODE	M§13.6.1.2-1
HYPOTHESIS SECTIONS 4.2.9 AND 4.4.9	• Abundance of juvenile anadromous salmonid will increase as habitat conditions improve over time.
MONITORING APPROACH	• MRC will estimate abundance of out-migrating smolts during the late winter and spring within 2 focus watersheds—South Fork Albion River and Little North Fork Navarro River. • MRC will monitor instream habitat conditions over time to allow for comparison between habitat quality and smolt abundance.
MEASUREMENT CRITERIA	• MRC will estimate smolt abundance using out-migrant traps to capture juvenile coho salmon and steelhead. • MRC will install out-migrant traps as soon as stream discharge allows and remove them when the out-migration of coho salmon smolts subsides in late spring and none have been captured within a week. • MRC will operate out-migrant traps on an annual basis, rotating between 2 focus watersheds every 3 years; we may consider expanding these efforts into the other focus watersheds, depending on available resources. • MRC will collect information on the timing of smolt out-migration; smolt size; fish conditions, e.g., length-to-weight relationships; and community structure of juvenile anadromous salmonids. • MRC will use DARR software[9] to analyze trap efficiency and coho salmon smolt abundance. • MRC will monitor habitat conditions (Appendix G, G.3.5, *Module: fish habitat*).
ADAPTIVE MANAGEMENT AND MONITORING	• MRC will examine the relationship between the status of instream habitat conditions and the abundance of coho salmon smolts. • MRC will evaluate probable causes, if the abundance of coho salmon smolts significantly declines while habitat conditions are improving, and confer with the wildlife agencies about possible solutions • MRC may initiate escapement estimates to assist in evaluating habitat performance.

[9] Darroch Analysis with Rank-Reduction (DARR) is a method for estimating abundance of smolts from outmigrant trap data (Bjorkstedt 2005).

13.6.2 Red-legged frog monitoring (California and northern)

Currently, the documented distribution of this sub-species is incomplete throughout the plan area. Surveys will provide a better understanding of that distribution. Refer to Appendix N (section N.2.4, *Surveying potential breeding sites*) for a description of the survey method.

Red-legged frogs may not use the same breeding site each season, especially when there are several documented breeding sites within close proximity to one another. The species uses certain sites in a given season and different sites in other seasons; this is most likely due to the amount of potential breeding habitat available. Because of this variability, MRC assigned each potential or documented breeding site to a Red-Legged Frog Management Unit (RLFMU).

MRC designated RLFMUs based on our own data, which showed that most variation in breeding site use occurred when sites were within 1000 ft of each other. Therefore, all sites within 1000 ft of each other are combined into 1 RLFMU. As of 2009, the number of documented or potential breeding sites in each RLFMU ranges from 1 to 9.

13.6.2.1 Effectiveness monitoring

Baseline distribution and habitat quality of RLF breeding sites

Effectiveness Monitoring	
Baseline Distribution and Habitat Quality of Red-legged Frog Breeding Sites	
PROGRAM CODE	M§13.6.2.1-1
OBJECTIVES O§10.2.2.2-1 O§10.2.2.2-3	• Establish the baseline distribution of both potential and documented red-legged frog breeding sites by Year 2 of HCP/NCCP implementation. • Maintain habitat quality (e.g., maximum depth and surface area) at 90% of potential breeding sites identified during distribution surveys, including water drafting sites.
MONITORING APPROACH	• MRC will make an effort to identify and survey the majority of the potential red-legged frog breeding habitat within the initial 2 years of the plan. • MRC will survey at least 1 CalWater planning watershed within all of its inventory blocks every year during the initial distribution study; collecting data across a wide geographic range will minimize the potential influence of annual variation in weather patterns. • MRC will survey all CalWater planning watersheds where MRC owns land within the first 2 years of our HCP/NCCP implementation. • MRC will determine, within the first 2 years of our HCP/NCCP, which potential habitats red-legged frogs are using for reproductive purposes; a documented breeding site has embryonic (egg mass) or larval (tadpole) life stages. • MRC will measure habitat attributes including maximum depth and surface area of the lentic habitat.

Occupancy of red-legged frogs in documented breeding sites

Effectiveness Monitoring	
Occupancy of Red-Legged Frogs in Documented Breeding Sites	
PROGRAM CODE	M§13.6.2.1-2
OBJECTIVE O§10.2.2.2-2	• Maintain red-legged frogs in 100% of the red-legged frog management units (RLFMUs) where baseline surveys and new surveys indicate their presence.
MONITORING APPROACH	• MRC will monitor all documented breeding sites on an annual basis for actual use by red-legged frogs.
MEASUREMENT CRITERIA	• MRC will consider that an RLFMU supports red-legged frog populations if one or more documented breeding sites within the RLFMU remains occupied. • MRC will conclude that red-legged frogs are occupying a documented breeding site if we detect them breeding at least once during 3 years of consecutive surveys.
ADAPTIVE MANAGEMENT	• MRC will consider any reduction in the number of CalWater planning watersheds with active breeding sites or any reduction in the number of RLFMUs as *significant*. • MRC will determine the reasons for the reduction in the number of RLFMUs, chart the appropriate action with the wildlife agencies, and possibly create additional habitat in strategic locations or adjust conservation measures.

Habitat quality and species present within RLF breeding sites

Effectiveness Monitoring	
Re-evaluate Habitat Quality and Species Presence within RLF Breeding Sites	
PROGRAM CODE	M§13.6.2.1-3
OBJECTIVE O§10.2.2.2-3	• Maintain habitat quality (e.g., maximum depth and surface area) at 90% of potential breeding sites identified during distribution surveys, including water drafting sites.
MONITORING APPROACH	• MRC will re-examine every 5 years all potential and documented breeding habitat identified during the initial study. • MRC will conduct re-examinations to monitor for changes in the maximum depth or surface area of the habitat present. • MRC will conduct surveys (Appendix N, section N.2.4, *Surveying potential breeding sites*) to determine if red-legged frogs are using potential habitats and expanding in range.
MEASUREMENT CRITERIA	• MRC will document a breeding site and monitor it annually if we observe evidence of red-legged frog reproduction (i.e., egg masses of larvae present). • MRC will conclude that habitat quality has been maintained (on a site specific basis) if at least 75% of the maximum depth of a feature is maintained and at least 75% of the total surface area remains lentic habitat.
ADAPTIVE MANAGEMENT	• MRC will consider degraded habitat at more than 10% of potential

Effectiveness Monitoring	
Re-evaluate Habitat Quality and Species Presence within RLF Breeding Sites	
	breeding habitat sites as *significant*. We will construct new habitat at a one-to-one ratio if there is a loss of potential breeding habitat or enhance existing habitat to meet habitat objectives. For example, we may dig a site with a hand shovel or making an existing site larger.

13.6.3 Coastal tailed frog monitoring

Current knowledge of the distribution of coastal tailed frogs throughout the plan area is incomplete. For this reason, MRC is completing a baseline assessment of coastal tailed frog distribution. Appendix N (section N.6.1, *Monitoring distribution of coastal tailed frogs*) describes our survey methods.

MRC will monitor all occupied streams, identified during baseline distribution surveys or new surveys as well as streams pinpointed from incidental observations, on average once every 7-8 years throughout the term of our HCP/NCCP permit. Monitoring will focus on determining (1) whether coastal tailed frogs remain present in occupied sites and (2) the relative abundance of coastal tailed frogs at occupied sites. Over time, information on the occupancy and relative abundance of coastal tailed frogs throughout all occupied streams in the plan area should provide sufficient data for effectiveness monitoring. In any given year, MRC will monitor at least 10 streams for occupancy and relative abundance. We will cycle through about 13% of occupied sites per year.

13.6.3.1 Effectiveness monitoring

Baseline distribution of coastal tailed frogs

Effectiveness Monitoring	
Baseline Distribution of Coastal Tailed Frogs	
PROGRAM CODE	M§13.6.3.1-1
OBJECTIVE O§10.2.3.2-1	• Establish the baseline distribution of larval coastal tailed frogs by Year 2 of HCP/NCCP implementation.
MONITORING APPROACH	• MRC will survey at least 1 CalWater planning watershed within all of its inventory blocks every year during the initial distribution study; collecting data across a wide geographic range will minimize the potential influence of annual variation in weather patterns. Each CalWater planning watershed will have a minimum of 10 survey sites. The survey sites will be in different watercourses. We will survey all CalWater planning watersheds where MRC owns at least 25% of the acreage by Year 2 of our HCP/NCCP implementation. • MRC will perform a 30-minute time constrained search (TCS) in each of the streams selected for survey. Two persons will walk the selected stream in an upstream direction, searching all potential habitats; they will expend their greatest effort in the best habitats. Searches consist of looking for larvae attached to rocks on the stream bottom, turning over movable rocks while holding a dip net downstream to catch dislodged frogs, and using a glass-bottomed viewing box to search the stream channel. The search crew will record the amount of time spent before locating a frog.

Effectiveness Monitoring	
Baseline Distribution of Coastal Tailed Frogs	
MEASUREMENT CRITERIA	• MRC will consider coastal tailed frogs to be present if larval life stages are present within a survey location. • MRC will conduct distribution surveys during the most appropriate season (May to August) before larvae metamorphose and leave the stream environment.

Distribution and relative abundance of coastal tailed frogs
All occupied streams identified during baseline distribution surveys, new surveys, or incidental observations will be monitored once every 7-8 years (on average) throughout the permit term. Monitoring will focus on determining (1) whether coastal tailed frogs continue to remain present in occupied sites and (2) the relative abundance of coastal tailed frogs at occupied sites.

Effectiveness Monitoring	
Distribution and Relative Abundance of Coastal Tailed Frogs	
PROGRAM CODE	M§13.6.3.1-2
OBJECTIVE O§10.2.3.2-2	• Maintain larval coastal tailed frogs in 95% of sites where the baseline distribution survey, new surveys, or incidental observations indicate their presence. **NOTE** MRC set the distribution objective at less than 100% to account for sampling error.
MONITORING APPROACH	• MRC will determine presence or probable absence with a 60-minute time constrained search (TCS) in each of the sites where we detected coastal tailed frogs during baseline or new surveys. Two persons will walk the selected stream in an upstream direction, searching all potential habitats; they will expend their greatest effort in the best habitats. Searches consist of looking for larvae attached to rocks on the stream bottom, turning over movable rocks while holding a dip net downstream to catch dislodged frogs, and using a glass-bottomed viewing box to search the stream channel. The search crew will record the amount of time spent before locating a frog. • MRC will conduct surveys from May to August before larvae metamorphose and leave the stream environment. • MRC will re-examine the distribution of coastal tailed frogs by conducting presence or probable absence surveys at all occupied sites identified through baseline surveys, new surveys, or incidental observations. • MRC will survey 10 streams per year, randomly rotating through all of the occupied streams within the plan area, on average, every 8 years. • MRC will collect relative abundance estimates at each monitoring site where we have confirmed the presence of coast tailed frogs (Appendix N, section N.6.2, *Monitoring relative abundance of coastal tailed frogs*).
MEASUREMENT CRITERIA	• MRC will consider coastal tailed frogs to be present if there is evidence of larval life stages within a survey location. • MRC will posit a decline in the abundance of coastal tailed frogs if, after 3 survey cycles, the proportion of sites with demonstrable declines exceeds the sites with demonstrable increases.

Effectiveness Monitoring	
Distribution and Relative Abundance of Coastal Tailed Frogs	
ADAPTIVE MANAGEMENT	• MRC will consider altering AMZ conservation measures or increasing AMZ protections if (1) there is a 5% reduction in the number of sites occupied by coastal tailed frogs or (2) relative abundance has declined.

13.7 Overview of Terrestrial Monitoring

MRC will implement our terrestrial effectiveness and validation monitoring through the programs outlined in Table 13-16. These programs evaluate populations of terrestrial species in the plan area, as well as habitat and habitat components directly related to terrestrial species. Timber inventory provides feedback for some of these monitoring programs (see Appendix U, section U.7, *Structure Classes and Habitat Inferences).*

Successful completion of the terrestrial surveys may depend upon annual MRC harvests (see section 13.2.2.7 and Table 13-7).

Table 13-16 Terrestrial Effectiveness and Validation Monitoring Programs

Terrestrial Effectiveness and Validation Monitoring Programs		
Monitoring Program Description	**Monitoring Code**	**Timing**
Snags, Wildlife Trees, Recruitment Trees, and Downed Wood	M§13.8.1-1	▪ Sample annually. ▪ Tabulate and compare results from inventory every 10 years.
Basal Area of Hardwoods in Timber Stands	M§13.8.1-2	▪ Report annually.
Post-Harvest Follow-up on Hardwood Representative Sample Areas	M§13.8.1-3	▪ Sample when harvest occurs in these areas. ▪ Report annually.
Acreage and Number of Hardwood Representative Sample Areas	M§13.8.1-4	▪ Visit and assess over a 10-year period; report every 10 years.
Acreage and Number of Old Growth Stands and Trees	M§13.8.1-5	• Visit and assess over a 10-year period; report every 10 years. • Report annually on individual old growth trees
Distribution and Area of Rocky Outcrops	M§13.8.1-6	• Visit and assess over a 10-year period; report every 10 years.
Common Natural Communities	M§13.8.2-1	• Compile and report every 5 years.
Uncommon Natural Communities	M§13.8.2-2	• Compile and report every 5 years.
Invasive Species Control	M§13.8.3-1	• Report annually.

Terrestrial Effectiveness and Validation Monitoring Programs		
Monitoring Program Description	**Monitoring Code**	**Timing**
Northern Spotted Owls: Level-1 and Level-2 Territories	M§13.9.1.3-1	• Complete and report annually.
Northern Spotted Owls: Distribution and Acreage of Nesting/Roosting Habitat	M§13.9.1.3-2	• Report every 10 years.
Population Trends of Northern Spotted Owls	M§13.9.1.4-1	• Complete and report every 5 years. • Report annually and ensure 1/5 of covered lands have been surveyed.
Identification of Nesting/Roosting Habitat for Northern Spotted Owls	M§13.9.1.4-2	• Survey at least 100 nest sites of individual spotted owl territories; initial survey was completed in 2007. • Survey at least 100 nest sites of individual spotted owls starting 40 years after plan initiation; estimate that the effort will take 8 years. • Optional
Benefits of High Protection for Northern Spotted Owls and Their Territories	M§13.9.1.4-3	• Complete annually. • Report every 5 years. • Optional
Effect of Harvest within 1000 ft of NSO Territories with Limited Protection	M§13.9.1.4-4	• Complete. • Report every 5 years
Effect of Habitat on Productivity of Northern Spotted Owls	M§13.9.1.4-5	• Complete annually. • Report every 5 years. • Optional
Effect of Hardwood Density on Northern Spotted Owls	M§13.9.1.4-6	• Complete annually. • Report every 5 years.
Effect of Barred Owl Control on Northern Spotted Owls	M§13.9.1.4-7	• Complete annually until wildlife agencies and MRC decide to terminate. • Report annually.
Activity Level of Marbled Murrelets in Lower Alder Creek	M§13.9.2.1-1	• Complete and report annually.
Murrelet Occupancy in Navarro, Greenwood Creek, Albion River Watersheds	M§13.9.2.1-2	• Complete and report annually.

Terrestrial Effectiveness and Validation Monitoring Programs		
Monitoring Program Description	**Monitoring Code**	**Timing**
Murrelet Habitat Distribution in LACMA	M§13.9.2.2-1	• Complete within the first 20 years of the plan. • Optional
Methods for Accelerating Growth of Murrelet Habitat	M§13.9.2.2-2	• No timeline • Optional
Radar Monitoring in Additional Drainages	M§13.9.2.2-3	• Rotate monitoring between 10 drainages on a 5 year basis. • Optional
Spatial Extent of Known Burrow Systems of Point Arena Mountain Beaver	M§13.9.3.1-1	• Complete surveys over 5 years. • Report every 5 years.
Creating Habitat with Timber Harvest within Dispersal Distance of Existing Burrow Systems	M§13.9.3.1-2	• Complete visits 2 years following harvest. • Document spatial extent when burrows discovered. • Report every 5 years
Defining Habitat for Point Arena Mountain Beavers	M§13.9.3.2-1	• Complete habitat surveys over 5 years along with surveys for spatial extent. • Report every 5 years. • Optional
Creating Potential Habitat in or Adjacent to Existing PAMB Burrow Systems	M§13.9.3.2-2	• No timeline • Optional
Status and Trend of Covered Rare Plant Species	M§13.10.3-1	• Complete baseline surveys within 5 years of implementation. • Sample every 10 years thereafter. • Report within year following sampling.

The terrestrial monitoring programs separate species, habitat, and natural communities. Although wildlife trees, hardwoods, downed wood, and old-growth may be important habitat components for both northern spotted owls and marbled murrelets, MRC will monitor them in separate programs. While wildlife trees, hardwoods, downed wood, and old-growth are all parts of natural communities, MRC will monitor them in separate programs as well. Each monitoring program relates directly to a conservation strategy for a specific species, habitat type, or habitat feature.

For each covered species, MRC will monitor both population and habitat. Effectiveness monitoring for northern spotted owls, for example, will determine the number of Level-1 and Level-2 territories on covered lands, as well as the amount and distribution of owl habitat. In monitoring both population and habitat, MRC can examine whether conservation measures are

appropriate. Effectiveness monitoring may indicate that the number of Level-1 and Level-2 owl territories is decreasing. If the number falls below its original baseline by 20% over 2 years, MRC will implement contingency measures to attempt to correct the negative trend in northern spotted owl productivity.

13.7.1 Timeline for terrestrial monitoring

While terrestrial monitoring is constrained by personnel and financial resources, MRC will monitor Level-1 and Level-2 territories for northern spotted owls and marbled murrelet activity in LACMA every year of our HCP/NCCP. Most monitoring programs will start within the first 10 years of our HCP/NCCP. Table 13-17 provides an estimated timeline for the first 20 years of terrestrial monitoring. Monitoring programs in subsequent years of the plan will recycle through this same schedule, as appropriate.

Table 13-17 Estimated Timeline for Terrestrial Monitoring

Estimated Timeline for Terrestrial Monitoring																				
Monitoring Program	**Years Since HCP/NCCP Initiation**																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
M§13.8.1-1 Snags, Wildlife Trees, Recruitment Trees, and Downed Wood																				
M§13.8.1-2 Basal Area of Hardwoods in Timber Stands																				
M§13.8.1-3 Post-Harvest Follow-up on Hardwood Representative Sample Areas																				
M§13.8.1-4 Acreage and Number of Hardwood Representative Sample Areas																				
M§13.8.1-5 Acreage and Number of Old Growth Stands and Trees																				
M§13.8.1-6 Distribution and Area of Rocky Outcrops																				
M§13.8.2-1 Common Natural Communities																				
M§13.8.2-2 Uncommon Natural Communities																				

Estimated Timeline for Terrestrial Monitoring																				
Monitoring Program	**Years Since HCP/NCCP Initiation**																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
M§13.8.3-1 Invasive Species Control																				
M§13.9.1.3-1 Northern Spotted Owls: Level-1 and Level-2 Territories																				
M§13.9.1.3-2 Northern Spotted Owls: Distribution and Acreage of N/R Habitat																				
M§13.9.1.4-1 Population Trends of Northern Spotted Owls																				
M§13.9.1.4-2 Identification of Nesting/Roosting Habitat for Northern Spotted Owls OPTIONAL																				
M§13.9.1.4-3 Benefits of High Protection for Northern Spotted Owls and Their Territories OPTIONAL																				
M§13.9.1.4-4 Effect of Harvest within 1000 ft of NSO Territories with Limited Protection																				

Estimated Timeline for Terrestrial Monitoring																				
Monitoring Program	**Years Since HCP/NCCP Initiation**																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
M§13.9.1.4-5 Effect of Habitat on Productivity of Northern Spotted Owls OPTIONAL																				
M§13.9.1.4-6 Effect of Hardwood Density on Northern Spotted Owls																				
M§13.9.1.4-7 Effect of Barred Owl Control on Northern Spotted Owls																				
M§13.9.2.1-1 Activity Level of Marbled Murrelets in Lower Alder Creek																				
M§13.9.2.1-2 Murrelet Occupancy in Navarro, Greenwood Creek, Albion River Watersheds																				
M§13.9.2.2-1 Murrelet Habitat Distribution in LACMA OPTIONAL																				
M§13.9.2.2-2 Methods for Accelerating Growth of Murrelet Habitat OPTIONAL																				
M§13.9.2.2-3 Radar Monitoring in Additional Drainages OPTIONAL																				

Estimated Timeline for Terrestrial Monitoring																				
Monitoring Program	**Years Since HCP/NCCP Initiation**																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
M§13.9.3.1-1 Spatial Extent of Known Burrow Systems of Point Arena Mountain Beaver																				
M§13.9.3.1-2 Creating Habitat with Timber Harvest within Dispersal Distance of Existing PAMB Burrow Systems																				
M§13.9.3.2-1 Defining Habitat for Point Arena Mountain Beavers Optional																				
M§13.9.3.2-2 Creating Potential Habitat in or Adjacent to Existing PAMB Burrow Systems Optional																				

TABLE NOTES

Solid grey shaded areas indicate the years that surveys will be occur.

Purple shaded areas indicate (a) the years that MRC will tabulate surveys and report results or (b) the years that a cycle of surveys will be complete, e.g., 5-year surveys.

13.8 Monitoring Terrestrial Habitat

For our HCP/NCCP, terrestrial habitat includes hard snags, wildlife trees, and downed wood; hardwoods; old-growth; rocky outcrops; and natural communities. Effectiveness monitoring will ensure that MRC meets or exceeds the requirements to maintain these habitat components.

13.8.1 Effectiveness monitoring

Snags, wildlife trees, recruitment trees, and downed wood

The initial number of snags across covered lands may be much lower than our stated objective. Since we only established specific characteristics of wildlife trees in 2006 and have not begun marking recruitment trees for wildlife trees or snags, we will use the first 10 years of our HCP/NCCP to acquire baseline information on these habitat elements.

Effectiveness Monitoring	
Snags, Wildlife Trees, Recruitment Trees, and Downed Wood	
PROGRAM CODE	M§13.8.1-1
OBJECTIVES O§9.2.2-1	• Retain in Class I and Large Class II AMZ at least ▪ 1 hard snag or recruitment tree *on average per acre*[10] that is ≥ 16 in. dbh and ≥ 30 ft in height. ▪ 2 hard snags or recruitment trees o*n average per acre* that is ≥ 24 in. dbh and ≥ 40 ft in height. ▪ 1 wildlife tree or recruitment tree *on average per acre* that is ≥ 16 in. dbh and ≥ 30 ft in height. ▪ 6 hard logs *on average* per acre that are (a) ≥ 16 in. average diameter; (b) ≥ 6 ft long; and (c) derived from at least 3 trees.
O§9.2.2-2	• Retain in general forested areas at least ▪ 1 hard snag or recruitment tree *on average per acre* that is ≥16 in. dbh and ≥ 30 ft in height. ▪ 1 hard snag or recruitment tree *on average per acre* that is ≥ 24 in. dbh and ≥ 40 ft in height. ▪ 1 wildlife tree or recruitment tree *on average per acre* that is ≥ 16 in. dbh and ≥ 30 ft in height. ▪ 5 hard logs *on average per acre* that are (a) ≥ 16 in. average diameter; (b) ≥ 6 ft long; and (c) derived from at least 3 trees.
MONITORING APPROACH	• Sample forests for snags, wildlife trees, recruitment trees, and pieces of downed wood (see Appendix U, section U.2.1.4, *Data collection at plots*).[11] ▪ Sample vegetative strata within inventory blocks. ▪ Measure all snags, wildlife trees, recruitment trees (trees marked with an "R"), and downed wood within a 37.2 ft radius (0.10 ac) plot. • Compile information, every 10 years, about trends in number of snags, wildlife trees, recruitment trees, and pieces of downed wood for all covered lands. Compilation will include a yearly estimate of snags, wildlife trees, recruitment trees, and pieces of downed wood to allow for annual comparisons and estimates of trend direction. Annual estimates will

[10] MRC calculated the value by silvicultural unit and then standardized the value per acre.

[11] Samples will come from stands sampled for inventory. For reporting purposes, we will distinguish AMZ stands and owl core areas from general forest stands.

Effectiveness Monitoring	
Snags, Wildlife Trees, Recruitment Trees, and Downed Wood	
	also be included in an annual report (see Appendix D, D.4.2, *Snags, wildlife trees, recruitment trees, and downed wood*). There will be report breakdowns by planning watersheds, by inventory blocks, and by covered lands (the standard for agency review). • Establish a baseline mean number of snags, wildlife trees, and pieces of downed wood based on forest inventory data. As of 2010, covered lands have an average of 0.36 snags per acre and 6.4 downed logs per acre based on the definitions in the current inventory protocol.[12] • Examine trends over 10-year periods to determine if there is a discernible upward, stable, or downward trend in number of snags, wildlife trees, or recruitment trees from the baseline assessment. • Examine trends over 10-year periods to determine if there is a discernible upward, stable, or downward trend in pieces of downed wood.
MEASUREMENT CRITERIA	• An upward trend shows an obvious or statistically significant increase (α = 0.10) in the number of snags, wildlife trees, recruitment trees, and pieces of downed wood from the baseline assessment. MRC will establish the baseline level of wildlife trees and recruitment trees after the first 10 years of HCP/NCCP implementation. • A static trend shows no detectable increase or decrease in the number of snags, wildlife trees, or pieces of downed wood over time from the baseline assessment, i.e., their number is not statistically different from the baseline (α = 0.10). • A downward trend shows a statistically significant (α = 0.10) decrease in the number of snags, wildlife trees, or pieces of downed wood from the baseline estimate.
ADAPTIVE MANAGEMENT	• If MRC detects an upward trend in any 10-year period, MRC and the wildlife agencies will concur on any changes to the recruitment requirement for snags, wildlife trees, recruitment trees, or pieces of downed wood. • If MRC detects a downward trend in any 10-year period, MRC and the wildlife agencies will concur on methods to improve performance such as ▪ Increase retention numbers, size, or condition of trees retained for recruitment. ▪ Provide screen trees for recruitment trees. ▪ Create snags.

[12] Currently, the inventory department collects data for downed wood with a diameter of at least 6 in. and a length of 10 ft or more. Snags must be at least 6 in. dbh and 10 ft or more in height.

Basal area of hardwoods in timber stands

Effectiveness Monitoring	
Basal Area of Hardwoods in Timber Stands	
PROGRAM CODE	M§13.8.1-2
OBJECTIVES O§9.3.2-1	• Retain, after harvest, 15 ft^2/ac of hardwoods > 6 in. dbh, if such hardwoods comprised at least 15 ft^2/ac of the total basal area of a silvicultural unit prior to harvest.
O§9.3.2-2	• Prohibit treatment of hardwoods > 6 in. dbh if such hardwoods comprise less than 15 ft^2/ac of the total basal area of a silvicultural unit prior to harvest.
O§9.3.2-5	• Retain hardwood areas within variable retention units.
MONITORING APPROACH	• Select, for sampling, silvicultural units[13] least likely to meet objectives. • Sample, at least 1 year after completion of harvest, 1 silvicultural unit from 2 separate PTHPs for a total of 2 sampled units per inventory block. • Survey each silvicultural unit with variable radius plots using a 20, 25, or 30 factor prism to determine basal area of hardwoods. • Complete 1 plot in every acre of a silvicultural unit and ensure that plots are a minimum of 50 ft from each other and within the boundary of the silvicultural unit. • Capture, in a GIS database, maps of all areas retained for hardwood retention. • Survey the entire PTHP area if the silvicultural unit is below basal area standards for hardwood. • Survey all silvicultural units within inventory blocks with PTHPs below hardwood standards.
MEASUREMENT CRITERIA	• Determine basal area by (a) dividing the total number of hardwood trees by the total number of plots and (b) multiplying trees per plot by the Basal Area Factor (BAF) in order to arrive at basal area retention for a silvicultural unit. **EXAMPLE** 20 trees/10 plots = average 2 trees/plot 2 trees X 20 (BAF) = 40 sq. ft. basal area retention • Track the number of acres retained per year as well as the cumulative number of acres.
ADAPTIVE MANAGEMENT	• MRC will ensure that PTHP silvicultural units within deficient inventory blocks have higher retention standards for hardwoods until the deficiency is corrected. **NOTE** For example, silvicultural unit-5 within the Rockport inventory block had, *on average*, a 10 ft^2/ac basal area of hardwoods after harvest. To make up for this deficiency, the next unit harvested in the Rockport inventory block, of

[13] A silvicultural unit is an area within a PTHP that has only 1 type of silviculture and that is non-contiguous with other areas of that same type.

Effectiveness Monitoring	
Basal Area of Hardwoods in Timber Stands	
	approximately the same or greater acreage as unit-5, must retain 20 ft^2/ac of basal area of hardwoods after harvest. Once deficiencies in unit-5 are counterbalanced with hardwoods from other silvicultural units in the Rockport inventory block, that inventory block can revert to the retention standard of 15 ft^2/ac of basal area after harvest.

Post-harvest follow-up on hardwood representative sample areas

Effectiveness Monitoring	
Post-Harvest Follow-up on Hardwood Representative Sample Areas	
PROGRAM CODE	M§13.8.1-3
OBJECTIVES O§9.3.2-6 O§9.3.2-7	• Harvest in representative sample areas only to maintain the relative proportion of hardwoods to conifers. • Designate 1487 ac as representative sample areas for early seral hardwood stands (Appendix B, *HCP/NCCP Atlas*, MAPS 4A-C).
MONITORING APPROACH	• Complete inventory cruise of all hardwood representative sample areas before and after harvest (Appendix U, section U.2, *Sampling Method*).
MEASUREMENT CRITERIA	• Determine relative site occupancy of hardwoods-to-conifers before and after harvest by ▪ Comparing basal area of each species by 8 in. size class before and after harvest. ▪ Comparing density of stems of each species before and after harvest.
ADAPTIVE MANAGEMENT	• If forestry operations result in a change in the relative proportion of hardwoods-to-confers in a representative sample area, MRC will designate a new representative sample area in the same general location and of the same general size, if possible, as a replacement.

Acreage and Number of Hardwood representative sample areas

Effectiveness Monitoring	
Acreage and Number of Hardwood Representative Sample Areas	
PROGRAM CODE	M§13.8.1-4
OBJECTIVES O§9.3.2-6 O§9.3.2-7	• Harvest in representative sample areas only to maintain the relative proportion of hardwoods to conifers. • Designate 1487 ac as representative sample areas for early seral hardwood stands (Appendix B, *HCP/NCCP Atlas*, MAPS 4A-C).
MONITORING APPROACH	• Review representative sample areas once every 10 years by aerial photos or satellite images and by ground visits to ensure they retain their desired characteristics.

Effectiveness Monitoring	
Acreage and Number of Hardwood Representative Sample Areas	
MEASUREMENT CRITERIA	• Compare the acreage of the original hardwood sample areas to current hardwood sample areas.
ADAPTIVE MANAGEMENT	• Review changes in current sample areas from the original 1487 ac of sample areas. • Substitute, if possible, a new representative sample area in the same general location and of the approximate acreage, if harvest changes the relative proportion of hardwoods to conifers in a representative sample area. • Meet with the wildlife agencies if changes are due to management practices—even practices outside of the hardwood sample areas—and determine if adaptive management is necessary.

Old growth

Effectiveness Monitoring	
Acreage and Number of Old Growth Stands and Trees	
PROGRAM CODE	M§13.8.1-5
OBJECTIVES	
O§9.4.2-1	• Maintain 101 ac of Type I old growth currently identified in the plan area, as well as any new Type I old-growth stands later discovered in the plan area, in order to retain their stand acreage and enhance stand function.
O§9.4.2-2	• Maintain 520 ac of Type II stands currently identified in the plan area, as well as any new Type II stands later discovered in the plan area in order to retain their stand acreage and enhance stand function.
O§9.4.2-3	• Increase acreage of mature and late successional forest within AMZ and LACMA (see M§13.9.2.2-1, M§13.5.1.2-2, M§13.5.1.1-1, M§13.5.1.1-2).
MONITORING APPROACH	• MRC will confirm the acreage of Type II old-growth stands during the first 40 years of our HCP/NCCP. • MRC will re-assess Type I and Type II old-growth acreage at least every 10 years or when the composition of the stand changes, e.g., with the discovery of new stands or after catastrophic fires or storms affect Type I stands or stands with Type II old-growth. • MRC acknowledges that drawing a “boundary line” around an old growth stand is difficult and will result in some observer bias. The intent is that the “boundary line” around each stand includes all old-growth trees within the stand and their screen trees. Type I stands will remain un-harvested reserves even if all their trees burn in a catastrophic fire or other natural disasters occur. • MRC will visit and assess, over a 10-year period, each Type I and Type II stand to ensure we maintain or enhance old-growth characteristics (e.g., density of old growth trees and presence of downed wood). • MRC will inventory single old-growth trees during timber cruises prior to harvest. • MRC will photograph, when possible, reference areas within Type I and Type II stands to assess changes over time.

Effectiveness Monitoring	
Acreage and Number of Old Growth Stands and Trees	
	• MRC will take aerial imagery at least once every 10 years, that show the boundaries of Type I and Type II old-growth stands. • MRC will report to the wildlife agencies the number of individual old-growth trees.
MEASUREMENT CRITERIA	• MRC will use acres of un-harvested old-growth (Type I) as well as number and acreage of Type II old-growth stands as indices of conservation effectiveness.
ADAPTIVE MANAGEMENT	• MRC does not expect acreage of old growth stands on our land to change drastically. • MRC expects Type II old-growth to increase slightly within the first 10 years of our HCP/NCCP as we discover new old growth stands. • MRC will report to the wildlife agencies any decrease in acres of old-growth stands. • MRC will meet with the wildlife agencies if the size of Type I or Type II old-growth stands decreases more than 10%. **NOTE** MRC set the "red flag" at a decrease that exceeds 10% because some stands may currently be misclassified or incorrectly mapped. Any reduction up to 10% could simply be a result of this type of measurement error. In fact, prior to HCP/NCCP implementation, we discovered errors that changed the amount of Type I acres by as much as 10%. • MRC will meet with the wildlife agencies to determine potential adaptive management if the number of individual old growth trees decline unexpectedly.

Rocky outcrops

Effectiveness Monitoring	
Distribution and Area of Rocky Outcrops	
PROGRAM CODE	M§13.8.1-6
OBJECTIVE O§9.5.2-1	• Preserve and maintain 3 rocky outcrops comprising 63 ac (20 ha) across 3 planning watersheds.
MONITORING APPROACH	• MRC will examine aerial imagery every 10 years to track changes in the number and size of rocky outcrops on our land. • MRC will identify all rocky outcrops on our land, excluding those in use as rock pits at the time of HCP/NCCP implementation. • MRC will evaluate acres of rocky outcrops by planning watershed using aerial photos and on-the-ground reconnaissance. • MRC acknowledges that drawing "boundary lines" around rocky outcrops is difficult. Our intent is to encompass all areas at least 1 ac in size in which ground cover is entirely rock and in which near vertical rock faces are at least 50 ft high and 100 ft long; these areas are not currently in use as rock pits.
MEASUREMENT CRITERIA	• MRC will use the number and size of rocky outcrops to detect changes across our land; rocky outcrops must be at least 1 ac in size and not

Effectiveness Monitoring	
Distribution and Area of Rocky Outcrops	
	currently in use as a rock pit to qualify for protection. • MRC will not use any of our current 63 ac of rocky outcrops for rock pits.
ADAPTIVE MANAGEMENT	• MRC anticipates that the actual acres of rocky outcrops on our lands may change as survey techniques improve. • MRC will meet with the wildlife agencies to determine potential adaptive management, if the distribution or area of rocky outcrops declines unexpectedly.

13.8.2 Natural communities

Obviously there is no single method to survey and monitor an entire ecosystem. At best, biologists can use indicators to judge the ongoing health of a natural community, for example:

- Is the acreage of a natural community shrinking or expanding?
- Is the population of a covered species in the natural community, such as the northern spotted owl, increasing, decreasing, or remaining stable?
- Is the distribution of an indicator species in a natural community changing?
- Is the species distribution within the natural community changing?

MRC is proposing that the level of monitoring intensity for a natural community be commensurate with the level of impact from management activities. Coastal redwood and Douglas-fir forest, mixed evergreen forest, and riparian forest comprise 98% of covered lands. The vast majority of the MRC monitoring effort will be in these 3 natural communities. Very limited monitoring will take place in the other natural communities—closed-cone or pygmy forest, oak woodland, salt marsh, and natural grassland—because they represent less than 2% of covered lands and little impact will occur in these areas. In pygmy forest, for example, there will be no timber harvesting and minimal road construction. Likewise, there will be no timber harvesting in oak woodlands; MRC will only conduct essential timber harvesting in conifer stands that border this natural community. Communities with few covered activities still merit monitoring to reveal changes in the status of constituent species or their habitat conditions. These changes may be due to human activity (e.g., litter, pollution, and alteration) or natural processes (e.g., succession and invasive species).

While Chapter 13 proposes specific monitoring goals for aquatic and terrestrial habitat and species, as well as rare plants, these goals in total can be a measure of the health of the MRC natural communities.

Common natural communities

This category applies to coastal redwood and Douglas-fir forest, mixed evergreen forest, and riparian forest. In this category, MRC will monitor covered species and their habitat through surveys and data gathering.

- Covered Species
  Monitoring abundance, richness, and distribution of covered species within a natural community can indicate whether changes are taking place that affect the health of the community. Analysis of data collected over time can show trends and signal declines and increases in the health of a community.
- Aquatic and Terrestrial Habitat

Monitoring abundance, richness, and distribution of habitat elements, such as snags, downed wood, or hardwoods, can show trends that signal declines and increases in the health of a community. More inclusive monitoring of species habitat, like the older forests preferred by northern spotted owls, may provide even better insight. All this information taken together can isolate limiting factors and improve community health.

Common natural communities

Effectiveness Monitoring	
Common Natural Communities	
PROGRAM CODE	M§13.8.2-1
OBJECTIVES O§9.6.1.2-1 O§9.6.1.2-2 O§9.6.1.2-3	• Regenerate harvested conifer forest with a mix of conifer species similar to the harvested stand. • Maintain various successional stages of coastal forest, including Type I and Type II old growth stands and representative hardwood forest areas. • Maintain existing stand dominance of native conifers other than redwood and Douglas-fir where this occurs.
MONITORING APPROACH	• MRC will review the number and species distribution of conifer species planted in harvested conifer stands. • MRC will conduct a review every 5 years of structure classes on covered lands. • MRC will assess the number of planted species to dominant species in any conifer stand in which conifers other than redwood and Douglas-fir predominate.
MEASUREMENT CRITERIA	• MRC will compare the number and species distribution of conifer species planted in a harvested stand with those that were harvested. If the distribution of planted conifer species is different from the distribution that existed prior to harvest, MRC will provide a rationale for the difference. MRC will consider proportion of planted species significantly different if it varies by more than 20% from the dominant conifer species mix. • MRC will continue ongoing review of structure classes in the expectation that there will be a trend towards mid-to-late successional stages. • MRC will review with the wildlife agencies if a change in structure class exceeds +/- 20%.
ADAPTIVE MANAGEMENT	• MRC will meet with the wildlife agencies, if any significant changes occur, to determine corrective actions, as needed. • MRC will review with the wildlife agencies any change in structure class which exceeds +/- 20% of the initial baseline numbers.

Uncommon natural communities

This category applies to closed-cone (pygmy and Bishop pine), oak woodland, and natural grassland. It is unlikely that covered activities will have a significant impact on these communities.

Effectiveness Monitoring	
Uncommon Natural Communities	
PROGRAM CODE	M§13.8.2-2
OBJECTIVES O§9.6.2.2-1	• Reintroduce and manage ecological processes or surrogates after obtaining approval of the wildlife agencies.
O§9.6.2.2-2	• Conserve 3274 ac of uncommon natural communities by limiting MRC activities within them: ▪ 135 ac of pygmy forest. ▪ 319 ac of Bishop pine. ▪ 1084 ac of oak woodlands. ▪ 1669 ac of grasslands. ▪ 67 ac of salt-marsh.
O§9.6.2.2-2	• Control any species which the wildlife agencies and MRC designate as an exotic invasive.
MONITORING APPROACH	**Pygmy forest and bishop pine** • MRC will delineate and provide acreage estimates of pygmy forest and bishop pine with each new set of satellite imagery, generally distributed in 5-year intervals. • MRC will list and describe populations of new invasive plant species in our pygmy forest and bishop pine communities. • MRC will map and describe every 10 years the intensity and acreage of natural disturbances within our pygmy forest and bishop pine communities. • MRC will describe specific information on other problems (such as feral pig damage or trash dumping) within our pygmy forest and bishop pine communities. • MRC will establish 10 permanent vegetation composition plots in the pygmy forest community and 10 in the bishop pine community. • MRC will measure the plots within 5 years of their establishment and every 10 years thereafter. • MRC will ensure that each plot is 1/100th of an acre (11.8 ft radius). • MRC will record the following data for each plot: ▪ Species and dbh of every tree > 3 in. dbh. ▪ Height of every 3rd tree measured for dbh. ▪ Percentage of shrub cover by species. ▪ Herbaceous ground cover. ▪ Count of regenerating tree species. **Oak woodlands** • MRC will delineate and provide acreage estimates of our oak woodlands with each new set of satellite imagery, generally distributed in 5-year intervals. • MRC will list and describe populations of new invasive plant species in our oak woodlands. • MRC will map and describe every 10 years the intensity and acreage of

Effectiveness Monitoring	
Uncommon Natural Communities	

	natural disturbances within our oak woodlands.
	• MRC will describe specific information on other problems (such as feral pig damage or trash dumping) within our oak woodlands.
	• MRC will establish 20 permanent vegetation composition plots within our oak woodlands.
	• MRC will measure the plots within 5 years of their establishment and every 10 years thereafter.
	• MRC will ensure that each plot is 1/10th of an acre (37.2 ft radius).
	• MRC will record the following for each plot:
	  ▪ Species and dbh of every tree > 6 in. dbh.
	  ▪ Height of every 3rd tree measured for dbh.
	  ▪ Percentage of shrub cover by species.
	  ▪ Count of regenerating tree species.
	
	Grasslands
	
	• MRC will delineate and provide acreage estimates of our grasslands with each new set of satellite imagery, generally distributed in 5-year intervals.
	• MRC will list and describe populations of new invasive plant species in our grasslands.
	• MRC will map and describe every 10 years the intensity and acreage of natural disturbances within our grasslands.
	• MRC will describe specific information on other problems (such as feral pig damage or trash dumping) within our grasslands.
	• MRC will establish permanent photo point plots at 20 randomly selected locations within our currently existing grasslands.
	• MRC will take photos in every cardinal direction from each plot center within 5 years of plot establishment and every 10 years thereafter.
	
	Salt-Marsh
	• MRC will delineate salt-marsh and estimate its acreage with each new set of satellite imagery, and then distribute this information in 5-year intervals.
	• MRC will list and describe populations of new invasive plant species in our salt-marsh.
	• MRC will map and describe the intensity and acreage of natural disturbances within our salt marsh every 10 years.

MEASUREMENT CRITERIA	• MRC will compare all future data to baseline data in a report provided to the wildlife agencies within 1 year following measurements. • MRC will compare future data to baseline data to determine if species composition is changing in natural communities.

Effectiveness Monitoring	
Uncommon Natural Communities	
ADAPTIVE MANAGEMENT	• MRC will analyze the data and meet with the wildlife agencies to assess changes in species composition in these uncommon natural communities. **NOTE** If MRC and the wildlife agencies agree that there is a change in species composition in these communities, the wildlife agencies may provide financial assistance to MRC to address the changes that shift the natural community away from its current type (e.g., oak woodland shifting towards Douglas fir).

13.8.3 Invasive species control

Effectiveness Monitoring	
Invasive Species Control	
PROGRAM CODE	M§13.8.3-1
OBJECTIVES O§9.7.2-1	• Eradicate or reduce the cover, biomass, and distribution of target, non-native invasive plants, such as jubata grass, broom, and eucalyptus, in the plan area through an Invasive Plant Control Program (IPCP).
O§9.7.2-2	• Reduce the number and distribution of non-native, invasive animals, such as bullfrogs, if they threaten the ecological balance in natural communities or the populations of covered species.
O§9.7.2-2	• Implement, with external or MRC funding and with the cooperation of the wildlife agencies as well as other land agencies, control programs which benefit the region through information on existing and newly discovered invasive species.
MONITORING APPROACH	• MRC will provide the wildlife agencies an annual progress report on developing the Invasive Plant Control Program (IPCP). • MRC will develop a database, in consultation with the wildlife agencies, of current and historic outbreaks of invasive species in the plan area, including ▪ Relative size of the outbreak. ▪ GPS location. ▪ Treatment (chemicals, amount, and application). ▪ Control outcomes. • MRC will report annually to the wildlife agencies on known populations of invasive species in the plan area.
MEASUREMENT CRITERIA	• MRC will compare all future data to baseline data and issue a report to the wildlife agencies within 1 year of data collection.
ADAPTIVE MANAGEMENT	• MRC will meet with the wildlife agencies, if any significant changes occur, to determine corrective actions, as needed.

13.9 Monitoring terrestrial species

13.9.1 Northern spotted owls

13.9.1.1 Productive and strategic territories

Effectiveness monitoring for northern spotted owls consists of 2 monitoring programs. The first monitoring program determines reproductive status of known productive territories and whether "strategic" territories may produce young in the near future. The "strategic" territories may replace other Level-1 and Level-2 territories that decline in productivity as the owls within the territories grow older or are displaced. The second program tracks habitat distribution on the landscape to ensure MRC is meeting our objectives.

13.9.1.2 Banding program

As part of our monitoring and management, MRC proposes to band spotted owls. This will help us better understand the demographic patterns of our owl populations, as well as the success at reproduction and survival of individual owls protected by different management strategies. Banding under our HCP/NCCP permit will replace the typical recovery permit. In order to accommodate the wildlife agencies, we have accepted the following restrictions:

1. MRC must band or re-sight at least 60 northern spotted owls in every calendar year.
2. MRC will meet with the wildlife agencies, if we do not succeed in banding or re-sighting the requisite number of spotted owls, to determine if we can continue the banding program.
3. MRC will include in an annual report (a) re-sightings of spotted owls dispersing from other timberlands or other territories on covered lands; (b) calculations to determine owl demographic parameters[14] of populations (such as survival); and (c) lists of all bands placed on spotted owls.
4. MRC will report any injury or mortality to the wildlife agencies.
5. MRC will only use individuals approved by the wildlife agencies to band spotted owls.

If MRC does not adhere to the above restrictions, the wildlife agencies may rescind our banding authorization.

13.9.1.3 Effectiveness monitoring

Level-1 and level-2 territories of northern spotted owls

Effectiveness Monitoring	
Northern Spotted Owls: Level-1 and Level-2 Territories	
PROGRAM CODE	M§13.9.1.3-1
OBJECTIVES O§10.3.1.2-1	**Population Objective 1** • Maintain at least 28 Level-1 territories and 67 Level-2 territories during the first 60 years of our HCP/NCCP.
O§10.3.1.2-2	**Population Objective 2** • Increase to 34 Level-1 territories and 80 Level-2 territories by Year 75 of our HCP/NCCP.

[14] Because of the years of data collection needed to calculate these parameters, MRC may not be able to provide any statistically valid demographics until 10 years after HCP/NCCP implementation.

Effectiveness Monitoring	
Northern Spotted Owls: Level-1 and Level-2 Territories	
O§10.3.1.2-3 O§10.3.1.2-4	**Distribution Objective 1** • Achieve by Year 40 of our HCP/NCCP a distribution of spotted owl territories in each inventory block that is proportionate to its potential nesting/roosting habitat in the plan area, i.e., an inventory block with 10% of the total nesting/roosting habitat on MRC covered lands should have at least 10% of the Level-1 and Level-2 territories specified in the population objectives (see Table 10-7). **Distribution Objective 2** • Achieve by Year 75 of our HCP/NCCP a distribution of spotted owl territories in each inventory block that exceeds *Distribution Objective 1* by 20% (see Table 10-7).
MONITORING APPROACH	• MRC will use standard protocols to survey and monitor northern spotted owl reproduction (see Appendix K, section K.5, *Protocols*). • MRC will annually monitor all territories assigned high or moderate protection as well as strategic territories with limited protection to identify their productivity level, using the following parameters: ▪ Occupancy status (male, female, pair, absent, unknown). ▪ Nesting status (nesting, nesting unknown, or non-nesting). ▪ Number of fledglings produced (unknown, 0, 1, 2, or 3). • MRC will determine the number and locations of strategic Level-3 owls to monitor using the following parameters: ▪ Number of Level-1 and Level-2 owl territories in the previous year. ▪ Number of Level-3 territories within inventory blocks that may not meet distribution objectives. ▪ Proximity of Level-3 territories to harvests or other operations. • MRC will band and track Level-1, Level-2, and strategic Level-3 spotted owls.
ADAPTIVE MANAGEMENT	• MRC will implement contingency strategies, if the number of Level-1 and Level-2 territories falls below contingency triggers (section 10.3.2.5).

Distribution and acreage of nesting/roosting habitat

Effectiveness Monitoring	
Northern Spotted Owls: Distribution and Acreage of Nesting/Roosting Habitat	
PROGRAM CODE	M§13.9.1.3-2
OBJECTIVES O§10.3.1.2-5 O§10.3.1.2-6	**Habitat Objective 1** • Achieve by Year 40 of our HCP/NCCP a landscape configuration in which 23% of all potential habitat is nesting/roosting habitat, while still maintaining separate objectives for each inventory block. **Habitat Objective 2** • Achieve by Year 75 of our HCP/NCCP a landscape configuration in which 25% of all potential habitat and 25% of each inventory block are nesting/roosting habitat.

Effectiveness Monitoring	
Northern Spotted Owls: Distribution and Acreage of Nesting/Roosting Habitat	
MONITORING APPROACH	• MRC will use data from our forest inventory and growth model to determine the amount of nesting/roosting habitat by inventory block every 10 years for all covered lands (see Appendix U, section U.7, *Structure Classes and Habitat Inferences*).
ADAPTIVE MANAGEMENT	• MRC will confer with the wildlife agencies, if we do not meet *Habitat Objective 1* or *Habitat Objective 2*, to determine whether we should implement potential adaptive management strategies including ▪ Increasing the minimum habitat retention within 0.7 miles of core areas. ▪ Increasing core areas in owl territories with high protection to increase overall habitat.

13.9.1.4 Validation monitoring

Though limited in scope, validation monitoring requires more intensive effort than effectiveness monitoring. MRC will examine 6 hypotheses related to owl population trends, habitat classification, and protection levels. All validation monitoring programs are optional with the exception of those for Hypothesis 1 and Hypothesis 4. Hypotheses 3 through 6 use the MRC banding program as an assessment tool.

Population trends (required)

Validation Monitoring	
Population Trends of Northern Spotted Owls	
PROGRAM CODE	M§13.9.1.4-1
HYPOTHESIS SECTION 5.2.10	• The number of northern spotted owl territories is stable or increasing on covered lands in the short-term and will increase in the long-term.
MONITORING APPROACH	• MRC will track trends of spotted owls by completing a rolling 5-year survey over covered lands; survey results will include the number of owl detections and territories located. • MRC will complete 3 surveys within 1 year in inventory blocks, covering an equivalent acreage every year (see Appendix K, section K.5, *Protocols*). • MRC will coordinate our survey efforts with other surveys (e.g., PTHP surveys and effectiveness monitoring for Level-1 and Level-2 territories) so that we do not "over-call" owls. • MRC will geographically stratify inventory blocks in order to decrease the effect of geography on results.
MEASUREMENT CRITERIA	• MRC will compare the number of territories located every 5 years with those located in the previous 5 years to determine if the number of territories has increased, decreased, or remained the same (see Appendix K, section K-7, *Survey plan for determining population trends*). • MRC will report on the number of territories detected annually and consult with the wildlife agencies on how to detect a trend in the number of territories.

Validation Monitoring	
Population Trends of Northern Spotted Owls	
ADAPTIVE MANAGEMENT	• MRC will examine the cause of any deviation from the previous number of territories and meet with the wildlife agencies. • MRC may convene a scientific review panel to examine the causes of decline and to recommend corrective actions.

Nesting/roosting habitat (optional)

Validation Monitoring	
Identification of Nesting/Roosting Habitat for Northern Spotted Owls	
PROGRAM CODE	M§13.9.1.4-2
HYPOTHESIS SECTION 5.2.10	• MRC has used structure classes to correctly designate nesting/roosting habitat.
MONITORING APPROACH	• MRC has developed a nest site protocol to ground-truth areas around nest sites and compare habitat features around nests to random sites (see Appendix K, section K.3.3. *Comparison of nest tree and random tree*). • MRC will ground-truth at least 100 nest sites using this method. • MRC will complete the first set of nest sites by HCP/NCCP commencement. • MRC will undertake the nest-site survey again 40 years after HCP/NCCP commencement to determine if northern spotted owls select different nesting habitat as habitat changes in response to timber management. • MRC will enter data from the nest-site survey into a spreadsheet and translate the data into inventory structure classes, used to assign habitat types to stands. • MRC will categorize structure classes as nesting/roosting, foraging, or unsuitable habitat (section 10.3.1.4.7, *Validation of habitat typing*). **NOTE** MRC will not re-sample nest sites from the same northern spotted owl territory until we have measured all Level-1 and Level-2 territories. This should limit any statistical biases associated with a lack of independence.
MEASUREMENT CRITERIA	• MRC will determine what percentage of our sampled nest sites are in plots not identified in our inventory as nesting/roosting habitat.
ADAPTIVE MANAGEMENT	• MRC will meet with the wildlife agencies to discuss potential changes in habitat typing if our verification rate is less than 60% correct. **NOTE** MRC can only make changes to structure class assignments with prior approval of the wildlife agencies. • MRC will meet with the wildlife agencies to change structure class assignments if either believes a change is warranted—even in cases where MRC habitat typing proves to be 60% or more correct. • MRC will notify the agencies of any changes in structure class assignments, including affected acreage, through the annual report for northern spotted owls. • MRC will adjust or alter the rules for designating structure class, as required.

Benefits of high protection (optional)

Validation Monitoring	
Benefits of High Protection for Northern Spotted Owls and Their Territories	
PROGRAM CODE	M§13.9.1.4-3
HYPOTHESIS SECTION 5.2.10	• The demographic parameters of individual owls and owl territories with high protection will show more improvement than those with moderate protection.
MONITORING APPROACH	• MRC will develop, in consultation with the wildlife agencies, a study plan. • MRC will follow all banding procedures outlined in Appendix K, section K.6.2, *Banding of northern spotted owls*. • MRC will band each northern spotted owl with a color patterned band on one leg (for ease of re-sighting) and an individual USFWS numbered band on the other leg (for recapture identification). • MRC will assess productivity levels of all territories and individual owls protected with high and moderate protection using protocols outlined in Appendix K, section K.5.3, *Protocols for determining reproductive status*. • MRC will assign owls the productivity level of the territory they inhabit at the time of assessment. • MRC will use 10 years of productivity data to assess a total productivity for each individual owl or owl territory assessed. • MRC will determine the total years of high protection for each individual owl or owl territory. • MRC will evaluate each territory on its assigned protections as well as on its functional protection (i.e., the average amount of habitat acreage present regardless of assigned productivity level) during the 10-year assessment timeline.

MEASUREMENT CRITERIA	• MRC will determine if high protection results in improved demographic parameters of northern spotted owls or owl territories.
	  ▪ MRC will infer that assigned or equivalent high protection results in enhanced vital rates or territory occupation if the number of fledglings, survival of adults, or fidelity to the territory is greater than sites assigned moderate protection.
	  ▪ MRC will infer that assigned or equivalent high protection results in equivalent vital rates or territory occupation if the number of fledglings, survival of adults, or fidelity to the territory is equal to sites assigned moderate protection.
	  ▪ MRC will infer that assigned or equivalent high protection has a negative impact on vital rates or territory occupation if the number of fledglings, survival of adults, or fidelity to the territory is less than sites assigned moderate protection.

ADAPTIVE MANAGEMENT	• MRC will provide the most productive spotted owls with a 90-acre core area if a there is a detectable positive effect from the high protection measures. • MRC will provide the most productive spotted owls with a 72-acre core area if there is a detectable negative effect from the high protection measures. • MRC will only make adaptive management changes after at least 20 years of data collection, including contingencies.

Effect of harvest (required)

Validation Monitoring	
Effect of Harvest within 1000 ft of NSO Territories with Limited Protection	
PROGRAM CODE	M§13.9.1.4-4
HYPOTHESIS SECTION 5.2.10	• Harvesting within 1000 ft of an activity center with limited protection results in the death, dispersal, or reduction in fecundity of excess productive owls and implementation of protections does not curb their disappearance from covered lands.
MONITORING APPROACH	• MRC will develop, in consultation with the wildlife agencies, a study plan within the first 10 years of our HCP/NCCP. • MRC will follow all banding procedures outlined in Appendix K, section K.6.2, *Banding of northern spotted owls*. • MRC will band each northern spotted owl with a color patterned band on one leg (for ease of re-sighting) and an individual USFWS numbered band on the other leg (for recapture identification). • MRC will assign all owls the productivity of the territory they inhabit in the assessment year. • MRC will assess—in each of the 3 years after harvest within 1000 ft of owls and owl territories with limited protection—the occupancy, pair status, and productivity level of all such owls and owl territories, using protocols outlined in Appendix K, section K.5.3, *Protocols for determining reproductive status*.
MEASUREMENT CRITERIA	• MRC will infer that an individual owl is not adversely affected by a harvest if it continues to occupy a territory or its productivity does not decrease in the next 3 years. • MRC will infer that an individual owl is adversely affected by a harvest if it does not occupy a territory or its productivity decreases in the next 3 years. • MRC, in consultation with the wildlife agencies, will compile results every 5 years to determine how many "no effect" harvests constitute an overall result of "no effect" in limited protection territories.
ADAPTIVE MANAGEMENT	• MRC may use this study, with concurrence of the wildlife agencies, to decrease or increase the breeding season buffer by 100 ft for owl territories with limited protection. **NOTE** MRC also uses validation monitoring to confirm our requirements for post-harvest termination mitigation (Appendix Y, *Termination Mitigation*).

Effect of habitat on productivity (optional)

Validation Monitoring	
Effect of Habitat on Productivity of Northern Spotted Owls	
PROGRAM CODE	M§13.9.1.4-5
HYPOTHESIS SECTION 5.2.10	• The pattern, arrangement, and amount of acreage of both foraging and nesting/roosting habitat within 0.7 miles of an activity center can affect the productivity of the associated owl and its territory.
MONITORING APPROACH	• MRC will develop, in consultation with the wildlife agencies, a study plan. • MRC will follow all banding procedures outlined in Appendix K, section K.6.2, *Banding of northern spotted owls*. • MRC will band each northern spotted owl with a color patterned band on one leg (for ease of re-sighting) and an individual USFWS numbered band on the other leg (for re-capture identification). • MRC will assess occupancy, pair status, and productivity level of (a) all banded owls, (b) all owls receiving high or moderate protection, and (c) some owls receiving limited protection, according to the protocols outlined in Appendix K, section K.5.3, *Protocols for determining reproductive status*. • MRC will assign all owls the productivity of the territory they inhabit in the assessment year. • MRC will compute the amount of each habitat type within 0.7 miles of selected spotted owl territories during the time frame of assessment.
MEASUREMENT CRITERIA	• MRC, in consultation with the wildlife agencies, will compile results every 5 years to determine if we need to make any changes in habitat protection.
ADAPTIVE MANAGEMENT	• MRC, with concurrence of the wildlife agencies, will decrease the amount of required habitat for moderate protection owls within 0.7 miles of the current activity center from 500 ac to 450 ac if owl productivity does not positively correlate with the amount of foraging and nesting/roosting habitat • MRC, with concurrence of the wildlife agencies, will increase the amount of required habitat for moderate protection owls within 0.7 miles of the current activity center from 500 ac to 550 ac if owl productivity does positively correlate with the amount of foraging and nesting/roosting habitat.

Effect of hardwood acreage on northern spotted owls (required)

Validation Monitoring	
Effect of Hardwood Density on Northern Spotted Owls	
PROGRAM CODE	M§13.9.1.4-6
HYPOTHESIS SECTION 5.2.10	• There is no correlation between spotted owls and the amount and basal area of hardwoods, especially tanoaks within 0.7 miles of owl activity centers.
MONITORING APPROACH	• MRC will develop, in consultation with the wildlife agencies, a study plan within the first 10 years of HCP/NCCP implementation. • MRC will follow all banding procedures outlined in Appendix K, section K.6.2, *Banding of northern spotted owls*. • MRC will assess productivity of all individual owls and territories selected for 3 consecutive years, using protocols outlined in Appendix K, section

Validation Monitoring	
Effect of Hardwood Density on Northern Spotted Owls	
	K.5.3, *Protocols for determining reproductive status*. • MRC will conduct a pilot study using 9 randomly selected spotted owl territories—3 from Navarro East inventory block, 3 from Navarro West inventory block, and 3 from Albion inventory block—that are not likely to be abandoned and that have a history of frequent occupation. **NOTE** MRC biologists determine annually which territories are likely to be abandoned by how long owls have been absent from those territories. If owls have been absent from a territory for 3 consecutive years, for example, we consider the territory abandoned. • MRC will evaluate, in each of the 3 years, hardwood basal area within several different spatial buffers up to 0.7 miles of activity centers using a sampling and inventory protocol agreed upon by us and the wildlife agencies. • MRC will determine if there is a correlation between spotted owl productivity and the amount of tanoak basal area in the vicinity of owl activity centers.
MEASUREMENT CRITERIA	• MRC will infer a positive relationship if there is a positive correlation between owl productivity and basal area of hardwoods within several different spatial buffers up to 0.7 miles of an owl activity center. • MRC will not infer a relationship if there is no correlation between owl productivity and basal area of hardwoods within several different spatial buffers up to 0.7 miles of an owl activity center. • MRC will infer a negative relationship if there is a negative correlation between owl productivity and basal area of hardwoods within several different spatial buffers up to 0.7 miles of an owl activity center.
ADAPTIVE MANAGEMENT	• MRC and the wildlife agencies will decide whether to continue this validation monitoring program based on the results of the pilot study • MRC and the wildlife agencies will determine a study plan for the remainder of the term, if they decide to continue the study. • MRC may increase hardwood retention within 0.7 miles of spotted owl activity centers, if there is a positive correlation between basal area of hardwoods and owl productivity.

Effect of barred owl control on northern spotted owls (required)

Validation Monitoring	
Effect of Barred Owl Control on Northern Spotted Owls	
PROGRAM CODE	M§13.9.1.4-7
HYPOTHESIS 5.2.10	• Occupancy of northern spotted owl territories where MRC has controlled or removed barred owls will improve. • Occupancy of northern spotted owl territories where MRC has not controlled or removed barred owls will decline.
MONITORING APPROACH	• MRC will develop, in consultation with the wildlife agencies, a study plan within the first 2 years of HCP/NCCP implementation. • MRC will follow all banding procedures outlined in Appendix K, section K.6.2, *Banding of northern spotted owls*.

Validation Monitoring	
Effect of Barred Owl Control on Northern Spotted Owls	
	• MRC will assess the demographic parameters of all individual northern spotted owls and their territories impaired by barred owls before MRC commences control efforts and for at least 10 years after such control efforts. • MRC will assess the demographic parameters of northern spotted owls and their territories where MRC has not controlled or removed barred owls for at least 10 years. • MRC will work with the wildlife agencies to gain the appropriate permits for the removal of barred owls from northern spotted owl territories; we will use these pilot efforts to guide further studies for barred owl control during HCP/NCCP implementation. **NOTE** After lethal removal of barred owls, MRC will make a reasonable attempt to locate authorized schools, museums, researchers, agencies, and others who can properly and legally use the carcasses. In the event that our attempts are unsuccessful, MRC will inform the wildlife agencies and offer them the specimens. After MRC exhausts all reasonable options for donation of the carcasses, we will burn or bury them in accordance with California State and federal law. • MRC will determine if there is any improvement in the demographics of northern spotted owl territories (i.e., greater productivity) following barred owl control. • MRC and the wildlife agencies will outline in a study plan the demographic parameters and statistical tests that MRC will use to determine the effectiveness of barred owl control.
MEASUREMENT CRITERIA	• MRC will infer a positive effect if occupancy and productivity of northern spotted owls improve after barred owl control and removal, and decline in areas where MRC has not implemented such control and removal. • MRC will not infer a relationship if there is no difference in the demographic parameters of northern spotted owls in areas with barred owl control and removal versus areas without such control and removal. • MRC will infer a negative effect if occupancy and productivity of a majority of northern spotted owls decline after barred owl control and removal or show no improvement over spotted owl demographics in areas where MRC has not implemented such control and removal. • MRC and the wildlife agencies will confer to determine how mixed results (i.e., no difference between northern spotted owl territories with control and those without) fit into adaptive management protocol.
ADAPTIVE MANAGEMENT	• If MRC infers a positive effect, we will continue with control of barred owls in northern spotted owl territories. • If MRC infers a mixed effect, MRC and the wildlife agencies will evaluate and improve the study plan to better understand the effect of barred owl removal on northern spotted owls. • If MRC infers a negative effect, we will implement a reduced contingency trigger (30% rather than 20% of the northern spotted owl population) and provide an 18 acre “no harvest” core area for all spotted owl pairs assigned limited protection.

13.9.2 Marbled murrelet

13.9.2.1 Effectiveness monitoring

Previous MRC surveys for murrelets in Lower Alder Creek were scattered throughout the watershed, rather than in consistent locations from year to year. As part of HCP/NCCP implementation, MRC will use permanent radar stations to determine the level of murrelet activity within Lower Alder Creek. These surveys will provide an index of murrelet abundance each year. MRC and the wildlife agencies will determine if the activity level of murrelets is increasing, decreasing, or remaining stable. By providing this information on murrelet activity trends in Lower Alder Creek, MRC will contribute considerably to regional knowledge of murrelet populations.

MRC will also complete annual radar surveys on the Navarro River, Greenwood Creek, and the Albion River as part of our effectiveness monitoring. Since we detected murrelets flying up the Navarro River in 2000 and 2001, we will survey this drainage for continued activity. However, MRC will not track activity trends due to the low number of detections. If additional detections occur on other drainages, MRC and the wildlife agencies may switch the monitoring effort to these locations. Moreover, the wildlife agencies may fund additional radar surveys above and beyond those in LACMA and the designated drainages.

Radar monitoring for murrelets in Lower Alder Creek

Effectiveness Monitoring	
Activity Level of Marbled Murrelets in Lower Alder Creek	
PROGRAM CODE	M§13.9.2.1-1
OBJECTIVE O§10.3.2.2-2	• Retain permanently all sites occupied by marbled murrelets.
MONITORING APPROACH	• MRC will establish and maintain 2 permanent radar survey stations (Appendix L, *Marbled Murrelet Data and Protocol*, Figure L-1) on the Lower Alder Creek drainage, specifically at the rock pit approximately 1 mile above the mouth of Alder Creek and 1 mile west of the rock processing plant (closer to the coast). • MRC began a pilot project[15] in 2011 to assess annual variation, determine our ability to detect trends in numbers of detections, and establish a baseline activity level in Lower Alder Creek. • MRC will continue the pilot project through 2011 at which point MRC and the wildlife agencies will decide on any alterations to the project. • MRC will, as part of the pilot project, ▪ Conduct all surveys from June 15th–July 31st in order to maximize detections. ▪ Conduct 5 surveys at each of the sites for a total of 10 surveys throughout the year. ▪ Start surveys 75 minutes before sunrise and end them 75 minutes after sunrise.

[15] Although MRC completed previous radar surveys near these radar stations, there were inconsistencies in the number of completed surveys, the time of year, and the location of the survey stations. For this reason, we will use data from surveys completed in 2007 through 2011 to establish a baseline number of murrelet detections in lower Alder Creek. We will use this baseline to assess whether the number of murrelet detections is declining. To assess the statistical power of our current proposal, we used data from 2003 through 2005. The results of this analysis are in Appendix L, section L.2, *Radar Surveys in LACMA*.

Effectiveness Monitoring	
Activity Level of Marbled Murrelets in Lower Alder Creek	
	▪ Maintain each radar station by topping small trees and shrubs less than 4 in. dbh to keep them below road level. ▪ Seek approval of the wildlife agencies for any other management at the radar sites. ▪ Photograph each radar site annually and provide these photos to the wildlife agencies in an annual report; take photos looking in the direction of the area surveyed by the radar unit. ▪ Determine, in consultation with the wildlife agencies, the appropriate radar settings (or range of radar settings) for surveys following the 2011 survey season. • MRC, in consultation with the wildlife agencies, will complete a power analysis on the data from the completed pilot study. From this analysis we will assess any detectable decrease in the murrelet population and possibly change survey efforts or protocol with the agreement of the wildlife agencies. • MRC may change, after consultation with the wildlife agencies, the locations of proposed survey sites if better sites emerge. • MRC and the wildlife agencies will concur on a monitoring plan if additional occupied murrelet sites are located in the plan area. • MRC will use the mean or median number (or other measures of abundance with the agreement of the wildlife agencies) of murrelet detections per radar survey per year; data from 2007-2011 will provide the baseline index for activity levels of murrelets in Lower Alder Creek. • MRC will analyze surveys prior to 2011 and thereafter to determine the number of detections at each survey station; for example, the number of detections closer to the mouth of Lower Alder Creek is vastly greater than the number of detections at the rock pit. • MRC will include survey statistics in an annual report, such as mean, median, range of detections, standard error, and standard deviation of detections.
MEASUREMENT CRITERIA	• MRC will compare annual detections of murrelets with the baseline number of detections in future years to uncover any decline in the number of detections.
ADAPTIVE MANAGEMENT	• MRC will continue to monitor permanent radar stations in Lower Alder Creek even if murrelets decline or if they are no longer detected for the term of the plan. • MRC and the wildlife agencies may explore independent correlates of trend including prey base, offshore conditions, and disease. • MRC may take a more conservative approach to conservation measures in Lower Alder Creek, providing (a) larger disturbance buffers and more habitat protections for known occupied sites; (b) active corvid management; and (c) temporary restrictions on harvesting.

Radar monitoring for murrelets in Navarro, Greenwood Creek, and Albion

Effectiveness Monitoring	
Murrelet Occupancy in Navarro, Greenwood Creek, Albion River Watersheds	
PROGRAM CODE	M§13.9.2.1-2
OBJECTIVE O§10.3.2.2-3	• Maintain murrelet presence in the Navarro River watershed and in drainages in which, in the future, MRC biologists detect murrelets.
MONITORING APPROACH	• MRC will establish and maintain 6 permanent survey stations for radar monitoring with concurrence of the wildlife agencies—2 on Navarro River, 2 on Albion River, and 2 on Greenwood Creek. **NOTE** Our intent is to set up radar monitoring stations on drainages where murrelets currently occur or likely will occur in the future. • MRC will ▪ Conduct all surveys from June 15th through July 31st in order to maximize detections. ▪ Conduct 2 surveys at each of the sites for a total of 12 surveys throughout the year. ▪ Start surveys 75 minutes before sunrise and end them 75 minutes after sunrise. ▪ Maintain each radar station by topping small trees and shrubs less than 4 in. dbh to keep them below road level. ▪ Seek approval of the wildlife agencies for any other management at the radar sites. ▪ Photograph annually each radar site in the direction of the area surveyed and provide these photos to the wildlife agencies in an annual report. ▪ Determine, in consultation with the wildlife agencies, the appropriate radar settings (or range of radar settings) after the initial survey season. • MRC may change, after consultation with the wildlife agencies, the locations of proposed survey sites if better sites emerge. • MRC will include survey statistics in an annual report, such as mean, median, range of detections, standard error, and standard deviation of detections.
MEASUREMENT CRITERIA	• MRC will compare annual detections of murrelet in the Navarro River, Albion River, and Greenwood Creek with previous data. • MRC will consider even 1 “murrelet-type” detection in the Albion River or Greenwood Creek a major finding that requires consultation with the wildlife agencies.
ADAPTIVE MANAGEMENT	• MRC will confer with the wildlife agencies if any murrelet-type detections occur on Greenwood Creek or Albion River. • MRC will consider all potential trees as primary murrelet trees in drainages where murrelet-type detections occur until MRC and the wildlife agencies agree and implement a plan to narrow down the areas where murrelets are present and absent. For example, in the Navarro watershed, MRC considers all potential trees as primary murrelet trees in the Navarro West inventory block; in the Navarro East inventory block, however, potential trees can be

Effectiveness Monitoring	
Murrelet Occupancy in Navarro, Greenwood Creek, Albion River Watersheds	
	either primary or secondary murrelet trees.

13.9.2.2 Validation monitoring

MRC will conduct validation monitoring on 3 hypotheses for marbled murrelets:

1. Current LACMA boundary covers all murrelet habitat within the Lower Alder Creek planning watershed.

   NOTE
   To our knowledge, we have included all potential murrelet habitat in the Lower Alder Creek watershed within LACMA; however, we have not completed a field review of all stands in the Lower Alder Creek watershed. As a result of habitat assessment, we may add or switch acres in LACMA to better protect potential habitat stands contiguous with LACMA.

2. Specific silvicultural techniques for specific stands will accelerate growth of marbled murrelet habitat.

   NOTE
   Management within LACMA will allow stands without current habitat to progress quickly to potential nesting stands. To further accelerate growth of marbled murrelet habitat, MRC may experiment with silvicultural prescriptions elsewhere in the plan area.

3. Murrelets may re-colonize other areas of MRC forestland.

   NOTE
   MRC will rotate radar stations in watersheds where murrelets are more likely to occur to determine if murrelets may be in areas previously thought to be unoccupied.

These 3 adaptive management programs are optional; MRC may or may not implement them during the term of our HCP/NCCP.

Murrelet habitat distribution in LACMA (optional)

Validation Monitoring	
Murrelet Habitat Distribution in LACMA	
PROGRAM CODE	M§13.9.2.2-1
HYPOTHESIS SECTION 5.3.8	• The current LACMA boundary covers all areas of murrelet habitat in the Lower Alder Creek drainage.
MONITORING APPROACH	• MRC, in consultation with the wildlife agencies, will determine within the first 5 years of our HCP/NCCP a system to evaluate areas of potential murrelet habitat within the Lower Alder Creek watershed that are contiguous with but outside of LACMA and that may provide better habitat. • MRC, in consultation with the wildlife agencies, will determine whether an area is characteristic of murrelet habitat or not; the most basic criteria is whether there are at least 3 potential habitat trees each within 100 ft of another. • MRC will set up radar or ground-observer stations for areas of potential murrelet habitat and, if possible, conduct surveys.
MEASUREMENT CRITERIA	• MRC will determine that murrelets are occupying an area if any murrelets exhibit behavior indicative of occupancy.

Validation Monitoring	
Murrelet Habitat Distribution in LACMA	
ADAPTIVE MANAGEMENT	• MRC may add newly discovered occupied stands within the Lower Alder Creek drainage to LACMA and extend the associated conservation measures to the stands as long as the maximum acreage of LACMA remains less than 1437 ac. • MRC, with the agreement of the wildlife agencies, may trade suitable habitat areas contiguous with the current boundary of LACMA for existing habitat areas in LACMA if LACMA has reached its maximum acreage of 1437 ac. **EXAMPLE** Area-1 is in LACMA; there have been no murrelet detections in Area-1. Area-2 is outside LACMA but within the Lower Alder Creek drainage; there have been murrelet detections in Area-2. MRC, with agreement of the wildlife agencies, could *trade* Area-2 for Area-1.

Accelerating murrelet habitat growth (optional)

Validation Monitoring	
Methods for Accelerating Growth of Murrelet Habitat	
PROGRAM CODE	M§13.9.2.2-2
HYPOTHESIS SECTION 5.3.8	• Specific silvicultural prescriptions will generate suitable marbled murrelet habitat quicker than not managing a stand silviculturally.
MONITORING APPROACH	• MRC will develop, in consultation with the wildlife agencies, a study plan within the first 5 years of our HCP/NCCP. • MRC will pre-test the proposed methods over a period of at least 5 years in 2 or more stands outside of LACMA before implementing them within LACMA, with the exclusion of murrelet core areas. • MRC will establish permanent paired habitat plots in stands in the Lower Alder Creek Habitat Area (LACHA) or the Lower Alder Creek Buffer Area (LACBA), managing one area with habitat improvement and leaving the other unmanaged. • MRC will evaluate permanent plots once every 5 years for changes in stand structure and individual trees. • MRC will measure all characteristics that could affect whether a stand is murrelet habitat or not (i.e., dbh, tree species composition, diameter of largest limbs, canopy cover, etc.). • MRC will permanently mark and identify trees in the plots so that they can be monitored throughout the term of our HCP/NCCP.
MEASUREMENT CRITERIA	• MRC will compare habitat characteristics between the managed and unmanaged stands.
ADAPTIVE MANAGEMENT	• MRC will confer with the wildlife agencies, after 20 years of monitoring, if (1) there is no detectable change between managed and unmanaged stands; or (2) unmanaged stands are producing murrelet habitat faster than managed stands; or (3) managed stands are producing murrelet habitat faster than unmanaged stands. • MRC and the wildlife agencies will decide if specific silvicultural prescriptions can be implemented for specific stands within LACMA that will not require wildlife agency consultation.

Validation Monitoring	
Methods for Accelerating Growth of Murrelet Habitat	
	• MRC may waive this adaptive management if both MRC and the wildlife agencies agree that (1) new research adequately addresses the issue of how to manage forests to accelerate habitat for marbled murrelets; and (2) MRC implements the methods behind that research.

Radar monitoring in additional drainages (optional)

Validation Monitoring	
Radar Monitoring in Additional Drainages	
PROGRAM CODE	M§13.9.2.2-3
HYPOTHESIS SECTION 5.3.8	• Murrelets will re-colonize other areas of MRC forestland.
MONITORING APPROACH	• MRC will rotate radar monitoring stations in 9 additional drainages over a 10-year period: [16] 1. Juan Creek (Rockport inventory block). 2. Hardy Creek (Rockport inventory block). 3. Mallo Pass Creek (South Coast inventory block). 4. Elk Creek (South Coast inventory block). 5. Russell Brook (Big River inventory block). 6. Noyo River (Noyo inventory block). 7. Hollowtree Creek (Rockport inventory block). 8. Garcia River (Garcia inventory block). 9. Cottaneva Creek (Rockport inventory block). • MRC will complete 2 radar surveys on 2 of the 9 drainages every year, i.e., 4 radar surveys per year. • MRC will ▪ Conduct all surveys from June 15th through July 31st in order to maximize detections. ▪ Conduct 5 surveys at each of the sites for a total of 10 surveys throughout the year. ▪ Start surveys 75 minutes before sunrise and end them 75 minutes after sunrise. ▪ Maintain each radar station by topping small trees and shrubs less than 4 in. dbh to keep them below road level. ▪ Seek approval of the wildlife agencies for any other management at the radar sites. ▪ Photograph annually each radar site in the direction of the area surveyed and provide these photos to the wildlife agencies in an annual report. ▪ Determine, in consultation with the wildlife agencies, the appropriate radar settings (or range of radar settings) after the initial survey

[16] The *HCP/NCCP Atlas* (MAPS 6A-C) shows the plan area, the inventory blocks, locations of documented detections from past murrelet surveys, and points of no detection.

Validation Monitoring	
Radar Monitoring in Additional Drainages	
	season. • MRC may change, after consultation with the wildlife agencies, the locations of proposed survey sites if better sites emerge. • MRC will include in the annual report survey statistics, such as mean, median, range of detections, standard error, and standard deviation of detections. • MRC and the wildlife agencies will review the ongoing need for this monitoring program after every 10-year cycle.
MEASUREMENT CRITERIA	• MRC will use the number of murrelet-type detections in each drainage to evaluate the hypothesis.[17]
ADAPTIVE MANAGEMENT	• MRC, if we do not complete this monitoring program in any given year, will consider all trees in all covered lands outside of Navarro, Albion, and Greenwood Creek watersheds as primary murrelet trees until we re-commence the program. • MRC will confer with the wildlife agencies if any murrelet-type detections occur during any surveys. • MRC will consider all potential trees as primary murrelet trees in drainages where murrelet-type detections occur until MRC and the wildlife agencies agree and implement a plan to narrow down the areas murrelets occupy. • MRC will designate primary and secondary murrelet trees in areas murrelets do not occupy.

13.9.3 Point arena mountain beaver

13.9.3.1 Effectiveness monitoring

MRC has not consistently monitored burrow systems of Point Arena mountain beavers in the past; information is sparse on burrow systems and spatial extent. We will use the spatial extents of known burrow systems to determine whether we are protecting the burrow systems under the proposed conservation measures. An on-going study of the Point Arena mountain beavers, begun in 2004, may help us to design a more effective monitoring program (Zielinski and Mazurek 2006).

Spatial extent of PAMB burrow systems

Effectiveness Monitoring	
Spatial Extent of Known Burrow Systems of Point Arena Mountain Beaver	
PROGRAM CODE	M§13.9.3.1-1
OBJECTIVE O§10.3.3.2-1	• Maintain or enhance at least 85% of the known burrow systems of Point Arena mountain beaver in the plan area (i.e., 12 of 14).
MONITORING APPROACH	• MRC will establish the initial size of known burrow systems by measuring their spatial extent. • MRC will designate any burrow greater than 32 ft (10 m) from its nearest burrow as a separate burrow system.[18]

[17] Appendix L, *Marbled Murrelet Data and Protocol*, defines "murrelet-type detection" on p. L-1.

Effectiveness Monitoring	
Spatial Extent of Known Burrow Systems of Point Arena Mountain Beaver	
	• MRC will re-visit each known mountain beaver burrow system in the initial year of HCP/NCCP implementation and every 5 years thereafter to assess whether it is active or inactive and its spatial extent. We will initially place fern bundles at the entrance to the 5 burrow openings exhibiting the greatest likelihood of being active in a system to determine if a site is active or inactive; sites in which bundles remain after 4 days will be considered inactive. Later, MRC may use hair snares or camera stations to assess active burrow systems. Other signs of an active burrow include fresh excavations and herbaceous plant clippings near or around the burrow. Signs of an inactive burrow include growth of vegetation over the burrow entrance, cobwebs over the burrow entrance, and a general appearance of abandonment. • MRC will set a reference point with a permanent marker and measure the distance from this point to openings at the edges of the burrow system (Figure 13-5). • MRC will convert information on burrow systems to GIS coverage in which polygons will represent each burrow system; GIS will determine the size of each burrow system.
MEASUREMENT CRITERIA	• MRC, in consultation with the wildlife agencies, will determine our ability (or statistical power) to detect differences in the size of burrow systems after completing 2 rounds of measurements on all surveyed burrow systems. • MRC will compare the area of each burrow system to previous assessments of the spatial extent of each burrow system. • MRC, in consultation with the wildlife agencies, will determine by year 2025 (1) the detectable size differences in average spatial extent of all burrow systems and (2) the spatial extent of individual burrow systems.
ADAPTIVE MANAGEMENT	• MRC will halt research and consult with the wildlife agencies if the number of active burrow systems falls below our objectives, namely 12. • MRC will consult with the wildlife agencies if we detect a decreasing trend in the spatial extent of burrow systems.

[18] In completing initial surveys of mountain beaver burrow systems, MRC surveyors generally noted that if another burrow was not found within 32 ft (10 m) of the last burrow, it was exceedingly unlikely to find more burrows farther away. As a result, we collected all baseline data with 32 ft as the minimum distance between two separate burrow systems.

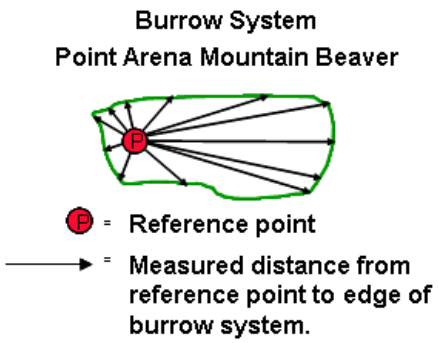


Figure 13-5 Measuring Spatial Extent of Burrow System

Creating habitat within dispersal distance of existing burrow systems

As part of the conservation measures and monitoring efforts for Point Arena mountain beaver, MRC has agreed to create new habitat for mountain beaver in the plan area. Both MRC and the wildlife agencies believe that, if successful, these efforts may increase the mountain beaver population and contribute directly to its recovery. MRC proposes to create patches of habitat within dispersal distance of existing burrow systems when timber harvest operations are nearby. This will entail harvesting small groups of trees to open up the canopy and allow herbaceous vegetation to grow. MRC and the wildlife agencies will monitor the success of these efforts to determine if further adaptive management is necessary. If the efforts prove successful, MRC, with the agreement of the wildlife agencies, may ratchet up the effort and create new habitat adjacent to or even within existing burrow systems (M§13.9.3.2-2).

Effectiveness Monitoring	
Creating Habitat with Timber Harvest within Dispersal Distance of Existing PAMB Burrow Systems	
PROGRAM CODE	M§13.9.3.1-2
OBJECTIVE O§10.3.3.2-2	• Create at least 1 site of potential habitat for each active burrow system when harvest occurs within the assessment area for Point Arena Mountain Beaver.
MONITORING APPROACH	• MRC will assess, after harvest, whether a managed area meets the habitat description. • MRC will document the length, diameter, species, and decay class of any downed wood pieces within a burrow system discovered in newly created habitat. • MRC, in consultation with the wildlife agencies, may add downed wood adjacent to or within the boundaries of newly created habitat. • MRC will follow the protocol for assessing spatial extent of burrow systems discovered in the newly created habitat. • MRC will monitor, within 100 ft (30 m) of a burrow system, the status (active or inactive) and spatial extent of the burrow system 2 years before and 5 years after timber harvest. **NOTE** If MRC biologists decide that additional years are necessary to detect a change in the burrow system, they will consult with the wildlife agencies before halting the monitoring effort.

Effectiveness Monitoring	
Creating Habitat with Timber Harvest within Dispersal Distance of Existing PAMB Burrow Systems	
MEASUREMENT CRITERIA	• MRC will evaluate the relative change between control and treated burrow sites in a Before-After-Control-Impact (BACI) approach, i.e., Area $_{control}$ – Area $_{treatment}$. • MRC will infer a positive effect if the relative area of the treatment site increases at least 1250 ft^2 more than the pre-manipulation area.[19] • MRC will infer a negative effect if the relative area of the treatment site decreases at least 1250 ft^2 less than the pre-manipulation area. • MRC will infer no effect for any change between these thresholds. **NOTE** MRC is proposing *a priori* inferences, as opposed to conducting statistical tests. There are inherently low sample sizes available and limited pre- and post-evaluation periods to quantify variability. Moreover, it is unlikely that the control and treatment experiments will be simultaneous.
ADAPTIVE MANAGEMENT	• MRC will confer with the wildlife agencies to determine if MRC should create more habitat with timber harvest.

13.9.3.2 Validation monitoring

The current definition of potential habitat for Point Arena mountain beavers is very broad (USFWS 2002). This is due to a lack of knowledge on habitat requirements for Point Arena mountain beavers (USFWS 1998a), especially on timberlands. As a result, MRC has applied a broad definition to our conservation measures for the Point Arena mountain beaver. We propose to complete research on our land; from that research there may emerge a more accurate definition of suitable habitat for Point Arena mountain beavers. All validation monitoring for Point Arena mountain beavers is optional.

Defining PAMB habitat (optional)

Validation Monitoring	
Defining Habitat for Point Arena Mountain Beavers	
PROGRAM CODE	M§13.9.3.2-1
HYPOTHESIS SECTION 5.4.9	• Our current habitat definition correctly describes potential habitat for Point Arena mountain beaver (section 10.3.3.2.1).
MONITORING APPROACH	• MRC will measure the spatial extent of all known burrow systems of Point Arena mountain beavers in the plan area. • MRC, after flagging spatial extent, will estimate the center point of the burrow system and measure soil texture, site impacts (i.e., timber harvest, vegetation management, and cattle grazing), aspect, slope, and canopy cover for the burrow system. • MRC will measure ground-cover using the line-transect method—establishing 2 transects (20 m in length, 1 m wide) in cardinal directions (i.e., north-south and east-west) centered on the center point of the burrow system. • MRC will measure canopy cover (using a spherical densiometer) at the boundaries of a burrow system in four cardinal directions (i.e., north, south, east, and west).

[19] The number 1250 ft^2 is approximately ½ the size of the smallest measured burrow system in the plan area.

Validation Monitoring	
Defining Habitat for Point Arena Mountain Beavers	
	• MRC will identify and determine relative abundance (%) of each plant species at a 1X1 m quadrant in the center of the burrow system and at 4 other 1X1 m quadrants in locations prescribed by random numbers. • MRC will use a random number table to determine a random distance and azimuth for placement quadrants in the burrow system. • MRC will count and identify tree species and determine height and dbh (for trees whose dbh is 4 in. or more) of all trees within the boundary of a burrow system. • MRC will identify species, diameter, and decay class of tree stumps within the burrow system. • MRC will count and identify by species all trees less than 4 in. dbh within the boundary of a burrow system. • MRC will use a random number table to generate a random azimuth. We will move the plot up to another 329 ft (100 m) following the random azimuth to a new point. The new point must fall within an area that meets the definition of potential habitat for Point Arena mountain beaver. If the new area does not meet the definition, we will move the plot another 329 ft (100 m) following the new azimuth from the original burrow system. At the end point, MRC will re-create the spatial extent of the initial burrow system using measurements from that burrow system. This will create, in effect, a replica of the spatial extent of the original burrow system. If the random site contains any burrows of Point Arena mountain beaver, the recreated site will be moved another 329 ft (100 m). The end point then becomes the new center point of the "random site." MRC will then use the same procedure as above to measure and record habitat characteristics of the re-created site with habitat characteristics of the actual burrow system.
MEASUREMENT CRITERIA	• MRC and the wildlife agencies will determine if data analysis from a pilot study suggests we should take action under adaptive management.
ADAPTIVE MANAGEMENT	• MRC and the terrestrial wildlife agencies will agree on any changes in the definition of potential habitat, if data analysis indicates the current definition is too narrow or too broad.

Creating potential habitat in or adjacent to existing burrow systems (optional)

Validation Monitoring	
Creating Potential Habitat in or Adjacent to Existing PAMB Burrow Systems	
PROGRAM CODE	M§13.9.3.2-2
HYPOTHESIS SECTION 5.4.9	• Timber harvest and other management techniques can create new habitat for Point Arena mountain beavers and allow for the expansion of burrow systems into new areas.
MONITORING APPROACH	• MRC will establish control and experimental burrow systems with similar topographical and vegetation conditions; the control plot will be no-harvest within a buffer area and the experimental plot will have harvest within 100 ft of a burrow system or within a burrow system. • MRC will monitor, within 100 ft of a burrow system, the status (active or inactive) and spatial extent of the burrow system 2 years before and 5 years after timber harvest. **NOTE**

Validation Monitoring	
Creating Potential Habitat in or Adjacent to Existing PAMB Burrow Systems	
	If MRC biologists decide that additional years are necessary to detect a change in the burrow system, they will consult with the wildlife agencies before halting the monitoring effort. • MRC will document the length, diameter, species, and decay class of any downed wood pieces within the burrow system. • MRC, in consultation with the wildlife agencies, may add downed wood adjacent to or within the boundaries of the burrow systems to determine its effect on the spatial extent of those systems. • MRC will assess, after harvest, whether the managed area meets the habitat description and exhibits burrows.
MEASUREMENT CRITERIA	• MRC will evaluate the relative change between control and treated burrow sites in a Before-After-Control-Impact (BACI) approach, i.e., Area $_{control}$ – Area $_{treatment}$. • MRC will infer a positive effect if the relative area of the treatment site increases at least 1250 ft^2 more than the pre-manipulation area. • MRC will infer a negative effect if the relative area of the treatment site decreases at least 1250 ft^2 less than the pre-manipulation area. • MRC will infer no effect for any change between these thresholds. **NOTE** MRC is proposing *a priori* inferences, as opposed to conducting statistical tests. There are inherently low sample sizes available and limited pre- and post-evaluation periods to quantify variability. Moreover, it is unlikely that the control and treatment experiments will be simultaneous.
ADAPTIVE MANAGEMENT	• MRC and the wildlife agencies may allow harvest within 100 ft of burrow systems without the need for consultation if ▪ At least 3 burrow systems have had no effect or a positive effect following timber harvest. AND ▪ No burrow systems have experienced a negative effect following timber harvest. • MRC will ensure that felled trees fall outside the burrow systems of Point Arena mountain beavers. • MRC will not plant conifers within 100 ft of a burrow system, if the wildlife agencies allow us to harvest within the protected buffer for mountain beavers. • MRC will meet with the wildlife agencies to determine a future course for conservation measures and experimentation, in the event that a harvest has a negative effect on the spatial extent of a burrow system. • MRC will meet with the wildlife agencies to develop habitat management guidance derived from the monitoring studies (e.g., LWD management and canopy management).

13.10 Monitoring Rare Plants

13.10.1 Elements of rare plant strategy

The conservation strategy for covered rare plants relies on 3 key elements: (1) conservation measures (see Chapter 11, *Conservation Measures for Rare Plants*); (2) monitoring; and (3) adaptive management. The intent of the conservation measures for rare plants is to

- Conserve the natural communities, habitats, and occurrences of covered rare plant species found in the plan area.
- Contribute to the recovery of covered rare plant species in the plan area that are listed as *threatened* or *endangered* by CDFG or USFWS.
- Manage and conserve rare plant species that are not listed as *threatened* or *endangered* so that listing remains unnecessary.

We will assess the effectiveness of our conservation measures through a long-term monitoring program that tracks the abundance and distribution of covered rare plants throughout our land. Monitoring results will reveal *trend*, i.e., whether rare plant species are decreasing, stable, or increasing on our land. We will evaluate trend conditions and other factors to determine whether we are meeting our conservation objectives or whether we need to propose changes in our conservation measures.

Rare plant monitoring will include effectiveness and compliance monitoring. In addition, MRC will use targeted studies to improve knowledge of some covered rare plants and to select appropriate species-specific conservation measures. In general, the monitoring protocols, which are species-specific, should

- Confirm that MRC is conducting rare plant surveys according to CDFG guidelines.
- Confirm that MRC is implementing conservation measures as prescribed in the rare plant conservation strategy.
- Evaluate the effectiveness of conservation measures.
- Determine whether MRC is meeting conservation objectives.

13.10.2 Implementation of rare plant monitoring

MRC will implement effectiveness monitoring for rare plants. We will scale the effectiveness monitoring according to the rarity and threat level of each plant species and the significance of its occurrences on our land, as expressed in each species management category (section 11.5.2, *Assigning covered rare plants species to management categories*). We will monitor species of highest concern (i.e., Management Category 1 and Management Category 2) more intensively, both in terms of survey frequency and data collected. Likewise, we will monitor species of lesser concern (i.e., Management Category 3 and Management Category 4) less intensively, while still collecting sufficient data for evaluation.

Effectiveness monitoring will consist of status and trend monitoring for Management Category 1 through Management Category 3, and presence or absence monitoring for Management Category 4. Status and trend monitoring will include measurements of abundance and distribution, as well as assessment of habitat characteristics. In addition, for each PTHP or covered activity, MRC will collect information on operation type, vegetation, and disturbance. Monitoring methods for rare plants must be species-specific and situation-specific (Elzinga et al. 1998); MRC will develop these protocols within 1-5 years of HCP/NCCP approval using the guidelines in section 13.10.2.2. The basis for specific monitoring protocols and elements (e.g., sample plot size, sample plot location) are characteristics such as life-form (e.g., annual, herbaceous perennial, shrub, and tree), size range of the plant, habitat characteristics, and distribution in the plan area. Atkinson and others (2004) support the use of different levels and frequencies of effectiveness monitoring for species in different management categories. Menges and Gordon (1996) propose scaling monitoring levels for rare plants to rarity and threat status, with the rarest and most threatened species receiving the most intensive monitoring. For the rarest plants, Menges and Gordon (1996) also recommend demographic monitoring (i.e., tracking the fate of individual plants throughout their life cycle) as a part of long-term effectiveness monitoring. However,

MRC is not proposing this approach for any of the species currently known on our land. Demographic monitoring can produce valuable data (Travis and Sutter 1986, Pavlik et al. 1993, Pavlik 1994), but it is labor-intensive and expensive (Menges and Gordon 1996); it should only be used when the data it produces is essential to determine status and trend as well as to select appropriate management options (Pavlik 1997).

In the future, MRC will consider demographic monitoring for plant species (1) if they are extremely rare and endangered in California; (2) if their growth form is suitable for demographic monitoring; and (3) if monitoring would provide essential management information. Examples of such plants include species ranked S1.1—known from 6 or fewer occurrences worldwide and highly endangered throughout their ranges. Roderick's fritillary (*Fritillaria roderickii*) and seacoast ragwort (*Senecio bolanderi* var. *bolanderi*) are examples of covered species for which demographic monitoring might be appropriate at some future date. Currently these two species are not known to occur in the plan area. MRC would not propose demographic monitoring for a species like Santa Cruz clover unless an occurrence was found on our land and the selection of conservation measures for it required a detailed life history.

The development of management-oriented models is an important component of long-term effectiveness monitoring for covered rare plant species (Atkinson et al. 2004). Models in our HCP/NCCP are basic and general. MRC may develop more detailed conceptual models for the most intensively monitored rare plants, i.e., Management Categories 1 and 2.

13.10.2.1 Evaluation of trend

MRC and the wildlife agencies will use trend to determine whether we are meeting conservation objectives. We will evaluate trend conditions as increasing, stable, or decreasing for all covered rare plant species with 1 or more occurrences in the plan area. Definitions for trend conditions will be species-specific and will use factors that indicate likelihood of long-term survival, such as number of occurrences, reproductive capacity, and other factors. MRC will develop definitions for species-specific trend conditions and determine trend as information becomes available from monitoring results and other sources. Table 13-18, using made-up data, shows an example of trend evaluation for coast lily (*Lilium maritimum*).

Table 13-18 Example of a Trend Evaluation

Example of a Trend Evaluation													
Inventory Block	CNDDB Occ Number	Year First Detected	Number individuals in First Year (baseline)	MONITORING DATA SUMMARY									Trend For Occurrence
				2007			2008			2009			
				# REPRO	# VEG	# SEEDL	# REPRO	# VEG	# SEEDL	# REPRO	# VEG	# SEEDL	
Albion	105	2003	5	7	2	0	9	5	1	15	4	2	increasing
Rockport	117	2004	8	8	3	1	7	2	0	10	1	1	stable
Annapolis	125	2004	2	4	1	0	5	1	0	6	2	0	increasing
Navarro W	142	2005	16	12	2	1	8	3	1	6	4	0	decreasing
Garcia	145	2005	7	6	1	0	7	1	1	6	1	2	stable

Example of a Trend Evaluation														
Inventory Block	CNDDB Occ Number	Year First Detected	Number individuals in First Year (baseline)	MONITORING DATA SUMMARY										Trend For Occurrence
				2007			2008			2009				
				# REPRO	# VEG	# SEEDL	# REPRO	# VEG	# SEEDL	# REPRO	# VEG	# SEEDL		
TREND FOR SPECIES IS INCREASING-STABLE														

Until and unless statistical measures can show otherwise, the following conventions will apply as trend definitions for single occurrences and for species in the plan area:

- *Trend Definitions for Single Occurrences*
  - INCREASING: Number of reproductive and vegetative individuals (combined) shows > 20% increase over time from baseline.
  - STABLE: Number of reproductive and vegetative individuals (combined) shows < 20% increase or decrease over time from baseline.
  - DECREASING: number of reproductive and vegetative individuals (combined) shows ≥ 20% decrease over time from baseline.
  - TREND NOT DETERMINED: Less than 3 monitoring events since baseline or variability in number of individuals is greater than described in definitions above.

- *Trend Definitions for Species in the Plan Area*
  - INCREASING: Majority[20] of occurrences are increasing.
  - INCREASING-STABLE: Majority of occurrences are increasing or stable.
  - STABLE: Majority of occurrences are stable.
  - STABLE-DECREASING: Majority of occurrences are stable or decreasing.
  - DECREASING: Majority of occurrences are decreasing.
  - TREND NOT DETERMINED: Variability is greater than described in definitions above.

13.10.2.2 Targeted studies

MRC is proposing targeted studies[21] to improve our biological knowledge of covered plant species and to select the most effective conservation measures for them. These studies will follow guidelines from *Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans* (Atkinson et al. 2004).

Targeted studies increase the effectiveness of monitoring and management by improving knowledge about the ecological system and about management techniques. Targeted studies, which may be implemented on a short or long term, typically

- Resolve critical uncertainties about natural systems under management (e.g., plant succession and weed dynamics in response to fire; top-down predator effects on food webs; identification of stress-sensitive and stress-tolerant species).
- Apply experimental management treatments.

Advantages of using targeted studies include the ability of management to

- Focus on the most critical aspects of a question.
- Spend a shorter duration compared to validation monitoring.
- Provide results that are scientifically valid, i.e., based on experiment and controls.

MRC is proposing targeted studies (1) to determine optimum buffer conditions for rare plant occurrences, (2) to investigate the characteristics of early successional rare species, and (3) to

[20] Majority, in the context of all trend definitions, means greater than 50 percent.
[21] Targeted studies are a form of validation monitoring.

select appropriate conservation measures for such species. Additional targeted studies may be proposed during future phases of our HCP/NCCP.

Determining optimum buffer conditions

MRC is proposing a targeted study to determine optimum buffer widths and management conditions necessary to protect covered rare plant occurrences. The intent of the buffer is to minimize the effects of covered activities on the core occurrence area by delineating a zone where habitat conditions favored by the rare plant will be maintained and harmful effects will be minimized (section 11.7.1.1). The buffer should maintain habitat characteristics important to a covered rare plant species, including microclimatic factors (humidity, temperature, and solar radiation); hydrology and soil characteristics; and populations of beneficial mycorrhizal fungi and potential pollinators. In addition, buffers will limit the range of disturbances associated with covered activities, such as soil compaction and vegetation removal.

MRC is unaware of published studies from California that have investigated the question of buffer width.[22] Studies by Harris (1984, 1988) and Russell et al. (2000) have examined changes in microclimatic factors in old-growth forests that are associated with adjacent clearcuts. Russell et al. (2000) studied the influence of clearcuts on adjacent old-growth redwood forests in northern California. They concluded that changes in microclimatic factors associated with clearcuts penetrated significant distances into old-growth forests—in some cases, distances approximately equal to 3 times the height of the dominant trees in the area. Their findings support the position that timber harvest activities can modify habitat conditions in areas distant from harvest activity. The use of buffers to minimize the impacts of covered activities on core occurrence areas of covered rare plants is supported by their findings.

Scientific data on which to base the selection of specific buffer widths and management conditions is very limited. The buffer widths and buffer management protocols proposed in our HCP/NCCP represent our best professional judgment, based on studies like those cited above and field observations of consultants and agency biologists familiar with the species, habitats, and timber harvest practices of coastal northern California. MRC is proposing a targeted study to examine the effectiveness of a range of buffer widths and buffer management protocols and to determine the optimum buffer widths and conditions.

MRC may develop a targeted study to examine buffer widths for covered rare plants after approval of our HCP/NCCP and collection of several years of monitoring data. Our targeted study will focus on issues identified by both MRC and the wildlife agencies. The study design process will

- Review relevant literature and other information, including the viewpoints of agency biologists and other scientists who have considered this problem.

- Include several different covered rare plant species that exhibit a range of variation in life form (e.g., annual, herbaceous perennial, shrub, and tree) and habitat preferences (e.g., forests, grasslands, wetlands).

- Include microclimatic variables that are known to be important to rare plant survival and reproduction, and that can be accurately measured.

[22] We are aware, however, that agency biologists working in northwestern California—Clare Golec (Caltrans), Tony LaBanca (CDFG), Linnea Hanson (USFS), and Dave Imper (USFWS)—have discussed the subject of appropriate buffer width.

- Investigate buffer effectiveness in response to a range of intensity of silvicultural activity in the adjacent harvested timberlands.

- Investigate a range of buffer widths and conditions (e.g., locale) for each covered rare plant species included in the study.

- Use an experimental approach with adequate controls and replicates.

- Organize and present findings in the final report so that they can be readily applied to adaptive management.

Monitoring methods for early successional species

MRC may propose an additional targeted study (1) to improve knowledge of the biology of the early successional species Humboldt milk-vetch (*Astragalus agnicidus)* and (2) to develop a monitoring strategy for this species. Standard monitoring methods for determining status and trend, and for evaluating whether conservation measures are being met, may not be effective (Elzinga et al. 1998). Many early successional species in California germinate vigorously in response to certain types of disturbance. They grow, produce seed crops, then decline in abundance (at least, above-ground individuals) as the habitat matures and the time since disturbance increases. Species of this type are known to persist for decades as seeds in the soil seed bank, even though there is no presence above ground (Leck et al. 1989). Evaluations of status and trend that rely mainly on standard measurements, such as numbers of extant individuals or area currently occupied, may not accurately represent the ability of these species to survive over the long term (Elzinga et al. 1998).

MRC may develop a targeted study to examine Humboldt milk-vetch after approval of our HCP/NCCP and after conducting pilot studies to test monitoring methods. If implemented, this targeted study will focus on issues identified by both MRC and the wildlife agencies. The study design process will

- Review relevant literature, including Berg and Bittman (1988), Hiss and Pickart (1992), Pickart et al. (1991), and Bencie (1997).

- Conduct reconnaissance-level field visits to Humboldt milk-vetch occurrences in the plan area.

- Summarize existing information, including data from PTHPs and other field observations, on the responses to disturbance exhibited by Humboldt milk-vetch, including responses to natural and human-caused disturbances.

- Consider demographic monitoring (tracing the fate of individuals) of a sample of Humboldt milk-vetch to determine life cycle characteristics, including year-to-year changes in plant size and seed production that occur over time.

- Consider a limited-scale investigation of the seed bank characteristics of Humboldt milk-vetch.

- Consider limited-scale experimental translocation (using seed as the propagule) to compare seed germination and seedling survival under different disturbance regimes.

- Consider the effects of reforestation on Humboldt milk-vetch.

- Consider a limited-scale experiment using fire to promote habitat quality and stimulate seed production.

13.10.3 Effectiveness monitoring

Effectiveness Monitoring	
Status and Trend of Covered Rare Plant Species	
PROGRAM CODE	M§13.10.3-1
OBJECTIVES	**Management Category 1 (MC1)**
O§11.2-1	• Maintain all covered rare plant occurrences in the plan area at stable-to-increasing levels of abundance and distribution (i.e., occurrence trend is stable-to-increasing).
O§11.2-2	• Avoid or minimize mortality of individual plants.
O§11.2-3	• Minimize direct and indirect adverse impacts to core occurrences, such as ground disturbances, accelerated erosion, accelerated sedimentation, fuel spills, slash deposition, and increases in number or cover of invasive pest plants.
O§11.2-4	• Retain existing site conditions of importance to covered rare plants, such as microclimatic factors (sun/shade levels, humidity); soil factors (soil structure, soil moisture regime, soil compaction level); local hydrology; ground disturbance levels; and plant species composition of the community and habitat.
	Management Category 2 (MC2)
O§11.2-5	• Maintain a stable-to-increasing number of occurrences in each inventory block where the covered species is known (i.e., species trend is stable-to-increasing).
O§11.2-6	• Maintain, on average, stable-to-increasing levels of abundance and distribution for the covered species throughout its range in the plan area (i.e., species trend is stable-to-increasing).
O§11.2-7	• Minimize mortality of individual plants.
O§11.2-8	• Reduce direct and indirect adverse impacts, such as ground disturbances, accelerated erosion, accelerated sedimentation, fuel spills, slash deposition, and increases in number or cover of invasive pest plants.
O§11.2-9	• Minimize changes in site conditions of importance to rare plants, such as microclimatic factors (sun/shade levels, humidity); soil factors (soil structure, soil moisture regime, soil compaction level); local hydrology; ground disturbance levels; and plant species composition of the community and habitat.
	Management Category 3 (MC3)
O§11.2-10	• Maintain stable-to-increasing levels of abundance and distribution within all inventory blocks where the covered species is found (i.e., species trend is stable-to-increasing).
O§11.2-11	• Reduce mortality of individual rare plants, as feasible.
O§11.2-12	• Reduce, as feasible, direct and indirect adverse impacts, such as ground disturbance, accelerated erosion, accelerated sedimentation, fuel spills, slash deposition, and increases in number or cover of invasive pest plants.
O§11.2-13	• Minimize, as feasible, changes in site conditions of importance to rare plants,

Effectiveness Monitoring	
Status and Trend of Covered Rare Plant Species	
	such as microclimatic factors (sun/shade levels, humidity); soil factors (soil moisture regime, soil compaction level); local hydrology; ground disturbance levels; and plant species composition of the community and habitat.
O§11.2-14 O§11.2-15 O§11.2-16	**Management Category 4 (MC4)** • Maintain number and size of occurrences in the plan area so that the species continues to qualify for its current S rank or an S rank that denotes greater abundance. • Reduce mortality of individual rare plants, as feasible. • Maintain stable-to-increasing occurrences in the plan area, mainly through community-based conservation measures.
MONITORING APPROACH	• MRC will monitor status and trend of covered rare plants on our land. • MRC will monitor individual plant species and occurrences at a level that is appropriate, based on the management category of each species. • MRC will design species-specific and situation-specific monitoring protocols, including sampling methods that meet accepted standards for accuracy and precision, using guidelines from *Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans* (Atkinson et al. 2004) and *Measuring and Monitoring Plant Populations* (Elzinga et al. 1998). • MRC will submit monitoring designs to the wildlife agencies for review. • MRC will use a pilot program to test the effectiveness and efficiency of initial monitoring approaches (Elzinga et al. 1998, Atkinson et al. 2004). • MRC will modify initial monitoring protocols, as needed, in response to new information, including detection of new core occurrences in the plan area and emergence of new information on the biological and ecological characteristics of covered rare plant species (Atkinson et al. 2004). • MRC will use the status and trend of individual core occurrences and of the species as a whole in the plan area to determine trend and evaluate whether we are meeting our conservation objectives.
MEASUREMENT CRITERIA	• MRC will use the following guidelines in developing species-specific and situation-specific monitoring protocols for each covered rare plant species known to occur in the plan area: **Management Categories 1 and 2/Monitoring Approach 1** **Monitoring Requirements: Plant Data** • MRC will monitor occurrences. ▪ **Number and frequency** ▪ MRC will monitor all occurrences in the plan area once a year until the initial status and trend of each occurrence (i.e., stable, decreasing, increasing) is established. **NOTE** The monitoring time required to determine status and trend will vary with the individual species and its characteristics. ▪ MRC will adjust monitoring frequency, after we have determined initial status and trend, as follows: ▫ If the trend for an occurrence is stable-to-increasing, monitor once every 5 years; in addition, for PTHP areas, monitor once in the year prior to stand entry and once in the year following stand entry. ▫ If the trend for an occurrence is declining, continue monitoring

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once per year until trend improves to stable-to-increasing; apply adaptive management.

- **Area**
  - MRC will monitor all of the core occurrence area (which may contract or expand from year to year), or one or more sub-areas that are representative of the occurrence as a whole, including its management history.
- **Time of Year**
  - MRC will monitor all occurrences at a time of year when we can accurately detect and identify the species, typically during the flowering or fruiting period.
  - MRC will monitor occurrences at approximately the same time each year.
- **Qualitative data**
  - MRC will record a general description of each occurrence, including size of plants; vigor of plants; rough estimate of percentage of flowering and percentage of fruiting; disease condition; predation; insects or other potential pollinators observed visiting the plants; soil or substrate type and condition; associated species of plants; invasive weeds in area; and other factors needed to assess self-sustainability.
  - MRC will take color landscape-scale photos from 1 or more permanent vantage points.
- **Quantitative data**
  - MRC will determine abundance for each occurrence using a census of all individuals, if practical.

    NOTE

    If a census is not practical, MRC will estimate abundance, using appropriate sampling methods and will analyze results with statistical tests (Elzinga et al. 1998) to estimate occurrence size. If estimating abundance is not feasible because the life form (e.g., mat-forming or rhizomatous habitat, floating or submerged aquatics, etc.) makes it difficult to count separate individuals, or for other reasons, MRC will estimate cover using appropriate methods (Elzinga et al. 1998).
  - MRC will use life stage to record the number or percent of reproductive and non-reproductive individuals.

    NOTE

    For annuals, MRC will estimate the number or percent of reproductive and non-reproductive individuals. For perennials (herbaceous and woody), MRC will estimate the number or percent of seedlings, non-reproductive adults, and reproductive adults.
  - MRC will select the appropriate census or sampling unit (e.g., individual plant; plant part such as inflorescence, fruit, or stem), according to guidelines in Elzinga et al. (1998).
  - MRC will determine, for early successional species only (e.g., *Astragalus agnicidus*, *Sidalcea malachroides*), a measure of long-term reproductive capability or viability (e.g., estimated seed production).

- MRC will determine trend.
  - MRC will develop, during monitoring protocol design, definitions for conditions of occurrence trend and species trend (stable, increasing, decreasing) that are species-specific.

NOTE

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Status and Trend of Covered Rare Plant Species

In general, definitions will incorporate parameters related to self-sustainability, such as area occupied; number or cover of individuals; and measures of viability like seed production (Pavlik 1996).

- MRC will evaluate data and determine trend for each occurrence and for all occurrences in the plan area.
- MRC will apply adaptive management in consultation with the wildlife agencies, based on trend condition. If the overall trend for the species in the plan area is (1) declining—conservation measures may increase; (2) stable—conservation measures will remain the same; (3) increasing—conservation measures may decrease.
- MRC will retain current management and monitoring, if the overall trend for species in the plan area is stable or increasing.

- MRC will monitor invasive pest plants and weed control efforts.
  - MRC will initially record for each species of invasive pest plant found in core occurrence and buffer areas the following information:
    - Name of invasive plant species.
    - Estimated percent cover of weeds in each core occurrence area and buffer area.
    - Observed and potential impacts to rare plants, including ecosystem and community effects.

  - MRC will record, after weed control treatment, the estimated percent cover of weeds within areas where weeds were controlled and in adjacent areas where weeds were not controlled.

Management Category 3/Monitoring Approach 2

Monitoring Requirements: Plant Data

- MRC will monitor occurrences.
  - **Number and frequency**
    - MRC will monitor a representative sample of occurrences in the plan area once a year until the initial status and trend of the monitored occurrence (i.e., stable, decreasing, increasing) is established.

      NOTE
      A representative sample of occurrences will include (1) one or more occurrences in each inventory block in which the species occurs; (2) occurrences that encompass the range limits of the species in the plan area for geographic distribution, size, and community or habitat type; and (3) enough occurrences so that overall status and trend for the species in the plan area can be tracked over the long-term. Selection of occurrences will follow guidance in Elzinga et al. (1998). If MRC discovers additional occurrences—after the initial monitoring program is established and within the timeframe of our HCP/NCCP—and these occurrences have special conservation significance due to size, ecology, or location, MRC may add them to the subset undergoing long-term status or trend monitoring.

    - MRC will adjust monitoring frequency, after we have determined initial status and trend, as follows:
      - If the trend for an occurrence is stable-to-increasing, monitor once every 5 years; in addition, for PTHP areas, monitor once in the year prior to stand entry and once in the year following stand entry.
      - If the trend for an occurrence is declining, continue monitoring once per year until trend improves to stable-or-increasing and

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Status and Trend of Covered Rare Plant Species

apply adaptive management.

Area

- MRC will monitor all of the core occurrence area (which may contract or expand from year to year), or one or more sub-areas that are representative of the occurrence as a whole, including its management history.

Time of Year

- MRC will monitor all occurrences at a time of year when we can accurately detect and identify the species, typically during the flowering or fruiting period.
- MRC will monitor occurrences at approximately the same time each year.

Qualitative data

- MRC will prepare a general description of the occurrence, including size of plants; vigor of plants; rough estimate of percentage of flowering and percentage of fruiting; disease condition; predation; insects or other potential pollinators observed visiting the plants; soil/substrate type and condition; associated species of plants; invasive weeds in area; and other factors needed to assess self-sustainability.
- MRC will take color landscape-scale photos from 1 or more permanent vantage points.

Quantitative data

- MRC will determine abundance using a census of all individuals, if practical; otherwise, we will estimate cover by cover class using visual estimates in representative sample plots (Elzinga et al. 1998).
- MRC will use life stage to record the number or percent of reproductive and non-reproductive individuals.

  NOTE
  For annuals, MRC will estimate the number or percent of reproductive and non-reproductive individuals. For perennials (herbaceous and woody), MRC will estimate the number or percent of seedlings, non-reproductive adults, and reproductive adults.
- MRC will select the appropriate census unit (e.g., individual plant; plant part such as inflorescence, fruit, or stem), according to Elzinga et al. (1998).

- MRC will determine trend.
  - MRC will develop, during monitoring protocol design, definitions for conditions of occurrence trend and species trend (stable, increasing, decreasing) that are species-specific.

    NOTE
    In general, definitions will incorporate parameters related to self-sustainability, such as area occupied; number or cover of individuals; and measures of viability like seed production (Pavlik 1996).
  - MRC will evaluate data and determine trend for all monitored occurrences in the plan area.
  - MRC will apply adaptive management in consultation with the wildlife agencies, based on trend condition. If the overall trend for the species in the plan area is (1) declining—conservation measures may increase; (2) stable—conservation measures will remain the same; (3) increasing—conservation measures may decrease.

Effectiveness Monitoring

Status and Trend of Covered Rare Plant Species

- MRC will monitor invasive pest plants and weed control efforts.
  - MRC will initially record for each species of invasive pest plant found in core occurrence and buffer areas the following information:
    - Name of invasive plant species.
    - Estimated percent cover of weeds in each core occurrence area and buffer area.
    - Observed and potential impacts to rare plants, including ecosystem and community effects.
  - MRC will record, after weed control treatment, the estimated percentage of weed cover within areas where weeds were controlled and in adjacent areas where weeds were not controlled.

Management Category 4/Monitoring Approach 3

Monitoring Requirements: Plant Data

- MRC will monitor occurrences.
  - **Number and frequency**
    - MRC will monitor presence/absence on a representative sample of occurrences in the plan area.

      NOTE
      A representative sample of occurrences will include (1) one or more occurrences in each inventory block in which the species occurs; (2) occurrences that encompass the range limits of the species in the plan area for geographic distribution, size, and community or habitat type; and (3) enough occurrences so that overall status and trend for the species in the plan area can be tracked over the long term. Selection of monitoring sites will follow guidance in Elzinga et al. (1998). If MRC discovers additional occurrences—after the initial monitoring program is established and within the timeframe of our HCP/NCCP—and these occurrences have special conservation significance due to size, ecology, or location, MRC may add them to the subset undergoing long-term status/trend monitoring.
    - MRC will adjust monitoring frequency, after we determine initial status and trend, as follows:
      - If trend for occurrence is stable-to-increasing, monitor once every 5 years; for PTHP areas, monitor once in the year prior to stand entry and once in the year following stand entry.
      - If trend for occurrence is declining, continue monitoring once per year until trend improves to stable-to-increasing and apply adaptive management.
  - **Area**
    - MRC will monitor all of the core occurrence area (which may contract or expand from year to year), or one or more sub-areas that are representative of the occurrence as a whole.
  - **Time of Year**
    - MRC will monitor all occurrences at a time of year when we can accurately detect and identify the species, typically during the flowering or fruiting period.
    - MRC will monitor occurrences at approximately the same time each year.
  - **Qualitative data**

Effectiveness Monitoring	
Status and Trend of Covered Rare Plant Species	
	▪ MRC will prepare a general description of the occurrence, including, at a minimum, a rough visual estimate of number of individuals or area covered by rare plants and a summary of occurrence characteristics important to conservation. ▪ MRC will take color landscape-scale photos from 1 or more permanent vantage points. • MRC will determine trend. ▪ MRC will base determination of species trend on data about presence or absence of occurrences. ▪ MRC will apply adaptive management in consultation with the wildlife agencies, if loss of occurrences in the plan area results in a change in S rank from less rare to more rare (e.g., from S4 to S3). • MRC will monitor invasive pest plants. ▪ MRC will list invasive pest plants observed in the vicinity of the occurrence and will note observed and possible future impacts to rare plants, including ecosystem and community effects. **Management Category 1-4/ Monitoring Approach 1-3** **Monitoring Requirements: Operation Type, Vegetation, and Disturbance Data** • MRC will collect, for each PTHP or other covered activity, the following data: ▪ Operation type (e.g., yarding, road maintenance, silviculture). ▪ Tree characteristics before and after harvest (species mix, density, and size class). ▪ Seral stage (primary, early, middle, late, mature), using consistent and objective definitions. ▪ Percent canopy cover, measured with the best available method, e.g., vertical densitometer or aerial photography. ▪ Understory species composition. ▪ Level of pre-harvest physical disturbance (none, low, medium, high), using consistent and objective definitions. ▪ Type of pre-harvest physical disturbance (road maintenance or use, erosion, landslides, blow-down, fire, flood effects).
ADAPTIVE MANAGEMENT	• MRC will determine the trend of all rare plant species found in the plan area, based on species-specific definitions of trend condition (declining, stable, or increasing) developed as a part of monitoring protocols. • MRC will determine whether conservation objectives are being met. • MRC will confer with the wildlife agencies on a regular basis (i.e., at least every 5 years or upon request) to decide whether we should modify conservation measures. ▪ If MRC or the wildlife agencies propose to modify conservation measures, they must determine whether adequate information exists—in the scientific literature, targeted studies, or other sources—to do so. ▪ If adequate information exists to modify existing conservation measures or to select an alternative conservation measure, MRC and the wildlife agencies may jointly select and approve the change, consistent with goals and objectives. ▪ If adequate information does not exist to modify existing conservation

Effectiveness Monitoring	
Status and Trend of Covered Rare Plant Species	
	measures or if monitoring reveals declines, MRC and the wildlife agencies will work together to develop the goals for a targeted study and select a person to design the study, collect and interpret study data, and make recommendations based on study findings. • MRC and the wildlife agencies will, jointly or individually, fund or seek funding for any targeted studies that they decide to implement. • MRC and the wildlife agencies will act on the findings of the targeted study in a timely manner. • MRC and the wildlife agencies may convene a science panel to advise the parties in the resolution of any disagreements that may persist during the adaptive management process (see section 13.11)

13.10.4 Adaptive management

Adaptive management for covered rare plants will be an interactive, long-term process that uses the results of monitoring and targeted studies to evaluate the effectiveness of conservation measures and make adjustments in conservation measures, if warranted. Adaptive management, required by the revised Natural Community Conservation Planning Act (2003), applies to covered rare plants as well as natural communities. It is inherent in the process that MRC and the wildlife agencies will use to determine management categories for rare plants. If the status of a covered rare plant improves or declines in the plan area, as determined through monitoring, there may be changes to its management category and to its conservation measures. Adaptive management also kicks in when MRC is not meeting conservation objectives. If trend condition and other information provided in the MRC annual status report to the wildlife agencies indicate that MRC is not meeting the conservation objectives, then MRC and the wildlife agencies will confer on appropriate modifications to the conservation measures. MRC will also confer with the wildlife agencies if conservation measures prove to be more restrictive than necessary; either MRC or the wildlife agencies may recommend modifications in this case. The long-term goal is to manage and conserve rare plant species that are not listed as *threatened* or *endangered* so that listing remains unnecessary

Key elements in implementation of adaptive management include the following:

- MRC will determine the trend of all covered rare plant species found in the plan area, based on species-specific metrics of trend condition (declining, stable, or increasing) developed in conjunction with monitoring protocols.

- MRC will determine whether we are meeting conservation objectives, based on trend and other factors.
- MRC will confer with the wildlife agencies on a regular basis (i.e., at least every 5 years or upon request) to decide whether we should modify conservation measures.

- MRC and the wildlife agencies must determine whether adequate information exists—in the scientific literature, targeted studies, or other sources—to modify conservation measures.

- MRC and the wildlife agencies will jointly select and approve

modifications to conservation measures, if adequate information exists to do so.

- MRC and the wildlife agencies will work together to fill information gaps, using, for example, targeted studies, if adequate information does not exist for modifying conservation measures.
- MRC and the wildlife agencies will develop goals and select a person to design a targeted study, collect and interpret study data, and make recommendations based on study findings, if such a study is warranted.
- MRC and the wildlife agencies will, jointly or individually, fund or seek funding for any targeted studies that they decide to implement.
- MRC and the wildlife agencies will act on the findings of the targeted study in a timely manner.

13.11 Program Structure for Adaptive Management and Monitoring

MRC oversees the programs for adaptive management and monitoring. The wildlife agencies will provide input and help guide the programs, but MRC has ultimate responsibility for implementing the programs. MRC will prioritize HCP/NCCP activities, develop annual and long-term work plans, and disseminate annual reports. The wildlife agencies—USFWS, NMFS, and CDFG—are responsible for ensuring the proper implementation of our HCP/NCCP. Based on the annual reports they receive, they will guide the efforts of MRC so that our HCP/NCCP remains in compliance.

A Science Panel will provide technical interpretations of issues in dispute and assist MRC and the wildlife agencies to reach consensus. If monitoring indicates that a conservation measure needs modification, MRC will meet with the wildlife agencies to determine the necessary changes. If MRC and the wildlife agencies cannot reach agreement on a change to a conservation measure, they will consult a scientific review panel. The scientific review panel will consist of experts in a discipline relevant to the conservation measure. The panel will include

- One person chosen by the wildlife agencies.
- One person chosen by MRC.
- One person acceptable to both MRC and the wildlife agencies.

The wildlife agencies will consider the findings and recommendations of the scientific review panel in determining changes to conservation measures.
For monitoring purposes, the 80-year term consists of 20-year intervals. At the end of 20, 40, and 60 years, MRC and the wildlife agencies will convene and discuss whether to change the monitoring programs, particularly the intensity of sampling. The wildlife agencies may ask for a review of a monitoring program any time during the term of our HCP/NCCP. Likewise, MRC, with approval of the wildlife agencies, can initiate minor changes to a monitoring program. As scientific knowledge and technology improve over the course of 80 years, MRC or the wildlife agencies will likely suggest many changes in monitoring methods and protocols.

13.11.1 Partnerships

MRC cannot shoulder the total cost of researching all issues of forest management that may arise during the term of our HCP/NCCP. However, we are willing to partner with governmental agencies, research institutions, as well as public and non-governmental organizations to examine the scientific justification for our current and future land management practices. Under such an arrangement, research partners must follow the rules in place for individuals or contractors entering and using our forest lands. MRC will share with the wildlife agencies any data gathered in research partnerships that might be useful in evaluating HCP/NCCP performance.

13.12 Reporting Requirements

MRC will prepare reports over the term of our HCP/NCCP that document permit compliance, as well as management actions, monitoring results, and targeted studies. Appendix D, *HCP/NCCP Report Timelines and Samples*, contains reporting schedules, report examples, and a cross-reference table to specific sections in Chapter 13 that link to the report examples. These reports provide the wildlife agencies with data on compliance, validation, and effectiveness monitoring for aquatic and terrestrial habitat and species, as well as information on roads, mass wasting, and timber inventory. The purpose of the reports is to communicate the findings of the monitoring and adaptive management program about the effectiveness of MRC in meeting the goals and objectives of our HCP/NCCP. Although MRC will submit most reports annually, there are different report intervals. Finally, MRC will submit reports to designated representatives of the wildlife agencies and share them with other interested parties, as appropriate.

The goals of the reports are to

- Demonstrate to the wildlife agencies that MRC is properly implementing our HCP/NCCP.
- Disclose and correct any problems with HCP/NCCP implementation.
- Document issues with HCP/NCCP implementation that may require consultation with wildlife agencies.
- Identify administrative or minor changes to HCP/NCCP components that could increase the effectiveness of conservation measures.

13.12.1 Compliance Reporting

To ensure that PTHPs conform to HCP/NCCP conservation measures and to assist the wildlife agencies in verifying compliance, MRC will provide the wildlife agencies with notices of operation start and completion, as well as compliance reports. In some cases, an individual report may serve several purposes. A report may indicate, for example, how MRC is complying with HCP/NCCP requirements and whether a group of conservation measures are effective.

For those years in which monitoring occurs, MRC will submit year-end reports to the wildlife agencies on

- Aquatic habitat and species.
- Long-term channels.
- LWD recruitment and placement.
- Sediment control.
- Northern spotted owls.
- Marbled murrelets.
- Point Arena mountain beavers.

- Snags, wildlife trees, and downed wood.
- Hardwoods.
- Rare plants.

MRC will submit reports every ten years to the wildlife agencies on

- Natural communities.
- Old growth.
- Rocky outcrops.

13.12.2 Website and workshops

Monitoring reports pertaining to our HCP/NCCP will be available to the public on the MRC website (www.mendocinoredwoodcompany.com). In addition, during each year of HCP/NCCP implementation, MRC will conduct public workshops that assess our progress in meeting the conservation objectives of the plan.

Chapter 14

Changed and Unforeseen Circumstances

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14 CHANGED AND UNFORESEEN CIRCUMSTANCES

14.1 Introduction

MRC recognizes that, while we can minimize management disturbances to species habitat, we cannot eliminate natural disturbances. Forest stands in the Pacific Northwest are dynamic ecosystems subject to natural forces such as floods, wind, fire, landslides, drought, pathogens, and earthquakes. MRC designed the conservation measures of the HCP/NCCP to cope with natural disturbances that routinely occur, such as small fires and small mass wasting events.

Scientific models can simulate forest landscapes and, to a degree, predict the frequency and intensity of natural disturbances; however, they cannot predict the time and location of the disturbance—or the impact it will have on the environment. Natural disturbances may significantly alter stream and forest habitats, producing, in the process, both positive and negative effects. Awareness of the important role natural disturbances play in maintaining animal populations and habitat characteristics is growing (Agee 1997; Perry and Amaranthus 1997; Schowalter et al. 1997). As we understand our environment better, our plans for protecting, restoring, and enhancing it will change as well.

14.2 Changed Circumstances vs. Unforeseen Circumstances

After each natural disturbance, MRC will determine whether a changed or unforeseen circumstance has occurred. MRC considers a changed circumstance to be a reasonably foreseeable condition that could affect covered species or covered land. Conversely, an unforeseen circumstance is a condition that (1) was not foreseeable at the time of HCP/NCCP development; (2) affects species, habitat, natural communities or lands covered by our HCP/NCCP; and (3) results in a substantial adverse change in the status of one or more covered species.

As explained in the *Implementing Agreement*, under an approved HCP/NCCP the wildlife agencies will require MRC to respond to changed circumstances with measures already identified in our HCP/NCCP. However, as long as our HCP/NCCP is properly implemented, the wildlife agencies will not require MRC, without their consent, to respond to unforeseen circumstances by expending more money, setting aside additional land, or implementing new conservation measures. The relevant notice from the Federal Register (63 FR 8868) is as follows:

> If additional conservation and mitigation measures are deemed necessary to respond to unforeseen circumstances, the Services may require additional measures of the permittee where the conservation plan is being properly implemented, but only if such measures are limited to modifications within conserved habitat areas, if any, or to the conservation plan's operating conservation program for the affected species, and maintain the original terms of the conservation plan to the maximum extent possible. Additional conservation and mitigation measures will not involve the commitment of additional land, water or financial compensation or restrictions on the use of land, water (including quantity and timing of delivery), or other natural resources otherwise available for development or use under the original terms of the conservation plan, without the consent of the permittee.

14.2.1 Natural events

As much as possible, MRC anticipates natural disturbances based on historical patterns. For phenomena that have estimable intervals of recurrence based on past occurrences (e.g., floods, earthquakes, and fires), MRC can anticipate the probability of potential future events over a given time period. Although most of these events occur randomly in nature, some are more likely than others to occur over the 80-year term of our HCP/NCCP. We understand that such events are out of the ordinary and may require conservation measures that go above and beyond our standard conservation measures. For phenomena that occur with little or no estimate of recurrence (e.g., climate change and pathogen invasion), MRC must be more flexible and creative in developing and applying conservation measures. In fact, MRC cannot be certain whether these conservation measures will ever be needed or applied. At best, we will select triggers that alert us to the need to apply more than just the standard conservation measures to protect covered species and natural communities. Most natural events will not precipitate revised or additional conservation measures.

14.2.2 Economic events

Changed circumstances may result as well from economic conditions affecting the log market; from that market, MRC earns revenue to fund our HCP/NCCP. In 2009, the log market was down. According to Random Lengths, an independent company which issues market reports for the timber industry, the framing lumber composite price (FLPC) was down 27% (27 February 2009). FLPC is the average of all the prices for different framing lumber used in home construction across the United States.

The 2008 global financial crisis affected everything from Wall Street to Main Street; its aftermath may persist for several years. Alan Greenspan, former Chairman of the Federal Reserve (1987-2006), described the banking and housing meltdown as a “once-in-a-century credit tsunami.” Economic uncertainty and the collapse of the housing market resulted in a significant reduction in timber sales for MRC and others in the industry. MRC sales volume was down 40%. Due to the economic downturn, MRC downsized its employee base by 60% in May 2009. In the ensuing year, as the lumber business started to pick up again, MRC was able to re-hire staff. By 2nd quarter 2010, the redwood log market showed some signs of improvement.

The source of funding for MRC monitoring programs is primarily revenue from our timber harvest. Over the 80-year term of our HCP/NCCP, the projected harvest levels will increase as the forest and the economy continue to recover. When this occurs, MRC will increase its milling capacity and customer base. If the future brings another financial meltdown like that of 2008, MRC will once again reduce harvest levels, staffing, milling, monitoring, and road repairs. Harvest cutbacks will not eliminate all monitoring programs; in some cases, MRC will monitor less frequently until harvest levels rebound. As harvest activities slow down, so does road repair since it usually occurs in conjunction with harvest operations. However, MRC will continue to adhere to overall timelines, such as the 30-year deadline for treating 1,302,000 yd^3 of controllable erosion (O§8.3.2-6).

14.2.3 Technological and scientific advances

There have been many new technologies and scientific advances over the last 30 years that have given us new opportunities for managing a commercial forest. Among these are

- Helicopter yarding.
- Cloning.
- Genetic engineering.

- Pre-fabricated building-block materials for road construction.
- Remote sensing of topographic data (e.g., LIDAR).
- Chemicals for plant growth or plant retardation.
- Chemicals for fighting fires (e.g., Thermo-Gel).
- GIS programs for pinpointing the location of fires in their early stages.

John Deere Logging Spider

Already we can assess what some of their benefits and drawbacks are. However, there will always be new technologies coming out of academic and industrial research that, when employed, might lead to "changed circumstances" in the forest environment. Several years ago, a Finnish company, Plustech Oy, which was a John Deere subsidiary, unleashed a prototype for a walking machine. Some dubbed it the “logging spider” and saw in it a way to improve maneuverability in confined forest spaces and minimize impact to habitat. As it turned out, the hexapod machine never made it into production.

Generally with new technology, we apply it in a limited scope and over a period of evaluation so we can "test the waters" and avoid any major disaster. Clearly, management has to be judicious and do research and testing before adapting a new technology. Like doctors administering what should be healing drugs, they have to have some antidote in their pocket in case things go wrong.

MRC will develop a company plan for addressing new technology and scientific research to decide what is right for us and how we should step things out to be innovative but cautious at the same time. We will confer with the wildlife agencies and seek their feedback on technological advances that might adversely impact HCP/NCCP conservation measures, habitat for covered species, or covered natural communities.

14.2.4 Identifying changed and unforeseen circumstances

MRC identifies the conditions for a changed and unforeseen circumstance in cases of

- Fire.
- Drought.
- Windthrow.
- Mass wasting.
- Flood.
- Pathogens and pests.
- Bullfrogs.
- Wild pigs.
- Barred owls.
- Other species interactions, like feral dogs and catfish.

14.2.4.1 Changed circumstance

In the event that USFWS, CDFG, or NMFS believes that a changed circumstance may exist in the plan area, they will notify MRC and the other signatory wildlife agencies. If MRC or any of the wildlife agencies concludes that a changed circumstance does in fact exist, they will explain the reason for their conclusion and propose in writing an appropriate response in accordance with the timelines listed in section 14.2.5. MRC will meet with the wildlife agencies within 21 days of receiving a written request in order to discuss their proposed response to the changed circumstance. If MRC cannot reach agreement with the wildlife agencies, the wildlife agencies will select a response from the alternatives listed in section 14.2.5 and MRC will implement the response.

14.2.4.2 Unforeseen circumstance

Under the regulatory assurances of our HCP/NCCP, MRC is not responsible for unforeseen circumstances, but only for what is covered in the plan, which includes changed circumstances. If an unforeseen circumstance occurs, it is the responsibility of the wildlife agencies to address it. MRC will confer and cooperate with the wildlife agencies in their efforts to do so.

14.2.5 Standard procedure for a changed circumstance

MRC will follow the procedures detailed in sections 7.2 through 7.3.1 of the *Implementing Agreement* if we believe a changed circumstance may have occurred.

- MRC will notify the wildlife agencies, as soon as practicable, when we undertake an assessment of a possible changed circumstance.
- MRC will notify the wildlife agencies within 7 calendar days of the date we actually determine a changed circumstance has occurred.
- MRC will prepare a proposal based on the best available science at the time of the changed circumstance and after preliminary consultation with the wildlife agencies.
- MRC will submit to the wildlife agencies our proposal within 60 calendar days of determining a changed circumstance and request the wildlife agencies to submit their comments within 10 working days.
- MRC will address any comments of the wildlife agencies and negotiate any changes.
- MRC will specify implementation schedules for any additional measures in a prompt and reasonable time-frame.
- MRC will create, in consultation with the wildlife agencies, a final draft with any additional measures.
- MRC will submit the final draft to the wildlife agencies and request that the wildlife agencies acknowledge receipt and acceptance of the proposal.
- MRC will enter into dispute resolution if the wildlife agencies and MRC cannot agree on the proposed measures in the final draft (see Appendix A, *Implementing Agreement*).
- MRC will begin implementing the measures within 30 calendar days of creating the final draft.

MRC, in consultation with the wildlife agencies, can modify the timelines outlined above. The intent of the timelines is to strike a balance between “rush to action” and “contributory delays.” Rushing to action before essential information is available might cause unintended consequences. On the other hand, delaying action that could prevent further damage is irresponsible.

14.2.6 Step up in intensity

In subsequent sections of this chapter, MRC describes 2 conditions: (1) an event triggers a changed circumstance and 2) an event triggers an unforeseen circumstance. The events for condition 1 are subsumed under the events for condition 2. For example, a changed circumstance (condition 1) for a windstorm is a storm that results in windthrow of at least 10 ac in LACMA; an unforeseen circumstance (condition 2) for a windstorm is a storm that results in windthrow of at least 50 ac in LACMA. In this example, 50 ac is a "step up" from 10 ac.

14.3 Fire

Lightning Fire in MRC Plan Area Late June 2008

Fire has a significant influence on the ecology of coastal coniferous forests. Fire frequency and intensity vary widely (Agee and Edmonds 1992), but generally increase with distance from the ocean and elevation (Sawyer et al. 2000b). Vegetation patterns follow this gradient; redwood-dominated stands along the coast phase inland into Douglas fir stands. For stand-replacing fires, the return interval is between 250-500 years in coastal old-growth forests, 150-200 years in transitional areas, and 33-50 years in inland areas (Veirs 1980, as cited in Sawyer et al. 2000b). The estimated fire return interval in Sonoma County for Douglas fir and hardwood-dominated forest stands with individual redwood trees is 6-23 years (Finney and Martin 1992, as cited in Sawyer et al. 2000b). Many studies of redwood forests found that fires hot enough to leave tree-ring evidence had, on average, fire return intervals than 25 years (Stephens and Fry 2005). Within these studies, uncommon.

Lightning is rare along the coast and fire conditions in coastal forests are seldom extreme; severe fires generally move into coastal redwoods from their eastern margins (Greenlee 1983, as cited in Sawyer et al. 2000b).

Fires often become catastrophic due to a combination of factors, including

- Climate.
- Inappropriate fuels management.
- Past timber management.

Agee predicts that it will take many decades to significantly reduce catastrophic fire potential at a landscape level (Agee 1997). In addition, the 21st century is facing global climate change. An increase of fire frequency is predicted for drier climates (Romme and Turner 1991, as cited in Agee 1997). In the past, catastrophic fires were associated with warming periods in the Pacific Northwest (Agee 1997).

Fire prevention and suppression is a common management tool in forested areas; as a result, combustible material that would normally be burned by more frequent, regular, low-intensity fires

gradually builds up. Fuel load is the term to describe this potentially combustible material. Fire risk increases with greater fuel loads. Timber harvest can also increase fuel loads in the short-term, when slash (branches, needles, and leaves of cut trees) are left after harvest. Appropriate site preparation, however, such as pile burning, can decrease fire risks.

14.3.1 Effects of fire on forest stands

Predicting the impacts of fire on a particular forest stand is difficult due to differences in forest-stand characteristics and fire variability (Morrison and Swanson 1990). Fire impacts tree species differently and tree species recover from fire at different rates. Redwoods, for example, are fairly fire resistant, whereas Douglas fir and tanoaks require fire to be competitive with shade-tolerant shrub and tree species. Fires create certain beneficial habitat elements, such as snags and downed wood. However, they also can alter habitat dramatically and produce adverse effects for covered species.

Stand-replacing fires can

- Convert forested habitat into early successional habitat.
- Alter aquatic habitats by decreasing canopy cover and stream-stabilizing vegetation.
- Increase the potential for erosion.
- Remove or diminish pre-existing snags and LWD.
- Generate new snags and LWD.

14.3.1.1 Redwoods

Fire plays an important role in the ecology of coastal redwood forests. Longer fire-free intervals favor establishment of fire-tolerant redwood forest stands, as well as tanoak and western hemlock. Repeated fires with short return intervals favor the growth of young redwoods because of their ability to sprout (Rydelius and Libby 1983, as cited in Sawyer et al. 2000a). Large catastrophic fires are rare but do occur in redwood forests. A fire in 1945 burned 306,404 ac (124,000 ha) of redwood forest stands in northern Humboldt County (Sawyer et al. 2000a). In unlogged areas, this fire did almost no damage to old-growth stands, but did lead to an increase in western hemlock and redwood sprouts. Within selectively logged areas, the fire destroyed the remaining Douglas fir and hemlock, leaving shrubs and red alder among dense clumps of redwood sprouts.

The impact of fire on redwood trees depends on the size of a tree. The bark of small trees with a dbh less than 8 in. (20 cm) is too thin to protect the cambium. Cool-to-hot fires can top-kill trees, i.e., destroy the above-ground tissues of a plant without killing underground parts from which the plant may produce new stems and leaves (Finney and Martin 1991, as cited in USDA 2002). Bark of mature redwoods is thick and fires often only reduce the amount of bark (Olson et al. 2002). Stand-replacing fires can cause basal wounding and top-kill. However, intense fires that burn too much of the cambium near the ground will kill roots; healing growth will be inadequate to reconnect enough of the stem and root system (Olson et al. 2002). With less water transported to the crown, growth rates decrease and the probability of a tree surviving another fire will be lower (Sawyer et al. 2000b). Surveys in Redwood National Park indicate that surface fires in 1894 and 1974 did not influence stand structure, although there was less competition among trees,

evidenced by the increased width of the growth rings after the fire (Abbott 1987, as cited in Sawyer et al. 2000b).

14.3.1.2 Douglas fir

Douglas fir benefits from fire. This species prefers open areas and, therefore, thrives in areas where fire has removed understory and canopy foliage (Sawyer et al. 2000b). Douglas fir re-generates by seeding (Mayer and Laudenslayer 1988) with good years for seed occurring irregularly. The proportion of Douglas fir in coastal forests increases with the distance from the ocean and with higher elevation, as does fire frequency.

14.3.1.3 Hardwoods (tanoak)

In northern California, tanoak is one of the primary successional species after timber harvesting or natural disturbances, such as fire and windthrow. Some previously logged areas in the plan area may have a higher component of tanoak than existed prior to commercial logging. Tanoak tends to dominate previously logged stands because of the long time frame required for conifers, like Douglas fir and redwood, to out-compete this hardwood species.

Tanoak re-generates by sprouting. Tanoak sprouts grow faster than Douglas-fir seedlings and coast redwoods (Mayer and Laudenslayer 1988); they may aggressively compete with Douglas fir and coast redwood in mixed coniferous forests (Little 1979, Burns 1983, Barrett 1995, all as cited in Piirto et al. 1997). Tanoak can form a nearly solid canopy for 60-100 years until natural mortality allows Douglas fir to eventually out-compete most tanoak and become dominant (Mayer and Laudenslayer 1988). The high stem densities in these stands may suppress growth of other trees and make these stands vulnerable to catastrophic fires, especially in the vicinity of ridge crests that are more prone to ignition by lightning strike.

14.3.2 Effects of fire on terrestrial covered species

14.3.2.1 Marbled murrelet

Because marbled murrelets depend on mature or old-growth stands for nesting and roosting, fires that destroy or reduce the size of these stands will probably have an adverse effect on marbled murrelet populations. However, marbled murrelets sometimes nest in unlogged mature stands or large sawtimber[1] stands burned 80 to 200 years ago; in these stands, open crown canopies or steep slopes provide access to and from large limbs (Marshall 1988). Marbled murrelets nest in habitat types characterized by long fire-free intervals. Sitka spruce stands in western Washington typically have a fire-free interval of 1146 years or more. Along the northern and southern Oregon coast, Sitka spruce has a fire-free interval of 200 to 400 years. Fires that do occur in Sitka spruce are usually stand replacing. Western hemlock forests along the coast have a fire-free interval of about 750 years (Agee 1993). Coastal redwood is tolerant of low-severity fires which appear to have occurred before the arrival of European settlers at 9-20 year intervals in coastal Mendocino County (Brown and Baxter 2003); stand-replacing fires occurred on 200-500 year intervals (Lehman 1989 and Agee 1993).

14.3.2.2 Northern spotted owl

Most northern spotted owl habitat in the Pacific Northwest owes its structure and species composition to fire (Lehman 1989). However, decades of timber harvest and timber management have created the spotted owl habitat in the plan area—not fire. The Mendocino Lightning Complex of 2008 reduced suitable owl habitat across the plan area, but MRC expects this habitat

[1] Trees with at least a 9 in. dbh (softwood) and an 11 in. dbh (hardwood)

to recover in a short ecological span. This will be the result of new growth in burnt areas and other areas growing into suitable habitat.

14.3.3 Effects of fire on aquatic systems

The effects of fire on aquatic systems are directly related to the intensity of the fire. Low intensity fires that burn the shrub layer may cause a slight increase in sediment loads because of exposed soils. High intensity fires, on the other hand, can cause a sharp increase in sediment loads by removing significant amounts of vegetation and killing trees whose roots help to maintain slope stability in sensitive terrain.

Low intensity fires are unlikely to significantly impact riparian areas, while high intensity fires can remove canopy and eliminate downed wood. Removal of canopy may lead to increased temperatures. Removal of existing downed wood reduces a stream's ability to meter the sediment load. High intensity fires, by killing trees, are more likely to recruit significant amounts of woody debris. However, this recruitment may not occur soon enough to meter the sediment load created by the fire.

Heavy rainfall following severe fires can move large quantities of soluble ash into streams. Ash contains nitrates and phosphorus; levels of these chemicals in streams increase after wildfires. The most pronounced effect of wildfire on water chemistry is usually an increase in nitrates (Gluns and Toews 1989). As a forest regenerates after fire, the dissolved chemical load of the stream generally returns to the levels observed before the fire.

> Changes in water regimes are most significant where fire has a large-scale impact on vegetation and water retention properties of soils. Annual water yield can be significantly increased after fire due to the reduction or elimination of vegetation. Loss of vegetation increases the speed at which water reaches soils during rainstorms, increasing the potential for sharp peaks in storm runoff to streams. Intensively burned soils can have their ability to retain water dramatically reduced, further heightening the magnitude and shortening the duration of water discharge to streams during storms. Evaporation of water on soils or in the top layer of soils may increase, but increases in evaporation are minimal compared to increases in the runoff. Summer flows may also increase due to vegetation loss, as water previously used by plants remains available in the summer to become stream flows. In dry areas this may be a significant benefit to aquatic (and terrestrial) systems. (Agee 1993)

Disturbances, whether caused by fire, storms, or volcanic eruptions, are important to the natural history of aquatic ecosystems. The biodiversity in many aquatic ecosystems is shaped by patterns of disturbance. Periodic large-scale disturbances of aquatic ecosystems are inevitable and often beneficial over long periods. Knowledge of the disturbance process can form an important ecological foundation for fire-related management (Bisson et al 2003).

14.3.4 Effects of salvage harvests after a fire

Harvesting all fire-damaged trees can inhibit the forest from developing significant habitat elements—like snags, goose pins, and downed wood—for several decades. A forest without such elements cannot support the diversity of wildlife desired by MRC and the wildlife agencies.

Un-restrained salvage operations after a fire can impact aquatic systems. Fires generally remove the duff and vegetative layer above the soil. Without specific erosion control measures, high impact yarding can promote increased sediment delivery into watercourses. Logging after a fire

generally damages soil by (1) compacting it; (2) removing vital organic matter; and (3) increasing the amount and duration of topsoil erosion and runoff (Kattleman 1996, as stated in Karr et al. 2004). Increased runoff and erosion alter the river hydrology by increasing the frequency and magnitude of erosive high flows and raising sediment loads (Waters 1995, as stated in Karr et al. 2004) Removal of burned trees that provide shade may hamper tree regeneration, especially on high-elevation or dry sites (Perry et al. 1989, as cited in Karr et al. 2004).

After a fire, MRC will salvage trees likely to die or trees not viable for timber production (evident by reduced live crown and basal scarring); at the same time, we will retain other trees and woody debris according to the conservation measures in our HCP/NCCP for AMZ, TSU, snags, LWD, wildlife trees, and spotted owl core areas. Depending on the location and intensity of a fire, about 25-70% of merchantable trees will remain after a fire salvage resulting from a changed circumstance. Steep AMZ areas near watercourses or high hazard TSUs (i.e., TSU1 through TSU3) will likely have a large amount of tree retention, while flat areas near ridge tops will generally have much less retention.

14.3.5 Fire occurrence in the assessment area

The trend has been to exclude large fires in the assessment area, as evidenced below:

1. Historical record
   Prior to 2008, the most recent large fire in Mendocino County was the Comptche fire, which burned or scorched approximately 29,000 ac (11,736 ha) in September 1931. Individuals working with smaller fires in upper Big River apparently started the Comptche fire. Strong winds swept the smaller fires into the Albion watershed. Due to unfavorable wind conditions and limited available personnel, firefighters took several days to control the fire. Burned lands owned by Union Lumber Company covered 20,000 ac (8094 ha) and consisted mainly of second-growth forest stands, a small number of 20-year old trees, some replanted redwoods, and brush. In late June of 2008, a series of lightning strikes ignited approximately 23,196 ac (9387 ha) of the plan area. The two largest fires burned 9495 ac (3842 ha) at South Coast and 8839 ac (3577 ha) at Rockport (see Table 1-5).

Photos of Mendocino Lightning Complex (2008) in the Plan Area

South Coast Fire at Cliff Ridge
25 June 2008

Burnover from Hardy Ridge Fire (Rockport)
View from CAL FIRE Helicopter 21 July 2008

2. Research
   At Jackson Demonstration State Forest, located dead center in our HCP/NCCP assessment area, Brown and Baxter (2003) found surface fires were frequent prior to the early 20th century. In the coastal redwood forest, the fire-free interval was 6-20 years; however, Brown and Baxter found no fire scars after 1930.

3. Improved strategies and infrastructure
   Based on our data analysis,[2] the only fires in the assessment area since 1970 that covered more than 5000 ac were from the Mendocino Lightning Complex (2008). The reduction in the number of large fires is likely the result of improvements in fire prevention and control tactics (i.e., fire suppression) and in road systems and maintenance (i.e., access to forests). The large extent and number of fires in the Mendocino Lightning Complex indicate that these types of events, while rare, may occur within the 80-year term of our HCP/NCCP.

MRC believes the trend to exclude large fires will continue during the term of our HCP/NCCP.

14.3.6 Changed and unforeseen circumstances for fire

14.3.6.1 Changed circumstance

Fire, including wildfires from timber operations and prescribed burning, constitutes a changed circumstance if one or more of the following conditions apply, i.e., the fire

- Covers, in 1 fire season, more than 15% of the plan area (32,000 ac/12,950 ha) or more than 50% of a planning watershed in which MRC owns at least 500 ac.
- Covers more than 10 ac (4 ha) in LACMA.
- Results in a reduction of at least 500 ac (202 ha) of suitable habitat per territory for up to 4 northern spotted owl territories receiving high or moderate protection.

14.3.6.2 Unforeseen circumstance

Fire constitutes an unforeseen circumstance if 1 or more of the following conditions apply, i.e., the fire

- Results in a change of structure class to more than 30% of the plan area (63,973 ac/ 25,889 ha) within 1 fire season.
- Results in a change of structure class to more than 50% of the plan area (106,622 ac/ 43,148 ha) over 10 years.
- Covers more than 50 ac (20 ha) in LACMA.
- Results in a reduction of more than 800 ac (324 ha) of suitable habitat per territory for 5 or more northern spotted owl territories receiving high or moderate protection.
- Results in the direct mortality of 5 or more northern spotted owls receiving high or moderate protection.

14.3.7 MRC response to fire

14.3.7.1 Fire does not trigger a changed circumstance

In the event fire burns more than 30 ac (12 ha) but does not constitute a changed circumstance, MRC will take the following action:

[2] Data is from Fire Perimeters: 1950-2009. Maps are from CAL FIRE and Resource Assessment Program (FRA). http://frap.cdf.ca.gov/webdata/maps/statewide/firep_map.pdf (accessed April 7, 2011).

- MRC may harvest timber in burned areas to salvage trees that are likely to die or that are not viable for timber production,[3] in accordance with the following prescriptions:
  - MRC will retain, per acre, 1 additional snag and wildlife tree over and above the number specified in C§9.2.3.1-1 to C§9.2.3.1-3.
  - MRC may harvest hard snags if the objective for hard snag retention is already met prior to harvest.
  - MRC will not harvest (a) old growth trees; (b) trees in which the diameter of the entrance hole leading to a cavity is greater than 3 in. and 10 ft or more above the ground; (c) nest trees of northern spotted owls; (d) trees that are potential habitat for marbled murrelet; (e) trees over 24 in. dbh with basal hollows that are more than 12 in. in any horizontal dimension and extend at least 6 in. vertically inside the cavity from the topmost point of the entrance hole; (f) trees with known raptor nests; or (g) granary trees.
  - MRC will meet, in Class I and Large Class II AMZ, objective O§9.2.2-1 (namely, retain 6 hard logs *on average per acre* that are (a) ≥ 16 in. average diameter, (b) ≥ 6 ft long, and (c) derived from at least 3 trees).

    NOTE
    If proposing harvest of downed wood, MRC will survey to ensure that enough downed wood exists in the stand to complete such a harvest.
  - MRC will meet, in general forested areas, objective O§9.2.2-2 (namely, retain 5 hard logs *on average per acre* that are (a) ≥ 16 in. average diameter, (b) ≥ 6 ft long, and (c) derived from at least 3 trees.)

    NOTE
    If proposing harvest of downed wood, MRC will survey to ensure that enough downed wood exists in the stand to complete such a harvest.
  - MRC will not reduce the conservation measures for AMZs, including the prohibition on salvaging, unless the wildlife agencies concur.
  - MRC will not reduce the conservation measures for TSUs, including the prohibition on logging in inner gorges of TSU1 and TSU2, unless the wildlife agencies concur.
  - MRC will conduct a rare plant survey during the blooming season, if the burned area has over-wintered since the fire event.

    NOTE
    During the summer and fall following a ground fire, there would be no rare plants for an observer to see. In the 2008 Navarro Fire, for example, the soil was bare and there were only standing conifer and hardwood trees.
  - MRC will protect known and newly detected rare plants with the conservation measures specified in Chapter 11, *Conservation Measures for Rare Plants*.
  - MRC, after consulting and concurring with the wildlife agencies, will suspend efforts at reforestation and erosion control (unrelated to watercourses) at the site of a rare plant occurrence for 2 years to allow its seed bank to replenish.
- MRC will develop site-specific erosion control, in accordance with the following prescriptions:
  - MRC will not construct sediment traps, gabions, instream structures, bank stabilization, weirs, or check dams in and along watercourses without a commitment to maintain such structures and concurrence of the wildlife agencies.
  - MRC will design yarding systems to minimize sediment delivery to watercourses.
  - MRC will not broadcast seed with persistent exotics (i.e., annual rye grass).

[3] Trees have reduced viability for timber production if they survive a fire with little possibility of healthy growth. To make this determination, MRC personnel will observe the extent of the burn on trees, including insect damage or bole damage that may result in a future insect problem and, subsequently, poor log quality, e.g., termite damage in redwoods.

- MRC will perform erosion control per Appendix E, section E.10, *Standards for Surface Erosion Control*.
- MRC will construct waterbars on truck and skid roads to high EHR (Erosion Hazard Rating) standards.
- MRC will construct waterbars on cable roads where runoff may drain into a watercourse.
- MRC will review watercourse crossings, which receive flow from a burned area, and commit to 1 of the following actions:
    1. Remove the crossing and excavate as close as feasible to the natural channel grade.
    2. Upgrade the crossing to a rock ford, bridge, or culvert capable of passing a 100-year event.
    3. Install a vented ford culvert crossing.
- MRC will inspect watercourse crossings with drainage from a burned area (a) once a month during the first winter period after a fire and (b) after storm events producing 4 in. or more of rain during the second winter period after a fire.
- MRC will maintain inspected watercourse crossings, as necessary, to retain their flow conveyance capacity.
- MRC, with concurrence of the wildlife agencies, may adopt other measures required by a specific fire incident.

- MRC, with concurrence of the wildlife agencies, will restore damaged red-legged frog breeding sites or create new sites in adjacent, unaffected areas.
- MRC will receive approval from the wildlife agencies before taking any actions after a fire in LACMA.

14.3.7.2 Fire triggers a changed circumstance

In the event of a fire that constitutes a changed circumstance, MRC will take the following action:

- MRC may harvest timber in burned areas[4] to salvage trees that are likely to die or that are not viable for timber production, in accordance with the following prescriptions:
    - MRC may harvest up to 50% of the burned stems during the same year as the fire event to aid in fire suppression and restoration efforts.
    - MRC may harvest more than 50% of the burned stems during the same year as the fire event with the concurrence of the wildlife agencies; the trees retained must encompass all the diameter sizes within the pre-harvest stand.

      NOTE

      Criteria for agency concurrence is that MRC maintain ecological function while recouping financial loss in the burned area.
    - MRC will consult with the wildlife agencies in the first winter following the fire event to develop a comprehensive plan for additional fire salvage and restoration efforts relevant to future timber damage.
    - MRC will retain snags according to the conservation measures for snag retention (C§9.2.3.1-1 to C§9.2.3.1-3).
    - MRC will retain, in addition, 1 snag > 24 in. dbh and more than 40 ft high per acre, if present.
    - MRC may harvest hard snags if the objective for hard snag retention is already met prior to harvest.
    - MRC will not harvest (a) old growth trees; (b) trees in which the entrance holes leading to cavities are >10 in. and 10 ft or more above the ground; (c) nest trees of northern

[4] A burned area is within the outer extent of the fire and may include pockets or islands of unburned areas.

spotted owls; (d) trees that are potential habitat for marbled murrelet; (e) trees >24 in. dbh with basal hollows that are >12 in. wide and extend vertically above the outside cavity; (f) trees with known raptor nests; or (g) granary trees.

- MRC will exceed, in Class I and Large Class II AMZ, objective O§9.2.2-1 (namely, retain at least 6 hard logs *on average per acre* that are (a) ≥ 16 in. average diameter, (b) ≥ 6 ft long, and (c) derived from at least 3 trees) by leaving 1 additional log/ac, i.e., at least 7 logs/ac.

  NOTE
  If proposing harvest of downed wood, MRC will survey to ensure that enough downed wood exists in the stand to complete such a harvest.
- MRC will exceed, in general forested areas, objective O§9.2.2-2 (namely, retain at least 5 hard logs *on average per acre* that are (a) ≥ 16 in. average diameter, (b) ≥ 6 ft long, and (c) derived from at least 3 trees) by leaving 1 additional log/ac, i.e., at least 6 logs/ac.

  NOTE
  If proposing harvest of downed wood, MRC will survey to ensure that enough downed wood exists in the stand to complete such a harvest.
- MRC will fell trees and place LWD in streams, if the instream LWD is at or below the current objective (see Appendix S, S.2.1, *Future Targets for LWD).*

  NOTE
  The trees should be at least key-piece size or larger and be placed with the least amount of impact to the riparian area.
- MRC will only place LWD in a stream section, with concurrence of the wildlife agencies, if fire reduces shade canopy within an AMZ by more than 15%.

- MRC will not reduce the conservation measures for AMZs, including the prohibition on salvaging, unless the wildlife agencies concur.
- MRC will not reduce the conservation measures for TSUs, including the prohibition on logging in inner gorges of TSU1 and TSU2, unless the wildlife agencies concur.
- MRC will fell trees parallel to the contours of a site when leaving logs in the woods, if this proves feasible.
- MRC will conduct a rare plant survey prior to any operations, if the burned area has over-wintered after the fire.

  NOTE
  During the summer and fall following a ground fire, there would be no rare plants for an observer to see. In the 2008 Navarro fire, for example, the soil was bare and there were only standing conifer and hardwood trees.
- MRC will conduct an additional rare plant survey during the blooming season.
- MRC will protect known and newly detected rare plants with the conservation measures specified in Chapter 11, *Conservation Measures for Rare Plants*.
- MRC will, with concurrence of the wildlife agencies, suspend efforts at reforestation and erosion control (unrelated to watercourses) at the site of a rare plant occurrence for 2 years to allow its seed bank to replenish.
- MRC will not harvest within extended protection areas of northern spotted owl territories receiving high or moderate protection unless the wildlife agencies concur (a) that the proposed harvest will improve conditions for the owls or (b) that MRC can replace the affected extended protection area and core area with high-producing territories currently receiving limited protection within the same inventory block.
- MRC will rehabilitate affected areas by planting conifers within the first winter following a fire or the first winter following a salvage operation.
- MRC will develop site-specific erosion control in consultation with the wildlife agencies, in accordance with the following prescriptions:

- MRC will not construct sediment traps, gabions, instream structures, bank stabilization, weirs, or check dams in and along watercourses without a commitment to maintain such structures and concurrence of the wildlife agencies.
- MRC will design yarding systems to minimize sediment delivery to watercourses.
- MRC will not broadcast seed with persistent exotics (i.e., annual rye grass).
- MRC will perform erosion control per Appendix E, section E.10, *Standards for Surface Erosion Control*.
- MRC will follow up mulching with control of any persistent exotics resulting from the erosion control, when using straw containing weeds.
- MRC will construct waterbars on cable roads where runoff may drain into a watercourse.
- MRC will review watercourse crossings, which receive flow from a burned area, and commit to 1 of the following actions:
    1. Remove the crossing and excavate as close as feasible to the natural channel grade.
    2. Upgrade the crossing to a rock ford, bridge, or culvert capable of passing a 100-year event.
    3. Install a vented ford.
- MRC will inspect watercourse crossings with drainage from a burned area (a) once a month during the first winter period after a fire and (b) after storm events producing 4 in. or more of rain during the second winter period after a fire.
- MRC will maintain inspected watercourse crossings, as necessary, to retain their flow conveyance capacity.
- MRC may adopt other measures required by a specific fire incident and in concurrence with the wildlife agencies.

- MRC will receive approval from the wildlife agencies before taking any actions after a fire in LACMA.
- MRC will initiate surveys for red-legged frog breeding sites in burned areas and assess damage in the first year following a changed circumstance resulting from a fire.
- MRC will restore damaged red-legged frog breeding sites or create new sites in adjacent, unaffected areas within the same planning watershed, in concurrence with the wildlife agencies.
- MRC will initiate distribution surveys for tailed frogs, coho salmon, Chinook salmon, and steelhead in burned areas and assess damage in the first year following a changed circumstance resulting from a fire.

14.4 Climate

Extreme climatic events can greatly affect vegetation growth, as well as stand dynamics and habitats for aquatic and terrestrial species. In addition to re-occurring events, such as droughts, change in global climate can influence the composition and abundance of local species by changing (a) temperatures; (b) frequency of drought and flood events; and (c) dispersal of plant and animal species, along with any subsequent inter-specific competition.

14.4.1 Drought

Droughts occur regularly and reflect variations in climate. In general, a drought occurs when there is “a period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrological imbalance” (Huschke 1959). Recent drought periods have occurred on decadal time scales and lasted approximately 3-5 years (CDWR 2002a). Data from the past 400

years indicates that recent droughts have been only moderately severe and relatively short compared to historical records (Woodhouse and Overpeck 1998). Droughts, such as the Dust Bowl of the 1930s, were not unusual events. The Dust Bowl was actually a series of droughts over a period of 10 years. In the Central Valley, flows during that period dropped to about 55% of a 90-year average. Evidence indicates that there were two major droughts in the 13th to the 16th centuries that "probably significantly exceeded the severity, length, and spatial extent of 20th century droughts" (Woodhouse and Overpeck 1998, p. 2699).

Unlike other natural disasters, droughts occur gradually. Determining when dry conditions reach an important threshold is a matter of observing their effects on affected receptors. The California Department of Water Resources, for example, used two primary criteria—runoff and reservoir storage—when they declared a drought to water users (agricultural and domestic) during the 1987-92 dry period (CDWR 2002b). If reservoir storage dropped below 70% of average, for example, this was considered a drought threshold. Single drought years have to be taken into account along with previous droughts because the effects of cumulative water depletion can manifest for several years.

14.4.1.1 Effects of drought

Lack of water limits tree growth. Insufficient water impairs tree tissues and physiological processes, causing wilting, leaf shedding, reduction in photosynthesis, growth inhibition, and eventual death (Coder 1999). Rainfall and soil moisture affect cambial growth. Droughts affect the width of annual growth rings, duration of cambial growth, proportions of xylem and phloem, and timing and duration of wood production in mature trees (Coder 1999).

Trees with efficient root systems will increase root growth during drought to increase water absorption. However, extended droughts lead to roots that are suberized or converted to impassive cork tissue to prevent water loss. Trees with a high root-to-shoot ratio reflect high water-absorbing capacity. When coupled with a low transpiration rate, this can increase the ability of trees to survive droughts. Redwoods, however, have an inefficient root system and cannot withstand low soil moisture stress; they have poor control over water loss from transpiration. Redwood seedlings wilt long before other moisture-sensitive plants (Stone 1965). Other species such as Douglas fir can continue drawing water from the soil and remain alive for longer periods of time during periods of water stress. Thus, a very prolonged drought can result in a species shift in forests.

Droughts can

- Increase the risk of fire due to increased fuel loads from dead and dying vegetation
- Lower fuel moisture of both live and dead vegetation.
- Increase disease and pest outbreaks as a result of stressed and dying vegetation (Franklin et al. 1991, as cited in Agee 1997; Coder 1999).
- Limit the quantity and quality of instream habitat by reducing stream flows.
- Reduce the amount of vegetative growth and, therefore, the amount of forage for wildlife.
- Reduce drinking water availability for wildlife and affect habitat use patterns and movement patterns.

14.4.1.2 Changed and unforeseen circumstances for drought

A drought (or series of droughts) constitutes a changed circumstance if it continues over several months or up to 1 year with rainfall less than 33% of average; 2 consecutive years with rainfall

less than 50% of average; or 3 or more consecutive years with annual rainfall less than 75% of average.[5]

A drought (or series of droughts) constitutes an unforeseen circumstance if it continues beyond 3 consecutive years with rainfall less than 33% of average; beyond 6 consecutive years with rainfall less than 50% of average; or beyond 10 consecutive years with annual rainfall less than 75% of average.

Data from South Fork Caspar Creek (Figure 14-1) shows only one year from 1963 to 2009, namely 1977, when average annual rainfall totals were less than 33% of the average annual total of 45.6 inches. The rainfall records from 42 locations across Mendocino County from 1945 to 1995 show that average annual rainfall never fell below 33% of the average annual total of 45.6 inches. According to the data, none of these locations in Mendocino County met the drought criteria for unforeseen circumstances.

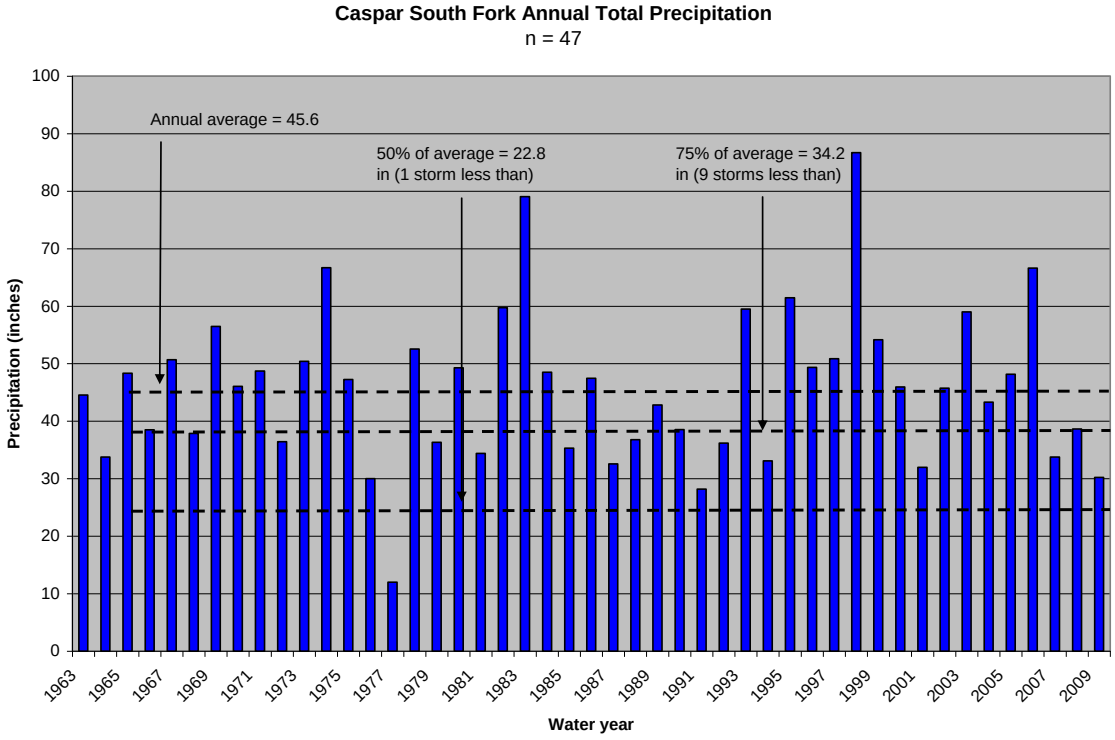


Figure 14-1 Rain Data from Caspar South Fork

14.4.1.3 MRC response to drought as a changed circumstance

- MRC will consult with the wildlife agencies on measures which reduce the amount of water pumped from streams to water roads; such measures affect road closures, traffic limitations, rocking or other surfacing of roads segments that otherwise require dust abatement.

[5] MRC will use the South Fork Caspar rain gauge.

- MRC will create or enhance, in consultation with the wildlife agencies, a minimum of 5 red-legged frog breeding sites across the plan area; the new breeding sites will be near known breeding sites that have failed due to the drought and in locations more likely to retain water until July1.
- MRC may close our lands to unnecessary activities (e.g., recreation, fire-wood cutting) during any period of extreme fire danger.

14.4.1.4 MRC response to drought as an unforeseen circumstance

MRC may propose measures which reduce the amount of water pumped from streams to water roads.

14.4.2 Climate change

Researchers predict that average surface temperature will increase by 2.5-10.4°F (1.4-5.7°C) from 1990 to 2100 (PEW 2002), with an average increase of 1-4.5°F (0.6-2.5°C) in the next 50 years. Often referred to as "global warming" in the media, climate change is a better term because the expected changes include: (1) regionally variable temperatures (some may be cooler than present); (2) regional changes in precipitation patterns and amounts; and (3) more extreme weather events.

14.4.2.1 Effects of climate change

The effects of climate change are both direct and indirect. Temperature changes that exceed a species tolerance range may directly impact them. Changes in precipitation may indirectly impact species by altering different aspects of their environment.

A predicted 3.6°F (2°C) warming could shift the ideal range for many North American forest species by about 200 mi (300 km) to the north (USEPA 2001b). Forested areas in California could decrease 25-50% depending on many variables (USEPA 2001b). However, determining vegetation change in the western United States is more difficult due to topographic complexity (Malcolm and Pitelka 2000).

Some experts expect that climate-sensitive plants will decline and only invading species that can disperse fast enough to keep up with the changing climate will survive. Climate change may also shift plant and animal communities that currently exist adjacent to each other; for example, in the redwood region, chaparral and oak woodland communities may expand their range. Most models predict more small-scale changes rather than broad northward shifts (Malcolm and Pitelka 2000).

Climate change could affect the processes causing upwelling of cold water along the California coast (Union of Concerned Scientists 2001). The increasing frequency of El Niño events or altered processes that cause less cold water to well up could significantly reduce coastal fog. Along the central western coast, warmer ocean waters could cause complex changes in the marine food web, altering food availability for species such as the marbled murrelet.

14.4.2.2 Literature review for impacts of climate change

ICF Jones & Stokes conducted a literature review for MRC on the impacts of climate change within the redwood forest region using (1) internet keyword searches, (2) academic databases, and (3) professional contacts. The reviewed articles and reports provide the basis for our predictions in section 14.4.2.

Literature search and review
The internet provided many generic (i.e. non-scientific) texts on the effects of climate change on coastal redwoods. Broadening the search to include the factors that influence coastal redwood growth and productivity (precipitation, temperature, fire frequency, and fog patterns) uncovered more varied scientific papers. The likely impacts on redwood forests in northern California were changes in temperature, precipitation, and fog patterns, along with changes in the disturbance regimes of fire, pests, tree falls, and flooding.

- **Global change**
  A report of the Intergovernmental Panel on Climate Change (IPCC 2001, 2007) provides assumptions and scenarios about climate change at the global scale on which regionally specific models are based.

- **Regional change**
  Bell et al. (2004), Hayhoe et al. (2004), Kim (2005), Leung and Ghan (1999) and Snyder et al. (2002) created climate change models to predict the effects of changes in temperature, precipitation, and coastal moisture on the vegetative communities of California.

- **Influence of redwood characteristics on species range**
  Busing and Fujimori (2005), Lenihan et al. (2003), Rogers and Westfall (2007), and reports by the California Climate Change Center (2006) and Field et al. (1999) discuss the role of disturbance on redwood forests and vegetative distribution. Dawson (1998), Herbert et al. (2003), Millar (2003), and Field et al. (1999), as well as reports by the California Climate Change Center (2006) and California Department of Forestry (CAL FIRE 2007) focus on the role of fog, ocean upwelling, temperature, and precipitation on the coastal redwood system and range.

- **Climate change in Sierra region**
  Stephenson and van Mantgem (2007) identify the current climate change effects within the Sierra region as it applies to mortality and juvenile recruitment in old growth forests.

- **Impacts of fire**
  Fried et al (2004) address the expected increase of fire frequency in northern California and its impact on the vegetative communities. Lloret et al (2005) explain the relationship between fire frequency and community ecology.

Summary and conclusions
The climatic factors of temperature, precipitation and fog patterns, along with the disturbance regimes of fire, pests, tree falls, and flooding affect redwood forests in northern California. Based on the IPCC report (2001), most climate models postulate that the atmospheric concentration of CO_2 has increased 2 times that of pre-industrial levels. These models predict that the climatic factors cited above will continue to change.

The effects of such changes are not clear. More rainfall, for example, may be beneficial to redwoods, especially if it occurs during what are now the drier periods of the year, when low soil moisture impacts growth. No one, of course, can predict the future patterns and duration of wet and dry seasons in the redwood region. Too much soil moisture during the normal dry periods of

summer could also alter forest regimes. The net effect on soil moisture will likely determine if redwood benefits from the climate changes or if it is impeded by them.

Recent research indicates that there may have been a 33% decrease in the frequency of summer fog days on the northern California coast during the 20th century (Johnstone and Dawson 2010). Elevated global temperatures, however, could increase fog intrusion along most of the coastal redwood range. Fog drip is an important factor in the growth and survival of coastal redwoods (Dawson 1998). During the growing season, June to November, rainfall is at its lowest and fog-days are at their highest, with water uptake 2-4 times higher in the summer months (Dawson 1998). At the global scale, temperatures are expected to increase by 2-4.5^{o} C during the 21st century before leveling off, with approximately 0.2^{o} C increase per decade. Warming causes more water to evaporate into the atmosphere which, in turn, causes the atmosphere to warm further. Water vapor, therefore, will be the largest *feedback* to temperature increases (IPCC 2007).

The rise in global temperature will also warm the oceans. During the last interglacial period, warming of the oceans favored expansion of the redwood range due to increased fog during summer months (Millar 2003, Herbert et al. 2000). Depending on wind and ocean upwelling effects, the proposed temperature increases would likely cause an increase in inland fog intrusions on the coast and create conditions more favorable to redwoods (CAL FIRE 2007, Herbert et al 2001).

Increases in quantity and intensity of winter precipitation will accompany increases in summer fog intrusions and favorable conditions for fog production. Researchers predict that heavy precipitation will increase in the mountainous regions of the northern California Coastal Range (Kim 2005). Increases in the influx of water vapor from the Pacific Ocean during the cold season (Kim 2005) could enhance moisture convergence along the coast as well (Leung and Ghan 1999). Within the redwood forest range, the North Coast and North Lahontan basins may have a 1-3% increase in mean annual rainfall (Bell et al. 2003). This includes an average of 2.5 additional events of heavy rainfall per year (Bell et al. 2003).

At the regional scale, researchers expect temperatures to warm across California by 1.4-3.8^{o} C (Snyder et al 2002). This regional warming may lead to vegetation shifts within California. The most significant changes would be the reduction in the extent of alpine/subalpine forest and the displacement of evergreen conifer forest, including redwoods, by mixed evergreen forests (Hayhoe et al 2006). Although mixed evergreen forests will displace evergreen conifer forests across their historic range, the latter may experience a net increase in percentage of coverage (Lenihan 2003). The warmer, wetter scenario predicted along the coast will favor the expansion of redwood and closed-cone pines from remnant, fragmented groves into live oak-madrone forests and chaparral in surrounding canyons (Lenihan 2003).

Forest disturbances include fire, flooding, tree falls, and pests. In old growth forests, there is typically a slow canopy turnover rate where disturbances are infrequent (Busing and Fujimori 2005). Climate change scenarios predict increases in fire frequency and flooding which would alter the present disturbance regimes within redwood-dominated ecosystems. Increased frequency of disturbance, including fire, flooding, and tree falls, will alter the age composition of redwood forests (Rogers and Westfall 2007), while increases in forest pests may have no effect (California Climate Change Center 2006).

Humidity, precipitation, temperature, and wind could affect fire behavior, ignitions, fire management (i.e., suppression), and vegetation fuel loads. Extrapolating for expected climate

change scenarios, we can expect warmer, less windy, more humid conditions, with increased precipitation in the northern coastal redwood range; the southern part of the range may experience drier, windier and warmer conditions, favoring an increase in fire (Fried et al 2004).

As a disturbance regime, fire influences a variety of early growth conditions including soil sterilization, mineralization, vegetative sprouting, and over-story removal (Rogers and Westfall 2007). In chaparral communities, increases in fire frequency decreases the number of fire-sensitive species, and favors growth of seeder species (sexual reproduction), with no change in the competitive ability of those species that regenerate by re-sprouting (asexual reproduction) (Lloret 2004). This reproductive observation holds true for coastal redwoods, as well. In old growth upland sites where fire is more frequent, there are a higher number of individuals from seed recruitment than lowland sites, where there are more clonal recruits (Rogers 2007). Given that chaparral post-fire competition occurs in redwood communities, increased fire frequency could lead to increased genetic variety within the coastal redwoods, as conditions increase the germination and recruitment of seeds.

Fire falls into 2 categories: contained fires and escaped fires. Under a climate change scenario in which the levels of CO_2 increase twofold, the number of escaped fires should not change for the North Coast, but may increase by 51% in the South San Francisco Bay area and by 125% in the Sierra Nevada region. Model results indicate that the northern coastal redwoods will be the least effected by fires due to fire management and climatic factors that favor slower burning fires and more intense fire management (Fried et al 2004). In the southern part of Northern California, drier, warmer summers could lead to an increase in fire activity (Brown and Heyda 1998). Based on the assumption that redwood forest will continue to have coastal fog, fire tolerance, and rapid regeneration after fire disturbance, these conditions would favor the spread of redwood in a mixed woodland system (Fried et al 2004, California Climate Change Center 2006). However, if the drier and warmer conditions combine with a decrease in fog, these conditions could have adverse effects in the southern portions of the redwood range, leading to lower productivity (California Climate Change Center 2006). Conversely, increased fire frequency in the southern part of the redwood range could allow for redwood persistence and competitive advantage over less tolerant species.

While scenarios for climatic change predict vegetative shifts, they also predict extension of ranges for forest pests previously limited by climatic factors. Coastal redwoods are not very susceptible to forest pests, and those that do attack cause minor damage. For this reason, forest pests should have no effect on coastal redwoods (California Climate Change Center 2006). However, if forest pests adversely affect other competing trees within the coastal redwood range and increased mortality ensues, coastal redwoods could have an increase in juvenile recruitment in gaps where trees fall. Such gaps are an important form of disturbance in redwood forests. They allow more light to penetrate the understory and reach redwood saplings. Access to light promotes sapling recruitment and survival.

Climate change in the Sierra Nevada region has increased tree mortality for giant sequoias but has not affected juvenile recruitment (van Mantgem and Stepheson 2007). Greater old growth mortality could change the age structure of a stand, favoring dominance of younger trees. If this scenario occurs in the coastal redwoods, we can expect an increase in juvenile stands within redwood forests. The increase in fire frequency due to drier, warmer summers could have negative impacts on these juvenile trees since they are not as fire resistant as old growth trees.

As stated earlier, precipitation should increase during the winter months in most of the redwood range. In addition, snow pack should decrease. Decreases in snow pack cause increases in winter

run-off; higher winter precipitation in the form of rain could allow for an increase in flooding events within the redwood region (Hayhoe et al 2004). Flooding replenishes nutrients, deposits sediments, and influences understory tree survival. Within coastal redwood forests, establishment of seedlings is common after major floods (Sawyer et al. 2000). An increase in flooding events would increase regeneration within redwood stands.

Overall, MRC anticipates that changes in the climatic factors of temperature, precipitation, and fog pattern, along with the disturbance regimes of fire, pests, tree falls, and flooding will be mixed, depending on site specific variables, particularly aspect, that influence soil moisture. The net effect is likely to be neutral.

14.4.2.3 Changed circumstances for climate change

Accurately predicting and reversing any effects of climate change in the plan area is very difficult if not impossible. We have addressed many of the potential manifestations of climate change (e.g., wildfires, drought, wind throw, flooding) in other sections of our HCP/NCCP.

Climate change constitutes a changed circumstance if a significant number (i.e., at least 10%) of culverts and crossings previously designed for 100-year events in the plan area are no longer fully controlled under new calculations for a 100 year event.

14.4.2.4 MRC response to climate change

The global nature of this problem places it outside of MRC control. University scientists, research institutes, think tanks, environmental agencies, the United Nations, international political summits—all are hotly debating the issue of climate change. The scientific consensus on the occurrence and cause of climate change is clear. On July 21, 2005, Ralph Cicerone, the Chancellor of the University of California (Irvine) and President of the National Academy of Sciences, testified before the U.S. Senate Committee on Energy and Natural Resources. "Nearly all climate scientists today believe," Cicerone said, "that much of earth's current warming has been caused by increases in the amount of greenhouse gases in the atmosphere, mostly from the burning of fuels." While burning of fossil fuels is a major cause of climate change, deforestation is also a factor. Until there is a global strategy for reducing the emissions of our automobiles, using cleaner sources of power to generate our electricity, and protecting the world's forests, warming trends will continue. In managing 213,244 ac of forest land that might otherwise be developed for industrial and residential use, MRC is contributing to the solution. In addition, over the term of our HCP/NCCP, MRC will increase timber inventory; this will sequester more carbon than an inventory that remains stable or declines.

MRC does anticipate that climate change may increase the frequency and intensity of severe droughts in northern California. Rising sea levels and changing weather conditions could also increase the frequency and magnitude of major floods in the plan area. Seasonal timing of precipitation may shift. Air and water temperatures may decrease. We cover the changed and unforeseen circumstances for climate change under specific events that may result, i.e., fires, droughts, and windthrow.

- MRC, in designing new crossings and reconstructing crossings, will use the best and latest information to calculate the 100-year storm size.
- MRC may adjust erosion control specifications (e.g., waterbar spacing) to achieve the same benefits that the specifications currently provide or better, if storm size or frequency increase.

- MRC will meet and confer with the wildlife agencies to adjust critical dates or take other actions in response to changes in precipitation patterns (e.g., definitions of "winter period").
- MRC will include propagules of trees from drier areas in our planting program.
- MRC will manage for species diversity to ensure increased forest tolerance to environmental impacts.
- MRC will continue to review and evaluate existing science in consultation with wildlife agencies to determine if we should take other actions.
- MRC will meet with the wildlife agencies at 10-year intervals after commencement of our HCP/NCCP to determine whether, by mutual agreement, we should modify any conservation measures because of climate change.

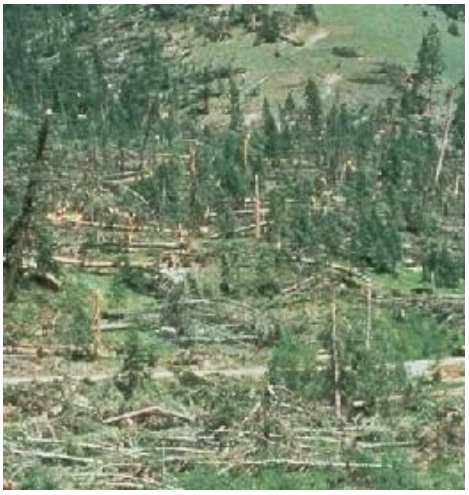
14.5 Windthrow

DEFINITION

Windthrow is the uprooting and felling of trees by wind, and is primarily affected by wind direction, soil moisture, soil depth, and topography.

Wind is one of the major disturbances influencing coastal forests in the Pacific Northwest (Agee and Edmonds 1992). Windthrow occurs when strong winds topple or break individual trees or clumps of trees (Noss 2000). Hurricane force winds are often recorded several times each winter on the Pacific Northwest Coast (Badura et al. 1974, as cited in Spies and Cline 1988), although winds are generally stronger in Washington and Oregon than along the Mendocino coast.

Windthrow adds wood directly to the forest floor, in contrast to fire which can leave dead trees standing for many years (Maser et al. 1988). The impact of winter storms on forests decreases with distance from the coast and from the forest edge. Forest stands growing on ridge tops or other locations exposed to high winds are also vulnerable. Most conifer and hardwood species are subject to windthrow, particularly when winter rains saturate soils.



Conifer Trees Flattened by Wind

14.5.1 Effects of windthrow

Small and large-scale windthrow can have positive and negative effects on both terrestrial and aquatic habitat. Winter storms can create large quantities of coarse woody debris both suspended by other trees and on the forest floor. Downed wood resulting from windthrow provides growing opportunities for wood-decay fungi, which can create rotten hollows and areas colonized by vascular plants including other trees and shrubs. Downed logs, in various states of decay, provide habitat for terrestrial species, such as the Pacific fisher.

Large woody debris that is spanning a stream or in a stream will provide shading, sediment storage and routing, and cover for fish until the forest canopy regenerates (Maser et al. 1988,

Meehan et al. 1984), as well as "bridges" for terrestrial species. Smaller logs are also beneficial, although they are more easily mobilized by higher flows and may not persist in the watercourse for as long as larger wood. Logs in riparian areas help stabilize slopes and store sediment (Wilford 1984, as cited in Meehan et al. 1984) and provide habitat for fish, invertebrates, and amphibians (Shrivell 1990, Welsh et al. 1993). Logs in flood prone areas may eventually be delivered to the stream through floods or bank cutting. Redwood logs are rot resistant and may persist for centuries buried in sediment or submerged in water. A migrating watercourse can exhume fallen logs in the CMZ that then become functioning LWD.

MRC does not expect small-scale windthrow to have long-term adverse impact on stream shading and water temperature. Zwieniecki and Newton (1999) reported that where water temperatures in streams were warmed due to a lack of canopy, temperatures re-cooled after re-entering shaded areas for 492-984 ft (150-300 m).
Windthrown trees or snapped off stems may be beneficial to a variety of wildlife by providing nesting cavities or refuge. Upturned root masses provide complex structures useful for some nesting birds. However, the loss of particular wildlife trees due to windthrow, such as northern spotted owl nesting trees, can have direct negative effects to wildlife populations. Large areas of dense debris generated by windthrow can form obstacles to wildlife movement. Windthrown trees are also more susceptible to pathogen and pest infestations and can increase the fuel load in the forest. Pest outbreaks occur within the dead wood of the windthrown trees. Pests can rapidly spread into neighboring live trees, causing further mortality. In small pockets, pest outbreaks can be beneficial to many species further up the food chain. More widespread wind events can cause an over-abundance of pests that wreak havoc on neighboring forested areas.

14.5.2 Changed and unforeseen circumstances for windthrow

14.5.2.1 Changed circumstance

A windstorm constitutes a changed circumstance if one or more of the following conditions apply, i.e., the storm results in

- Windthrow of more than 200 ft (61 m), measured along a Class I or Class II watercourse, and a decrease of 60% of the trees > 16 in. dbh within the AMZ.
- Windthrow of at least 100 ac (40.5 ha) outside the AMZ.
- Windthrow of at least 10 ac (4.05 ha) in LACMA.
- Windthrow that reduces more than 150 ac of suitable habitat per territory for up to 4 northern spotted owl territories receiving high or moderate protection.

14.5.2.2 Unforeseen circumstance

A windstorm constitutes an unforeseen circumstance if one or more of the following conditions apply, i.e., the storm results in

- Windthrow of more than 500 ft (152 m), measured along a Class I or Class II watercourse, and a decrease of more than 75% of the trees >16 in. dbh within the AMZ.
- Windthrow of more than 500 ac (202 ha) outside the AMZ.
- Windthrow of more than 50 ac (20 ha) in LACMA.
- Windthrow that reduces more than 400 ac (162 ha) of suitable habitat per territory for 5 or more northern spotted owl territories receiving high or moderate protection.

14.5.3 MRC response to windthrow

14.5.3.1 Windthrow does not trigger a changed circumstance

In the event windthrow does not constitute a changed circumstance but does occur on more than 5 ac, MRC will take the following action:

- MRC may propose timber harvesting in areas affected by windthrow to salvage trees that are likely to die or that are no longer viable for timber production as well as downed wood, in accordance with the following prescriptions:
  - MRC will retain snags according to the snag retention policy.
  - MRC, in addition to the conservation measures for snags and wildlife trees, will retain 1 snag > 24 in. dbh and more than 40 ft high, if present.
  - MRC will meet, in Class I and Large Class II AMZ, objective O§9.2.2-1 (namely, retain 6 hard logs *on average per acre* that are (a) ≥ 16 in. average diameter, (b) ≥ 6 ft long, and (c) derived from at least 3 trees).

    NOTE
    If proposing harvest of downed wood, MRC will survey to ensure that enough downed wood exists in the stand to complete such a harvest.
  - MRC will meet, in general forested areas, objective O§9.2.2-2 (namely, retain 5 hard logs *on average per acre* that are (a) ≥ 16 in. average diameter, (b) ≥ 6 ft long, and (c) derived from at least 3 trees.)
  - MRC may harvest hard snags if the objective for hard snag retention is already met prior to harvest
  - MRC will not harvest (a) old growth trees; (b) trees in which the diameter of the entrance hole leading to a cavity is greater than 3 in. and 10 ft or more above the ground; (c) nest trees of northern spotted owls; (d) trees that are potential habitat for marbled murrelet; (e) trees over 24 in. dbh with basal hollows that are more than 12 in. in any horizontal dimension and extend at least 6 in. vertically inside the cavity from the topmost point of the entrance hole; (f) standing trees with known raptor nests; or (g) granary trees.
  - MRC will not reduce AMZ conservation measures, including the prohibition on salvaging, unless the wildlife agencies concur.
  - MRC will harvest downed wood to prevent a pest outbreak by removing the brood material.
  - MRC will remove logs or portions of logs within Class I or Class II watercourses to prevent a diversion or reduce the risk of pest outbreak, with concurrence of the wildlife agencies.
  - MRC will not reduce conservation measures in TSUs.
  - MRC will provide rare plant protection measures for known occurrences that may be affected by the harvest.
  - MRC will not harvest within extended protection areas of northern spotted owl territories with moderate or high protection unless the wildlife agencies concur that (a) the proposed harvest will improve conditions for the owls or (b) MRC can replace the affected extended protection areas and core areas with high-producing owl territories currently receiving high or moderate protection within the same inventory block.
- MRC will receive approval from the wildlife agencies before taking any actions after a windthrow incident in LACMA.

14.5.3.2 Windthrow triggers a changed circumstance

In the event windthrow does constitute a changed circumstance, MRC will take the following action:

- MRC may propose timber harvesting in areas affected by windthrow to salvage trees that are likely to die or that are no longer viable for timber production as well as downed wood, in accordance with the following prescriptions:
  - MRC will retain snags according to the snag retention policy.
  - MRC, in addition to the conservation measures for snags and wildlife trees, will retain 1 snag > 24 in. dbh and more than 40 ft high, if present.
  - MRC may harvest hard snags if the objective for hard snag retention is already met prior to harvest.
  - MRC will not harvest (a) old growth trees; (b) trees in which the diameter of the entrance hole leading to a cavity is greater than 3 in. and 10 ft or more above the ground; (c) nest trees of northern spotted owls; (d) trees that are potential habitat for marbled murrelet; (e) trees over 24 in. dbh with basal hollows that are more than 12 in. in any horizontal dimension and extend at least 6 in. vertically inside the cavity from the topmost point of the entrance hole; (f) standing trees with known raptor nests; or (g) granary trees.
  - MRC will exceed, in Class I and Large Class II AMZ, objective O§9.2.2-1 (namely, retain at least 6 hard logs *on average per acre* that are (a) ≥ 16 in. average diameter, (b) ≥ 6 ft long, and (c) derived from at least 3 trees) by leaving 1 additional log/ac, i.e., at least 7 logs/ac.

    NOTE
    If proposing harvest of downed wood, MRC will survey to ensure that enough downed wood exists in the stand to complete such a harvest.
  - MRC will exceed, in general forested areas, objective O§9.2.2-2 (namely, retain at least 5 hard logs *on average per acre* that are (a) ≥ 16 in. average diameter, (b) ≥ 6 ft long, and (c) derived from at least 3 trees) by leaving 1 additional log/ac, i.e., at least 6 logs/ac.

    NOTE
    If proposing harvest of downed wood, MRC will survey to ensure that enough downed wood exists in the stand to complete such a harvest.
  - MRC will not reduce AMZ conservation measures, including the prohibition on salvaging, unless the wildlife agencies concur.
  - MRC will harvest downed wood to prevent a pest outbreak by removing the brood material.
  - MRC will remove logs or portions of logs within Class I or Class II watercourses to prevent a diversion or reduce the risk of pest outbreak, with concurrence of the wildlife agencies.
  - MRC will not reduce conservation measures in TSUs.
  - MRC will conduct a rare plant survey prior to any operations, even if such operations fall outside the blooming season.
  - MRC will conduct an additional rare plant survey during the blooming season if we do not complete salvage operations prior to blooming season.
  - MRC will protect known and newly detected rare plants with the conservation measures specified in Chapter 11, *Conservation Measures for Rare Plants*.
  - MRC will not harvest within extended protection areas of northern spotted owl territories with moderate or high protection unless the wildlife agencies concur that (a) the proposed harvest will improve conditions for the owls or (b) MRC can replace the affected extended protection areas or core areas with high-producing owl territories currently receiving high or moderate protection within the same inventory block.
  - MRC will re-forest windthrown areas by planting conifers and by other silvicultural treatments, within the first winter following the windthrow or the first winter following a salvage operation.

- MRC will receive approval from the wildlife agencies before taking any actions after a windthrow incident in LACMA.

14.6 Earthquake

Several earthquake zones, including the San Andreas Fault and the Maacama Fault, affect the plan area. An earthquake of 7.0 or higher on the Richter scale is considered a major earthquake. The Tohoku earthquake, for example, that occurred on 11 March 2011 near the northeast coast of Honshu, Japan was a 9.0, while the earthquake that struck Haiti on 12 January 2010 was a 7.0. Earthquakes of magnitude 4.0 and less are common in California. Since 1975, however, at least 8 earthquakes of magnitude 5.0 or higher have been recorded near the plan area (Table 14-1). On August 1-2, 1975, 3 earthquakes spread out from an epicenter near Oroville, CA, about 65 mi. (point-to-point) from the eastern boundary of our Ukiah inventory block. Another 4 earthquakes originated from an epicenter south of Eureka and off the coastline—again about 65 miles (point-to-point) from the northwestern border of the plan area; these occurred on 16 March 2000, 19 July 2006, 26 February 2007, and 9 May 2007. Finally, on 10 January 2010, a more powerful earthquake—6.5— radiated again from this approximate location out in the ocean. Events of this magnitude are not predictable.

Table 14-1 Earthquakes Above 5.0 Near Plan Area: 1975-2011

Date	Latitude	Longitude	Magnitude
08/01/1975	39.4322	121.546	5.7
08/02/1975	39.4493	121.480	5.1
08/02/1975	39.4378	121.485	5.2
03/16/2000	40.3887	125.239	5.7
07/19/2006	40.2807	124.433	5.0
02/26/2007	40.6428	124.863	5.4
05/09/2007	40.3745	125.016	5.2
01/10/2010	40.6520	124.693	6.5
05/17/2011	39.2200	123.170	3.8

TABLE NOTE
The information in this table is from the Northern California Earthquake Data Center (NCEDC), a joint project of the University of California Berkeley Seismological Laboratory (BSL) and the United States Geological Survey (USGS). See the complete data at http://www.ncedc.org/ncedc/catalog-search.html (accessed 11 April 2011).

Landslides from earthquakes can occur in areas with high topographic relief and unstable surface soils. MRC produces maps of areas susceptible to mass wasting (*HCP/NCCP Atlas*, MAPS 5A-C). Tsunamis can also be triggered by earthquakes. Since 2000, the most lethal tsunamis across the globe were those resulting from the Sumatra-Andaman earthquake in 2004 and the Japanese earthquake in 2011. In the latter case, the tsunami surged 5000 miles across the Pacific Ocean and slammed into the coast of northern California on March 12, 2011, causing scattered damage to boats and harbors from Santa Cruz to the Oregon border. While there have been various tsunamis from distant earthquakes to strike northern California, the one generated from the 1964 earthquake in Prince William Sound, Alaska (magnitude 9.2—the 2nd largest in history) was the most destructive. However, these events, and their magnitude and frequency, are unpredictable. Since the magnitude and frequency of tsunamis are unpredictable, any tsunami that affects covered lands is considered an unforeseen circumstance.

14.6.1 Changed and unforeseen circumstances for earthquakes

The changed and unforeseen circumstances for earthquakes are covered under other sections, such as mass wasting.

14.7 Mass Wasting

Most mass wasting occurs during large storms, particularly on slopes weakened by logging (Kelsey et al. 1995). Climate-based models suggest that the frequency of mass wasting has increased since the late 1930s due to the frequency of high-intensity storms (Reid 1998b). Without proper land management, failure frequency increases for a given storm frequency, resulting in higher rates of landslide erosion (Kelsey et al. 1995).

14.7.1 Effects of mass wasting

Mass wasting has a significant impact on the forest ecosystem. Impacts may include changes to existing plant communities and changes in the amount of sediment delivery to streams. Such changes may impact wildlife and aquatic habitat in a positive or negative way. Mass wasting, for instance, may provide coarse sediment and large woody debris to stream channels that are important sources of spawning, rearing, and over-wintering habitat. Conversely, mass wasting can fill pools and scour riffles, block fish access, disturb side-channel rearing areas, and add fines to spawning gravels.

2006 Landslide at Headwaters of South Fork Garcia (Plan Area)

MRC has designed the conservation measures for riparian areas, road use, road construction, and mass wasting to reduce management-induced mass wasting events. However, we estimate that it will take about 30-40 years to address legacy issues.[6] A storm with a return interval of 50 years or more could be problematic for meeting HCP/NCCP objectives in that time frame, because a majority of the existing crossings only meet 50-year standards. Large mass wasting events (man-made or natural) could obliterate habitat for covered species, e.g., filling in breeding sites of red-legged frogs or silting over salmon spawning gravels. The proximity of a mass wasting event to covered species and the ability of the watershed to transport the additional sediment determine the level of impact. In 1995, the Floodgate slide—so called because it was near Floodgate Creek— was one of the largest mass wasting events in the plan area. The slide occurred during a heavy rain event and delivered approximately 84,000 tons (about 70,000 yd^3) of sediment into the mainstem Navarro, temporarily damming it. Although large in size, we do not believe that such an event, occurring today, would prevent MRC from meeting our HCP/NCCP objectives. The Navarro was able to move the sediment relatively quickly through the remainder of the watershed. However, an event of the same magnitude in the upper reaches of a much smaller watershed could have a severe impact on covered species for a longer period of time. In a smaller watershed, sediment remains

[6] Sections 8.3.3.2.1 to 8.3.3.2.3 detail the MRC schedule for treating controllable erosion. Basically, during the first 20 years of HCP/NCCP implementation, MRC will treat controllable erosion sites which have a high or moderate priority and are within coho core watersheds. MRC will treat all high and moderate sites by Year 30 of HCP/NCCP implementation and all low priority sites by Year 40.

in the system longer, precluding breeding or spawning and shrinking available rearing habitat for an indefinite period of time.

14.7.2 Changed and unforeseen circumstances for mass wasting

14.7.2.1 Changed circumstance

A mass wasting event constitutes a changed circumstance if it delivers more than 20 yds^3 of sediment per acre of upstream drainage (upstream of the affected watercourse) to a Class I or Large Class II watercourse in 3 years.

14.7.2.2 Unforeseen circumstance

A mass wasting event constitutes an unforeseen circumstance if one or more of the following conditions apply, i.e., the event or combination of events

- Coincides with a storm that has a return interval equal to or greater than 100 years.
- Delivers more than 50 yds^3 of sediment per acre of upstream drainage (upstream of the affected watercourse) to a Class I or Large Class II watercourse in 3 years.

14.7.3 MRC response to mass wasting

14.7.3.1 Mass wasting triggers a changed circumstance

In the event of mass wasting that constitutes a changed circumstance, MRC will take the following actions:

- MRC will re-forest affected areas by planting conifers and by other silvicultural treatments within the first winter following a mass wasting event or the first winter following a salvage operation.
- MRC will complete a watershed analysis, including road inventory, for the affected planning watershed or watershed analysis unit within 2 years of the mass wasting event, unless the wildlife agencies extend the time period because of the scope of the required effort.

  NOTE
  MRC will use watershed analysis to develop sediment prevention plans for activities and roads in the watershed, based on the condition of stream channels after a mass wasting event.
- MRC will add, with the approval of the wildlife agencies, key pieces of LWD to watercourses that fall below HCP/NCCP objectives.
- MRC will repair watercourse crossings within 3 years of watershed analysis, starting with those that still have uncontrolled fill, compromised capacity, or structural problems.

  NOTE
  Depending on the amount of work entailed, MRC may extend the time for the repairs with concurrence from the agencies.
- MRC will initiate surveys for red-legged frog breeding sites and assess damage in the first year following a mass wasting event that triggers a changed circumstance.

  NOTE
  Sites are no longer viable when mass wasting events fill in the breeding site.
- MRC may restore, with the approval of the wildlife agencies, damaged red-legged frog breeding sites or create new sites in adjacent areas within the same planning watershed that were not affected by mass wasting.
- MRC will initiate distribution surveys for tailed frogs, coho salmon, Chinook salmon, and steelhead, and assess damage in the first year following the mass wasting event.

- MRC will evaluate a landslide to determine causes and, if due to land management, will propose enhancements to relevant practices such as road and landing specifications.
- MRC may propose timber harvesting in areas affected by mass wasting to salvage trees that are likely to die or that are no longer viable for timber production as well as downed wood, in accordance with the following prescriptions:
  - MRC will retain snags according to the snag retention conservation measures (C§9.2.3.1-1 to C§9.2.3.1-3).
  - MRC, in addition to the conservation measures for snag and wildlife trees, will retain 1 snag > 24 in. dbh and more than 40 ft high, if present.
  - MRC may harvest hard snags if the objective for hard snag retention is already met prior to harvest.
  - MRC will not harvest (a) old growth trees; (b) trees in which the diameter of the entrance hole leading to a cavity is greater than 3 in. and 10 ft or more above the ground; (c) nest trees of northern spotted owls; (d) trees that are potential habitat for marbled murrelet; (e) trees over 24 in. dbh with basal hollows that are more than 12 in. in any horizontal dimension and extend at least 6 in. vertically inside the cavity from the topmost point of the entrance hole; (f) trees with known raptor nests; or (g) granary trees.
  - MRC will exceed, in Class I and Large Class II AMZ, objective O§9.2.2-1 (namely, retain at least 6 hard logs *on average per acre* that are (a) ≥ 16 in. average diameter, (b) ≥ 6 ft long, and (c) derived from at least 3 trees) by leaving 1 additional log/ac, i.e., at least 7 logs/ac.

    NOTE
    If proposing harvest of downed wood, MRC will survey to ensure that enough downed wood exists in the stand to complete such a harvest.
  - MRC will exceed, in general forested areas, objective O§9.2.2-2 (namely, retain at least 5 hard logs *on average per acre* that are (a) ≥ 16 in. average diameter, (b) ≥ 6 ft long, and (c) derived from at least 3 trees) by leaving 1 additional log/ac, i.e., at least 6 logs/ac.

    NOTE
    If proposing harvest of downed wood, MRC will survey to ensure that enough downed wood exists in the stand to complete such a harvest.
  - MRC will not reduce AMZ conservation measures, including harvesting of downed wood, unless the agencies concur that is beneficial.
  - MRC will harvest downed wood to prevent a pest outbreak by removing the brood material.
  - MRC will not remove logs or portions of logs within Class I or Class II watercourses (e.g., to prevent a diversion or reduce the risk of pest outbreak), unless the wildlife agencies concur.
  - MRC will not reduce conservation measures in TSUs.
  - MRC will not fell trees from the toe of a slide unless a professional geologist concurs that the felling is necessary to stabilize the toe; removal of the trees is permitted only with concurrence of the wildlife agencies.
  - MRC will note in reports on canopy and shade conditions in planning watersheds the number, timing, and size of any mass wasting event that results in a changed circumstance during the prior 20 years.
  - MRC will conduct a rare plant survey prior to any operations, even if such operations fall outside the blooming season.
  - MRC will conduct an additional rare plant survey during the blooming season.
  - MRC will protect known and newly detected rare plants with the conservation measures specified in Chapter 11, *Conservation Measures for Rare Plants*.

- MRC will not harvest within extended protection areas of northern spotted owl territories receiving high or moderate protection unless the wildlife agencies concur (a) that the proposed harvest will improve conditions for the owls or (b) that MRC can replace the affected extended protection areas and core areas with high-producing territories currently receiving limited protection within the same inventory block or (c) that MRC should remove brood material from the eroded area to prevent a pest outbreak.

14.8 Floods

Stream flows are responsive to rain, particularly heavy rainfall that saturates soil. Along the north coast, the majority of the precipitation and floods occur in the late fall and winter. Flow data for the Navarro and Noyo rivers from the last 50 years indicates that there have been 4 floods with a magnitude greater than a 20-year recurrence and 4 with a magnitude greater than a 10-year recurrence. These floods have the capacity to re-shape stream channels and transport sediment and large woody debris.

14.8.1 Effects of floods

Large floods affect fluvial processes, such as sediment transport, and can impact riparian habitat. During floods, hill slope stability decreases due to increased moisture in the soil. This, in turn, results in increased frequency and magnitude of mass wasting events and increased sediment delivery to streams. Channel alterations can be extreme, with scour or deposition of coarse sediment, changes to the course of a stream, and decreased stream bank stability. Riparian vegetation is affected by loss of bank stability and deposition of sediment on inundated floodplains. Increased transport of debris in streams can cause failure of stream crossings.

Redwoods are more tolerant to periodic flooding and subsequent burial of their root system than species such as tanoak and Douglas fir (Stone 1965). After their roots are buried, roots first grow vertically through the deposited sediments and then later horizontally to keep the root system just below the surface (Stone 1965; Stone and Vasey 1968, as cited in Sawyer et al. 2000b). With each new deposit, a new root system is developed.

MRC has designed new stream crossings to pass a 100-year flood. Previous owners of the land designed stream crossings to pass a 25-year flood. Conservation measures for riparian areas, road use, road construction, and mass wasting should reduce the effects of management-induced mass wasting events.

14.8.2 Changed and unforeseen circumstances for flood

14.8.2.1 Changed circumstance

- A flood with a magnitude ≥ 25-year recurrence, as determined by any gauging station near the watershed in question with a flood record covering at least 20 years, constitutes a changed circumstance.

14.8.2.2 Unforeseen circumstance

- A flood of magnitude > 100-year recurrence, as determined by any gauging station near the watershed in question with a flood record covering at least 20 years, constitutes an unforeseen circumstance.[7]

14.8.3 MRC response to flood

14.8.3.1 Flood triggers a changed circumstance

In the event a flood constitutes a changed circumstance, MRC will take the following actions:

- MRC may re-set priorities for road re-construction or decommissioning, as well as channel and slope stabilization.
- MRC will complete a rapid road assessment and crossing inventory (noting any changes to controllable volume and treatment priority from the initial inventory) within 1 year of the flood event, unless the wildlife agencies extend the time period because of the scope of the required effort.
- MRC will revise the watershed analysis, as necessary, for the affected planning watershed or watershed analysis unit (WAU) within 2 years of the flood event, unless the wildlife agencies extend the time period because of the scope of the required effort.

  NOTE
  MRC will use the revised watershed analysis to develop sediment prevention plans for activities and roads in the watershed. We will determine the need for such plans based on the condition of stream channels after the flood event.
- MRC will repair, within 1 year of the rapid road and crossing assessment, all watercourse crossings designated high priority as a result of the flood event (starting with those at risk of imminent failure) and do so according to the most current 100-year standard,
- MRC will complete repairs of watercourse crossings upgraded to high priority as a result of the flood event within 3 years of the revised watershed analysis.

  NOTE
  The wildlife agencies may extend the time period because of the scope of the required effort.

14.9 Pathogens and pests

Dying Tanoaks in a Redwood Forest in Marin County
College of Natural Resources, University of California, Berkelev

Insects, fungi, and pathogens, including viruses, underlie the stability and productivity of the forest ecosystem (Bormann and Likens 1979, Edmonds 1982, Swank and Crossley 1987, as cited in Schowalter et al. 1997). These organisms can increase primary productivity through pruning, thinning, and stimulating nutrient cycling (Mattson and Addy 1975, Wickman 1980, Alfaro and Shepard 1991, as cited in Schowalter et al. 1997). Changes in stand characteristics caused by pathogens and insects usually occur slowly, with a few exceptions such as some bark beetle outbreaks (Schowalter et al. 1997). Outbreaks of any of these organisms do not pose a threat to forests in

[7] As of 2005, the 25-year flood event at the Navarro River (USGS gauging station #11468000) had a peak discharge of about 54,000 cfs, while the 100-year flood event had a peak discharge of about 72,950 cfs. Refer to http://waterdata.usgs.gov/ca/nwis/uv?site_no=11468000

general (Schowalter et al. 1997).
Researchers predict that epidemic outbreaks in many forests will increase due to past timber practices, such as establishing monocultures and fire suppression.

Overcrowding and climate change may also exacerbate these outbreaks; however, appropriate forest practices, such as thinning and uneven-aged management, can control pathogens and pests (Schowalter et al. 1997). Within the term of our HCP/NCCP, additional non-native pathogens will likely find their way onto covered lands, especially given global travel and trade.

Viruses, fungi, and other pathogens can impact wildlife in the plan area. Chytrid fungus may infect covered amphibians, and West Nile virus may infect northern spotted owls.

Several plant pathogens and pests present potential risks to MRC forests. The greatest threat is from introduced pathogens, such as Sudden Oak Death (SOD). Native trees can coexist with native pathogens and insects, but have little or no resistance to introduced pathogens (Schowalter et al. 1997).

Sudden Oak Death
Photo by Pavel Svihra, UCCE

SOD has occurred on approximately 0.25 ac of MRC forest land in 2 locations of the Annapolis tract. MRC suspects SOD in portions of Willow Creek as well. None of these locations are within the plan area. Although not confirmed, SOD may be in Mendocino County at Rockpile Creek in the Gualala River watershed. If the Rockpile Creek area does have SOD, it could affect the Garcia inventory block in the plan area, since the suspected infestation is within the Gualala River drainage. Upper Garcia River, well above the plan area, has confirmed SOD in the Mailliard Redwoods Reserve. SOD also appears to be downstream of this reserve. While many of the aforementioned infestations have not been confirmed through tissue analysis, large swaths of tanoak have died, in some cases denuding the canopy along large creeks in Anchor Bay.[8]

There are pockets of Douglas fir, approximately 2 ac in size, which have died in the Lower Albion as a result of the Douglas fir beetle (Dendroctomus pseudotsuga) and the flathead fir borer (Melanophila drumondi). The pockets, observed in 1999 by CAL FIRE Forest Pathologist Jack Marshall, are mainly contained within the Watercourse and Lake Protection Zone (WLPZ) of the plan. The age of the mortality suggests the infestation has passed (Marshall 1999). The infestation was the result of large concentrations of windthrow. MRC is also in the zone of infestation for pine pitch canker, but there are no documented cases in the plan area. The closest known site is located adjacent to HWY 1 in Anchor Bay.

Pathogens Cause Die-back to Conifer Branches
Photo by Dr. David Rizzo
University of California, Davis

[8] Email to Elicia Wise (MRC) from Jack Marshall (CAL FIRE) on September 28, 2006

14.9.1 Effects of pests and pathogens

Although there are a few pathogens and insects that infect redwoods, large outbreaks in redwood forests are uncommon; there are currently no known pathogens that kill redwoods past the seedling stage (Sawyer et al. 2000b).

Several different pathogens and pests can affect Douglas-fir stands. Likewise, several insects, including the Douglas-fir tussock moth and the western spruce budworm, can heavily defoliate forest stands, sometimes over several years. The Douglas-fir beetle is a key pathogen for Douglas-fir stands (Schmitz and Gibson 1996). Outbreaks occur sporadically and are of short duration, although usually severe, especially after episodes of windthrow or fire. Coastal Douglas fir is more resistant to the beetles than inland Douglas fir. The higher moisture content in the soil and air prevents wood from drying and beetles from thriving in the green or moist wood.

Chytridiomycosis is an infectious disease, caused by the chytrid fungus, which results in mass mortality in frog populations. The chytrid fungus attacks a substance called keratin, a tough, fibrous protein that forms a resistant layer in amphibian skin; in frogs infected by chytrid fungus, this layer is damaged. The fungus can also damage or destroy teeth, which are composed of keratin as well. MRC biologists have only observed absent teeth in bullfrogs in the plan area; however, there is no evidence that ties this condition to chytrid.

West Nile virus (WNV) is a mosquito-borne disease. Originally seen in Africa, it was detected in the eastern United States as early as 1999. Subsequently, it has spread throughout the United States, likely arriving in California around 2003. Mosquitoes are the primary carriers of the disease. They become infected when they feed on infected birds. Studies suggest a higher susceptibility to the disease in corvids and raptors (Ellis, et. al., 2007). A bite from an infected mosquito can then spread WNV to humans and other animals. The website of the California Department of Health publishes information and statistics on the disease (Table 14-2). As of 1st quarter 2011, only Sacramento and Riverside Counties in California had reportable cases of WNV—1 infection in a dead bird and the other in a single mosquito sample. Between January 2007 and April 2011, Mendocino County reported a total of 7 cases of WNV (Table 14-3).

Table 14-2 California Statistics: West Nile Virus (2003-2011)

California West Nile Virus Summary: 2003-2011										
Type Case	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Human (fatal)	3(0)	779(29)	880(19)	278(7)	380(21)	445(15)	112(4)	111(6)	0	2988(101)
Horses	1	540	456	58	28	32	18	19	0	1152
Dead Birds	96	3232	3046	1446	1396	2569	515	416	1	12,717
Mosquito Samples	32	1136	1242	832	1007	2003	1063	1305	1	8621
Sentinel Chickens	70	809	1053	640	510	585	443	281	0	4391
Squirrels	0	49	48	32	26	32	10	24	0	221

TABLE NOTE
Table 14-2 is adapted from a similar table at http://www.westnile.ca.gov/. The numbers were last updated on 03/09/2011.

Table 14-3 Mendocino County Statistics: West Nile Virus (2007-2011)

Mendocino County West Nile Virus Summary: 2007-2011						
Type Case	2007	2008	2009	2010	2011	Totals
Human (fatal)	2					2
Horses						
Dead Birds	3	1				4
Mosquito Samples						
Sentinel Chickens						
Squirrels	1					1

TABLE NOTE
Table 14-3 is adapted from information at http://www.westnile.ca.gov/. The numbers were last updated on 04/19/2011.

Outbreaks of pests or pathogens could adversely impact the ability of MRC to meet some HCP/NCCP objectives. Pathogens, such as sudden oak death, could reduce forest canopy and alter the food web of associated communities. This could negatively affect streamside canopy along sensitive AMZ areas. LWD may increase due to the breakdown of hardwoods; however, tanoak decays more rapidly than conifers, so the increase may only be temporary. Upslope areas may also become denuded of tanoak, which is a valuable food source for many wildlife species. Currently, MRC employees inspect areas for signs of SOD, and insure that material moved off of plan sites stays within the "zone of infestation." Licensed timber operators (LTOs) inspect material on log trucks to avoid moving small leaves and branches, which are more susceptible to the spread of the pathogen.

14.9.2 Changed and unforeseen circumstances for pathogens and pests

14.9.2.1 Changed circumstance

Pathogens or pest outbreaks constitute a changed circumstance if one or more of the following conditions apply, i.e. the outbreak

- Covers more than 100 ac, in total, within a plan area watershed where MRC owns 10% or more of the land—for causes not related to SOD.
- Covers more than 1000 ac, in total, within a plan area watershed where MRC owns 10% or more of the land—for causes related to SOD.
- Covers more than 10 ac in LACMA.
- Reduces more than 150 ac of suitable habitat per territory for up to 4 northern spotted owl territories receiving high or moderate protection—for causes not related to SOD.
- Reduces more than 300 ac of suitable habitat per territory for up to 4 northern spotted owl territories receiving high or moderate protection—for causes related to SOD.
- Results in the direct mortality of up to 4 northern spotted owls whose territories received high or moderate protection.

14.9.2.2 Unforeseen circumstance

Pathogens or pest outbreaks constitute an unforeseen circumstance if one or more of the following conditions apply, i.e. the outbreak

- Covers more than 500 ac, in total, within a plan area watershed—for causes not related to SOD.
- Covers more than 2000 ac, in total, within a plan area watershed—for causes related to SOD.
- Covers more than 50 ac in LACMA.
- Results in a reduction of more than 400 ac (162 ha) of suitable habitat per territory for 5 or more northern spotted owl territories receiving high or moderate protection.
- Results in the direct mortality of 5 or more northern spotted owls whose territories received high or moderate protection.
- Results in the loss of more than 5 active red-legged frog breeding sites detected during initial survey within a planning watershed.
- Results in coho salmon, Chinook salmon, or steelhead remaining undetected in more than 3 stream reaches for more than 3 years.
- Results in the loss of coastal tailed frogs from more than 75% of known occupied coastal tailed frog sites within a planning watershed.

14.9.3 MRC response to pathogens and pests

14.9.3.1 Outbreak of pathogens or pests does not trigger a changed circumstance

MRC understands that prevention and early intervention are essential to successfully and efficiently confront outbreaks of pathogens and pests, especially those that are not native to the area. To that end, MRC aquatic specialists already follow a policy designed to prevent the transfer of aquatic pathogens from one watershed to another (see Appendix X, *Pathogen Transfer*).

- MRC will cooperate and participate as possible with individuals and organizations working on early detection activities relative to new pathogens and pests.
- MRC will consult with a professional regarding unexplained forest health issues or fish and wildlife die-offs, such as a forest or wildlife pathologist, and with the wildlife agencies to determine the causes for the outbreak and alternatives for remediation.
- MRC will inform the wildlife agencies of any proposed actions regarding outbreaks of pathogens.
- MRC will cooperate and participate as possible with individuals and organizations working on rapid response and eradication activities relative to new pathogens and pests.
- MRC will follow guidelines proposed by state or federal agencies relative to prevention, quarantine, and treatment of pathogens and pests.
- MRC will develop a plan to address outbreaks of invasive exotic species on covered lands (C§9.7.3-1 to C§9.7.3-4).

14.9.3.2 Outbreak of pathogens or pests triggers a changed circumstance

- MRC will consult with a professional, such as a forest or wildlife pathologist, and with the wildlife agencies to determine the causes for the outbreak and possible remediation.
- MRC will re-forest areas affected by pests or pathogens.
- MRC may propose timber harvesting in infected areas to harvest trees that are likely to die or are no longer viable for timber production in accordance with the following prescriptions:
  - MRC will retain snags according to the snag retention conservation measures (C§9.2.3.1-1 to C§9.2.3.1-3).
  - MRC, in addition to conservation measures for snags and wildlife trees, will retain 1 snag > 24 in. dbh and more than 40 ft high, if present.

- MRC may harvest hard snags, if the objective for hard snag retention is already met.
- MRC will not harvest the following trees unless a forest pathologist determines that they need to be removed to stop the spread of a pathogen: (a) old growth trees; (b) trees in which the diameter of the entrance hole leading to a cavity is greater than 3 in. and 10 ft or more above the ground; (c) nest trees of northern spotted owls; (d) trees that are potential habitat for marbled murrelet; (e) trees over 24 in. dbh with basal hollows that are more than 12 in. in any horizontal dimension and extend at least 6 in. vertically inside the cavity from the topmost point of the entrance hole; (f) trees with known raptor nests; or (g) granary trees.
- MRC will exceed, in Class I and Large Class II AMZ, objective O§9.2.2-1 (namely, retain at least 6 hard logs *on average per acre* that are (a) ≥ 16 in. average diameter, (b) ≥ 6 ft long, and (c) derived from at least 3 trees) by leaving 1 additional log/ac, i.e., at least 7 logs/ac.

  NOTE
  If proposing harvest of downed wood, MRC will survey to ensure that enough downed wood exists in the stand to complete such a harvest.
- MRC will exceed, in general forested areas, objective O§9.2.2-2 (namely, retain at least 5 hard logs *on average per acre* that are (a) ≥ 16 in. average diameter, (b) ≥ 6 ft long, and (c) derived from at least 3 trees) by leaving 1 additional log/ac, i.e., at least 6 logs/ac.

  NOTE
  If proposing harvest of downed wood, MRC will survey to ensure that enough downed wood exists in the stand to complete such a harvest.
- MRC will not reduce AMZ conservation measures, unless to prevent an outbreak of a pathogen by harvesting downed wood with brood material.
- MRC will not remove logs or portions of logs within Class I or Class II watercourses unless the wildlife agencies concur that such removal is beneficial, e.g., in preventing a diversion or eliminating brood material.
- MRC will not reduce TSU conservation measures, unless the wildlife agencies concur.
- MRC will conduct 1 rare plant survey during the first blooming season after an outbreak of pests or pathogens in any location where the outbreak necessitates sanitation or a salvage timber harvest.
- MRC will protect any known or discovered occurrences of rare plants with the protection measures specified in Chapter 11, *Conservation Measures for Rare Plants*.
- MRC will not harvest within the extended protection areas of northern spotted owl territories receiving high or moderate protection unless the wildlife agencies concur that (a) the proposed harvest would improve habitat; (b) the proposed harvest is necessary to remove brood material and prevent a pest outbreak; or (c) the extended protection area and core area can be replaced by high producing owl territories currently receiving limited protection.
- MRC may, with concurrence of the wildlife agencies, harvest trees and logs below the standards mentioned above, if retaining the trees and logs is contrary to the goal of reducing or eliminating the pest or pathogen outbreak.

- MRC will restore damaged red-legged frog breeding sites or create new sites in adjacent, unharmed areas within the same planning watershed, in concurrence with the wildlife agencies.
- MRC will not draft water from an infected watershed in the event there are water borne pathogens without taking precautions approved by the wildlife agencies.

14.10 Toxic Spills

Oil-soaked Pelican in Barataria Bay, LA
Photographer: Carolyn Cole - *Los Angeles Times*
4 June 2010

In May 2010, the oil spill that resulted from the explosion and sinking of the oil rig, Deep Horizon, in the Gulf of Mexico became the worst such incident in U.S. history, creating devastation for wildlife and ecosystems. It drew public attention once again to concerns about toxic contamination of our environment. MRC has developed, in-house, a prevention and response plan for toxic spills in our forestlands. Because this plan is already in place and is outside the purview of the HCP/NCCP, we will not propose any additional procedures. When required, MRC will inform the necessary governmental agencies of toxic spills. Mendocino County Department of Environmental Health is the lead agency for spills in Mendocino County. The RWCB, CDFG, EPA and CEPA would also be part of remediation.

14.11 Species interactions

In a healthy ecosystem, native species evolve to co-exist. However, sometimes community structure and processes can change in undesirable ways (e.g., species irruptions and declines). Achieving management goals and objectives may demand intervention.

Non-native species are often more tolerant to disturbances and can out-compete native species. Although many of these non-native species are known, MRC cannot predict their long-term effect on endangered or threatened species and community processes in the plan area. The introduction of non-native species or the extension of their geographical range can have detrimental effects, possibly irreversible, on the abundance and composition of native species. Prevention is a critical element in management. Sections 14.11.1 to 14.11.3 focus on 3 species in the plan area: bullfrogs, wild pigs, and barred owls. Section 14.11.4 describes the MRC response to invasions of these species during the 80-year term of our HCP/NCCP.

If MRC discovers new invasive animal species during the term of the plan which threaten our biological objectives for covered species, we will develop with the wildlife agencies a plan to control the spread of these infestations or develop a landscape-level plan to manage the infestations. As part of the conservation measures for invasive species (C§9.7.3-1), MRC will also develop an Invasive Plant Control Program (9.7.3.1) with similar goals.

14.11.1 Bullfrogs

The bullfrog is the largest frog in North America, reaching over 6 in. (15 cm) in length. Bullfrogs occur in a variety of aquatic habitats, including rivers, lakes, streams, swamps, and marshes. Bullfrogs require permanent bodies of water, such as lakes, sloughs, creeks, and ponds for breeding. They are voracious feeders and eat almost anything that they can swallow, including insects, crayfish, earthworms, spiders, snails, salamanders, other frogs, snakes, turtles, fish, birds, small rodents, and bats.

Bullfrog
Photo by
Michael P. Gadomski

Red-legged frogs are California's largest native frog. They have been listed as a threatened species since 1996 due in part to the introduction of the American bullfrog, a non-native species. In laboratory studies, researchers found that the presence of bullfrog adults and tadpoles significantly reduced mass-at-metamorphosis, increased time-to-metamorphosis, and decreased survival-to-metamorphosis of red-legged frog tadpoles (Kiesecker and Blaustein 1998). Adult bullfrogs also significantly decreased the survival of post-metamorphs of northern red-legged frogs. The presence bullfrog tadpoles and small-mouth bass appeared to hinder development of larval red-legged frogs (Kiesecker and Blaustein 1998).

Bullfrogs are present in some Class I watercourses and ponds within the plan area, e.g., near occupied breeding habitat of red-legged frogs in the Albion River, Navarro River (Ray Gulch), and Greenwood Creek. MRC has engaged in bullfrog control in Greenwood Creek. We have detected bullfrogs in the following basins within the plan area: Noyo River, Big River, Little River, Albion River, Navarro River, Greenwood Creek, and Garcia River. There were no detections in Hollow Tree, Cottaneva, Juan Creek, Howard Creek, Hardy Creek, Elk Creek, and Mallow Pass Creek.

14.11.1.1 Changed and unforeseen circumstances for bullfrogs

Changed circumstance

Bullfrog invasion constitutes a changed circumstance if there is

- Loss of 3 or more active red-legged frog breeding sites within a planning watershed, which MRC assumes is the result of bullfrogs since bullfrogs are at the site.

Unforeseen circumstance

Bullfrog invasion constitutes an unforeseen circumstance if there is

- Loss of 5 or more active red-legged frog breeding sites detected within a planning watershed, which MRC assumes is the result of bullfrogs since bullfrogs are at the site.

14.11.1.2 MRC response to bullfrogs

Number of bullfrogs does not trigger a changed circumstance

If the number of bullfrogs does not constitute a changed circumstance, MRC will take the following action:

- MRC will implement the bullfrog control plan (C§10.2.2.3-6 and C§10.2.2.3-7).
- MRC will construct new upslope ponds with fixtures that allow the pond to be drained if bullfrogs invade.

Number of bullfrogs triggers a changed circumstance

If the number of bullfrogs does constitute a changed circumstance, MRC will take the following action:

- MRC will continue to implement the bullfrog control plan (C§10.2.2.3-6 and C§10.2.2.3-7) and consult the wildlife agencies for additional measures.
- MRC will drain affected ponds manually or mechanically upon bullfrog invasion after red-legged frogs have metamorphosed.

14.11.2 Wild pigs

Wild Pigs
Photo by Rick Sweitzer

Wild pigs include formerly domestic swine, Eurasian wild boars, and hybrids of the two. Wild pigs have undergone a dramatic range expansion in California—from 10 counties in the 1960s to 49 of the 58 counties by 1996 (Waithman et al. 1999). This range expansion is due to natural dispersal, hunting, and release of domestic pigs (Mayer and Brisbin 1991). In the plan area, the population of wild pigs is generally in medium-to-high densities (Waithman et al. 1999); however, in isolated pockets of the plan area, there may be dense populations of wild pigs.

Land Rooted by Pigs
Photo by Rick Sweitzer

Wild pigs are very fecund; females can produce up to 2 litters of 5-6 piglets per year. This makes it extremely difficult to control populations once they are well-established. According to research from New Zealand, removal of up to 70% of wild-pigs in areas with moderate-to-high densities may be necessary to reduce or maintain wild-pig populations (Dzieciolowski et al. 1992). The percentage could be less in areas where there are natural predators such as mountain lions, black bears, and coyotes and where there is persistent hunting of wild pigs. Although there are predators of wild pigs in the plan area, hunting pressure is low. As a result, predators and sport hunting alone are unlikely to control pig populations.

Wild pigs in the plan area could cause significant damage by rooting out endemic plants (Kastadalen 1982), altering soil processes (Lacki and Lancia 1983), and destroying the burrows of Point Arena mountain beavers. Wild pigs also may compete with some native species for food resources (Ilse and Hellgren 1995).

Although no studies have assessed the damage wild pigs may cause to mountain beaver burrows, wild pigs could destroy an entire burrow system while rooting in the area. They could also disturb or destroy amphibian breeding sites by creating wallows in streams, seeps, and springs.

14.11.2.1 Changed and unforeseen circumstances for wild pigs

Prior to reaching a changed circumstance

- MRC may allow wild pig hunting on covered lands consistent with safety, Fish and Game laws, and other sections of our HCP/NCCP.

Changed circumstance

Damage from wild pigs constitutes a changed circumstance if it

- Leads to destruction of more than 20% of the vegetation growing on an occupied Point Arena mountain beaver burrow system, as shown by a comparative measure of damaged and non-damaged vegetation above the burrow system.

- Leads to significant destruction of a burrow system of Point Arena mountain beaver within a planning watershed (i.e., at least 10% collapse of the burrow), as shown by a measure of the burrow extent before and after damage.
- Results in a loss of 2 or more active red-legged frog breeding sites within a planning watershed.
- Results in a significant reduction of coastal tailed frogs (i.e., a decline outside the range of natural variability) in 1or more index reaches.
- Results in a loss of any known MC1 core occurrence, more than 10 % of monitored MC2 core occurrences, or more than 25% of monitored MC3 sites for any covered plant species within a planning watershed (see section 11.7).

Unforeseen circumstance

Damage by wild pigs constitutes an unforeseen circumstance if it

- Results in a loss of 3 or more active red-legged frog breeding sites within a planning watershed.
- Results in loss of 50% or more of known MC1 and monitored MC2 and MC3 sites for any rare plant within a planning watershed (see section 11.7).

14.11.2.2 MRC response to wild pigs

Damage from wild pigs triggers a changed circumstance

In the event damage from wild pigs constitutes a changed circumstance, MRC will take the following action:

- MRC will initiate surveys for red-legged frog breeding sites the first year after the wild pigs have damaged such sites.
- MRC will initiate surveys for coastal tailed frog sites the first year after wild pigs have damaged such sites.
- MRC will meet with the wildlife agencies and implement a program to control feral pigs based on the particular situation and available options.

  NOTE
  Our intent in developing a program to control feral pigs is to stop damage to our landscape.

14.11.3 Barred owls

During the drafting of this plan, MRC and the wildlife agencies concluded that control of barred owls is necessary to conserve northern spotted owls. We have incorporated this understanding in our conservation measures and adaptive management program. However, we may not actually receive a permit to control barred owls within the prescriptions of our HCP/NCCP.

14.11.3.1 Changed circumstance

MRC does not receive a permit to control barred owls as part of our HCP/NCCP.

14.11.3.2 Unforeseen circumstance

Barred owl populations in the plan area increase to the point where it is not possible for MRC to achieve our HCP/NCCP objectives for northern spotted owls.

14.11.3.3 MRC response to barred owls

If MRC does not receive a permit to control barred owls and barred owls impact spotted owl territories (M§13.9.1.4-7), we will implement contingency strategies (Y§10.3.1.2.5-6).

14.11.4 Other species interactions

In the 80-year term of the HCP/NCCP, there may be other species that merit inclusion in the MRC proposal for changed circumstances. Species extant in the plan and adjustment areas which are potentially problematic include feral dogs and cats, turkeys, cowbirds, starlings, centrarchids (fish in the bass family), ictalurids (fish in the catfish family), and cyprinids (especially pikeminnow). Currently, there is little information about whether there are interactions between these species and covered species or communities in the plan area and the extent of such interactions.

14.11.4.1 Changed and unforeseen circumstances for other species interactions

Changed circumstance

Damage from other species interaction constitutes a changed circumstance if it

- Leads to destruction of more than 20% of the vegetation growing on an occupied Point Arena mountain beaver burrow system, as shown by a comparative measure of damaged and non-damaged vegetation above the burrow system.
- Leads to significant destruction of a burrow system of Point Arena mountain beaver within a planning watershed (i.e., at least 10% collapse of the burrow), as shown by a measure of the burrow extent before and after damage.
- Results in a loss of 2 or more active red-legged frog breeding sites within a planning watershed.
- Results in a significant reduction of coastal tailed frogs (i.e., a decline outside the range of natural variability) in 1 or more index reaches.
- Results in a loss of any known MC1 core occurrence, more than 10 % of monitored MC2 core occurrences, or more than 25% of monitored MC3 sites for any covered plant species within a planning watershed (see section 11.7).

Unforeseen circumstance

Damage by other species interactions constitutes an unforeseen circumstance if it

- Results in a loss of 3 or more active red-legged frog breeding sites within a planning watershed.
- Results in loss of 50% or more of known sites of MC1 and monitored MC2 and MC3 sites for any rare plant within a planning watershed (see section 11.7).

14.11.4.2 MRC response to other species interactions

In the event damage from other species interactions constitutes a changed circumstance, MRC will meet with the wildlife agencies and implement a program to reduce or eliminate the negative impacts from such interactions. Moreover, MRC will develop a plan to address outbreaks of invasive exotic species on covered lands (see section 9.7.3.1).

14.12 New species listing

If the wildlife agencies, subsequent to approval of our HCP/NCCP, list additional species in the plan area as threatened, endangered, or a state candidate species, this constitutes a changed

circumstance according to the "no surprises rule." The wildlife agencies will immediately notify MRC if they plan to list a new species that might occur on covered lands.

14.12.1 MRC response to new species

In the event the wildlife agencies list new species that might occur on lands covered by our HCP/NCCP, MRC will take the following action:

- MRC will seek technical assistance and implement take-avoidance measures prescribed by the wildlife agencies for newly listed species.
- MRC will consult with USFWS and, in some cases, with other wildlife agencies to ensure that covered activities in the plan area do not jeopardize plants listed in the future.
- MRC will confer with the wildlife agencies about necessary amendments to the existing HCP/NCCP as a result of a new listing of *threatened* or *endangered* species.
- MRC will decide whether to pursue an amendment to our HCP/NCCP in order to provide coverage for a newly listed species.
- MRC will, if we decide to amend the plan, follow the procedures set forth in the Implementing Agreement for adding a new species to our HCP/NCCP, including consultation with the wildlife agencies.

Chapter 15

Alternatives Considered

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15 ALTERNATIVES CONSIDERED

15.1 Introduction

While the California Natural Community Conservation Planning Act is silent regarding the presentation of alternatives in an NCCP, the federal ESA requires MRC to identify alternatives to our HCP/NCCP and provide reasons why we did not select these alternatives. At least 2 alternatives are often included in an HCP/NCCP. One is a specific alternative considered before or after the HCP/NCCP process has begun, that reduces *take* below levels anticipated in the project proposal. The second is a "no action" alternative, where no Incidental Take Permit (ITP) will be issued; take is avoided or the project does not proceed.

Reasons for rejecting project alternatives can include economic considerations, especially if they would significantly and adversely impact the applicant financially. Applicants must provide data to support such claims, if available and non-proprietary, and show that their HCP/NCCP represents minimization and mitigation to the maximum extent possible.

In this chapter, MRC will analyze the alternatives to our HCP/NCCP in relation to the goals of this plan, outlined in section 1.4. USFWS and NMFS do not force applicants to choose one of the alternatives analyzed in their HCP/NCCP; rather they provide recommendations to the applicants about developing an acceptable HCP/NCCP that is likely to meet the criteria for ITP issuance. Whatever the alternative selected by the applicant, USFWS and NMFS must process the application and notify the public in the Federal Register in order to provide an opportunity for public comment.

MRC recognizes that the joint EIS/PTEIR will consider project alternatives. These may in substance be similar to, or they may differ substantially from, the alternatives we considered and describe below. The EIS/EIR may also contain a different number of alternatives than the HCP/NCCP.

15.2 Alternatives

In addition to the preferred alternative described in the remainder of this document, MRC considered 3 other alternatives:

1. No action.
2. Enhanced HCP/NCCP.
3. Terrestrial reserves.

15.2.1 No action

Under this alternative, MRC would continue current strategies for avoiding take of covered species and comply with all existing state and federal regulations for timber operations, as well as the MRC *Option A* and *Management Plan*. MRC would not submit an HCP/NCCP nor would the wildlife agencies issue a permit.

Under this alternative, MRC, as is currently the case, would prepare a THP in accordance with Forest Practice Rules (FPR) and develop site-specific measures to address potential environmental impacts not covered by these rules. CAL FIRE reviews the THP with a multi-disciplinary team composed of CAL FIRE, CDFG, CGS, and North Coast RWQCB. In some situations and for certain impacts, USFWS and NMFS provide technical assistance for the THP process.

Covered species would still receive "no take" protection and other benefits from existing regulations for watershed analysis, sensitive species, and cumulative impacts. MRC would also continue to gather information on the status of these species, through mandatory monitoring, such as surveys for northern spotted owls during THP fieldwork, and through voluntary monitoring, such as watershed analysis.

MRC rejected this alternative because it does not meet a goal of our plan, namely to attain "regulatory certainty" for our endangered species management. Our HCP/NCCP allows for species management for the entire plan area with specific goals and objectives to maintain and enhance covered species populations and habitats. The no-action alternative does not consider covered species as a whole, with over-arching population and habitat goals. At most, the no-action alternative looks at species populations and habitat within a watershed or smaller biological assessment area. By choosing the no-action alternative, we would still need to consult with the agencies on a project-by-project basis. Our HCP/NCCP, on the other hand, allows a programmatic approach. A Master Agreement for Timber Operations (Appendix T) is an example of such an approach. MRC may proceed with covered activities affecting stream crossings, for example, as long as we are in compliance with MATO; there will be no need for us to apply for individual stream permits.

15.2.2 Enhanced HCP/NCCP

According to this alternative, the term, plan area, and covered species would be the same as the proposed HCP/NCCP, but the protection measures would be enhanced. An enhanced HCP/NCCP would

- Authorize take of covered species through an ITP.
- Prescribe timber operations in accordance with the HCP/NCCP.
- Monitor only as necessary to ensure prescribed take levels.

An enhanced HCP/NCCP would propose stricter conservation measures, such as more extensive "no harvest" areas in Aquatic Management Zones (AMZs); larger core areas for spotted owl territories with high and moderate protection; larger buffers around potential marbled murrelet habitat; increased rates of sediment control; and increased canopy retention in high hazard TSUs. To offset the financial burden of stricter conservation measures, MRC would reduce the monitoring programs to the minimum required to ensure prescribed levels of take.

Under this alternative, MRC would develop THPs that go through the CAL FIRE review process, but the THPs would be in accordance with the HCP/NCCP. Because MRC would address issues on a landscape level, site-specific review would focus on activities or issues not covered in the HCP/NCCP and EIS/PTEIR.

Covered species in an enhanced HCP/NCCP would theoretically receive greater protection. Confirming this, however, would be difficult because of reduced monitoring. Non-listed species that thrive in mature forest would also benefit indirectly from the enhanced protection measures for covered species. However, early successional species may not fare as well.

Although this alternative could meet the goals of our HCP/NCCP, MRC would need to reduce funding for monitoring in order to cover the greater cost of the additional conservation measures. Without robust monitoring, we would not be able to implement a flexible adaptive management strategy to ensure that the conservation measures initially proposed keep pace with advancing scientific research and techniques. The intent of such monitoring is to accurately prescribe and, if necessary, adapt conservation measures for habitat and populations. This ensures that covered

species maintain their presence where they are populous, and increase their presence where, according to historic accounts, they are currently under-populated.

15.2.3 Terrestrial reserves

Under this alternative, MRC would provide reserve areas of about 55,000 ac for marbled murrelet, northern spotted owl, and Point Arena mountain beaver. This alternative would allow for

- An HCP covering terrestrial species.
- Take of only marbled murrelet, northern spotted owl, and Point Arena mountain beaver (authorized by the HCP, as well as 2080.1[1] and 2081 take permits under a revised Option A, SYP, or PTEIR from CDFG).
- Operations in the reserves only to meet ecological objectives.

This alternative may or may not preclude an NCCP since aquatic species, part of the natural communities within MRC forests, would not be covered. NMFS and USFWS are unlikely to approve an HCP for "terrestrial species only." USFWS would need to consult with NMFS to issue an ITP to MRC since there might be potential adverse effects for listed salmonids as a result of ITP issuance. Our understanding is that USFWS and NMFS have a joint policy to avoid such situations and discourage HCPs for "terrestrial species or aquatic species only." Moreover, under the 2081 or 2080.1 Fish and Game Code, CDFG can only give permits for incidental take of currently state-listed species and cannot give assurances about additional requirements.

Harvesting and management outside of reserves would be the same as the *No Action* alternative discussed in 15.2.1. MRC would continue to move away from even-aged management.

MRC would prepare THPs in accordance with the HCP and 2081 permit, along with the FPR. THPs would follow protections within the HCP for marbled murrelet, northern spotted owl, and Point Arena mountain beaver; protections for all other species would be dictated by the FPR and other no-take requirements. A THP would propose site-specific measures to address significant impacts on non-covered species; a multi-disciplinary team would review the THP on a site-specific basis.

Marbled murrelet, northern spotted owls, and Point Arena mountain beaver would receive great benefit from this plan. Salmonids and amphibians would receive the same level of protection as the *No Action* alternative. Non-covered species would not receive any benefit other than that derived from current "no take" standards, FPR, and voluntary monitoring from MRC.

Once again, MRC rejected this alternative because it does not meet a goal of our plan, namely to attain "regulatory certainty" for all of our covered species, not simply for marbled murrelets, northern spotted owls, and Point Arena mountain beaver.

[1] The numbers "2080.1" and "2081" refer to sections of the California Fish and Game Code related to take of state-listed species.

Chapter 16

Glossary

16 GLOSSARY

abandonment (as in road or landing)	According to the California Forest Practice Rules, "abandonment means leaving a logging road reasonably impassable to standard production four wheel-drive highway vehicles, and leaving a logging road and landings in a condition which provides for long-term functioning of erosion controls with little or no continuing maintenance."
active channel	The stream area occupied by typical flood events comparable to a 2-year recurring flood. The active channel generally coincides with the ordinary high-water mark.
activity center	A nest or spot where a single owl or a pair of owls consistently roosts during the breeding season; it can be located as a point on a map. Although, within a single year, there can be multiple roost sites in a territory, only the roost site believed to be most central to the owl's biology (see Appendix K.5.4) will receive activity center status. Activity centers for the same owl or pair of owls can occur in different locations each year.
adaptive management	Monitoring results of management decisions in relation to changing biological and social goals and, if necessary, modifying management strategies to produce better results. Also called adaptive resource management.
adjustment area	The adjustment area encompasses the plan area as well as land adjacent to the plan area—primarily commercial timberland—from which MRC may add or delete covered lands.
age class	A distinct group of trees originating from a single natural event or regeneration activity, or a group of trees used in inventory or management, e.g., a 10-year age class.
aggradation	Deposition in one place of material eroded from another place. Aggradation raises the elevation of streambeds, floodplains, and the bottoms of other bodies of water. The process of building up a surface by deposition
aggrade	To build up a river bed and flood plain with deposited sediment.
alevin	A newly hatched salmonid with yolk sack still attached found dwelling in redds and gravels.
allochthonous	Describing an organism that originates from a place other than that in which it is found. The organism is usually a transient member of a community.
alluvial	Having originated through the transport by and deposition of running water. Found in clay, silt, sand, gravel, or similar material. Pertaining to or composed of alluvium, or deposited by running water
AMZ (aquatic management zone)	The zone along Class I, Class II, and Class III watercourses where riparian function is managed.
AMZ improvement harvests	Timber harvest within the AMZ with the intention of removing hardwood species or poorly growing conifer species to create a conifer dominated stand over the long term.
anadromous	Ascending from the sea to rivers for spawning.
anadromous fish	Fish that spawn in freshwater, migrate to the ocean or estuaries to grow and mature, and return to freshwater to reproduce. Salmon and steelhead are examples.

anuran	Any of an order Anura of amphibians comprising the frogs, toads, and tree frogs all of which lack a tail in the adult stage and have long strong hind limbs suited to leaping and swimming.
aquifer	Water-bearing stratum of permeable rock, sand, or gravel. A body of rock that is sufficiently permeable to conduct ground water and to yield economically significant quantities of water to wells and springs
assessment area	An assessment area is any location inside or outside the adjustment area that MRC evaluates for its habitat, species, sediment load, or other resources, as well as for HCP/NCCP impacts.
atyid	Shrimp of the family Atyidae.
aufwuchs	German for growth. The community of plants and animals that are attached to or move about on the surfaces of submerged stems, leaves, rocks, sticks, or debris but do not penetrate the surface.
avulsion	A sudden cutting off of land by flood, currents, or change in course of a body of water; especially one separating land from one person's property and joining it to another's.
bankfull discharge	Discharge that just fills a stream to its banks. Bankfull discharge occurs approximately every 1 to 2 years and is generally considered to be the primary channel-forming discharge.
bankfull width	The channel width at bankfull discharge. This stage is delineated by the presence of a floodplain at the elevation of incipient flooding and indicated by deposits of fine sediments such as sand or silt at the active scour mark, break in stream bank slope, and/or perennial vegetation limit (Flosi and others 1998). In the absence of a well-defined floodplain surface, other indicators are useful; in any case, parallel lines of evidence should be used (Kondolf 2003).
basal area	The area of the cross section of a tree stem, including the bark, generally at breast height (4.5 feet above the ground). As used in the HCP/NCCP, the term refers to the amount of basal area per acre, unless otherwise specified.
bedload	Sediment that is not continuously in suspension but is transported along the channel bottom in the lower layers of streamflow by rolling and bouncing. The part of the stream's load that is moved on or immediately above the stream bed, such as the larger or heavier particles (boulders, pebbles, gravel).
best management practices (BMP)	Techniques in various land use activities, such as forestry, to mitigate or prevent harm to or inhibition of natural attributes or processes.. Usually, BMPs are applied as a system of practices rather than a single practice.
biodiversity	The number and variety of organisms found within a specified geographic region, including the variability within and between species and within and between ecosystems.
biomass	Organic material, such as leaves, needles, branches, stems, and vertebrate and invertebrate animal species.
blowdown	Trees felled by high wind.
board feet	A unit of measure equaling a piece of lumber 1 in. thick, 1 ft wide, and 1 ft long, or its equivalent in dried and surfaced lumber. It is often expressed in units of thousand board feet.

bog	A hydrologically isolated, low-nutrient wetland that receives its water from precipitation only. Bogs typically have no inflow and rarely have outflows. Bogs have peat soils (except where over bedrock), and specially adapted vegetation, such as sphagnum moss, Labrador tea, bog laurel, sundews, and some sedges. Bogs may have an over-story of spruce, hemlock, cedar, or other tree species, and may be associated with open water.
bole	The trunk of a tree.
boulders	A rock mass with a diameter > 256 mm in diameter.
broadcast burning	A controlled burn, where fire is intentionally ignited in a designated area within well-defined boundaries; used to reduce of fuel hazard after logging or for site preparation before planting.
broodstock	Adult fish used for breeding in a hatchery.
brush rake	A blade with teeth at the bottom, attached to a cat or skidder and used in site preparation. It penetrates and mixes soil and tears roots.
buffer strip	A strip of land where disturbance is not allowed or is closely monitored to preserve or enhance aesthetic and other qualities along or adjacent to roads, trails, and watercourses.
buffer zone	The area of protection surrounding a nest tree in which timber operations cannot be conducted.
cable yarding	A harvest technique in which cut logs are suspended above the ground via a series of cables and transported to a landing.
CEQA	California Environmental Quality Act
canopy	The more or less continuous layer of branches and foliage formed collectively by the crowns of adjacent trees and other woody species.
canopy closure	The degree to which canopy blocks sunlight or obscures the sky. It can only be accurately determined from measurements taken under the canopy that account for the openings in the branches and crowns. MRC only measures canopy for trees taller than 30 ft—the equivalent of about 10 years of growth. This conservative approach reduces the impact of vegetation removal on hydrologic change.
carrying capacity	The maximum number of organisms that can be sustained in a given area of habitat.
catastrophic event	An infrequent, large-scale, high intensity disturbance of natural or anthropogenic causes, such as disease or pestilence, large flood events, or severe fire that would require action to protect public safety and drinking water, and prevent significant damage to natural resources.
catastrophic salvage	The removal of trees for sale from an area or areas of forest that experienced a catastrophic event.
cavity tree	Nesting, roosting, or foraging habitat for birds and mammals. Cavities are created by fire, rotting, limb breakage, and/or excavation by birds.
CDFG	California Department of Fish and Game
centroid	Center of mass; the point in a body or system of bodies at which the whole mass may be considered as concentrated.

channel	Natural or artificial waterway of perceptible extent that periodically or continuously contains moving water.
channel migration zone	Current boundaries of bankfull channel along with the portion of the floodplain that is likely to become part of the active channel in the next 50 years.
chaparral	Shrubby plants adapted to dry summers and moist winters that occur especially in southern California.
chironomids	Any of a family of midges (tiny flies) that lack piercing mouthparts.
Class I watercourse	1. Domestic supplies, including springs, on site and/or within 100 feet downstream of the operations area; and/or 2. Fish always or seasonally present on-site, includes habitat to sustain fish migration and spawning.
Class II watercourse	1. Fish always or seasonally present off-site within 1000 feet downstream; and/or 2. Aquatic habitat for non-fish aquatic species; 3. Excludes Class III waters that are tributary to Class I waters.
Class III watercourse	No aquatic life present, watercourse shows evidence of being capable of sediment transport to Class I and II waters under normal high water flow conditions after completion of timber operations.
Class IV watercourse	Man-made watercourses, usually downstream, established domestic, agricultural, hydroelectric supply, or other beneficial use.
clear-cut	Removal of a stand of trees in one harvest.
climax	The culminating, highly stable stage in plant succession for a given environment. An ecosystem will stay at the climax stage until disturbance affects the ecosystem and the stages of ecological succession begin again.
clinometer	A tool used by foresters to calculate percent slope, tree height, and other functions that involve trigonometry.
closed canopy	Description given to a stand of trees when the crowns of the main level of trees forming the canopy are touching and intermingled so that light cannot reach the forest floor directly.
CMZ	Channel migration zone. A channel migration zone is the area where the active channel of a stream is prone to move over time. Stream channels are dynamic features of the landscape that change position. CMZ is based on historic meander patterns.
coarse woody debris	Large pieces of wood, such as logs, pieces of logs, large branches, stumps, and snags, which add to forest biodiversity, increase forest structure complexity, and provide multiple-use habitat for many different animals
codominant tree	A tree whose crown extends above the general level of the main canopy of even-aged stands or, in uneven-aged stands, above the crowns of the tree's immediate neighbors, thereby getting full sunlight from above and comparatively little sunlight from the sides.
colluvium	Rock detritus and soil accumulated at the foot of a slope.
commercial thinning	To promote timber growth, increase average stand diameter, and improve forest health by removing trees to produce a stand with two or three distinct canopy layers.
concurrence	Agreement in an action to be taken; consent; approval.

cone rake	Device for collecting cones from a standing tree. It is lowered, usually from a helicopter, over the crown of a tree. Cones or cone-bearing branches are removed and retrieved by the machine.
confined reaches	Stream or river segments that have relatively constrained, well-defined channels, with narrow flood plains; often in mountainous areas and having a steep gradient.
connectivity	The extent to which suitable habitat patches are connected, in some cases by wildlife corridors, enabling movement of and dispersal by species.
conservation measure	A conservation measure is a specific action taken to (a) avoid or minimize take, (b) compensate for loss of habitat, or (c) provide for the conservation of covered species.
conservation strategy	A collective set of measures to avoid , minimize, or mitigate the potential take (or equivalent take) of species addressed by the HCP/NCCP, or for protecting, rehabilitating, enhancing, or restoring habitats for these species.
controllable erosion	Controllable erosion meets the following conditions: 1. The erosion is discharging or has the potential to discharge sediment to waters of the State of California in violation of requirements of the California Water Quality Control Board (CWQCB) or other provisions of Waste Discharge Requirements (WDRs). 2. The erosion was caused or affected by human activity. 3. The erosion may feasibly and reasonably respond to prevention and minimization by management measures.
core area	An area surrounding northern spotted owl territories based on landscape stands where habitat will not be disturbed.
core occurrence area	The core occurrence area is the portion of a CNDDB (California Natural Diversity Database) occurrence subject to covered activities.
critical habitat	Under the federal Endangered Species Act, critical habitat is defined as specific areas 1. Within the geographic area occupied by a federally listed species on which are found physical and biological features essential to the conservation of the species, and that may require special management considerations or protection. 2. Outside the geographic area occupied by a listed species, when it is determined that such areas are essential for the conservation of the species.
crown cover	The degree to which the crowns of trees are nearing general contact with one another. Generally measured as the percentage of the ground surface that would be covered by a downward vertical projection of tree crown foliage.
cultivar	A variety of a plant that has been created or selected intentionally and maintained through cultivation.
culvert	Buried pipe that allows streamflow or road drainage to pass under a road.
cumulative watershed effects	Those effects that occur within and near bodies of water or significant wet areas, where individual impacts are combined to produce an effect that is greater than any of the individual impacts acting alone. Factors considered are: sediment, water temperature, organic debris, and chemical contamination.

debris flow	A moving mass of rock fragments, soil, and mud, more than half the particles of which are larger than sand size that can travel many miles down steep, confined mountain channels.
debris torrent	Debris flow or dam-break flood. Rapid movement of a large quantity of materials, including wood and sediment, down a stream channel. Usually occurs in smaller streams during storms or floods, and scours the stream bed.
decommissioning	The act of permanently closing a road or road features to control erosion and maintain water movement. Methods of decommissioning include removal of bridges, culverts, and fills.
deep-seated landslide	An area where landslide material has moved downslope either as a relatively cohesive mass (rotational slides and translational block slides) or as an irregular, hummocky mass (earthflow). The failure surface is generally deeper than 5 ft and is usually well-exposed at the head scarp.
diameter at breast height (dbh)	The diameter of a tree measured outside its bark at breast height—a point 4.5 feet above average ground level
diel	Involving a 24-hour period that usually includes a day and the adjoining night, e.g., diel fluctuations in temperature.
dispersal	The movement of juvenile, sub adult, or adult animals from one sub-population to another. Individuals may disperse for foraging, breeding, and other reasons.
distribution	The spatial arrangement of individuals of a species within its range.
dominant tree	A tree whose crown extends above the general level of the main canopy of even-aged stands or, in uneven-aged stands, above the crowns of the tree's immediate neighbors and, thereby getting full sunlight from above and partial sunlight from the sides.
downed log	Any section of the bole or of the thicker branches of a dead and downed tree.
DPS	Distinct Population Segment. A level of classification under the ESA that allows for legal protection of populations which are distinct, relatively reproductively isolated, and representative of a significant evolutionary lineage to the species.
drainage area	Watershed. Total land area draining to any point in a stream, as measured on a map, aerial photo, or other horizontal, two-dimensional projection.
early seral forest	Stage in forest development that includes seedling, sapling, and pole-sized trees.
effective shading	The percent reduction of potential solar radiation delivered to the water surface; the amount of shade, averaged to account for daily and seasonal cycles.
effectiveness monitoring	A type of monitoring that tests the effectiveness of management decisions by determining whether or not the expected results are taking place.
electrofishing	Use of electrical current to stun fish for capture and identification, or to count them for population estimates.
element	An identifiable component, process, or condition of an ecosystem.
embeddedness	Degree to which large particles (boulders, rubble, gravel) are surrounded or covered by fine sediment, usually measured in classes according to percent coverage.
emergent vegetation	Aquatic plants that are only partially submerged, and are rooted in the aquatic environment with the majority of photosynthesis occurring above the surface of the water.

endangered species	Any plant or animal species in danger of extinction in all or a significant part of its range.
Endangered Species Act (ESA)	Federal act of 1973, as amended, 16 U.S.C. Sections 1531-1543; California act of 1984, as amended, Fish and Game Codes Sections 2050-2098. (PL)
entrainment	Mobilization, by flowing water, of sediment or organic debris from the bed or banks of a stream channel.
entrenchment ratio	The ratio of floodprone width to bankfull width.
epiphytic	Characterizing a plant that grows on another plant, but is not parasitic.
equipment exclusion zone (EEZ)	The area where heavy equipment associated with timber operations is totally excluded for the protection of water quality, the beneficial uses of water, and/or other forest resources.
equipment limitation zone (ELZ)	The area where heavy equipment associated with timber operations is limited for the protection of water quality, the beneficial uses of water, and/or other forest resources.
estivation	To pass the summer in a state of torpor; summer or dry-season dormancy.
ESU	Evolutionary Significant Unit. A designation of the Endangered Species Act (from NOAA Technical Memorandum NMFS F/NWC-194). A population must satisfy 2 criteria to be considered an ESU. It must 1. Be reproductively isolated from other conspecific population units. 2. Represent an important component in the evolutionary legacy of the species. Isolation does not have to be absolute, but it must be strong enough to permit evolutionarily important differences to accrue in different population units. The second criterion would be met if the population contributed substantially to the ecological/genetic diversity of the species as a whole.
evapotranspiration	Loss of water from the soil both by evaporation and by transpiration from the growing plants.
even-aged forest	A forest stand comprised of trees with less than a 20-year difference in age.
existing road	Road which existed prior to a construction or maintenance operation. No alteration of the road prism is required in order to use an existing road. Pick-ups can travel on an existing road after brush and rock slides have been cleared.
existing structures	In the context of this HCP/NCCP, existing structures refers to roads, landings, skid trails, spoils piles, etc.
extinct	Disappearance of a species due to failure to reproduce in sufficient numbers to maintain succeeding generations.
extirpate	To destroy completely; wipe out.
extirpation	The elimination of a species from a particular area.
federally listed	Species formally listed as a threatened or endangered species under the federal Endangered Species Act; designations are made by the U.S. Fish and Wildlife Service or National Marine Fisheries Service.
felling	The cutting down of trees.

fen	A wetland similar to a bog, but are less acidic (pH 5-8); fens have more nutrient-rich water than bogs.
fine sediments	Sediment with particle sizes of 2 mm and less, including salt, silt, clay, and sand.
floodplain	A level, low-lying area adjacent to streams that is periodically flooded by stream water.
floodplain depth	Twice the maximum depth at bankfull conditions; used to estimate the depth at which flooding will occur at a specific location within the stream.
floodprone width	Width of the stream channel at floodprone depth.
focus species	Candidate species or species of concern.
foraging	Looking or searching for food.
forb	An herb other than grass.
Franciscan assemblage	A series of rocks from a deep ancient seabed that, according to the National Park Service, was "jumbled, altered, shoved up, and attached to the North American plate."
freshet	A great rise or overflowing of a stream caused by heavy rains or melted snow.
fry	Life stage of trout and salmon between full absorption of the yolk sac and a somewhat arbitrarily defined fingerling or parr stage.
fuel loading	The amount of combustible material present per unit area, usually expressed in tons per acre.
full log suspension	Suspension of the entire log above the ground during yarding operations.
functional large woody debris (LWD)	Pieces of LWD that provide function for stream habitat or stream and bank stability. The minimum size is 4 in. in diameter and 10 ft in length.
fusiform	Tapering toward each end.
geographic information system (GIS)	A computer system capable of storing and manipulating spatial data and producing a variety of maps and analyses. A geographic information system has four major subsystems: data input; a data storage and retrieval; data manipulation and analysis; and data reporting.
geomorphic processes	Landscape-modifying processes, such as erosion, mass wasting, and stream flow.
gravel	Substrate particles between 2 and 64 mm in diameter.
green tree	A living and growing tree
ground truthing	Use of a ground survey to confirm the findings of an aerial survey or to calibrate quantitative aerial observations.
group selection	To establish and maintain multi-storied, uneven-aged stands of redwoods and Douglas-fir by harvesting trees in small (<2.5 acre) groups.
growth and yield model	A mathematical model used to predict forest growth and production of forest products associated with different silvicultural regimes.

gully	An erosion channel formed by concentrated surface runoff which is generally larger than 1 ft^2 in cross-sectional area (1 foot deep by 1 foot wide). Gullies often form where road surface or ditch runoff flow onto unprotected slopes.
habitat conservation measures	Steps taken to protect resources (especially non-timber resources) that have been identified as sensitive in some areas from adverse effects of various management practices or land use activities. Habitat conservation measures can be applied at many levels: local mappable units, planning watersheds, management units, or projects. These measures are often incorporated into the resource capability models or policy models.
habitat conservation plan (HCP)	A plan submitted to USFWS or NMFS by an applicant seeking an incidental take permit which describes (a) the impacts that will result from taking listed species; (b) the steps the applicant will take to monitor, minimize, and mitigate such impacts; (c) the funding that will be available to implement such steps; (d) the procedures for dealing with unforeseen circumstances; (e) alternatives considered; (f) reasons alternative actions were not proposed; and (g) other measures UWFWS or NMFS may require.
habitat fragmentation	The breaking up of habitat into discrete islands through modification or conversion of habitat by management activities.
harass	Defined in regulations implementing the Endangered Species Act (ESA) and promulgated by the Department of Interior as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, and sheltering" (50 CFR17.3). NMFS has not defined "harass" by regulation.
harm	Defined in regulations implementing the ESA and promulgated by the Department of Interior as a form of take. USFWS defines harm as an act "which actually kills or injures" listed wildlife; harm may include "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering." (50 CFR 17.3). NMFS defines harm as an act "which actually kills or injures fish or wildlife. Such and act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering" (50 CFR 222.102).
hauling	General term for the transportation of logs from one point to another, usually from a landing to the mill or shipping point.
headwall	Steep (generally > 50%), planar, or concave slopes at or near the heads of swales, gullies, and Class II and Class III streams.
headwall swale	A concave depression, with convergent slopes generally greater than 50%.
headwaters	The source of a stream or stream system.
heavy equipment	Any equipment that comes in contact with the ground and is ≥ 6 tons.
helicopter yarding	Use of helicopters to transport logs from where they are felled to a landing.
high retention selection	To accelerate stand development of large trees and closed canopy by harvesting individual trees and maintaining special habitat elements, such as decadent trees, snags, and downed logs.

historically active landslide	Landslide which has undergone movement within historic time (i.e., the past 100 years); features include shallow-seated and deep-seated landslides with a high likelihood of delivering sediment to a watercourse.
historically dormant landslide	Landslides which shows no evidence of movement within the past 100 years.
home range	The area used by a species and to which it exhibits fidelity.
Humboldt crossing	A Humboldt crossing consists of logs and soil placed over a stream in order to allow vehicle transport.
hydric	Requiring an abundance of moisture.
hydrology	Scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.
hypogeous	Growing underground.
implementation agreement (IA)	A part of the application for an incidental take permit, which specifies the terms and conditions, resources, schedule of activities, and expectations of the parties to the agreement.
implementation monitoring	A type of monitoring that tracks how well management policy and direction are being followed or implemented.
incidental take	The take of a threatened or endangered species that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.
incidental take permit (ITP)	A permit issued by the U. S. Fish and Wildlife Service or National Marine Fisheries Service to a non-federal entity that allows the incidental take of a threatened or endangered species; requires the permitee to carry out specified actions that minimize and mitigate the impacts of the incidental take to the maximum extent practicable, and in a manner that does not appreciably reduce the likelihood of survival or recovery of the species in the wild.
inner gorge	A geomorphic feature formed by coalescing scars that originate from landslide and erosion processes caused by active stream erosion. Inner gorge is that area of stream bank immediately adjacent to the stream channel. Its side slope is generally over 65% and occurs below the first break in slope above the active stream channel.
intermittent stream	A stream that flows intermittently based on season. Typically flows for the majority of the wet season but does not have surface flow during the dry season.
introgression	Introduction of a gene from one gene complex into another.
invasive pest plant	Plants that invade and disrupt native plant communities or that have a potential to do so. Invasive pest plants are listed by the California Department of Food and Agriculture (2004) and the California Invasive Plant Council (Cal-IPC) (formerly the California Exotic Pest Plant Council) (Cal-EPPC 1999).
inventory block	A unit of scale that contains multiple planning watersheds and typically represents a region (Albion, Navarro, Rockport etc) of the plan area. MRC uses inventory blocks in characterizing landscape conditions
jeopardy	A finding made through consultation under the Federal Endangered Species Act that the action of a federal agency would be reasonably expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

keyway	A bench excavated at the toe of a fill during road building operations when it is necessary to provide a stable footing for the fill material.
land type	A basic landscape unit for which alternative management regimes are evaluated over time. A land type comprises planning watersheds, vegetation classes, site productivity, and special concern areas.
landing	An area where cut trees are gathered for transport out of the forest.
landscape stands	Areas approximately 20-40 acres in size, grouped by common features such as vegetation, harvest design, and sensitivity, such as proximity to a watercourse.
landslide	A general term for a wide variety of processes and landforms involving the downslope movement, under gravity, of soil and rock material. In forested watersheds, landsliding typically occurs when local changes in the soil pore water pressure increase to a degree that the friction between soil particles is inadequate to bind them together. (DNR)
large woody debris (LWD)	Any piece(s) of large woody debris (e.g., dead boles, limbs, and large root mass) on the ground in forest stands or in streams. For terrestrial LWD, downed logs or fallen trees greater than 16 in mean diameter and longer than 10 ft. For instream LWD, it is any piece of wood functioning for habitat development or stream channel stability in a watercourse.
late seral	The PTEIR refers to this as advanced successional.
leave tree	A tree left (i.e., not harvested) during a timber harvesting operation to provide for specific management objectives, such as wildlife structure, recruitment of future snags, seed source for natural vegetation, or minimum basal area standards.
leks	Areas where male foothill yellow-legged frogs aggregate and display to attract females.
lentic	Living in still waters, such as lakes, ponds, or swamps.
litterfall	Organic debris, mainly bark, twigs, and leaves, on the forest floor.
lobate	Resembling a lobe.
Long-Term Sustained Yield (LTSY)	Estimated timber harvest that can be maintained indefinitely once stands have been converted to a managed state under specific management intensity.
lop	Severing and spreading slash so that no part of it remains more than 30 in.
lotic	Living in actively moving water.
mainline roads	Major arteries for log transportation, generally used at least 3 out of every 5 years.
management prescription	A description of the silviculture, harvest methods, and road and landing construction or reconstruction associated with a stand. Management prescriptions are broader in scope than silvicultural prescriptions.
management unit	The part or parts of timberland ownership that are analyzed together as part of an SYP and may include areas outside the property.
marginal timberland	Lands that are forested but that have site productivity less than site class 5.
marsh	Wetlands characterized by seasonally or permanently saturated soils, often with seasonal standing water, vegetated by emergent, suffrutescent herbaceous plants. Marsh types include salt, brackish, freshwater, and alkali.

mass wasting	A general term for the down-slope movement of soil and rock material under the direct influence of gravity.
mast	Nuts or fruits of trees and shrubs that accumulate on the forest floor, providing forage for wildlife.
Mendocino Triple Junction	Area of convergence between the continental North American and oceanic Pacific and the Juan De Fuca plates
mesic	Requiring a moderate amount of moisture.
metamorphs	Frogs in the intermediate stages of metamorphosis that no longer respire via gills, and are sexually immature.
metapopulation	A population that is divided into several smaller sub-populations (often isolated in fragments of habitat).
microclimate	Climate of small areas, especially insofar as this differs significantly from the general climate of the region.
minimize	To reduce to the smallest part or proportion possible, e.g., conservation measures for rare plants might minimize impacts by avoiding a plant or by assuring that functional habitat is maintained.
mitigation measures	Modifications of actions that (1) avoid impacts by not taking a certain action or parts of an action; (2) minimize impacts by limiting the degree or magnitude of the action and its implementation; (3) rectify impacts by repairing, rehabilitating, or restoring the affected environment; (4) reduce or eliminate impacts over time by preservation and maintenance operations during the life of the action; or (5) compensate for impacts by replacing or providing substitute resources or environments.
monitoring	The evaluation of management practices in order to determine how well objectives have been met.
multi-aged stand	A forest stand that has more than one distinct age class arising from specific disturbance and regeneration events at various times. These stands will normally have multilayered structure.
multilayered canopy	Forest stands with two or more distinct tree layers in the canopy. Also called multistoried stands.
MWAT	Maximum Weekly Average Temperature
MWMT	Maximum Weekly Maximum Temperature
mycorrhizae	Fungi that have developed a symbiotic (mutually beneficial) relationship with the root systems of living plants, from garden vegetables to old growth.
natal area	Area in which an organism was born.
NCCP	Natural Community Conservation Plan. Authorized under State of California Fish and Game Code.
nesting	Activity of birds including the building of a nest, egg laying, incubation, and the raising of nestlings, i.e., young birds not yet able to fly.
nesting platform	Any large limb or other structure generally in the upper two-thirds of a tree and at least 6 in. in diameter.

NMFS	National Marine Fisheries Service, part of the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA).
nomograph	A chart relating three or more scales across which a straightedge can be placed to provide a graphical solution for a particular problem.
non-breeding	The time when an organism is not occupied with mating, reproduction, and carrying for eggs and young; often seasonal.
non-point source pollution	Pollutants detected in a concentrated water source, such as a stream, river, or lake, that come from a range of sources that cannot be isolated to one particular point.
occupied marbled murrelet site	Any area that has been traditionally occupied or used by marbled s, i.e., Lower Alder Creek Management Area.
overburden	Overburden is the earth and other material that is removed from its natural state in the process of mining.
overstory canopy	That portion of trees forming the upper canopy layer. MRC sets a minimum tree height of 30 feet for these trees.
oviposition	To lay eggs.
parr	Young salmonid, in the stage between alevin and smolt, that has developed distinctive dark parr marks on its sides and is actively feeding in freshwater.
partial harvest	Harvest in which more than 25% of the original stand remains.
pelagic	Of, relating to, or living in the open sea.
perennial surface flow	Significant flow of surface water throughout a normal water year.
periphyton	A complex matrix of algae and microbes attached to submerged substrata in almost all aquatic ecosystems. It serves as an important food source for invertebrates and some fish, and is also an important indicator of water quality.
photoperiod	Recurring cycle of light and dark periods of constant length.
piscivorous	Feeding on fish.
plan area	The land within the boundaries of the MRC property lines at the time the HCP/NCCP was submitted.
planning watershed	The contiguous land base and associated drainage system that forms a fourth-order or other watershed typically less than 10,000 acres in size.
plot	A carefully measured area laid out for experimentation or measurement.
podzolized	A process of soil formation that develops in humid regions, especially under coniferous or mixed forest, involving principally leaching of the upper layers with accumulation of organic material in lower layers.
point source pollution	Pollutants come from a specific point of discharge. For MRC, the only point source pollution is from soil erosion features, such as gullies, road crossing wash-outs, and large erosion features created by overland flow of water.
pole	A young tree, from the time its lower branches begin to die until the time the rate of crown growth begins to slow and crown expansion is noticeable.

pool	Often the deepest portion of holding water, anywhere from a few feet deep in the smallest streams to several fathoms deep in large rivers, but commonly from 5 to 20 ft deep. Every pool has three main holding areas for fish: the whitewater head, the main pool, and the tailout.
pool/riffle ratio	The ratio of surface area or length of pools to the surface area or length of riffles in a given stream reach; frequently expressed as the relative percentage of each category. Used to describe fish habitat rearing quality.
population dynamics	How populations and the environment interact to cause changes in a population.
population viability	Probability that a population will persist for a specified period across its range despite normal fluctuations in population and environmental conditions.
potentially suitable habitat	Any area that could grow into northern spotted owl foraging or nesting/roosting habitat. This would exclude rocky outcrops, pygmy forest, grasslands, etc.
pre-commercial thinning	The practice of removing some of the trees less than merchantable size from a stand so that remaining trees will grow faster.
predominant	A tree whose crown has grown above the general level of the upper canopy.
prescription	The assignment of management actions, such as harvesting, planting, thinning, erosion control, and streamside buffers... An appropriate prescription is determined by the management action in relation to vulnerability of a sensitive resource and landowner management objectives.
P-value	P is short for probability. P-value is the probability of observing the given result by chance alone in a stationary random process.
pygmy forest	Pygmy forests are unique to the Mendocino Coast, California, and are located between Navarro River and Ten-Mile River. They are characterized by highly leached, acid, nutrient poor, and year-round saturated soils. Vegetation is located on old (3rd to 5th) terraces with little nutrient run-off available from upslope. Trees remain mostly between 1 to 3m. Soil is usually covered with lichens, which are rare anywhere else in California. These lichens help prevent erosion.
“pygmy transition” forest	A transitional community located between pygmy forest and coast redwood-Douglas fir forest that includes Bishop pine and Douglas fir as co-dominants; understory may include some shrubs and herbs characteristic of pygmy forest. Operationally, MRC may conduct timber harvesting within “pygmy transition” forest, but not within pygmy forest.
rain-on-snow	A hydrologic event where snow-packs are partially or completely melted during rainstorms.
ranid	Any of a large family (Ranidae) of frogs distinguished by slightly dilated transverse sacral processes.

reach — A length of stream channel exhibiting, on average, uniform hydraulic properties and morphology. Reaches can be divided into 3 general types (see http://www.stream.fs.fed.us/fishxing/publications/PDFs/AOP_PDFs/AppendixA.pdf):

1. Source reaches are headwater channels which store sediment until large flow events or debris flows scour it out.

2. Transport reaches are usually steep streams that tend to resist erosion, because they have bed and bank structures dominated by boulders, gravels, wood, etc. Although these reaches store some sediment, they tend to quickly pass increases in sediment to lower-gradient reaches.

3. Response reaches are lower-gradient reaches where sediment transport is limited. When sediment supply increases from upstream transport, it generally deposits in the response reach. The reach will respond to changes in sediment supply by making adjustments, e.g., in channel size.

rearing habitat — Areas in rivers or streams where juvenile fish find food and cover in which to live and grow.

recovery plan — A plan developed by a government agency, that if implemented is expected to result in the recovery of a threatened or endangered species to the extent that the species can be de-listed from threatened or endangered status.

redd — A depression in streambed gravel dug by a spawning female salmonid as a nest for her eggs.

reforestation — The natural or artificial restocking of an area with forest trees; most commonly used in reference to artificial stocking.

refugia — Locations and habitats that support populations of organisms which are limited to small fragments of their previous geographic range.

regeneration — The seedlings and saplings existing in a stand, or the act of establishing young trees naturally or artificially.

regime — A detailed description of the sequence of harvests and other treatments that will occur in a forest stand. A regime describes the timing and details of harvests, including residual basal areas and volumes by site class. A set of regimes describe different timing options for a single silvicultural prescription. See also silvicultural system.

rehabilitation — To rehabilitate poorly stocked conifer stands experiencing excessive hardwood competition and allow for site preparation, conifer regeneration, and transition into well-stocked stands of conifers.

reserve — An area of forest land that, by law or policy, is not available for harvesting. Areas of land and water set aside for ecosystem protection, preservation of rare species, wildlife protection etc.

residual stand — The trees that remain standing after some event, such as selection cutting.

restoration — Return of an ecosystem or habitat to its original community structure, natural complement of species, and natural functions.

riffle — Fast-flowing, shallow segment of a stream where the surface of the water is broken over rocks (e.g., gravel and cobbles) or debris.

rill — An erosion channel, varying in size from a rivulet up to about 1 ft^2 in cross-sectional area, that typically forms where rainfall and surface runoff is concentrated on fillslopes, cutbanks and ditches. If larger than 1 ft^2 in size, the channel is called a gully.

RM	River Mile
road construction/re-construction	Any road work excluding that which requires changing the road prism.
road prism	The horizontal template of a road that includes the road surface, cutslope, fillslope, and ditch.
rootwad	Length of tree trunk, with its root mass attached, used to provide fish habitat and protection to stream banks.
RPF (registered professional forester)	A person who holds a valid license as a professional forester pursuant to Article 3, Section 2, Division 1 of the California Public Resources Code.
salmonid	Any of the family Salmonidae, e.g., salmon and trout.
saprophytic	Obtaining nourishment from the breakdown and decay of organic matter.
scarp	Steep cliff face usually formed by erosion.
screen tree	A screen tree creates a barrier of protection, e.g. from wind, for an adjacent tree and for wildlife that might be occupying it.
sediment	Fragments of rock, soil, and organic material transported and deposited in beds by wind, water, or other natural phenomena.
sediment budget	A sediment budget is an accounting of the sources and deposition of sediment as it travels from its point of origin to its eventual exit from a drainage basin (Reid and Dunne, 1996).
sedimentation	The process of deposition of sediment by mechanical means from a state of suspension in air or water
seed tree removal step	This step harvests a portion of the seed trees left in an earlier entry and after a fully stocked stand of regenerated trees has become established.
seek approval	To elicit the assent of the wildlife agencies on a course of action or on an issue related to the HCP/NCCP.
segment	MRC uses the term *segment* in 3 aquatic monitoring programs: watershed analysis, long-term channel monitoring, and focus watershed studies. A segment is typically 20-30 bankfull widths in length (roughly 300–1500 ft for most streams in the plan area). Each planning watershed will have anywhere from 3 to 30 field-observed segments, depending upon how much of the planning watershed MRC owns. The average planning watershed where MRC owns a majority of the watershed contains roughly 10–20 segments for watershed analysis and 1 long-term channel monitoring segment.
sensitive species	Those species that (1) have appeared in the Federal Register as proposed for classification and are under consideration for official listing as endangered or threatened species, (2) are on an official state list, or (3) are recognized by the U.S. Fish and Wildlife Service or other management agency as needing special management to prevent placement on federal or state lists.

serpentine-influenced communities	Communities and habitats growing in locations where the geology is composed of or the soil is derived from classes of ultramafic rocks known as serpentine, serpentinite or serpentinized peridotites. The vegetation of these areas typically includes plant species that are usually or often restricted to serpentine-derived soils. Examples of serpentine-influenced communities and habitats with the potential to occur in the plan area include (but are not limited to) serpentine grassland, serpentine chaparral, serpentine woodland, and serpentine seep.
shade	Determinations of in-stream shade, or shade quality, are based on the existing temperature conditions (most recent 3-year average maximum MWAT) and the in-stream canopy conditions. See Appendix G, Protocols for Watershed Analysis, section G.2.4.
shallow landslide	Shallow landslides, also known as shallow-seated landslides, are areas where surface material (unconsolidated rock colluvium and soil) has moved downslope along a relatively steep, shallow failure surface. The failure surface is generally greater than 65% in steepness and generally less than ten ft in depth.
shelterwood removal	Removing trees in a series of two or more cuttings so new seedlings can grow from the seed of older trees.
silvicultural method	A single scheduled entry into a stand. A group of silvicultural methods make up a silvicultural system. Silvicultural methods include selection, clear-cut, commercial thin, rehabilitation, sanitation salvage, no harvest, and alternative prescriptions.
silvicultural prescription	A detailed description of the sequence of treatments that might occur in a forest stand. A prescription is one component of a silvicultural system, or the scheduled entries into a stand, including harvesting, planting, thinning, and controlling brush and other competing species.
silviculture	The science and practice of controlling the establishment, composition, and growth of the vegetation of forest stands. It includes the control of production of stand structures, such as snags and downed logs, in addition to live vegetation.
silvicultural unit	An area within a harvest plan with only 1 type of silviculture that is non-contiguous with other areas of that same type.
single tree selection	To establish and maintain multi-storied, uneven-aged stands of redwoods and Douglas-fir by harvesting individual trees more or less uniformly throughout the stand. Provides space for growth of remaining trees and space for growth of new trees.
site class	Site class reflects the potential productivity of forest stands for present and future timber species growth. Classes range from I to V. A site class of I is the most productive while a site class of V is the least productive. It is important to note that site classes are only applicable to specific regions. A site class of I in the mixed conifer region of the Sierra Nevada, for instance, is not likely to have the same growth potential as a site class of I in the north coast redwood region.
site index	A measure of forest productivity expressed as the height of the tallest trees in a stand at an index age. 50-year and 100-year bases are commonly used.
site potential tree height	The height a dominant tree may attain given its species, the site conditions where it occurs, and the time interval of growth.
site preparation	Any activity involving mechanical disturbance of soils or burning of vegetation that is performed during or after completion of timber harvesting and is associated with preparation of any portion of a logging area for artificial or natural regeneration.

site productivity	The ability of a geographic area to produce biomass, as determined by conditions (e.g., soil type and depth, rainfall, temperature) in that area.
skid trail crossing	A temporary crossing constructed for tractor logging operations that is removed following completion of logging operations, and always before the start of the winter rainy period.
skidding	Removing cut trees from an area by dragging or carrying trees on the ground with a tractor.
skid trail	A path created by dragging logs to a landing.
slash	Woody residue left on the ground after trees are felled, or accumulated there as a result of a storm, fire, or silvicultural treatment.
slope stability	The resistance of a natural or artificial slope or other inclined surface to failure by landsliding (mass movement).
snag	Any standing dead tree greater than 16 in. dbh and taller than 10 ft. A hard snag is composed primarily of sound wood, generally merchantable. A soft snag is composed primarily of wood in advanced stages of decay and deterioration, generally not merchantable.
soil pipe	A pipe-shaped void that may extend for some distance within the shallow subsurface environment as either a continuous feature or as a system of inter-connected features that form extensive, branched networks capable of transporting water and/or sediment.
source tree	A source tree is a dominant, co-dominant, or pre-dominant tree that contains large amounts of long-beard lichen in the canopy and provides propagules for dispersal.
special concern areas	Areas that contain any additional conditions that are mappable and that may affect the range of prescriptions or constrain the size of an area upon which some management activity takes place.
species of concern	Unofficial status given to a species that appears to be in jeopardy, but for which insufficient information exists to support listing.
sphagnum	Mosses of acidic, wet soils or boggy locations. About 50 species occur in North America.
spoils piles	A mound of refuse from forest operations.
springtails	Any of an order of small primitive wingless insects, usually with a forked structure on the fourth or fifth abdominal segment used for jumping.
stand	Stands are contiguous areas within the forest that have similar characteristics for vegetation (species composition and the size and density of trees), and growth potential or site quality (soil type and topographic factors, such as elevation and aspect). Stands are usually the units to which silvicultural prescriptions are applied.
stochastic	Random, uncertain; involving a random variable.
stocked	The degree to which an area of land is occupied by trees as measured by basal area or number of trees per acre.

stream order	A number from 1 to 6 or higher, ranked from headwaters to river terminus, which designates the relative position of a stream or stream segment in a drainage basin. First order streams have no discrete tributaries; the junction of two first-order streams produces a second-order stream; the junction of two second-order streams produces a third order stream.
structure class	Structure classes are a vegetation classification based on a stand's species composition, diameter distribution, and density. Structure classes relate vegetation conditions to forest wildlife species.
structural retention	Harvest practices that leave physical elements (e.g., green trees, snags, downed logs) of mature forests on site after harvest.
substrate	Mineral or organic material that forms the bed of a stream. The substance or nutrient on or in which an organism lives and grows
succession	A series of dynamic changes by which one group of organisms succeeds another through stages leading to potential natural community or climax. An example is the development of series of plant communities (called seral stages) following a major disturbance.
succession	A series of dynamic changes by which one group of organisms succeeds another through stages leading to potential natural community or climax. An example is the development of series of plant communities (called seral stages) following a major disturbance.
suffrutescent	Describes a somewhat shrubby plant stem that is slightly woody at the base.
suitable spotted owl habitat	The forest vegetation with the age class, species of trees, structure, sufficient area, and adequate food source to meet some or all of the life needs of the northern spotted owl. This excludes areas such as rocky outcrops and pygmy forest.
surface erosion	The detachment and transport of soil particles by wind, water, or gravity. Surface erosion can occur as the loss of soil in a uniform layer (sheet erosion), in many rills, or by dry ravel.
surficial	Of or relating to a surface.
suspended sediment	Sediment suspended in a fluid by the upward components of turbulent currents or by colloidal suspension.
sustained yield plan (SYP)	Document intended to supplement the THP process by providing a means for addressing long-term issues of sustained timber production and cumulative effects analysis, which includes assessing impacts on fish, wildlife, and watersheds over a large landscape.
SVL	Snout-to-Vent Length. Term used in the measurement of salamanders. This measurement does not account for lengths of tails, since fish sometimes bite them off.
swale	An unchanneled hillslope where subsurface flow is concentrated. Swales are often sites of accumulation of colluvium.
sympatry	Occupying the same range without loss of identity from interbreeding.
tadpole	Larvae (tadpoles) are frogs which respire via gills and are tied to aquatic environments.
tailout	Where the depth of the pool gradually lessens, literally the tail-end.

take	Under the federal Endangered Species Act, take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect an animal, or to attempt to engage in any such conduct.
tectonism	Structural behavior of an element of the earth's crust; crustal instability.
terrain stability unit	Categorization of a land area based on terrain similarity, mass wasting potential, and sediment delivery risk. The HCP/NCCP plan area has 8 TSUs.
territory	Area defended by a single owl or a pair of owls against members of the same species, generally during the breeding season.
thalweg	The line connecting the lowest or deepest points along the riverbed, usually identical to the center of the navigation channel. The deepest point of a stream along any channel cross-section.
timber harvesting plan (THP)	As described in Public Resources Code 4582. A three-year plan for the harvesting of commercial timberlands that (1) must be prepared by a registered professional forester, (2) must be filed with and approved by the California Department of Forestry, and (3) must contain detailed information about the land to be harvested, the silvicultural methods to be applied, special provisions (if any) to protect unique and sensitive resources in the area, the dates when timber operations will commence and conclude, and any other information that may be required by the State Board of Forestry.
timberland	Land, other than land owned by the federal government, and land designated by the California Board of Forestry as experimental forest land, which is available for, and capable of, growing a crop of trees of any commercial species used to produce lumber and other forest products, including Christmas trees.
TMDL	Total Maximum Daily Load. A TMDL describes the amount of a pollutant that a watercourse can receive without violating water quality standards
tractor end-lining	Winching logs on steep ground with a crawler tractor situated on a skid road or a temporary, seasonal, or permanent road.
tractor yarding	Skidding (or transporting) logs by a self-propelled vehicle, generally by dragging the logs with a grapple or chokers.
transition	To develop an uneven-aged stand from an even-aged stand or a stand with unbalanced or irregular stocking. Involves removal of trees individually or in small groups to create a balance of different stand structure and natural reproduction.
trophic	Relating to nutrition.
turbidity	A measure of water clarity, which may be affected by material in suspension in the water.
understory	The trees and other woody species growing under the canopies of larger adjacent trees and other woody growth.
uneven-aged system	A silvicultural system that results in a multi-aged stand, containing three or more distinct age classes. The combination of actions that simultaneously maintains continuous tall forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes.
unique habitat elements	Important components of wildlife habitat, such as snags, large woody debris, hardwoods, streams and riparian areas, wetlands, seeps and springs, meadows, rock outcrops, cliffs, talus slopes, serpentine barrens and other areas with uncommon soil types, burrows, caves, and cavity trees.

upwelling	Upwelling is the process by which nutrients are brought up to the surface of the ocean.
vagility	Free to move about.
variable retention	To rotate stands with poorly stocked conifers and relatively high densities of hardwood. The entire stand will be harvested, with dispersed and/or aggregated retention of 10% to 40% or more of the existing stand. This will allow for vigorous growth of the remaining stand along with pockets of undisturbed trees to provide for ecological functionality, habitat structure, and forest complexity.
vegetation strata	The vegetation category, in a stratified sampling system for vegetation data, which is assigned to a stand using interpretations of aerial photos. See Appendix U, Inventory Strategy.
waterbar	Technique to divert flowing water off roads or trails in order to prevent erosion and sediment delivery to streams. Usually, a ditch or shallow gully is constructed across the road or trail at a diagonal to prevent water from flowing directly down.
watershed	A watershed is that part of a landscape that drains to a particular stream, river, or other body of water. If rain falls on saturated soil, it will run off downhill. Runoff from all the hillsides in a watershed eventually will reach the stream or river for which the watershed is named. The boundaries between watersheds are called divides and generally follow ridge crests. The biggest divide in the United States is the Great Divide, along the crest of the Rocky Mountains. The Great Divide separates waters flowing to the Atlantic Ocean from those that flow to the Pacific.
watershed analysis	A structured approach to developing a forest practices plan for a watershed analysis unit (WAU) based on a biological and physical inventory, which was originally developed by the Washington State Department of Natural Resources.
watershed analysis unit	An area of land where a watershed analysis is being or has been conducted, including, in some cases, multiple planning watersheds.
weir	Fence or enclosure set in a waterway for taking fish.
wetlands	Wetlands are transitional areas between aquatic and terrestrial habitats in which the soil is usually saturated, either on a permanent or temporary basis.
windthrow	Trees uprooted by the wind.
xeric	Characterized by, relating to, or requiring only a small amount of moisture.
yarding	Transporting logs from the point of felling to a collecting point or landing.

Chapter 17

List of Abbreviations

17 LIST OF ABBREVIATIONS

Abbreviation	Expanded Name
AMZ	aquatic management zone
ASMB	annual salmonid monitoring basin
BOF	California Board of Forestry and Fire Protection
CAL FIRE	California Department of Forestry and Fire Protection
CCMP	California Coastal Management Program
CDFG	California Department of Fish and Game
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFPR	California Forest Practice Rules
CFR	Code of Federal Regulations
cfs	cubic feet per second
CGS	California Geological Survey
CMZ	channel migration zone
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CRP	certified regulatory program
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dbh	diameter at breast height
DOI	Department of the Interior
DPS	distinct population segment
EEZ	Equipment Exclusion Zone
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ELZ	Equipment Limitation Zone
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESHA	environmental sensitive habitat areas
ESU	evolutionary significant unit

Abbreviation	Expanded Name
FPA	Forest Practice Act
FSC	Forest Stewardship Council
GIS	geographical information system
HCP	Habitat Conservation Plan
ITP	incidental take permit
JDSF	Jackson Demonstration State Forest
LACMA	Lower Alder Creek Management Area
LCP	local coastal program
LTFAMS	larval tailed frog abundance monitoring stream
LTSAA	Long Term Streambed Alteration Agreement (aka MSAA)
LWD	large woody debris
LUP	land use plan
MAMU	marbled murrelet
MOU	memorandum of understanding
MRC	Mendocino Redwood Company
MSAA	Master Streambed Alteration Agreement (aka LTSAA)
MSP	Maximum Sustained Production
MWAT	maximum weekly average temperature
MWMT	maximum weekly maximum temperature
mya	million years ago
NCCP	Natural Community Conservation Plan
NCCPA	Natural Community Conservation Planning Act
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NSO	northern spotted owl
OCRM	Ocean and Coastal Resource Management
PTEIR	Programmatic Timber Environmental Impact Report
RLFMU	red-legged frog management unit
RMZ	riparian management zone
RPF	Registered Professional Forester
RWQCB	Regional Water Quality Control Board

Abbreviation	Expanded Name
SCS	Scientific Certification Systems
SOD	sudden oak death
SWRCB	State Water Resources Control Board
SYP	Sustained Yield Plan
TDML	Total Maximum Daily Loads
THP	timber harvest plan
USFWS	United States Fish and Wildlife Service
WAU	watershed analysis unit
WDR	water discharge requirement
WQMP	Water Quality Management Plan

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