



April 2019
Greater Mill Creek Ecosystem Restoration Project

Draft Initial Study/Negative Declaration and Environmental Assessment

Prepared for Redwoods Rising

**REDWOODS
RISING™**



Initial Study/Negative Declaration and Environmental Assessment

Project: Greater Mill Creek Ecosystem Restoration Project

Lead Agencies: California Department of Parks and Recreation (CDPR; California Environmental Quality Act [CEQA] lead) and National Park Service (NPS; National Environmental Policy Act [NEPA] lead)

Project Description: CDPR and NPS are proposing to complete vegetation management, aquatic restoration, and road removal activities over 34,080 acres within the Greater Mill Creek area (the Proposed Action). Vegetation management actions would include forest restoration through thinning; snag creation; crown manipulation; tree planting; manual and mechanical vegetation removal; flaming and torching; mowing, solarization, and covering; girdling; and fuels reduction. Abandoned logging roads and related road infrastructure would be removed. Temporary roads may need to be constructed to access restoration areas and would be removed as soon as possible after treatment. Proposed aquatic restoration would include placement of large wood in streams to enhance habitat and stream function. Proposed Action implementation is anticipated to commence in late 2019.

Impact Summary: The Proposed Action would result in either less-than-significant or no impacts on the environment. Less-than-significant impacts would be temporary in duration. The Proposed Action is anticipated to result in long-term benefits to aesthetics, biological resources, greenhouse gas emissions, hydrology and water quality, and reduced wildfire risk in the project area.

Availability of Documents: This joint Initial Study/Negative Declaration and Environmental Assessment (ISND/EA) is available for review at <http://parkplanning.nps.gov/GreaterMillCreek>, https://www.parks.ca.gov/?page_id=980, and at the following locations:

- Arcata Library, 500 7th Street, Arcata, California 95521
- California Department of Parks and Recreation, North Coast Redwoods District, 3431 Fort Avenue, Eureka, California 95503
- California Department of Parks and Recreation, Northern Service Center, One Capitol Mall, Suite 410, Sacramento, California 95814
- Del Norte County Library, 190 Prince Mall, Crescent City, California 95531
- Humboldt County Library, 1313 3rd Street, Eureka, California 95501
- Humboldt State University Library, 1 Harpst Street, Arcata, California 95521
- McKinleyville Library, 1606 Pickett Road, McKinleyville, California 95519
- National Park Service, South Operations Center, 121200 Highway 101, Orick, California 95555
- Redwood National and State Parks, 1111 Second Street, Crescent City, California 95531
- Thomas H. Kuchel Visitor Center, US-101 and Redwood Highway, Orick, California 95555

Public Comments: Questions or comments regarding this document should be addressed to both CDPR and NPS at the following addresses:

- California Department of Parks and Recreation, Fort Humboldt, ATTN: Shannon Dempsey, P.O. Box 2006, Eureka, California 95502
- National Park Service, South Operations Center, ATTN: Leonel Arguello, P.O. Box 7, Orick, California 95555.

Findings: A copy of the IS is incorporated into this document. CDPR and NPS have independently reviewed and analyzed this ISND/EA for the Proposed Action and finds that the document reflects the independent judgement of CDPR and NPS. As the CEQA and NEPA lead agencies, respectively, these agencies confirm that the standard project requirements/project-specific requirements detailed in this document are feasible and will be implemented as stated in the ISND/EA.



4-4-2019

Shannon Dempsey
California Department of Parks and Recreation
District Environmental Coordinator

Date

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1 Introduction

The Greater Mill Creek (GMC) Ecosystem Restoration Project (hereafter referred to as the Proposed Action) is being proposed by Redwood National and State Parks (RNSP), consisting of the California Department of Parks and Recreation (CDPR) and National Park Service (NPS). Redwoods Rising is a partnership among CDPR, NPS, and the Save the Redwoods League (League). This partnership builds upon decades of efforts to protect and improve the health of redwood forest ecosystems and offers a unified approach to expand and connect the remaining 40,000 acres of old-growth trees and accelerate the recovery of previously logged stands, setting them on the path to once again becoming old-growth forests. It coordinates and integrates existing efforts to restore stream health and critical wildlife habitat and create landscapes that will be resilient in the face of future change. It works in tandem with essential collaborators and brings additional financial support to bear on a shared restoration for RNSP. Redwoods Rising brings together the existing RNSP partnership and the League to more strategically and holistically address restoration needs. It serves to formalize the existing relationships among these organizations and further leverage the strengths of each partner to more efficiently and effectively restore and protect RNSP's redwood forest ecosystems. A separate environmental compliance document is being prepared for the Greater Prairie Creek Ecosystem Restoration Project, which is also being proposed.

This document is organized to present introductory information on the Proposed Action (Section 1), alternatives evaluated (Section 2), and affected environment and environmental consequences (Section 3). It also contains numerous appendices, some of which have global reference throughout the document, including abbreviations (Appendix A), glossary (Appendix B), tables (Appendix C), figures (Appendix D), agency consultations and approvals (Appendix E), *Draft Greater Mill Creek Vegetation Management Plan* (Appendix F), *Draft Aquatic Habitat Restoration Strategy for Greater Mill Creek Project Area* (Appendix G), alternatives considered but eliminated (Appendix H), photographs (Appendix I), special-status species tables (Appendix J), document preparers (Appendix K), and references (Appendix L).

1.1 Regulatory Guidance

This Initial Study/Negative Declaration and Environmental Assessment (ISND/EA) has been jointly prepared by the California Department of Parks and Recreation (CDPR) and National Park Service (NPS) to evaluate the potential environmental effects of the Proposed Action within Redwood National and State Parks (RNSP) in Del Norte County, California. This document has been prepared to meet the requirements of the California Environmental Quality Act (CEQA; Public Resources Code [PRC] Section 21000 et seq.), the State CEQA Guidelines (California Code of Regulations [CCR] Section 15000 et seq.), and the National Environmental Policy Act (NEPA; 42 United States Code [USC] 4321 et seq.).

Under CEQA, an IS is conducted by a lead agency to determine whether a project may have a significant effect on the environment (CEQA Guidelines Section 15063[a]). If there is substantial evidence that a project may have a significant effect on the environment, an Environmental Impact Report (EIR) must be prepared in accordance with CEQA Guidelines Section 15064(a). However, if the lead agency determines that there is no substantial evidence that the project plans or any of its aspects may cause a significant effect on the environment, a Negative Declaration (ND) may be prepared. In this case, the lead agency prepares a written statement describing the reasons a

proposed project would not have a significant effect on the environment and, therefore, why an EIR need not be prepared.

Similarly, under NEPA, an Environmental Assessment (EA) is prepared to determine whether a federal action has the potential to cause significant environmental effects. If the lead agency determines that the action would not have significant environmental impacts, the agency would issue a Finding of No Significant Impact (FONSI). A FONSI presents the reasons why the agency has concluded that there are no significant environmental impacts projected to occur upon implementation of the action. If the EA determines that the environmental impacts of a proposed federal action would be significant, an Environmental Impact Statement (EIS) would be prepared.

1.2 Lead Agencies

The CEQA lead agency is the public (state or local) agency with primary approval authority over the Proposed Action. In accordance with CEQA Guidelines Section 15051(b)(1), "the lead agency will normally be an agency with general governmental powers, such as a city or county, rather than an agency with a single or limited purpose." The NEPA lead agency is the federal agency with primary responsibility for NEPA compliance and is generally the federal agency with greatest responsibility for approving or denying approval of the Proposed Action. For the Proposed Action, CDPR is the CEQA lead agency and NPS is the NEPA lead agency.

1.3 Project Location

The Proposed Action is located in the Del Norte Coast Redwoods State Park (DNCRSP) and a portion of Redwood National Park within the larger RNSP (Figure 1). The project area includes approximately 34,080 acres considered for restoration treatments, including invasive species management in 3,730 acres of old-growth stands. The project area is subdivided into nine regions: Coastal Old Growth, Upper West Branch, Lower West Branch, First Gulch/Hamilton Buffer, Bummer Lake, East Fork, Lower Rock Creek, Upper Rock Creek, and Main Stem Mill Creek.

1.4 Project Background

Portions of the project area were extensively logged from 1908 to 1939 and from 1954 to 2000, resulting in over 27,000 acres of intensively harvested forest (mostly clearcut) within the project area. These stands consist of unnaturally dense young forests where progression towards late-seral habitat is hindered, species diversity has been reduced, and invasive exotic plants threaten to alter natural communities. Unmaintained logging roads, skid trails, and stream crossings have eroded since construction, leading to fill material entering nearby stream channels and stream crossing failures.

Consistent with the *RNSP General Management Plan/General Plan (GMP/GP; NPS/CDPR 1999)* and the 2010 amendment to include the GMC area (CDPR 2010), CDPR began restoration efforts in the project area in 2003 and has since treated approximately 5,470 acres of overly dense forests, removed over 70 miles of roads, and installed 121 large wood habitat structures into streams. These efforts have helped to improve and protect vegetation and wildlife habitat, but are only the beginning of the necessary restoration. With the Proposed Action, CDPR and NPS propose to continue restoration efforts in the project area through a combination of vegetation management, aquatic restoration, and road removal activities.

1.5 Purpose and Need for Action

The purpose of the Proposed Action is rehabilitation of the watersheds within the project area and restoration of ecosystem function and processes that have been degraded by historical land use activities, including intensive forest management. Rehabilitation would be accomplished through reducing stand density and shifting species composition to promote growth of remaining trees and understory vegetation and development of multi-story canopy; maintaining sensitive plant communities; managing invasive species and pathogens; reducing erosion and sedimentation into streams; restoring instream habitat complexity; and managing vegetation within riparian corridors.

These actions are needed to build resiliency through accelerating development of forest characteristics more typical of late-seral forests, reducing fire hazards and chronic sediment inputs to streams, and enhancing habitat for aquatic and terrestrial species.

The following vegetation management objectives have been identified for the Proposed Action:

- **Forest restoration objectives** include creating conditions to put impaired forests on a trajectory that expedites the development of late-seral forest structure; protecting and connecting existing, fragmented old-growth forest; creating and buffering habitat for threatened, endangered, and sensitive species as appropriate given the historic range of habitat conditions; implementing treatments that contribute to the desired species composition and vegetation structure while considering the historical range of variability and the resiliency needed to face future challenges such as climate change and altered fire regimes; and reducing the potential for large and unnaturally high-intensity wildfires.
- **Uncommon and sensitive natural community objectives** include controlling conifers and other vegetation encroaching into uncommon and sensitive natural communities where they would not normally occur; facilitating the expansion of underrepresented habitats to more closely resemble the extent that existed prior to logging and fire exclusion; and protecting and managing sensitive plant populations and natural communities in the GMC area, creating additional habitat and buffering existing habitat for special-status plant species.
- **Non-native plant and pathogen management objectives** include preventing the expansion or new establishment of invasive non-native plant and pathogen populations within the GMC area; prioritizing control efforts of existing invasive non-native plant species based upon their potential to spread, especially into sensitive and uncommon habitats, and the feasibility of their successful control; and controlling the spread of non-native pathogens.
- **Cultural vegetation management objectives** include providing for the protection, preservation, and management of culturally important plant communities; and reestablishing and maintaining the relative prevalence of savannas and other uncommon habitat types that support culturally significant species that existed prior to European American contact.

Aquatic restoration objectives include improving fish habitat, restoring floodplain function, and expanding and improving riparian forest.

Road removal objectives include reducing erosion and sediment delivery from existing infrastructure into streams, reducing mass wasting, reestablishing natural stream morphology, restoring surface and shallow subsurface hydrology, restoring stream function, and reducing terrestrial habitat fragmentation.

1.6 Relevant Laws, Policies, Guidelines, and Plans

DNCRSP is one of four parks that makes up RNSP, which is jointly administered by CDPR and NPS to more efficiently protect resources and serve visitors. The agencies worked together to prepare the *RNSP 1999 Final General Management Plan/General Plan, Environmental Impact Statement/Environmental Impact Report* to guide joint management of the parks for 15 to 20 years (NPS/CDPR 1999). The original DNCRSP, founded in 1927, more than doubled in size in 2002 with the addition of the 25,000-acre Mill Creek property known as the Mill Creek Addition (MCA). The MCA was acquired to restore late-seral forest characteristics and associated natural functions that maximize benefits to the salmonid species and wildlife associated with late seral forest. In 2005, Congress approved the expansion of the RNSP boundary and the GMP/GP was amended in 2010 to include the MCA (CDPR 2010). The General Plan Amendment (GPA) established a comprehensive framework that directs ongoing management activities and projects, determines appropriate public uses, and guides future development decisions in the MCA. Subsequently, the Mill Creek Watershed Management Plan (WMP; CDPR 2011a) was released in 2011. The WMP laid the groundwork for implementation of natural resource restoration and protection activities, including sediment control and reduction, forest recovery directed toward resilient late-seral conditions, and monitoring to assess project progress and direct adaptive management. The GMP/GP, its amendment for the MCA, and the WMP call for the development of a Vegetation Management Plan (VMP) to guide these restoration activities by identifying stand conditions or specific areas of high priority, treatment alternatives, monitoring methods, and adaptive management as needed. CDPR completed the *Draft Greater Mill Creek Vegetation Management Plan* in March 2019 (CDPR 2019a; Appendix F). CDPR also completed the *Draft Aquatic Habitat Restoration Strategy for Greater Mill Creek Project Area* in April 2019 to guide aquatic restoration activities within the GMC area (CDPR 2019b; Appendix G).

The GMC Ecosystem Restoration Project ISND/EA is consistent with the GMP/GP, GPA, WMP, VMP, and Landscape Stabilization and Erosion Prevention Plan (LSEP; CDPR 2005) documents, which direct that forest restoration activities in the park emphasize use of silvicultural methods in second-growth forests to re-attain old-growth characteristics in the shortest time possible, and that watershed restoration activities in the parks emphasize landform restoration through removal of abandoned logging roads that pose the greatest threat to park resources. This ISND/EA is also consistent with the GMC Aquatic Habitat Restoration Strategy.

Management goals in the GMP/GP that are relevant to the Proposed Action include protecting and preserving the natural resources of the parks and restoring lands, ecosystems, and processes that have been altered by modern human activities. Natural resource management and protection strategies from the GMP/GP that guide forest restoration include supporting the perpetuation of ecosystem processes and components, including the redwood forest ecosystem as the prime RNSP resource, and restoring and maintaining RNSP ecosystems as they would have evolved prior to European American settlement of the region in 1850.

1.7 Public Involvement

Public scoping for the Proposed Action was conducted from August 9, 2018, through September 7, 2018. To initiate the public scoping process, CDPR and NPS sent a brochure describing the planning process, purpose and need, alternatives under consideration, and general description of the Proposed Action to 102 recipients, including individuals, agencies, and organizations. The brochure was also emailed to 62 addresses. During the public scoping period, two public scoping meetings

were held. The first was held at the Crescent Fire Protection District in Crescent City, California, on August 22, 2018, and the second was held at the Arcata Community Center in Arcata, California on August 23, 2018. Both meetings presented information about the purpose, need, and objectives of the Proposed Action in an open-house format. Members of the public were able to submit comments by mail, in person at the meetings, or electronically at the NPS Planning, Environment, and Public Comment website (<https://parkplanning.nps.gov/GreaterMillCreek>).

Comments were received from a total of seven individuals, agencies, and organizations through the public scoping process. Comments primarily related to the following: requesting details of the project description; voicing support for the Proposed Action; suggesting the addition of out-of-scope elements to the Proposed Action; and suggesting that NPS and CDPR coordinate and consult with organizations as part of the Proposed Action.

2 Alternatives

No alternatives besides the No Action Alternative and Proposed Action were identified that would meet the purpose and need of and have meaningful differences in environmental effects from the Proposed Action.

2.1 No Action Alternative

The No Action Alternative is required under NPS guidelines for compliance with NEPA and is used to compare existing conditions with the other evaluated alternatives. "No Action" means either a continuation of existing management practices or "no project." In this case, "No Action" means that, in the project area, CDPR and NPS would not undertake large-scale vegetation management activities to accelerate the development of old-growth characteristics; sensitive plant communities would not be maintained; invasive species and pathogens would not be managed; in-stream habitat and riparian corridors would not be restored or reestablished; and road removal/repair would not occur to reduce erosion and sedimentation into streams. Within the project area, existing vegetation conditions would change on their current trajectory, existing abandoned logging roads would remain, and fill material would remain in streams. In other portions of the project area, ecosystem restoration projects could occur on a project-by-project basis, as has been the case with the 2005 LSEP (CDPR 2005), 2006 Forest Ecosystem Restoration and Protection Project (FERPP; CDPR 2006), and the 2011 Mill Creek Watershed Young Forest Restoration Project (CDPR 2011b). Regular monitoring and maintenance activities would continue as they historically have throughout the project area.

2.2 Proposed Action

The Proposed Action consists of activities associated with CDPR's VMP and LSEP, as well as other restoration-related activities. Under the Proposed Action, vegetation management, aquatic restoration, and road removal activities would occur over 34,080 acres within the GMC area over the course of the next 30 years. The following sections provide further detail on these activities.

2.2.1 *Vegetation Management Actions*

Proposed vegetation management actions include those described for implementing the five Vegetation Management Areas identified in CDPR's VMP: Forest Restoration; Uncommon and Sensitive Natural Communities Management; Prescribed Fire and Fire Use; Non-native Plants and

Pathogens; and Cultural Vegetation Management. Table 1 summarizes the implementation actions associated with each Vegetation Management Area. Each action may be applicable to more than one Vegetation Management Area. The following subsections describe the proposed vegetation management actions identified in Table 1.

2.2.1.1 Forest Thinning

The Proposed Action includes forest thinning throughout the project area, as shown in Figure 2. A forest treatment includes a thinning method and an operational method. These treatments, and how they would be applied under the Proposed Action, are described in the following subsections. During forest thinning activities, trees may also be removed to reduce fuel loads and control fire in strategic locations, such as along roads and ridgetops.

2.2.1.1.1 Thinning Methods

Thinning method refers to any silvicultural treatment intended to reduce stand density, redistribute growth among remaining trees, and enhance conditions to expedite the development of late-seral structure. The primary thinning method that would be used under the Proposed Action is variable density thinning (VDT), which focuses on the enhancement of spatial heterogeneity (i.e., uneven variation of tree spatial pattern over areas and time) across the landscape by prescribing fine-scale variation to the forest structure. VDT can take many forms, and in the case of the Proposed Action may incorporate a mixture of treatments, including the following:

- Low thinning (thinning from below) focuses on the removal of trees from the lower crown classes (i.e., suppressed, intermediate, and co-dominant crown classes) to benefit trees in the upper crown classes (i.e., co-dominant and dominant crown classes), and generally removes the smallest diameter trees. Trees greater than 5 inches in diameter would be removed first, with successively larger trees removed until the basal area retention is met.
- Crown thinning focuses on the removal of trees from the dominant or co-dominant crown classes to benefit adjacent trees of the same crown class. While diameter class ranges vary from stand to stand, most trees cut would be in the middle-diameter classes (8 to 30 inches) as opposed to the smaller-diameter classes cut in the low thinning method.
- Gaps (areas with few trees and up to 0.5 acre in size) may be used to establish and maintain a new cohort of trees, encourage a robust assemblage of understory vegetation, and promote landscape-scale heterogeneity. All trees in the largest diameter classes (above the 80th percentile) would be retained, and no more than 10% of the area within in any unit would be treated with forest gaps.
- Skips refer to areas where few to no trees would be cut and may be established at the same size and frequency as gaps to further increase stand heterogeneity.
- Canopy release removes competition from around individual trees or small groups of trees that are retained. For example, every tree that falls within the drip line of a retention tree or retention group is cut. This method may be implemented in hardwood-dominated stands to release conifers, or to release under-represented species in a dense forest setting.
- Conifer cutting in pine savannahs would retain a maximum of 20% canopy cover. All conifer seedlings and saplings would be removed as needed to temporarily restrict new recruitment.

Under the Proposed Action, forest thinning treatments would vary in intensity to encourage heterogeneity throughout the project area. When averaging across an entire forest restoration unit, defined as an area delineated by similar vegetation types, treatments would not exceed a 50%

reduction in the basal area, and the basal area (the sum of cross-sectional areas of tree trunks at breast height for a given plot of land) would be reduced by 40% or less in most locations. Most treatments would retain more than 100 trees per acre across a treatment unit. In a few cases within older stands, treatments may reduce stem density to less than 100 trees per acre, closer to the number of trees found in old-growth forests.

Different thinning methods would be selected in the field based on site-specific conditions to further promote landscape-scale heterogeneity. The thinning method would vary according to current conditions and landscape context, per the following treatment considerations:

- In some areas, previous logging activities have altered the species composition (e.g., redwood is underrepresented, excessive alder in-growth, minor species underrepresented). Thinning treatments would aim to shift species composition, which can result in patchy thinning severities and removal of undesired tree species (e.g., exotic and overrepresented tree species). Once the desired species composition is met, further thinning may continue to increase stand heterogeneity and the available growing space for retention trees.
- While there is no upper limit to implementing forest thinning operations on steep slopes, the thinning intensity may be reduced to maintain slope stability.
- Bear damage is generally higher in forests thinned at high intensities and which have a larger proportion of smaller trees (i.e., diameter at breast height [DBH] is less than 24 inches); therefore, forests mostly composed of small-diameter trees may need to be thinned at lower intensities to avoid excessive bear damage.

2.2.1.1.2 *Operational Methods*

Operational method refers to the method by which trees are felled (mechanized heavy equipment or manually with chainsaws) and how woody material is treated and/or removed from the treatment area. The following types of operational methods would be used as part of the Proposed Action (relevant photographs are provided in Appendix I):

- **Biomass removal.** Biomass removal refers to removing trees from treatment units to minimize fuel accumulation and encourage understory development. It may also offset the costs of operations. Excess biomass that is not removed from the site would be lopped and scattered on site. Biomass removal requires the use of heavy equipment to fell trees, transport cut trees to a landing, process wood products (e.g., limbing and bucking), and load and transport material off site. Biomass removal would be accomplished using one or a combination of methods. The method would change based on the existing slope of the work area or access considerations, as described below. Within the project area, all forested land being considered for restoration has the potential for biomass removal to restore ecosystem function and reduce uncharacteristically large wildfire risk, while retaining ample wood for soil nutrients and fish and wildlife habitat. The following types of biomass removal methods would be used as part of the Proposed Action:
 - Traditional ground-based operations refers to the use of ground-based mechanized equipment (e.g., tractor, feller-buncher, rubber-tired skidder, or shovel harvester/processor) to fell trees and/or skid logs or whole trees from the stump area to the landing or roadside area. At the landing, a processor would limb and buck the material into lengths appropriate for hauling. Loaders would be used to load log trucks, which would transport the logs to a mill or cogeneration power plant. Tree removal

using traditional ground-based operations would be restricted to areas with slopes less than 40%.

- Tethered harvesting systems, such as cut-to-length, are a variation on traditional ground-based operations. In tethered systems, a winch is mounted to the back of a harvester or a forwarder and secures the equipment to an anchor point. This allows that piece of equipment to lower itself down or climb up steep slopes. These types of systems differ from other ground-based operational methods in that the harvester fells, processes, and bucks the trees at the stump. Tree limbs and tops are placed in front of the harvester and are driven over as the machine moves ahead, minimizing ground disturbance. The forwarder follows in the harvester's trail, loads the cut logs into log bunks on the machine, and transports the logs to the landing area. Tethered systems could be used on slopes up to 85%.
- Skyline operations refers to the use of a stationary cable yarding machine and an overhead system of winch-driven cables to pull logs or whole trees from the stump area to the landing or roadside area. All trees would be felled and processed (cut to log length and limbed) using chainsaws prior to skyline yarding. Trees to be removed would be skyline yarded to a landing, skid trail, or road using a cable yarder or yoader. A slack-pulling carriage would be used to skid felled trees to the main cable yarding pathway or corridor. Tree removal from skyline operations would generally be restricted to areas with slopes greater than 40%.
- In areas that are difficult to access, helicopter operations could be used to remove trees or portions of trees in areas where access by other means is infeasible. Trees would be cut in advance and a ground crew would assist the helicopter crew by securing trees to a cable hanging from the helicopter. The cost of helicopter operations is prohibitive in many circumstances but may be more feasible when the wood would be used to create instream structures in areas where vehicle access is prohibited.
- **Lop-and-scatter.** Lop-and-scatter refers to an operational method where felled trees are cut and limbed using chainsaws (i.e., lopped) and broadcast (i.e., scattered) throughout the treatment area for natural decomposition. This method would be used in locations where equipment cannot access the stand because of steep slopes, special management zones, where the stand is predominately pre-commercial tree sizes, or where there is limited access because there are no existing haul roads (i.e., roads that can support the heavy equipment required for operations). No felled trees would be removed and no heavy equipment would be used in these areas.
- **Fuels reduction (mastication).** Mastication is the process of grinding, shredding, chipping, or otherwise reducing the size of live or dead vegetation to expedite decomposition and alter fire behavior. Treatments are generally achieved using heavy equipment that may reach out into a stand or material may be brought to the equipment for processing.

2.2.1.2 Snag Creation

Snag creation is a vegetation management method that refers to trees that may be intentionally killed and left standing to create wildlife habitat. Snag creation would be limited to older stands with larger trees because large snags are more useful and last longer as wildlife habitat. Snags would be created by girdling trees by removing bark and cambium in a continuous strip around the bole of the tree or burning slash material under selected trees. Snag creation may occur as part of a thinning operation or as a stand-alone treatment.

2.2.1.3 Crown Manipulation

Crown manipulation is used to enhance the structural complexity of the forest canopy to develop late seral forest characteristics and is achieved by pruning the crown or cutting the top out of trees. Neighboring trees may be cut to release the pruned tree. The resulting crown damage is intended to create reiterations and other features that would enhance the vertical complexity of the forest. Additionally, some trees may be selected for tree topping or crown manipulation using arborist methods that involve climbing selected trees and pruning the crown.

2.2.1.4 Manual Removal

Manual removal would be used as a vegetation management technique to reduce the number of trees and cut back shrubs encroaching on sensitive features like *Darlingtonia* fens, to remove non-native plants, to reduce fuel loads in strategic locations (along roads and ridgetops) to control fire, and to aid in maintaining or restoring the condition of culturally important non-forest areas and tanoak orchards in the project area.

Plants and small trees would be removed using hand tools such as weed wrenches, Pulaskis, or shovels. For larger plants and trees, a brush cutter, handsaw, masticator, or chainsaw would be used. All cut vegetation or trees would either be left in place, lopped or chipped and scattered, piled and burned, transported to other locations within the GMC area, or some combination thereof. Fuel loads would be reduced to levels that would protect sensitive resources that could be damaged by wildfire. When feasible, removed vegetation would be placed in inconspicuous areas not visible to the public and allowed to decompose naturally.

2.2.1.5 Tree Planting

Most tree planting activities under the Proposed Action would occur in conifer-deficient stands in riparian areas and on recently removed roads, as identified by agency staff, to help revegetate these areas. Other tree planting efforts may seek to shift species composition or to introduce plants that are resistant to disease. To mitigate browsing, small protection structures may be used, and regular monitoring of reforestation sites for several years would help ensure higher seedling survival. Planting areas would be monitored in accordance with the North Coast Redwoods District (NCRD) Monitoring Tree Planting Survival Protocol (CDPR 2019a).

In areas where replanting is proposed, seed collection, propagation, and tree planting would follow the NCRD policy on genetic integrity, which states the following: "In order to maintain the genetic integrity and diversity of native California plants, revegetation or transplant efforts in the State Park System would be from local populations, unless shown by scientific analysis that these populations are not genetically distinct from populations being proposed for use. If local populations have been decimated, the closest, most genetically similar population(s) to that State Park System unit would be used" (CDPR 2003).

When funding and capacity is available, the on-site nursery in Mill Creek would be used to propagate and store seedlings until they are ready to be planted. If the Mill Creek nursery is not capable, then seedlings would be propagated in other local and regional nurseries and preference would be given to local seed sources from the project area, as outlined in the genetic integrity guidelines.

2.2.1.6 Complete Conifer Removal

Under the Proposed Action, the few historic non-forest areas where patches of grassland are still intact (e.g., along the Bense Trail) would be assessed for conifer removal. The Proposed Action

includes potential conifer removal where tree diameter is less than 14 inches DBH to maintain natural non-forested communities. Complete conifer removal of trees with a diameter greater than 14 inches DBH is not included as part of this Proposed Action and would require a separate project-specific environmental compliance review process. Manual brush removal and mastication may be used to contain encroaching shrub species.

2.2.1.7 Invasive Species Management

Proposed treatment methods to control non-native plants would be completed in conformance with the Draft NCRD Invasive Species best management practices (BMPs; CDPR 2019a). This ISND/EA only provides environmental assessment of invasive species management on CDPR lands because NPS invasive plant management is analyzed and covered by a separate Invasive Plant Management Plan (NPS 2017). Potential removal methods that would be used alone or in combination to manage invasive species include the following:

- **Manual Removal.** See Section 2.2.1.4.
- **Mechanical Removal.** Heavy equipment (e.g., a dozer or excavator) would be used for the initial treatment of large deeply rooted invasive species (e.g., jubata grass).
- **Flaming/Torching.** Flaming/torching is a vegetation removal technique that can effectively control a variety of plant species without disturbing the ground. A handheld and/or backpack propane torch would be used to burn the target species. Two types of flaming (green and black) are commonly used. Green flaming is sometimes called wilting or blanching and uses a small torch that is applied just long enough to wilt and eventually kill the plant. Black flaming uses the same equipment, but the torch is left on the plant long enough to cause it to incinerate. Both techniques would be used to treat multiple invasive non-native plants, such as Scotch and French broom seedlings. Torching/flaming would be conducted during the wet season, and any necessary permits from the California Department of Forestry and Fire Protection (Cal Fire) or North Coast Unified Air Quality Management District (NCUAQMD) would be obtained prior to using this treatment method. Vegetation left after flaming treatments would be left in place.
- **Mowing/Solarization/Covering.** Mowing/solarization/covering would be used to control non-native species. Infestations would first be mowed to the ground with weed whackers and shrubs and small trees (smaller than 8 inches DBH) would be cut at the base. Weed cloth, black 6-mil plastic tarps, or a combination of both would then be placed over the target species and secured with sand bags. If clean chips (free of invasive non-native plant material) can be obtained, they would be placed over the tarping to help keep it in place and reduce the aesthetic impact. Based on the target species, the weed cloth and/or plastic tarps would be left in place for at least 1 year, or longer if plants are not completely dead.

2.2.2 Road Extension, Reoccupation, and Removal

Road management activities include reoccupation, road extensions, and removal. Vegetation management actions, particularly forest thinning, would utilize existing roads, skid trails, and landings, where their topographical alignment and location are suitable. Approximately 2.5 miles of temporary roads may need to be constructed as extensions on existing roads to access restoration areas (Figure 3) and would be removed after treatment. The 2.5 miles of temporary roads are all on upper slopes, outside of all intermittent and larger drainages, and would be designed for dry season use only. Although these temporary roads would be for dry-season use, they may be left intact for

multiple seasons. Any additional temporary road construction beyond these 2.5 miles would be required to undergo additional environmental review outside of this ISND/EA.

Some abandoned logging roads would require temporary reoccupation to access areas for restoration. These roads have been planned for removal under the LSEP. These roads would first be improved to allow vehicles to use them and would then be removed once restoration treatments are completed in the area accessed by the roads. Reoccupation would also include installation of temporary bridges on existing open roads where current bridges do not have a load rating capable of withstanding highway-rated loads.

The process of road extension construction or reoccupying abandoned roads for restoration treatments can be divided into the following three phases:

1. Slopes, soils, mass wasting potential, and natural drainages would be evaluated to minimize detrimental effects of road construction or reoccupation. This preparation work would be guided by forest restoration planning and treatment area selection.
2. The second step would include road construction, reoccupation, and/or drainage structure installation.
 - a. New road construction alignment would seek to minimize drainage crossings, but where they occur, culverts would be sized using geomorphic indicators and flow calculations based on the rational method.
 - b. Road reoccupation would involve different activities depending on the use of the road. Reoccupation activities may include vegetation clearing, removing water bars, grading road surfaces, and drainage reconstruction as needed. Fill material and old culverts may need to be removed from abandoned roads before new culverts could be installed. Single-season-use roads would be removed at the end of the dry season and would not be reoccupied in following years. Roads needed for multiple years would be constructed using more robust drainage structures, including multi-layer headwalls and tailwalls and hardened road surfaces, to facilitate ephemeral drainage.
 - c. Temporary stream crossings and bridges would be sized to pass the 100-year recurrence interval discharge of flow, sediment, and debris during the seasons they would remain in place and would be capable of holding highway rated loads. CDPR has installed numerous stream crossings of this nature throughout the project area. Structures such as rolling dips may also be installed to limit concentration of runoff and erosion on roads used during restoration activities.
3. Once vegetation management and aquatic restoration actions are complete and access to an area is no longer needed, all new and formerly abandoned roads would be removed as part of the final phase. However, existing open roads that are currently part of the transportation network would not be changed until after a road and trail management plan is developed for the property. Complete fill recovery and drainage structure removal would be implemented along all unneeded roads and landings. Road removal would entail removing fill from stream channels, excavating sidecast fill material, and restoring drainage patterns to reduce the potential for material to erode and be deposited in streams.

2.2.3 Aquatic Habitat Restoration

The Proposed Action involves placement of large wood in streams and floodplains, which is consistent with the GMC Aquatic Habitat Restoration Strategy (Appendix G). Large wood would be

placed to create complex fish habitat by creating areas of lower velocity during higher flows, providing additional instream cover, scouring pools, sorting gravels, metering sediment, and facilitating floodplain connectivity and off-channel habitat.

Wood placement is expected to occur in Mill Creek, East Fork Mill Creek, West Branch Mill Creek, and Rock Creek, and their tributaries (Figure 4). These creeks are all tributaries to the Smith River. In a given year, no more than 20 structures would be placed per stream reach. The quantity of large wood to be placed would be determined by wood availability, logistical constraints, and access locations. Where appropriate, large wood placement would include a mixture of large, medium, and small volume stems with a target of one to 100 stems per structure. Whole tree material (larger than 15 inches in diameter) would be incorporated between riparian trees or existing large wood structures to mimic natural wood jams. The target size for the large wood to be placed in the channel is greater than 2 feet in diameter and 50 feet in length with the rootwad attached (placing the rootwad in the channel increases the function and ability of large wood to create channel complexity). However, based on availability of wood, a variety of wood sizes would be used. Single or multiple pieces of large wood, ideally with the rootwad attached, would be wedged between riparian trees or other existing structures to anchor the wood in place. The large wood should function similarly to riparian trees that have fallen naturally into the stream and offer the potential to create pools. Wood would also be periodically placed within the active channel and along floodplain reaches to augment wood loading until natural recruitment and delivery processes become self-sustaining.

Considerations in selecting large wood locations would include current stream morphology; spacing for fish utilization; equipment access; and an assessment of effects to the streambed, floodplain, and downstream infrastructure, such as bridges and roads (Flannery et al. 2017). Where opportunities exist, hardwoods would be placed in channel in such a way to promote continued persistence, while providing cover for aquatic species.

The following techniques would be used to place large wood jams in streams:

- Large wood would be positioned using heavy equipment (e.g., a loader or excavator) and/or labor crews using chainsaws and grip hoists. Crane mats may be used if adjacent road access is lacking and soil conditions warrant their use. Work would be conducted in the late summer or early fall when site conditions are most likely to be dry.
- Cable and rebar would not be used to anchor large wood due to safety risks and aesthetic concerns. Large wood is expected to be dynamic in the channel and may break loose and deposit naturally at downstream sites. As such, large wood would not be placed less than 300 feet upstream of at-risk infrastructure without consultation with an engineering geologist.
- Large alders would be pushed or pulled into the channel from the bank with roots remaining attached to the banks to the extent possible. These trees would recruit wood and provide instream cover and velocity refugia. Selective removal of riparian trees by pushing or pulling them into the stream would not create large openings in the canopy.
- Where access with heavy equipment would not be possible, helicopters would be used to place wood in target locations.

Instream large wood would be recovered from forest restoration, road/landing removal, and stream crossing excavations, and stockpiles generated as part of the Proposed Action.

2.2.4 *Proposed Action Sequencing*

Ecosystem restoration activities would occur throughout the project area in phases determined by a prioritization process that considers a combination of factors, including stand density, species composition, erosion risk and threat, landscape scale considerations, and coordination with other projects (see Appendix B [Forest Restoration Strategy] of the VMP [Appendix F]). Areas where tree growth is most suppressed would generally have the highest priority for treatment; however, treating adjacent stands or forests where access may soon be restricted (e.g., due to road removal) may also occur if the stand could benefit from restorative actions. Restoration activities would initially occur in the Phase 1 areas, as shown in Figure 5. Aquatic restoration activities would not be restricted to the Phase 1 areas shown in Figure 5. The selection of priority areas to include in future phases of work would also include the following landscape scale considerations:

- Coordinating restoration efforts with other projects
- Considering which habitat types are most likely to degrade, fail to recover, or recover slowly without intervention
- Comparing the cost and benefits of different projects (e.g., X acres of restoration area A has a similar cost to Y acres of restoration area B)
- Comparing the effectiveness of treatments and time needed to reach benchmarks with and without treatment
- Identifying special-status wildlife species present in the general area that might benefit from vegetation management or erosion prevention
- Considering enlarging and buffering rare and high-quality habitat or known linkages for imperiled species at species-appropriate spatial scales

In addition, CDPR and NPS would prioritize restoration areas based on the unique contributions of a given area or restoration strategy. CDPR and NPS would specifically prioritize restoration efforts that accomplish the following:

- Enhance the development of late-seral habitat and its functional characteristics to provide connectivity between the old growth in Jedediah Smith Redwoods State Park and the westernmost portion of the project area (the two largest tracts of old growth in the area)
- Treat degraded habitat adjacent to old growth when needed to reduce edge effects and fuel loads (prevent high-severity fire from entering the old growth), and to improve the functionality and resilience of old-growth forests
- Use the most current habitat suitability and connectivity modeling for the Humboldt marten to inform vegetation management design and prioritization
- Treat unnaturally dense conifer forests to avoid forest stagnation and promote tree growth and development of heterogeneous forest conditions
- Treat relatively old or high-quality second-growth conifer forests where late-seral conditions can most rapidly be achieved or where residual old-growth structure remains, and where imperiled species can benefit in the shorter term
- Plant conifers in stands along anadromous streams that are conifer deficient compared to pre-logging conditions to improve shading and eventually encourage large wood recruitment in stream corridors

Direct road access would not be required for lop-and-scatter treatment areas because biomass would not be removed from these areas. Therefore, lop-and-scatter treatment could occur during any phase of Proposed Action implementation.

2.2.5 Actions Within the Scope of this ISND/EA

The VMP, Aquatic Habitat Restoration Strategy, and this ISND/EA cover NPS and CDPR performing the following actions within the GMC area: vegetation management, including forest thinning, snag creation, crown manipulation, manual removal, tree planting, complete conifer removal, and invasive species management, as detailed in Section 2.2.1; road extension, reoccupation, and removal, as detailed in Section 2.2.3; and placement of large wood in Mill Creek, East Fork Mill Creek, West Branch Mill Creek, and Rock Creek, as detailed in Section 2.2.2.

Before NPS or CDPR undertake these types of actions, outside those identified as Phase 1 implementation, a project description that incorporates all appropriate Standard Project Requirements (SPRs) and Project-Specific Requirements (PSRs) listed in Section 2.2.6 would be developed. The project-level project description would be evaluated by CDPR resources staff using CDPR's Project Evaluation Form (PEF) and NPS resources staff using NPS's Environmental Screening Form (ESF) to ensure actions and impacts are within the scope of this ISND/EA. If resources staff confirm that the action is within the scope of this ISND/EA, no additional CEQA or NEPA documentation would be required. If the PEF or ESF indicate that all or portions of the action are outside the scope of this ISND/EA, then NPS and CDPR would conduct additional environmental review and determine the appropriate type of NEPA and CEQA documentation needed for the action.

2.2.6 Project Requirements

CDPR maintains a list of SPRs that have been standardized statewide to avoid significant project-related impacts to the environment. They are assigned to all CDPR projects as appropriate and address requirements regarding air quality, vegetation, wildlife, cultural resources, erosion prevention, soil stability, hazards, and hydrology. In addition to SPRs, CDPR also uses PSRs to address projects with unique issues that would not typically be standardized for at a statewide level but are used to address known issues. A summary of all SPRs and PSRs relevant to activities proposed as part of the Proposed Action is presented in Table 2. CDPR and NPS have grouped the requirements thematically into air quality (AIR), biological resources (BIO), visual resources (VIS), cultural resources (CULT), geology and soils (GEO), hydrology and water quality (HYDRO), potential hazards and hazardous materials (HAZ), noise (NOISE), and utilities (UTIL). These SPRs and PSRs would apply to all Proposed Action phases undertaken pursuant to this ISND/EA.

2.2.7 Monitoring

Compliance monitoring would occur during all phases of the Proposed Action. CDPR and NPS staff or representatives would accompany contractors during operations and would be responsible for assuring that they adhere to all requirements listed in this document (see Section 2.2.5). Inspectors would be required to complete daily activity logs documenting the work conducted by the contractors. If CDPR or NPS determines that work is not in compliance, then they would notify the contractors, project manager, and responsible CDPR and NPS staff to ensure that corrective measures can be taken. If problems continue, work would cease while the project is re-evaluated and workers are instructed on measures necessary to improve work standards. Persistent breaches of compliance would result in termination of the contractor's contract.

Reports would be filed annually with CDPR and NPS regional offices and with the regulatory agencies, as required by permits, which would summarize the quality and quantity of work accomplished. Any breaches of compliance with the terms of this ISND/EA would be noted along with recommendations to improve future efforts.

Completed restoration areas would be visited on a regular basis after completion, as safety permits. Photograph points that were established during original surveys would be re-photographed. CDPR and NPS vegetation management staff would establish permanent plots to determine the stand characteristics before and after restoration is completed to monitor effectiveness and recovery in treated areas.

3 Affected Environment and Environmental Consequences

3.1 Introduction

3.1.1 *Resources Eliminated from Detailed Analysis*

The following impact topics will not be evaluated in this ISND/EA because it was found through screening that they would not be affected at all by the alternatives or are not relevant to the project area: energy, mineral resources, population and housing, public services, utilities and service systems, accessibility, and environmental justice.

3.1.2 *Methodology and Significance Criteria*

Impacts on resources are predicted based on impacts observed and measured from similar projects, relevant scientific research and publications, and the best professional judgment of park specialists, registered professional foresters and other forestry professionals, and environmental specialists.

The format for this ISND/EA is largely based on the CEQA environmental checklist included as Appendix G of the CEQA Guidelines. Under CEQA, thresholds are used to determine whether project-related changes to the environment are significant (CEQA Guidelines Section 15064.7). Per NEPA regulations (40 Code of Federal Regulations [CFR] 1508.27), significance is based on context and intensity. Usage of the term “significance” in this document is made pursuant to CEQA only, and the evaluation of environmental factors pursuant to CEQA significance thresholds is presented in the checklist. Under NEPA, all impacts are discussed regardless of the threshold amount and each resource area discusses the context and intensity of environmental impacts and mitigation measures. One resource topic—socioeconomics, which is not included in the checklist—is included in this ISND/EA for consistency with NEPA and past NPS environmental documents.

3.1.3 *Cumulative Impact Scenario*

Cumulative impacts result from the “incremental impact of the action when added to other past, present, or reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions” (40 CFR 1508). When considering cumulative impacts, the analysis must consider the increment contributed by the direct and indirect impacts of the proposed action and the total impact that would result when the impacts from the proposed action are added to the impacts of the other actions. Therefore, it is important to determine the scope of the cumulative impact analysis to identify the potential for incremental increased environmental effects caused by a series of actions.

The Proposed Action is located in a heavily forested area with a long history of timber harvesting starting in the 1850s. These activities have encouraged the development of logging roads within the forest and changes in natural species composition and forest structure through clearcutting old-growth trees. More recently, NPS and CDPR have developed ongoing ecosystem restoration and maintenance plans to manage and restore forest resources on public land. Private harvesting practices in the region have also changed in response to regulation. Other past, present, and reasonably foreseeable future projects occurring in the vicinity of the Proposed Action include the following projects:

- LSEP: This project by CDPR is ongoing and includes road removal of abandoned, unstable inner-gorge service and skid roads within the Mill Creek, Rock Creek, Wilson Creek, Hunter Creek and Turwar Creek watersheds. To date, approximately 70 miles of roads have been removed and 330 stream crossings have been excavated since 2004 under LSEP. Approximately 60 miles of LSEP roads still require removal and 191 stream crossings still require excavation.
- FERPP: This CDPR project proposed treatment across 3,500 acres of the highest priority MCA forest stands that were established between 1980 and 1993. FERPP treatments were largely completed by 2012 (approximately 3,100 acres or 88%).
- Young Forest Restoration Project: This project was implemented in 2012 to restore young forests (11 to 24 years old) by mechanically thinning (using chainsaws) formerly harvested stands to promote historic species composition, encourage rapid tree growth, and accelerate the development of late-seral forest characteristics. By the end of 2018, approximately 5,500 acres have been treated under FERPP and the Young Forest Restoration project.
- Last Chance Grade Project: This project by the California Department of Transportation proposes to realign U.S. Highway 101, between Wilson Creek and Crescent City (mileposts 12.0 to 15.5), due to landslides and road failures (Caltrans 2018). This could result in zoning changes, the loss or conversion of forest land to non-forest uses (i.e., highway), and removal of old-growth trees and marbled murrelet habitat along its footprint. The Last Chance Grade Project would be subject to a rigorous permitting and environmental review process that would consider changes to forest use among other potential impacts. The environmental documentation process is expected to be complete in 2026.
- DNCRSP Coast-to-Crest Trail Project: This project would provide a linkage needed to connect the California Coastal Trail with the Pacific Crest Trail to become part of the Redwood Coast-to-Crest Trail. The trail would traverse in an east-west trend through the MCA of DNCRSP (CDPR 2016). Stringer Gap road is part of the Coast-to-Crest Trail route and is also part of Phase 1 of that project. CDPR would not construct the trail as part of the Proposed Action, but after implementation activities are complete in that area, removal of that road would need to occur according to the prescriptions developed for the future trail construction (i.e., instead of complete road removal, a small trail bench would be left for the future trail construction).
- GMC Road Drainage Reconstruction (Maintenance) Program: Along the 414-mile road network in the GMC area, 1,962 drainage structures capture and convey runoff and sediment from seasonal rainfall. As part of ongoing maintenance efforts, CDPR proposes to reconstruct or replace these drainage structures as they fail or as part of deferred maintenance when funds are available. CDPR also proposes to regrade sections of road associated with the drainage structures to reduce capture and diversion of runoff.

- Six Rivers Aquatic Restoration: This project would address recovery actions for listed salmonids and aquatic habitat restoration on the Smith, Klamath, Salmon, Trinity, Mad, and Eel River watersheds within the Six Rivers National Forest. It would promote healthy fisheries and aquatic habitats and foster commercial, recreational, subsistence fishing and food gathering. Implementation of this project is anticipated to commence in the summer of 2019 (USDA 2018).
- Greater Prairie Creek (GPC) Ecosystem Restoration Project: The purpose of the GPC project is to continue Redwoods Rising efforts to rehabilitate the GPC watershed (parts of Prairie Creek Redwoods State Park and Redwood National Park) and restore ecosystem processes that have been degraded by historical land use. NPS and CDPR propose to complete forest and aquatic restoration and road removal activities over 9,200 acres within the GPC watershed. Restoration activities are expected to commence in fall 2019 and last approximately 10 to 15 years.

Cumulative impacts are evaluated in this chapter by comparing the impacts of the action alternatives under evaluation with those of these past, present, and reasonably foreseeable future projects.

3.2 Environmental Checklist

Project Information	
1. Project Title:	Greater Mill Creek Ecosystem Restoration Project
2. Lead Agency Name and Address:	California Department of Parks and Recreation; North Coast Redwoods District; ATTN: Shannon Dempsey; 3431 Fort Avenue; Eureka, California 95503 National Park Service; South Operations Center; ATTN: Leonel Arguello; P.O. Box 7; Orick, California 95555
3. Contact Person & Phone Number	Shannon Dempsey: (707) 445-5344; Leonel Arguello: (707) 465-7780
4. Project Location:	Del Norte Coast Redwoods State Park and Redwood National Park
5. Project Sponsor and Address	See #2
6. General Plan Designation:	Del Norte Coast Redwoods State Park and Redwood National Park
7. Description of Project:	CDPR and NPS are proposing to complete vegetation management, aquatic restoration, and road removal activities over 34,080 acres within the Greater Mill Creek area (the Proposed Action). Vegetation management actions would include forest restoration through thinning; snag creation; crown manipulation; tree planting; manual and mechanical vegetation removal; flaming/torching; mowing/solarization/covering; girdling; and fuels reduction. Abandoned logging roads and related road infrastructure that threaten aquatic resources would be removed. Temporary roads may need to be constructed to access restoration areas and would be removed as soon as possible after treatment. Proposed aquatic restoration would include placement of large wood in streams to enhance habitat and stream function. Proposed Action implementation is anticipated to commence in late 2019.
8. Surrounding Land Use and Setting:	See Section 3.13
9. Approval Required from Other Public Agencies:	See Appendix E

Environmental Factors Potentially Affected

If implemented as written, this project could result in a "Potentially Significant Impact" involving at least one area of the environmental factors checked below, as indicated in the Initial Study on the following pages.

- | | | |
|---|--|--|
| <input type="checkbox"/> Aesthetics | <input type="checkbox"/> Agricultural Resources | <input type="checkbox"/> Air Quality |
| <input type="checkbox"/> Biological Resources | <input type="checkbox"/> Cultural Resources | <input type="checkbox"/> Geology/Soils |
| <input type="checkbox"/> Hazards & Hazardous Materials | <input type="checkbox"/> Hydrology/Water Quality | <input type="checkbox"/> Land Use/Planning |
| <input type="checkbox"/> Mineral Resources | <input type="checkbox"/> Noise | <input type="checkbox"/> Population/Housing |
| <input type="checkbox"/> Public Services | <input type="checkbox"/> Recreation | <input type="checkbox"/> Transportation/Traffic |
| <input type="checkbox"/> Wildfire | <input type="checkbox"/> Energy | <input type="checkbox"/> Utilities & Service Systems |
| <input type="checkbox"/> Mandatory Findings of Significance | <input checked="" type="checkbox"/> None | |

Determination

On the basis of this initial evaluation:

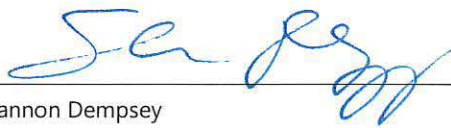
I find that the proposed project **COULD NOT** have a significant effect on the environment and a **NEGATIVE DECLARATION** will be prepared.

I find that, although the original scope of the proposed project **COULD** have had a significant effect on the environment, there **WILL NOT** be a significant effect because revisions/mitigations to the project have been made by or agreed to by the applicant. A **MITIGATED NEGATIVE DECLARATION** will be prepared.

I find that the proposed project **MAY** have a significant effect on the environment and an **ENVIRONMENTAL IMPACT REPORT** or its functional equivalent will be prepared.

I find that the proposed project **MAY** have a "potentially significant impact" or "potentially significant unless mitigated impact" on the environment. However, at least one impact has been adequately analyzed in an earlier document, pursuant to applicable legal standards, and has been addressed by mitigation measures based on the earlier analysis, as described in the report's attachments. An **ENVIRONMENTAL IMPACT REPORT** is required, but it will analyze only the impacts not sufficiently addressed in previous documents.

I find that, although the proposed project could have had a significant effect on the environment, all potentially significant effects have been adequately analyzed in an earlier EIR or Negative Declaration, pursuant to applicable standards, and have been avoided or mitigated, pursuant to an earlier EIR, including revisions or mitigation measures that are imposed upon the proposed project. Therefore, all impacts have been avoided or mitigated to a less-than-significant level and no further action is required.



Shannon Dempsey
California Department of Parks and Recreation
District Environmental Coordinator

4-4-2019

Date

3.3 Aesthetics

3.3.1 Existing Conditions

Forest land defines the visual landscape of Del Norte County and is abundant both in protected parkland and lands outside the park. The project area features a diverse mosaic of natural communities associated with Mill and Rock creeks and their tributaries, areas of remaining old-growth redwood stands, and Douglas-fir forest and tan-oak forest (CDPR 2010). Old-growth redwood stands are specifically recognized for their aesthetic value. The project area has been heavily altered from its natural condition because of a long history of commercial logging. Therefore, it contains a mix of habitats and conditions. Logging has resulted in a dominance of young forest stands where progression towards late-seral habitat is hindered and invasive exotic plants have been introduced. A network of timber hauling roads, associated skid trails, and log landings have resulted in areas of abrupt vegetation changes on the forested hillslopes within and surrounding the project area. Clearcut blocks, road scars, and numerous road-related landslides are visible within the project area. These resources contribute to its visual character.

Sweeping coastal and inland general scenic vistas of the park are available from several high-elevation vantage points within the project area. These overlooks award views of the Pacific Ocean to the west and Crescent City and the “Klamath Knot,” a southern Oregon mountain range, to the north.

The Redwood Highway is a designated State Scenic Highway in Del Norte County along a 12-mile portion of U.S. Highway 101 that traverses through the project area (Caltrans 2011). The 12-mile segment starts about 5 miles north of Klamath where U.S. Highway 101 again enters the Redwood National Park near the Trees of Mystery. The highway leaves the park about 2.5 miles south of Crescent City, at which point the officially designated segment terminates. The segment between Crescent City and the Oregon state line is also eligible for designation. There are also two eligible state highways in the vicinity of the project area: State Route (SR) 197 (from the north side of Smith River to the SR 199/U.S. Highway 101 connection) and U.S. Route 199 (from U.S. Highway 101 near Crescent City to the Oregon state line; Caltrans 2011).

Existing sources of light and glare in the project area are minimal. The former timber company office building, which is now used as office space during regular daytime hours, has interior and exterior lighting.

3.3.2 Proposed Action Impacts

Except as provided in Public Resources Code Section 21099, would the project:		Less Than Significant Impact	No Impact
a.	Have a substantial adverse effect on a scenic vista?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b.	Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings along a scenic highway?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c.	In non-urbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings? (Public views are those that are experienced from publicly accessible vantage point). If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
d.	Create a new source of substantial light or glare that would adversely affect daytime or nighttime views in the area?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

A. Impacts to scenic vistas could occur if the Proposed Action were to alter conditions such that existing scenic views would no longer be accessible to park visitors, if a structure were to be installed and block such views, or if a landscape were to be substantially altered that could affect scenic vistas of the park itself.

As part of the Proposed Action, general scenic vistas from vantage points have the potential to be temporarily affected during and immediately following implementation activities. Spaces between trees and decomposing slash from thinning operations; excavation or grading from road extension, reoccupation, and removal activities; and large wood placement activities could be visible in the short term to park visitors traversing the project area on hiking, biking, or equestrian trails, or viewing it from a scenic vantage point. However, the Proposed Action is intended to enhance the long-term aesthetic quality of the project area's landscape by facilitating the redevelopment of the old-growth forests and aquatic ecosystems. The visual experience within the project area would enhance over time as thinned forests develop diverse understory vegetation and the forest canopy stratifies. In addition, implementation activities would not occur within old-growth forests in the project area. Implementation activities would not permanently affect visitor access to scenic vistas or involve the installation of any structures. For these reasons, impacts on scenic vistas would be less than significant.

B. Implementation activities associated with the Proposed Action have the potential to be viewed from segments of the Redwood Highway, which is a designated scenic highway, as well as areas of highways eligible for listing. However, implementation activities would not permanently damage scenic resources, such as rock outcroppings and historic buildings. While some trees would be removed during implementation, such removal activities would not change the overall character of the view (overall forest views would be maintained) and would help to enhance the view by restoring old-growth forests and aquatic ecosystems. Following implementation, the Proposed Action would enhance the aesthetic views from these highways. There would be no impact to scenic highways or resources.

C. The Proposed Action could result in temporary impacts to the visual character or quality of public views of the project area. However, as noted above, scenic quality of the project area would likely improve over decades, as thinned forests develop diverse understory vegetation and the forest canopy stratifies. Impacts on visual character and quality of public views would be less than significant.

D. No new permanent light sources would be introduced into the landscape as a result of the Proposed Action. Implementation activities would generally be limited to daylight hours, minimizing the need for construction work lights. Worker vehicles may travel through the project area before dawn or after dusk. Temporary lighting resulting from implementation activities or headlights would neither produce a substantial amount of light, nor would they be visible from the Mill Creek Campground or from any private land. Larger trees, which moderate light intensities and provide shade within the project area, would be preserved within the treatment areas. There would be no impact associated with new sources of light or glare.

Cumulative Impacts. The Proposed Action is intended to enhance, among other values, the long-term aesthetic quality of the project area by facilitating the redevelopment of old-growth forests and aquatic ecosystem, thereby addressing past impacts of over-harvesting and road

development. Combined with other present and future forest restoration and maintenance activities, the Proposed Action would have a cumulative benefit to aesthetic resources.

3.3.3 No Action Alternative Impacts

Under the No Action Alternative, there would be no implementation activities and therefore no temporary impacts to the visual appeal of the project area from implementation. However, as compared to the Proposed Action, the long-term aesthetic enhancements to RNSP resources would not occur and the scenic quality would remain degraded because unnatural overstocked forest conditions, abrupt changes in vegetation, abandoned logging roads, and stream infills would remain unchanged. NPS and CDPR may continue to treat stands, road systems, and riparian areas on a project-by-project basis if funding allows. However, this would occur in a fragmented manner and at a slower pace as compared to the Proposed Action. There would be no new sources of light or glare.

3.4 Agriculture and Forestry Resources

3.4.1 Existing Conditions

There are no agricultural resources or lands under Williamson Act contracts in the project vicinity.

Portions of the project area were extensively logged from 1908 to 1939 and from 1954 to 2000, resulting in over 27,000 acres of intensively harvested forest (mostly clearcut) within the project area. By the time that CDPR acquired the land through the MCA, nearly the entire property had been converted from old-growth to young coniferous forests. Today, these stands consist of unnaturally dense young forests where progression towards late-seral habitat is hindered, species diversity has been reduced, and invasive exotic plants have been introduced that threaten to alter natural communities. To the south (and outside) of the project area are privately owned lands currently under timber production.

3.4.2 Proposed Action Impacts

Would the project:		Less Than Significant Impact	No Impact
a.	Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b.	Conflict with existing zoning for agricultural use or conflict with a Williamson Act contract?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c.	Conflict with existing zoning for or cause rezoning of forest land, timberland, or timberland zoned Timberland Production?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d.	Result in the loss of forest land or conversion of forest land to non-forest use?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e.	Involve other changes in the existing environment that, due to their location or nature, could result in conversion of Farmland to non-agricultural use or conversion of forest land to non-forest use?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

A. No land in the project area is zoned as agricultural (CDPR 2010) or used for agricultural purposes, as defined by the Farmland Mapping and Monitoring Program. There would be no impact on any category of California farmland.

B. The project area is part of RNSP and does not allow for agricultural use, contain any land zoned for agriculture, or use Williamson Act contracts. There would be no impact on agricultural zoning or Williamson Act contracts.

C. The project area is part of the RNSP system and zoned as parkland. The Proposed Action would not result in any zoning change. There would be no impact on forest or timberland zoning.

D. The Proposed Action would result in the restoration of forest land. Restoration would be accomplished through reducing stand density and shifting species composition to promote growth of remaining trees and understory vegetation and development of multi-story canopy. The resulting post-implementation stand characteristics would be trees that are more widely spaced and that would release and grow at a faster rate. In addition, the opened canopy would allow for the development of understory vegetation and a commensurate increase in species biodiversity. The removal of roads would allow for the revegetation of the restored road prisms, which would increase forest cover. In addition, as part of the Proposed Action, all trees in the largest diameter classes (above the 80th percentile) would be retained (PSR-BIO-5) and equipment operators conducting work would be required to avoid striking residual old-growth trees or trees identified by Park staff (SPR-BIO-14). The Proposed Action would have no impact regarding loss of forest land.

Gaps, or areas with few trees in an area up to 0.5 acre in size, may be used as a thinning method, which could impact forest land. However, the intent of implementing this thinning method is to establish and maintain a new cohort of trees, encourage a robust assemblage of understory vegetation, and promote landscape-scale heterogeneity. When using this method, all trees in the largest diameter classes (above the 80th percentile) would be retained (PSR-BIO-5), and no more than 10% of the area within in any unit would be treated with forest gaps. As such, the Proposed Action would have no impact related to loss of forest land.

Additionally, as part of the Proposed Action, the few historic non-forest areas where patches of grassland are still intact (e.g., along the Bense Trail) would be assessed for conifer removal. The Proposed Action includes potential conifer removal where tree diameter is less than 14 inches DBH to maintain natural non-forested communities. This activity would result in the removal of conifers for maintaining natural non-forested communities. As such, the Proposed Action would have no impact related to loss of forest land.

E. There are no other changes expected to the existing environments associated with the Proposed Action that could convert forest land to non-forest use. There are no agriculture lands in the project area. There would be no impacts associated with farmland conversions.

Cumulative Impacts. Historic forest management practices (clearcut tractor logging, road building, and minimal road maintenance) have had a substantial direct adverse effect on forestry resources. The Proposed Action is designed to result in improved forest conditions, not the loss or conversion of forest land to non-forest uses. The other projects listed in Section 3.1.3 would not result in the loss or conversion of forest land, except for the Last Chance Grade Project, which could result in zoning changes, loss or conversion of forest land to non-forest uses (i.e., highway), and removal of old-growth trees along its footprint. This project would be subject to a permitting and environmental review process that would consider changes to forest use. The Proposed Action would not result in cumulatively considerable impacts.

3.4.3 *No Action Alternative Impacts*

The No Action Alternative involves no changes to existing forestry and agricultural conditions in the project area. There would be no impact on any category of California farmland because the project area does not include areas of agriculture and zoning would not be affected. However, the project area would continue to consist of unnaturally dense forests with hindered growth, that would be considered impaired forestry resources. NPS and CDPR could continue to treat forest stands, road systems, and riparian areas on a project-by-project basis if funding allowed. However, this would occur in a fragmented manner and at a slower pace as compared to the Proposed Action.

3.5 **Air Quality**

3.5.1 *Existing Conditions*

The Proposed Action is in the North Coast Air Basin (Basin) in Del Norte County, which is under the jurisdiction of NCUAQMD, overseen by the California Air Resources Board (CARB) under the California Clean Air Act and the United States Environmental Protection Agency (USEPA), Region IX, under the Clean Air Act (CAA). NCUAQMD regulates sources of air pollution within Humboldt, Trinity, and Del Norte counties and has the primary responsibility of controlling air pollution from stationary sources. The climate within the Basin is characterized by cool summers and mild winters with frequent fog and substantial amounts of rain in coastal areas. Further inland, the summers are hotter and drier and the winters colder and have more snow.

Air pollutants are defined as the following two general types: 1) criteria pollutants, representing pollutants for which USEPA and CARB have set health- and welfare-protective ambient air quality standards (national ambient air quality standards [NAAQS] and California ambient air quality standards [CAAQS]); and 2) toxic air contaminants (TACs), which may lead to serious illness or increased mortality even when present at relatively low concentrations. TACs generally do not have ambient air quality standards.

USEPA and CARB classify an area as attainment, unclassified, or nonattainment depending on whether the monitored ambient air quality data show compliance, lack of data, or noncompliance with the ambient air quality standards, respectively. The two pollutants of greatest concern in the region are ozone (O₃) and particulate matter (PM; NCUAQMD 2018). O₃ is formed via chemical reactions between reactive organic gases (ROG) and nitrogen oxides (NO_x) in the presence of ultraviolet radiation or sunlight. Tiny particles of solids or liquids (excluding pure water) that are suspended in the atmosphere are known as PM and are classified according to their diameter in microns (as either PM_{2.5} for PM 2.5 microns or smaller in diameter or PM₁₀ for PM 10 microns or smaller in diameter). PM can be emitted directly (primary PM, such as dust or soot), or can form in the atmosphere through photochemical reactions or gaseous precursors (secondary PM). The major sources of emissions are burning (wood smoke), combustion (from automobiles and diesel engines), and dust. As shown in Table 4, PM and O₃ can lead to a host of respiratory issues including breathing difficulties, lung damage, and disease for prolonged exposure at levels higher than set standards. Table 4 also presents the national and state standards for criteria pollutants, as well as the most common health effects. With frequent rains, ocean winds, low levels of commuter traffic, and a small industrial base, the air quality in the Basin is generally good and Del Norte County is currently in attainment for all NAAQS and CAAQS.

TACs are airborne compounds that are known or suspected to cause adverse human health effects after long-term and/or short-term exposure. Examples of TAC sources are diesel- and gasoline-powered internal combustion engines in mobile sources and naturally occurring minerals. Soils in the area contain naturally occurring asbestos (NOA) minerals, as described in more detail in Section 3.9.1.4, which has the potential to pose a hazard to human health. Sensitive receptors are children, elderly, asthmatics, and others who are at a heightened risk of negative health outcomes due to exposure to air pollution. The locations where these sensitive receptors congregate are considered sensitive receptor locations (CARB 2018). The closest residential sensitive receptors to the project area are in the Bertsch-Oceanview community, with homes located within 0.5 mile of the northwest project area boundary. Sensitive receptors could also include park visitors using hiking, biking, and equestrian trails or campground.

The following determinations were based on regional significance thresholds, which are designed to assist CEQA lead agencies in analyzing localized air quality impacts from proposed projects as determined by NCUAQMD, and federal requirements under the CAA. In determining whether a project has significant air quality impacts on the environment, planners typically apply their local air district's thresholds of significance to projects in the review process. However, NCUAQMD has not formally adopted significance thresholds, and instead uses Best Available Control Technologies (BACT) and various control strategies.

3.5.2 Proposed Action Impacts

When available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:		Less Than Significant Impact	No Impact
a.	Conflict with or obstruct implementation of the applicable air quality plan?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b.	Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is a nonattainment area for an applicable federal or state ambient air quality standard?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c.	Expose sensitive receptors to substantial pollutant concentrations?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
d.	Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

A. Forest management activities in general have the potential to reduce long-term emissions of air pollutants by lessening the incidence and severity of fires, which is a major source of periodic air emissions in the state. The Proposed Action would also reduce the number of unpaved roads in the area, thereby reducing fugitive dust. However, while limited in overall scope and intermittent, the short-term use of heavy equipment and torching would emit criteria air pollutants, TACs, and fugitive dust (PM₁₀). In addition, grading and soil movement has the potential to generate dust, including asbestos mineral dust.

As noted above, Del Norte County is in attainment for all NAAQS and CAAQS. NCUAQMD has not established numerical standards to limit air emissions, but instead relies on a number of BACT and control strategies to maintain attainment status. Fugitive emissions as a result of vehicular traffic on unpaved roadways is the largest source of PM emissions within NCUAQMD, and dust control is key to NCUAQMD's attainment strategy. The Proposed Action includes the following project requirements which are consistent with NCUAQMD guidance: requirements for proper maintenance of equipment (SPR-AIR-1), watering during implementation to minimize fugitive dust (PSR-AIR-2), 5-minute maximum idling restrictions (SPR-AIR-3), fugitive dust-related excavation/grading restrictions

(PSR-AIR-4), NOA soil watering requirements prior to any ground disturbance in serpentinitic soils (PSR-AIR-5), and NOA notification requirements to workers (PSR-HAZ-9). The Proposed Action would not conflict with or obstruct implementation of any applicable air quality plan for the Basin.

B. As described in the response to Question A, the Proposed Action is not in an area of non-attainment and would not emit air contaminants at a level that, by themselves or cumulatively, violate any air quality standard or contribute to a permanent or long-term increase in any air contaminant which would threaten attainment. Impacts would be less than significant.

C. Sensitive receptors have the potential to be exposed to short-term emissions from construction activities and dust from serpentine roads. As noted above, the closest residential sensitive receptors are residents in the Bertsch-Oceanview community neighborhood located 0.5 mile from the northwest border of the project area. All implementation activities would occur at least 1 mile from residential receptors. Sensitive receptors could also include park visitors within the project area. Areas of active implementation would be closed to the public and a closure order specifying closure dates would be posted on all sections of public trail where forest treatment operations are being conducted. The closure would also be noticed in a news release and update on both the NPS and CDPR websites. While workers are not generally considered sensitive receptors, the potential for asbestos exposure from serpentine roads was also considered. As noted above, the Proposed Action would include notifications to workers during NOA soil watering (PSR-HAZ-9), which would further protect any sensitive receptor and workers by limiting the amount of dust exposure. While the Proposed Action would generate emissions during implementation activities, emissions would be short term, localized, and minor and would not violate air quality standards. Impacts on sensitive receptors and workers would be less than significant.

D. During implementation, diesel exhaust produced by off-road equipment could generate odors. Several pieces of equipment would need to operate near receptors and concurrently in a relatively small area to generate a constant plume of diesel exhaust. As noted above, implementation would occur at least 1 mile from residential areas and active implementation areas would be closed to the public. Heavy equipment would also be limited to a few pieces, used intermittently. Because such conditions for equipment operation would not be met, the Proposed Action would not result in the generation of objectionable odors that would affect a substantial number of people, and there would be no impact.

Cumulative Impacts. Combined with other past, present, and future forest restoration and maintenance activities, which include emissions from implementation or logging equipment, the Proposed Action would contribute to overall emissions. However, Proposed Action implementation emissions would be short term and would not violate air quality standards. The Proposed Action would not result in a substantial cumulative contribution to air quality impacts.

3.5.3 No Action Alternative Impacts

The No Action Alternative would not result in short-term implementation emissions. However, the No Action Alternative has the potential to result in long-term and sustained impacts to regional air quality because the forests would not benefit from management techniques that help increase resiliency to severe wildfires. NPS and CDPR could continue some forest management on a project-by-project basis if funding allows, which could result in some resilience but would also result in short-term implementation emissions. However, this would occur in a fragmented manner and at a slower pace as compared to the Proposed Action.

3.6 Biological Resources

3.6.1 Existing Conditions

The list of special-status species known or with the potential to occur in the project area for terrestrial and aquatic resources was developed by querying the following: the California Natural Diversity Database (CNDDDB) list of state species of special concern and state and federal proposed endangered, threatened, and candidate species, including those with Bureau of Land Management sensitive status (CDFW 2018b); the USFWS list of federally listed and proposed endangered, threatened, and candidate species (USFWS 2018); the California Native Plant Society (CNPS) online Inventory of Rare and Endangered Vascular Plants of California (CNPS 2018); the NMFS West Coast Region species list of endangered and threatened species and critical habitat (NMFS 2018); State Parks (CDPR 2016); and the eBird database (2019).

The database queries for CNDDDB, USFWS, and CNPS were each based on a search of the greater project vicinity, which includes the U.S. Geological Survey (USGS) 7.5-minute quadrangles in which the Proposed Action is located and the adjacent quadrangles (Requa, Childs Hill, Sister Rocks, Klamath Glen, Cant Hook Mountain, Crescent City, Hiouchi, and Gasquet). Occurrence information for special-status species was based on prior studies, analyses conducted by RNSP, professional knowledge, and recorded observations.

3.6.1.1 Vegetation

The coastal fog belt provides good growing conditions for fast-growing conifers such as the coast redwood (*Sequoia sempervirens*). Douglas-fir (*Pseudotsuga menziesii*) is found in association with redwoods, particularly in the eastern portion of the project area, where coastal influence is diminished. Sitka spruce (*Picea sitchensis*), grand fir (*Abies grandis*), western hemlock (*Tsuga heterophylla*), western redcedar (*Thuja plicata*), Port Orford cedar (*Chamaecyparis lawsoniana*), red alder (*Alnus rubra*), and tan oak (*Notholithocarpus densiflorus*) are found as minor components of the coastal forest on the property. Past management of the project area has resulted in primarily even-aged, monospecific forest stands of various ages. These dense second-growth forests have low species and habitat diversity compared with late-seral redwood forests and are threatened by invasive exotic plants.

The tree-dominated vegetation alliance (Sawyer et al. 2009) in the project area includes redwood, red alder, western white pine, knobcone pine, Sitka spruce, and Jeffrey pine (CDPR 2011b). The herbaceous-plant-dominated alliance includes bulrush, bulrush-cattail, California annual grassland, introduced perennial grass, and pampas grass. The shrub-dominated alliance includes blue blossom and huckleberry oak. Other vegetation types present include freshwater wetlands and *Darlingtonia* fens. Wetlands provide important ecological services, including fish and wildlife habitat, water quality, groundwater recharge, nutrient/chemical cycling, flood control, and local/global climate regulation. Seasonal wetlands, including swamps, mesic roadside drainages, and depressions, are present in the project area (Barrett 2014). Streams in the upper watersheds have limited floodplains and riparian zones dominated by redwood and Douglas-fir. Riparian areas in the project area along lower-gradient, less-confined channels are dominated by hardwoods, particularly red alder and big-leaf maple (*Acer macrophyllum*). Redwood and Douglas-fir are dominant along the streams in the upper parts of the watershed. Road building, timber harvesting, and associated bank erosion and landslides have altered the original riparian vegetation along streams in the project area.

Unmaintained logging roads, skid trails, and stream crossings have degraded and threaten stream channels with increased sedimentation and stream crossing failures.

Botanical surveys have documented 437 species in DNCRSP, including 26 tree species, 66 shrubs, 265 forbs, 65 grasses and 15 ferns. In Appendix A of the VMP (Appendix F), the Park list of all vascular plants (exported from the NRCDB Botanical Survey Database; CDPR 2018) species are identified as native/non-native and as of cultural significance.

Based on CSP field survey reports, at least 25 vegetation alliances as defined in *A Manual of California Vegetation* (Sawyer et al. 2009) are present in DNCRSP. The names of the alliances are derived from the names of the prominent plant species according to membership rules. The following tree-dominated vegetation alliances are found in the park: Redwood, Douglas-fir (with inclusions of Port Orford cedar forest), Douglas-fir-tanoak, Red Alder, Tanoak and Sitka Spruce forest, Knobcone Pine woodland, and Jeffrey Pine savanna. Because current survey data and imagery are not sufficient to map shrub and herbaceous alliances parkwide, these alliances were grouped into 13 vegetation cover types plus three other cover types (developed areas, barren ground and beach strand). Shrub-dominated alliances in upland areas were grouped into "chaparral" and include a matrix of the Blue blossom, Huckleberry oak, Shrub tanoak, Canyon live oak chaparral, and Golden chinquapin thickets alliances. The other shrub dominated cover type is "coastal scrub," which is mainly represented by Coyote brush scrub and smaller patches of Coastal bramble in DNCRSP. Arroyo willow thickets are included in the cover type wetlands. Herbaceous-plant dominated alliances in the park are grouped into two cover types. "Wetlands" includes Small-fruited bulrush marsh, Cattail marshes, Pacific reed grass meadows, California pitcher plant fens, and inclusions of Slough sedge swards. A second herbaceous cover type is upland prairies with Idaho fescue grasslands and the semi-natural Velvet grass-sweet vernal grass meadows and Pampas grass patches. Current vegetation types generally follow a west-to-east gradient with coastal scrub existing along the coast, followed by a narrow strip of Sitka spruce. Redwood dominates much of the property, but gives way to Douglas-fir and hardwoods (tanoak and madrone) on ridgetops. The dominant vegetation is more variable in the Rock Creek drainage than elsewhere, but usually consists of redwood, Douglas-fir, and tanoak. The eastern and northeastern edges of the Park, where serpentine and peridotite soils limit or prohibit tree growth, partially consist of lower montane mixed conifer stands containing Port-Orford-cedar, knobcone pine, Jeffrey pine, western white pine, and the occasional sugar pine, while other portions are savanna or chaparral, and often have few trees or are devoid of trees all together.

No parkwide mapping exists that provides estimates of acreage for each cover type or alliance. However, the VMP contains a map (Map 2-d) of cover types and vegetation alliances based on an Ikonos satellite imagery-based forest stand reclassification project from 2005. Acreage by vegetation type for DNCRSP is summarized in Table 5. This table of current vegetation represents a snapshot in time.

Past management of the project area has resulted in primarily even-aged, monospecific forest stands of various ages. These dense second-growth forests have low species and habitat diversity compared with late-seral redwood forests and are threatened by invasive exotic plants. Road building, timber harvesting, and associated bank erosion and landslides have altered the original riparian vegetation along streams in the project area. Unmaintained logging roads, skid trails, and stream crossings have degraded and threaten stream channels with increased sedimentation and stream crossing failures.

A total of 126 special-status¹ plant species and four sensitive natural communities² were identified from the database queries as having the potential to occur in the project area (Appendix J). Of these, 16 special-status plant species and two sensitive natural communities were eliminated from further consideration because no suitable habitat is present in the project area or the project area is outside of the species' current range. There are 74 special-status plant species with a CNPS rank of 1 or 2 and two sensitive natural communities with moderate or high potential to occur in the project area. The remaining 36 special-status plant species have CNPS ranks of 3 or 4. The complete list of special-status species is included in Appendix J. Though alliance-level vegetation mapping has not been conducted in the entire project area, it is known that other sensitive natural communities, including the *Notholithocarpus densiflorus* (Tanoak forest) Alliance (G4 S3), *Picea sitchensis* (Sitka spruce forest) Alliance (G5 S2), *Rubus* (*parviflorus*, *spectabilis*, *ursinus*) (Coastal brambles) Alliance (G4 S3), and the *Sequoia sempervirens* (Redwood forest) Alliance (G3 S3) occur in the project area (Barrett 2014).

3.6.1.2 Fish and Wildlife

Wildlife diversity within the project area is very high. Thirty-five special-status fish and wildlife (amphibian, reptile, bird, and mammal) species were identified from the database queries as having the potential to occur in the project area. Five of these species were eliminated from further consideration, because no suitable habitat is present in the project area or the project area is outside of the species' current range (Appendix J). Eliminated species include the green sturgeon, longfin smelt, eulachon, tidewater goby, and western snowy plover. Three species were considered to have low potential to occur in the project area and are not discussed further; these include the Western pond turtle due to limiting low water temperatures, Northern harrier due to no suitable habitat, and golden eagle due to no suitable nesting habitat. The following 27 special-status fish and wildlife species have been documented or have a moderate or high potential to occur in the project area and are discussed in the following paragraphs:

- Mollusks: western pearlshell mussel (*Margaritifera falcata*)³
- Fish: Pacific lamprey (*Entosphenus tridentatus*); river lamprey (*Lampetra ayresii*); coho salmon (*Oncorhynchus kisutch*), Southern Oregon/Northern California Coasts (SONCC) Evolutionarily Significant Unit (ESU); Chinook salmon (*O. tshawytscha*), SONCC ESU; steelhead, Klamath Mountain Province Distinct Population Segment (DPS) (*O. mykiss irideus*); and coastal cutthroat trout (*O. clarkii clarkii*)
- Amphibians: southern torrent salamander (*Rhyacotriton variegatus*); Pacific tailed frog (*Ascaphus truei*); northern red-legged frog (*Rana aurora*); and foothill yellow-legged frog (*Rana boylei*)
- Birds: white-tailed kite (*Elanus leucurus*); bald eagle (*Haliaeetus leucocephalus*); American peregrine falcon (*Falco peregrinus anatum*); marbled murrelet (*Brachyramphus marmoratus*); northern spotted owl (*Strix occidentalis caurina*); vaux's swift (*Chaetura vauxi*); olive-sided

¹ Special-status plant species are defined as those listed, proposed, or under review as threatened or endangered under the federal ESA and/or CESA; designated as rare under the California Native Plant Protection Act; and/or taxa that meet the criteria for listing as described in Section 15380 of the CEQA Guidelines, including plants with a California Rare Plant Rank of 1, 2, 3, or 4, and/or considered a locally significant species (i.e., rare or uncommon in the county or region).

² Sensitive natural communities are defined as those natural community types (i.e., legacy natural communities in CDFW's CNDDb, vegetation alliances and/or associations) with a state ranking of S1 (critically imperiled), S2 (imperiled), or S3 (vulnerable) on CDFW's California Sensitive Natural Communities List (CDFW 2018c) or in the CNDDb.

³ The western pearlshell mussel is not a special-status species; however, it is on the CDFW Special Animals List (CDFW 2018d), has a state ranking of critically imperiled, and was incorporated into this document at the request of CDFW during the agency scoping process held by Redwoods Rising.

flycatcher (*Contopus cooperi*); willow flycatcher (*Empidonax traillii*); yellow warbler (*Setophaga petechial*); and purple martin (*Progne subis*)

- Mammals: Sonoma tree vole (*Arborimus pomo*); white-footed vole (*Arborimus albipes*); Townsend's big-eared bat (*Corynorhinus townsendii*); pallid bat (*Antrozous pallidus*); Humboldt marten (*Martes caurina humboldtensis*); and fisher, west coast DPS (*Pekania pennanti*)

Western pearlshell mussels require clear, nutrient-poor, cool, highly oxygenated, low-mineralized, and moderate to fast flowing water. The mussels are found in gravel, lodged between cobbles, boulders, bedrock, or areas of coarse sand. Fine sandy, silty, or muddy areas do not provide substrates that are sufficiently stable for mussels. Western pearlshell mussels are known to be present in the Smith River and the mainstem Mill Creek. They were documented in 1953 in Mill Creek within Jedediah Smith State Park up to the confluence of the West Branch and East Fork Mill creeks (CDPR 2011a). During annual surveys conducted by Redwood National Park staff between 2005 and 2010, an average of 25 mussels per square meter (30 mussels per square yard) (n = 10, SD = 13.1) were found across 10 sample transects, a comparably high population density. Approximately 33% of the mussels sampled were juveniles (Bensen 2010), indicating a sustaining or growing population. Any mussel population with more than 20% of individuals in the juvenile age class is considered a sustaining or growing population (CDPR 2011a).

Mill Creek supports both anadromous and resident salmonid populations and is one of the most productive salmonid tributaries to the Smith River. Special-status anadromous salmonids found in Mill Creek include coho salmon, Chinook salmon, steelhead, and coastal cutthroat trout. Chum salmon (*O. keta*), a non-special-status anadromous fish, are also occasionally found in the Smith River drainage. The extent of anadromy (anadromy describes fish that hatch and rear in freshwater, go to the ocean, and then return to freshwater to spawn) extends 9.8 miles along the West Branch Mill Creek and 10.9 miles along the East Fork Mill Creek and its tributaries (Garwood and Larson 2014; Walkley and Garwood 2017). Other special-status fish species known to occur in the project area include the Pacific lamprey and river lamprey (CDPR 2016).

Large wood was routinely removed from streams in the project area until as recently as 1992 and the lack of instream wood was identified as a limiting factor for overwintering and summer rearing juvenile salmonids, especially coho salmon (Stillwater Sciences 2002). Pool characteristics data collected in 2007 documented that for the West Branch Mill Creek, 64% of the channel length was composed of pools with a mean maximum pool depth of 2.6 feet and for the East Fork Mill Creek, 50% of the channel length was composed of pools with a mean maximum pool depth of 2.9 feet. The data showed that pool frequency, and thus habitat complexity, increased with wood loading. In 2006, RNSP started installing complex wood structures in Mill Creek. Wood loading since that time has generally increased in specific treatment locations (Rodriguez 2018). The West Branch of Mill Creek has substantially more wood loading than the East Fork (CDPR 2011a). However, forest stands adjacent to many of the low-gradient channels are still dominated by hardwoods and lack the large conifers necessary for long-term recruitment and retention of instream wood.

The project area provides high-quality habitat for several special-status amphibians. These include the southern torrent salamander, Pacific tailed frog, northern red-legged frog, and foothill yellow-legged frog. The southern torrent salamander occurs in permanent seeps, headwater springs, and high-gradient streams that contain coarse rocky substrates (Thomson et al. 2016); this type of habitat is common in the project area. Pacific tailed frogs, also known as coastal tailed frogs, can be found in cold, clear, and moderate- to fast-flowing perennial streams. Southern torrent salamanders and

tailed frogs tolerate a narrow thermal range and are both susceptible to increased sediment loads (Thomson et al. 2016). Northern red-legged frogs breed in still or slow-moving water, including small streams, ponds and lakes, and drainage ditches (California Herps 2019). Juvenile and adult northern red-legged frogs may use coastal streams for dispersal, and in one study the species was detected within 5 meters of water 90% of the time; however, they also have been documented hundreds of meters away from water within densely vegetated or down cover (Haggard 2000). Foothill yellow-legged frogs breed in margins of relatively wide and shallow sections of streams and rivers (Kupferberg 1996). Breeding habitat for foothill yellow-legged frogs is present along Mill Creek but is lacking in smaller higher-gradient tributaries. Adult and juvenile foothill yellow-legged frogs can also be found in smaller perennial streams far upstream from breeding areas.

Special-status bird species in the project area include year-round resident species such as the white-tailed kite, bald eagle, American peregrine falcon, marbled murrelet, northern spotted owl, and migrants, such as Vaux's swift, olive-sided flycatcher, willow flycatcher, yellow warbler, and purple martin. Bald eagle is known to nest in the project area and is occasionally observed foraging along Mill Creek. American peregrine falcon has been observed foraging, but it is not known whether they nest in the project area. Marbled murrelet is associated with old-growth forest and has been documented within and adjacent to the Mill Creek watershed. Northern spotted owl has not been documented in the last 10 years, with one exception, during surveys conducted at historical activity centers (best known location of most recent nest site) in the most suitable habitat. The reduction of northern spotted owl in the RNSP may be due to the influx of barred owls (*Strix varia*). Vaux's swift is known to occur in the project area, is present in Del Norte County between late March through mid-October, and often nests on the inside wall of a hollow tree (Ehrlich et al. 1988, eBird 2019). The olive-sided flycatcher has been documented in the project area along the grassland and riparian areas and is present in Del Norte County between mid-April and late August (eBird 2019). The willow flycatcher is also known to occur in the project area and has been documented in Del Norte County between early May and mid-October (eBird 2019). Yellow warbler is known to occur in the project area and nests in second-growth woodlands, scrub, and riparian habitats, and is present in Del Norte County between mid-April and mid-October (Ehrlich et al. 1998; eBird 2019). Purple martin rely on relic buildings and other man-made structures for nesting in the project area while alternative habitat includes tree holes or other cavities (Ehrlich et al. 1988). Purple martins have been documented in Del Norte County between early April and late August (eBird 2019).

The RNSP area includes numerous non-special-status migratory bird species that have been documented to occur in Del Norte County between mid-February and mid-October (eBird 2019). Ken Burton documented the following migratory species at Little Bald Hills Trail on July 2, 2012, Del Norte Coast Redwoods Mill Creek Campground on June 2, 2017, and MCA at Hamilton Road on March 3, 2019 (eBird 2019): Allen's hummingbird (present in Del Norte County mid-February through late September), Pacific-slope flycatcher (April through late September), Swainson's thrush (early April through mid-October), hermit warbler (late April through mid-September), Wilson's warbler (late March through late September), and black-headed grosbeak (mid-March through late September). Species present year-round included northern flicker, sharp-shinned hawk, Hutton's vireo, red crossbill, pine siskin, fox sparrow, song sparrow, Steller's jay, common raven, Pacific wren, hermit thrush, and dark-eyed junco.

There are six special-status mammal species that have either been documented to occur in the RNSP area or there is a moderate potential for occurrence based on habitat presence. The Sonoma tree

vole is known to occur in the project area and prefers coastal coniferous mature forests to feed exclusively on Douglas-fir needles. The white-footed vole can be found closer to streams with dense riparian vegetation, and although no detections have been recorded in the project area, the species has been recorded immediately to the north in the Jedediah Smith Redwood State Park. The pallid and Townsend’s big-eared bats have not been documented in the project area, but suitable habitat exists in the basal hollows of large trees and in buildings. The Humboldt marten was recently recorded in the Rock Creek watershed after decades of being considered extirpated. The Humboldt marten is associated with mid- to advanced successional stands of conifer with complex structure near the ground and dense canopy closure. Pacific fishers have been documented in the project area and use cavities in large trees for denning.

3.6.2 Proposed Action Impacts

Would the project:		Less Than Significant Impact	No Impact
a.	Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b.	Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c.	Have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marshes, vernal pools, coastal wetlands, etc.) through direct removal, filling, hydrological interruption, or other means?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
d.	Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
e.	Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f.	Conflict with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or state habitat conservation plan?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

A. The purpose of the Proposed Action is rehabilitation of the project area through thinning second growth forests to reduce stand density and alter species composition to promote growth of remaining trees, understory vegetation, and development of multi-story canopy; removing or maintaining roads to reduce the potential for erosion and sedimentation into streams; restoring instream habitat complexity; and augmenting riparian corridors by planting native vegetation. These actions may cause limited short-term impacts to special-status species; however, these actions are needed to expand and enhance habitat for populations of aquatic and terrestrial species, including special-status species, by accelerating development of forest characteristics more typical of late-seral forests and preventing chronic and catastrophic sediment inputs to creeks. As a result of implementing the Proposed Action, habitat conditions for special-status species in the project area are expected to be substantially improved in the long term.

Plants. The Proposed Action would use heavy equipment to assist in the thinning of dense second-growth forests and to reoccupy, construct extensions, and remove legacy roads and/or stream crossings, which could impact populations of special-status plants. Only two of the special-status

plants with a moderate or high potential to occur in the project area have a state or federal listing (Western lily [*Lilium occidentale*] and McDonald's rockcress [*Arabis mcdonaldiana*]); the remaining 72 special-status plant species have a CNPS rank of 1 or 2 (Appendix J). Prior to the start of implementation activities, special-status plant surveys would be conducted (SPR-BIO-1). Any individual or populations of rare, threatened, endangered plants, those listed as CNPS Ranks 1 and 2, identified during pre-implementation special-status plant surveys (SPR-BIO-1) would be clearly marked with an appropriate buffer and avoided (PSR-BIO-2). If avoidance is not possible, then CDFW would be consulted to determine a mutually agreeable strategy. For some species, the temporary disturbance associated with vegetation management activities would result in a net benefit to special-status plant populations, especially thinning that would create openings in the forest. Implementation of SPR-BIO-3 (invasive plant and pathogen control) manages the spread of invasive non-native plants and pathogens into adjacent populations of special-status plants by implementing BMPs such as prevention training, pre-implementation site assessments for invasive plant infestations, and designated equipment and vehicle cleaning and inspection areas. Although work may occur within and adjacent to populations of special-status plants, impacts on special-status plants would be less than significant.

Mollusks. The Proposed Action includes project components (crossing removal, temporary crossing installation, and thinning in riparian zones) that could result in short-term sediment delivery to streams, which could adversely affect western pearlshell mussels or their temporary fish hosts. The Proposed Action as implemented would manage potential increased sediment by conducting activities associated with heavy equipment during the non-rainy season (PSR-HYDRO-5), conducting stream crossing excavations and culvert replacements in dry channels or in channels where stream flow is diverted around the excavation site (PSR-HYDRO-6), establishing equipment exclusion zones along perennial, intermittent, and ephemeral streams (PSR-HYDRO-1), and implementing erosion control measures such as placing mulch to reduce runoff into stream channels (PSR-HYDRO-8 and PSR-BIO-13). The removal of roads and crossings would result in a long-term reduction in sediment delivery to channels, which could affect this species and their temporary fish hosts. The Proposed Action would have a less-than-significant short-term impact on western pearlshell mussels or their temporary fish hosts.

Installation of large wood in streams could result in direct impacts on western pearlshell mussels through contact with logs during placement. These mussels are found at depths between 0.3 to 6.5 feet and are usually located in stream areas that provide some flow refuge during high-flow events, such as along the outside bends of pools, glides, backsides of very large boulders, and near pool tails (CDPR 2011a). Large wood used for instream habitat restoration is typically placed in areas that experience relatively high water velocities and reduced pool and cover elements. These areas generally do not provide preferred habitat for mussels. In addition, the slow water areas provided by the wood structures would increase refuge for mussels during high flows. Impacts on western pearlshell mussels would be less than significant.

Fish. The Proposed Action includes implementation activities that would occur within and adjacent to habitats that support special-status fish species. Figure 4 shows streams in the project area that contain special-status anadromous fish species. The Proposed Action would: 1) remove infrastructure including legacy roads and/or stream crossings to reduce erosion and sediment delivery into streams by removing fill from stream channels, excavate fill material, and restore drainage patterns to reduce the potential for material to erode and be deposited in streams; 2) install temporary stream crossings

and bridges; 3) place large wood in streams and floodplains to create instream structures using heavy equipment, dropping wood into the streams using chainsaws or placement using helicopters, or pulling the pieces into the stream from banks or floodplains; and 4) thin and plant within stream riparian zones. Depending on habitat conditions, these actions could increase sediment delivery to streams that support special-status fish and could result in impacts on special-status fish species or their habitat during operations.

Increased sediment delivery could adversely affect spawning and rearing habitat for special-status fish species within the first year or two following road treatments as the re-established channels stabilize. The Proposed Action would be implemented by conducting road removal activities during the non-rainy season (PSR-HYDRO-5). Stream crossing excavations and culvert replacements would take place in dry channels or in channels where stream flow is diverted around the excavation site (PSR-HYDRO-6). Erosion control measures such as placing mulch to reduce runoff into stream channels (PSR-HYDRO-8 and PSR-BIO-13) would be implemented. Large wood encountered during stream crossing excavations would be retained on-site as mulch or used as in-channel habitat (PSR-BIO-10). Equipment exclusion zones would be established along perennial, intermittent, and ephemeral streams for activities on dry lands (i.e., those not associated with stream crossings, instream large wood placement, and road removal operations; PSR-HYDRO-1). The Proposed Action would have a less-than-significant short-term impact from sediment delivery in streams on special-status fish species and would result in long-term benefits to fish and their habitat by reducing the overall sediment load into the streams.

Large wood structures would be placed in the stream channels and on floodplains consistent with the GMC Aquatic Habitat Restoration Strategy (Appendix G) and described in Section 2.2.3. The intent of this activity is to aid in the development of complex aquatic habitat by creating areas of lower velocity during higher flows, providing additional instream cover, creating scour pools, and recruiting wood. The placement of large wood in streams would be beneficial for fish and their habitat. However, some of these activities would occur within perennial fish-bearing streams and could therefore directly impact fish species during operations. The Proposed Action would follow all ESA and CESA documentation requirements related to fish and amphibian management protocols (PSR-BIO-12). The Proposed Action would have a less-than-significant impact on direct mortality from implementation activities related to placement of large wood and large wood structures.

The Proposed Action includes installing temporary stream crossings and bridges that have the potential to overlap with aquatic habitat that supports special-status fish. All project locations are above the anadromous distribution of Pacific lamprey, coho salmon, Chinook salmon, and steelhead. However, in-water activities have the potential to overlap with the distribution of coastal cutthroat trout, and if activities occur within the wetted stream channel, relocation would be implemented to reduce impacts on these species.

If water drafting becomes a necessary component of the Proposed Action, drafting would be conducted as described in the NMFS Water Drafting Specifications (NMFS 2001; PSR-HYDRO-11). Screening devices would be used for water drafting pumps to minimize removal of aquatic species, including juvenile fish, amphibian egg masses, and tadpoles, from aquatic habitats. Drafting sites would be planned to avoid adverse effects to special-status aquatic species and associated habitat, instream flows, and depletion of pool habitat. Water drafting would have a less than significant impact on special-status fish and amphibian species.

The Proposed Action would thin trees within riparian areas to promote the development of late-successional conditions at a more rapid rate than is currently occurring. This means that trees would become taller, overstory and understory canopy would become denser, and the ability of the riparian area to provide cool microclimates to area streams would improve at a more rapid rate than if treatments were not conducted. Tree-thinning operations would occur within stream zones and remove shade canopy, which could result in increases in water temperatures and adversely affect special-status fish species. At least 60% of canopy cover adjacent to perennial streams would be retained (PSR-HYDRO-1); therefore, sustained increases of water temperature are not likely to occur. The potential for water-temperature-related effects or direct injury or mortality on special-status fish species from thinning activities in the riparian zone would be less than significant.

Planting of riparian conifers along streams in the project area would eventually provide future large wood for natural recruitment to streams, which would provide cover for aquatic species and help create pools. These activities would neither encroach into the stream channel nor result in increased sediment delivery. Planting of conifer species in the riparian zone would have no impact on special-status fish species or their habitat in the short term and would be beneficial in the long term.

Amphibians. There are four special-status amphibian species within the project area that primarily inhabit aquatic habitats. As discussed above, seeps, springs, streams, rivers, and riparian habitats that support these species are present within the project area. The Proposed Action includes project components that would occur within and adjacent to habitats that support special-status amphibian species including: 1) removal of infrastructure including legacy roads and/or stream crossings to reduce erosion and sediment delivery into streams by removing fill from stream channels, excavate fill material, and restore drainage patterns to reduce the potential for material to erode and be deposited in streams; 2) installation of temporary stream crossings and bridges; 3) placement of large wood in streams and floodplains to create instream structures using heavy equipment, dropping wood into the streams using chainsaws or placement using helicopters, or pulling the pieces into the stream from the banks or floodplains; and 4) thinning and planting operations within stream riparian zones. Depending on habitat conditions, these actions could increase sediment delivery to streams that support special-status amphibians, resulting in impacts to special-status amphibian species or their habitat during operations.

Increased sediment delivery could adversely affect habitat for special-status amphibians. The Proposed Action as implemented would manage potential increased sediment by conducting activities during the non-rainy season (PSR-HYDRO-5), implementing stream crossing excavations and culvert replacements to occur in dry channels or in channels where stream flow is diverted around the excavation site (PSR-HYDRO-6), establishing equipment exclusion zones along perennial, intermittent, and ephemeral streams (PSR-HYDRO-1), and implementing erosion control measures such as placing mulch to reduce runoff into stream channels (PSR-HYDRO-8 and PSR-BIO-13). The Proposed Action would have a less-than-significant short-term impact from sediment delivery in streams on special-status amphibians and would result in long-term benefits to their habitat by reducing the overall sediment load into the streams.

Amphibians breeding and metamorphosing in aquatic habitats have the potential to be present and directly affected by Proposed Action activities (Table 6). Proposed Action activities are anticipated to primarily occur during the summer and fall months when the areas are dry. However, implementation activities may extend into winter. Direct injury or mortality may occur from equipment, desiccation of eggs or tadpoles as a result of drying of work areas and felling trees.

Amphibian survey requirements, habitat modification, and operational restrictions for all activities would be implemented in conformance with CDFW CESA requirements (PSR-BIO-12). Foothill yellow-legged frog surveys would be conducted prior to operations to determine whether frogs are occupying the project site. If foothill yellow-legged frogs are found to be occupying a site, then protection measures would be implemented to minimize take of individuals (PSR-BIO-14). Prior to implementation of activities on dry lands, (i.e., those not associated with stream crossings, instream large wood placement, and road removal operations) equipment exclusion zones (PSR-HYDRO-1) would be established in areas near streams. Water drafting requirements (PSR-HYDRO-11) would be employed. Impacts would be less than significant.

The Proposed Action would thin trees within riparian areas to promote the development of late successional conditions at a more rapid rate than is currently occurring. This means that trees would become taller, overstory and understory canopy would become denser, and the ability of the riparian area to provide cool microclimates to area streams would improve at a more rapid rate than if treatments were not conducted. Tree-thinning operations would occur within stream zones and remove shade canopy, which could result in increases in water temperatures and adversely affect special-status amphibian species. At least 60% of canopy cover adjacent to perennial streams would be retained (PSR-HYDRO-1); therefore, sustained increases of water temperature are not likely to occur. The potential for water-temperature-related effects on special-status amphibian species would be less than significant.

Planting of riparian conifers along streams in the project area would eventually provide future large wood for natural recruitment to the channel, which would create cover for aquatic species. These activities would neither encroach into the stream channel nor result in increased sediment delivery. Planting of conifer species in the riparian zone would have no impact on special-status amphibian species or their habitat in the short term and would be beneficial in the long term.

Birds. The Proposed Action includes activities that would result in habitat and noise disturbance by removing trees and vegetation and use of equipment, which could result in disturbance to or mortality of nesting birds. Potential impacts could result from adult nest abandonment due to noise above ambient conditions (e.g., from chainsaws and helicopters), as well as habitat removal resulting in physical harm to young or eggs. Special-status species that have the potential to be present include marbled murrelet, northern spotted owl, raptors (white-tailed kite, bald eagle, American peregrine falcon), willow flycatcher, Vaux's swift, olive-sided flycatcher, yellow warbler, and purple martin.

Marbled murrelet are known to exist in the old-growth stands in the project area. Bird species, especially marbled murrelet, would benefit from forest-thinning activities, which would promote the development of late-successional conditions more rapidly than is currently occurring in the overstocked stands. The Proposed Action includes treatments of individual tree crowns to promote the development of branch reiterations and other structure that could serve as nesting platforms for marbled murrelet. Improved late-successional conditions would aid in connecting isolated marbled murrelet stands in Mill Creek to other occupied stands in RNSP. In addition, road restoration operations would reduce the amount of human disturbance and attraction of corvid predators (jays, crows, and ravens) to trash in and around occupied stands.

The Proposed Action is anticipated to include thinning and other restoration activities within 0.25 mile of marbled murrelet habitat during the critical nesting season from March 24 through

September 15. Forest restoration activities would retain all trees that are 30 inches DBH or larger (PSR-BIO-5). The Proposed Action also incorporates wildlife tree retention standards (PSR-BIO-15), which would preserve suitable nesting structure within the project area, and would conform with all surveys, minimization measures, and requirements identified in USFWS's Biological Opinion or CESA documents (PSR-BIO-7). The Proposed Action would have a less-than-significant impact as a result of noise disturbance on marbled murrelet and a beneficial impact as a result of developing late-successional forest conditions.

Although the northern spotted owl is not common in the project area, one occurrence has been documented. Thinning of overstocked stands and removal of roads would ultimately result in improvements to northern spotted owl habitat by increasing the forest floor shrub layer, which would provide habitat for small mammal prey (e.g., voles and woodrats). However, there is the potential that nesting or roosting northern spotted owl could be affected by the Proposed Action. Forest restoration activities would retain all trees that are 30 inches DBH or larger (PSR-BIO-5). The Proposed Action also incorporates wildlife tree retention standards (PSR-BIO-15), which would preserve suitable nesting structure within the project area, and would conform with all surveys, minimization measures, and requirements identified in USFWS's Biological Opinion or CESA documents (PSR-BIO-7). If required as part of USFWS's Biological Opinion, protocol-level surveys (USFWS 2012) would be conducted to identify the presence of any nesting northern spotted owl. If activities that have the potential to impact the species are scheduled to occur during the breeding season, and if nesting owls are present, buffers would be implemented to prevent impacts on the species. The Proposed Action would have a less-than-significant impact as a result of noise disturbance or habitat removal on northern spotted owl and a beneficial impact as a result of developing late-successional forest conditions.

Raptors, including bald eagle, white-tailed kite, and peregrine falcons, have been documented in the project area. Bald eagle is known to nest in the project area and is occasionally observed foraging along Mill Creek. Peregrine falcon foraging habitat is present, but no nesting habitat is present; therefore, the species is not likely to be affected because it can move to other foraging habitats. Similar to marbled murrelet and northern spotted owl, thinning of overstocked stands would result in higher-quality nesting habitat for bald eagle and possibly white-tailed kite through the development of an advanced-successional conifer forest at a more rapid rate than if treatments were not conducted. There is a potential that noise created from thinning operations and habitat improvement actions (e.g., helicopter use) could impact these species, if they are breeding in the area. Project activities that modify or disturb vegetation would not occur during the peak nesting season between May 1 to June 30 to avoid nesting migratory birds, and if any vegetation manipulation or road removal is deemed necessary during the typical breeding period (May 1 to July 31), an RNSP biologist would conduct weekly breeding bird surveys within the area of potential disturbance. If occupied nests are detected, work would either be suspended until the birds have fledged, or a spatial buffer would be applied to protect the nest. The size of the spatial buffer would be determined by the RNSP biologist based on the species found and the nest site specifics (PSR-BIO-6). The Proposed Action would conform with all minimization measures and requirements identified in CESA documentation or USFWS's Biological Opinion (PSR-BIO-7) and restoration activities would not occur within raptor temporal and spatial buffers (PSR-BIO-8). The Proposed Action would have a less-than-significant impact as a result of noise disturbance or habitat removal on bald eagle and white-tailed kite and a beneficial impact on bald eagle as a result of developing late-successional forest conditions.

Willow flycatcher is a migrant to Del Norte County between early May through mid-October and has been documented in the project area (eBird 2019). Suitable habitat may include riparian vegetation along Mill Creek; however, occurrences of breeding willow flycatchers in Humboldt County are currently rare and localized (Hunter et al. 2005). This species is unlikely to be affected by upslope forest thinning, other vegetation management, and road rehabilitation operations because their preferred multi-storied deciduous riparian stands are generally located along the low-gradient habitats found along the main channel of Mill Creek. There is the potential that instream wood placement could affect this species, if present. CDPH and NPS would conduct nesting bird surveys as part of the Proposed Action in accordance with PSR-BIO-6. The Proposed Action would conform with all minimization measures and requirements identified in CESA documentation or USFWS's Biological Opinion (PSR-BIO-7). The Proposed Action would have a less-than-significant impact on willow flycatchers from noise disturbance or habitat removal.

Vaux's swift, olive-sided flycatcher, yellow warbler, and purple martin are also migrants to the area. As discussed above, Vaux's swift is present in Del Norte County between late March and mid-October, olive-sided flycatcher between mid-April and late August, yellow warbler between mid-April and mid-October, and purple martins between early April and late August (eBird 2019). Thinning of overstocked stands would result in higher-quality nesting habitat for Vaux's swifts and purple martins, which both nest in tree holes or cavities found in late-successional forest. However, there is a potential for habitat removal through tree removal or noise disturbance as a result of implementing the Proposed Action. CDPH and NPS would conduct nesting bird surveys as part of the Proposed Action in accordance with PSR-BIO-6. The Proposed Action would conform with all minimization measures and requirements identified in CESA documentation or USFWS's Biological Opinion (PSR-BIO-7). The Proposed Action would have a less-than-significant impact as a result of noise disturbance or habitat removal on Vaux's swift, olive-sided flycatcher, yellow warbler, and purple martin and a beneficial impact on Vaux's swift and purple martin as a result of developing late-successional forest conditions.

Mammals. The Proposed Action would promote tree species composition and structural changes that together favor the development of late-seral forest conditions. Features of late-seral forests, such as hollows in large trees, snags, and complex structure, would improve habitat for special-status mammals such as Sonoma tree vole, Townsend's big-eared bat, pallid bat, Humboldt marten, and fisher. The vegetation to be removed is likely too young to support Sonoma tree vole nesting habitat which is associated with late-seral/old-growth forest attributes such as large diameter, older, and variably sized trees (Dunk and Hawley 2009); Townsend's big-eared bat and pallid bat roosting habitat, which includes tree cavities and basal hollows in large trees; and Humboldt marten or Pacific fisher habitat, which is advanced-successional conifer forest with denning features in hollow trees. The preferred habitat of the white-footed vole may be most associated with young alder riparian stands (Bean et al. 2016) and project-related impacts on individuals in these habitats would likely not occur except during aquatic restoration activities that could remove alder trees. The Proposed Action has the potential to result in direct mortality to individuals; however, impacts would not result in population-level changes and would be less than significant. A portion of intermediate trees or snags would be retained (PSR-BIO-4), the largest trees (greater than the 80th percentile size class) in the stand would be retained (PSR-BIO-5), striking residual old-growth trees would be avoided (PSR-BIO-11), and wildlife trees that have characteristics such as cavities, hollows, and snag tops would be retained (PSR-BIO-15). In addition, road removal activities associated with the Proposed Action would result in reduced habitat fragmentation, reduced generalist carnivores that prey on forest-

specialists such as the Humboldt marten and Pacific fisher, and human disturbance on these species. The expected increase in the forest floor shrub layer would provide increased habitat for small mammal species (e.g., voles and woodrats) that provide the prey base for species such as Pacific fisher and Humboldt marten. The proposed project would also conform with any minimization measures and requirements identified in CESA documentation or USFWS's Biological Opinion (PSR-BIO-7), including, but not limited to, limiting the removal of the number of large trees greater than 30 inches DBH (PSR-BIO-5), retaining snags and logs as feasible, and retaining trees that could support suitable roosting and denning structure, as feasible (PSR-BIO-15). The Proposed Action would have a less-than-significant short-term impact on special-status mammals from habitat removal and a long-term benefit.

B. Several sensitive natural communities are within the project area and would be impacted during the Proposed Action. The two sensitive natural communities identified during the CNDDDB query (Appendix J) with a moderate or high potential to occur in the project area are Coastal and Valley Freshwater Marsh and *Darlingtonia* Seeps. Other sensitive natural communities, including the *Notholithocarpus densiflorus* (Tanoak forest) Alliance (G4 S3), *Picea sitchensis* (Sitka spruce forest) Alliance (G5 S2), *Rubus (parviflorus, spectabilis, ursinus)* (Coastal brambles) Alliance (G4 S3), and the *Sequoia sempervirens* (Redwood forest) Alliance (G3 S3), occur in the project area. Proposed Action activities would be focused on second-growth forests and existing road networks and it is not anticipated that Coastal and Valley Freshwater Marsh would be impacted. The Proposed Action includes forest thinning and road removal throughout the project area and would occur within sensitive natural communities. The Proposed Action also includes manual removal of vegetation adjacent to *Darlingtonia* fens to reduce the number of trees and cut back encroaching shrubs. The forest stands that would be thinned during the Proposed Action consist of unnaturally dense young forests that have been degraded by historical land use activities. Consistent with the *RNSP General Management Plan/General Plan* (GMP/GP; NPS/CDPR 1999), the 2010 amendment to include the GMC area (CDPR 2010), and the VMP (Appendix F), the Proposed Action would rehabilitate sensitive natural communities within the project area and restore ecosystem function and processes to these degraded habitats.

The Proposed Action also includes a riparian component, which consists of planting conifers in stands along anadromous streams that are conifer-deficient compared with pre-logging conditions, to improve shading and eventually encourage large wood recruitment in stream corridors. These planting activities would improve the conditions of riparian zones in the project area that have been altered by past road building, timber harvesting, and associated bank erosion and landslides.

Pre-implementation special-status plant surveys (SPR-BIO-1) in the project area would identify sensitive natural communities prior to the start of implementation activities. Any sensitive natural communities that are not a component of the Proposed Action (e.g., forest thinning, riparian planting) would be clearly marked with an appropriate buffer and avoided (PSR-BIO-2). If avoidance is not possible, then CDFW would be consulted to determine a mutually agreeable strategy. In most cases, the temporary disturbance on sensitive natural communities associated with the Proposed Action would result in a net benefit to the ecosystem. Invasive plant and pathogen control (SPR-BIO-3) would reduce the spread of invasive non-native plants and pathogens into adjacent sensitive natural communities by implementing BMPs such as prevention training, pre-implementation site assessments for invasive plant infestations, and designated equipment and vehicle cleaning and inspection areas. In addition, the Proposed Action would retain at least 60% canopy cover adjacent

to streams (PSR-HYDRO-1) and retain an equipment exclusion zone within at least 30 feet from fish-bearing streams and perennial non-fish-bearing streams and on the inner slope of non-fish-bearing intermittent or ephemeral streams. Impacts on riparian habitat and other sensitive natural communities would be less than significant.

C. The Proposed Action could temporarily impact state or federally protected wetlands in the project area during road reoccupation and removal (i.e., culvert upgrades and stream crossing removal) and large wood placement. However, these activities would have a long-term benefit on wetlands by reducing sediment input. Riparian and wetland plantings would also have a long-term benefit on wetlands in the project area. In addition, road and crossing removal would increase the amount of forest and riparian habitat at those locations. To minimize impacts on wetlands, the Proposed Action would include conducting special-status plant surveys prior to the start of implementation activities by a Park plant ecologist (SPR-BIO-1). Any individual or populations of rare, threatened, endangered plants, those listed as CNPS Ranks 1 and 2, or sensitive natural communities identified during pre-implementation special-status plant surveys (SPR-BIO-1) would be clearly marked with an appropriate buffer and avoided (PSR-BIO-2). If avoidance is not possible, then CDFW would be consulted to determine a mutually agreeable strategy. The Proposed Action would retain an equipment exclusion zone within at least 30 feet from fish-bearing streams and perennial non-fish-bearing streams and on the inner slope of non-fish-bearing intermittent or ephemeral streams (PSR-HYDRO-1) and riparian buffers would be established to retain between at least 60% canopy cover adjacent to streams (PSR-HYDRO-1). In addition, decontamination of heavy equipment would occur prior to delivery onto Park lands (SPR-HYDRO-3) and trees would be fully suspended in the air when travelling near streams (PSR-HYDRO-4). Work in wetland or riparian areas and stream channels may require heavy equipment to cross wetlands to access treatment sites. Crane mats or other appropriate cover material would be placed along the heavy equipment access routes that cross wetlands and herbaceous-dominated habitats (e.g., pasture or grasslands; PSR-BIO-16) to avoid wetland impacts. The Proposed Action would have a less-than-significant impact on wetlands.

D. The Proposed Action is designed to increase the development of late-successional forest structure through thinning of dense stands, which would release the retained trees and improve their growth rates. One of the main goals of the Proposed Action is to use the thinning operations to improve migration corridors for native wildlife species that are dependent on late-successional forest conditions. For example, thinning would improve the ability of wildlife species to move, migrate, and promote gene flow between the old-growth stands in Mill Creek and those in other areas of RNSP. This would result in long-term benefits for several species, including, but not limited to, marbled murrelet, northern spotted owl, Pacific fisher, and Humboldt marten. In addition, removal of roads and crossings would reduce habitat fragmentation and improve the ability of fish and amphibians to move between habitats needed for different life-history stages and use areas where access is currently limited. The stabilization of erosion sites along the road system would reduce sediment delivery and improve anadromous fish spawning habitat in fish-bearing streams. Finally, the introduction of large wood in the project area streams would improve the ability of juvenile anadromous salmonids to find cover and survive high-flow periods while rearing and during their transition period from their natal streams to adult habitat.

Wildlife movement could be temporarily affected during active implementation operations. However, these impacts would be short-term and there are nearby unaffected areas to which wildlife could move to during implementation activities. The potential for impacts on nursery sites would be

minimized by establishing spatial and temporal buffers around all identified raptor nests (PSR-BIO-8) during the nesting period. In addition, CDPR and NPS would conduct nesting bird surveys as part of the Proposed Action in accordance with PSR-BIO-6. The Proposed Action would conform with all minimization measures and requirements identified in CESA documentation or USFWS's Biological Opinion (PSR-BIO-7), which may include, but may not be limited to, conducting northern spotted owl protocol-level surveys (USFWS 2012) for activities that have the potential to impact the species scheduled to occur during the breeding season, implementing a buffer around an active northern spotted owl nest, and implementing a no-work area within 0.25 mile of marbled murrelet habitat during the critical breeding season. In addition, the Proposed Action would retain wildlife trees that provide habitat components that support nesting northern spotted owl, marbled murrelet, and Humboldt marten (PSR-BIO-5 and PSR-BIO-15). The impact of the Proposed Action on the movement of any native resident or migratory fish or wildlife species, established native resident or migratory wildlife corridors, or native wildlife nursery sites would be less than significant.

Non-special-status nesting birds are also protected by California Department of Fish and Game Code Sections 3503 and 3503.5, which indicate that "It is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto" and "It is unlawful to take, possess, or destroy any birds in the orders Falconiformes or Strigiformes (birds-of-prey) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto." Although not a comprehensive list, the following species have been documented to occur in Del Norte County between mid-February and mid-October (eBird 2019) and may breed in the project area (see location and timing details given above): Allen's hummingbird, Pacific-slope flycatcher, Swainson's thrush, hermit warbler, Wilson's warbler, and black-headed grosbeak. Spatial and temporal buffers would be established around all identified raptor nests (PSR-BIO-8) during the nesting period. CDPR and NPS would conduct nesting bird surveys as part of the Proposed Action in accordance with PSR-BIO-6. The Proposed Action would conform with all minimization measures and requirements identified in CESA documentation or USFWS's Biological Opinion (PSR-BIO-7). The Proposed Action would have a less-than-significant impact on active bird nests of non-special-status birds and raptors.

E. The Proposed Action is being conducted in conformance with the policies and directions of RNSP. There would be no conflict with local policies or ordinances protecting biological resources.

F. There are no applicable Habitat Conservation Plans, Natural Community Conservation Plans, or other such approved local, regional, or state habitat conservation plans for these state and federal lands. The Proposed Action would comply with RNSP management plans and policies. There would be no conflict with any conservation plans.

Cumulative Impacts. The Proposed Action is designed to result in improved habitat features for terrestrial and aquatic species in the long term and less-than-significant impacts on biological resources in the short-term. Future regional projects considered as part of the cumulative analysis would also be subject to permitting and environmental review processes which would avoid, minimize, or mitigate impacts on biological resources. Therefore, the Proposed Action, when combined with future actions in the region, would result in a cumulative net benefit to biological resources.

3.6.3 *No Action Alternative Impacts*

Under the No Action Alternative, the development of forest stands would continue toward late successional conditions, but at a much slower rate than under the Proposed Action. NPS and CDPR could continue to treat forest stands, road systems, and riparian areas on a project-by-project basis as funding allows, but such an approach would be fragmented and would occur over smaller areas as compared with the Proposed Action. Compared with the Proposed Action, the No Action Alternative would result in fewer short-term operations-related impacts on wildlife resources but would also maintain the current level of chronic legacy effects of previous forest and road management actions. In addition, the risk of road system sediment delivery to streams and associated impacts on aquatic habitats would likely increase under the No Action Alternative as old culverts and substandard crossings fail at an increasing rate. This could result in a significant impact on biological resources.

3.7 Cultural Resources

3.7.1 *Existing Conditions*

Under NEPA, cultural resources are historic properties (prehistoric or historic districts, sites, buildings, structures or objects) that are eligible for listing in the National Register of Historic Places (NRHP).

To be eligible for listing in the NRHP, a property must have significance, integrity, and generally must be at least 50 years old. A historic property can be significant under one more of the following criteria. Historic properties include those: a) that are associated with events that have made a significant contribution to the broad patterns of our history; b) that are associated with the lives of significant persons in our past; c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or d) that have yielded or may be likely to yield, information important in history or prehistory. An NRHP-eligible property must also possess one or more of the seven aspects of integrity: location, design, setting, materials, workmanship, feeling, and association.

Under CEQA, cultural resources are resources of architectural, historical, archaeological, and cultural significance that are: 1) eligible for listing in the California Register of Historical Resources (CRHR); 2) included in a local preservation register; 3) identified as significant in a cultural resources survey; or 4) determined significant by the CEQA lead agency.

To be eligible for listing in the CRHR, a resource must have significance, integrity, and generally must be at least 45 years old. A resource can be significant under one or more of the following criteria: 1) associated with events that have made a significant contribution to the broad patterns or California's history and cultural heritage; 2) associated with the lives of persons important in our past; 3) embodies the distinctive characteristics of a type, period, region, or method of construction or represents the work of an important creative individual, or possesses high artistic values; or 4) has yielded, or may be likely to yield, information important in prehistory or history. A CRHR-eligible property retains integrity, defined as the authenticity of the resource's physical identity.

This analysis uses the term "potential cultural resources" to describe properties that may be NRHP- or CRHP-eligible but that have not been evaluated, and "cultural resources" to describe properties that have been determined eligible for the NRHP, the CRHR, or both.

The CEQA checklist questions regarding impacts divide cultural resources into two categories: historical resources (standing structures and buildings) and archaeological resources (surface or buried sites, features, and objects of any era). Historic-era buried sites, surface artifact scatters, or road grades are examples of archaeological resources. Bridges, culverts, or standing outbuildings are examples of historical resources.

The likelihood that cultural resources would be adversely impacted in the project area depends on how the area was used in the past, the potential for preservation of cultural materials that would have been left behind by those uses, and the potential for Proposed Action implementation activities to encounter such materials. A review of the environmental and cultural history in the project vicinity forms the basis for identifying what kinds of cultural resources could be present and assessing the potential for adverse project impacts. The following review is summarized from the *Research Design and Cultural Resources Inventory Work Plan for the Redwoods Rising Project, Greater Mill Creek and Greater Prairie Creek, Humboldt and Del Norte Counties, California* (Allen et al. 2018).

The project area is in the northern part of the Coast Ranges' geomorphic region, a series of low mountain ranges shaped by the San Andreas Fault system (CGS 2015). Streams and rivers occupy valleys and gorges, and level ground is rare. At present, natural communities are classified as blue oak-foothill pine forest, California prairie, and chaparral, which host mule deer, pronghorn, and elk, as well as a wide variety of small mammals and birds. The natural environment would have varied in the past with climatic shifts, affecting the location and density of resources available to people living in the area (Benson et al. 2002).

A variety of cultural themes could be applicable to the project area, including specific temporal and cultural sequences for the northern coast of California and the Great Basin. The general summary presented here describes these themes within the context of the geological epochs (e.g., Pleistocene and Holocene) in which they occurred and in terms of geographically widespread general cultural traditions (Periods), and locally distinct expressions of those Periods (patterns).

The oldest archaeological sites in the north Coast Ranges area likely date to the late Pleistocene, known as the Paleoindian Period (locally expressed as the Post pattern). However, none of the sites attributed to this period are securely dated, and artifacts generally consist only of isolated stone tools.

In the Early and Middle Holocene (about 10,000 to 4,500 years ago), the Borax Lake pattern (a local expression of the Middle and Lower Archaic Periods) was found in the north Coast Ranges. The pattern is characterized by projectile points, but also includes the introduction of millingstones and manos, milling slabs, drills, cobble tools, and flaked stone crescents. In the interior, Borax Lake pattern sites "reflect a subsistence orientation around hunting and seed gathering, with little or no evidence of fishing" (Justice 2002). However, on the coast during the Middle Holocene (coinciding with the latter part of the Borax Lake pattern), net sinkers and bone fishhooks are evidence of a focus on fishing. Mortars and pestles also appear on the coast (Erlandson 1997).

In the Late Holocene (about 4,500 years ago to European American contact), sites before 1,500 years ago are attributed to the Mendocino pattern (a local expression of the Upper Archaic Period). During this time, residential patterns shifted to the use of specialized hunting camps in upland settings with more permanent villages in riverine and coastal environments (Hildebrandt 2007). Artifact assemblages included specialized lithic tools, manos, and milling slabs. After 1,500 years ago, archaeological assemblages indicate increased coastal resource use and permanent residential sites

(Hildebrandt 2007). This is known as the Emergent Period; the local expression is the Gunther or Tuluwat pattern. Sites from this period are mostly coastal, with a strong focus on fish, shellfish, and marine mammal procurement. Typical artifacts include net sinkers, bone and antler spears, harpoons, and hooks. The faunal assemblages also represent this focused subsistence pattern with a high occurrence of marine animals (Hildebrandt 2007). These sites correspond closely with ethnographically reported cultures.

The majority of the project area is in the traditional territory of the Tolowa people, with a small section of the southern project boundary that is in an area ancestral to the Yurok people. The Tolowa are an Athabaskan-speaking people whose traditional territory includes the Smith River watershed and the adjacent coast from the Winchuck River in Oregon to Wilson Creek in northwestern California. The Tolowa are part of a larger group of Athabaskan speakers who occupied the northern California and southern Oregon coasts at time of contact and were divided into "tribes," perhaps inaccurately, by early ethnographers (Kroeber 1976). To the south, the Yurok are an Algonquian-speaking people whose ancestral territory encompasses a region generally between the Little River in the south and Damnation Creek in the north, including 42 miles of the Klamath River watershed and 30 miles of Pacific Coast (Yurok Tribe 2007; Huntsinger and McCaffrey 1995).

For most of the year, the Tolowa that lived in coastal villages relied on procurement of marine mammals and shellfish, while Tolowa at interior villages focused on terrestrial resources such as deer and acorn. In the fall, coastal communities moved to camps in forested areas where they harvested acorns, salmon, and eels, particularly in fir-tanoak groves situated on level areas adjacent to waterways. Oak groves, as well as fishing and eeling places along the streams, could be claimed by families or individuals. The Tolowa used controlled fire to reduce underbrush and keep the grass low to aid the harvest of fallen acorns the next fall. Travel occurred between fall camps and coastal villages, as well as along trade networks with neighboring tribes (Gould 1975).

The Yurok also used a variety of coastal and terrestrial resources during the ethnographic period, including hunting bear, deer, elk, and generally any large game animal (excluding cougars), along with a variety of small game. The once-open prairies of Bald Hills and those within the project area along Prairie Creek were sources of manzanita, nettle, iris, huckleberry, soap root, pepperwood, bear grass, and oak resources. The Yurok also used controlled fire to stop the encroachment of non-native trees and stimulate growth of subsistence resources. Fishing was done with a variety of spear, harpoon, and trap methods along the Klamath and its tributaries for species including chinook and coho salmon, steelhead, Pacific lamprey, eulachon, coastal cutthroat, and green sturgeon. Yurok village organization was well-defined and based on topography, ceremonial, and practical functions. Though important, villages represent a small portion of the area used by the Yurok; hunting, fishing, gathering, and ceremonial places spread several miles from their primary settlements.

Early European explorers are known to have sailed towards the north Coast Ranges area in the 1500s, and Captain George Vancouver's expedition passed by 1792. Although these parties did not appear to have spent more than a few days at anchor in the area, Native American communities were impacted by introduced diseases prior to land-based contact, and Russian sailors in 1803 found Native villages deserted on the Sonoma County coast (Erlandson and Bartoy 1995; Bearss 1969). The first documented European American exploration on land was by fur trapper Jedediah Smith's party in 1828. The remote region was still little visited until the Gold Rush of the 1850s, which spurred population growth and the development of infrastructure. This growth also ushered in the state-sanctioned genocide of Native American peoples, which resulted in the murder of thousands of men,

women, and children in northern California, primarily by roving militia groups and the United States military (Heizer 1993). Native communities also experienced the degradation of their subsistence base, forced removal from their homes, placement onto reservation lands, and formal and informal suppression of language and culture. Nevertheless, these Tolowa and Yurok communities persisted, continue to practice cultural traditions, and are a vibrant part of the communities in northwest California.

While the Gold Rush brought miners in great numbers to northern California, few settled in Del Norte County. Most gold mining occurred prior to 1858 and was mostly unproductive. Copper mining began in 1860 with limited success. While exploration for mining was generally unsuccessful, it did lead to homestead claims. Agricultural settlement to supply miners and a few growing towns first began along the coast and then moved further inland to the fertile valleys. In the project area, about 29 claims were filed for homesteads between 1882 and 1901. Many of these were speculative and appear to have been filed to obtain land for logging, though a few families used the homestead plots as a base to grow their cattle and dairy ranches.

With mining and agricultural activity offering paltry rewards, settlers turned to the coastal redwood forests. Logging began in the project area soon after the first settlements with much of the lands being acquired through illegal land fraud schemes. Logging continued to expand into the 1950s, becoming the primary industry of the north Coast Ranges area. The first saw mill was built on Humboldt Bay by 1852, after which logging in the project area began. Logging techniques were standard in the forests starting in the 1870s, using spring boards set 8 to 10 feet above the flared base of the tree. By the 1880s, logging operations and the associated camps were spread through the forests, serving mills and ports. Logging railroads stretched between the hills and the logging camps with spurs leading to the wharf. A 12-mile-long common carrier known as the Crescent City & Smith River Railroad was built between 1890 and 1894 (Bearss 1969).

Logging activity grew during World War I, declined during the Depression, then peaked with the California population boom in the 1950s. A variety of companies and subsidiaries logged project area lands and operated mills. The Miller-Rellim Mill was built in 1964 and expanded several times in the 1960s. This rapid expansion led to the decimation of old-growth forests, which had two primary effects: first, it forced logging and milling companies to adjust to harvesting and processing smaller logs; and second, it fueled an expansion of the conservation movement that had begun in the early 1900s. The local conservation movement, together with national environmental laws and regulations passed in the late 1960s and early 1970s, brought increased scrutiny and regulation to the logging industry.

Given the cultural history described here, a number of types of cultural resources could be present in the project area, including (but potentially not limited to) the following:

- Precontact Sites: Village sites, short-term or temporary habitation sites, resource procurement or processing locations, lithic scatters, quarries, or isolates, rock art, rock features, or other ceremonial or sacred places, and trails or other transportation features
- Historic-era Sites: Native American village and habitation sites with evidence of historic contact, direct or indirect evidence of European American and Indian conflicts or warfare, mining equipment and infrastructure, agricultural equipment and infrastructure, historic debris scatters and dumps, borrow and prospect pits, linear features (roads, rail lines, utilities,

and trails), domestic residences, townsites, and a variety of logging-related sites (spring boxes, notched stumps, blaze marks, steam donkeys, flumes, and others)

A number of cultural resources and potential cultural resources are recorded in the project area. A search of the California Historical Resources Information System was conducted in June 2018 and records provided by NPS and CDPR were reviewed. In addition, a cultural resources survey of Phase 1 project areas was conducted in 2018. The records searches and survey revealed 49 resources. These include the following: precontact sites, including nine occupation sites (13); historic-era isolated finds, such as a single piece of equipment (10); historic-era agricultural complexes (ranches, homesteads) and other structures (six); historic-era logging sites (five); precontact lithic scatter (four); historic-era roads (three); historic-era debris scatters or dump sites (two); historic-era tourism-related properties (2); multi-component sites including both historic-era and precontact materials (two); one precontact isolate; and one unknown; site number was assigned but the record is missing.

A cultural resources survey has been conducted in the Phase 1 project areas. The survey results documented 20 potential cultural resources. Five resources were recorded on historic maps or other documents but were not located or relocated during archaeological survey. Documented resources in the Phase 1 area include the following: historic era isolated finds (seven); historic era rail grade segments (five); historic era logging roads (four); historic era debris scatters (two); one precontact lithic site (the Child’s Hill lithic scatter); and one historic structure (a high-explosives shed and associated cut near the Mill Creek Campground).

3.7.2 Proposed Action Impacts

Would the project:		Less Than Significant Impact	No Impact
a.	Cause a substantial adverse change in the significance of a historical resource pursuant to Section 15064.5?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b.	Cause a substantial adverse change in the significance of an archaeological resource?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c.	Disturb any human remains, including those interred outside of dedicated cemeteries?	<input checked="" type="checkbox"/>	<input type="checkbox"/>

In general, ground disturbance has the potential to adversely affect the integrity of archaeological resources. Archaeological sites may have features or components that are not visible from the ground surface. These elements may be damaged by digging through the intact stratigraphy of an archaeological site, thereby compromising the ability of archaeological resources to be eligible for the NRHP or CRHR. Modification or demolition of a structure, or change in its setting or location, could compromise the ability of historical resources to be eligible for the NRHP or CRHR. Potential impacts of the various activities proposed as part of the Proposed Action could include the following:

- Forest thinning, snag creation, and crown manipulation could result in ground disturbance where heavy equipment traverses off-road areas, where trees fall or are cable-yarded, or where fixed equipment is anchored in the ground. Falling trees or moving equipment could also potentially damage structures.
- Invasive species removal could result in ground disturbance where plants are removed including roots.
- Placement of large wood for aquatic restoration could result in ground disturbance where vegetation is pulled from streambank to stream channel, or where heavy equipment traverses off-road areas.

- Riparian planting could result in ground disturbance where trees and understory vegetation is planted, or where invasive vegetation is removed by methods that include root removal.
- Road removal could result in partial or total demolition of historic road grades, or removal of historic structures such as bridges or culverts.
- Road improvements (extension or reoccupation) could result in the modification of road surfaces, bridges or culverts.

Projects with federal funding or approvals, or that take place on NPS property, are subject to review under Section 106 of the NHPA. NPS is developing a Programmatic Agreement (PA), in consultation with the SHPO and Native American tribes for future phases of the Proposed Action that will assist in meeting its consultation requirements under Section 106 of the NHPA and its implementing regulation at 36 CFR 800. The PA will be attached to the final Finding of No Significant Impact.

A. One potential historical resource has been identified in the Phase 1 project areas: a high-explosives shed and associated cut, located in the Mill Creek Campground South area. Implementation activities in the vicinity would consist of vegetation management activities, potentially including forest thinning (ground-based operations and skyline operations), invasive species removal, crown manipulation, and snag creation. Preliminary evaluation indicates that the structure is not NRHP- or CRHR-eligible. If further research and consultation indicates that it is eligible for the NRHP or CRHR, it would be protected by flagging the area and establishing a 30-foot protective buffer during implementation as described in PSR-CULT-1 and adhering to aerial suspension removal requirements as described in SPR-CULT-4, or would be protected as described in the PA, depending on whether NPS is involved in the specific activity. No Proposed Action activities would be allowed to traverse the area, nor would any trees be allowed to fall in the buffer area.

For future phases of the Proposed Action, project areas would be surveyed for historical resources prior to implementation. For projects with NPS involvement, survey would occur as described in the PA, which includes a detailed research design and consultation requirements. For projects without NPS involvement, reports would be submitted to and reviewed by the NCRD Archaeologist, and PRC 5024 compliance documentation would be completed (PSR-CULT-1).

The Proposed Action is not anticipated to result in substantial adverse change in the significance of a historical resource and impacts would be less than significant, because the historical resource may be completely avoided and protected from Phase 1 project activities. Future phases would be defined and implemented to avoid impacts on historical resources (as is the case for Phase 1).

B. The 19 archaeological resources identified in the area of Phase 1 projects have not yet been fully evaluated for NRHP and CRHR eligibility. Preliminary evaluations indicates that three sites may be eligible for both preservation registers, while the remaining 16 may not be eligible. The three archaeological resources that preliminary evaluations indicate may be eligible include a scatter of historic logging artifacts in Section 5, a precontact lithic scatter in the Child's Hill Burn Block, and a section of the Old County Road (aka 1894 Crescent City to Trinidad Wagon Road) grade in Mill Creek Campground South.

Implementation activities in the vicinity of the 20 archaeological resources include vegetation management activities including forest thinning (ground-based operations and skyline operations), invasive species removal, crown manipulation, snag creation, and road removal. Archaeological resources that are determined NRHP- or CRHR-eligible would be protected by flagging the area and establishing a 30-foot protective buffer during implementation as described in PSR-CULT-1 and

adhering to aerial suspension removal requirements as described in SPR-CULT-4, or would be protected as described in the PA, depending on whether NPS is involved in the specific activity. No Proposed Action activities would be allowed to traverse the area, nor would any trees be allowed to fall in the buffer area.

For future phases of the Proposed Action, project areas would be surveyed for archaeological resources prior to operations. For projects with NPS involvement, survey would occur as described in the PA, which includes a detailed research design and consultation requirements. For projects without NPS involvement, reports would be submitted to and reviewed by the NCRD Archaeologist, and PRC 5024 compliance documentation would be completed (PSR-CULT-1). Future phases would be defined and implemented to avoid impacts on archaeological resources (as is the case for Phase 1).

If archaeological materials are discovered during implementation of activities with NPS involvement, response would occur as described in the PA. For projects without NPS involvement, work would be suspended until CDPR has evaluated the find in consultation with the SHPO and Native American tribes as appropriate (SPR-CULT-2). The Proposed Action is not anticipated to result in substantial adverse change in the significance of an archaeological resource, and impacts would be less than significant.

C. No cemeteries or other locations where human remains are likely to be present have been identified in the area of Phase 1 projects, where cultural resources survey has been completed. For future phases of the Proposed Action, project areas would be surveyed for such locations. If any are located, the following would occur:

- For activities with NPS involvement through funding or approvals, but not occurring on NPS land, human remains would be treated as described in the PA.
- For activities on NPS land, provisions of the Native American Graves Protection and Repatriation Act (NAGPRA) would apply.
- For activities without NPS involvement, reports would be submitted to and reviewed by the NCRD Archaeologist, and PRC 5024 compliance documentation would be completed (PSR-CULT-1).

Future phases would be defined and implemented to avoid impacts on cemeteries or human remains (as is the case for Phase 1). If human remains or suspected human remains are discovered during implementation, work would stop immediately and the provisions of the PA, NAGPRA, or SPR-CULT-3 would be followed as appropriate. The Proposed Action is not anticipated to result in substantial adverse change in the significance of a cemetery or other location where human remains may be present, and impacts would be less than significant.

Cumulative Impacts. Impacts from actions within the project area prior to NPS and CDPR management likely included destruction and loss of integrity of historical resources. There have also likely been more recent impacts from such natural processes as erosion, weathering, modification of structures, and fire, as well as disturbance from use, access, vandalism, and unauthorized collection. The potential for impacts on cultural resources would continue, but adverse effects would be avoided or minimized through compliance with applicable laws. The potential for adverse impacts associated with the Proposed Action is unlikely to contribute to significant impacts on cultural resources, when combined with past, present, and reasonably foreseeable future activities.

3.7.3 No Action Alternative Impacts

Under the No Action Alternative, NPS and CDPH could continue to treat forest stands, road systems, and riparian areas on a project-by-project basis as funding allows. Projects that move forward into construction could have impacts to cultural resources, but the geographic extent of activities would probably be smaller absent a coordinated ecosystem restoration plan; therefore, there would be a lower potential for impacts. Impacts would be considered less than significant.

3.8 Tribal Cultural Resources

3.8.1 Existing Conditions

A tribal cultural resource is defined as a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and is eligible for the CRHR or a local historic register (or is determined by the lead agency to be a tribal cultural resource). Tribal cultural resources review is required under CEQA, but not specifically under NEPA. NRHP-eligible historic properties (evaluated as cultural resources under NEPA) could include resources that are also tribal cultural resources under CEQA. NRHP-eligible historic properties can include Traditional Cultural Properties (TCPs) or cultural landscapes, either of which could be NRHP-eligible in part for importance to a Native American tribe. A TCP or cultural landscape that is of importance to a tribe would likely also be a tribal cultural resource under CEQA. However, tribal cultural resources as defined by CEQA are not necessarily also NRHP-eligible TCPs or cultural landscapes.

The precontact lithic scatter in the Child's Hill Burn Block is recommended eligible for the CRHR and may be of cultural value to the Tolowa people, in whose ancestral homelands this resource is located. Consultation with the Tolowa has not included describing the lithic scatter as a tribal cultural resource. If consultation on this draft document or other documents indicates that it is a tribal cultural resource, then this document would be updated. No other tribal cultural resources have been identified.

3.8.2 Proposed Action Impacts

Would the project:		Less Than Significant Impact	No Impact
a.	Cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:		
	Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k), or	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resource Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.	<input checked="" type="checkbox"/>	<input type="checkbox"/>

A. Potential impacts of the various activities proposed as part of the Proposed Action could include ground disturbance that impacts archaeological sites from vegetation management, invasive species

removal, aquatic restoration, or road removal; introduction of noise or visual impacts from implementation activities in the vicinity of cultural or sacred sites; or disruption of access to cultural or sacred sites during or after implementation.

Activities in the Child's Hill Burn Block, the unit where the precontact lithic scatter is located, would consist of vegetation management activities, including forest thinning via ground-based operations and skyline operations, and road reoccupation and removal activities. These operations could include ground disturbance. However, these operations are not anticipated to significantly impact the resource, because operations are not planned to occur on the segment of road which contains the site.

In the remainder of the Proposed Action area, if any tribal cultural resources are identified in further consultation under PSR-CULT-1 or as described in the PA, they would be protected as described in SPR-CULT-4 and/or as described in the PA, as appropriate. Impacts would be less than significant.

Cumulative Impacts. Impacts from actions within the project area prior to NPS and CDPR management likely included destruction and loss of integrity of tribal cultural resources. There have also likely been more recent impacts from such natural processes as erosion, weathering, modification of structures, and fire, as well as disturbance from use, access, vandalism, and unauthorized collection. The potential for impacts on tribal cultural resources would continue, but adverse effects would be avoided or minimized through compliance with applicable laws. The potential for adverse impacts associated with the Proposed Action is unlikely to contribute to significant impacts on tribal cultural resources, when combined with past, present, and reasonably foreseeable future activities.

3.8.3 *No Action Alternative Impacts*

Under the No Action Alternative, NPS and CDPR could continue to treat forest stands, road systems, and riparian areas on a project-by-project basis as funding allows. Projects that move forward into construction could have impacts to tribal cultural resources, but the geographic extent of activities would probably be smaller absent a coordinated ecosystem restoration plan; therefore, there would be a lower potential for impacts. Impacts would be considered less than significant.

3.9 Geology and Soils

3.9.1 *Existing Conditions*

The project area lies in a tectonically active and geologically complex area, with high uplift rates and regular seismic activity (Aalto and Harper 1982). Most of the underlying bedrock in the region has been faulted, folded, and sheared by tectonic forces, making it relatively weak, easily weathered, and inherently susceptible to erosion and landsliding. The geology of the project area, and the surrounding region of northwestern California, is dominated by the Coast Range thrust fault (also referred to as the South Fork fault), which strikes north-northwest along the eastern extent of the project area and forms the boundary between rocks of the Coast Range and the Klamath Mountain geomorphic provinces (Figure 6).

3.9.1.1 **Bedrock Geology**

Bedrock geology in the project area is predominately the Broken Formation of the Eastern Belt Franciscan Complex (Figure 6). Broken Formation rocks are Late Jurassic to early Cretaceous in age and are comprised of tectonically fragmented and interbedded greywacke, shale, and conglomerate

(Aalto and Harper 1982). Most of the sandstones and shales are classified as unmetamorphosed, although slightly metamorphosed rocks are exposed at Bald Hills (Madej et al. 1986). Bedrock just west of the fault is composed of highly sheared and foliated metagraywacke, argillite, and semischist (Davenport 1984). Bedrock east of the fault is composed of highly sheared serpentinite and peridotite (Aalto and Harper 1982). Shallow-water marine deposits of the Miocene-age Wimer Formation cap the highest ridge crests in the northern portion of the project area. Remnants of uplifted, Pliocene-age alluvial terrace deposits cap ridge crests in the Childs Hill area. Alluvial terrace and floodplain deposits of Pleistocene to Holocene age occur in valley bottoms along mainstem Mill Creek, East Fork Mill Creek, West Branch Mill Creek, and Rock Creek. There may be fossils present in Franciscan Complex bedrock, of which there are outcroppings in the project area. These fossils include a diverse assemblage of marine invertebrates. Marine vertebrate fossils are present but scarce (Hilton 2003).

3.9.1.2 Faulting and Seismicity

The project area and surrounding region are in a seismically active area that experiences faulting along major regional tectonic plate boundaries (i.e., the Cascadia subduction zone) as well as along smaller faults within individual plates (Atwater et al. 1995; Goldfinger et al. 2012). Goldfinger et al. (2012) estimated a 37 to 42% probability of a magnitude 8 Cascadia subduction zone earthquake event capable of producing severe ground shaking and permanent ground elevation changes along portions of the northern California, Oregon, and Washington coasts by 2062; and estimated a 7 to 10% probability of a magnitude 9 earthquake over the same time period. Because of its capability, recurrence interval, and timing of its last known earthquake (AD 1700), this is the largest source of consideration for earthquake hazards potentially affecting the Proposed Action.

Other active faults in the vicinity include the Whalehead fault zone in southern Oregon and offshore extensions of the Grogan and Lost Man faults, the Bald Mountain-Big Lagoon fault zone, and other unnamed thrust faults southwest of Crescent City. These faults are considered Quaternary, suggesting they have been active within the past 1.6 million years (Kelsey and Cashman 1983; Clarke and Field 1989; Jennings 1994). They could produce strong groundshaking within the project area but have lesser recurrence and lesser maximum magnitude capability than the Cascadia subduction zone (Atwater et al. 1995; Goldfinger et al. 2012).

3.9.1.3 Geomorphology

The project area is characterized by steep, mountainous terrain typical of the north Coast Ranges. The ridges, or drainage divides, are generally broad and gently sloping. Hillslopes are steep and straight to convex upwards with gradients that frequently exceed 50% (Madej et al. 1986). Drainage basin patterns are predominantly dendritic with drainage densities ranging from 7 to 9 miles per square mile. Smaller tributaries occupy narrow, deeply incised canyons with bedrock floors and little floodplain development. The mainstem of Mill Creek and the lower reaches of the West Branch and East Fork occupy broad, flat valley bottoms that store large volumes of stable sediment in terraces located above the active channel. These terraces tend to buffer sediment input and yield by protecting the base of hillslopes from erosion (Madej et al. 1986). Rock Creek, and headwater reaches of Cushing, Nickel, Damnation, Wilson, Hunter, and Turwar creeks flow through narrow valleys for most of their lengths within the project area.

Repeat stream channel cross section surveys conducted by USGS and NPS from the 1970s through 1990s have recorded aggradation and channel widening in response to upstream sediment input in

the Mill Creek campground area, as well as minor channel geometry adjustments following log jam removal and culvert replacements in the same area (Madej et al. 1986; Stillwater Sciences 2002). Stream cleaning or removal of large wood was routinely conducted in streams in the project area until as recently as 1992 (Verhey and Schwabe 1993). Surveys of large wood conducted by the Stimson Lumber Company in eight streams on their Mill Creek property during March 1997 showed wide variation in large wood abundance within and between different channel types. Large wood was generally most abundant in West Branch Mill Creek and least abundant in the Rock Creek drainage. Conifers, primarily redwoods, accounted for most in-channel large wood. More recently, wood loading efforts have focused on restoring the functional role large wood plays in forested mountain streams. In 2006 and 2008, CDPR constructed multiple large wood jams in East Fork Mill Creek with the intention to restore natural large wood instream processes, including pool formation, trapping and sorting sediment, and providing essential salmonid habitat (Benegar 2011; Flannery et al. 2017).

3.9.1.4 Soils

Soils in the project area are highly varied due to changes in parent material, slope position, and climate. Approximately 15 soil associations and soil series of varying slopes are identified in the project area (USDA NRCS 2008). In general, soils are predominantly derived from sandstone and mudstone and are deep and well drained. These soils tend to have loam to gravelly loam surface textures and gravelly clay loam subsoils. Management concerns with all the major soil units in the project area are seasonally saturated soil conditions, the potential for mass wasting on unstable slopes, and low soil strength. Approximately 75% of the project area, primarily located on valley hillslopes, has a severe erosion hazard rating (Merrill et al. 2011). Only the Bigtree-Mystery soil association, located on prominent floodplains along Mill Creek, lower East Fork Mill Creek, and lower West Branch Mill Creek, has a low erosion hazard rating (USDA NRCS 2008). Moderate erosion hazard ratings generally occur on ridgetops. On steep, highly dissected slopes, saturation is the most common cause of soil erosion and mass wasting. Erosion on undisturbed forested mountain slopes is infrequent. Thick organic layers and soil layers with abundant pore space allow rainwater to infiltrate into the soil. Soil erosion can occur when the organic and mineral surface layers are removed or compacted as a result of logging, road building, or other disturbances. Compaction and gullyng reduce the diffuse movement of water into soil and tend to increase surface runoff and erosion.

Some soils in the project area may contain NOA, which is primarily found in soil and sediment derived from bedrock containing serpentine minerals, although it can be associated with other rock types. The majority of the project area is underlain by Franciscan sedimentary rock units which do not pose an NOA threat (Figure 6). However, a few small areas along the very eastern margin of the project area are underlain by serpentine-bearing ultramafic rocks. Even if a project location is not underlain by serpentine-bearing bedrock, NOA could still be present because soils and sediment derived on serpentine hillslopes can be transported downslope by landsliding and fluvial transport in streams. Additionally, NOA could be present on roads surfaced with gravel mined from serpentine-bearing quarries. Approximately 4 miles of road in the project area have base rock sourced from serpentine-bearing quarries but are otherwise located outside of serpentine terrain (CDPR 2011a).

3.9.1.5 Erosion and Landsliding/Mass Wasting

As described above, the project area is geologically diverse and has varying degrees of landslide potential and slope failure modes, both natural and disturbance-induced. Figure 6 shows the general distribution of landslides throughout the project area. Previous efforts have conducted mass wasting

and erosion studies within the project area by analyzing aerial photographs from the 1950s to early 2000s, supplemented with field investigations (Stimson Lumber Company 1998; Pacific Watershed Associates 1996, 1997, 1998; Merrill et al. 2011).

Stimson Lumber Company found that the majority of slides (52%) occurred within deeply incised inner gorges. Inner gorge landslides were most common where: 1) sidecast fill from road and log landings had failed; 2) stream crossing structures failed catastrophically during high flows; and 3) clearcut units extended to the streambank. Inner gorge landslides were common along the entire length of Rock Creek where steep side slopes directly abut the channel. A smaller number of failures (16%) originated from hillslope hollows, the majority of which were associated with altered drainage patterns and failure of road fillslopes. Large, deep-seated landslides were mapped in the East Fork Mill Creek and Bummer Lake Creek sub-basins and along the eastern side of the Rock Creek basin.

Pacific Watershed Associates (1997, 1998) concluded that most future erosion and road-related sediment yield in the Mill Creek and Rock Creek watersheds was likely to come from three primary sources: 1) failure of road and landing sidecast fill; 2) erosion at or associated with stream crossings; and 3) road surface and ditch erosion.

Merrill et al. (2011) found that road fillslope failures had the highest occurrence of all failure events inventoried in their study. Due to their frequency, road fillslopes also accounted for the largest aggregate volume of failed material and the largest volume of delivered material. Landing fillslope failures accounted for the largest volume of material delivered to streams per event (an average of 1,063 cubic meters per event). The greatest delivery rates (total volume delivered divided by total volume failed) were exhibited by inner-gorge failures (75%) and landing fillslopes (62%). Merrill et al. (2011) concluded that their investigation indicates the majority of landslides in the Mill Creek and Rock Creek watersheds are road-related and that large storm events trigger marked increases in landslide activity.

3.9.2 Proposed Action Impacts

Would the project:		Less Than Significant Impact	No Impact
Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:			
Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.		<input type="checkbox"/>	<input checked="" type="checkbox"/>
Strong seismic groundshaking?		<input checked="" type="checkbox"/>	<input type="checkbox"/>
Seismic-related ground failure, including liquefaction?		<input checked="" type="checkbox"/>	<input type="checkbox"/>
Landslides?		<input checked="" type="checkbox"/>	<input type="checkbox"/>
b.	Result in substantial soil erosion or the loss of topsoil?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c.	Be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project and potentially result in an on-site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
d.	Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating direct or indirect substantial risks to life or property?	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Would the project:		Less Than Significant Impact	No Impact
e.	Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems in areas where sewers are not available for the disposal of wastewater?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f.	Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	<input checked="" type="checkbox"/>	<input type="checkbox"/>

A. There are no mapped Alquist-Priolo Earthquake Fault Zones within the project area. The Lost Man faults bisect the very southern extent of the project area and the Surpur Creek fault terminates just to the south of the project area. These faults are considered Quaternary, which means they have likely been active during the past 1.6 million years, but further refinement of the age of their last activity is undetermined. Faults with this undifferentiated age determination are not considered active under the Alquist-Priolo Earthquake Fault Zoning Act and the Proposed Action would have no impact.

Strong groundshaking could occur within the project area in the event of a large magnitude earthquake on a nearby fault. The Proposed Action, however, would not directly or indirectly cause substantial adverse effects, including the risk of loss, injury, or death, should a seismic event occur. Although those working on restoration components of the Proposed Action would be exposed to any event that might occur, the entire region is seismically active and lives with a risk of being exposed to groundshaking. The Proposed Action is specifically designed to avoid sites with potential hazards associated with strong groundshaking. Restoration actions would avoid unstable areas and certain substantial environmental events (e.g., new landsliding, nearby earthquakes, episodes of major precipitation, and wildfire) would trigger consultation and approval with a professional geologist before any treatment year (PSR-GEO-1 and PSR-GEO-2). Existing roads and landings proposed for reuse would be evaluated by an earth sciences/physical sciences professional who would provide necessary reconstruction and/or maintenance prescriptions (PSR-GEO-9). Seismic impacts associated with the Proposed Action would be less than significant.

Portions of the project area are underlain by alluvial deposits, primarily in valley floor locations, that are potentially susceptible to liquefaction. Alluvial deposits in the project area are typically well graded and contain coarse sands, gravels, and cobbles, which minimizes the chance for liquefaction to occur. However, in addition to implementing PSR-GEO-1 and PSR-GEO-9 (described above) as part of the Proposed Action, new landings would be constructed outside of geologically unstable areas and preferentially placed outside of stream buffers, reducing the exposure to sites potentially susceptible to liquefaction (PSR-GEO-6 and PSR-GEO-13). Liquefaction-related impacts associated with implementation of the Proposed Action would be less than significant.

Individual project components of the Proposed Action would be selected specifically to avoid areas with potential landslide hazards. In addition to implementing PSR-GEO-1, PSR-GEO-2, PSR-GEO-9, and PSR-GEO-13 (described above) as part of the Proposed Action, slope limitations for forest thinning operations would avoid potentially unstable steep hillslopes (PSR-GEO-3 and PSR-GEO-4). Winterization and seasonal-use requirements would prevent erosion and concentrated runoff that could initiate slope instability (PSR-GEO-5). Equipment operators at road construction and removal sites would minimize exposure to unstable slopes (PSR-GEO-10). Landslide-related impacts associated with implementation of the Proposed Action would be less than significant.

B. The Proposed Action includes a set of treatments to prevent erosion and control sediment. In addition to implementing PSR-GEO-2, PSR-GEO-3, PSR-GEO-9, PSR-GEO-10, and PSR-GEO-13 (described above) as part of the Proposed Action, winterization, seasonal-use requirements, and dispersing cut vegetation across exposed soils would prevent erosion and concentrated runoff (PSR-GEO-5 and PSR-GEO-7). Yarding would be restricted to using equipment capable of one-end log suspension to reduce ground surface disturbance (PSR-GEO-8). Erosion prevention and sediment control measures would be implemented on skid trails and disturbed soils with the potential for erosion and sediment delivery to waterbodies, floodplains, and wetlands (PSR-GEO-11). In addition, road removal work included in the Proposed Action is specifically being implemented to address existing and future erosion related to legacy logging uses, resulting in an overall benefit related to soil erosion and topsoil loss. Impacts would be less than significant.

C. Project operations and locations would be selected to avoid unstable areas or areas that could become unstable as a result of the Proposed Action. Roads, landings, and skid trails would be maintained, upgraded, and constructed to engineering and geologic standards to ensure site stability. PSR-GEO-1, PSR-GEO-2, PSR-GEO-3, PSR-GEO-5, PSR-GEO-9, PSR-GEO-10, and PSR-GEO-12 (described above) would be implemented as part of the Proposed Action. Impacts on unstable areas associated with implementation of the Proposed Action would be less than significant.

D. Expansive soils do not present a substantial potential impact due to the types of soils found within the project area. Additionally, most Proposed Action operations would not be susceptible to effects related to expansive soils. Any potential effects related to expansive soils are most relevant to footings for culvert and bridge structures. Any ground surface cracks or evidence of disrepair related to expansive soils would be evaluated by an earth sciences/physical sciences professional who would provide any necessary reconstruction or maintenance prescriptions (PSR-GEO-9.) Bridge crossings would be designed by a California-licensed professional engineer (PSR-HYDRO-7). Impacts related to expansive soils associated with implementation of the Proposed Action would be less than significant.

E. The Proposed Action does not include the use of septic or wastewater disposal systems. There would be no impact.

F. There are no known unique paleontological or unique geologic features in the project area. Any unique geologic features would be detected during site-specific geologic investigations. If unique paleontological or geologic features were detected during future surveys, adverse impacts to these resources would be unlikely because the Proposed Action generally would not include any disturbance of bedrock. Any identified potential impacts would be avoided during site-specific design. Impacts would be less than significant.

Cumulative Impacts. Historical forest management practices (clearcut tractor logging, road building, and minimal road maintenance) have had substantial direct adverse effects on soils and led to erosion. The Proposed Action includes treatments to prevent erosion and control sediment transport. Combined with other past, present, and future forest restoration and maintenance activities, the Proposed Action would address restoration of natural systems. In addition, it would not increase exposure of people or structures to loss, injury, or death for seismic or other geological events. The Proposed Action would not result in cumulatively considerable impacts.

3.9.3 No Action Alternative Impacts

Under the No Action Alternative, there would be no new impacts on geology and soils resources because there would be no new forestry and aquatic restoration. However, eroding soils, unstable hillslopes, and degraded aquatic habitats as a result of past logging would continue to persist and represent a significant impact under the No Action Alternative as compared to the Proposed Action, under which geology and soils resources effects due to past forest management practices would be reduced and, in some cases, reversed.

3.10 Greenhouse Gas Emissions

3.10.1 Existing Conditions

Global climate change results from greenhouse gas (GHG) emissions caused by several activities, including fossil fuel combustion, deforestation, and land use change. GHGs play a critical role in the Earth's radiation budget by trapping infrared radiation emitted from the Earth's surface, which otherwise escapes to space. The most prominent GHGs contributing to this process include carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). Certain refrigerants, including chlorofluorocarbons, hydrochlorofluorocarbons, and hydrofluorocarbons, also contribute to climate change. The greenhouse effect keeps the Earth's atmosphere near the surface warmer than it would be otherwise and allows for successful habitation by humans and other forms of life.

Recent environmental changes linked to climate change include rising temperatures, shrinking glaciers, thawing permafrost, a lengthened growing season, and shifts in plant and animal ranges (IPCC 1995; Melillo et. al 2014; CCCC 2012). Predictions of long-term negative environmental impacts in California include worsening of air quality problems, a reduction in municipal water supply from the Sierra snowpack, sea level rise, an increase in wild fires, increased periods of drought, damage to marine and terrestrial ecosystems, and an increase in the incidence of infectious diseases, asthma, and other human health problems (CCCC 2012).

GHG emissions in California are regulated under several state-wide measures, most prominently the California Global Warming Solutions Act of 2006, widely known as Assembly Bill (AB) 32, which require CARB to develop and enforce regulations for the reporting and verification of statewide GHG emissions and sets limits on state emissions. Specific to CDPR, and under AB 32, the Forest Climate Action Team (FCAT) was assembled in August 2014. FCAT is comprised of executive-level members from many of the state's natural resources agencies, state and federal forest land managers, and other key partners directly or indirectly involved in California forestry. On May 10, 2018, the Forest Carbon Plan was released (FCAT 2018). This document outlines a detailed implementation plan for the forest carbon goals embodied in the 2030 Target Scoping Plan Update through *California's 2017 Climate Change Scoping Plan* (CARB 2017).

3.10.2 Proposed Action Impacts

Would the project:		Less Than Significant Impact	No Impact
a.	Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b.	Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

A. The Proposed Action would result in GHG emissions from implementation activities involving use of diesel- and gas-powered equipment, forest thinning, and controlled burning techniques. However, the goals of the Proposed Action are to rehabilitate the project area and restore ecosystem processes that have been degraded by historical land use activities, which would increase carbon sequestration. In general, old-growth forests store more carbon than young-growth forests (Busing and Fujimori 2005; IPCC 2000) with the ancient coast redwood forests of RNSP storing more carbon than all other forest ecosystems. For example, the redwood forest on the slopes of Jedediah Smith Redwoods State Park boasts the highest aboveground carbon storage ever recorded (more than 2,500 metric tons of carbon per hectare). The higher sequestration rates found in redwood forests are made possible by several factors, including the mass and longevity of redwood trees, which bind large amounts of carbon; widely-spaced, large redwood trees maintain deep crowns full of leaves while also providing room on the forest floor for smaller trees and understory vegetation to thrive; and the fact that carbon stays bound in the persistent heartwood of fallen logs which resist decay for hundreds, if not thousands, of years. These factors result in record-breaking forest productivity and carbon storage (Van Pelt et al. 2016). The limited resource availability in these forests (e.g., water and sunlight) stunts growth and reduces annual carbon sequestration. Disturbance events, such as fire, drought, and insects and diseases, accelerate tree loss, which releases stored carbon back to the atmosphere over several decades through decay. Forest restoration would lead to a more diverse, resilient, and robust ecosystem that can offset implementation emissions, store carbon, resist insect disease, and decrease the risk of accelerated carbon loss through severe fires. While fire is a natural process in California, the incidence of large wildfires and the duration of the wildfire season across much of the United States has increased in part due to warming trends, dry, drought-affected landscapes, and lower fuel moisture associated with climate change (USGS 2018). Rehabilitation of these functions would decrease the incidence and severity of forest fires, which release mass amounts of carbon into the environment. Impacts would be less than significant.

B. As discussed in the response to Question A, the Proposed Action would likely reduce carbon emissions by increasing carbon sequestration rates region-wide and therefore would not conflict with an applicable plan, policy, or regulation adopted for reducing the emissions of GHGs. The Proposed Action is consistent with the California Forest Carbon Plan (FCAT 2018). There would be no impact.

Cumulative Impacts. Any GHG emissions released by the projects listed in Section 3.1.3 would be additive because of the nature of climate change. Development projects would be required to perform their own analysis of associated GHG impacts, including development of mitigation measures to address these impacts, if required. The Proposed Action's GHG emissions would be limited to during implementation and would represent a less-than-significant cumulative contribution to climate change because the Proposed Action would likely result in a net decrease in GHG emissions in the long term through sequestration. The Proposed Action would result in a more dynamic forest that would be more capable of storing larger amounts of carbon in a shorter period than if the restoration were not to occur. The Proposed Action would not result in a substantial cumulative contribution to GHG emissions.

3.10.3 No Action Alternative Impacts

The No Action Alternative would not result in short-term GHG emissions from implementation activities. However, the No Action Alternative has the potential to result in long-term and sustained

impacts to regional climate change because the forests would not benefit from management techniques that lead to development of old-growth forest characteristics, including the ability to store more carbon at a faster rate and help reduce the incidence and severity of fires, and thereby decrease release of GHG emissions.

3.11 Hazards and Hazardous Materials

3.11.1 Existing Conditions

Hazards are potential risks to public safety and the environment related to hazardous materials, airports, emergency response and evacuation plans, and wildland fire. Hazardous materials include all flammable, reactive, corrosive, or toxic substances, which pose potential harm to the public or environment because of these properties. No fuel storage facilities currently exist within or adjacent to the project area.

The nearest public use airport is approximately 7 miles northwest of the project area in Crescent City. There are no private air strips in Del Norte County. The nearest school (Joe Hamilton Elementary School in Crescent City) is located approximately 5 miles west of the project area.

Physical hazards in the project area are similar to any outdoor setting and include steep slopes, rushing water, poisonous plants, wild animals, disease-carrying insects, and inclement weather. A potential emergency route around Last Chance Grade (Highway 101, between Wilson Creek and Crescent City [mileposts 12.0 to 15.5]) would run through a portion of the project area in the event that the existing route fails though this route would require construction prior to use. The emergency route would start in the southeast portion of the project area and then run up to the northwest portion. The project area is in a remote portion of Del Norte County and transportation to the nearest hospital would require 1 hour of driving time from some locations. Helicopter landing locations have been identified and geo-referenced throughout RNSP and could be used to evacuate personnel in an emergency.

Cal Fire lists the fire hazard severity for the watershed as mostly Very High, High, and Moderate (Cal Fire 2006). The CDPR lands in the project area are State Responsibility Areas and the NPS lands are Federal Responsibility Areas in the event of a fire.

The California Department of Environmental Protection has the responsibility for compiling information on hazardous material sites in California that together are known as the Cortese list, pursuant to California Government Code Section 65962.5. A review of these lists found no known hazardous materials sites in the project area (CalEPA 2018).

As noted in Section 3.9.1.4, some of the roads and treatment locations in the northeast side of the project area may contain serpentine soils or roads may be capped with serpentine-containing gravel. Serpentine soils can contain NOA minerals that occur as asbestiform fibers. The fibers in rock can become airborne, and therefore a potential health risk, when disturbed.

3.11.2 Proposed Action Impacts

		Less Than Significant Impact	No Impact
Would the project:			
a.	Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Would the project:		Less Than Significant Impact	No Impact
b.	Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c.	Emit hazardous emissions or involve handling hazardous or acutely hazardous materials, substances, or waste within 0.25 mile of an existing or proposed school?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d.	Be located on a site that is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e.	Be located within an airport land use plan area or, where such a plan has not been adopted, be within 2 miles of a public airport or public use airport, and result in a safety hazard or excessive noise for people residing or working in the project area?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f.	Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
g.	Expose people or structures, either directly or indirectly, to a significant risk of loss, injury, or death involving wildland fires?	<input checked="" type="checkbox"/>	<input type="checkbox"/>

A. The Proposed Action would require the use of certain potentially hazardous materials such as fuels, oils, or other fluids associated with the operation and maintenance of equipment and vehicles. These materials would generally be contained within vessels engineered for safe storage. CDPR and NPS employees and contractors would be driving to and from the project area transporting potentially hazardous materials such as fuels, oils, or other fluids associated with the operation and maintenance of vehicles and equipment. Spills, upsets, or other operational accidents could result in release of fuel or other hazardous substances into the environment. However, as part of the Proposed Action, decontamination of heavy equipment would occur prior to delivery onto park lands (SPR-HYDRO-3); all equipment would be stored, serviced, and fueled at least 150 feet from any stream channel and 50 feet outside of riparian areas and away from unstable slopes and all primary fuel storage containers (fuel tankers) would have secondary containment (SPR-HAZ-1); and spill prevention, monitoring, and response activities would occur (PSR-HAZ-2).

Some of the roads and treatment locations in the northeast side of the project area may contain serpentine soils or roads may be capped with serpentine-containing gravel. Serpentine soils can contain NOA minerals, some of which pose a hazard to human health. The closest sensitive receptors are residents in the Bertsch-Oceanview community neighborhood located 0.5 mile from the northwest border of the project area. However, all implementation activities would occur at least 1 mile from residential receptors. Sensitive receptors could also include park visitors using hiking, biking, and equestrian trails or campground. However, areas of active implementation would be closed to the public and a closure order specifying closure dates would be posted on all sections of public trail where forest treatment operations are being conducted. The closure would also be noticed in a news release and update on both the RNP and CDPR websites. For areas where implementation activities are taking place, but not adjacent to the public use trail, a closure order would be posted for added safety. While workers are not generally considered sensitive receptors, the potential for asbestos exposure from serpentine roads was also considered. As noted above, the Proposed Action would include notifications to workers during NOA soil watering (PSR-HAZ-9), which would further protect any sensitive receptor and workers by limiting the amount of dust exposure.

Based on the above discussion, implementation of the Proposed Action would have less-than-significant impacts related to the routine transport, use, or disposal of hazardous materials.

B. During implementation of the Proposed Action, hazardous substances could be released to the environment from vehicle or equipment fluid spills or leaks, or through the presence of fugitive dust containing asbestos minerals. However, as part of the Proposed Action, if there is a discovery of unknown spillage from or free product discovered on or adjacent to the project sites, work would be halted or diverted from the immediate vicinity of the find, and the RNSP hazardous materials coordinator would be contacted (SPR-HAZ-8). Hazardous materials, if present, would be contained and removed from the site prior to resuming work. Additionally, prior to any ground disturbance in a unit located in serpentinitic soils, or vehicle or equipment travel on road either constructed through, or rocked with NOA gravel, as identified in the WMP (CDPR 2011a), the ground would be sufficiently wetted to prevent fugitive dust emissions consistent with the requirements of PSR-AIR-5. These measures would reduce the potential for asbestos exposure. Impacts related to implementation of the Proposed Action to on-site workers and the public would be less than significant.

C. There are no schools or proposed schools within 0.25 mile of the project area. There would be no impact.

D. The project area is not included on a list of hazardous materials sites compiled pursuant to California Government Code Section 65962.5. There would be no impact.

E. The project site is not located within 2 miles of a public use airport or private airstrip and would not result in a safety hazard related to airport use. There would be no impact.

F. Implementation activities associated with the Proposed Action would not interfere with an adopted emergency response plan or emergency evacuation plan. The only identified emergency route in the project area is a potential emergency route around Last Chance Grade that would run through the northwestern portion of the project area in the event that the existing route fails. This route would require construction prior to use. The Proposed Action has been designed to avoid conflicts with the potential emergency route. Impacts would be less than significant.

G. One of the objectives of the Proposed Action is to promote fire-resistant stands while avoiding problems with heavy thinning such as a prolonged increase in fire danger due to increased fuel loads and microclimate changes. A detailed analysis of the potential impacts of the Proposed Action related to wildfires is presented in Section 3.18. Through thinning the forest stands in the project area, the Proposed Action would reduce the potential risk of wildfire and reduce exposure of the public to pollutant concentrations or the uncontrolled spread of wildfires. As part of the Proposed Action, implementation of equipment requirements for spark arrestors and fire extinguishers (PSR-HAZ-3), vehicle parking restrictions (SPR-HAZ-4), radio dispatch requirements in case of fire (SPR-HAZ-5), road access requirements (PSR-HAZ-6), fire hazard reduction requirements (PSR-HAZ-7), and burning specifications (PSR-HAZ-10) are included. Impacts associated with exposing people or structures to wildland fires would be less than significant.

Cumulative Impacts. The Proposed Action would not result in significant impacts associated with hazards or hazardous materials. Several of the projects listed in Section 3.1.3 may include the use, transport, and disposal of hazardous materials. For these projects, potential impacts from hazardous materials on site would likely be localized, and any transport or disposal of materials would occur per federal, state, and local regulations. Implementation of the Proposed Action, cumulatively combined

with other related past, present, or probable future projects, would not result in substantial cumulative adverse effects related to hazards and hazardous materials.

3.11.3 No Action Alternative Impacts

Under the No Action Alternative, there would be no change in transport or use of hazardous materials, or emergency response, as compared to existing conditions. Compared to the Proposed Action, there may be fewer impacts because fewer vehicles and pieces of equipment would be operating in the area, reducing the risk of accidental discharge.

3.12 Hydrology and Water Quality

3.12.1 Existing Conditions

Cool, wet winters and warm, dry summers with frequent coastal fog characterize the Mediterranean climate of northern California and the project area. The fog belt extends to Rattlesnake Ridge along the eastern edge of the property, approximately 8 miles inland. Less fog and more variable seasonal and diurnal temperatures correspond with increasing distance from the coast. Most precipitation falls as rain during the winter months, although small accumulations of snow are not uncommon at higher elevations. Stillwater Sciences (2002) reported mean annual precipitation in the project area ranging from approximately 60 to 150 inches.

Historical floods of significance most recently occurred in northwestern California in 1997 and 1998. The 1997 flood, which was the most damaging event since 1975, had a 12-year recurrence interval in Redwood Creek, approximately 25 miles south of the project area. Six floods with long-term recurrence intervals of approximately 25 years occurred in Redwood Creek during a particularly active flood period between 1953 and 1975 (Harden 1995). The Smith River, downstream from the project area, had major floods in 1955, 1964, 1972, and 1975. The largest of these floods, in December 1955 and December 1964, had respective long-term average recurrence intervals of 25 to 30 years and 45 to 50 years. At least five floods comparable to those from the period from 1953 through 1975 occurred between 1861 and 1890, but caused less damage because the landscape was less developed during that time (Harden 1995). Madej et al. (1986) report that the Mill Creek and Smith River hydrographs are similar but that the Smith River has a higher runoff per unit area.

Water quality in the project area ranges from extremely clear and free of any pollutants in streams that drain from old-growth forests, to turbid and poor quality in areas previously impacted by road construction and previous commercial forest management. However, while there are short duration spikes in turbidity during storm events, the overall water quality is among the best in Northern California (CDPR 2011a).

Sediment transport data collected by USGS (from water years 1975 through 1981) for the mainstem of Mill Creek was synthesized by Madej et al. (1986), who reported that the total average sediment yield was 400 tons per cubic mile. Of the total load, 60% was reported to be suspended sediment, 30% dissolved load, and 10% bedload. Annual suspended sediment yields ranged between 11 and 528 tons per cubic mile; a mean annual suspended sediment yield of 200 tons per cubic mile resulted from the period of record during industrial timber operations (CDPR 2011a).

Stillwater Sciences (2002; Winzler and Kelly 1980) estimated the annual average suspended sediment concentrations recorded between 1973 and 1980 during the industrial logging period. According to

Stillwater Sciences, Rock Creek had suspended sediment concentrations ranging from 0.1 to 74.4 milligrams per liter (mg/L) upstream from logging operations and from 2.5 to 142.3 mg/L downstream. East Fork concentrations ranged from 1.1 to 37.6 mg/L, West Branch concentrations ranged from 1.2 to 15.3 mg/L, and mainstem Mill Creek concentrations ranged from 3.8 to 40.9 mg/L (CDPR 2011a).

Water temperature data have been collected at various sites on or near the project area since 1973 (CDPR 2011a). In general, the highest temperatures were recorded in lower Rock Creek and the lower mainstem of Mill Creek. Stillwater Sciences (2002) reported that peak water temperatures in Rock Creek and Mill Creek ranged from 18°C to 21°C at various sites during summer sampling between 1973 and 1980. Data collected by Stimson and reported in Stillwater Sciences indicate that peak summer water temperatures in 1996 ranged from 16.2°C in the headwaters of Turwar Creek to 24.4°C in lower Rock Creek. Data were also collected in the West Branch near the campground and at the mouth of Mill Creek (reported in Stillwater Sciences [2002]) during July and August 2000 and between June and October 2001. RNSP staff also collected data near the campground during the summers of 2006 through 2009. Minimum temperatures reported were 10.8°C in the West Branch and 10.2°C at the mouth of Mill Creek. Maximum temperatures reported were 17.0°C in the West Branch and 19.4°C at the mouth of Mill Creek (CDPR 2011a). Maximum weekly average temperatures at the Mill Creek Campground ranged from 13.9°C to 15.3°C between 2000 and 2009, which are well within target criteria (below 16.8°C) for Coho salmon.

Dissolved oxygen concentrations likely remain near saturation in most of the Mill Creek drainage, except during periods of low flow (Bradford and Iwatsubo 1978, Stimson Lumber Company 1998, Winzler and Kelly 1980). Even during periods of seasonally low flows, dissolved oxygen concentrations are reported to remain above the 7 mg/L threshold currently set as a specific water quality objective for streams in the Smith River hydrological unit (NCRWQCB 2011). The mean dissolved oxygen concentration of 188 samples taken during 1975 and 1976 was 9.59 mg/L and ranged between 6.3 and 12.1 mg/L (CDPR 2011a).

Groundwater in the project area is relatively free of pollutants and considered very high quality because very few potential pollution sources exist. The groundwater table in the project area fluctuates annually, depending on rainfall and seasonal temperatures. The groundwater table varies throughout the area because of the geological or topographical influences. The area does not serve to recharge commercially available aquifers. According to the California State Water Board's well tracking website (SWRCB 2019), there are no private water sources in the project area.

In 2006 and 2007, CDPR developed production and monitoring wells in the alluvial floodplain that underlies the Mill Creek Campground. An additional monitoring well was advanced in the alluvial floodplain downstream from the campground. The wells within reasonable proximity to the West Branch are generally highly productive and respond quickly to rainfall. One of these production wells, located approximately 120 feet from the creek, serves the campground. This well is 30 feet deep, has a production rate of 80 gallons per minute, and a static water level of 8 feet below ground surface (DWR 2006). Other wells were drilled into bedrock but proved to be unproductive (CDPR 2011a).

3.12.2 Proposed Action Impacts

Would the project:		Less Than Significant Impact	No Impact
a.	Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b.	Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c.	Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner that would:		
	i. Result in substantial erosion or siltation on site or off site?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	ii. Substantially increase the rate or amount of surface runoff in a manner that would result in flooding on site or off site?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	iii. Create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	iv. Impede or redirect flood flows?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d.	In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
e.	Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

A. The Proposed Action is required to comply with all applicable water quality standards and waste discharge requirements. NPS and CDPD would comply with all permits and approvals noted in Section 1.8, which would specify monitoring and compliance criteria for managing water quality throughout implementation of the Proposed Action.

The Proposed Action is designed to provide long-term benefits to instream habitats and water quality. Reestablishing the natural drainage networks and reducing sediment delivery along the road system that would be subject to restoration would provide long-term benefits to water quality. For forest thinning activities, the Proposed Action includes streamside protection zones (PSR-HYDRO-1) in which no heavy equipment would be permitted and prohibits heavy equipment from operating on slopes greater than 40% (PSR-GEO-3), except for cable-assisted equipment (e.g., tethered harvesters and forwarders), which would be allowed on slopes up to 85% as long as the equipment stays on designated trails covered with a minimum of 6 inches of slash and operations within the riparian management zone are restricted as detailed in Table 3 (PSR-GEO-4). In addition, short-term sediment discharge is managed by the inclusion of streamside and wetland buffers and prescriptions (PSR-HYDRO-1), avoidance of trees contributing to streambank stability (PSR-HYDRO-12), and timing restrictions on road reconstruction and/or removal (PSR-HYDRO-5). The potential for sediment-related effects on water quality would be less than significant.

The Proposed Action would thin trees within riparian areas to promote the development of late successional conditions (e.g., taller trees with greater canopy complexity) at a more rapid rate than is currently occurring. This would improve the ability of the riparian area to provide cool microclimates to area streams would improve at a more rapid rate than if treatments were not conducted. The potential for short-term increases in water temperature is minor because the Proposed Action includes retention of a minimum of 60% to 80% of canopy cover adjacent to perennial streams

(PSR-HYDRO-1). The potential for water temperature-related effects on water quality would be less than significant.

B. The Proposed Action does not include activities that require direct (i.e., well) use of groundwater, therefore, would not substantially decrease groundwater supplies or interfere substantially with groundwater recharge. Reducing tree densities may slightly decrease water uptake, allowing an increase in water available for groundwater recharge, but the effect would be short term and negligible. The impact of the project on groundwater supplies or the ability to sustainably manage groundwater would be less than significant.

C.i. The Proposed Action does not include the installation of impervious surfaces. The Proposed Action would remove approximately 59 miles of road and 191 stream crossings. These roads also contain inboard ditches and cross drains, which alter the natural drainage patterns of the project area. Approximately 2.5 miles of temporary roads may need to be constructed to access restoration areas. The 2.5 miles of temporary roads would all be constructed on upper slopes, outside of all intermittent and larger drainages, and would be designed for dry season use only. Once thinning treatments are completed in specific areas, the project roads, crossings, cross drains, and other impediments to drainage patterns in the project area would be removed, which would help return the area hydrography to a more natural system and reduce the potential for chronic and catastrophic erosion and sediment delivery to streams.

There is the potential for the newly completed forest treatment and road removal areas to experience minimal erosion and sediment delivery during the recovery phase. The Proposed Action includes timing restrictions for road reconstruction and/or removal (PSR-HYDRO-5), in-water work area isolation requirements (PSR-HYDRO-6), drainage structure and stream crossing maintenance requirements (PSR-HYDRO-7), and erosion control adjacent to stream channels (PSR-HYDRO-8). Impacts on existing drainage patterns, erosion, and siltation would be less than significant.

C.ii. The road surfaces, stream crossings, numerous inboard ditches, and cross drains have altered surface runoff patterns in the project area. The hydrologic connections created by the road system has effectively increased peak flows in the affected area by allowing for a more rapid runoff pattern than under the natural condition. All new roads would be constructed upslope and outside of intermittent and permanent drainages. Any upgraded roads needed to access thinning areas would be upgraded to current standards (e.g., 100-year flood return interval culvert sizes, outsloping, cross-drains, and rolling dips), which would reduce the hydrologic connectivity and potential for concentrated surface runoff (PSR-GEO-5). The Proposed Action would conduct road and crossing removal upon completion of thinning operations to return drainage patterns back to a natural condition. The forest thinning portion of the Proposed Action would require the reoccupation and occasional construction of skid trails on slopes less than 40% to remove logs. As part of the Proposed Action, cut vegetation would be spread and left on-site across skid trails and erosion control measures would be implemented on skid trails (PSR-GEO-11). Impacts of runoff-induced flooding would be less than significant.

C.iii. The Proposed Action would not create or contribute runoff water in amounts that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff. No stormwater systems are downslope from the project location and none are planned. There would be no impact on stormwater drainage systems.

C.iv. The Proposed Action would conduct road and stream crossing removal upon completion of thinning operations to return drainage patterns back to a natural condition. Any reoccupied roads needed to access thinning areas would implement current crossing standards (PSR-GEO-5). These activities would improve the ability of the project area to handle flood flows. The Proposed Action would require the installation of bridges; however, these bridges would fully span the creeks and not require encroachment into the channels. Full channel spanning bridges would not impede or redirect flood flows. There would be no negative impact on flood flows.

D. The Proposed Action's aquatic restoration activities are located in flood hazard zones, but not in tsunami or seiche zones. Aquatic restoration work would be conducted during the dry season, when flooding is unlikely to occur. All fueling and servicing of vehicles and equipment associated with the Proposed Action would occur at least 150 feet from any stream channel and 50 feet outside of riparian areas and away from unstable slopes (PSR-HAZ-1). The risk of release of pollutants due to inundation would be less than significant.

E. The Proposed Action involves restoration of forest land and aquatic resources. The Smith River is currently not on the Clean Water Act Section 303d list of impaired water bodies. The Proposed Action complies with the water quality standards and would continue to implement measures that are detailed in the Local Watershed Plan (CDPR 2011a) to reduce sediment delivery and other pollutants into Mill Creek streams. Implementation of the Proposed Action would have a long-term beneficial effect on water quality. The project area does not currently have a sustainable groundwater management plan. There would be no impact.

Cumulative Impacts. The cumulative adverse effects on hydrology, water quality, floodplains, and wetlands in and around the project area are related to past logging and road building practices, both within what is now RNSP land and upstream of current RNSP boundaries. The Proposed Action is designed to provide benefits to instream water quality and hydrology by repairing some of the damage caused by past projects and practices. Combined with other present and future forest restoration and maintenance activities, the Proposed Action would have a cumulative benefit to hydrology and water quality.

3.12.3 No Action Alternative Impacts

Under the No Action Alternative, CDPR and NPS could continue to treat forest stands, road systems, and riparian areas on a project-by-project basis as funding allowed. However, this approach would occur at a slower pace and would be fragmented as compared to the Proposed Action. Compared to the Proposed Action, the No Action Alternative would result in fewer short-term operations-related impacts on water quality, but would also maintain the current level of chronic legacy effects of pre-Park forest and road management actions on drainage patterns and hydrology in the project area. In addition, the risk of road system sediment delivery to streams and associated impacts on water quality would likely increase under the No Action Alternative as old culverts and substandard crossings fail at an increasing rate.

3.13 Land Use and Planning

3.13.1 Existing Conditions

The project area is in the DNCRSP and a portion of Redwood National Park, within the larger RNSP, in a non-populated area of Del Norte County, approximately 5 miles southeast of Crescent City. The

Bertsch-Oceanview community, an unincorporated census tract, is located along the north western border south of Crescent City. The project area is set away from any public roads and consists of unmaintained logging roads and skid trails, which are generally not accessible to vehicles. However, a public trail allows for hiking, biking, and equestrian use on an identified group of haul roads. DNCRSP is zoned for recreation in Del Norte County. DNCRSP aims to preserve outstanding natural, scenic, and cultural values; and indigenous aquatic and terrestrial fauna and flora; and to allow for recreational opportunities consistent with other uses (CDPR 2011b).

The RNSP GMP/GP (NPS/CDPR 1999) focuses on park establishment, cooperative management of park resources, and the visitor experience. Per the GMP/GP, the Park’s goals are to “preserve and protect the Parks’ resources... provide for the public enjoyment and visitor appreciation of the parks... [and] maintain collaborative relationships with gateway communities and local American Indian tribes.” Although the majority of the project area is generally not accessible to the public, current uses of adjacent park lands within the general vicinity of the project area include primarily passive recreational activities, such as hiking, picnicking, and observing nature.

3.13.2 Proposed Action Impacts

Would the project:		Less Than Significant Impact	No Impact
a.	Physically divide an established community?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b.	Cause a significant environmental impact due to conflict with any applicable land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

A. Implementation of the Proposed Action would not physically divide an established community, because no established communities exist within the boundaries of the project area. There would be no impact.

B. The Proposed Action would not conflict with any land use project, policy, or regulation of any agency adopted for the purpose of avoiding or mitigating an environmental effect. In general, the Proposed Action has been designed to meet a critical resource protection need and is in agreement with the GMP/GP (NPS/CDPR 1999), *Del Norte County General Plan* (Del Norte County 2003), and *Del Norte County Local Coastal Plan* (Del Norte County 1983), as well as all applicable state and local land use plans, policies, and regulations. The Proposed Action is also in compliance with all conservation plans, policies, and ordinances that apply to the project and/or surrounding areas. There would be no impact.

Cumulative Impacts. Historic forest management practices (clearcut tractor logging, road building, and minimal road maintenance) have had significant direct adverse effects on forested area, which has led to the development and implementation of zoning and habitat conservation plans. The Proposed Action is consistent with such land use and planning which seeks to protect forests and their resources. The Proposed Action would not result in cumulative effects when combined with other known present and future projects in the area.

3.13.3 No Action Alternative Impacts

There would be no potential impact to land use and planning under the No Action Alternative because this alternative would maintain existing land use and planning as they currently are. There

would be no change as compared to the Proposed Action because the Proposed Action would also not result in impacts to land use and planning.

3.14 Noise

3.14.1 Existing Conditions

The Proposed Action is located within a remote forested area in Del Norte County surrounded by mountains and the Pacific Ocean. The closest communities are Crescent City, located northwest of the DNCRSP, and the Bertsch-Oceanview community, located along the northwestern border of the DNCRSP. The closest sensitive receptors would be residents in the Bertsch-Oceanview community and could also include park visitors using hiking trails and campgrounds. Ambient natural noise is made up of bird songs (i.e., bird sounds that are melodious to the human ear), especially during the early morning hours, known as the dawn chorus. Human-generated noise associated with the project area results from RNSP vehicles on roads; occasional air traffic, including small private planes, Coast Guard helicopters, and Cal Fire firefighting aircraft; and limited timber felling activities. Local regulation of noise involves implementation of general plan policies and noise ordinance standards. Local general plans identify general principles intended to guide and influence development plans, while local noise ordinances establish standards and procedures for addressing specific noise sources and activities. Del Norte County does not have established noise ordinances.

3.14.2 Proposed Action Impacts

Would the project:		Less Than Significant Impact	No Impact
a.	Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in a local general plan or noise ordinance or applicable standards of other agencies?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b.	Generation of excessive groundborne vibration or groundborne noise levels?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c.	Be located within the vicinity of a private airstrip or an airport land use plan area, or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport and expose people residing or working in the Project area to excessive noise levels?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

A. Noise is a concern if it affects sensitive receptors. Proposed Action-related noise would only occur during implementation activities, which would temporarily increase ambient noise levels on an intermittent basis. Implementation-related noise levels would fluctuate depending on the level of work and the proximity of a receptor to the implementation area. While most of the activities would be located in parts of the project area which are not in the vicinity of any noise-sensitive human land uses, there may be limited activities that occur adjacent to residential areas. As noted above, the closest sensitive residential receptors are located in the Bertsch-Oceanview community neighborhood located 0.5 mile from the northwest border of the project area.

While there are no established County noise ordinance or standards for human receptors, noise standards in state and federal parks are guided by several laws, regulations, and policies, including NPS Director’s Order No. 47 and the Noise Control Act of 1972, which all aim to reduce human noise to the extent possible. Areas of active implementation would be closed to the public and a closure order specifying closure dates would be posted on all sections of public trail where implementation activities would be conducted. The closure would also be noticed in a news release and update on

both the NPS and CDPR websites. The Proposed Action also includes notification requirements to off-site noise-sensitive receptors (PSR-NOISE-1) and power equipment use and maintenance requirements (SPR-NOISE-2) to reduce noise levels from equipment and ensure human receptors are notified of intermittent implementation activities. Impacts would be less than significant.

B. Unless implementation activities using heavy equipment are conducted extremely close (within a few feet) to neighboring structures, vibrations from Proposed Action implementation activities are expected to rarely reach levels that damage structures. For example, heavy equipment (e.g., a large bulldozer) generates vibration levels of 0.089 inch per second peak particle velocity at a distance of 25 feet. Aside from old building associated with the former mill, there are no buildings in the project area. Implementation activities would not occur in the immediate vicinity of these buildings. There would be no impact.

C. The Proposed Action is not within an airport land use plan and is not within 2 miles of an airport or private airstrip. There would be no impact.

Cumulative Impacts. Combined with other past present and future forest restoration and maintenance activities, which include noise from implementation or logging equipment, the Proposed Action would contribute to overall ambient noise levels. However, noise from Proposed Action implementation activities would be short term. In addition, the long-term forest restoration actions would create healthier areas of natural forest to further muffle surrounding ambient sounds especially at park edges. The Proposed Action would not result in a substantial cumulative contribution to noise impacts.

3.14.3 No Action Alternative Impacts

As the No Action Alternative would not involve any implementation activities, there would be no impacts related to noise or vibration as compared to the Proposed Action. NPS and CDPR could continue some forest management on a project-by-project basis if funding allows, which could result in some noise from implementation activities, but less noise would be produced than under the Proposed Action.

3.15 Recreation

3.15.1 Existing Conditions

The project area is located within and adjacent to RNSP land supporting various recreational activities, namely hiking, biking and camping. RNSP recorded 536,000 visitors in 2016 (Cejnar 2017), up 100,000 from 2014 (Kemp 2016). Larger recreational areas observed within or near the project area include the Wilson Creek Day Use Area, Mill Creek Horse Trail Picnic Area, Mill Creek Vista Area, Mill Creek Campground, Damnation Creek Trailhead, Crescent City Vista Point, former Miller Rellim Mill, and DeMartin Campground. These areas include campgrounds, campsites, toilets, cabins, parking, picnic tables, and over 70 facility signs.

There are trails and a campground within the project area, but large portions of project area are relatively inaccessible and rarely used by visitors. Identified haul roads are currently being used as hiking, biking, and equestrian trails in the project area, but vehicle accessibility to the public is limited to the visitor entrance area.

3.15.2 Proposed Action Impacts

Would the project:		Less Than Significant Impact	No Impact
a.	Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b.	Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

A. In the short term, sections of some biking, hiking, and equestrian trails within the project area would be prohibited for public access during implementation activities associated with the Proposed Action, but these restrictions would only last for a temporary period (seasonally over a 2-to-4-year period). Other trails would still be accessible to the public during these temporary closures. In the long-term, ecosystem restoration activities, including forest thinning, would increase the aesthetic value of the park, thereby encouraging its recreational use, but not to a significant degree, because most of the project area is and would remain relatively inaccessible to and rarely used by visitors. The Proposed Action would have less-than-significant impacts on recreational parks and facilities.

B. The Proposed Action does not include or is not the type of activity (i.e., subdivision) that would result in the construction or expansion of any recreational facility. There would be no impact.

Cumulative Impacts. Historic forest management practices (clearcut tractor logging, road building, and minimal road maintenance) have limited some recreational activities because land that could potentially be used for recreation was off limits to the public. However, with the advent of the state and federal park systems, recreational opportunities in forested areas have increased. The Proposed Action would maintain the availability of recreational activities. Therefore, the Proposed Action would not result in cumulative effects when combined with other known present and future projects in the area.

3.15.3 No Action Alternative Impacts

As discussed, recreational opportunities are limited in the project area. While there would be no short-term impacts to bike trails under the No Action Alternative, there would also be no improvement to recreational resources through park enhancements as compared to the Proposed Action, although the recreational resource improvements of the Proposed Action would be limited.

3.16 Socioeconomics

3.16.1 Existing Conditions

The economies of the local and regional communities and neighborhoods have historically been reliant on the logging industry (NPS 2014). Intensive logging occurred from 1860 to the end of the 1960s, when Redwood National Park was established. The creation and expansion of the Park, the removal of most of the old-growth trees, and the enactment of laws protecting water quality and endangered species contributed to the decline of the logging industry as the principal source of income for Crescent City.

Today, Del Norte County ranks lower than the state average on indicators of socioeconomic status, including unemployment rate, education, poverty levels, and household and per capita incomes. The

percentage of persons living below the poverty threshold in Del Norte County is particularly high (23.2% in 2017 against a California average of 15.1%; USCB 2019a). According to the U.S. Census Bureau's 2012 Economic Census, health care and social assistance and retail trade are the sectors that employ most of the population of Del Norte County (USCB 2019b). Finally, Del Norte County's total population has been slowly decreasing over the past 7 years and is now approximately 27,000 people based on population estimates (USCB 2019c).

Crescent City specifically also ranks low on many socioeconomic indicators. It qualifies as a disadvantaged community, based upon median household incomes (USCB 2019d). According to the U.S. Census Bureau, 2012 Economic Census, health care and social assistance and retail trade are the sectors that employ most of the population of Del Norte County. Based on these statistics, the economy is service-based. According to the U.S. Census Bureau's 2013-2017 American Community Survey 5-Year Estimates and the 2010 Demographic census, Crescent City's population is declining: in 2010, the population was 7,643 (USCB 2019e), whereas in 2017, it was 6,399 (USCB 2019f).

3.16.2 Proposed Action Impacts

Under the Proposed Action, there would potentially be a positive impact to socioeconomics related to increased tourism, local employment, and purchased goods in the region. There could be positive long-term impacts on socioeconomics because improving the condition of the forest and aesthetic value could lead to more tourism and visitors coming and spending money in Crescent City. There could be an economic benefit to the local economy from contracted services, such as temporary and permanent local worker employment to complete the implementation activities, and from the purchase of materials and plantings, such as seeds and trees.

Cumulative Impacts. As discussed above, the historic forest industry was once a large and important part of the regional economy. Even if logging was not limited by laws and regulation, the industry may have decreased due to declining resources. The Proposed Action, in combination with other known present and future projects, as listed in Section 3.1.3, may contribute to an economic benefit to the local economy from contracted services, such as temporary local worker employment to implement the Proposed Action.

3.16.3 No Action Alternative Impacts

There would be no change to the local economy under the No Action Alternative because no implementation activities would be conducted; therefore, there would be no economic benefit to the local economy from contracted services, such as temporary local worker employment, and from the purchase of materials and plantings, such as seeds and trees. NPS and CDPR could continue some forest management on a project-by-project basis if funding allows, which could result in some economic benefits, but these would be less than under the Proposed Action. Impacts would be negligible because these services would not substantially affect the economy in the project area.

3.17 Transportation

3.17.1 Existing Conditions

The project area is located along U.S. Highway 101 in Del Norte County, which serves as the main north/south highway in the project area. U.S. Highway 101 is a two-lane highway at the main park entrance that is a designated truck highway and also serves as the Pacific Coast Bike Route (Caltrans 2017). Regional traffic and transportation resources are overseen by the Del Norte County

General Plan (Del Norte County 2003) which requires most roads to operate at a level of service (LOS) of C or better. The Plan also seeks to encourage bicycle ridership in the area. Traffic along U.S. Highway 101 is also addressed in *Caltrans District 1: US Route 101 Transportation Concept Report*, (Caltrans 2017) which requires an LOS of D or better (the segment of U.S. Highway 101 near the project area currently operates at LOS B).

The project area can be accessed by public vehicles traveling along U.S. Highway 101 at the main entrance at Hamilton Park Road with a secondary access at Mill Creek Campground. Numerous old dirt roads overgrown with vegetation historically connected U.S. Highway 101 with the project area.

The project area currently contains numerous miles of logging roads and associated skid trails that were built to facilitate timber extraction prior to the area's inclusion in the state and federal park systems. Most of these roads have been unmaintained and have eroded. There is also a system of publicly accessible trails for hiking, biking, and equestrian use as well as plans for future Coast-to-Crest trail.

3.17.2 Proposed Action Impacts

Would the project:		Less Than Significant Impact	No Impact
a.	Conflict with a program, plan, ordinance, or policy addressing the circulation system including transit, roadway, bicycle and pedestrian facilities?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b.	Conflict with or be inconsistent with CEQA Guidelines Section 15064.3, subdivision (b)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c.	Substantially increase hazards because of a geometric feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
d.	Result in inadequate emergency access?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

A. The Proposed Action would not affect public roadways in the long term because it would not affect park usage. During implementation, there would be periodic movement of heavy equipment and logs using U.S. Highway 101. These activities could result in up to approximately 30 trucks a day (based on similar projects in the area) spread throughout the day or an average of three trucks per hour. The trucks would primarily enter and exit the park at Hamilton Road but could also use other roadways. As these trips would be intermittent (a maximum of eight trucks per hour), the Proposed Action would not substantially increase the traffic on any public street system. In addition, the removal of existing roadways in the project area would not affect local or regional access as all roads slated for removal do not currently support any public access. The project area also includes hiking, biking, and equestrian trails. While there may be short-term periodic closures of sections of the trails, there would be no long-term changes to these trail systems. The Proposed Action would not conflict with program, plan, ordinance or policy addressing the circulation system, and impacts would be less than significant.

B. The Proposed Action would not cause additional long-term vehicle trips or change circulation patterns, and thereby would not increase vehicle miles traveled levels consistent with Section 15064.3(b) of the CEQA Guidelines. There would be no impact.

C. The Proposed Action does not contain a design feature or incompatible use that would substantially increase traffic hazards because it does not alter the public roadways systems. The current intersection at Hamilton Road is stop controlled and includes a turning lane to allow for safe traffic movements in and out of the park entrance. If other roadways are used to directly enter and

exit U.S. Highway 101, CDPR or NPS would coordinate with Caltrans as appropriate so impacts would be less than significant.

D. While the Proposed Action includes the removal of roadways that could potentially be used to access areas in the park in the case of an emergency such as a fire, all roads that would be removed as part of the Proposed Action have areas that already impede access, such as sections of washouts or blocks from landslides. The Proposed Action would not result in inadequate emergency access because it would not impact any roads that are currently open to public vehicle use or used for emergency access by park or other emergency vehicles. There would be no impact.

Cumulative Impacts. The Proposed Action would not affect roadways or transportation resources outside RNSP. No other projects in the past, present, or future are known or expected to have a negative or positive impact on transportation resources within RNSP.

3.17.3 No Action Alternative Impacts

The No Action Alternative would have no impact on transportation or traffic because it would not involve any implementation activities or change in existing conditions. Impacts would be similar to the Proposed Action because the project area includes limited public roadways and does not support public transit.

3.18 Wildfire

3.18.1 Existing Conditions

In 2007, Cal Fire's Fire and Resource Assessment Program developed fire hazard maps for each county in California (Cal Fire 2007). The maps included areas that fell under the responsibility of local, state, and federal governments. The Del Norte County fire hazard map (Figure 7) includes the project area and associated local, state, and federal responsibility areas. Within the project area, 1,523 acres were rated as having a moderate fire hazard; 16,927 acres had a high fire hazard; and 15,624 acres had a very high fire hazard rating. In general, the fire hazard rating increases with distance from the coast.

Woody surface fuels are classified into four categories based on how they respond to changes in atmospheric moisture (NRI 2004). This response time is referred to as time lag. The four categories are as follows: 1-hour fuels: up to 1/4 inch in diameter; 10-hour fuels: 1/4 inch to 1 inch in diameter; 100-hour fuels: 1 inch to 3 inches in diameter; and 1000-hour fuels: 3 inches to 8 inches in diameter.

In general, higher temperatures increase fire danger, but relative humidity and wind speed are the most important factors among the weather variables. As relative humidity drops, fuel moistures also decrease. One-hour fuels are most critical regarding fire starts, followed by 10-hour fuels due to their relatively short drying times. It is the 100-hour fuels that sustain fires once they start burning and provide the majority of the heat and flame intensity of fires. Other factors that can affect fire danger include slope, confinement, and tree spacing. In general, older forest stands with wider spacing between trees are likely less susceptible to stand-replacement fires than younger, densely-spaced stands. In addition, forests within the coastal fog belt have a higher moisture level and generally experience longer fire return intervals than interior areas.

3.18.2 Proposed Action Impacts

Would the project:		Less Than Significant Impact	No Impact
a.	Substantially impair an adopted emergency response plan or emergency evacuation plan?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b.	Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to pollutant concentrations from a wildfire or the uncontrolled spread of a wildfire?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c.	Require the installation or maintenance of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d.	Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes	<input checked="" type="checkbox"/>	<input type="checkbox"/>

A. Implementation activities associated with the Proposed Action would not impair an adopted emergency response plan or emergency evacuation plan. The only identified emergency route in the project area is a potential emergency route around Last Chance Grade (Highway 101, between Wilson Creek and Crescent City [mileposts 12.0 through 15.5]) though this route would require construction prior to use. The potential emergency route would start in the southeast portion and then run up to the northwest portion of the project area in the event that the existing route fails. The Proposed Action would avoid conflicts with the potential emergency route. Impacts would be less than significant.

B. The conifer stands in the former commercial timberlands in the project area are generally composed of densely spaced small- and medium-sized classes of trees. Vertical fuels have become more continuous, contributing to higher risk of canopy fires. The forests with high stand density have intertwined canopies (high canopy bulk density), allowing fire to spread easily from one tree to the next. Through thinning the forest stands in the project area, the Proposed Action would reduce the potential risk of high-intensity wildfires that are the hardest to control and reduce exposure of the public to pollutant concentrations or the uncontrolled spread of wildfires. During forest thinning activities and manual removal of invasive species, trees may also be removed to reduce fuel loads and control fire in strategic locations, such as along roads and ridgetops.

One aspect of the Proposed Action (forest thinning) would increase short-term fuels on the forest floor after operations. These low fuels would have the potential for ignition and sustainable fire prior to full decomposition. Depending on ambient moisture conditions, lop-and-scatter fuels could increase fire intensity and make control of fire spread more difficult in the short term (Keyes and Varner 2006). One study found an increased fire risk for about 1 year following operations (Jacobson and Dicus 2006), while another found elevated fine fuels for 7 years (Glebocki 2015). Another study within the project area has shown slash depth to be reduced by 50% to 66% in 4 years after treatment (O'Hara et al. 2010) with the fine fuels (those that most affect rates of spread) decaying first. The risk of rapid wildfire spread from the ground to canopy would abate by controlling fuel depth (PSR-HAZ 9) and retention of at least 60% canopy that slows drying, speeds up decomposition and blocks wind. Thinning conducted using lop and scatter or other methods removes mid-level fuel ladders and the vertical continuity of fuels that can result in ground fires reaching the forest crown layer. Thinning can therefore minimize the potential for crown fires by increasing canopy base height

and lowering canopy bulk density. Fire hazard reduction requirements (PSR-HAZ-7) would be implemented to increase the rate of decay of thinning slash and debris to reduce the time the 1-hour and 10-hour fuels are available for ignition. In addition, the Proposed Action includes the use of mastication, which is the process of grinding, shredding, chipping, or otherwise reducing the size of live or dead vegetation to expedite decomposition and alter fire behavior. Mastication may be used along roads, ridgelines, and strategic locations to reduce loads. As part of the Proposed Action, any burn piles would be managed in accordance with PSR-HAZ-10. Finally, the removal of roads associated with the Proposed Action would reduce public use of restored areas and the risk of anthropogenic fire starts. Impacts would be less than significant.

C. The Proposed Action would not require the installation of additional infrastructure. The Proposed Action would result in the removal of roads upon completion of the vegetation management and aquatic restoration activities. Existing access roads required for maintenance of power lines or other utilities would be retained; no new permanent access roads would be required. The Proposed Action would result in no impact.

D. The project area does not contain residential development. However, near the Park entrance there are scattered buildings that are used to serve park staff and portable toilets that are used by the public visiting the project area. The Proposed Action would reduce the potential risk of high-intensity crown fires through forest treatments. In addition, the removal of roads and reestablishment of the natural hydrological patterns in the watershed would reduce risks associated with runoff, post-fire slope instability, or drainage changes. The Proposed Action would result in a less-than-significant impact.

Cumulative Impacts. Through thinning the forest stands in the project area, the Proposed Action would reduce the long-term risk of high-intensity crown fires that are difficult to control and reduce exposure of the public to pollutant concentrations or the uncontrolled spread of wildfires. Previous forest thinning projects and additional forest thinning projects that could occur as part of the Redwoods Rising partnership would also reduce the potential risk of catastrophic wildfire within RNSP. Short-term surface fuel hazards associated with slash reduction treatments would be abated over short time intervals (less than 5 to 7 years) as fuels decompose in the coastal environment. In addition, fires in the redwood zone are rare due to the lack of ignition sources and high humidity, so even with the increase of short-term fuel hazards there is a low probability of wildfire. Therefore, the Proposed Action, when combined with future actions in the region, would result in a cumulative net benefit in terms of wildfire risk.

3.18.3 No Action Alternative Impacts

The No Action Alternative would result in no short-term operations-related impacts on wildlife resources that could increase wildfire potential (i.e., lop and scatter operations would not occur). However, the No Action Alternative would also maintain, and thus not reduce, the current level of wildfire risk in the project area.

3.19 Mandatory Findings of Significance

This section pertains to CDPR's CEQA review and anticipated issuance of a ND. It does not apply to or prevent the anticipated NPS NEPA decision to issue a FONSI for the Proposed Action.

Would the project:		Less Than Significant Impact	No Impact
a.	Have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b.	Have impacts that are individually limited but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c.	Have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?	<input checked="" type="checkbox"/>	<input type="checkbox"/>

A. Based on the analysis presented in the preceding sections, the Proposed Action would have either less-than-significant or no impacts on the environment. The Proposed Action does not have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory. Impacts would be less than significant.

B. The Proposed Action is designed to result in improved habitat quality, rehabilitate the GMC area, and restore ecosystem processes that have been degraded by historical land use. For these reasons, the Proposed Action, when combined with past actions in the region, would not result in cumulatively considerable impacts. Combined with other present and future forest restoration and maintenance activities, the Proposed Action would have a cumulative benefit. Impacts would therefore be considered less than significant.

C. The Proposed Action would occur in remote areas where the public has limited access and would therefore have no substantial adverse impacts on humans. Impacts would be less than significant.

3.19.1 No Action Alternative Impacts

The No Action Alternative would not include actions to improve habitat quality, rehabilitate the GMC area, and restore ecosystem processes that have been degraded by historical land use. NPS and CDPR could continue to treat forest stands on a project-by-project basis as funding allows but such an approach would be fragmented and occur over smaller areas as compared to the Proposed Action. Therefore, as compared to the Proposed Action, the No Action Alternative would have a long-term negative impact on biological and forestry resources, as well as hydrology and water quality. In addition, the No Action Alternative would have reduced impacts on aesthetics, air quality, GHG, and geology and soils as compared to the Proposed Action.

Appendix A

Abbreviations

Appendix A: Abbreviations

AB	Assembly Bill
BACT	Best Available Control Technologies
Basin	North Coast Air Basin
BMP	best management practice
BO	Biological Opinion
CAAQS	California ambient air quality standards
Cal Fire	California Department of Forestry and Fire Protection
CARB	California Air Resources Board
CCC	California Coastal Commission
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CDPR	California Department of Parks and Recreation
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CH ₄	methane
CNDDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CO ₂	carbon dioxide
CRHR	California Register of Historical Resources
CWA	Clean Water Act
DBH	diameter at breast height
DNCRSP	Del Norte Coast Redwoods State Park
DPS	distinct population segment
EA	Environmental Assessment
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESF	Environmental Screening Form
ESU	evolutionarily significant unit
FCAT	Forest Climate Action Team
FERPP	Forest Ecosystem Restoration and Protection Project
FONSI	Finding of No Significant Impact
GHG	greenhouse gas
GMC	Greater Mill Creek
GMP	general management plan

GP	general plan
GPC	Greater Prairie Creek
IS	Initial Study
LOS	level of service
LSEP	Landscape Stabilization and Erosion Prevention Plan
MCA	Mill Creek Addition
mg/L	milligrams per liter
MLD	Most Likely Descendant
MND	Mitigated Negative Declaration
MOU	Memorandum of Understanding
N ₂ O	nitrous oxide
NAAQS	national ambient air quality standards
NAHC	Native American Heritage Commission
NCRD	North Coast Redwoods District
NCRWQCB	North Coast Regional Water Quality Control Board
NCUAQMD	North Coast Unified Air Quality Management District
ND	Negative Declaration
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOA	naturally occurring asbestos
NO _x	nitrogen oxides
NPS	National Park Service
NRHP	National Register of Historic Places
O ₃	ozone
PA	Programmatic Agreement
PEF	Project Evaluation Form
PM	Particulate matter
PM ₁₀	particulate matter less than 10 microns in diameter
PM _{2.5}	particulate matter less than 2.5 microns in diameter
PRC	Public Resources Code
PSR	Project-Specific Requirement
RNSP	Redwood National and State Parks
ROG	reactive organic gases
SHPO	State Historic Preservation Officer
SONCC	Southern Oregon/Northern California Coasts
SPR	Standard Project Requirement

TAC	toxic air contaminant
USACE	U.S. Army Corps of Engineers
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VDT	variable density thinning
VMP	Vegetation Management Plan
WMP	Mill Creek Watershed Management Plan

Appendix B

Glossary

Appendix B: Glossary of Terms

Abandoned road	Road lacks obvious maintenance. Ditches may lack cleaning and vegetation may be encroaching the road and road surface. Culverts may be partially or completely plugged, badly rusted, or crushed. The road is typically not drivable without improvements (Merrill et al. 2011).
Alignment	The area affected by a road or trail, including the fill slopes, road bench, and cut bank. Also, a linear representation of features on a map such as a stream channel (Merrill et al. 2011).
Basal area	Cross-sectional area of a stem at breast height (see "Diameter at breast height"), often expressed in square feet or meters. "Stand basal area" refers to the cross-sectional area of all stems in a stand measured at breast height and expressed in a unit of land area (i.e., square feet of basal area per acre or square meters of basal area per hectare).
Berm	General term used to describe a constructed mound of earth typically long and narrow in shape. Berms can form a barrier along the edges of roads, can confine runoff along a road, and may also be present along stream channels and floodplains (Merrill et al. 2011).
Bridge	Structure, including supports, erected over a depression or stream, and which has a deck for carrying traffic and may have railings (Merrill et al. 2011).
Clearcut	Logging practice in which most or all trees in an area are uniformly cut down.
Complete fill recovery	Road removal process which recovers all displaced road, crossing and landing fill. Recovered fill is typically placed along the road cutbench, compacted, shaped to provide sheet drainage, and mulched. Excess fill that cannot be accommodated in the cutbench is relocated to nearby stable locations such as skid trails or quarry pits etc. Complete fill recovery is the preferred method of road removal. (Merrill et al. 2011).
Crane mat	Mats placed to support heavy equipment and protect vegetation and soils from disturbance.
Cross drain culvert	A culvert installed just below road grade that intercepts and conveys water from the inboard ditch to the outside embankment edge of the road. These structures are intended to trap runoff from the roadbed, the hillslope, and shallow groundwater and deliver it to the slope below (Merrill et al. 2011).
Crown class	Category of tree based on its crown position relative to those of adjacent trees. Types of crown classes are as follows: <ul style="list-style-type: none">• Codominant- A tree whose crown helps to form the general level of the main canopy.• Dominant- A tree whose crown extends above the general level of the main canopy.• Intermediate- A tree whose crown extends into the lower portion of the main canopy.

- Suppressed- A tree whose crown is completely overtopped by one or more neighboring trees (NPS 2014).

Culvert	Metal, plastic or concrete pipe set below the road surface. Used to pass stream-flow from upslope of the road to downslope of the road. Culverts can also be placed to drain springs and inboard ditch flow from the inside to the outside of the road, beyond the outer edge of the road fill, or fillslope (Merrill et al. 2011).
Cutbank	Portion of the hillslope along the upslope side of the roadbed that has been cut into bedrock or native soil (Merrill et al. 2011).
Cutbench	Portion of a roadbed that has been cut into bedrock or native soil. Compare with embankment (Merrill et al. 2011).
Delivery	Amount, expressed as a percentage or ratio of material (sediment), that is delivered to a stream from a site. Also referred to as Sediment Delivery Ratio (SDR). The percentage is an objective estimation based on site conditions, including, but not limited to, slope steepness, groundwater emergence, road drainage, fill materials, adjacent instability, and vegetative cover (Merrill et al. 2011).
Diameter at breast height (dbh)	Diameter of a tree at breast height (4.5 feet above the ground), most often expressed in inches or centimeters. Average dbh of a stand is expressed as the diameter of the tree with the average basal area (quadratic mean diameter) rather than the average of all diameters in a stand (arithmetic mean diameter) (NPS 2014).
Embankment	Fill excavated from the cutbench and used to construct the outboard road bench, often referred to as the fill slope, outboard fill material, or sidecast material. (Merrill et al. 2011). Embankments may also be constructed as bridge supports or approaches or causeways through low-lying areas. Embankments should be constructed with clean, well-graded fill and compacted in lifts by mechanical means.
Even-aged	Stand having trees of approximately the same age, usually within a range of 10 or 20 years, and normally a simple vertical structure (NPS 2014).
Feller-buncher	Harvesting machine that cuts a tree with a shear or saw and carries one or more cut trees in its hydraulically operated arms as it moves to cut the next tree. It deposits small piles of cut trees on the ground to be transported by a skidder (NPS 2014).
Fill	Material used to construct roads and related structures. Fill can include soil, rock, large organic debris, and man-made objects (e.g., cars) (Merrill et al. 2011).
Fillslope	Area of excavated material cast on the downslope side of road cut (also called embankment) (Merrill et al. 2011).
Geomorphology	Study of the earth's surface and the processes that shape it. Geomorphology is closely related to geology (Merrill et al. 2011).
Grade	Proposed or planned ground surface. Grade is usually set to match the surrounding topography or stream gradient. Grade also refers to the

longitudinal slope of a roadway. Typically expressed as a percent (Merrill et al. 2011).

Gradient	The measurement of the angle along a natural slope or a stream. This term is often confused with grade (see "grade") (Merrill et al. 2011).
Ground-based operations	Operational logging method ground-based mechanized equipment (e.g., feller-buncher, skidder, harvester/processor) to fell trees and/or skid logs or whole trees from the stump area to the landing or roadside area (NPS 2014).
Gully	Steeply sided channel caused by erosion from surface runoff or a diverted stream channel. Gullies can usually be identified by their location away from natural stream valleys. Gullies are at least 1 square foot in cross-sectional area. Compare with rill (Merrill et al. 2011).
Harvester	Machine that falls trees and performs processing functions at the stump (see "processor") (NPS 2014).
Humboldt crossing	Stream crossing constructed with logs set parallel to the stream channel and covered with fill (Merrill et al. 2011)
Hydrology	Science of water found on the surface of the earth and in the atmosphere. This term is often confused with hydrogeology, which is the science of groundwater (Merrill et al. 2011).
Inboard ditch	Drainage ditch cut along the inboard edge of the road that collects and conveys road surface runoff, slope runoff, small streams and spring discharge. Inboard ditches convey runoff to the next cross drain culvert or stream crossing down the road (Merrill et al. 2011).
Inventory	Set of objective sampling methods designed to quantify the spatial distribution, composition, and rates of change of resource parameters within specified levels of precision for the purposes of management (NPS 2014).
Landing	Location where logs are collected and loaded onto trucks for transport. Landings are typically located along haul roads and are observed as a "wide spot" in the road. Landings are most often constructed with typical cut/fill techniques but have a large embankment fill volume due to their size, and typically contain a higher concentration of large woody debris (than regular road embankment fill because tree limbs and discarded pieces from logging operations were typically pushed over the outboard edge for removal from the work area (Merrill et al. 2011).
Large wood placement	Placement of large wood in stream channels to create conditions that improve stream habitat. When wood is placed by heavy equipment, the acronym is LW-HEP. When wood is placed by field crews walking channels without heavy equipment, but using chainsaws and other equipment, the acronym is LW-WHEP (Ozaki 2018).
Loader	Self-propelled machine with a grapple or tongs and a supporting structure designed to pick up and discharge trees or logs for the purpose of piling or loading (NPS 2014).

Lop-and-scatter	Hand method of removing the upward-extending branches from tops of felled trees and bucking to keep slash low to the ground, to increase rate of decomposition, lower fire hazard, or as a pretreatment prior to burning (NPS 2014).
Mass wasting	General term that includes many types of mass earth movements. These include rockslides, debris slides, debris flows, and earthflows, etc. (Merrill et al. 2011).
Open road	Road passable to a standard four-wheel-drive vehicle during dry weather without clearing brush or making other improvements. Road typically shows evidence of recent maintenance, including clearing culvert inlets and inboard ditches, grading, rolling dip or waterbar reconstruction, and brushing (Merrill et al. 2011).
Outsloped	Road surface shaped to slant toward the outboard edge of a road. The slanted surface naturally disperses surface runoff. A road that is outsloped may or may not be drivable depending on the intent of treatment. An outsloped road may or may not have an inboard ditch. Pitch is expressed as a negative number (Merrill et al. 2011).
Outsloping	Act of changing a flat or insloped road to an outsloped road. For erosion control treatments, substantial fill is removed from the outer edge of the road prism, and spread and shaped along the inside edge of the road, typically against the cutbank. For surface drainage on active roads, the road surface has a mild outslope that is drivable by logging trucks and forms a relatively maintenance-free road surface that disperses road surface runoff (Merrill et al. 2011).
Processor	Machine that that performs two or more functions on a felled tree, including delimiting, debarking, bucking, measuring, or chipping (see "harvester") (NPS 2014).
Rills	Small erosional feature similar to a gully in morphology but less than 1 square foot in cross-sectional area. Rills often form on soft bare soil or road surfaces. Compare with "gully" (Merrill et al. 2011).
Removed road	Road that has been physically removed from the landscape and is no longer accessible to vehicles (see "road removal"). (Merrill et al. 2011).
Roadway	Corridor of the road within the limits of excavation and embankment, including the cutbank, the inboard ditch, the roadbed, and the outboard fill. (Merrill et al. 2011).
Road outsloping	Treatment of a road to eliminate collection or diversion of water along the roadbed and provide uniform sheet drainage. Outsloping can be prescribed for roads still in use or roads that are no longer used (see "outsloping") (Merrill et al. 2011).
Road removal	Treatment of a road that completely recovers unstable side-cast fill and stabilizes the fill within the original cut-bench. Stream crossing fill is excavated, and all excavated materials are placed in stable locations along

the cutbank. This type of treatment is also referred to as road recontouring or road obliteration. May include associated landings (Merrill et al. 2011).

Road surface	Material, native or placed, that comprises the top layer of the roadbed (see "surfacing") (Merrill et al. 2011).
Rolling dip	Broad, shallow, gentle dip (low point) in the road surface that collects road surface runoff and conveys it to the outer edge of the road. It can also drain an inboard ditch. Rolling dips are drivable at slow speeds without abrupt bumps in the road surface (Merrill et al. 2011).
Runoff	Rainwater flowing on the surface of the ground. Runoff can be generated by rain falling on saturated ground or from heavy rain that cannot soak in fast enough (Merrill et al. 2011).
Sediment	Silt, sand, clay, and gravel that is moved by water or air and deposited at some location (Merrill et al. 2011).
Sediment yield	Amount of sediment that reaches a stream channel after eroding from a site. Expressed in cubic meters and calculated by multiplying the erosion volume and delivery ratio (Merrill et al. 2011).
Silviculture	Art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society (NPS 2014).
Skid	Method of transporting cut logs from the point of felling, limbing, and topping, to a landing for bucking into logs and loading onto a truck for removal from the forest. This is done along narrow, temporary trails by heavy equipment (e.g., skidders and bulldozers) (NPS 2014).
Skid trail	Small single-lane tracks that develop as ground-based equipment moved logs across harvest units. Skid trails are not constructed like haul roads; they lack a constructed roadbed and typically follow, rather than cut through the surrounding topography (Merrill et al. 2011).
Skidder	Self-propelled machine with, often articulated (hinged) in the center, for dragging trees or logs (NPS 2014).
Skyline operation	Operational logging method that uses a cable yarding machine, an overhead system of winch-driven cables, to pull logs or whole trees from the stump area to the landing or roadside area.
Slash	Waste from logging, including the tops and other unusable parts of trees (NPS 2014).
Soil	Uppermost layer of decayed organic matter, clay, silt, sand, air, water, and weathered rock mixed in various proportions. Soil consists of horizons or layers that display different amounts of weathering and fertility (Merrill et al. 2011).
Snag	Standing dead tree.

Stand	Section of forest having relatively uniform composition regarding species, size structure, and density; distinguishable from other stands by attributes such as these. The stand is the basic unit of silviculture, since it is by stands that nearly all cultural treatments are prescribed. A stand type is the designation given one kind of stand within a particular classification system, and it normally consists of symbols referring to principal species, heights, and densities (NPS 2014).
Stand density	Quantitative measure that describes the degree of stem crowding within a stocked area. Absolute measures of stand density are often reported in terms of number of trees, basal area, or volume per unit area or relative to a standardized condition.
Stream crossing	Constructed road section across a natural stream. There are many types of crossings, such as bridges, culverts, Humboldt (see "Humboldt crossing"), and fill crossings. A stream crossing includes all locations where a road crosses a channel, whether water is flowing, and whether a drainage structure has been provided (Merrill et al. 2011).
Thinning	Silvicultural treatment made to reduce stand density primarily to redistribute growing space and available resources, enhance forest health, or recover potential mortality (NPS 2014).
Through-cut	Portion of a road that has cutbanks on both sides with drainage flowing down the road or inside ditch (Merrill et al. 2011).
Topography	Natural shape of the land's surface. (Merrill et al. 2011).
Winterization	Winterization includes: 1) grading exposed road and landing surfaces to allow water to freely drain across them without concentrating, ponding or rilling, 2) installing rolling dips/drains to drain steeper sections of road, 3) clearing clogged drainage ditches or culverts, and 4) installing silt fences and other erosion control devices where necessary to convey concentrated water across exposed road and landing surfaces, 5) removing temporary road-stream crossings that do not meet 100- year flood discharge standard for flow, sediment, and debris, and 6) mulching all exposed soil surfaces beyond road driving surface.
Yarder	System of power-operated winches and a tower used to haul logs or trees from the stump area to a landing or roadside area (NPS 2014).
Yoader	Loader that is converted into a small yarder (see "yarder") (NPS 2014).

Appendix C

Tables

Appendix C: Tables

Table 1
Vegetation Management Areas and Associated Actions

Vegetation Management Actions	VMP Vegetation Management Areas				
	Forest Restoration	Uncommon and Sensitive Natural Communities Management	Prescribed Fire and Fire Use ¹	Non-native Plants and Pathogens	Cultural Vegetation Management
Forest Thinning	X	X	X	X	X
Snag Creation	X		X		
Crown Manipulation	X		X		
Tree Planting	X				
Manual Removal		X		X	X
Complete Conifer Removal		X			
Mechanical (e.g., Dozer or Excavator) Removal				X	
Flaming/Torching				X	
Mowing/Solarization/Covering				X	
Girdling		X			X

Note:

1. Implementation of prescribed fires is not included as part of the Proposed Action; however, prescribed fire and control is included as a VMP Vegetation Management Area. Because implementation of prescribed fires is not included as part of the Proposed Action, additional environmental review would be necessary before CDPR could undertake any prescribed fires on its lands.

Table 2
Standard Project Requirements and Project-Specific Requirements

Element/Title	Requirement
SPR-AIR-1	Equipment maintenance. All diesel- and gasoline-powered equipment engines would be maintained in good condition, in proper tune (according to manufacturer’s specifications), and in compliance with all state and federal requirements.
PSR-AIR-2	Watering to minimize fugitive dust. Prior to use of roads and/or landings for hauling and yarding activities, sufficient water must be applied to the area to be disturbed to minimize fugitive dust emissions. Exposed areas would not be overwatered such that watering results in runoff. Water would not be sprayed on bridge running surfaces. Water sources and drafting specifications would be identified per permit requirements. Alternatively, unpaved areas subject to hauling and yarding activities could be stabilized through the effective application of gravel or treated with biodegradable dust suppressant. Any dust suppressant product used must be environmentally benign (i.e., non-toxic to plants and shall not negatively impact water quality) and its use shall not be prohibited by CARB, USEPA, or the State Water Resources Control Board.
SPR-AIR-3	Idling restrictions. All motorized heavy equipment would be shut down when not in use. Idling of equipment and haul trucks would be limited to 5 minutes.
PSR-AIR-4	Fugitive dust-related excavation/grading restrictions. Excavation and grading activities on road removal sites would be suspended when fugitive dust from project activities might obscure driver visibility on public roads.
PSR-AIR-5	Naturally Occurring Asbestos (NOA) soil watering. Prior to any ground disturbance in a unit located in serpentinitic soils (soils that contain NOA), or vehicle or equipment travel on roads either constructed through, or rocked with NOA gravel, as identified in the WMP [CDPR 2011a]), the ground would be sufficiently wetted to prevent fugitive dust emissions. Sufficient ground wetting may be accomplished either by transporting water to the project area or by conducting project activities during the wet season when soil moisture conditions are adequate. Exposed areas would not be overwatered such that watering results in runoff. To minimize track-out (i.e., mud from truck tires that is deposited on the dry road surface after leaving the wetted portion of the road): 1) road wetting would stop 500 feet from the end of the NOA portion to allow the mud to track off over the existing dry NOA area; or 2) the last 500 feet of NOA rocked gravel road would be capped with non-NOA-containing gravel so NOA track-out can occur over the capped area and not spread to the uncontaminated portions of road. In addition, all heavy equipment would be rinsed of NOA soil prior to leaving the asbestos containing work area to prevent track-out.
SPR-BIO-1	Pre-implementation special-status plant surveys. Prior to the start of project activities, and when the plants are in a phenological stage conducive to positive identification, a qualified botanist would conduct surveys for special-status plant species and sensitive communities throughout the project area if deemed necessary by a Park plant ecologist. Surveys would be conducted in conformance with the <i>California Department of Fish and Wildlife Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Sensitive Natural Communities</i> (CDFW 2018a).

Element/Title	Requirement
PSR-BIO-2	Special-status plant buffers and avoidance. Individuals or populations of rare, threatened, endangered plants, or those listed as CNPS Ranks 1 and 2, would be avoided where feasible with an appropriate buffer delineated by high-visibility flagging. Personnel would be instructed to keep project activities out of the flagged areas. The buffer size would be 25 feet unless agreed otherwise with regulatory agencies. If avoidance of special-status plants is not possible, then CDFW would be consulted to determine a mutually agreeable strategy to minimize project impacts.
SPR-BIO-3	Invasive plant and pathogen control. All project activities that could spread invasive non-native plants and pathogens are subject to the Draft NCRD Invasive Species BMPs (within the VMP [CDPR 2019a]) or the <i>Invasive Plant Management Plan for Redwood National Park</i> (NPS 2017), and the Aquatic Invasive Species Management Plan (CDFG 2008).
PSR-BIO-4	Suppressed and intermediate tree management. In all forest restoration units, a minimum of three suppressed trees, intermediate trees, or snags (unless they pose a risk to worker safety), in any combination, would be left per acre.
PSR-BIO-5	Tree retention. Thinning projects would retain all trees that are 30 inches DBH or larger with two exceptions: trees up to 38 inches DBH may be cut 1) to release trees of underrepresented species; and 2) in stands where the average tree diameter is 28 inches (or greater) DBH. In both cases, the largest trees (80th percentile) would be retained.
PSR-BIO-6	Timing restrictions and surveys for nesting migratory birds. In general, project activities that modify or disturb vegetation would not occur during the peak nesting season (May 1 to June 30) to avoid nesting migratory birds. If modification or disturbance to vegetation is deemed necessary at any time during the typical bird breeding period (May 1 to July 31), an RNSP biologist would conduct weekly breeding bird surveys within the area of potential disturbance. If occupied nests are detected, work would either be suspended until the birds have fledged, or a spatial buffer would be applied to protect the nest. The size of the spatial buffer would be determined by the RNSP biologist based on the species found and the nest site specifics.
PSR-BIO-7	Special-status bird surveys and restrictions. All special-status bird survey requirements, habitat modification, and normal operating season restrictions for all project activities would be implemented in conformance with all minimization measures and requirements identified in the Biological Opinion issued by USFWS in compliance with ESA Section 7 requirements or CESA documents issued by the California Department of Fish and Wildlife. Special-status birds includes those that are state and federally listed as threatened or endangered and state-listed species of special concern.
PSR-BIO-8	Raptor breeding temporal and spatial buffers. Prior to the start of project-related work occurring from May 1 through July 31, the on-site inspector/monitor would be responsible for implementing raptor temporal and spatial buffers around observed nests. No project activities would occur within temporal and spatial buffer zones. Temporal buffers are temporary buffers established around nest sites that restrict operations during the species critical nesting period. Spatial buffers are permanent habitat retention buffers established around a species nest site. Until the nest site is determined to be no longer active (normally after 3 years of no use), habitat modification is not allowed within the spatial buffer.

Element/Title	Requirement
PSR-BIO-9	Large wood placement restrictions. Cable and rebar would not be used to anchor large wood in streams. Large wood is expected to be dynamic in the channel and may break loose and deposit naturally at downstream sites. However, no large wood would be placed within 300 feet upstream of bridges without being reviewed and approved by a California-licensed professional engineer. If mobile large wood accumulates within 300 feet upstream of a bridge and is deemed a potential threat to the bridge, a California-licensed professional engineer would evaluate the debris and make recommendations for stabilization or removal.
PSR-BIO-10	Large wood retention requirements. Any large wood encountered during excavation of stream crossing would be retained primarily on site as mulch or used in channel to provide habitat.
SPR-BIO-11	Tree protection. Equipment operators conducting work would be required to avoid striking residual old growth trees or trees identified by park staff.
PSR-BIO-12	Fish and amphibian management. All fish and amphibian survey requirements, habitat modification, and operational restrictions for all project activities would be implemented in conformance with all minimization measures and requirements identified in the Biological Opinion issued by NMFS in compliance with ESA Section 7 requirements and CDFW CESA requirements.
PSR-BIO-13	Mulching exposed soils. All areas of exposed soils resulting from instream large wood placement shall be mulched with native fuel cover, or in pasture or grass-dominated areas, seeded with native seed mixes to minimize the delivery of sediment into the adjacent stream.
PSR-BIO-14	Foothill yellow-legged frog surveys. Surveys for foothill yellow legged frogs shall be conducted within 5 days of any operations being conducted in streams that exhibit surface flow. The surveys shall extend a distance of 100 feet upstream and downstream of the project site. CDFW would be notified if any frogs are observed within the survey reach. Appropriate actions shall be taken to avoid or minimize take of these species under the direction of CDFW. These actions include, but shall not be limited to, installation of exclusion fencing, removal and relocation, and daily pre-implementation surveys to ensure frogs have not reoccupied the project site during periods of inactivity.
PSR-BIO-15	Wildlife tree retention. All designated wildlife trees would be retained that are associated with forest thinning. A wildlife tree would have one or more of the following characteristics: <ol style="list-style-type: none"> 1. Large lateral branches: greater than 5 inches in diameter 2. Cavities: wood voids with (estimated) small-to-medium interior dimensions and an entrance opening of at least 1.5 inches suitable for use by a variety of small mammal and bird species 3. Hollow: Wood voids with (estimated) large interior dimension and a large (6 inches or larger) entrance opening suitable for use by a variety of small mammal and bird species 4. Decay: Extensive decayed wood as evidence by large and/or extensive fungal fruiting bodies (conk), lichen, cavity entrances, and sloughing wood and/or bark 5. Broken top: Trees with a minimum diameter at the ordinal break of 12 inches or larger 6. Multiple tops: Trees with two or more leaders near the top of the tree that provide opportunities for resting, denning, or nesting 7. Snag top: Trees where the top the tree is dead with the lowest portion of the dead top is at least 12 inches in diameter

Element/Title	Requirement
PSR-BIO-16	<p>Protection of equipment access routes through wetlands. If access is necessary during implementation, crane mats or other appropriate cover material would be placed along the heavy equipment access routes that cross wetland or herbaceous-dominated (pasture/grasslands) areas.</p>
PSR-BIO-17	<p>Planting tree seedlings. Within 3 years of the winter following implementation, on all road removal crossings, tree seedlings would be planted within 100 feet of the channel centerline on 20-foot centers in a random distribution according to an appropriate species composition as determined by a qualified forester. Tree seedling stock would conform to NCRD genetic integrity guidelines.</p>
PSR-CULT-1	<p>Historical and archaeological resource inventories. Proposed project areas would be inventoried for the presence or absence of historical and archaeological resources prior to operations within the project area and reports would be submitted to and reviewed by the NCRD Archaeologist. PRC 5024 compliance documentation would be completed. A report would be prepared by a qualified archaeological consultant with direct oversight by the NCRD Archaeologist prior to any project activities. Any cultural resources identified during the inventory would be recorded and flagged with a 30-foot buffer (or as needed based on topography and access points to protect the find). CDPR reserves the right to alter this measure through the PRC 5024 process.</p> <p>This requirement would only apply to projects with no NPS involvement. Projects with NPS involvement, where compliance with Section 106 is required, would follow the process described in the Section 106 Programmatic Agreement.</p>
SPR-CULT-2	<p>Suspend work for the inadvertent discovery of an archaeological resource. In the unlikely event that previously undocumented archaeological resources, including but not limited to flaked stone artifacts (arrowheads or flakes), shellfish, bone, deposits of old bottles and cans, and wooden or rock structural debris, are encountered during project implementation, work in that location would be immediately suspended until an archaeologist meeting the Secretary of the Interior’s standards has evaluated the find in consultation with the SHPO, Yurok Tribe, Tolowa Dee-ni’ Nation, and Elk Valley Rancheria, as appropriate.</p> <p>This requirement would only apply to projects with no NPS involvement. Projects with NPS involvement, where compliance with Section 106 is required, would follow the process described in the Section 106 Programmatic Agreement.</p>
SPR-CULT-3	<p>Stop work for inadvertent discovery of human remains. For ground-disturbing activities, in the event that human remains or suspected human remains are discovered, work would cease immediately within 100 feet of the find (or as needed based on topography and access points to protect the find) and the project manager/site supervisor would notify the Cultural Resources Program Manager of the NCRD and the District Superintendent. The human remains and/or funerary objects would not be disturbed and would be protected by covering with soil or other appropriate methods. The District Superintendent (or authorized representative) would notify the County Coroner (in accordance with Section 7050.5 of the California Health and Safety Code) and NAHC. The District Superintendent (or authorized representative) would also notify the local tribal representative. The County Coroner would determine whether the human bone is of Native American origin.</p> <p>If the Coroner determines the remains represent Native American interment, the NAHC would be consulted to identify the MLD and appropriate disposition of the remains. Work would not resume in the area of the find until proper disposition is complete (PRC Section 5097.98). No human remains or funerary objects would be cleaned, photographed, analyzed, or removed from the place of discovery prior to determination and consultation with the MLD. If it is determined that the find indicates a sacred or religious site, the site would be</p>

Element/Title	Requirement
	<p>avoided to the maximum extent practicable. Formal consultation with the SHPO and review by the NAHC, as well as appropriate tribal representatives, would occur as necessary to define additional site mitigation or future restrictions.</p> <p>This requirement would only apply to projects with no NPS involvement. Projects with NPS involvement, where compliance with Section 106 is required, would follow the process described in the Section 106 Programmatic Agreement. Additional procedures may also apply to projects on NPS-owned lands under the Native American Graves Protection and Repatriation Act.</p>
SPR-CULT-4	<p>Aerial suspension removal requirements within a culturally sensitive area. If forest thinning activities are proposed within a culturally sensitive area (an archaeological site, tribal cultural resource, or historical site described in PSR-CULT-1), downed and other forest debris would be removed by aerial suspension; no portion of logs, slash, or debris would be dragged across the surface.</p> <p>This requirement would only apply to projects with no NPS involvement. Projects with NPS involvement, where compliance with Section 106 is required, would follow the process described in the Section 106 Programmatic Agreement.</p>
PSR-GEO-1	<p>Unstable area buffer. Within a 50-foot-wide buffer around unstable areas (areas that appear to have recent soil movement, as evidenced by characteristics such as conifers with excessive sweep, tilted stumps, scarps, cracks, hummocky or benched terrain, or slide debris) regardless of percent slope, no trees would be cut. Unstable areas would be marked by park staff with training and expertise in geologic and watershed processes.</p> <p>Landslides within a project area would be mapped by park staff; this would trigger evaluation and approval for use by an earth sciences/physical sciences professional if the feature is related to travel routes or operations. Heavy equipment and/or vehicles or one-end cable yarding would not be allowed to cross areas of instability (as defined above) without approval from an earth sciences/physical sciences professional.</p>
PSR-GEO-2	<p>Consultation with professional geologist. Before any treatment year, and over the life of this plan, a professional geologist would be consulted for management recommendations in the following cases: 1) the Smith River near Crescent City (11532500) stream gage operated by USGS has peak flows in excess of 140,000 cubic feet per second; 2) an earthquake epicenter of moment magnitude 5 to 5.9 occurs within 10 miles of the proposed treatment block, moment magnitude 6 to 6.9 occurs within 20 miles of the proposed treatment block, moment magnitude 7 or greater occurs within 50 miles of the proposed treatment block, or the southern segment of the Cascadia Subduction Zone has fault rupture; or 3) wildland fire burns within the sub-watershed of the proposed treatment block.</p>
PSR-GEO-3	<p>Slope limitations for traditional ground-based equipment. Traditional ground-based equipment would be limited to slopes less than 40%. Operations within the riparian management zone would be restricted as described in Table 3.</p>
PSR-GEO-4	<p>Slope limitations for cable-assisted thinning operations. Cable-assisted equipment (e.g., tethered harvesters and forwarders) may be allowed on slopes up to 85%. Equipment would stay on designated trails covered with a minimum of 6 inches of slash. Operations within the riparian management zone would be restricted as described in Table 3.</p>

Element/Title	Requirement
PSR-GEO-5	<p>Winterization requirements and timing restrictions on activities causing soil erosion. Project work would typically be completed during the normal operating season between June 15 and October 15. If more than 0.5 inch of rain is forecast during the normal operating season, project operations would temporarily cease and sites would be winterized. Within riparian management zones, areas with disturbed soils must be stabilized prior to the beginning of the winter period subject to extensions provided by dry weather, and/or prior to the sunset if the National Weather Service forecast is a “chance” (30% or more) of rain within the next 24 hours, or at the conclusion of operations, whichever is sooner. Implementation activities may continue past the end of the normal operating season if the work can be completed within a window of dry weather as predicted by NOAA’s Fall Transition Season Precipitation and Hydrology Decision Support Service notifications.</p> <p>Work sites, including roads and landings, would be winterized before the end of the normal operating season. Winterization includes: 1) grading exposed road and landing surfaces to allow water to freely drain across them without concentrating, ponding or rilling; 2) installing rolling dips/drains to drain steeper sections of road; 3) clearing clogged drainage ditches or culverts; 4) installing silt fences and other erosion control devices where necessary to convey concentrated water across exposed road and landing surfaces; 5) removing road-stream crossings that do not meet 100-year flood discharge standard for flow, sediment, and debris; and 6) mulching all exposed soil surfaces beyond road driving surface. Operations may be started prior to the normal operating season when the soil is dry throughout the entire top 8 inches of the profile, as evidenced by the field guide for soil moisture described in the <i>Wet Weather Operations Standards for Heavy Equipment Use and Log Hauling for Redwoods Rising</i> (RNP 2019a) guidelines.</p> <p>Roads and landings used outside of the normal operating season or after significant rain events would be winterized. Prevention measures would occur before damage occurs, or the area would be avoided until it is sufficiently dry for use. All road use would comply with the Park Seasonal Road Use Policy (March 11, 2011, version or later), and <i>Wet Weather Operations Standards for Heavy Equipment Use and Log Hauling for Redwoods Rising</i> guidelines, which prohibit any road use that would cause rutting or other road deformation. Roads not currently listed as all season may be brought up to that standard if winter travel is necessary.</p>
PSR-GEO-6	<p>Requirements for existing and used landings. Existing landings that were constructed for commercial logging operations prior to park establishment would be used when practicable. Reopening old landings would include shrub and small tree removal, minimal grading, and stump removal. New landings (fewer than two per 50 acres) may need to be constructed for yarding equipment. New landings would be located outside of geologically unstable areas, and the grade would not exceed 15%. Individual landings would not be larger than 0.25 acre. New landings or equipment pull outs would not be placed within 100 feet of streams except where existing roads occur within this threshold distance and there is no other place to land logs. The total number of landings created within 100 feet of a stream would not cumulatively make up more than 35% of the total number of new landings needed in the project area. Existing roads and skid trails would be used to access the break-in-slope where cable yarders can set up. Landings would be kept to the minimum size needed to accomplish the job and existing road and skid trail surfaces would be used as much as practicable.</p>

Element/Title	Requirement
PSR-GEO-7	Road removal and erosion control. Brush, trees, rootwads, and other organic debris removed during excavation and clearing of project areas would be collected, stockpiled, and placed on slopes adjacent to live streams or other locations where fine sediment may be mobilized and has potential to enter the stream system. If there is not enough vegetative debris at a particular work site to achieve the amount of ground cover specified, vegetative debris may be moved from nearby, less erosionally sensitive work sites. In the event that imported material (such as straw or shredded redwood bark) is needed, RNSP would purchase and deliver it as close as possible by truck to the area needed. Materials would be selected to comply with RNSP guidelines to minimize introduction of exotic plant species and interference with re-establishment of native forest species.
PSR-GEO-8	Cable and ground-based yarding one-end log suspension minimum. Cable and ground-based yarding would be restricted to the use of equipment capable of maintaining a minimum of one-end log suspension to reduce surface disturbance.
PSR-GEO-9	Evaluation of existing roads/landings for reuse. Existing roads and landings proposed for reuse would be evaluated. Any cracks or other signs of instability or erosion potential would be evaluated by an earth sciences/physical sciences professional who would provide reconstruction or maintenance prescriptions necessary for the intended purpose of reuse.
PSR-GEO-10	Monitor equipment operations at road construction and/or removal sites. At road reconstruction and/or removal sites, a qualified inspector trained in road rehabilitation or removal would monitor equipment operation. Heavy equipment operators would be cautioned to minimize their exposure to unstable slopes that may occur naturally or result from the earthmoving process.
PSR-GEO-11	Skid trail erosion control measures. On skid trails with no measurable fill cross section, tire tracks, skidding ruts, and other depressions and surface irregularities would be removed and restored to a non-sediment delivery status. Erosion control measures such as outsloping (preferred) or water bars in conjunction with slash placement on skid trails and disturbed soils would be implemented where the potential exists for erosion and delivery of sediment to waterbodies, floodplains, and wetlands. Slash generated from forest restoration would be spread uniformly as mulch.
PSR-GEO-12	Wet weather operations. All roads and landings must be adequately rocked (with compacted Class 2 1.5-inch aggregate base) and winterized to be considered for use during wet weather. No ground-based yarding operations would occur during wet weather as defined in the <i>Wet Weather Operations Standards for Heavy Equipment Use and Log Hauling in Redwood National and State Parks</i> guidelines.
PSR-GEO-13	Restrictions on new road and landing alignments. All new road and/or landing alignments and subsequent construction would be supervised by an earth sciences/physical sciences professional. Grades would never exceed 15% and never exceed 10% for more than 500 continuous feet. No roads would be constructed on slopes over 50%. Riparian Management Zones would be avoided whenever possible.
PSR-HYDRO-1	Riparian buffers. Equipment exclusion zones around riparian corridors would be established as defined in Table 3.
PSR-HYDRO-2	Use of dropped trees as instream structures. Trees that are dropped into or across stream channels would not be removed, but their position may be adjusted for use as instream structures.

Element/Title	Requirement
SPR-HYDRO-3	<p>Equipment decontamination. Decontamination of heavy equipment would occur prior to delivery onto park lands. Heavy equipment would be thoroughly power washed prior to delivery to the park. Equipment would be free of woody and organic debris, soil, grease, and other foreign matter. The engine compartment, cab, and other enclosed spaces would also be free of the aforementioned debris. Equipment would be thoroughly inspected by an agency representative upon delivery and may be rejected if, in the opinion of the representative, the equipment does not meet decontamination standards. If a piece of equipment is removed from the park for unrelated work or work not identified as part of implementation, it would be re-inspected upon re-entry to the park. Decontamination would take place off site upon demobilization.</p>
PSR-HYDRO-4	<p>Cable yarding across perennial streams. When cable yarding across perennial streams, trees must be fully suspended in the air when traveling near streams, as defined in Table 3.</p>
PSR-HYDRO-5	<p>Timing restrictions for road reconstruction and/or removal. Road reconstruction and/or removal work would generally occur outside of the rainy season (June 15 through October 15). On roads where potential sediment delivery to streams exists, restoration activities after October 15 would only proceed according to permit conditions established in consultation with regulatory agencies. If periods of dry weather are predicted after October 15, small additional work items may be done with regulatory agency approval, if they can be completed within the window of dry weather. RNSP would have materials to sufficiently mulch bare work areas on site. Work would be conducted so that no more than 1 half-day would be required to finish all earth moving and mulching work. All access roads would be winterized prior to any additional earth moving tasks.</p>
PSR-HYDRO-6	<p>In-water work area isolation requirements. Stream crossing excavations and/or culvert replacements would take place in dry channels or in channels where stream flow is diverted around the excavation sites to reduce turbidity. In crossings where flow is sufficient to be intercepted, a small diversion dam would be built upstream and stream flow piped around the worksite and discharged into the stream below the worksite. In crossings where the stream flow is too low to be captured and diverted, filter structures would be installed downstream to filter turbid discharge from the worksite. The project inspector would monitor the structures to prevent failures. All temporary berms, ponds, and piping would be completely removed at the completion of excavations or culvert replacement</p>
PSR-HYDRO-7	<p>Drainage structure and stream crossing maintenance requirements. On roads where vehicle or heavy equipment access is required for forest restoration, culverts, water bars, and other damaged or non-functional drainage structures would be repaired or replaced. All stream crossings proposed for reconstruction and left over winter would be designed to convey the 100-year flood discharge including wood debris and sediment loads. Crossings through fish bearing streams would allow for fish passage throughout their lifecycle if they are to remain in place over winter. Bridges and supporting structures would be designed by a California-licensed professional engineer.</p>
PSR-HYDRO-8	<p>Erosion control adjacent to stream channels. At road reconstruction and/or removal sites, disturbed soil adjacent to stream channels would receive mulch coverage with brush and trees (generated during the clearing phase of rehabilitation work) to reduce sheet erosion. Coverage would be heaviest adjacent to the stream or where no native mulch buffer exists downslope between disturbed soil and a stream channel. If needed, hand crews would cut and lop upright branches to further increase ground contact and/or spread finer mulch over small bare areas. Similarly, duff laden with seed, nutrients, and fungi may be collected and scattered. Care would be taken not to impact source areas.</p>

Element/Title	Requirement
SPR-HYDRO-9	<p>Removal requirements for wet roads. At road removal sites, cutbanks exposing seeps or springs would not be recontoured. Instead, the entire embankment fill adjacent to the wet area would be exported to dry sections. An outsloped cutbench would extend along all wet road sections.</p>
PSR-HYDRO-10	<p>Stream crossing monitoring. Selected stream crossing sites would be photo-documented following treatment to enable rough-estimate quantitative assessment of post-treatment adjustments according to monitoring protocols. Stream crossing sites would be reviewed in the field during the first winter following treatment to identify any deficiencies in treatment or treatment techniques.</p>
PSR-HYDRO-11	<p>Water drafting requirements. If water drafting becomes a necessary component of the proposed project, drafting would be conducted as described in the NMFS <i>Water Drafting Specifications</i> (NMFS 2001). Screening devices would be used for water drafting pumps to minimize removal of aquatic species, including juvenile fish, amphibian egg masses, and tadpoles, from aquatic habitats. Drafting sites would be planned to avoid adverse effects to special-status aquatic species and associated habitat, in-stream flows, and depletion of pool habitat.</p> <p>If water drafting becomes a necessary component of the proposed project, drafting would be conducted as described in the NMFS <i>Water Drafting Specifications</i> (NMFS 2001). These specifications include the following:</p> <ul style="list-style-type: none"> • Screening devices no greater than 3/32 inch would be used for water drafting pumps to avoid removal of aquatic species, including juvenile fish, amphibian egg masses, and tadpoles, from aquatic habitats. • Drafting sites would be planned to avoid adverse effects to special-status aquatic species and associated habitat, in-stream flows, and depletion of pool habitat. • All drafting sites would occur outside of occupied coho habitat. • Seek streams and pools where water is deep and flowing, as opposed to streams with low flow and small isolated pools. • Pumping rate shall not exceed 350 gallons per minute (gpm). • The pumping rate shall not exceed 10% of the stream flow as measured by a visual observation of water level in relation to a moss line or rock to determine if stream level is dropping due to pumping. • Operators shall keep a log on the truck containing the following information: Operator’s Name, Date, Time, Pump Rate, Filling Time, Screen Cleaned (Y or N), Screen Condition, and Comments.
PSR-HYDRO-12	<p>Avoid trees contributing to stream bank stability. No trees that contribute to stream bank stability or are within an inner gorge (as determined by an earth sciences/physical sciences professional) would be felled.</p>
PSR-HYDRO-13	<p>Cable yarding requirements. Cable yarding corridors would not be larger than 20 feet in width. Stumps or trees (second-growth only) would be used as tail holds. Guylines for the yarder would be anchored to old-growth stumps (not trees) or second-growth stumps or trees surrounding the landing. Skyline operations pull logs fully or partially suspended from the ground, resulting in minimal ground disturbance.</p>
PSR-HAZ-1	<p>Equipment storage, servicing, and fueling limitations. All equipment would be stored, serviced, and fueled at least 150 feet from any stream channel and 50 feet outside of riparian areas and away from unstable slopes. Fuel tankers would be stored outside of riparian areas. When long stretches of road are entirely within riparian areas, smaller refueling devices (under 200 gallons) may be used to refuel large equipment. In such cases, drip pads/pans or other protective devices may be placed under the fueling area.</p>

Element/Title	Requirement
PSR-HAZ-2	<p>Spill prevention, monitoring, and response requirements. All equipment, including hand tools, heavy equipment, and cable yarding equipment, would be checked daily for leaks and equipment with leaks would not be used until leaks are repaired. RNSP staff would ensure a spill kit is maintained on site at all times. Additionally, contractors would equip each piece of heavy equipment with a spill response kit. Should leaks develop in the field, they would be repaired immediately, or work with that equipment would be suspended until repairs are made. In the event of any spill or release of any chemical in any physical form on or immediately adjacent to the project sites or within the project area during operations, the contractor would immediately notify the appropriate RNSP staff (e.g., the project inspector). All contaminated water, sludge, spill residue, or other hazardous compounds would be contained and disposed of outside the boundaries of the project area at a lawfully permitted or authorized destination.</p>
PSR-HAZ-3	<p>Equipment requirements for spark arrestors and fire extinguishers. All equipment would be required to include spark arrestors or turbo chargers that eliminate sparks in exhaust and to have fire extinguishers on site. One shovel or one serviceable fire extinguisher would be in the immediate vicinity of all persons operating chain saws during the dry season. All heavy equipment would be required to carry a 10-pound fire extinguisher with a valid inspection tag.</p>
SPR-HAZ-4	<p>Vehicle parking restrictions. Crews would park vehicles a minimum of 10 feet from flammable material such as dry grass or brush.</p>
SPR-HAZ-5	<p>Radio dispatch requirements in case of fire. RNSP personnel would have a RNSP radio at the park unit which allows direct contact with a centralized dispatch center to facilitate the rapid dispatch of control crews and equipment in case of a fire.</p>
PSR-HAZ-6	<p>Road access requirements. All project roads with active operations must be made passable as soon as reasonable and practicable for emergency vehicles and Park staff.</p>
PSR-HAZ-7	<p>Fire hazard reduction requirements. All felled trees would be brought to the ground and would not be left suspended or hanging in crowns of other trees. Slash would be lopped and scattered to within 3 feet of ground when determined necessary by the project manager or their designee for short-term fire hazard reduction.</p>
SPR-HAZ-8	<p>Inadvertent discovery of unknown material spillage. If there is discovery of unknown spillage from, or free product discovered on or adjacent to the project sites, work would be halted or diverted from the immediate vicinity of the find, and the RNSP hazardous materials coordinator would be contacted. Hazardous materials, if present, would be contained and removed from the site prior to resumption of work.</p> <p>Removal of all contaminants, including sludge, spill residue, or containers, would be conducted following established procedures and in compliance with all local, state, and federal regulations and guidelines regarding the handling and disposal of hazardous materials.</p>
PSR-HAZ-9	<p>NOA notification requirements. To prevent exposure to asbestos dust, workers would be informed of areas where asbestos is present in the roads and unpaved areas subject to vehicle traffic would be kept adequately wetted. Signs would be posted at endpoints of identified NOA road segments to alert users.</p>
PSR-HAZ-10	<p>Burning specifications. Burn piles of removed vegetation would not be larger than 10 feet by 10 feet by 5 feet in size and placed away from the dripline of predominant trees and sensitive plant buffer areas and Riparian Management Zones. Piles would be burned under appropriate conditions as described in the burn plan. A burn permit would be obtained prior to pile burning any removed vegetation. Burning would occur on burn days only or with approval from Cal Fire and NCUAQMD.</p>

Element/Title	Requirement
PSR-NOISE-1	Notification requirements to off-site noise-sensitive receptors. Written notification of project activities would be provided to all off-site noise-sensitive receptors (e.g., residential land uses) located within 1,500 feet of work locations. Notification would include anticipated dates and hours during which activities are anticipated to occur and contact information of the project representative, including a daytime telephone number.
SPR-NOISE-2	Power equipment use and maintenance requirements. All powered heavy equipment and power tools would be used and maintained according to manufacturer specifications. All diesel- and gasoline-powered equipment would be properly maintained and equipped with noise-reduction intake and exhaust mufflers and engine shrouds, in accordance with manufacturers' recommendations.
PSR-UTIL-01	Utility Right of Way notification requirements. The utility company would be notified 5 days before material is hauled that limited road access would be available within portions of their Right of Way.

Table 3
Greater Mill Creek Riparian Management Zones

Watercourse Type	Fish bearing (may be perennial or intermittent) and perennial non-fish bearing		Non-fish bearing and evidence of scour or deposition (intermittent or ephemeral)		
Inner Zone Width ¹	30 feet from confined channel, or channel migration zone		30 feet or to break in slope or other feature that prevents sediment delivery to watercourse, whichever is less		
Inner Zone Canopy Cover Retention ²	80%		60%		
Inner Zone Restrictions	EEZ, no tree removal		EEZ, no tree removal		
Outer Zone Width ¹	130 feet from outer edge of inner zone		20 feet from outer edge of inner zone		
Outer Zone Canopy Cover Retention ²	60%		60%		
Outer Zone Slope	More than 35%	Less than 35%	More than 85%	35 to 85%	Less than 35%
Outer Zone Restrictions	EEZ	EEZ, unless sediment delivery is prevented by a break in slope or another barrier such as a bench ³	EEZ	EEZ, except tethered equipment that does not increase sediment delivery potential over one-end, cable suspension systems	EEZ, unless sediment delivery is prevented by a break in slope or another barrier such as a bench ³

Notes:

1. Zone width measured in slope distance.
2. Canopy cover averaged across 1,000-foot sections of streams.
3. If there is a bench or break in slope that is closer and prevents sediment delivery, then the outer zone can be less than 160 feet from the stream channel.

**Table 4
National and California Ambient Air Quality Standards**

Pollutant	Averaging Period	California Standards	National Standards	Health Effects
O ₃	1-hour	0.09 ppm	--	Breathing difficulties, lung tissue damage
	8-hour ^b	0.070 ppm	0.075 ppm	
PM ₁₀	24-hour	50 µg/m ³	150 µg/m ³	Increased respiratory disease, lung damage, cancer, premature death
	Annual	20 µg/m ³	--	
PM _{2.5}	24-hour ^c	--	35 µg/m ³	Increased respiratory disease, lung damage, cancer, premature death
	Annual	12 µg/m ³	12 µg/m ³	
CO	1-hour	20 ppm	35 ppm	Chest pain in heart patients, headaches, reduced mental alertness
	8-hour	9.0 ppm	9 ppm	
NO ₂	1-hour	0.18 ppm	0.100 ppm ^a	Lung irritation and damage
	Annual	0.030 ppm	0.053 ppm	
SO ₂	1-hour	0.25 ppm	0.075 ppm ^a	Increases lung disease and breathing problems for asthmatics
	3-hour	--	0.5 ppm	
	24-hour	0.04 ppm	--	
Lead	30-day	1.5 µg/m ³	--	Increased body burden and impairment of blood formation and nerve conduction
	Quarter	--	1.5 µg/m ³	
	3-month	--	0.15 µg/m ³	
Sulfates	24-hour	25 µg/m ³	--	Decrease in ventilator function, aggravation of asthmatic symptoms, aggravation of cardio-pulmonary disease
Visibility-reducing particles	8-hour	In sufficient amount to give an extinction coefficient of >0.23 inverse kilometers (visual range to less than 10 miles with relative humidity less than 70%)	--	--
Hydrogen sulfide	1-hour	0.03 ppm	--	Odor
Vinyl chloride	24-hour	0.01 ppm	--	Short-term exposure: central nervous system effects – dizziness, drowsiness, and headaches Long-term exposure: liver damage, cancer

Table 5
Current Vegetation and Cover Types

Cover Type	Alliance	Acres
Old-growth redwood	Redwood forest	2,820
Previously harvested redwood	Redwood forest	13,450
Douglas-fir	Douglas-fir forest	4,300
Douglas-fir-tanoak forest	Douglas-fir-tanoak forest	6,330
Broadleaved evergreen forest	Tanoak forest	550
Red alder	Red alder forest	490
Red alder (riparian)	Red alder forest	500
Sitka spruce forest	Sitka spruce forest	200
Jeffrey pine savanna	Jeffrey pine forest	6
Knobcone pine woodland	Knobcone pine forest	460
Chaparral	Blue-blossom, Huckleberry oak, Shrub tanoak, and Canyon live oak chaparral; Golden chinquapin thickets	1,600
Coastal scrub	Coyote brush scrub	165
Upland prairie	Idaho fescue grasslands, Semi-natural Velvet grass-sweet vernal grass	23
Wetlands	Small-fruited bulrush marsh, Cattail marshes, Pacific reed grass meadows, California pitcher plant fens	11
Barren ground	Not applicable	480
Developed areas	Not applicable	47
Beach strand	Not applicable	68
	Total	31,500

Table 6
Timing of Special-status Amphibian Life Stages that Occur within Aquatic Habitats

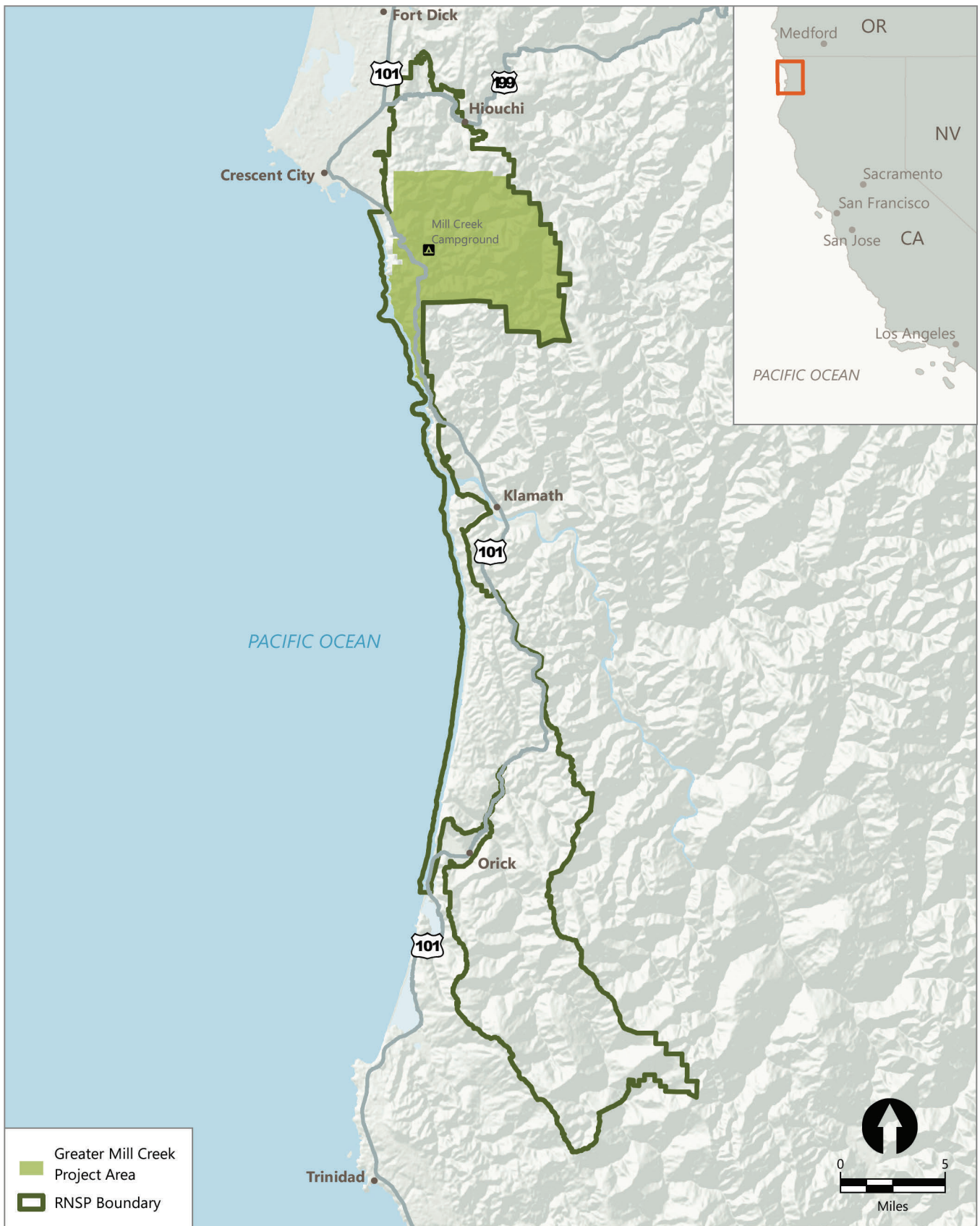
Species	Months											
	J	F	M	A	M	J	J	A	S	O	N	D
Southern torrent salamander												
Oviposition ¹								x	x			
Hatching ¹			x	x	x							
Metamorphosis ²	x	x	x	x	x	x	x	x	x	x	x	x
Pacific tailed frog												
Oviposition ³							x	x	x			
Metamorphosis ⁴	x	x	x	x	x	x	x	x	x	x	x	x
Northern red-legged frog												
Oviposition ⁵	x	x	x	x								x
Hatching ⁶	x	x	x	x	x	x						
Metamorphosis ⁷			x	x	x	x	x	x	x	x		
Foothill yellow-legged frog												
Oviposition ⁸				x	x							
Hatching ⁹				x	x	x						
Metamorphosis ¹⁰								x	x			

Notes:

1. Southern torrent salamander peak oviposition is in August and September in California, with peak hatching occurring in the spring (Tait and Diller 2006).
2. Southern torrent salamander larval development from hatching to metamorphosis takes 2.5 years (Tait and Diller 2006).
3. Pacific tailed frog oviposition occurs between July and September in California (Sever et al. 2001; Karraker et al. 2006).
4. Pacific tailed frog metamorphosis in lowland coastal California populations takes 1 to 2 years (Wallace and Diller 1998, Bury and Adams 1999).
5. Northern red-legged frog breeding occurs for a few weeks between December and April (Calef 1973).
6. Following northern red-legged breeding (see above), hatching occurs within 39 to 45 days (Calef 1973).
7. Following northern red-legged hatching (see above), metamorphosis may take 3 to 5 months (California Herps 2019).
8. Foothill yellow-legged frog breeding in Del Norte County in 2002 to 2007 was initiated in early April and lasted 19 to 52 days, with earlier breeding occurring in low-flow years (Wheeler and Welsh 2008).
9. Foothill yellow-legged frog eggs take 2 to 3 weeks to hatch (Kupferbuerg 1996).
10. Foothill yellow-legged frogs metamorphose in late summer through early autumn (Wheeler and Welsh 2008).

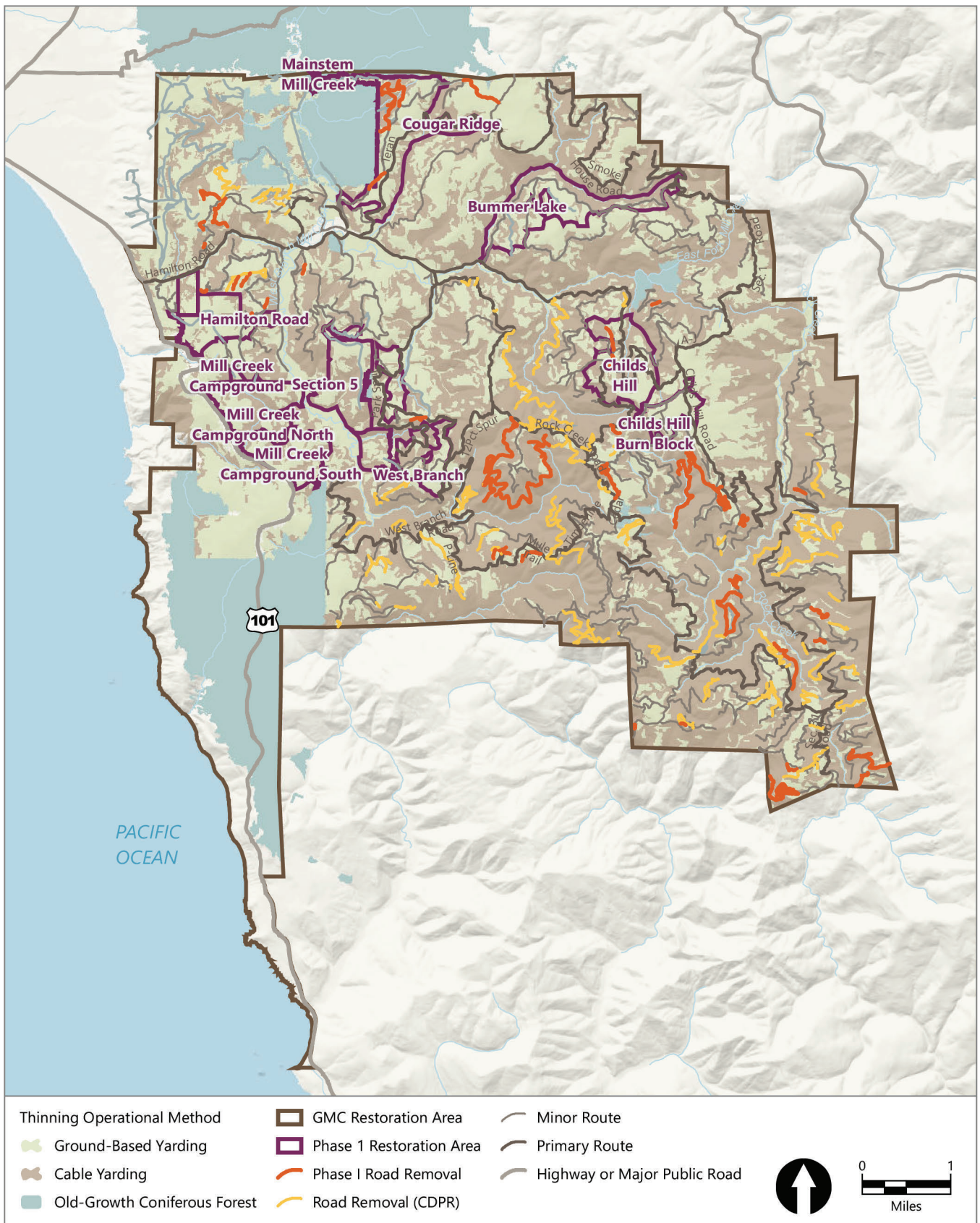
Appendix D

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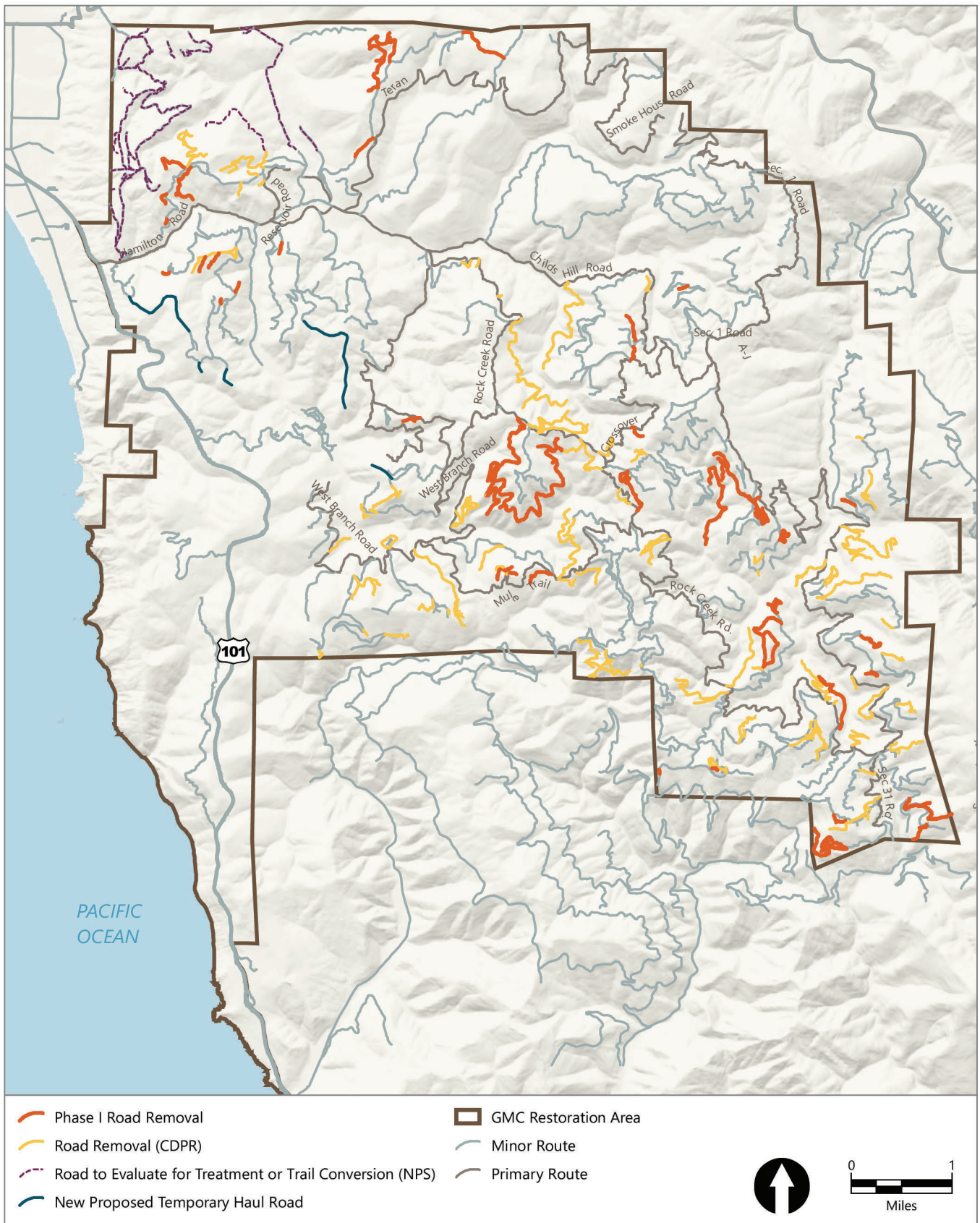
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Figure 1
Project Area and Vicinity
 Greater Mill Creek Ecosystem Restoration Project



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Figure 2
Forest Restoration Operational Methods
 Greater Mill Creek Ecosystem Restoration Project



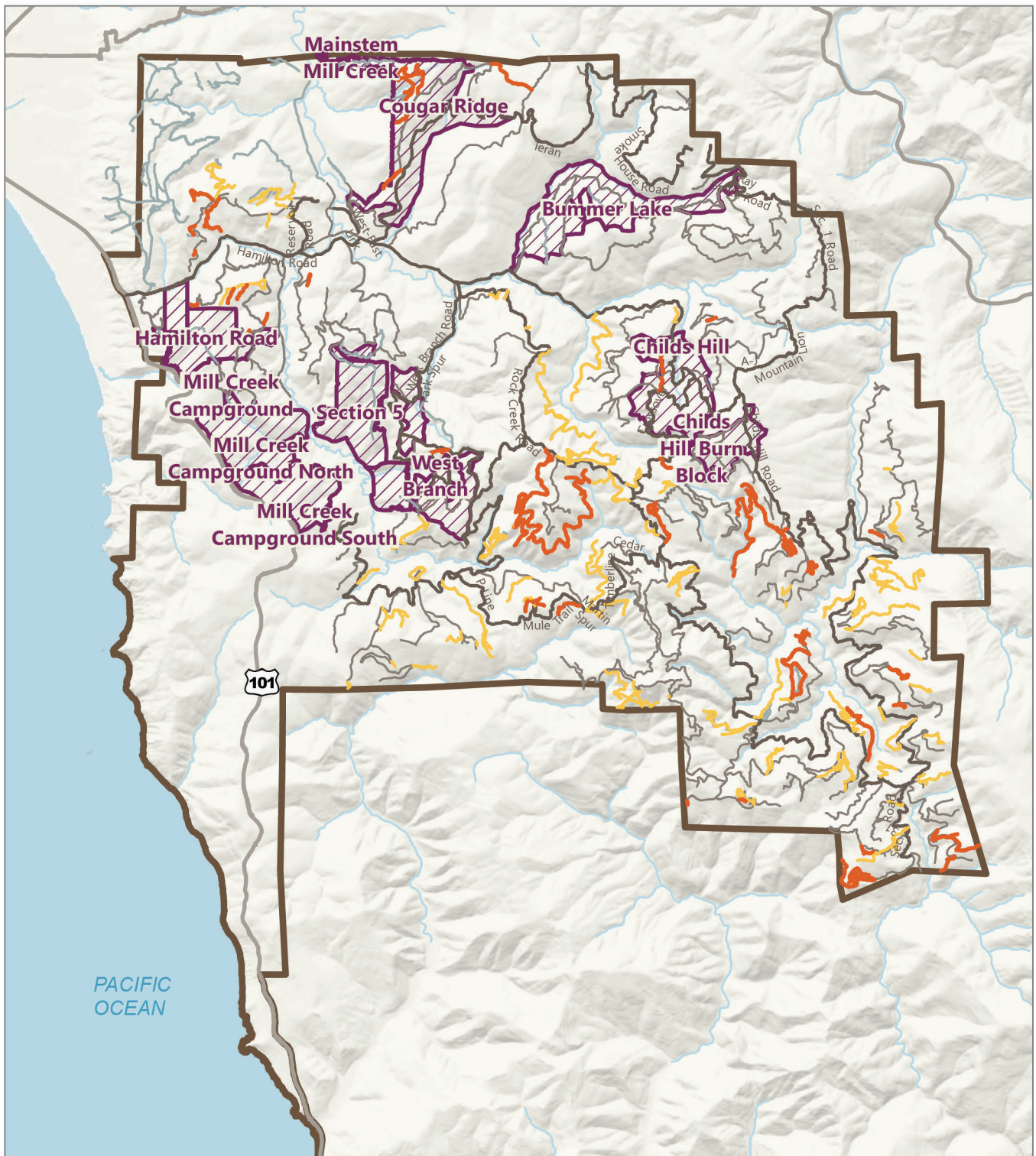
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Figure 3
Roads in the Project Area
 Greater Mill Creek Ecosystem Restoration Project

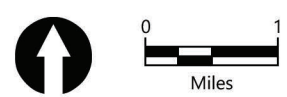


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Figure 4
Streams in the Project Area
 Greater Mill Creek Ecosystem Restoration Project

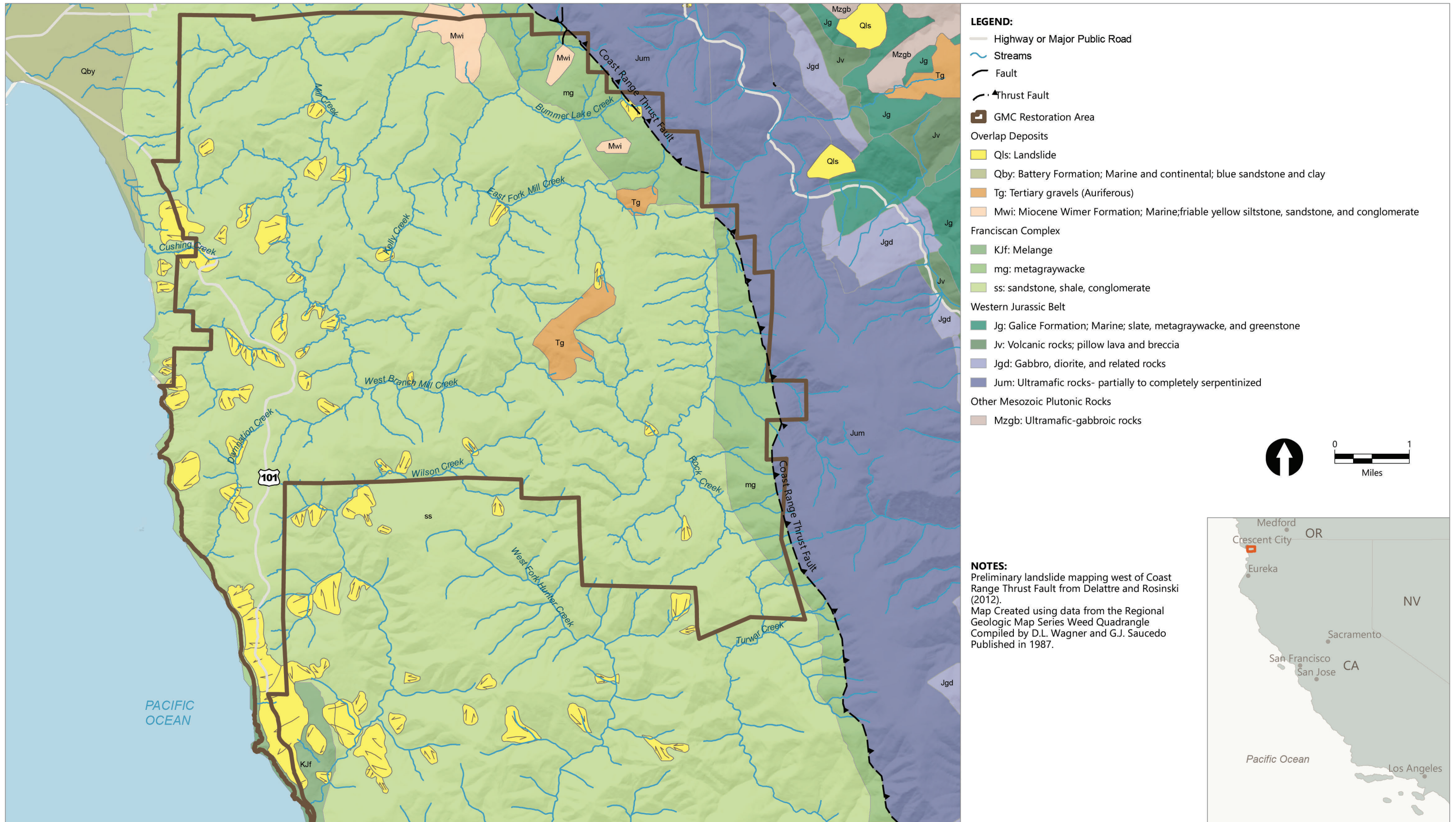


-  Phase 1 Areas
-  GMC Restoration Area
-  Phase I Road Removal
-  Road Removal (CDPR)
-  Minor Route
-  Primary Route
-  Highway or Major Public Road



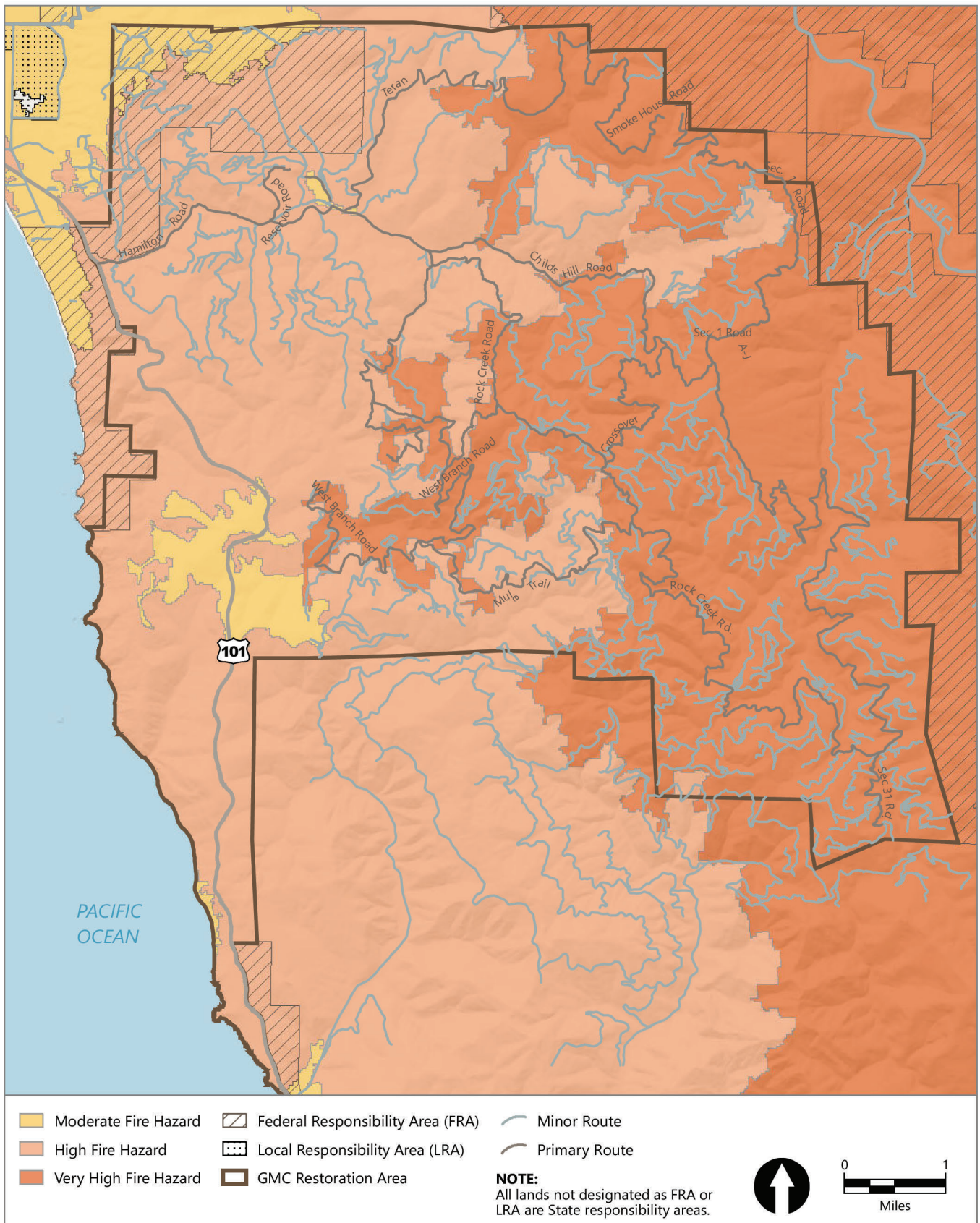
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Figure 5
Phase I Implementation Areas
 Greater Mill Creek Ecosystem Restoration Project



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Figure 6
Geologic Map of the Project Area
 Greater Mill Creek Ecosystem Restoration Project



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Figure 7
Fire Hazards in the Project Area
 Greater Mill Creek Ecosystem Restoration Project

Appendix E

Agency Consultations and Approvals

Appendix E: Agency Consultations and Approvals

CDPR and NPS will perform all necessary reviews and obtain all required permits prior to implementing any component of the Proposed Action. CDPR and NPS retain approval authority for the Proposed Action within the RNSP, and the Proposed Action meets the goals presented in the GMP/GP and GPA. NPS and CDPR will sign separate decision documents for the Proposed Action's NEPA and CEQA reviews, respectively, and CDPR approval is a prerequisite for NPS's approval.

The Proposed Action requires approval or permits from the following federal and state agencies:

- U.S. Army Corps of Engineers (USACE): USACE will issue a Clean Water Act (CWA) Section 404 Regional General Permit for the Proposed Action's impacts to waters of the United States.
- U.S. Fish and Wildlife Service (USFWS): NPS will initiate consultation under Section 7 of the Endangered Species Act (ESA) with USFWS for marbled murrelet and northern spotted owl and USFWS will prepare a Biological Opinion (BO) for the Proposed Action.
- National Marine Fisheries Service (NMFS): NPS will initiate consultation under Section 7 of the ESA with NMFS for potential effects on coho salmon, and NMFS will prepare a BO for the Proposed Action.
- California Coastal Commission (CCC): CCC will approve a Coastal Zone Management Act (CZMA) consistency determination prepared by NPS for restoration activities located in the coastal zone that are proposed as part of the Proposed Action. Because NPS assumes responsibility for CZMA compliance, a Coastal Development Permit is not necessary for activities on CDPR lands.
- North Coast Regional Water Quality Control Board (NCRWQCB): NCRWQCB will issue a CWA Section 401 Water Quality Certification for the Proposed Action's impacts to waters of the state; coverage under Category B of the Waiver of Waste Discharge Requirements for Nonpoint Source Discharges Related to Certain Federal Land Management Activities on National Forest System Lands in the North Coast Region (NCRWQCB 2015) for the Proposed Action's potential water quality impacts from forest restoration and road removal; and coverage under the Discharges of Storm Water Associated with Construction Activity Construction General Permit Order 2009-0009-DWQ for clearing or grading activities occurring outside of the scope of other NCRWQCB approvals.
- California Department of Fish and Wildlife (CDFW): CDFW will issue a Streambed Alteration Agreement for the Proposed Action's work in streams and riparian areas and a Memorandum of Understanding (MOU) for the Proposed Action's potential effects on state endangered, threatened, and candidate species, including foothill yellow-legged frog, Humboldt marten, marbled murrelet, northern spotted owl, and willow flycatcher. A consistency determination with the federal NMFS BO will be prepared for coho salmon; therefore, that species will not be included in the MOU.
- State Historic Preservation Officer (SHPO): Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to consider the effects of their proposed actions on historic properties, including prehistoric or historic sites, buildings, districts, or objects eligible for listing in the National Register of Historic Places. Agencies are required to consult with the SHPO and other parties; identify historic properties; assess the action's potential effects; and avoid, minimize, or mitigate adverse effects to historic properties.

- Native American tribes: Section 106 of the NHPA also requires NPS to engage in government-to-government consultation with federally recognized tribes regarding the identification and evaluation of historic properties, and the assessment of project effects. Traditional cultural properties and cultural landscapes are potential historic properties.

Appendix F
Draft Greater Mill Creek Vegetation
Management Plan

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Map 2-b. Hydrology of DNCRSP (identifies perennial, intermittent and ephemeral streams, stream classes, fish distribution (anadromous, fish-bearing, potentially fish-bearing based on intrinsic steelhead potential).

Map 2-c. Historic vegetation (including estimate of non-forested area based on 1948 aerial imagery).

Map 2-d. Current vegetation cover types.

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Appendix C - DNCRSP List of Sensitive Natural Communities.

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Appendix E - Project requirements.

Appendix F - Forest Restoration Strategy.

Appendix G - DNCRSP EDRR Target Species List.

1 Purpose and Need

1.1 Introduction

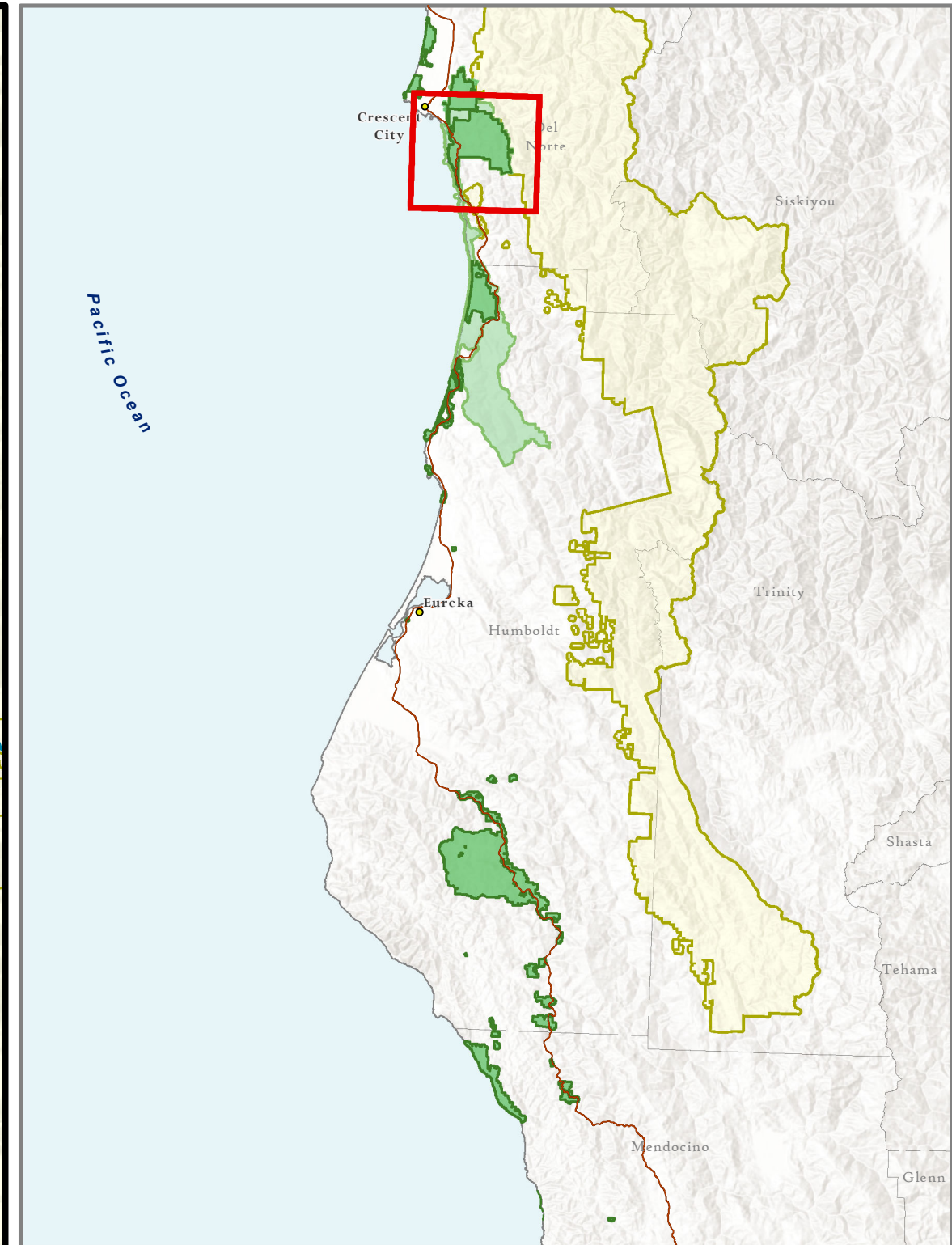
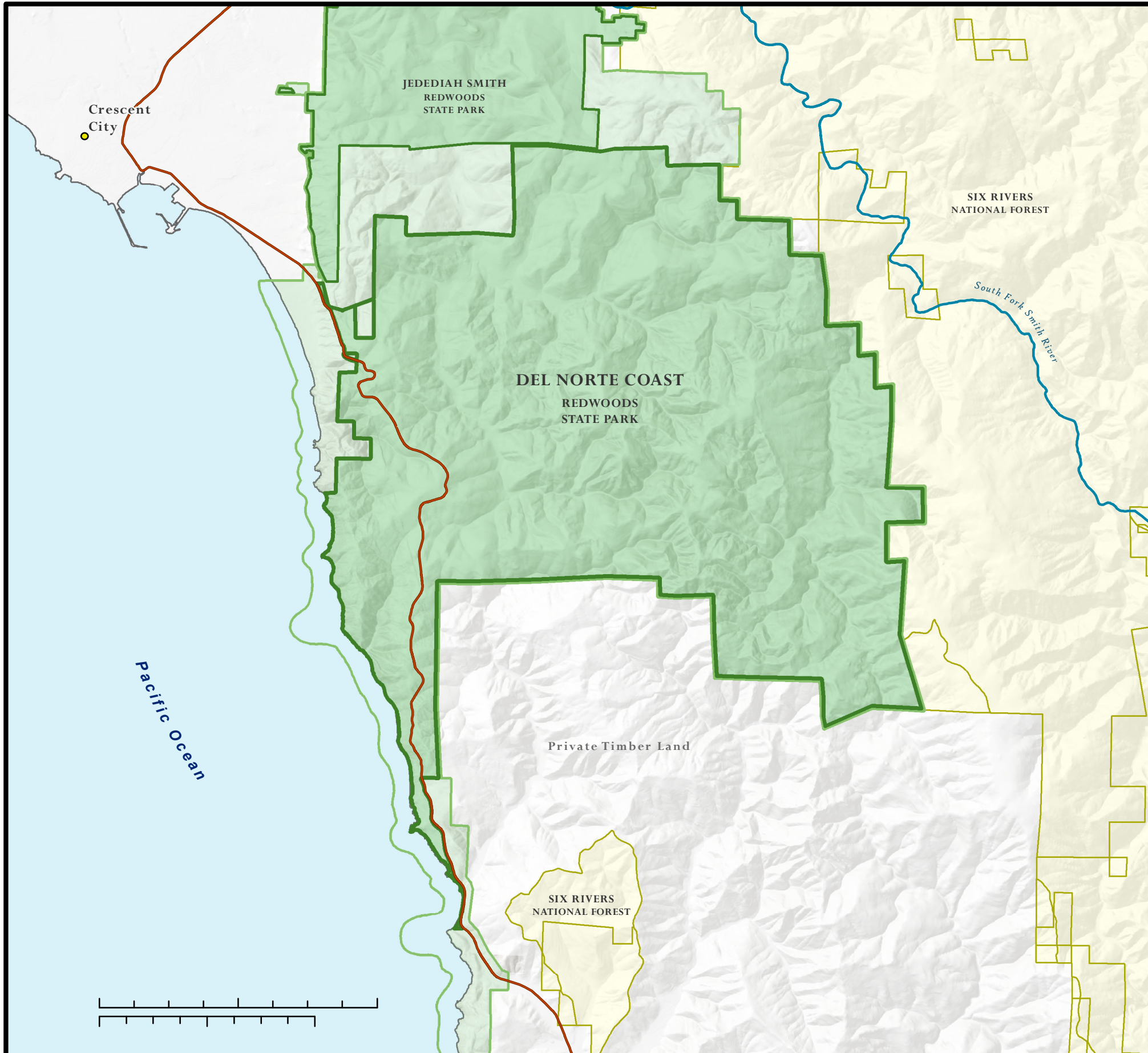
This document provides a framework for the implementation of a vegetation management program at Del Norte Coast Redwoods State Park (DNCRSP). DNCRSP is one of four parks that make up Redwood National and State Parks (RNSP) and is managed under a joint General Management Plan/General Plan (RNSP 2000, CDPR 2010). The original DNCRSP, founded in the 1927, more than doubled in size in 2002 with the addition of the 25,000 ac Mill Creek property (Sometimes referred to as the Mill Creek Acquisition/Addition (MCA) or the Mill Creek Watershed – the latter is somewhat misleading since it includes portions of watersheds outside of Mill Creek). In 2005 Congress approved the expansion of the Redwood National and State Parks boundary and the GMP/GP was amended in 2010 to include the MCA (CDPR 2010). Subsequently, the Mill Creek Watershed Management Plan (CDPR 2011a) was released in 2011, and though specific to the MCA, the plan is generally relevant for all of DNCRSP. The GMP/GP, its amendment for the MCA, and the Watershed Management Plan all call for the development of a Vegetation Management Plan that would describe the parks' vegetation communities and guidance for maintaining and restoring these communities.

Vegetation, defined as all the plant species of a region and the way those species are arranged (Sawyer and Keeler-Wolf 1995), is fundamental to healthy ecosystem function. Vegetation is influenced by, and is influencing, a combination of factors such as moisture, soil chemistry, temperature and disturbance. Today's ecosystem conservation approach stems from the need to step away from single-species management and move toward a more proactive, holistic effort -- conserving the broad umbrella of habitat and community around sensitive, threatened, or endangered species. This "coarse filter" approach assumes that the vegetation type is the signpost for the biological environment in which any individual species is embedded (CNPS Vegetation Program, <http://www.cnps.org/cnps/vegetation/>). The preservation of vegetation protects faunal habitat and ecosystem processes, while upholding biodiversity and intrinsic vegetation patterns. This plan will guide vegetation management at DNCRSP while facilitating the protection, maintenance, and restoration of natural ecosystem processes thereby preserving the state's biological diversity.

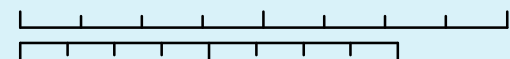
Visitors from around the world are drawn to California State Parks (CSP) to admire the diverse and complex vegetation that makes up the scenery of the State Parks system. Del Norte Coast Redwoods State Park, famous for its ancient redwood forests, is one such place and is now part of the UNESCO World Heritage Site of RNSP. The Park is located primarily in the Smith River watershed in Del Norte County and is one of twenty-three units within the North Coast Redwoods District (NCRD) (Map 1-a, Location).

Del Norte Coast Redwoods State Park

Vegetation Management Plan - Location



- | | |
|--|---|
|  NCRD Park Units |  Highway 101 |
|  Redwood National Park |  Major Watercourse |
|  Six Rivers National Forest |  California Counties |



The North Coast Redwoods District is dedicated to upholding the State Parks' mission "To provide for the health, inspiration and education of the people of California by helping to preserve the state's extraordinary biological diversity, protecting its most valued natural and cultural resources, and creating opportunities for high quality outdoor recreation." Specifically, the NCRD efforts focus on protecting, managing and interpreting our prime cultural and natural resources (especially ancient redwood forests, wild and scenic rivers, and unspoiled coastline); creating high quality recreational opportunities with associated infrastructures; and providing outstanding services to all, in a safe environment.

The impetus for the establishment of DNCRSP was to make available to the people for their inspiration and enjoyment forever, the scenic grandeur of the coast of Del Norte County with all the scenic, historic, scientific and recreational values and resources of the area. The MCA was acquired to restore late-seral forest characteristics and associated natural functions that maximize benefits to the salmonid species and wildlife associated with late seral forest.

1.2 Background

With the arrival of the first European settlers both subtle and not so subtle changes began to occur within the Smith River watershed and the surrounding area. A seminal year in these changes was 1853 when the first mill was opened in Crescent City and logs cut from the old-growth redwoods in the Mill Creek watershed were hauled over Howland Hill to feed it (Bearss 1969). That was the same year of the Yontoket massacre, which was the largest single event that destroyed so much of the Tolowa Dee-ni' nation. From 1851-1856 the majority of Native Americans living in the DNCRSP area were either killed by European settlers and the diseases they brought with them or were confined to distant reservations. With the demise of the local population, the use of fire and other land management practices that had existed since time immemorial were abruptly halted. These indigenous management practices were important to the development of the vegetation as it appeared when first observed by Euroamericans. The lack of Native American burning, combined with changing attitudes about fire use and fire suppression, resulted in increased time spans between wildland fires. The lack of fire allowed woody plants to convert grasslands into forests and shrublands, and shrublands to become forests. The resulting landscape has become more vulnerable to high severity fires where plants and animals dependent on frequent fire have declined. The most visible impacts on DNCRSP are results of logging. The majority of the logging was conducted by Hobbs Wall from 1908 to 1939 and subsidiaries of Stimson Lumber Company from 1954 to 2000, resulting in over 27,000 ac of intensively harvested forest (mostly clearcuts) within the Park (see chapter 2.5.1). These logged over lands are now dominated by overly dense, young forests where progression towards late-seral habitat is hindered, altered landscapes where species diversity has been diminished and the introduction of exotic plants threaten to change vegetation communities. Several plant pathogens are found

within the property and Sudden Oak Death (SOD), found both north and south of Del Norte County, is likely to have a significant impact on the Park soon. DNCRSP is likely to be impacted by increased visitor use and development including a potential rerouting of Highway 101 in the Last Chance Grade Project.

1.3 Need and Purpose for the DNCRSP Vegetation Management Plan

The Park's goals as described in the GMP/GP include restoring or replicating "lands, ecosystems, and processes that have been altered by modern human activities." The goals also state that "Redwood National and State Parks serve as a laboratory for scientific study and research that promotes preservation, restoration, and understanding of the parks' resources." The GPA for the MCA more specifically describes a vegetation management plan as follows:

Develop a Vegetation Management Plan ... that will guide the restoration of late-seral forest habitat throughout much of the property. Identify priority areas, treatment types, areas to be treated, performance standards, monitoring strategies, and adaptive management, as needed. The Vegetation Management Plan should also address management of invasive plant species present on the property, management related to Port-Orford-cedar root disease, SOD and management of rare and sensitive vegetation types, such as the *Darlingtonia* fens to ensure their long-term protection. The role of transportation corridors as venues for the spread of invasive weeds and diseases should also be addressed in the Vegetation Management Plan (CDPR 2010).

The Watershed Management Plan (WMP) states that a complete vegetation management plan should:

- Identify conditions or specific areas of high priority for restoration, "treatment alternatives, monitoring methods and adaptive management as needed."
- Map existing vegetation communities including exotic plants with priorities and methods to control or eradicate.
- Discuss "the known and potentially occurring sensitive plants" and make "recommendations for inventorying, monitoring and assessing these resources."
- Include a Prescribed Burn Plan.
- Address pathogens and cultural vegetation management (CDPR 2011a).

CSP began restoration efforts in DNCRSP in 2003 and have since treated approximately 5,500 ac of overly dense forests, removed over 70 miles of roads and installed 100 wood structures into streams. These efforts have helped to improve and protect vegetation and wildlife habitat, but are only the beginning of the restoration needed.

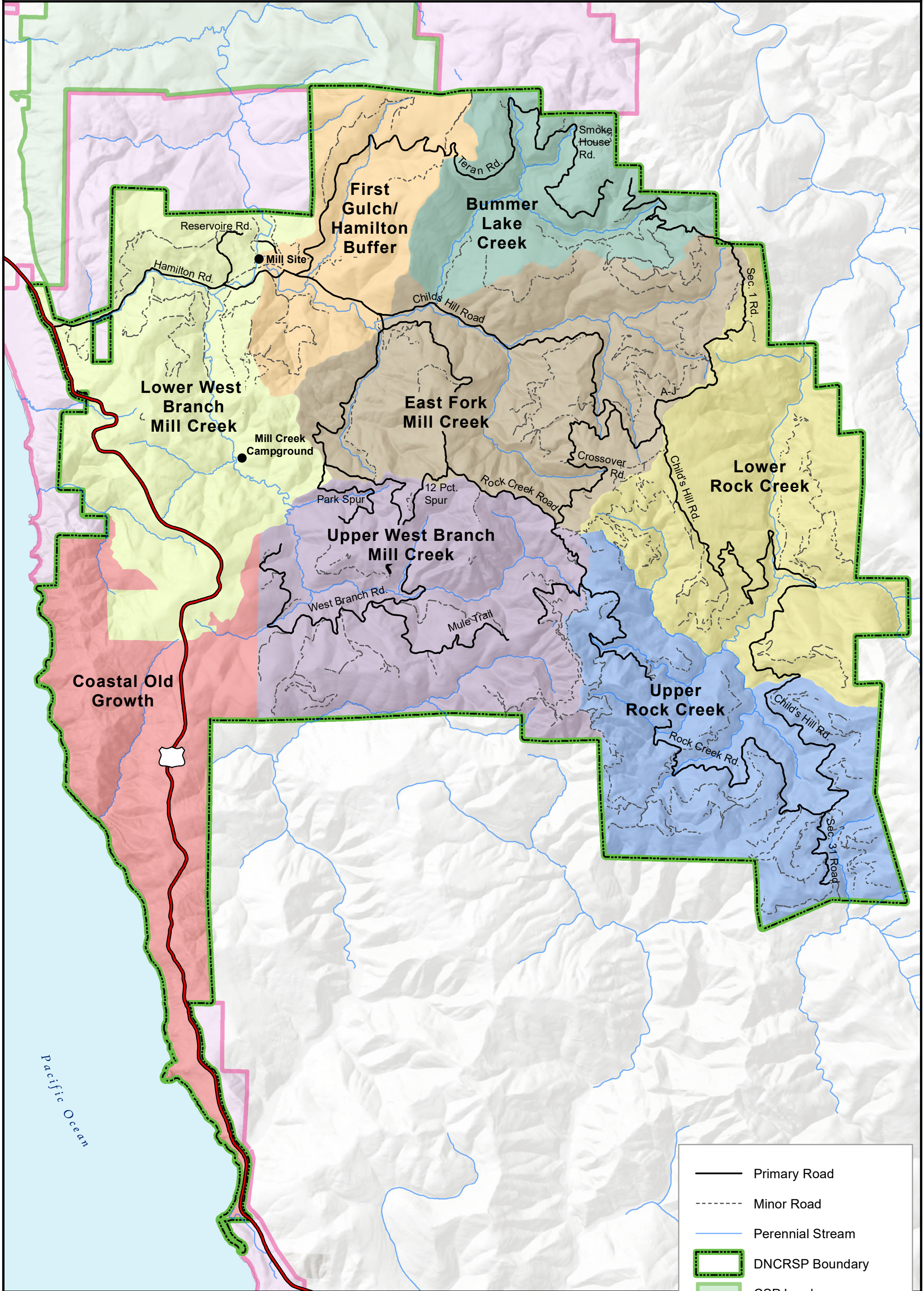
2 Description of the Environment

2.1 Location

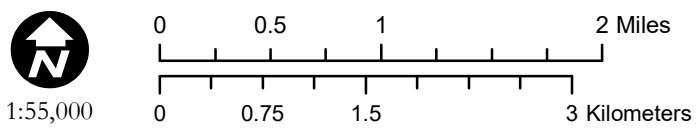
Del Norte Coast Redwoods State Park is located along the northern California coast, approximately 5 miles southeast of Crescent City in Del Norte County (Map 1-a, Location). DNCRSP is bordered by Jedediah Smith Redwoods State Park and two small parcels of Redwood National Park to the north, Six Rivers National Forest (Smith River National Recreation Area) to the East, private industrial timber land to the south, and the Pacific Ocean to the west. The park includes a total of 31,353 ac, including 6,344 ac given or sold to the State of California between 1924 and 1966, and ~25,000 ac acquired as part of the MCA. The original park is located in the southwest region of the current boundary, and Highway 101 runs through north-south. The MCA lies to the north and east of the original park and stretches inland towards the South Fork of the Smith River. Access to the park from Eureka is via Highway 101 north, and from Crescent City via Highway 101 south. The main access to the MCA from Highway 101, Hamilton Road, is located 2 miles (3 km) north of the Mill Creek Campground. Major roads within the Park include Hamilton road, West Branch road, Rock Creek road, Child's Hill road, and Bummer Lake road. For the purpose of this vegetation management plan the park was subdivided into 8 regions: Coastal old-growth, Upper West Branch, Lower West Branch, First Gulch/Hamilton Buffer, Bummer Lake, East Fork, Lower Rock Creek, and Upper Rock Creek (Map 2-a, Park Regions).

2.2 Climate

The climate along the north coast of California is characterized as a Mediterranean climate, with cool wet winters and warm dry summers. The fog belt extends approximately 13 km (8 mi) inland (CDPR 2011a), and is an important influence on vegetation in much of the park (Dawson 1998) though reductions in fog over time have been observed (Johnstone and Dawson 2010). In general temperatures remain relatively moderate throughout the year due to the influence of the Pacific Ocean. However, farther inland temperatures reach greater extremes, and large temperature gradients can occur within park. In Crescent City the average monthly minimum and maximum temperatures range from 8 to 19 °C (41 to 67 °F), but temperatures in the eastern portions of the park can drop below 0 °C and exceed 36 °C. Most of the precipitation falls as rain between October and April, and snow accumulation occurs at higher elevations. In general, DNCRSP receives high amounts of precipitation relative to other redwood parks further to the south, and the highest amounts of precipitation fall closer to the ocean and at high elevations. Annual precipitation over the last 30 years (1988-2017) ranged from 46 to 143 in (117-363 cm) with an average of 90 in (229 cm) (California Department of Water Resources, Gasquet Ranger Station).



	Primary Road
	Minor Road
	Perennial Stream
	DNCRSP Boundary
	CSP Land
	NPS Land



2.3 Geology and Soils

Most of DNCRSP lies within the California Coastal Range and 462 ac are within the western Klamath Mountains along the eastern boundary of the park. The Coast Range and Klamath mountain provinces are separated by the Coast Range Thrust Fault, which runs north-northwest through the Rock Creek watershed. Regional tectonic convergence and uplift continue to contribute to the development of steep and incised drainages. The bedrock to the west of the fault line is primarily the Broken Formation of the Eastern Belt Franciscan Complex, and contains late Jurassic to early Cretaceous sandstone (largely graywacke), shale and conglomerate. Along and east of the Coast Range thrust fault, pre-Nevadan bedrock, common in the Klamath Mountains, is present along with highly sheared serpentinite and peridotite. Many of the ridges in DNCRSP are capped with deposits of marine, estuarine and fluvial siltstone, sandstone, and conglomerate from the early Pliocene to late Miocene, deposited during development of the "Klamath Peneplain". They crop out along Childs Hill and Little Bald Hills. Holocene to Pleistocene fluvial terraces and floodplain deposits exist within the park and are susceptible to liquefaction and/or landsliding. Geologic activity, erodible soils, and high levels of rainfall have created steep and potentially unstable slopes. Past land use and the construction of poorly designed roads have destabilized some slopes and are presently contributing to additional instability. Mapping by Merrill et al. (2011) revealed point locations in the center of historic mass wasting within the MCW. Using SINMAP, a software package for assessing shallow slope instability, they also mapped zones most prone to shallow failure (CDPR 2011a). Based on the SINMAP modeling there are project areas located within geologic units with potentially unstable soils.

As part of the analysis for potential rerouting of Highway 101 around slope instability at Last Chance Grade, Wills (2000) mapped numerous landslides and their activity along the west side of the park.

Seismicity: Goldfinger et al. (2012) estimated the probability for a magnitude 8 Cascadia subduction zone earthquake capable of affecting vertical change along significant portions of the North Coast, as having a probability of occurrence between 37 and 42% by 2062; for a magnitude 9 earthquake they estimated a 7-10% probability over the same time period. Because of its capability, recurrence and timing of its last known earthquake, this is the source for the earthquake design at the project site. Other faults that trend offshore west from DNCRSP include the Big Lagoon-Bald Mountain thrust and the Trinidad thrust. The Whaleshead fault zone in Southern Oregon is another potential seismic source.

Table 2a: Faults and Parameters near DNCRSP

Fault Name & Geometry[1]	Slip Rate (mm/year)	Recurrence Interval (years)	Maximum Moment Magnitude	Last Known Fault Displacement
Big Lagoon-Bald Mountain (thrust)	0.9	1380	7.5	No Data
Whaleshead (strike slip)	2.4	145	7.0	No Data
Trinidad (thrust)	4.4	1900	7.5	No Data
Cascadia Subduction Zone (thrust)	40	200-800	9.0	1700

(References: Topozada, T., Borchardt, G., Haydon, W., Petersen, M., Olson, R., Lagorio, H., and Anvik, T., 1995, Planning scenario in Humboldt and Del Norte counties, California for a great earthquake on the Cascadia Subduction Zone, California Department of Conservation, Division of Mines and Geology, Special Publication 119, 157 pages; and http://earthquake.usgs.gov/research/hazmaps/products_data/2002/faults2002.php)

Changes in geology and terrain, combined with the climate, create highly variable soils in DNCRSP. The soils and Quaternary fluvial deposits of the MCW are derived from the Franciscan Formation and Tertiary deposits. Most soils in the Park are well developed because the mild wet climate has caused a high degree of weathering of the underlying materials. Many of the soils have strongly developed surface horizons that are rich in organic matter and nutrients, particularly in areas that have coniferous vegetation. In some places, the top soil is relatively thin owing to the steep slopes and past logging disturbance. In 2008, staff from the NRCS completed soil mapping of Redwood National and State Parks, including DNCRSP, providing a modern soil survey with a wealth of soil data (USDA 2008). Twenty soil associations and two soil series of various slopes are identified in this mapping. A description of all soil map units present in the MCA can be found in Appendix C to the Local Watershed Plan (CDPR 2011a). Map Unit Descriptions were published as part of the 2008 Soil Survey (USDA 2008).

With respect to surface erosion, approximately 75% of the land base has a severe erosion hazard rating. Side slopes have a severe erosion hazard rating, while ridge crests have a medium rating and broader valley floors have a slight erosion hazard rating (CC Trail).

Very deep soils made from sandstone with some colluvial mudstone, schist and metasedimentary colluvial, and mixed alluvial residual soils support many forest types (CC Trail, CDPR 2016, CDPR 2011a). 1,168 ac of strongly alkaline serpentine soils along the Coast Range Thrust Fault, near the eastern park boundary, create poor growing conditions for most forest types. However, these soils support a high diversity of serpentine endemic plants. Roads and treatment locations containing serpentine soils (Merrill et al. 2011) can contain naturally occurring asbestos minerals, some of which pose a hazard to human health. All of the serpentine-bearing roads within the park are greater than one mile from a sensitive receptor; however workers may be exposed to asbestos dust minerals if they are in proximity to on site or fugitive dust.

2.4 Topography and Hydrology

The highly irregular terrain in DNCRSP includes elevations that range from sea level to 2,247 feet on the summit of Child's Hill. The park contains high ridgelines and deep drainages, and steep slopes above 50% grade are common across the landscape. The steep terrain combined with the high amounts of precipitation and locally weak, underlying geology and soils can lead to mass wasting events that transport large amounts of sediment to streams.

Road scars are ubiquitous and dissect all the subwatersheds within the Mill Creek watershed. Numerous road-related landslides are visible within the MCA.

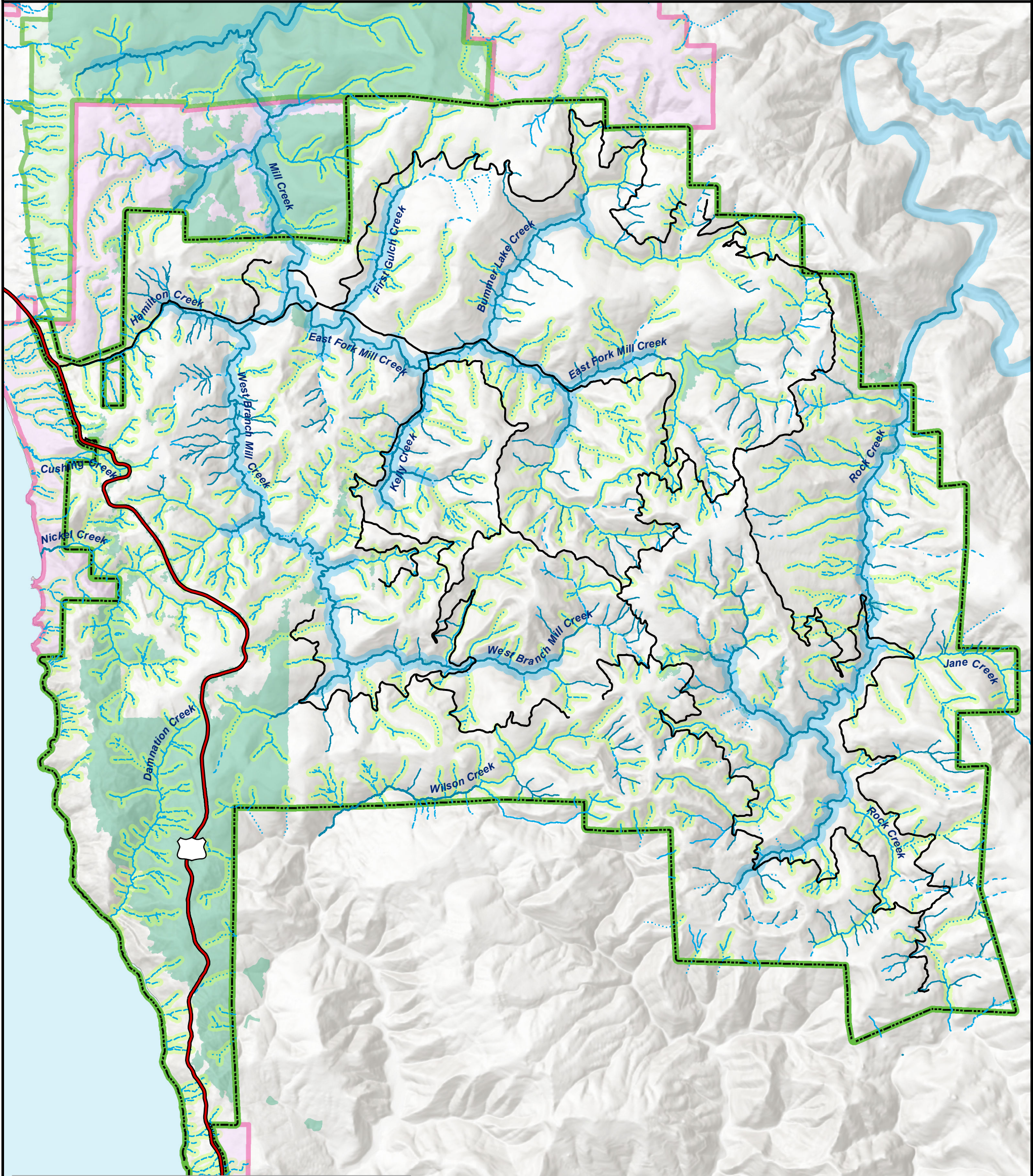
The Mill Creek watershed is the largest watershed in the park, covering 17,023 ac within the park boundary (Map 2-b, Hydrology). The mainstem of Mill Creek flows north, through Redwood National Park and Jedediah Smith Redwoods State Park, into the Smith River, a nationally designated Wild and Scenic River. Important sub-watersheds include the East Fork, West Branch, First Gulch, and Bummer Lake.

Rock Creek is the second largest watershed in the park spanning 7,735 ac, and entering the South Fork of the Smith River to the east.

The headwaters for Turwar and the west fork of Hunter creek begin along the southern boundary of the park and flow through private timberland and the Yurok Reservation before draining into the Klamath River.

Drainages on the western side of the park flow directly into the Pacific Ocean, and include Damnation creek, Nickel creek, Cushing Creek and portions of the headwaters of Wilson Creek.

The North Coast Regional Water Quality Control Board (NCRWQCB) regulates water quality in the area of California where the Park is located and is responsible for implementing the Water Quality Control Plan for the North Coast Region (Basin Plan). All watersheds in the Park are located in the political boundaries of the Klamath River Basin,

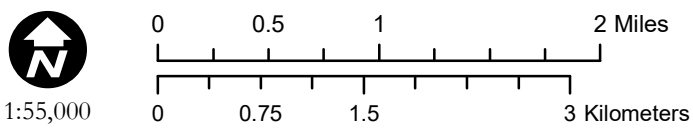


Sources:
GIS routable hydrology layer using a flow accumulation model derived from integrated 1 m lidar data acquired in 2007 by Sanborn. Prior to calculating flow accumulation, the data were hydrologically enforced. The elevations of artificial impediments (i.e. roads) were modified to simulate how man-made drainage structures such as culverts or bridges affect continuous downslope flow. Most hydro-enforcement lines were verified in the field during the 2011 road assessment. Additional attributes for this dataset were transferred from:
- perennial/ intermittent/ ephemeral: National Hydrography Dataset (NHD) from the US Geological Survey,
- fish-bearing: CalFish (anadromous fish and stream habitat data) updated with 2015 data for the Smith River Basin collected by CDFW,
- potentially fish-bearing: NOAA intrinsic potential (IP) model for Steelhead for the Klamath Mountain Province updated in 2012. It models the IP of stream reaches to provide favorable habitat characteristics for spawning and rearing juvenile steelhead. The IP model uses geomorphic and hydrological attributes (mean annual discharge, channel gradient, and channel constraint). Indices for the model are derived from a 10 m DEM and PRISM precipitation data.
- THP stream classes from CalFire

Streams

- Anadromous
- Potentially Fish-Bearing, Unverified
- Class 1 (fish-bearing)
- Class 2
- Class 3
- Class 5 (Unclassified Perennial)
- Class 6 (Unclassified Intermittent)
- Unclassified Ephemeral

- Primary Roads
- Old Growth
- DNCRSP Boundary
- CSP Land
- NPS Land



which covers an area of approximately 10,830 square miles within northern California. The Basin Plan contains implementation plans and policies for protecting waters of the basin, and incorporates by reference plans and policies adopted by the State Water Board. (NCRWQCB, 2011).

Water quality in the park watersheds ranges from extremely clear and free of any pollutants, in streams that drain from old-growth forests, to turbid, poor quality in areas previously impacted by logging; however, while there are short duration spikes in turbidity, the overall water quality is among the best in Northern California.

Groundwater in the Park is relatively free of pollutants and considered very high quality because very few potential pollution sources exist. The groundwater table in the Park fluctuates annually, depending on rainfall and seasonal temperatures. The groundwater table varies throughout the area because of the geological or topographical influences. The area does not serve to recharge commercially available aquifers. There is a public water source at the Mill Creek campground, fed by a well in the floodplain of West Branch Mill Creek.

Rock Creek won't get as cold as Mill Creek because it runs north-south, has more solar exposure, and the serpentine soils tend to produce more heat than forested soils. However, the higher overall stream gradient tends to cool the water and Rock Creek is not federally or state listed as temperature impaired.

Information on flood regimes and flow monitoring can be found in the Local Watershed plan (CDPR 2011a), though data in the Park itself is comparatively sparse - most analysis relates Smith River flows as a proxy for the park watersheds.

2.5 Historical Land and Resource Use

The information contained in this overview is intended to provide a summary of cultural resources and land use with an emphasis on those relevant for vegetation management. Background information was obtained from the Archaeological Survey Report for the Coast to Crest Trail Project, Del Norte Coast Redwoods State Park, prepared by Rebecca Kellawan and Allika Ruby from Far Western Anthropological Research Group (2014), additional sources are cited within the text.

2.5.1 Prehistoric Context

Prior to Euro-American settlement and active timber harvesting, the landscape in DCNRSP was utilized by Native American tribes. Archeological sites have been found in northwestern California that date human presence in the area as far as the end of the Pleistocene (13,500-10,000 years before present [B.P.] in the form of isolated clovis points (Hildebrandt 2007). Intact archaeological sites have been dated to approximately 9,000 years B.P. (Hildebrandt and Hayes 1983). Beginning about 9,000 BP climatic

conditions and archaeological evidence suggest people were using a more diverse range of environments on the north coast (White 2013). Mobile lithic tool kits, macro botanical remains, and site distributions suggests both lowland and upland resources were used. (Hildebrandt 2007; White 2013). There is a lack of archaeological evidence for the occupation of northwest California during this period. No known sites or artifact types that date to the Middle Holocene have thus far been documented (Hildebrandt 2007). Between 4,500 B.P. and 1,500 B.P. residential patterns shift to the use of specialized hunting camps in upland settings with more permanent villages in riverine and coastal environments. After 1500 B.P. an overwhelming amount of archaeological evidence points to increased coastal resource use and permanent residential sites (Hildebrandt 2007).

At the time of Euro-American contact, the area around DNCRSP was occupied by the Athabascan speaking Tolowa. Tolowa territory, as defined by early ethnographers, included the Smith River watershed and adjacent coast from the Winchuck River in Oregon to Wilson Creek in northwestern California (Kroeber 1976; Tushingham 2013) The Tolowa occupied a number of major villages along the coast and inland riverine environments (Tushingham 2013) Three ethnographic villages have been identified in DNCRSP. (Citation?) For nine to 10 months of the year the Tolowa remained on the coast, two of their main food staples being marine mammals and shellfish. However, from early September to November when interior resources (acorns, salmon) predominated over coastal ones, they lived in three forested areas that include a belt of redwood forest, a Douglas fir-tanoak flat region, and a riverine area around the Smith River. The redwood forest immediately inland from the coast generally lacked food sources, however there is recent evidence of habitation sites (Gould 1975). The Douglas fir-tanoak habitat beyond the redwood forest furnished an abundant supply of acorns to provide the third staple food. Dispersed trees along the slopes of canyons were little used by the Tolowa, since slopes were too steep for easy movement or collection, but groves situated on grass-covered creekside flats were heavily exploited. Individuals and individual families claimed ownership of particular oak groves or even specific trees as well as fishing and eeling places along the streams, and it was to these places that they moved in the fall (Gould 1975). The presence of seasonal camps and acorn processing areas within the Mill Creek Watershed is evidenced by the tanoak bowl mortar found near the Miller-Rellum mill site, ethnographic location of Tolowa village site. Women with burden-baskets full of acorns would move constantly back and forth between the oak groves and their home villages on the coast during this period, and they processed and stored the acorns in these coastal villages. Before leaving an oak grove after the annual acorn collection, families set fire to the grass over the entire flat. This was done to reduce underbrush and keep the grass from growing too high so that it would be easy to see and pick up the fallen acorns during the next year's harvest (Gould 1975). Few of the best oak groves from former times remain intact today, owing to commercial stripping of tanbark

oak, road building and residential development on these precious parcels of level land (Gould 1975).

Travel corridors linked trade networks with neighboring tribes. Like the neighboring Yurok, the Tolowa built dwellings from splintered redwood planks; other typical structures within a village included a sweathouse, and detached areas devoted to tool-making. Active land stewardship was widely integrated into culture and society, and techniques such as prescribed fire were used to maintain healthy ecosystems (GMP 1999, IMR Stillwater Sciences 2002).

The ethnographic boundary between the Tolowa and Yurok tribes is identified as Wilson Creek by Waterman (1920), however, the Yurok Tribe places the traditional boundary farther north, at Damnation Creek.

Local contact with Europeans came relatively late compared to the rest of California, and first encounters were short. The earliest recorded interaction with the Tolowa did not happen until 1828 when Jedidiah Smith's fur trapping party passed through. Initially, the greatest effect on local tribes was fast spreading disease (e.g. cholera and small pox). Then in the 1849 gold was discovered in the Klamath region, and many new settlers moved in. The Contact Period was devastating to local Indian populations, who suffered unprecedented social upheaval and population crashes resulting from widespread violence, forced removals, and disease.

2.5.2 Historic Context

The following chapter is adapted from History Basic Data, Redwood National Park, Del Norte and Humboldt Counties, California by Edwin Bearss (1969), which includes an extensive history of the north coastal redwood region. This compilation provides extraordinary detail and should be consulted for additional historical information regarding the area; additional sources are cited within the text.

The earliest documented non-native inland expedition near the park was conducted by Jedediah Smith. Smith and his fur trapping party arrived in what is now Redwood National Park during the summer of 1828 before continuing north to Oregon. His journey is documented by diary entries that detail interactions with Native peoples and the difficulties his party faced during the expedition. Journal entries for June 1828, indicate that Smith and his party camped at Nec-Kah, an Indian village near the mouth of Cushing Creek. The following day they moved northward across the Enderts Beach area (Sullivan 1934). The party then continued north up the coast. As part of the 1850s gold rush, Crescent City was founded in 1853 and quickly emerged as a trading center, its natural harbor was used to transport gold mining supplies to Yreka and local infrastructure was developed. Timber harvesting followed to supply the boom, progressing slowly at first. Although mining was part of the early development of the region, it was the gigantic coast

redwood stands that secured a stronghold for the lumber industry, and dominated Del Norte County's economy until the last half of the twentieth century. Important historic trails roads and railroads include: the Kelsey and Bense Trails connecting Crescent City to Klamath mining camps; remnants of previously lost sections to the Redwood Highway (Highway 101); and rail lines constructed by the Hobbs, Wall and company and operated under the Del Norte and Southern Railroad.

2.5.2.1 Lumber Industry

Hobbs Wall began logging in the Rellim Ridge area around Howland Hill Road around 1908 and gradually worked their way south, then up the West Branch of Mill Creek. Their logging camp was designed to be moved on the rail line to keep the workers close to the area being harvested. The camp was self-sufficient enough to include a cook house and a school, and they often cleared the land and burned the slash to allow grazing to support the camp. Early camps were located near Howland Hill Road and moved south up the ridge. The demand for spruce during World War I motivated them to move the camp to the area around the gate on Hamilton Road near Hwy 101. In 1920 Camp 12-2 was established along the West Branch of Mill Creek where it stayed until Hobbs Wall abruptly ceased operations in 1939 and filed for bankruptcy. By this time most of the West Branch of Mill Creek and areas to the west (much of Nickel and Cushing Creek) had been logged except for the upper reaches of the West Branch (south and east of the Mill Creek campground) which remained intact until logging resumed in 1954.

Much of the remainder of the Hobbs Wall lands in Mill Creek were purchased by Harold Miller in 1944. Miller worked for Stimson Lumber Company and was the son in law of its owner C.W. Stimson. Miller ran a subsidiary company called Rellim Redwood Company and later Miller-Rellim - Rellim being Miller spelled backwards. Before Miller did any logging in Mill Creek, he spent considerable time and energy with Del Norte County on tax issues. Individual members of the Miller family owned different properties, which made them eligible for a higher tax rate than if they were all owned by one company - the logic being that a small owner could log their land quickly, but a large landowner would need more time to clear their land (Richard Cox personal communication). While Miller was busy consolidating the family land and negotiating a lower tax rate, he worked out an agreement so that the Hamilton Brothers' Lumber Company could access their timberland through the Rellim property (Ross and Adams 1983). The current Hamilton Road is the result of this agreement and the area logged during this period appears to be near the top of Childs Hill in the Rock Creek drainage.

In 1954, Rellim began logging the lower reaches of the East Fork of Mill Creek, where the logging style appeared a little less intensive than Hobbs Wall and Hamilton methods. Rellim cleared most of the trees but left seed trees, and generally cleared at least 70% of the timber to avoid paying taxes on the value of the standing timber. The company

planned to sustain their logging operation in the area for the long term. In these early years the company sold their timber to the Hamilton Brothers and other local mills for processing, sharing in the profits. By the early 1960s Miller began planning to build an on-site mill that would increase company profits and allow them to haul directly to the mill using all off-road access. A subsidiary company, Miller Redwood Company, was formed to run the mill. They opened the sawmill on site on May 19, 1964 where timber was processed. Large roads were built to accommodate the off-highway logging trucks that never had to meet public road weight limits, and they expanded capacity over the years by building planer, veneer, and small log mills on site.

The logging methods changed over the years as regulations were introduced and markets changed. For example, Rellim switched to clearcutting, along with other companies, in the early 1960's (Arvola 1976), and increased the pace of logging to pay for large land purchases (e.g. Rock Creek). In the 1970's new regulations introduced retention requirements to meet water quality standards. New Forest Practice rules came into law in 1973, and stocking requirements prompted the practice of post-harvest planting. Aerial seeding was at best uncommon on the property, but replanting using local seeds of redwood and Douglas-fir became the norm around 1975. A few years later they began burning all of the units after logging to improve conditions for planting and seedling survival. Herbicides were also used in the later years to control competing vegetation. Douglas-fir was usually planted in greater numbers than redwood since redwoods were likely to sprout from existing stumps. In most cases local seeds were propagated. The only known exceptions to the use of seeds from the property are three progeny trials on a total of less than 100 ac (historic Stimson Douglas-fir stands E51E0706, 161E2811 and possibly 151E2701), a few hybrid bishop pines in the Rock Creek drainage (Stimson stand 151E1302) (that have since been cut down) and a few giant sequoias planted in several stands around Upper First Gulch and Teran. Rellim also purchased seedlings occasionally from local nurseries when stocks were low. During the 1970's intense logging within DNCRSP also moved into the Rock Creek and upper East Fork drainages. Logging rates were not sustainable by modern standards, but by most definitions of the time, Rellim responsibly cared for the land. Most timber professionals at the time considered old-growth to be messy forests full of decaying trees that should be cut down to make way for young, uniform, fast growing forests that could produce a consistent product (though inferior to old-growth in wood quality). In order to make this model sustainable, and to keep the mills operating, Rellim purchased neighboring tracks of land from other owners, including the Jones Lumber Corporation, and individual landowners Hamilton, Hoffman and Viser.

By the late 1970's Rellim was running out of prime old-growth to log (Schrepfer 1983) so they transitioned into cutting less productive lands and second growth that had been logged by Hobbs Wall. They helicopter logged high value trees from remote areas (such

as Port-Orford cedars from the upper reaches of Jane Creek), and even cut some hardwood stands to convert them to conifers. By the 1980's much of the Mill Creek watershed existed as fragmented timber harvest units. In the 1990's timber resources within the MCA were highly depleted and Rellim closed the Mill in 1993, rather than retool for smaller logs, but saw profits steadily increase as wood was sold to more modern mills equipped for the smaller logs. If harvest rates were to be maintained, a ten year gap in harvesting was looming for the Rellim company (Richard Cox, personal communication). The owners discussed scaling back from two to one logging crew and contracting out other pieces of the operation to avoid the gap, but the cost of developing their habitat conservation plan continued to rise and Stimson (who had dissolved the Rellim company) decided to sell all of their land in California and focus on their main holdings further north. When logging stopped in 2000, approximately 120 ac of old-growth remained within the 25,000 ac Rellim property.

The timber industry left cultural and historic resources including abandoned logging equipment, early logging camps (though the buildings have been torn down), the mill site and supporting structures. The demonstration forest lodge and main saw mill were removed by Stimson but other buildings (sans equipment) including the plainer and veneer mills are still present but in disrepair. The early era of logging relied on steam donkeys and, according to a report by Madej et al. (1986), the techniques associated with steam donkeys "resulted in large clearcut areas, heavy concentrations of slash, and intense localized ground disturbance surrounding landings and skid trails." After about 1930, the steam donkeys were replaced by crawler tractors, which allowed for selective or partial cutting, but clearcutting remained the norm. As the West Branch of Mill Creek was logged, few trees were left and much of the slash was burned to make pasture lands. Much of Rellim Ridge (now part of JSRSP) and the lower reaches of the West Branch of Mill Creek were intensively managed for grazing by the Hoffman family, including various strategies to remove redwood stumps until 1962 (Howard 2003).

The extensive history of timber harvesting throughout the twentieth century, has left most of DDCRSP with second growth forest (approx. 28,000 ac) that is dramatically different from the previously existing old-growth forests and other habitat types present before logging. First, the massive trees that took centuries to develop have been replaced by a young, small and dense forest. This resulted in a loss of the complex structures that old-growth forests provided, and many threatened and endangered species rely upon for critical habitat. Logging operations also regularly manipulated the tree populations for resource use, affecting genetics, species composition and diversity, and simplifying forest structure into a uniform forest similar to a plantation. Other vegetation types such as chaparral, prairie, and savanna have been diminished and in some cases lost at DDCRSP due to habitat conversion associated with logging and the lack of fire.

2.5.2.2 Environmental Preservation

In the early 1900's, a growing conservation movement was emerging, and there was increasing support nationally for preserving natural treasures in parks. The first major effort to preserve redwood groves occurred in 1901 with the establishment of Big Basin State Park, but the efforts gained significant momentum in 1918 with the founding of the Save the Redwoods League (the League). In 1919 Madison Grant (one of the League founders) and Stephen Mather (director of the National Park Service) visited Mill Creek and decided that a redwood national park should be located in the watershed. From this time on there was continued interest from the League to preserve old growth redwood in the area, and in 1925, old-growth redwoods along the coast were purchased with the help of the League and transferred to State Parks to establish DNCRSP in 1927. In the 1930's the League attempted to create a Redwood National Park in Mill Creek, but this and six early efforts by congress failed. In later years (1941-1942), much of the area logged by Hobbs Wall was purchased and incorporated into DNCRSP, including the Mill Creek Campground area.

The debate about whether to make and where to put a redwood national park was long and complex, culminating in the Johnson administration and the League preferring Mill Creek while the Sierra Club pushing for Redwood Creek. In response Miller united with other lumber companies to form the Redwood Region Conservation Council and lobbied for the timber industry. In 1966 Miller began clearcutting a section of his land adjacent to JSRSP while he was in Washington lobbying for the Park to be placed elsewhere in part because there wasn't much old-growth left on his land and because of the devastating effect it would have on the local economy. If not for Miller's efforts and the discovery of the three tallest trees in the world in Redwood Creek, things might have turned out differently. In 1968 Redwood National Park was placed primarily in Redwood Creek (Spence 2011). However, a small coastal strip was included to connect PCRSP and DNCRSP and approximately 2,300 ac of the Mill Creek watershed (just upstream from JSRSP) was transferred from Rellim in exchange for land elsewhere. In 2002, the Mill Creek property was finally purchased and integrated into California State Parks as part of DNCRSP, except for one small portion that was included in JSRSP (Rellim Ridge). The successful preservation of the land in DNCRSP was a struggle that lasted for over 80 years, and resulted in parks in need of restoration from the years it remained under timber management.

2.6 Fire History

Understanding the role of fire in forests on California's North Coast has been ambiguous (Lorimer et al. 2009). In the northern reaches of the redwood range, where DNCRSP is located, the previous consensus among researchers and managers was that fire was

rare. Veirs (1982) found that humid coastal sites in RNSP had return intervals up to 500 years. The hypothesis was that fire regimes were driven by climate gradients, and the wetter and cooler climate in most of DCNRSP would limit the spread of fire. Additionally, natural ignition from lightning was infrequent, and few strikes would result in a fire because of climate conditions such as summer fog.

More recently, higher frequency fire intervals of about 10 years have been found in Prairie Creek Redwoods State Park (Brown and Swetnam 1994), and many studies along the coast in the northern redwood range have confirmed a frequent fire return of less than 50 years (Stuart 1987, Brown and Baxter 2003). It is now believed that natural gradients in fire regimes were overridden by Native American land use, and cultural burns were the primary source of ignition along the coast (Lorimer et al. 2009). It is important to recognize that fire in DNCRSP was likely highly variable across the landscape, and factors such as climate, human populations, vegetation, and topography all influenced historical fire regimes.

Following the addition of the Mill Creek watershed a fire history study was completed and discovered that fire frequency was much higher than previously thought (Norman 2007). From 1700-1850 the mean fire interval was 21 years and ranged from 11 to 26 years across 8 sites. Following 1850, the mean fire interval increased to 28 years, and only one fire was recorded at one site following 1920, meaning that many areas in DNCRSP have not seen fire in a century. It should be recognized that this study was limited to the MCA.

Norman 2007 suggested that patterns of fire regimes in and around DNCRSP were likely explained by an extensive history of cultural burning. Prior to 1850 fires were ignited by Native Americans that lived in the Mill Creek area for thousands of years, most recently the Tolowa. It was also believed that changes in the fire frequency were likely the result of changes in human land use because the fire history closely followed the known ethnographic record. For example, a decline in fire frequency around 1780 could correspond to a known cholera outbreak that reduced the Tolowa population and, therefore, scaling down management of the landscape. Annual burning or higher fire frequency intervals likely existed near villages, important resources, and travel corridors with longer intervals further away from these areas (Norman 2007). The Tolowa regularly used xa'slh-nvt, or control burn, in forests, meadows, and open areas where plants were collected and animals hunted. Burns were timed according to the rains so the fire could be controlled. The practice of controlled burning likely resulted in low intensity fires that mostly impacted the understory.

The old growth to the southwest of the Park likely experienced a similar fire frequency and intensity to what was found in the MCA. However, it was also likely that fire frequency immediately adjacent to the ocean was highly variable, and less frequent. Redwood in particular has a set of biological traits that suggest the species is highly adapted to fire (e.g. thick bark, flammable litter, basal resprouting), and redwood likely has a competitive

advantage in a frequent low intensity fire regime. Norman (2007) found evidence of more severe, less frequent fire in Rock Creek watershed as compared to the Mill Creek watershed. Lightning was more frequent, the terrain steeper, and fuel moisture was less influenced by the ocean leading to drier conditions in late summer. Vegetation communities such as chaparral, Jeffrey pine savanna, and pine forests likely resemble what is found in the western Klamath mountains, but have not been studied in the park. Klamath forests burned frequently (11.5 - 16.5 years), and varied with aspect with less frequent fire on northern aspects (Taylor and Skinner 2003). The fire intensity and severity likely differed from the Mill creek watershed, and the Klamath Mountains experienced more a mixed severity fire regime.

After the mid nineteenth century, Anglo-European settlers began to occupy the area, and dramatically altered the fire regime across DNCRSP. Around the turn of the century, settler attitudes towards fire use changed, the practice of cultural burning was banned, and gradually fire use ceased. The loss of human ignition sources and Native American fire management also coincided with policy of wildland fire suppression. By 1920 much of the land in and around DNCRSP entered a period of fire exclusion. Starting in the late 1970's the timber company regularly burned after harvesting to make it easier to plant and to improve seedling survival. These burns mostly consumed leftover slash and coarse woody debris, leaving previously harvested stands deficient of coarse woody debris. Some of these fires escaped into neighboring stands, but were quickly put out. The Klamath fire in 1988 reached over 6,000 ac, but only about 100 ac in the southeastern corner of the park were affected. Forests that had evolved for over 10,000 years in the presence of frequent fire were now in a largely fire-free landscape, and most of the land in DNCRSP has not experienced a fire in nearly a century.

2.7 Vegetation

Most of DNCRSP lies within the Outer North Coast Ranges of the California Floristic Province, with 462 ac on the eastern park boundary within the Klamath Ranges (Baldwin et al., 2012). The Outer North Coast is characterized by redwood, mixed-evergreen, and mixed-hardwood forests and is bounded to the east by the serpentine-rich Klamath subregion. The distribution and species composition of vegetation is largely determined by temperature-moisture gradients (both topographic and coastal). Soil texture, chemistry, and time since last disturbance (fire, landslides, and, to a lesser extent, wind) were the other major variables influencing species composition before Euro-American settlement. Many of the historical ecosystems still persist today, and biodiversity remains relatively high; however, logging and land conversion has dramatically altered vegetation communities in DNCRSP. Nearly all of the remaining old-growth within DNCRSP is located in the southern portion of the original park. The northern portion consists of relatively older (>80 years) second growth surrounding the Mill Creek Campground.

2.7.1 Historic Vegetation

Prior to European settlement, most of DNCRSP was heavily forested, and was predominantly old-growth redwood (*Sequoia sempervirens*) forest, especially on the lower slopes. Sitka spruce (*Picea sitchensis*) was common on the coast and Douglas-fir and tanoak (*Notholithocarpus densiflorus*) were more common in the interior and on upper slopes. On ridgetops and in portions of the Rock Creek watershed, tanoak and madrone were dominant species. Redwoods were uncommon outside of drainages. Ridgetops and south facing slopes with thin or serpentine soils (especially in the eastern and northeastern portion of the Park) were often more open, with chaparral and savannas. Many of these areas have grown into forest, but in areas, where edaphic conditions limited or prohibited tree growth, a great diversity of plant life persists. These unique vegetation types are described below.

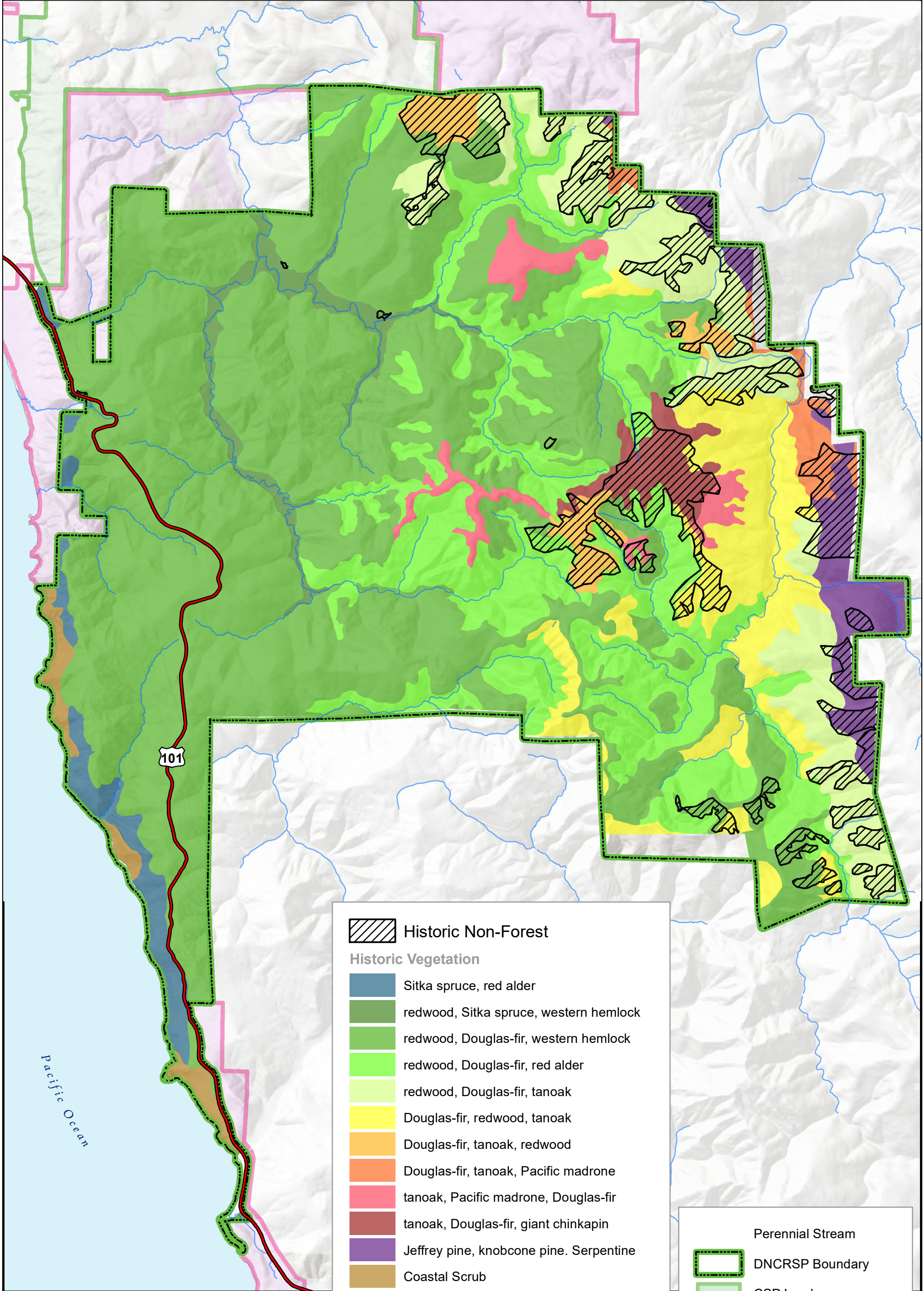
The Natural Resources Conservation Service (NRCS) soils data delineates the Park into coarse soil type units and describes ecological site classes for each soil unit (USDA 2008). In the survey that covered the entirety of RNSP, all of DNCRSP was identified as forestland (where the historic climax plant community was dominated by a 25 percent overstory canopy of trees), except for 300 acres of coastal scrub. Based on physical properties, forested landscapes were divided into 24 ecological sites that characterize and quantify forestland by its ability to produce various kinds, amounts, and proportions of vegetation, along with its characteristic plant communities. Eleven of these ecological site classes occur in DNCRSP. In many cases the forestland classes represent the vegetation that has developed because of the disrupted fire regime and therefore does not always represent pre-european conditions. To identify areas with non or lightly forested vegetation types NCRD staff used 1948 georeferenced aerial imagery and classified the areas into prairie, prairie with scattered trees, shrubland, shrubland with scattered trees, and shrubland with scattered trees and patchy prairie (Table 2-b). Areas were considered either prairie or shrubland if no trees were present; and prairie or shrubland with scattered trees when trees were estimated to cover $\frac{1}{4}$ or less of a shrub or grassland area. Polygons were hand digitized for these areas using ArcMap. The historic non-forested areas identified in the old photos represent a snapshot in time at DNCRSP, approximately 100 years after fire regimes were altered by European influences, and therefore likely underrepresent the area historically occupied by non-forest habitat types. Map 2-c (Historic Vegetation) shows the NRCS ecological classes overlain with the non-forested areas identified in the 1948 photos, which together offer guidance for the appropriate species composition with the understanding that the georeferenced photos are not perfectly aligned and that vegetation adjacent to the identified non-forested areas were also likely either non-forest or were influenced by frequent fire, and were often on

relatively low-quality soils where hardwoods and open forests or grasslands likely prevailed.





Table 2-b. Historic vegetation typing for non and lightly forested areas identified in 1948 aerial imagery and digitized in ArcMap.

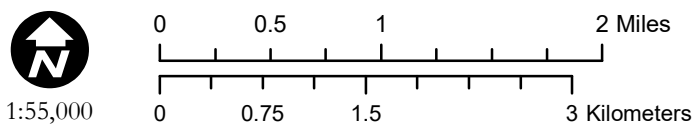
Historic Veg Type	Area (ac)
Prairie	8
Prairie w/scattered trees	186
Shrubland	695
Shrubland w/scattered trees	2312
Shrubland w/scattered trees and patchy prairie	85
Total Historic Non-Forest	3,286

The 1948 historic non-forest areas include two small prairies, one near the current mill site, and the other near the junction of Rock Creek Road and Childs Hill Road. Other prairies and shrublands existed along the eastern edge of the park. A larger prairie appears to have already been converted to young forest near Bense Trail (a road that has since been removed). On top of Child's Hill an area that appears as shrubland in the 1948 photos was likely prairie prior to the change in fire regimes. Other prairies may have existed along the West Branch of Mill Creek, but this area had been logged prior to our earliest (1936) aerial photos. We estimate that 20% of the historic non-forested areas (from 1948) persisted in a non-forest condition into the early 2000's, and the rest grew into a forest. Approximately 25% of the historic non-forest was logged between 1948 and 2000 and then managed for conifer dominated forests. There are also areas that were classified as chaparral based on recent imagery but are sufficiently dense with young trees that they will revert to forest quickly unless a disturbance prevents it.



-  Historic Non-Forest
- Historic Vegetation**
-  Sitka spruce, red alder
-  redwood, Sitka spruce, western hemlock
-  redwood, Douglas-fir, western hemlock
-  redwood, Douglas-fir, red alder
-  redwood, Douglas-fir, tanoak
-  Douglas-fir, redwood, tanoak
-  Douglas-fir, tanoak, redwood
-  Douglas-fir, tanoak, Pacific madrone
-  tanoak, Pacific madrone, Douglas-fir
-  tanoak, Douglas-fir, giant chinkapin
-  Jeffrey pine, knobcone pine. Serpentine
-  Coastal Scrub

-  Perennial Stream
-  DNCRSP Boundary
-  CSP Land
-  NPS Land



* Historic vegetation based on NRCS soils data
* Historic non-forest based on 1948 aerial imagery

2.7.2 Current Vegetation

Since the expansion, botanical surveys have documented 437 species in DNCRSP, including 26 tree species, 66 shrubs, 265 forbs, 65 grasses and 15 ferns. In Appendix A, the Park list of all vascular plants (exported from the NRCD Botanical Survey Database, CSP 2018) species are identified as native/ non-native and as of cultural significance.

Based on CSP field survey reports, at least 25 vegetation alliances as defined in *A Manual of California Vegetation* (MCV, Sawyer et al. 2009) are present in DNCRSP. The names of the alliances are derived from the names of the prominent plant species according to membership rules. The following tree-dominated vegetation alliances are found in the park: Redwood, Douglas-fir (with inclusions of Port Orford cedar forest), Douglas fir-tanoak, Red Alder, Tanoak and Sitka Spruce forest, Knobcone Pine woodland, and Jeffrey Pine savanna. Because current survey data and imagery are not sufficient to map shrub and herbaceous alliances parkwide, these alliances were grouped into 13 vegetation cover types plus 3 other cover types (developed areas, barren ground and beach strand). Shrub-dominated alliances in upland areas were grouped into “chaparral” and include a matrix of the Blue blossom, Huckleberry oak, Shrub tanoak, and Canyon live oak chaparral as well as Golden chinquapin thickets alliances. The other shrub dominated cover type is “coastal scrub”, which is mainly represented by Coyote brush scrub and smaller patches of Coastal bramble in DNCRSP. Arroyo willow thickets are included in the cover type wetlands. Herbaceous-plant dominated alliances in the park are grouped into two cover types. “Wetlands” includes Small-fruited bulrush marsh, Cattail marshes, Pacific reed grass meadows, California pitcher plant fens, and inclusions of Slough sedge swards. A second herbaceous cover type is upland prairies with Idaho fescue grasslands and the semi-natural Velvet grass-sweet vernal grass meadows and Pampas grass patches. Current vegetation types generally follow a west to east gradient with coastal scrub existing along the coast, followed by a narrow strip of Sitka spruce. Redwood dominates much of the property, but gives way to Douglas-fir and hardwoods (tanoak and madrone) on ridgetops. The dominant vegetation is more variable in the Rock Creek drainage than elsewhere, but usually consists of redwood, Douglas-fir and/or tanoak. The eastern and northeastern edges of the Park, where serpentine and peridotite soils limit or prohibit tree growth partially consists of lower montane mixed conifer stands containing Port-Orford-cedar, knobcone, Jeffrey, western white pine (*Pinus monticola*), and the occasional sugar pine (*Pinus lambertiana*) while other portions are savanna or chaparral, and often have few trees or are devoid of trees all together.

At a finer scale, associations of two or more dominant or characteristic species were noted for some alliances during project related surveys. Where associations have been assigned to alliances, this information will be included in the alliance description.

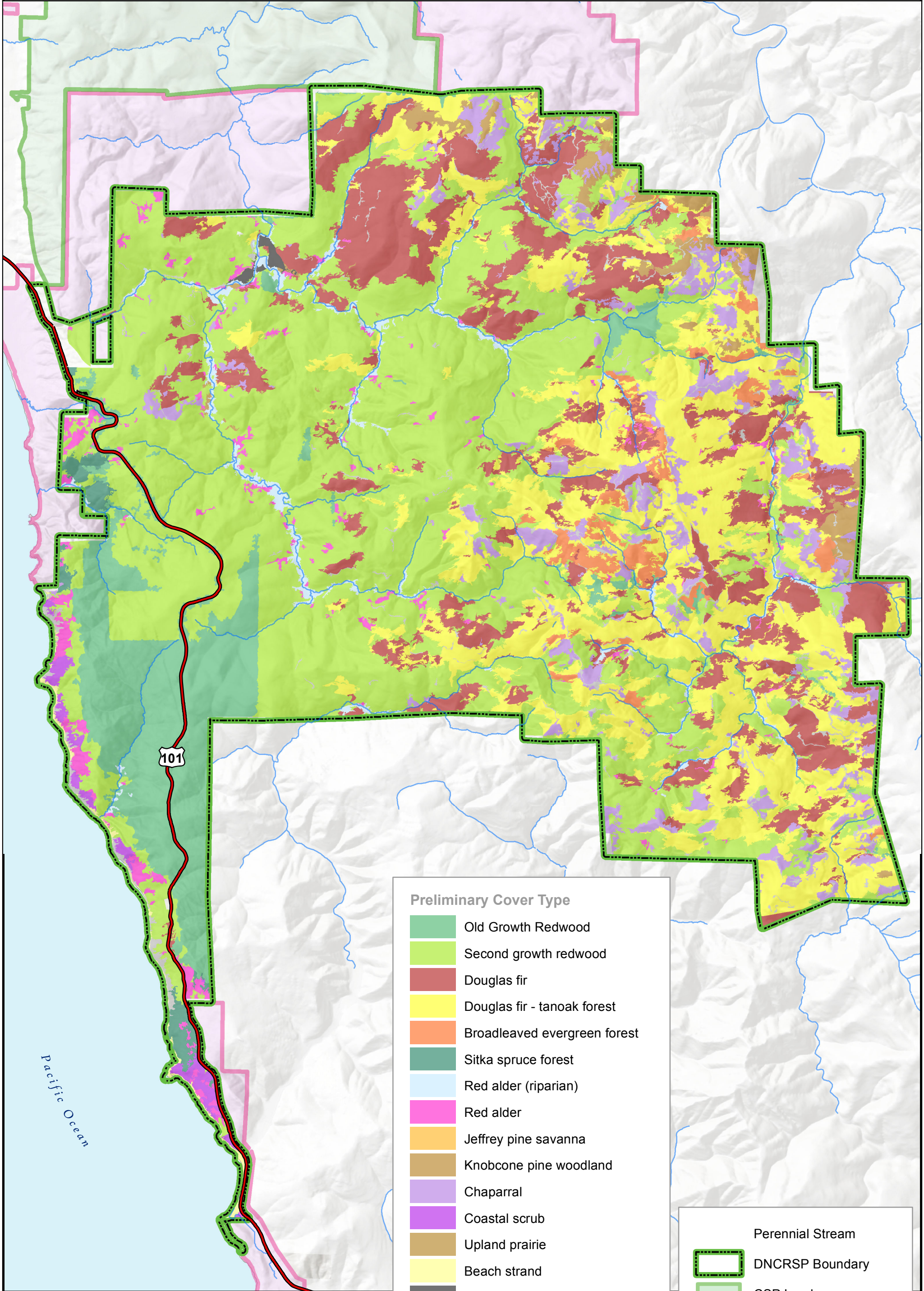
2.7.2.1 Vegetation Classification Methodology

At the time of writing this plan, no parkwide mapping existed that provided up-to-date estimates for the acreage for each cover type or alliance. The draft mapping of cover types and vegetation alliances presented here (Map 2-d, Vegetation) is initially based on an Ikonos satellite imagery-based forest stand reclassification project from 2005. Acreage by vegetation type for all of DNCRSP is summarized in Table 2-c. Just as with the 1948 aerial photo analysis, the current vegetation table represents a snapshot in time.

The 2005 study is summarized in the report "Estimating Landscape Scale Conifer and Hardwood Cover Values On the Mill Creek Property Using Remotely Sensed Satellite Imagery" (Fox 2005). Its purpose was to characterize the presence, abundance and relative cover of native hardwoods on the Mill Creek Property. It used a four band multispectral image with 1m resolution dated 03/28/2004, and the pixels were downsampled to a 15m resolution for a stand structure classification. The 32 Ikonos based classes were then classified into alliances. This vegetation classification was slightly modified for use in the Vegetation Management Statement for DNCRSP (VMS, CDPR 2011b).

In 2018, cover types from the 2005 Ikonos classification were simplified but where a Manual of California Vegetation Alliance was assigned, this information was maintained. Old-growth forest delineations were corrected based on 2016 NAIP imagery, 2016 lidar-derived canopy height models, and overlaid onto the 2011 VMS classifications. Trees 60m and taller with a 5m buffer that overlap a 25m buffer of trees 65m or taller were included in contiguous old-growth stands, excluding known harvested areas per the 1936 and 1948 georeferenced air photos. Further refinement based on field surveys will be made to this preliminary old-growth classification.

The resulting vegetation map will be updated with current NAIP imagery and will be compared to the Geographic Resource Solutions (GRS) mapping for RNSP that was started in 2007 and finalized with a report in 2017 (RNSP 2017). GRS polygons group similar pixels into 1.2 ac stands. The boundaries of these mapping units are coarse and derived information seemed less useful as a basis for vegetation management in the park than the above described Ikonos based mapping. In the GRS Polygons, individual vegetation types were mostly delimited as represented by releve plot data collected and assigned an MCV alliance. Additionally, this data set contains species-specific cover estimates, cover estimates for major lifeforms of trees (conifer and hardwood), shrubs (tall and low), herbaceous plants, aquatic plants, and other abiotic landscape features such as bare rock, gravel, litter, coarse woody debris, and duff. This information was developed using GRS's Discrete Classification Mapping Methodology (DCMM).



Preliminary Cover Type

- Old Growth Redwood
- Second growth redwood
- Douglas fir
- Douglas fir - tanoak forest
- Broadleaved evergreen forest
- Sitka spruce forest
- Red alder (riparian)
- Red alder
- Jeffrey pine savanna
- Knobcone pine woodland
- Chaparral
- Coastal scrub
- Upland prairie
- Beach strand
- Developed Areas
- Barren ground

- Perennial Stream
- DNCRSP Boundary
- CSP Land
- NPS Land

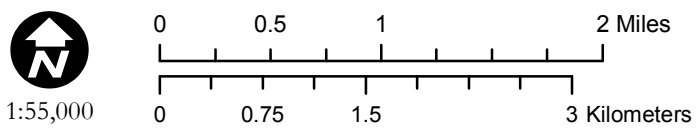


Table 2-c. Current vegetation and cover types

Cover Type	Alliance	Acres
Old-growth redwood	Redwood forest	2,820
Previously harvested redwood	Redwood forest	13,450
Douglas fir	Douglas fir forest	4,300
Douglas fir - tanoak forest	Douglas fir - tanoak forest	6,330
Broadleaved evergreen forest	Tanoak forest	550
Red alder	Red alder forest	490
Red alder (riparian)	Red alder forest	500
Sitka spruce forest	Sitka spruce forest	200
Jeffrey pine savanna	Jeffrey pine forest	6
Knobcone pine woodland	Knobcone pine forest	460
Chaparral	Blue-blossom, Huckleberry oak, Shrub tanoak, and Canyon live oak chaparral; Golden chinquapin thickets	1,600
Coastal scrub	Coyote brush scrub	165
Upland prairie	Idaho fescue grasslands, Semi-natural Velvet grass-sweet vernal grass	23
Wetlands	Small-fruited bulrush marsh, Cattail marshes, Pacific reed grass meadows, California pitcher plant fens	11
Barren ground	NA	480
Developed Areas	NA	47
Beach strand	NA	68
Total		31,500

Discussions of cover types and alliances below are summarizing data from botanical reports 2003-2017 and the 2011 Vegetation Management Statement (CDPR 2011c), unless referenced otherwise.

2.7.2.2 Tree-dominated vegetation

Redwood Forest

The coastal fog belt provides good growing conditions for fast-growing conifers such as coast redwood. Prior to European settlement and industrial logging, the Park was mostly comprised of old-growth redwood forest. Today, the *Sequoia sempervirens* forest alliance (Redwood forest) is still the most extensive vegetation type in the Park comprising approximately 16,230 ac. However, only approx. 2,820 ac is comprised of old-growth Redwood forest.

The southwestern portion of the Park contains approximately 2,600 ac of old-growth redwood forest and few stands of old growth (220 ac) are scattered elsewhere within the Mill Creek Watershed. Residual old-growth trees are dispersed across an additional 1,600 ac and vary greatly in size and habitat value. Redwoods were planted in many areas in the MCA, including some that were likely devoid of redwood prior to logging. Douglas-fir is the most common codominant. Other less common trees in the overstory include Port-Orford-cedar (*Chamaecyparis lawsoniana*), western red-cedar (*Thuja plicata*), red alder (*Alnus rubra*), tanoak, western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*) and grand fir (*Abies grandis*). The understory in the old-growth redwood forest is primarily composed of sword fern (*Polystichum munitim*), evergreen and red huckleberry (*Vaccinium ovatum* and *V. parvifolium*), rhododendron (*Rhododendron macrophyllum*), thimbleberry (*Rubus parviflorus*), salmonberry (*Rubus spectabilis*), with a groundcover of skunk cabbage (*Lysichiton americanum*), Douglas iris (*Iris douglasiana*), redwood sorrel (*Oxalis oregana*), honeysuckle (*Lonicera hispidula*), and trillium (*Trillium ovatum*).

Two sensitive plant species, leafy-stemmed mitrewort (*Mitellastra caulescens*, CNPS Rank 4.2, a facultative wetland species with a total of 112 detections in DNCRSP) and coast fawn lily (*Erythronium revolutum*, CNPS Rank 2B.2) have been documented in shaded mesic areas of the old-growth and second-growth redwood forest.

Approximately ~13,400 ac of the Park are composed of previously harvested redwood forest. The majority of the previously harvested redwood forest occurs in the MCA, where past management has resulted in primarily even-aged, conifer dominant forest stands of various ages. Within these stands redwood and Douglas-fir are now often codominants, and Douglas-fir is proportionally more common than pre-logging. Other tree species associated with older redwood forests (see above) are often underrepresented. The heavily shaded sub-canopy within these forests is typically occupied by California cascara

(*Frangula purshiana* ssp. *purshiana*) in mesic sites and tanoak in drier sites. The understory and ground cover in the second-growth redwood forest is mainly composed of the same species as the old-growth redwood forest. Common associations are *Sequoia sempervirens* - *Pseudotsuga menziesii* / *Vaccinium ovatum*, and *Sequoia sempervirens* - *Alnus rubra* / *Rubus spectabilis* with a dense layer of evergreen huckleberry and brambles (*Rubus* spp.) frequently dominating the understory shrub layer along with scattered red elderberry (*Sambucus racemosa* var. *racemosa*) and Pacific rhododendron. Sword fern and salal (*Gaultheria shallon*) occur in relatively dense patches within the sub-shrub layer within this habitat. Due to the lack of light and growing space, the herbaceous layer is sparsely occupied by various native herbs such as western brook-foam (*Boykinia occidentalis*), pig-a-back plant (*Tolmiea diplomenziesii*), skunk cabbage, redwood violet (*Viola sempervirens*), false lily of the valley (*Maianthemum dilatatum*), candy flower (*Claytonia sibirica*), western wild ginger (*Asarum caudatum*), and graminoids like slender-footed sedge (*Carex leptopoda*), trisetum (*Trisetum* spp.), and narrow-flowered brome (*Bromus vulgaris*). Other habitats found within the second-growth forests include seeps, swamps, and riparian forests that are now dominated by red alder. As of 2018, 11 occurrences of heart-leaved twayblade (*Listera cordata*, CNPS Rank 4.2) were found within shaded, mesic redwood-Douglas-fir forest. Nodding semaphore grass (*Pleuropogon refractus*, CNPS Rank 4.2, an obligate wetland species) was observed within semi-open, mesic redwood forest.

Douglas-fir Forest

Approximately 4,300 ac of the Park is dominated by the *Pseudotsuga menziesii* forest alliance with the majority occurring in the more xeric eastern portion of the Mill Creek and the Rock Creek watershed in upper elevations, where coastal influence is diminished and on sites with a lower site quality (moderate soils). Smaller areas, especially in the alluvial and lower elevational zones with a higher site quality, have been converted from the Redwood to the Douglas-fir forest alliance. Douglas-fir was better able to seed in from neighboring stands than other species and was planted in greater numbers, under the assumption that redwoods would resprout.

Subdominant tree species include tanoak, red alder, Port-Orford-cedar, western red-cedar, western hemlock, grand fir and canyon live oak (*Quercus chrysolepis*). In mesic sites, the understory is composed of similar species to those found in the redwood forests, such as salal, sword fern, and huckleberry. In more xeric sites at higher elevations within the eastern region, where Douglas-fir forms more open to moderately dense canopies, the understory and groundcover are similar to those described for knobcone pine and Jeffrey pine.

Many occurrences of Suksdorf's wood-sorrel (*Oxalis suksdorfii*, CNPS Rank 4.3), were found within and along the boundary of this habitat. The plants occur within open to

moderately shaded disturbed grassy roadsides and upland forests dominated by Douglas-fir, coast redwood, and tanoak.

Infestations of jubata grass (*Cortaderia jubata*) occur in high densities within open, disturbed areas such as recent clearcuts of poor site quality where canopies haven't closed and along roads, both existing and decommissioned, that border Douglas-fir forest. Within the dense understory, this species only persists as isolated, frequently senescent, smaller-sized individuals. Scotch broom (*Cytisus scoparius*) and french broom (*Genista monspessulana*) were also found along many roads in the Park bordering Douglas-fir forest and under the powerlines.

Douglas-fir-tanoak Forest

Within the eastern region of the park, broadleaved upland forests are a dominant transitional habitat between the conifer-dominated (redwood and Douglas-fir) forests to the west and lower montane coniferous forests (Jeffrey pine, knobcone pine) at higher elevations to the east. On approximately 6,300 ac, Douglas-fir and evergreen broadleaved trees such as tanoak, golden chinquapin, Pacific madrone (*Arbutus menziesii*) and California bay (*Umbellularia californica*) form moderately to densely closed canopies within this forest type. Understory shrub layers are usually dominated by sclerophyllous species of ceanothus (*Ceanothus* spp.), manzanita (*Arctostaphylos* sp.), and huckleberry which can form an impenetrable layer of vegetation. Diversity of herbaceous species is relatively low given the dense shrub layer within this habitat; however, open areas within the forest, especially along roads, can include a relatively high diversity of both native and exotic species. Common groundcover in this habitat includes sword fern, bear grass (*Xerophyllum tenax*), pearly everlasting (*Anaphalis margaritacea*), jubata grass, Pacific bedstraw (*Galium triflorum*), white-flowered hawkweed (*Hieracium albiflorum*), rosy lotus (*Hosackia rosea*), iris, broad-leaved lupine (*Lupinus latifolius*), Bolander's phacelia (*Phacelia bolanderi*), California milkwort (*Polygala californica*), Hooker's fairy bells (*Prosartes hookeri*), hedgenettle (*Stachys* spp.), starflower (*Lysimachia latifolia*), inside-out flower (*Vancouveria planipetala*), and modesty (*Whipplea modesta*). Del Norte pea (*Lathyrus delnorticus*, CNPS Rank 4.3) was found within mesic drainages and road sides on serpentine soils within Douglas-fir-tanoak forest with knobcone pine, and golden chinquapin. Suksdorf's wood-sorrel occurs within semi-open Douglas-fir-tanoak forest.

Tanoak Forest

Notholithocarpus densiflorus (tanoak) forest alliance areas are the dominant cover in 546 ac of the Park. The alliance's distribution within the Park has been influenced logging practices, edaphic conditions and topography and recent fire regimes. The high stem densities in these stands suppress growth of other trees and can make these stands more vulnerable to catastrophic fires, especially in the vicinity of ridge-crests, which may be prone to lightning strike ignition. Primarily found in the eastern portion of the Park and

the ridgetops near Childs Hill, the tanoak understory is generally sparse. A common association is *Notholithocarpus densiflorus* - *Umbellularia californica*. Subdominant tree species include big leaf maple (*Acer macrophyllum*), red alder, Pacific madrone, and golden chinquapin (*Chrysolepis chrysophylla*). The sparse herbaceous layer is composed similar to the Douglas-fir-tanoak forest.

In 2015, one occurrence of California pinefoot (*Pityopus californicus*, CNPS Rank 4.2) was found within a densely shaded tanoak-dominated broadleafed upland forest. Non-native plant surveys have only been conducted in the small tanoak stands that were part of past forest restoration projects.

Riparian Forest

The composition of riparian stands in the Park differs depending on whether the stands border high-gradient, confined channels or lower-gradient, less-confined channels. Deciduous trees, particularly red alder and big-leaf maple, are common components of the closed, shaded canopy of riparian stands with a few scattered large-diameter old-growth redwoods in the overstory along the lower-gradient, less-confined channels. Hardwoods quickly colonize gravel bars that become stable following large floods or channel avulsions. Approximately 500 ac of riparian forest within the Park are currently dominated by the *Alnus rubra* forest alliance (Red alder forest). Almost half of these riparian areas in the MCA (~200 ac) were historically conifer stands and were converted to alder dominance during logging operations.

A common association is *Alnus rubra* / *Rubus spectabilis* - *Sambucus racemosa*. There are also various species of willow (*Salix* spp.), sword fern, huckleberry, California blackberry (*Rubus ursinus*), thimbleberry, skunk cabbage, occurring in the understory. Some of the same herbaceous species that occur within mesic Sitka spruce and redwood forests also occur within riparian forests and include other species such as Pacific waterleaf (*Hydrophyllum tenuipes*), coast man-root (*Marah oregana*), coast monkeyflower (*Mimulus dentatus*), western colt's foot (*Petasites frigidus* var. *palmatus*), barbed buttercup (*Ranunculus uncinatus*), hedge-nettle, curled starwort (*Stellaria crispa*), sedges (*Carex* sp.) and rushes (*Juncus* spp.). Leafy-stemmed mitrewort and coast fawn lily have been detected in shaded, mesic red alder forest. Nodding semaphore grass was observed within semi-open and shaded, mesic red alder forest.

Some observed non-native plants within the red alder forests include curly dock (*Rumex crispus*), pennyroyal (*Mentha pulegium*), Cat's ear (*Hypochaeris* sp.), and dandelion (*Taraxacum officinale*).

Non-riparian Red Alder

Non-riparian red alder forests (~490ac) are generally found along the western boundary of the Park along the coast but also in minor amounts occupying drainages, mesic slopes, roadsides and decommissioned roads within broad-leafed upland forests. Within the coastal forests, Sitka spruce forests and Red alder forests intergrade in mesic areas

where Slough sedge swards and Coastal brambles form components of the understory within both forest types. Otherwise species composition in the understory is similar to riparian alder and additionally contains salal and Oregon grape (*Berberis nervosa*).

Sitka Spruce Forest

Found primarily above the coastal bluffs along the western boundary of the Park there are approximately 200 ac of *Picea sitchensis* (Sitka spruce) forest alliance dominated area, including 13 ac of old-growth forest. Common associations are *Picea sitchensis* - *Tsuga heterophylla*, and *Picea sitchensis* / *Polystichum munitum*. Subdominant tree species are red alder and grand fir and additional understory species include salal, huckleberry, California blackberry, thimbleberry, skunk cabbage, Douglas iris, fairy bells (*Prosartes smithii*), false Solomon's seal (*Maianthemum stellata*), and false lily of the valley. English ivy (*Hedera helix*), a non-native, invasive plant, has been found within the Sitka spruce forest along Highway 101.

Knobcone Pine Forest and Woodland

There are approximately 460 ac of forest dominated by species found in the *Pinus attenuata* forest alliance (Knobcone pine forest). Knobcone pine is a serotinous species (dependent on fire for reproduction) that can be a climax species on poor soils or an early successional species in redwood and Douglas-fir forests. On non-serpentine, rocky soils in the xeric eastern region of the park, even-aged stands of knobcone pine frequently intergrade with broadleaved upland forests where Pacific madrone is a co-dominant tree species. While there are relatively few pure stands of knobcone pine, most occur as scattered individuals within a canopy of Douglas-fir, Jeffrey pine, tanoak and Port Orford cedar. Knobcone pine has become more common in these stands of various ages where extensive logging and broadcast burning occurred. Burning to clear slash encouraged their serotinous cones to spread seed; recently harvested and burned plantations are characterized by an abundance of knobcone pine saplings. Common associations are *Pinus attenuata* / *Arctostaphylos columbiana*, and *Pinus attenuata* / *Quercus vacciniifolia*. In more open knobcone pine and Jeffrey pine stands, dense patches of sclerophyllous (leathery-leaved) chaparral species such as huckleberry oak, manzanita, and California coffeeberry (*Frangula californica*) occupy exposed sites within the understory shrub layer. On especially poor or highly serpentine soils, the understory and ground cover are often sparse. Where the canopy is more open, the herbaceous layer is also more diverse and rich in species in both of these forest types. Many of the herbs are both unique to these habitats and rare within the Park. Herbaceous species commonly found include, leafy fleabane (*Erigeron foliosus* var. *confinis*), Siskiyou bedstraw (*Galium ambiguum* ssp. *siskiyouense*), Bolander's hawkweed (*Hieracium bolanderi*), Thompson's iris (*Iris thompsonii*), Sierra Nevada pea (*Lathyrus nevadensis* var. *nevadensis*), Bridges's triteleia (*Triteleia bridgesii*), violet (*Viola* spp.), western bear grass, northwestern sedge (*Carex concinnoides*), Mendocino sedge (*Carex mendocinensis*), and serpentine lace-fern

(*Aspidotis densa*). The serpentine endemic Klamath arnica (*Arnica spathulata*, CNPS Rank 4.3) was documented in 2013 in knobcone woodland.

Jeffrey Pine Savanna

Pinus jeffreyi (Jeffrey pine) forest alliance dominated areas in the Park are limited to only a few isolated groves comprising approximately 6 ac within a savanna community mosaic (*Pinus jeffreyi* / *Quercus vacciniifolia* - *Arctostaphylos nevadensis* / *Festuca idahoensis* association) comprised of Idaho fescue (*Festuca idahoensis*) grassland with nested patches of huckleberry oak, manzanita and tanoak chaparral, barrens, and a few Douglas-firs. The mosaic pattern is partially due to localized differences in the degree of peridotite serpentinization, which yields different soil characteristics and is also influenced by fire (Dubendorfer 1987), the primary disturbance agent in these communities. The importance of fire in maintaining the Jeffrey pine savanna community is uncertain given the low productivity and limited woody fuels that carry and hold a fire. Historically, fires were expected to be frequent and of low to moderate intensity (Skinner et al. 2006) moving quickly through the grass dominated areas and burning more intensely in shrub/conifer dominated areas. Jeffrey pine is the dominant species in the overstory layer of this community where canopy cover varies from less than 5% to upwards of 20% (USFS 2018). Small trailing shrubs such as pine-mat manzanita (*Arctostaphylos nevadensis*), Siskiyou mat (*Ceanothus pumilus*), and common juniper (*Juniperus communis*) are interspersed amongst clumps of Idaho fescue. In addition to the herbs mentioned in Knobcone pine, the Jeffrey pine savanna and within it, Idaho fescue grasslands hold the greatest occurrence of serpentine endemics. The rare Koehler's stipitate rock cress (*Boechera koehleri* var. *stipitata*, CNPS Rank 1B.3) and the federally endangered McDonald's rock cress (*Arabis macdonaldiana*) may occur in association with this alliance. See Idaho fescue grasslands for common herbaceous and other rare species. Non-native plant surveys have not been conducted in this area.

Western White and Sugar Pine

Western white pine and sugar pine are limited to the eastern side of Rock Creek, with the exception of one mature Western white pine along Rock Creek Road near Cabin Spur, about four miles from the nearest seed source. The mature tree is remarkable in that it is growing about 60 feet off of the ground in a broken topped redwood tree and the redwood is alive but sufficiently rotten so that the roots of the pine can be seen through the bole at ground level. Knobcone pine, western white pine, and Jeffrey pine exist in no other Park in the NCRD and are considered locally significant species (CDFW 2018). The seed from knobcone, sugar pine and western white pine, require bare mineral soil and open canopy created by fire to propagate. Port-Orford-cedar is generally uncommon across its range, although it is locally abundant in some areas of the MCA. It generally occupies coastal ranges in a 40-km (25-mi) wide zone extending from Reedsport, Oregon south to central Humboldt County. Pacific yew (*Taxus brevifolia*) is only found near watercourses in the

Rock Creek watershed and is also generally uncommon across its range. Both species are suffering substantial mortality due to an exotic, fatal root disease called Port-Orford-cedar root disease (*Phytophthora lateralis*), see 2.7.5.

2.7.2.3 Chaparral

Shade-intolerant herbaceous and shrub vegetation continues to be reduced in many areas as young forest canopies close. Chaparral is typically adapted to frequent fires and many species in this habitat are stimulated by fire through resprouting or seed germination.

Mixed chaparral currently occurs on approximately 1,500 ac, but its range and extent has fluctuated under the previous owners as logging and fire suppression shifted species composition. The matrix of potential shrub alliances includes shrub tanoak chaparral (*Notholithocarpus densiflorus* var. *echinoides* Shrubland Alliance), Golden chinquapin thickets (*Chrysolepis chrysophylla* Alliance), and Canyon live oak chaparral (*Quercus chrysolepis* Alliance). Other native species found in the chaparral alliances are Columbia manzanita (*Arctostaphylos columbiana*), pinemat manzanita (*Arctostaphylos nevadensis*), blue blossom (*Ceanothus thyrsiflorus*), creeping snowberry (*Symphoricarpos mollis*), and ocean spray (*Holodiscus discolor*). Many of the same species described for knobcone and Jeffrey pine forests also occur within chaparral habitats. non-native plant surveys have not been conducted in the post-harvest mixed chaparral.

Of the mixed chaparral alliances in the eastern MCA, only one has been individually mapped, the *Quercus vacciniifolia* (Huckleberry oak) shrubland alliance. It is dominant in approximately 112 ac, much of which became established after intensive logging occurred. In open forest stands huckleberry oak supports surface fire and can act as a ladder fuel. Huckleberry oak sprouts from root crowns after fire. Emergent conifers include grand fir, Jeffrey pine, and Douglas-fir.

Not found within the general area prior to logging, approximately 254 ac of *Ceanothus thyrsiflorus* shrubland alliance (blue blossom chaparral) established throughout the Park where intensive logging occurred. Primarily found in the northeastern portion of the Park, native plants associated with the blue blossom chaparral include coyote brush, huckleberry, manzanita, California blackberry, and salal. An obligate-seeding species that germinates from dormant seed banks after fire, blue blossom chaparral will eventually convert to Douglas fir or redwood forest with the suppression of fire.

2.7.2.4 Coastal Scrub

Along the coastal bluffs in the southwestern portion, the Park contains approximately 170 ac composed of *Baccharis pilularis* shrubland alliance (Coyote brush scrub). Common associations are *Baccharis pilularis* - *Ceanothus thyrsiflorus*; and *Baccharis pilularis* /

Annual Grass – Herb. Other native species found within the coyote brush scrub include California blackberry, thimbleberry, salmonberry, and sword fern. Invasive, non-native plants like Himalayan blackberry (*Rubus armeniacus*) and jubata grass have been known to be a major problem in the coyote brush scrub.

2.7.2.5 Grasslands

Approximately 20 ac of the Park have been classified as upland grasslands in 2005. Historically there were likely more than ten times that amount - the 1948 airphotos show more than 180 ac of prairie and prairie with scattered trees, and additional 80 ac of chaparral with scattered prairies still existing approximately 100 years after the fire became less frequent. The grasslands on the western side of the park (near the current mill site, and at the junction of Rock Creek Road and Childs Hill Road) are primarily composed of non-native species in the *Holcus lanatus* – *Anthoxanthum odoratum* semi-natural stands (Velvet grass-sweet vernal grass meadows). Other non-native species that have colonized these areas include redtop (*Agrostis capillaris*), orchard grass (*Dactylis glomerata*), annual bluegrass (*Poa annua*), Cat's ear, burnweed (*Senecio minimus*), foxglove (*Digitalis purpurea*), and tansy ragwort (*Senecio jacobaea*). The grassland near the junction of Rock Creek Road and Childs Hill Road has been used as a logging deck and equipment staging area and is highly altered. It still supports wetland plants at its southern edge and a viable population of Suksdorf sorrel at the forest edge in the east.

The Bense Trail area is one of the few areas in the park where patches of historic prairie are still scattered amongst a shrub and conifer matrix. Portions of this prairie were re-established when the Bense Trail road was removed. Many sensitive plant populations, e.g. Suksdorf's sorrel (*Oxalis suksdorfii*, CNPS Rank 4.3), Del Norte Pea and California pine foot have been documented in these open areas. It is also an area of interest for the Tolowa tribe since it contains big patches of bear grass.

In the eastern part of the Park, intact Idaho fescue grassland has been mapped on approximately 17 ac. Idaho fescue grassland is limited in distribution to rocky serpentine soils within openings in a mosaic of Jeffrey pine savanna (see above), knobcone pine woodlands, chaparral, and broadleafed upland forests. While this vegetation type is more widespread in the Little Bald Hills region of Redwood National Park to the northeast of the park boundary, the relatively small amount of Idaho fescue grassland occurring within the park is significant given the large number of rare and endemic species that occur in this habitat. Moreover, much of the original Idaho fescue grassland within the region has been significantly reduced in area due to lack of fire, densification of Jeffrey pine, and encroachment by Douglas-fir and chaparral shrubs (Sahara 2012). Idaho fescue grasslands are characterized by a low to moderately dense cover of bunchgrass with numerous herbs, other graminoids, and small shrubs interspersed amongst the clumps.

Due to the high plant diversity, abundance of space and light, and relatively xeric, serpentine soils, the herbaceous flora consists of many early and late blooming species as well as plants with relatively short or periodic blooming periods. A common association is *Festuca idahoensis* - *Achillea millefolium*. Other common herbaceous components include serpentine lace-fern (*Aspidotis densa*), Tolmie's pussy-ears (*Calochortus tolmiei*), harvest brodiaea (*Brodiaea elegans*), leafy fleabane, Siskiyou bedstraw, serpentine monardella (*Monardella purpurea*), mountain selfheal (*Prunella vulgaris* var. *lanceolata*), western buttercup (*Ranunculus occidentalis* var. *occidentalis*), purple sanicle (*Sanicula bipinnatifida*), small-headed clover (*Trifolium microcephalum*), snapdragon skullcap (*Scutellaria antirrhinoides*), harsh checker-bloom (*Sidalcea asprella* ssp. *asprella*), blue-eyed grass (*Sisyrinchium bellum*), deathcamas (*Toxicoscordion venenosum* ssp. *venenosum*), Bridges's triteleia, western dog violet (*Viola adunca* ssp. *adunca*), yellow pine violet (*Viola lobata* ssp. *lobata*), California oatgrass (*Danthonia californica*), and northwestern sedge (*Carex concinnoides*), Geyer's melic (*Melica geyeri*), prairie june-grass (*Koeleria macrantha*), and California fescue (*Festuca californica*), non-native salsify (*Tragopogon pratensis*). There are 40 rare plant species associated with serpentine soils that have the potential to occur in the Jeffrey pine-Idaho fescue savanna (see 2.7.2). Sixteen have been documented in the park: Howell's manzanita (*Arctostaphylos hispidula*, CNPS Rank 4.2), Del Norte manzanita (*Arctostaphylos nortensis*, CNPS Rank 4.3), serpentine sedge (*Carex serpenticola*, CNPS Rank 2B.3), Howell's lomatium (*Lomatium howellii*, CNPS Rank 4.3), Howell's sandwort (*Minuartia howellii*, CNPS Rank 1B.3), Klamath arnica, serpentine arnica (*Arnica cernua*, CNPS Rank 4.3), short-lobed paintbrush (*Castilleja brevilobata*, CNPS Rank 4.2), horned butterwort (*Pinguicula macrocera*, CNPS Rank 2B.2) and Howell's horkelia (*Horkelia sericata*, CNPS Rank 4.3), Bolander's lily (*Lilium bolanderi*, CNPS Rank 4.2), Siskiyou Mountains ragwort (*Packera macounii*, CNPS Rank 4.3), white-flowered rein orchid (*Piperia candida*, CNPS Rank 1B.2), Del Norte willow (*Salix delnortensis*, CNPA Rank 4.3), Peck's sanicle (*Sanicula peckiana*, CNPS Rank 4.3), serpentine catchfly (*Silene serpentinicola*, CNPS Rank 1B.2), and glaucous tauschia (*Tauschia glauca*, CNPS Rank 4.3).

2.7.2.6 Wetlands

There are multiple types of wetlands in the Park comprising a total of approximately 11 ac.

Swamps and seasonal wetlands

Swamps are represented by small patches of early successional wetlands which occur in the western region of the park within both coniferous forests and riparian forests (CDPR 2015b, Coast to Crest). Swamps are typically comprised of suffrutescent, hydrophytic herbs adapted to seasonally or permanently saturated soils. Common herbaceous plant

species within this habitat include both facultative (FAC/FACW) and obligate (OBL) wetland plants such as slough sedge (OBL), skunk cabbage (OBL), lady fern (*Athyrium felix-femina*) (FAC), stream violet (*Viola glabella*) (FACW), Brewer's bitter-cress (*Cardamine breweri*) (FACW), pig-a-back plant (FACW) and the special status species leafy-stemmed mitrewort (FAC), nodding semaphore grass (OBL), Pacific golden-saxifrage (*Chrysosplenium glechomifolium*, OBL, CNPS Rank 4.3). Many of these species also occur within mesic sites of the coniferous forest alliances and riparian forests. The alliances found within these wetlands include *Salix lasiolepis* shrubland alliance (Arroyo willow thickets), *Carex obnupta* herbaceous alliance (Slough sedge swards), *Schoenoplectus californicus* herbaceous alliance (California bulrush marsh), and *Typha* herbaceous alliance (Cattail marshes). *Carex obnupta* wetlands and skunk cabbage swamps were mapped just east of the 101 and another *Carex obnupta* inclusion close to Teran Rd. in the northwestern part of the park.

Willow thickets are found within all of the areas classified as wetlands and within some of the red alder riparian areas. The bulrush and cattail marshes are primarily found along Wilson Creek. Other native species found in the wetlands include silverweed (*Potentilla anserine* ssp. *pacifica*), and horsetail (*Equisetum* sp.).

Other seasonal wetlands include moist ditches and depressions along roads which primarily occur within the north-eastern section of the park within broadleaved upland forests, coniferous forests, and riparian forests. Seasonal wetlands are also typically comprised of suffrutescent, hydrophytic herbs adapted to seasonally or permanently saturated soils. Common herbaceous plant species within these habitats include slough sedge (OBL), nodding semaphore grass (OBL), Bolander's rush (*Juncus bolanderi*) (OBL), iris-leaved rush (*Juncus xiphiodes*) (OBL), dagger-leaved rush (*Juncus ensifolius*) (FACW), toad rush (*Juncus bufonius*) (FACW), tall flatsedge (*Cyperus eragrostis*) (FACW), bristle-leaved bulrush (*Isolepis setacea*) (FACW), and small-fruited bulrush (*Scirpus microcarpus*) (OBL). One *Scirpus microcarpus*-*Juncus bolanderi* seasonal wetland was mapped within a road ditch in the northeastern corner of the park (CDPR 2015b).

Fens

Darlingtonia californica herbaceous alliance (California pitcher plant fen), a rare and sensitive community, is an early successional habitat found on ultramafic soils in at least two locations in the Park. The carnivorous California pitcher plant (*Darlingtonia californica*, CNPS Rank 4.2) is almost completely restricted to areas with flowing water and is particularly vulnerable to competition from encroaching woody plant species, which can lead to *Darlingtonia* fens drying out. They need frequent fire to keep conifers and chaparral from encroaching. The size of the fen east of Child's Hill Rd is approximately 2,500 ft² and that of the fen west of Dry Lake Rd (on the lower slope of Rattlesnake Mountain) is approximately 5,800 ft². Dominant species are California pitcher plant,

Labrador-tea (*Rhododendron columbianum*), salal, slough sedge, and western azalea (*Rhododendron occidentale*) and encroached by Sitka alder (*Alnus viridus var. sinuata*), cascara and in the Dry Lake fen also Port-Orford-cedar. Both Darlingtonia fens are associated with other sensitive plant species, a small population of Vollmer's lily (*Lilium pardalinum* spp. *Vollmeri*, CNPS Rank 4.3) is located in one site and California lady's slipper (*Cypripedium californicum*, CNPS Rank 4.2) in the other. More fens may be present on the east slope of Childs Hill, in the northeast portion of the property and on the west slope of Rattlesnake Mountain.

Another fen habitat found in DNCRSP, *Rhododendron columbianum*/ *Calamagrostis nutkaensis* fens, occurs in a few areas in Park. The Child's Hill *Calamagrostis* Fen, approximately 2,700 ft², is dominated by Pacific reedgrass (*Calamagrostis nutkaensis*), deer fern (*Struthiopteris spicant*), Labrador tea, salal, bog St. John's wort (*Hypericum anagalloides*), and peat moss (*Sphagnum* spp.) with emergent Sitka alder and Lodgepole pine (*Pinus contorta* ssp. *murrayana*). Management of this fen has included removing encroaching shrubs and trees. Similar fens are exceedingly rare in northern California. The Child's Hill *Calamagrostis* Fen is similar to a fen located in the Crescent City Marsh Wildlife Area (described by Imper and Sawyer 1992), approximately 1.5 miles to the north, which supports the largest known population of the federally endangered western lily (*Lilium occidentale*). Thus, the fen on the Mill Creek property provides a transitional stage between the coastal habitat of the western lily, and the more inland Darlingtonia fens. Additional rare species at the southern limits of their distributions such as sweet grass (*Anthoxanthum nitens*) and great burnet (*Sanguisorba officinalis*, CNPA Rank 2B.2) could be present in wetlands in the east half of the Mill Creek property.

2.7.3 Special Status Plants and Sensitive Communities

Special status plants are rare, threatened or endangered species as defined by the Federal and California Endangered Species Acts, as well as non-listed species that require consideration under section 15380 of CEQA and locally significant plants, that is, plants that are not rare from a statewide perspective but are rare or uncommon in a local context such as within a county or region (CEQA Guidelines, § 15125, subd.(c)). Based on records in the NRCDB Botanical Survey Database (CDPR 2018a) and the CDFW RareFind (CDFW 2017) 36 vascular special status plants, 1 lichen and 1 moss have been documented within DNCRSP. An additional 62 species have the potential to occur in the park (Appendix B, Special Status Plants) including McDonald's rock cress and Western lily - two plants listed as endangered both federally and in the state of California.

The majority of the sensitive plants detected in DNCRSP have been in association with sensitive plant surveys for assessing potential impacts from proposed projects. This includes 5 species considered as Rare, Threatened or Endangered in California by the

California Native Plant Society (CNPS Rank 1.B), 8 CNPS Rank 2.B species, considered Rare, Threatened, or Endangered in California but More Common Elsewhere, and 23 CNPS List 4 species (plants of limited distribution; a watch list) (see Appendix B).

Sixteen of these 36 detected species are serpentine endemics (see Idaho fescue grasslands). The description of the alliances (above, in Chapter 2.7.1) includes known rare plant occurrences for each alliance.

Disturbed roadsides are one of the few habitats providing enough light for several special status species including maple-leaved checkerbloom (*Sidalcea malachroides*, CNPS Rank 4.2) that often occurs along roads within coniferous forests of the Park.

CNPS requires that sensitive bryophyte and lichen species be considered during botanical surveys (CNPS 2001), and an increasing number of species are now being listed and documented by CNPS and CDFW. Future surveys in the Park will likely document additional bryophytes and lichens, especially in serpentine areas where diversity is probably high.

Sensitive Plant Communities

CDFW maintains a list of natural communities based on the Alliances and Associations as described in MCV (Sawyer et al. 2009), that are of limited distribution statewide or within a county or region and are often vulnerable to environmental effects of projects. These communities may or may not contain special status species or their habitat. Currently there are 22 Sensitive Communities documented within DNCSP. For mapping sensitive communities NCRD has developed a protocol with minimum patch sizes (CSP 2018e). Natural Communities with ranks of S1-S3 are considered Sensitive Natural Communities to be addressed in the environmental review processes of CEQA. For alliances with State ranks of S1-S3, all associations within them are also considered Sensitive. Most types of wetlands and riparian communities are considered special status natural communities due to their limited distribution in California. Appendix C lists all natural communities (alliances, associations) occurring within DNCRSP. Four alliances (Pacific reed grass meadows, Golden chinquapin thickets, Sitka spruce forest and Small-fruited bulrush marsh) have a state rank of S2; considered Imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province. Eight alliances, Redwood forest, Slough sedge swards, Port Orford cedar forest, California pitcher plant fens, Idaho fescue grassland, Tanoak forest, Shrub tanoak chaparral, and Coastal brambles have a state rank of S3, which are considered to be Vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation. The other listed alliances are either state ranked S4 = Apparently Secure - Uncommon but not rare; some

cause for long-term concern due to declines or other factors or S5 = Secure - Common, widespread, and abundant in the state.

2.7.4 Non-native plants

Invasive species include all types of organisms that can invade any ecosystem, from rivers to lava fields (NPS 2017). The California Invasive Plant Council (Cal-IPC) defines invasive non-native plants as species not native to an environment, which once introduced, establish quickly, reproduce and spread, and cause harm to the environment, economy, or human health (Cal-IPC 2018a). The spread of invasive non-native plants is the second leading cause to the loss of biodiversity in the world and nationally, the second-greatest threat to endangered species, after habitat destruction (Cal-IPC 2018a, Bossard et al. 2000). Invasive non-native plants change ecosystem functions and can physically displace or eradicate native plants, which provide food and habitat for the native wildlife. Some species have toxins that when digested cause liver damage and failure to ungulates including elk and deer or when in water release toxins that can kill fish. Many of these species generate higher fuel loads than native plants changing fire frequency and intensity (Cal-IPC 2018a). Some invasive non-native plants alter sediment deposition and erosion and change the hydrology of an area by consuming large quantities of water, or clogging creeks reducing their water-carrying capacity and increasing the chance of floods during winter storms; therefore, reducing the available water for fish and wildlife (Cal-IPC 2018a). In addition, invasive non-native plants can alter soil chemistry (e.g. allelopathy- making it especially difficult for other plants to survive and reproduce and nitrogen fixing) and damage infrastructure (NPS 2017, Cal-IPC 2012).

In 1824, there were 16 known non-native plant species in California, by 1848 that number rose to 79 (Bossard et al. 2000), in 1993 the Jepson Manual (Hickman 1993) recorded 1,023 non-native plant species in California and by 2012, the Jepson Manual 2nd Edition recorded 2,419 (Baldwin et al. 2012). In addition, there are many non-native ornamental plant species that have the potential to become invasive and are not listed in the Jepson Manual. Although humans are more aware than ever of the potential deleterious impacts from invasive non-native plants, new species are introduced to California annually and previously introduced species continue to spread.

Of the 437 plant species recorded in DNCRSP, 91 are non-native (Appendix A). Most of the invasive non-native plants in the Park are located along roads and in developed areas including maintenance facilities, the abandoned mill site, office and housing areas, and other areas with barren ground and/or exposed soil. As the developed and barren areas are adjacent to wildlands, non-native plants should be controlled to protect the natural resources from further invasion. The most abundant and dominant invasive non-native plant species documented in the park include: jubata grass, Scotch broom, cotoneaster,

tansy ragwort and French broom. Other non-native plant species include Himalayan blackberry, English daisy (*Bellis perennis*), bull thistle (*Cirsium vulgare*), suckling clover (*Trifolium dubium*), Cat's ear, pennyroyal, curly dock, false dandelion, coastal burnweed (*Senecio glomeratus*), hairgrass (*Aira caryophyllaea*), sweet vernal grass, annual bluegrass, colonial bentgrass (*Agrostis capillaris*), and several other species of non-native annual and perennial grasses. Species profiles of the most dominant invasives with Cal-IPC invasive rating, rates of spread, seed viability, an impact description and recommended treatments are compiled in the NCRD Invasive Species BMPs (CSP 2018c).

As part of the RNSP partnership, NPS staff has mapped multiple occurrences of non-native plants between 2005 and 2016 mainly in the southwestern part of DNCRSP. Sixteen of these occurrences of non-native species (Himalayan blackberry, English ivy, Robert's geranium, and fennel (*Foeniculum vulgare*)), along Highway 101 and Hamilton Road) have been manually treated by NPS staff). Two patches of the competing red sepaled evening primrose (*Oenothera glazioviana*) were treated in 2012 relatively close to a wolf's evening primrose (*Oenothera wolfii*, CNPS Rank: 1B.1) population and one patch of rattlesnake grass (*Briza maxima*) directly in the population in 2013 to protect this very rare species.

The densest infestations of jubata grass occur within open, disturbed habitats such as along roads, both existing and decommissioned, landings, and in other areas of DNCRSP that have been disturbed during previous logging activities. Within the dense understory of forest habitats, this species only persists as isolated, frequently senescent, smaller-sized individuals. Large occurrences of jubata grass were observed growing at the edge of serpentine habitats along Smoke House-5 Road and Section 1 Road. Jubata grass occurs at low to moderate densities on serpentine soils along other roads within the Park (CDPR 2015a). Since jubata grass is generally known to be invasive also in serpentine habitats (Cal-IPC 2018b), it has the potential to spread from the roads into serpentine habitat.

Scotch and French broom, both abundant invasive non-native plants within the Park, also occur along exposed, disturbed roads, primarily in the western half of the Park. A large French broom occurrence comprised of approximately 5,000 individuals distributed within a ~10,000 sq. ft. area was found along the decommissioned Powder House Left Rd. just south of a thinning unit.

An emerging invasive non-native in Del Norte County is shining geranium, an escaped cultivar that tolerates both sun and shade conditions, grows as an understory species and invades riparian corridors, forest edges, roadsides and pastures throughout the Pacific Northwest (DiTomaso et al. 2013). In 2012, RNSP staff discovered shining geranium in DNCRSP along HWY 101, between Hamilton Road and the Mill Creek Campground Road. Caltrans has been treating the shining geranium infestation along HWY 101

between Hamilton Road and the Mill Creek Campground Road with herbicide within the right of way since 2014. Despite the treatment, shining geranium has moved into the Park along Hamilton Rd. and off of Hwy 101. In 2012, NPS staff mapped a patch of shining geranium just across Highway 101 from an NPS occurrence and hand treated it in 2015. NPS mapped and treated another occurrence on the north side of Hamilton Road, south of the NPS boundary, annually from 2013-2016. Although NPS has been manually treating the shining geranium the infestations are growing. In 2017, CSP staff mapped seven occurrences. Therefore, within DNCRSP shining geranium will be treated using herbicide. A separate CEQA document for treating the shining geranium will be completed in 2018, with the first treatment planned in 2018.

Reed canarygrass (*Phalaris arundinacea*) is a perennial grass with creeping rhizomes that grows along stream, in grasslands, and woodlands. Most populations of reed canarygrass in California contain two biotypes; one originating from North America and the other from Europe. Due the introduction of the European biotype in California and subsequent hybridization, almost all populations of reed canarygrass are invasive.

Reed canarygrass occurs along the main stem of Mill Creek and smaller tributaries, including Hamilton Creek.

2.7.5 Pathogens

Sudden oak death is a forest and nursery disease caused by the plant pathogen *Phytophthora ramorum*. *Phytophthora ramorum* has 135 tree, shrub, and herbaceous host species, many of which are found within DNCRSP. Sudden oak death was first observed in California in the mid-1990s and has spread throughout coastal forests of the west killing millions of trees in Oregon and California, primarily red oak species and tanoak. Sixteen counties in California are infested, it has not yet been detected in Del Norte county, but infected sites have been found to the north and south of the county. *P. ramorum* can spread by means of soil, water (e.g. wind-driven rain, watercourses), or by transport of infected plant materials and this pathogen thrives in wet conditions (Frankel & Palmieri 2014). The disease has different effects on different plant species, killing some, and causing symptoms on others. It has the potential to change the stand structure of forests with a heavy tanoak component and could result in creating unstable areas. Current information based on the best available science can be found at www.suddenoakdeath.org

In the 1950's, Port-Orford-cedar became threatened by an exotic pathogen known as **Port-Orford-cedar root disease** (*Phytophthora lateralis*) which has since become widespread throughout the species range. Pacific yew is also susceptible to this pathogen. *P. lateralis* is a water mold that kills infected trees. Although the disease was common in the nearby South Fork of the Smith River drainage and the Smith River

National Recreation Area, until 2000 there had been no indication that the disease was present within the Mill Creek Watershed. Lack of the disease was probably due to the absence of through traffic and the relatively isolated watersheds. In addition, Stimson tended to keep all of its heavy equipment on-site, which decreased the potential for the disease to be introduced from other areas. Between 2002 and 2005, *P. lateralis* was discovered (and quickly confirmed by U.S. Forest Service plant pathologists) at three locations in upper Bummer Lake Creek area and one location in the Rock Creek drainage. All four sites were treated in 2006 (see section 4.4.3.2) and as of 2018, there have been no new detections. *P. lateralis* typically is spread during the rainy season (October to May) and by the transport of water downstream or soil from infected sites to non-infested sites. Long-range transport is primarily through infected soil on vehicles (construction, maintenance, and logging), other equipment, nursery stock, or foot traffic (human, livestock, or game) and much less common is aerial spread via air moisture and water (USFS 2011).

White pine blister rust, caused by the non-native fungus *Cronartium ribicola*, is the most destructive disease of five-needle (white) pines in North America. All species of white pine are susceptible at all ages; however, seedlings and young trees are often more easily infected and die more quickly as a result of infection (USFS 2003). The fungus originated in Asia and was introduced into North America about 1900 on white pine seedlings grown in European nurseries and by the 1950s had spread to most of the commercial white pine regions (Maloy 2001). White pine blister rust has a complex life cycle that requires two hosts, a white pine and, most commonly, a currant or gooseberry plant (*Ribes* spp.). Recently indian paint brush (*Castilleja* spp.) and snapdragon (*Pedicularis* spp.) have been discovered to be alternate hosts as well (McDonald et al. 2006). An infected pine branch will swell and after a year or more, the rust forms aeciospores that are contained in blister - like sacks that erupt through the bark of the twig or stem. When the blisters rupture they release bright orange colored spores which infect the alternate host. While hosted on these other plants the rust produces basidiospores that are released in the fall when the plants drop their leaves and it can infect the pines. The fungus grows from the needles down to the twig, into the branch and ultimately to the main stem of the tree. The rust kills the cambium causing a canker, which prevents water and nutrients from passing through the canker area; as a result the distal portion of the twig, branch or stem dies. If the canker forms on the main stem, it will cause topkill and often causing the tree to die. The spores can be damaged by dry air; therefore wet, cool conditions during spore shedding can lead to successful infection.

White pine blister rust is present in some western white pines (and possibly sugar pines) east of Rock Creek (L. Leonard, personal communication 2018). The infection has only been seen in young trees, but further monitoring is necessary to ensure adequate regeneration is present.

2.8 Wildlife

The varied habitat types found in the Park provides for a relatively diverse assemblage of wildlife. Seventeen special status wildlife species are known to inhabit DNCRSP (Appendix D), four of which are federally or state listed. In general, wildlife species in the park are managed through the protection and restoration of habitats and ecosystems.

The California Wildlife Habitat Relationship (CWHR) System, developed by Mayer and Laudenslayer (1988), is a classification system that describes California's wildlife species; their distribution, life history, habitat requirements, and conservation status. The CWHR provides a broad habitat-based system that attempts to classify vegetation based on its value to vertebrate animals. Largely based on vegetation type, the system describes 59 different habitat types in California that have since been translated to alliances (Sawyer et al. 2009). The following 14 CWHR classifications encompass the vertebrate species found in DNCRSP, including 17 special status wildlife species. **Redwood (RWD)** habitats correspond primarily to the Redwood forest alliance and provide food, cover, and/or special habitat elements for 193 potential wildlife species (Marcot 1979 in Mayer and Laudenslayer 1988). The second most common habitat type in the Park, **Douglas-fir (DFR)** corresponds primarily to the Douglas-fir alliance. Mixed **Chaparral and Montane Chaparral (MCP and MCH)** are currently the third most common habitats followed by red alder dominated **Montane Riparian (MRI) and Riverine (RIV)**. **Montane Hardwood Conifer [MHC]** habitats in the park consist of at least one-third conifers and at least one-third (mostly evergreen) hardwoods. The mast crops produced within mature MHC habitats are an important food source for many species of mammals and birds. Other habitat types in the Park that occur in much smaller patches include **Coastal Scrub (CSC), Annual Grasslands (AGA), Perennial Grasslands (PGS), Freshwater Emergent (FEW), Lacustrine (LAC), Urban (URB), and Barren (BAR)**.

Reptile diversity in these habitats is low. Western pond turtles (SSC) have not been documented in the Park. However, shaded seeps and streams (RIV and FEW) and adjacent forests (RED, DFR, MHC, MRI) provide habitat for a variety of amphibians, including ensatina (*Ensatina eschscholtzii*), northwestern salamander (*Ambystoma gracile*), coastal giant salamander (*Dicamptodon tenebrosus*), clouded salamander (*Aneides ferreus*) and five species listed by CDFW as Species of Special Concern (SSC): southern torrent salamander (*Rhyacotriton variegatus*); Del Norte salamander (*Plethodon elongatus*); Pacific tailed frog (*Ascaphus truei*); northern red-legged frog (*Rana aurora aurora*) and foothill yellow-legged frog (*Rana boylei*). The southern torrent salamander, which occurs in perennial and ephemeral seeps, springs, and lower order streams that contain clean gravels with interstitial spaces, is common in the Park. This species and the larval form of the tailed frog are both susceptible to increased sediment loads and

increased water temperatures. The Del Norte salamander is known to occur in many of the talus slopes located throughout the Park. Freshwater Emergent Wetlands (FEW) near the Mill Site provide some of the most productive red-legged frog habitat observed on the northcoast, and most of the aquatic habitats in the Park provide habitat for adults (Justin Garwood pers. comm.). Foothill yellow-legged frogs are usually found near water, preferring open gravel bars and shallow, rocky edges of streams and rivers.

Small to medium-sized mammals known to occur in forested habitats (RWD, DFR, MHC, MRI) include deer mice (*Peromyscus maniculatus*), dusky-footed woodrats (*Neotoma fuscipes*), northern flying squirrels (*Glaucomys sabrinus*), Douglas squirrel (*Tamiasciurus douglasii*), western redbacked vole (*Clethrionomys californicus*), Sonoma tree vole (*Arborimus pomo*, SSC), fog shrew (*Sorex sonomae*), and American shrew-mole (*Neurothrichus gibbsii*). White-footed voles are known to occur in MRI habitats in JSRSP, but have not been detected in DNCRSP to date. The North American beaver (*Castor canadensis*) and river otter (*Lontra canadensis*) occur in aquatic habitats of the park. Several bat species are known to occur within DNCRSP, including Townsend's big-eared bat (*Corynorhinus townsendii*, SSC), big brown bat (*Eptesicus fuscus*), long-legged myotis (*Myotis volans*), Yuma myotis (*M. yumanensis*), and little brown bat (*M. lucifugus alascensis*). All of these bat species rely on cavities and basal hollows of old growth redwood trees (Zielinski et al. 2007) for critical breeding and resting habitat. Humboldt marten (*Martes caurina humboldtensis*), a State Candidate Endangered species, was detected in 2014 in DFR and MHC of the Rock Creek Watershed and has been documented on USFS lands to the east of the Park. The Pacific fisher (*Pekania pennanti*) West Coast Distinct Population Segment (DPS), has been documented in numerous forested locations within DNCRSP. Larger mammals including gray fox (*Urocyon cinereoargenteus*), coyote (*Canis latrans*), black bear (*Ursus ai domericanus*), bobcat (*Felis rufus*), mountain lion (*Puma concolor*), Columbian black-tailed deer (*Odocoileus hemionus columbianus*), and Roosevelt elk (*Cervus elaphus roosevelti*) occur throughout the park, often utilizing roads and trails.

Of the 144 bird species observed in the Park (NCRD Bird List 2018), six are State or federally listed, or are SSC (Appendix D, Special Status Wildlife). Birds often occurring in Redwood habitats include brown creeper (*Certhia americana*), Pacific wren (*Troglodytes pacificus*) which prefers dense understory, pileated woodpecker (*Dryocopus pileatus*), red-breasted nuthatch (*Sitta canadensis*), Steller's jay (*Cyanocitta stelleri*), varied thrush (*Ixoreus naevius*) and osprey (*Pandion haliaetus*). Mature MHC habitats are valuable to cavity-nesting birds such as pileated woodpecker, western screech-owl (*Otus kennicottii*), chestnut-backed chickadee, and red-breasted nuthatch. The mast crops produced within these habitats are an important food source for mountain quail (*Oreortyx pictus*) and band-tailed pigeon (*Columba fasciata*). American dippers (*Cinclus mexicanus*) are found in the structurally diverse Montane Riparian habitat while ruffed grouse (*Bonasa umbellus*) forage in all closed forest habitat types. Bird species in the Park include many

neotropical migrants, such as Pacific-slope flycatcher (*Empidonax difficilis*), olive-sided flycatcher (*Contopus cooperi*), Swainson's thrush (*Catharus ustulatus*), hermit warbler (*Dendroica occidentalis*), MacGillivray's warbler (*Oporornis tolmiei*), western tanager (*Piranga ludoviciana*) and three California SSC: purple martin (*Progne subis*), yellow warbler (*Setophaga petechia*), and Vaux's swift (*Chaetura vauxi*). Another neotropical migrant, the common nighthawk (*Chordeiles minor*), nests in the gravel on old logging roads. The State endangered willow flycatcher (*Empidonax traillii*) has been documented in the Park. The northern goshawk (*Accipiter gentilis*) has not been reported in the Park although it has been observed nearby. The northern spotted owl (NSO, *Strix occidentalis caurina*) is a Federally and State threatened species that is now rare in the Park due to past loss of functional habitat and the influx of barred owls (*Strix varia*). There were six known northern spotted owl activity centers (AC) in the MCA in 1995, according to a summary document of the status of wildlife and fisheries resources, produced by Rellim Redwood Company for the property (Jones & Stokes Associates 1995). Despite annual monitoring 2003-present, the last observation of a NSO pair was at Georges Saddle in 2015 and the last known breeding attempt was in 2008. Since then, monitoring at the George's Saddle AC has been done by song-meter, with detections of single NSO and paired BAOW each year. Paragon grove has been unoccupied since 2013. Other suitable habitat (Damnation Creek AC) was last occupied in 1995 (NPS database), and surveyed through 2003, when a pair of barred owls were detected. The marbled murrelet (MAMU, *Brachyramphus marmoratus*), an old-growth-associated species that is Federally threatened and State endangered, occurs within the Park. Marbled murrelets are commonly detected near the Hamilton Buffer Grove and in the original old-growth sections of DNCRSP (Transou, pers. com., 2018). Residual old-growth trees located throughout the Park provide potentially suitable habitat. Another State endangered species that is known to occur in the Park is the bald eagle (*Haliaeetus leucocephalus*). No known bald eagle nests occur in the Park; however, there is a nest located on Mill Creek within Redwood National Park, located approximately one mile west of the Park boundary. Bald eagle use of the Park is primarily restricted to winter foraging along the fish bearing streams during the salmonid runs.

Streams within the Park support both anadromous and resident fish populations. The Southern Oregon/ Northern California Coast Evolutionarily Significant Unit coho salmon (*Oncorhynchus kisutch*) is Federally and State threatened from Punta Gorda to the Oregon border, and is currently the only listed fish species found in the Park, in the Mill Creek and Wilson Creek watersheds. Other anadromous salmonids known to occur in the Mill Creek Watershed include fall chinook salmon (*Oncorhynchus tshawytscha*), chum salmon (*Oncorhynchus keta*), steelhead (*Oncorhynchus mykiss*), and SSC coast cutthroat trout (*Oncorhynchus clarkii*). Other fish species that have been reported from streams in the Park include lamprey (*Lampetra sp.*), prickly sculpin (*Cottus asper*), riffle sculpin (*Cottus gulosus*), threespine stickleback (*Gasterosteus aculeatus*). For additional

information on anadromous salmonid can be found in chapter 2.3 (Aquatic Populations and Periodicity) of the Mill Creek Watershed Plan.

2.9 Climate Change and Air Quality

Climate change (i.e changes in weather patterns including temperature and precipitation) has already shown to have substantial impacts on many vegetation communities, and requires special consideration to ensure the objectives of this plan are met. Successful outcomes are especially challenging to reach due to uncertainty about how climate will change in specific locations and how those changes might affect vegetation (Fernandez et al. 2015). Anticipating the outcomes of vegetation management projects, or other disturbances requires an adaptive management approach that utilizes a toolbox of management techniques that account for climate change potential (Millar et al. 2007). Furthermore, because future conditions will be different from the past, reference conditions for management and restoration projects should adjust, meaning it may not be appropriate to manage or restore ecosystems to historical conditions. We do not anticipate radical departures from historic conditions to be warranted during the life of this plan but likely changes to climate and fire regimes will require flexible management that begins by accumulating knowledge about current and historic conditions and incorporates the latest information from scientific research on how they may adapt to both predicted and unexpected changes.

An increasing body of scientific research attributes changes in climate over the past 150 years to increasing rates of greenhouse gas (GHG) emissions beyond natural levels, which have been caused mostly from human activities. Gasses that absorb infrared radiation thereby trapping and holding heat in the atmosphere are called greenhouse gases because they are responsible for causing the greenhouse effect thereby contributing to global warming. In the United States, the largest source of GHG emissions from human activities is from burning fossil fuels for electricity, heat, and transportation (USEPA, 2016b). Greenhouse gases include carbon dioxide (CO₂), nitrous oxide (N₂O), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

As of 2010, California ranked second highest, behind Texas, among states in the US in total emissions, but from a per capita standpoint, is the 45th lowest in emissions. On a global level, if California were considered as an independent state, it would have ranked the 20th highest in CO₂ emissions worldwide (CARB, 2014).

In an effort to help reduce global warming, new state laws regulating GHGs were enacted in 2006. Assembly Bill 32, the Global Warming Solutions Act, requires the State to implement a series of actions to achieve a reduction in GHG emissions to 1990 levels by 2020. Assembly Bill 1803, required the California Air Resources Board to prepare, adopt, and update California's GHG inventory (CARB, 2016c).

California State Parks has developed a “Cool Parks” initiative to address climate change within the State Park system. Cool Parks proposes that CSP itself as well as resources under its care adapt to the environmental changes resulting from climate change. In order to fulfill the Cool Parks initiative, CSP is dedicated to cooperate with other entities to create “landscape reserves” and acquire “habitat corridors” in order to help sustain biodiversity and allow plants and animals to readjust their range in response to climate change. CSP is also doing its part to make their facilities more energy efficient, use alternative energy sources, switch to lower emission vehicles, and educate staff and visitors on climate change (CDPR, 2018).

In December 2009, the Natural Resource Agency adopted amendments to the Guidelines for Implementation of the California Environmental Quality Act addressing the significance of impacts for greenhouse gas emissions (California Natural Resources Agency, 2014). Section 15064.4 of the amended CEQA Guidelines states: “A lead agency should make a good-faith effort, based to the extent possible on scientific and factual data, to describe, calculate or estimate the amount of greenhouse gas emissions resulting from a project.” As a result of revisions to the CEQA Guidelines that became effective in March 2010, CSP is obligated to determine whether a project’s GHG emissions significantly affect the environment and to impose feasible mitigation to eliminate or substantially lessen any such significant effects.

3 Vegetation Management Goals

The DNCRSP Vegetation Management Plan presents a detailed program of actions to carry out vegetation management policies and objectives in the Park. The goals and objectives of the plan have their foundations in the Park’s guiding management documents: the joint General Management Plan/General Plan (GMP/GP) (add source, 1999), GMP/GP amendment that includes the MCA (CDPR 2010), the Mill Creek Watershed Management Plan (CDPR 2011a), the Department Operations Manual (CDPR 2004), the RNSP Foundation Document (RNSP 2016), the draft RNSP Shared Restoration Strategy (Redwoods Rising 2017), and District Policy.

Vegetation management goals were developed from a desire to protect, and where appropriate, restore and maintain the diversity of ecosystems that existed prior to European settlement when the dominant ecosystem was old-growth redwood forest. These goals recognize the constant state of change in park ecosystems due to adaptation to, and recovery from, stochastic events including climatic events, fire and other disturbances. Ideal current conditions therefore should not be based on a snapshot of prior conditions, but rather use the past as a guide as to what conditions will promote resilience or will facilitate adaptation to future disturbance and changing conditions such as the spread of new, exotic plants or pathogens. Each goal has a set of related

management guidelines which may evolve during the life of the vegetation management plan, as part of the adaptive management process.

Consistent with the above guiding documents, this vegetation management plan seeks to:

- Preserve and manage the Park's interdependent ecosystems, in order to maintain and/or improve ecosystem function and structure.
- Protect special status plants and sensitive plant communities within the Park to manage for their perpetuation.
- Preserve, and reestablish effective habitat linkages within and between the Park and other protected lands.
- Establish, maintain, and preserve buffers around high priority (e.g. old-growth) or sensitive Park natural resources as protection against adverse environmental impacts.
- Reestablish ecological process of fire.
- Enhance the ability of ecosystems to withstand and be resilient to changes in abiotic and biotic conditions (E.g. climate change, exotic pathogens, high severity fire).
- Provide guidelines for prioritizing restoration treatment areas and methods including invasive removal, forest thinning, planting and prescribed burning.
- Work with universities and other researchers to further our understanding of vegetation communities and to better achieve Park objectives

4 Vegetation Management Program Areas

This section discusses each vegetation management program area and the objectives, implementation strategies, and monitoring guidelines specific to each program.

Project requirements are included in all project designs to reduce impacts to resources. A complete list of project requirements relevant to activities suggested in the DNCRSP Vegetation Management Plan is found in Appendix E, Project Requirements. They address requirements regarding air quality, vegetation, wildlife, cultural resources, erosion prevention, soil stability, hazards and hydrology. Standard Project Requirements (SPR) have been standardized statewide for the use of avoiding significant project-related impacts to the environment. They are assigned as appropriate to all projects. For example, projects that include ground-disturbing activities, such as trenching; would always include standard project requirements addressing the inadvertent discovery of archaeological artifacts. However, for a project that replaces a roof on an historic structure, ground disturbance would not be necessary; therefore standard project requirements for ground disturbance would not be applicable and would not be assigned to the project. DPR also makes use of project specific requirements (PSR), developed to address project impacts for projects that have unique issues; that would not typically be standardized for projects statewide. The requirements are grouped thematically into air

quality (AIR), biological resources (BIO), cultural resources (CULT), geology and soils (GEO), hydrology, aquatic resources and water quality (HYDRO), potential hazards and hazardous materials (HAZ), and noise (NOISE).

4.1 Forest Restoration

Forest restoration, which includes reforestation, thinning and crown manipulation may be used to adjust tree spacing, density, size distribution, species composition and structural complexity. These activities are crucial to DNCRSP's vegetation management program. Large areas of the Park were impacted by logging and fire suppression. Although not all logged areas will need treatment to restore their stand structure and composition, many areas will. The science of restoration forestry is new and still evolving. The goals include outcomes that may take centuries to achieve, and thus an adaptive management approach will be utilized that allows modification of the procedures outlined in this plan based upon observed outcomes.

Our understanding of the current impediments to healthy forest development are described below. The Forest Restoration Strategy (Appendix F, Forest Restoration Strategy) describes, previous efforts at restoration and priorities.

4.1.1 Impaired Stand Types

Approximately 23,600 ac of DNCRSP have been identified as previously harvested forest dominated by redwood, Douglas-fir or tanoak. These stands do not include areas that were identified in 1948 photos as historic non-forest (mostly grasslands and chaparral with some scattered trees, but also young forests that appeared to have recently colonized prairies). The age of dense conifer stand types range from 90 to 18 yrs old, with stand dates of birth (DOB) ranging from the 1920s to 2000 (Table 4a).

Table 4a. Acres of unnaturally dense conifer forest by stand age class, based on Stimson date of birth data. Acreage excludes all areas identified as historic non-forest in 1948 aerial photos.

Stand Age Class	Acres
< 1940	4,080
1940 to 1959	1,078
1960 to 1979	9,925
1980 to 2000	8,343

Previously harvested and impaired conifer forests are divided into three general stand types with associated strategies for improving conditions within each type.

4.1.1.1 Unnaturally dense conifer forests

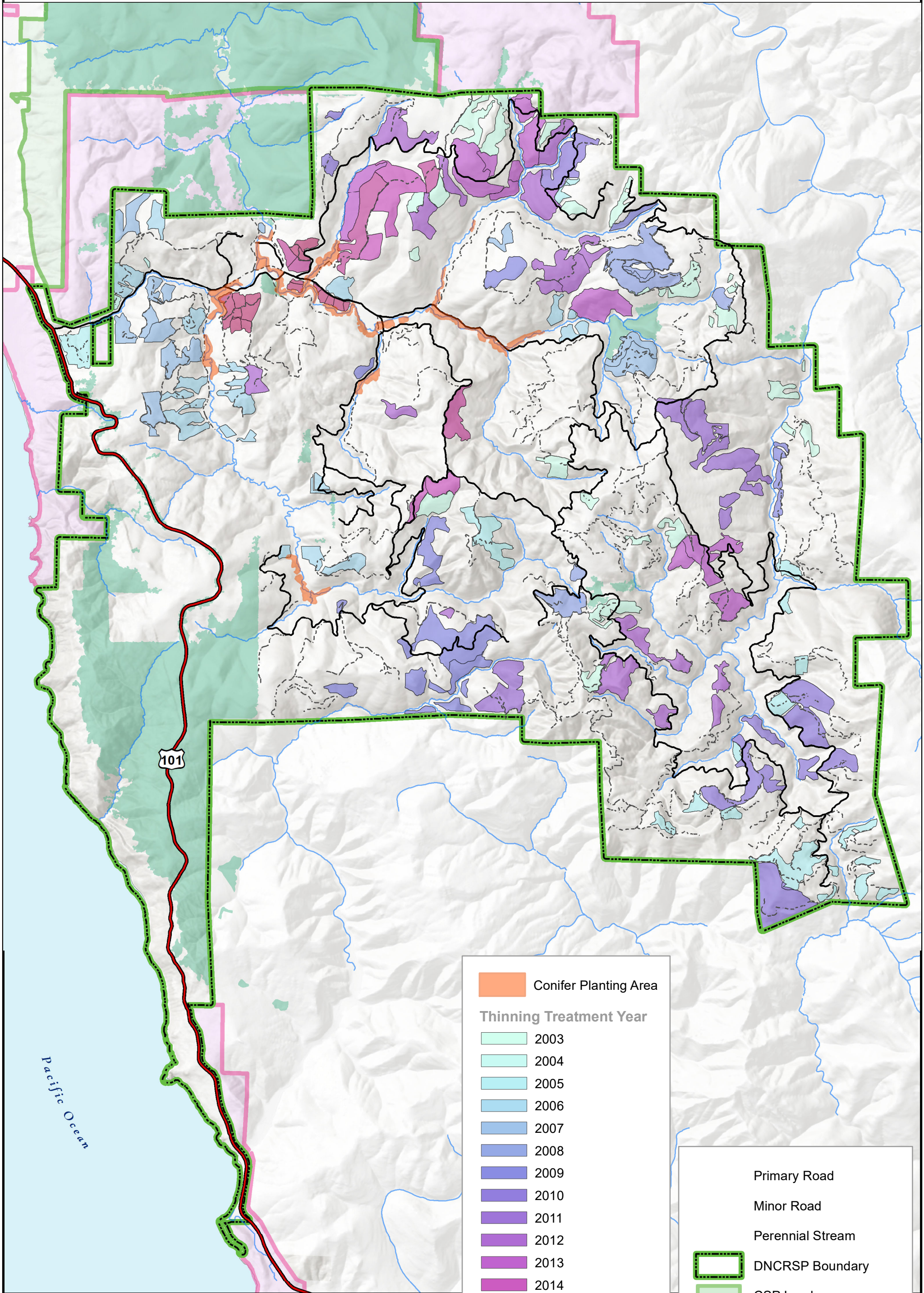
This is the most common degraded forest type within the property due to the long history of management to produce timber. Stands are dense with low-vigor conifers and lacking a sufficient number of dominant, vigorous trees to develop late-seral attributes rapidly. This is the highest priority forest type because growth and forest health is most jeopardized by slow stand stratification (dominants slow to emerge above codominants) and overcrowding. This forest type is also most capable of developing late-seral conditions if treated, but failing to treat promptly can reduce crown vigor which diminishes the effects of treatments done later (Oliver and Larson 1996, O'Hara and Oliver 1999).

Objectives specific to dense conifer forests are: 1) release individuals or groups of trees to accelerate growth and enhance crown vigor and tree resistance to disturbances, 2) initiate diverse understory plant communities, 3) enhance vertical and horizontal structural heterogeneity 4) maintain or enhance underrepresented species and species that promote resilience, 5) establish multiple cohorts as stands reach older ages, and 6) reintroduce fire as a natural process where appropriate.

Treatment in this forest type includes forest thinning and in older forests prescribed fire. Treatments may involve establishing a new cohort in older stands thru the release of advanced regeneration, seedling establishment, or by underplanting following treatment. Generating large forest gaps or sparse understory may be necessary where Douglas-fir or other underrepresented species are needed. Over 5,000 ac of this forest type has been thinned between 2003 and 2018 (Map 4-a, Treatment History). Prioritization of unnaturally dense conifer stands is described in Appendix F.

4.1.1.2 Unnaturally dense hardwood/conifer stands

This forest type is characterized by overly dense stands of mixed hardwoods and conifers, with tree growth hindered by the high competition. A few of these stands may be a high priority for treatment, but they are generally a lower priority than unnaturally dense conifer stands. The difference in growth rates between various species can lead to a natural stratification of the canopy, and allow dominant trees to stay healthy and grow well (O'Hara and Oliver 1999). However, growth and structural heterogeneity may be enhanced by reducing tree densities in these stands, and treatment may be necessary to retain a diverse understory or shade intolerant trees like madrones which tend to become less common over time as they get overtopped by taller, faster-growing trees. Treatment options include thinning and prescribed fire.

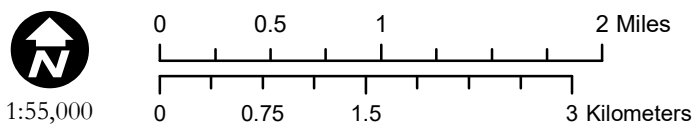


Conifer Planting Area

Thinning Treatment Year

- 2003
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2017

- Primary Road
- Minor Road
- Perennial Stream
- DNCRSP Boundary
- CSP Land
- NPS Land



4.1.1.3 Conifer deficient forests

These are forests that are deficient in conifers as compared to pre-logging conditions. There are three main forest conditions that fall into this category:

Conifer/hardwood mixed stands

The conifer deficient conifer/hardwood mixed stands are areas that historically had more conifers or conifers of a different species than are currently present. One area where this condition exists is in patches along Hamilton Road, from its intersection with Highway 101 to the West Branch of Mill Creek, which was grazed for several decades until 1962 (see 2.5.) Landowners in the redwood region who burned redwood clearcuts for grazing often found that the redwoods sprouted back vigorously, but other tree species could be virtually eliminated through repeated burning. In many cases landowners would eventually give up on grazing and the stand would be left to regenerate and species composition often shifted towards redwood. Managers in the Hamilton Road area removed at least some redwood stumps to prevent this and to keep the land open, but it is uncertain how extensive their efforts were. Much of the area (especially north of Hamilton road) appears to lack stumps in the 1948 photos, but it is unclear if this area was once dominated by spruce and other non-sprouting species (recall Hobbs Wall placing Camp 12 in the area to extract spruce), whose stumps would have long since rotted away, or if their redwood stump removal efforts were widespread. In short the historic ratio of spruce to redwood and other conifers of this area is less certain than for other portions of the property, but spruce was certainly more common near the coast and lower slopes. Most of this area was logged again in the 1990's and has a varying mixture of conifer and alder trees in the overstory. Additional research into soils and other climatic data may help clarify species composition, but it appears that some redwood and/or spruce planting would be appropriate in this area.

Other areas lacking conifers were partially cut or high-graded (mostly in the 1950's and 60's) to remove valuable conifers with little or no follow-up management. The remaining hardwoods (mostly tanoak) were too dense for many conifers to establish or thrive in the understory. This is probably an uncommon impairment condition within the property but it is not well documented. Areas along Rock Creek Road between Upper Viser and Crossover roads should be examined (along with aerial photos of this area) to better identify this forest type and assess forest type changes. Other conifer deficient areas may include early cuts in hardwood dominant areas, such as along the ridge tops on and around Childs Hill. Tools to best improve conifer deficient mixed conifer/hardwood stand conditions include prescribed fire (to kill some overstory trees and create bare ground for natural regeneration), thinning (to get sufficient light to the forest floor and improve growth of existing conifers), and tree planting. It may be necessary to assist seedling survival

with the application of herbicides on resprouting hardwoods such as tanoak. Herbicide application is beyond the scope of this document and would have to be covered under a separate compliance process.

Riparian stands

Conifer deficient riparian areas, are areas that were historically old-growth conifer and were converted to alder dominance during logging operations. Most, if not all, of these areas (approximately 200 ac) were identified in the CDPR 2009 riparian conifer planting project where over 10,000 conifer seedlings were planted along the East Fork and West Branch of Mill Creek and a few of their tributaries to promote the historic species mix of these stands (see past treatments in Appendix F). Additional work in these 200 ac is needed, including planting additional conifer trees and removing competing vegetation around smaller conifer trees. Restoring these areas can be challenging due to competition from dense vegetation in both the shrub layer and the overstory. Successful efforts often involve planting larger than standard seedlings (2 - 6 feet tall), removing competing vegetation and sometimes protecting seedlings from animal browse. Many trees planted over 8 years ago either died from animal browse, debris falling on them, scouring during high flows or competition and survivors are generally only 4 - 5 feet tall due to repeated browsing of the top leader and shading. Planting taller seedlings and brushing around individual trees is recommended, but some alders may need to be removed, especially when trees become taller than surrounding shrubs. Alders may be cut individually to release trees, but overstory canopy cover should remain high to prevent water quality degradation.

Stands with conifers in poor condition

Stands with conifers in poor condition are a high priority for treatment prevent the loss of existing conifers. This condition is uncommon but is present in some of the youngest clearcuts. These stands were not treated with herbicide to protect conifer seedlings because the timber company sold the land and CSP is more reluctant to use herbicides. In most cases this probably resulted in a lower, but acceptable conifer density for current objectives, but in a few cases hardwoods (alders in the park's demonstration forest and the sheepshed units, and tanoak in the upper reaches on Rock Creek) continue to hinder conifer growth. In extreme cases, competing vegetation threatens to kill Douglas-firs and leave insufficient conifers to meet long-term forest restoration objectives.

Although previous restoration treatments have removed hardwood trees around individual conifers to maintain conifer health and improve growth, additional treatments are likely needed in the park's demonstration forest, the sheepshed units, and perhaps in other areas. Planting in these areas is probably not necessary unless more conifers die and natural regeneration does not occur, or if further analysis shows a unfavorable species composition. It may be necessary to assist natural regeneration with treatments to

manually cut competing vegetation or to use herbicides on resprouting hardwoods. But herbicide application is beyond the scope of this document and would have to be covered under a separate compliance process.

4.1.2 Forest Restoration Objectives

- Place forests on a trajectory that expedites the development of late-seral forest structure.
- Promote growth in individual trees
- Enhance structural complexity
- Encourage desired tree and understory species composition that considers historic conditions and future stressors such as climate change and altered fire regimes.
- Increase resiliency and spatial heterogeneity

4.1.3 Forest Restoration Implementation

4.1.3.1 Forest Thinning

Silvicultural Methods

Forest thinning treatments utilize silvicultural methods that are intended to reduce stand density, redistribute growth among remaining trees and enhance forest health. Variable density thinning (VDT) will be the primary silvicultural method used in forest restoration activities at DNCRSP. VDT focuses on the enhancement of spatial heterogeneity across the landscape by prescribing fine-scale variation to the forest structure. VDT can take many forms and may incorporate a mixture of thinning severities and methods within any given treatment unit. Thinning severity (also known as thinning weight or intensity) refers to the amount of trees that are cut, and is often expressed in terms of basal area or volume reduction over a given area. The following describes the primary thinning methods that can be used independently or in combination within VDT treatments:

- *Canopy release* removes competition from around individual trees or small groups of trees that are retained (similar to the Dx prescription described in O'Hara et al. 2012). For example, every tree that stands within the drip line of a retention tree or retention group is cut. This method may be implemented in stands where hardwoods are over represented with the objective of releasing conifers, or to release underrepresented species in a dense forest setting.
- *Low thinning* (thinning from below) focuses on the removal of trees from the lower crown classes (i.e., suppressed, intermediate, and co-dominant crown classes) to benefit trees in the upper crown classes (i.e., co-dominant and dominant crown classes), and generally removes the smaller diameter trees first, with successively larger trees removed until the basal area retention is met.

- *Crown thinning* focuses on the removal of trees from the dominant or co-dominant crown classes to benefit adjacent trees of the same crown class. Most trees cut will be in the middle diameter classes as opposed to the smaller diameter classes in the low thinning method. This thinning method is likely to result in prolonged benefits to growth in retention trees and understory vegetation when compared to low thinning of the same severity.
- *Gaps and Skips*. Gaps (areas with no or few trees) may be used to establish and maintain a new cohort of trees, encourage a robust assemblage of understory vegetation, and promote landscape-scale heterogeneity, but will not exceed ½ ac in size. All trees in the largest diameter classes (80th percentile) will be retained, and a maximum of 10% of the area of any treatment will be treated with forest gaps. Skips are areas where few to no trees will be cut and may be established at the same size and frequency as gaps to further increase stand heterogeneity.

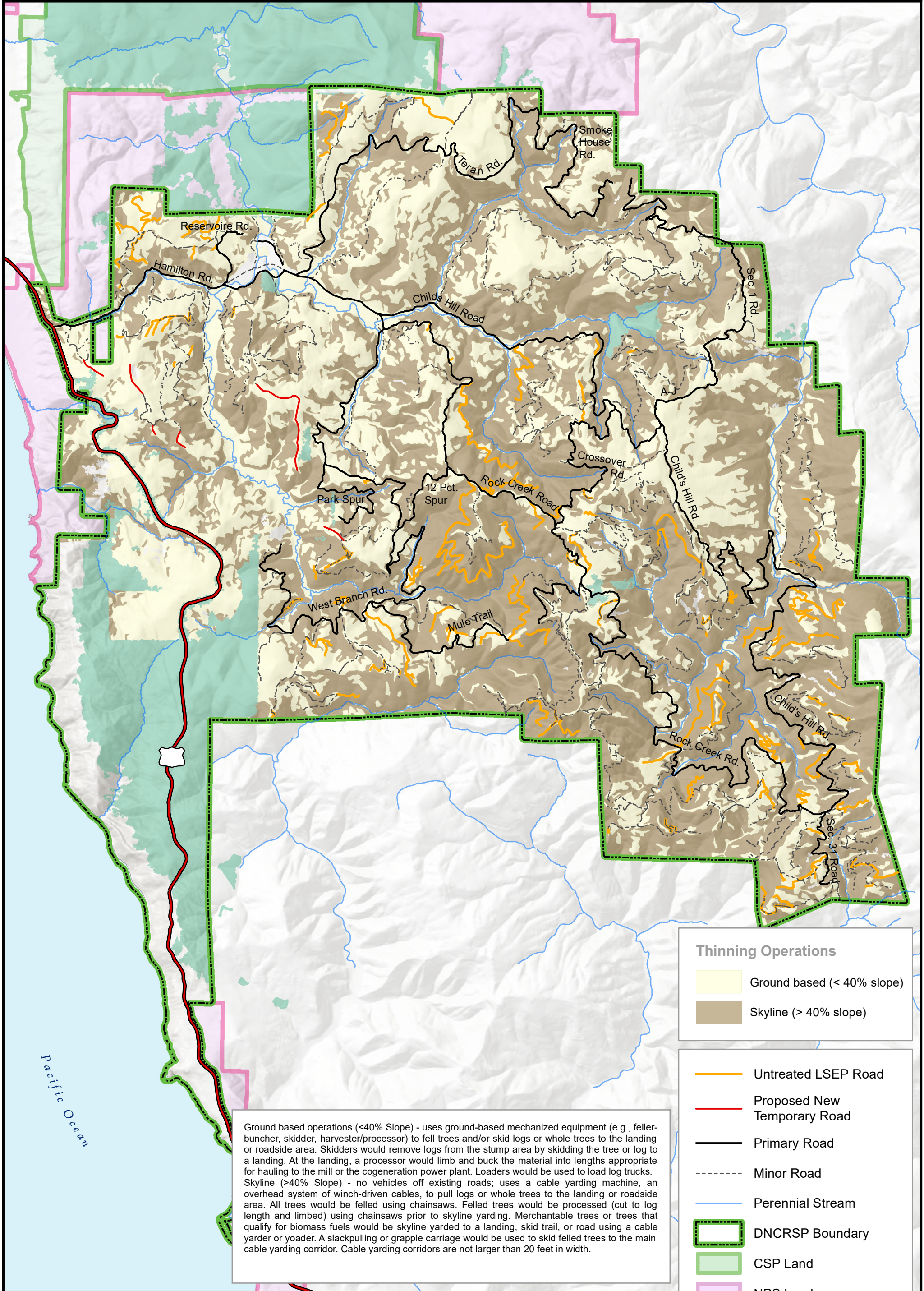
For all forest types except for those discussed in Uncommon Habitats (Chapter 4.2), all trees within the 80th percentile diameter class and larger will be retained in each stand (PSR-BIO-5). When averaging across an entire forest restoration unit, treatments will not exceed a 50% reduction in the basal area, and the basal area will be reduced by 40% or less in most locations. Most treatments will retain more than 100 trees per ac across a treatment unit. In a few cases within older stands, treatments may reduce stem density to less than 100 tpa, closer to old-growth forest densities. Silvicultural method and severity will vary according to current stand and site specific conditions, landscape context, and project requirements (Chapter 4). The following describes common treatment considerations that will guide silvicultural prescriptions:

- **Undesirable species composition** - In some areas, previous logging activities have altered the species composition (e.g. redwood is underrepresented, excessive alder in-growth, non-commercial species discouraged...). Thinning treatments will aim to shift species composition by targeting undesired tree species (e.g. exotic and overrepresented tree species). This can result in patchy thinning severities, and may not require further variation in the prescription for a treatment unit. Once the desired species composition is met, further thinning may continue to increase stand heterogeneity and the available growing space for retention trees.
- **Tree size** - Bear damage is generally higher in forests thinned to low tree densities and in smaller trees (<24" dbh), therefore forests with smaller trees may need to be thinned to higher tree densities to avoid excessive bear damage (Russell et al 2001 and Perry et al 2016).

Operational Methods

Forest thinning operations include the methods by which trees are felled and how woody material is treated and/or removed from the stand. There are two operational methods:

- **Lop-and-scatter** - Lop-and-scatter operations use chainsaws to fell trees that are cut into small pieces (i.e., lopped) and broadcast (i.e., scattered) throughout the treatment area for natural decomposition. No felled trees would be removed, and no heavy equipment would be utilized in these areas. Lop-and-scatter will be used where few or only small conifers are being cut, areas that are too far from useable haul roads, and in special management zones. (Map 4-b, Forest Thinning Operations) displays potential operational methods for DNCRSP.
- **Biomass removal** - Trees may be removed from the project area to reduce fire hazard and offset the costs of operations if the material is not necessary to improve habitat in the park (e.g. coarse woody debris on the forest floor and large woody debris for aquatic restoration). Removing whole trees requires the use of heavy equipment to fell trees, transport cut trees to a landing, process merchantable wood products (e.g. limbing and bucking), load logs and transport material off-site. The methods for biomass removal will use ground based and skyline/cable yarding operations concurrently, and operational methods tend to shift according to slope.
- **Ground based operations** - uses ground-based mechanized equipment (e.g., feller-buncher, skidder, harvester/processor) to fell trees and/or skid logs or whole trees from the stump area to the landing or roadside area. Skidders would remove logs from the stump area by skidding the tree or log to a landing. At the landing, a processor would limb and buck the material into lengths appropriate for hauling to the mill or the cogeneration power plant. Loaders would be used to load log trucks. Log trucks would transport logs from the project area to a mill or cogeneration power plant. Tree removal from ground based operations will generally be restricted to slopes under 40%.
- **Tethered equipment operations** such as cut-to-length, are a variation on traditional ground-based operations. In tethered systems, a winch is mounted to the back of a harvester or a forwarder and secures the equipment to an anchor point. This allows that piece of equipment to lower itself down or climb up steep slopes. These types of systems differ from other ground-based operational methods in that the harvester fells, processes, and bucks the trees at the stump. Tree limbs and tops are placed in front of the harvester and are driven over as the machine moves ahead, minimizing ground disturbance. The forwarder follows in the harvester's trail, loads the cut logs into log bunks on the machine, and transports the logs to the landing area. Tethered systems could be used on slopes up to 85%.
- **Skyline operations** - uses a cable yarding machine, an overhead system of winch-driven cables, to pull logs or whole trees from the stump area to the landing or roadside area. All trees would be felled using chainsaws. Felled trees would be processed (cut to log length and limbed) using chainsaws prior to skyline yarding.

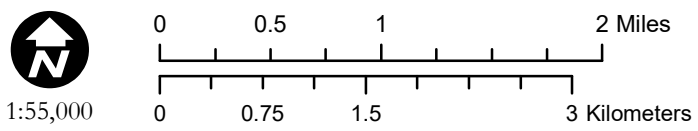


Ground based operations (<40% Slope) - uses ground-based mechanized equipment (e.g., feller-buncher, skidder, harvester/processor) to fell trees and/or skid logs or whole trees to the landing or roadside area. Skidders would remove logs from the stump area by skidding the tree or log to a landing. At the landing, a processor would limb and buck the material into lengths appropriate for hauling to the mill or the cogeneration power plant. Loaders would be used to load log trucks. Skyline (>40% Slope) - no vehicles off existing roads; uses a cable yarding machine, an overhead system of winch-driven cables, to pull logs or whole trees to the landing or roadside area. All trees would be felled using chainsaws. Felled trees would be processed (cut to log length and limbed) using chainsaws prior to skyline yarding. Merchantable trees or trees that qualify for biomass fuels would be skyline yarded to a landing, skid trail, or road using a cable yarder or yoader. A slackpulling or grapple carriage would be used to skid felled trees to the main cable yarding corridor. Cable yarding corridors are not larger than 20 feet in width.

Thinning Operations

- Ground based (< 40% slope)
- Skyline (> 40% slope)

- Untreated LSEP Road
- Proposed New Temporary Road
- Primary Road
- Minor Road
- Perennial Stream
- DNCRSP Boundary
- CSP Land
- NPS Land
- Old Growth



Merchantable trees or trees that qualify for biomass fuels would be skyline yarded to a landing, skid trail, or road using a cable yarder or yoader. Regardless of the type of skyline system used, a slackpulling or grapple carriage would be used to skid felled trees to the main cable yarding corridor. Cable yarding corridors are generally not larger than 20 feet in width. Tail holds (anchors the end of a mainline) can be trees or stumps. If trees are used as a tailhold or lift tree, only second-growth trees would be used, and no large residual trees of any species that pre date logging would be used. Guylines would also be anchored to stumps, or second-growth trees; residual trees of any species would not be used to anchor guylines. Impacts to soils on slopes over 40% grade will be minimized by the use of these cable yarding operations.

- **Helicopter operations** - uses a helicopter to remove trees or portions of trees in areas where access by other means is infeasible. Trees are generally cut in advance and a ground crew assists the helicopter crew by securing trees to a cable hanging from the helicopter. The cost is prohibitive in many circumstances, but may be more feasible when the wood will be used to create instream structures in areas where vehicle access is prohibited.

Within DNCRSP all forested land being considered for restoration has the potential for biomass removal to restore ecosystem function and reduce catastrophic fire risk, while retaining ample wood for soil nutrients and fish and wildlife habitat. Typically, the larger diameter dead trees can accommodate a greater variety of species and stand longer than smaller diameter snags (USFS 2002). Snags will not be cut unless they pose a safety risk to workers. In all treatment units, all coarse woody debris present before treatment will be retained. In all forest restoration units, three suppressed trees, intermediate trees or snags, in any combination, will be left per acre.

The operation period and specifications for winter operations are covered in the project requirements in Appendix E (see PSR-GEO-5). Project work would typically be completed during the normal operating season between June 15 and October 15. If more than 0.5 inch of rain is forecast during the normal operating season, project operations would temporarily cease and sites would be winterized. Within riparian management zones, areas with disturbed soils must be stabilized prior to the beginning of the winter period subject to extensions provided by dry weather, and/or prior to the sunset if the National Weather Service forecast is a “chance” (30% or more) of rain within the next 24 hours, or at the conclusion of operations, whichever is sooner. Implementation activities may continue past the end of the normal operating season if the work can be completed within a window of dry weather as predicted by NOAA’s Fall Transition Season Precipitation and Hydrology Decision Support Service notifications.

Riparian corridors

As listed in the project requirements (Appendix E and Table 4b), fish bearing and all perennial streams will retain a minimum of 80% canopy (post treatment) within 30 feet of the stream (and 60% elsewhere) and trees will not be removed from within 30 feet (PSR-HYDRO-1). Equipment exclusion zones (Appendix E and Table 4b) and avoiding trees that contribute to bank stability (PSR-HYDRO-12) will provide additional protections to prevent sediment delivery. When cable yarding across riparian corridors, trees must be fully suspended in the air (PSR-HYDRO-4).

Table 4b. Riparian Management Zones

Watercourse Type	Fish bearing (may be perennial or intermittent) and perennial non-fish bearing		Non-fish bearing and evidence of scour or deposition (intermittent or ephemeral)		
	Inner Zone Width ¹	30 feet from confined channel, or channel migration zone		30 feet or to break in slope or other feature that prevents sediment delivery to watercourse, whichever is less	
Inner Zone Canopy Cover Retention ²	80%		60%		
Inner Zone Restrictions	EEZ, no tree removal		EEZ, no tree removal		
Outer Zone Width ¹	130 feet from outer edge of inner zone		20 feet from outer edge of inner zone		
Outer Zone Canopy Cover Retention ²	60%		60%		
Outer Zone Slope	More than 35%	Less than 35%	More than 85%	35 to 85%	Less than 35%
Outer Zone Restrictions	EEZ	EEZ, unless sediment delivery is prevented by a break in slope or another barrier such as a bench ³	EEZ	EEZ, except tethered equipment that does not increase sediment delivery potential over one-end, cable suspension systems	EEZ, unless sediment delivery is prevented by a break in slope or another barrier such as a bench ³

Notes:

1. Zone width measured in slope distance.
2. Canopy Cover averaged across 1000-foot sections of streams.
3. If there is a bench or break in slope that is closer and prevents sediment delivery, then the outer zone can be less than 160 feet from the stream channel.

Slopes and unstable areas

The mapping by Merrill et al. (2011) reveals point locations in the center of historic landslides within the MCW. This mapping and the SINMAP modeling (see chapter 2.3) serve as preliminary evaluation tools for unstable areas. Before any forestry operations, the extent of unstable areas will be mapped and marked with an appropriate exclusion buffer in consultation with a qualified geologist (PSR-GEO-1 in Appendix E). See project requirements PSR-GEO-6 for treatment limitations on steep and unstable slopes.

Roads and landings

Forest restoration will involve the use of existing haul roads, skid trails and landings. A portion of the property was logged in the 1930's and some roads in these areas were constructed in or adjacent to streams or in other areas that make reusing them problematic. Approximately 2.5 miles of temporary roads will need to be constructed to access this area (Map 4-b, Thinning Operations), and will be removed immediately after treatment. The temporary roads are all on upper slopes, outside of all perennial, intermittent and larger drainages (as shown on Map 2-b (Hydrology)) and will be designed for dry season use only. A California licensed Certified Engineering Geologist (CEG) will assess terrain and proposed routing for the new road alignment. Grades will never exceed 15% and never exceed 10% for more than 500 continuous feet. No roads will be constructed on slopes over 50%. Any additional temporary road construction will undergo additional environmental review outside of this plan.

Parks will also need to reoccupy some decommissioned/abandoned logging roads to access areas for restoration. These roads are planned for removal under the CEQA approved Landscape Stabilization and Erosion Prevention Plan (LSEP). These roads will need to be improved to allow vehicles to use them and will be removed once restoration treatments are completed in the area.

The process of new road construction or reoccupying decommissioned/abandoned roads for restoration treatments can be described in three phases. In the first phase, a California licensed Certified Engineering Geologist (CEG) will assess terrain and proposed routing for the new road alignment and placement of landings. Slopes, soils, mass wasting potential, and natural drainages will be evaluated to minimize detrimental effects of road construction or reoccupation. This preparation work will be guided by forest restoration planning and treatment area selection. The second phase will include road construction and drainage structure installation. New road routing will seek to minimize drainage crossings. Culverts on any road crossing will be sized using geomorphic indicators and flow calculations based on the rational method. Fill dirt and old culverts will have to be removed from abandoned roads before new culverts are installed. Along slopes greater than 60% full-bench construction will be applied. Fill material from full-bench construction will be stockpiled at nearby stable locations for eventual removal of the road. Roads used

for single-season use will be removed at the end of the dry season and will not be reoccupied in following years. Roads needed for multiple years will be constructed using more robust drainage structures including multi-layer headwalls and tailwalls and hardened road surfaces to facilitate ephemeral drainage. Temporary stream crossings and bridges will be capable of passing 100-year discharge and wood and sediment of the channel during the seasons it is to remain in place and be capable of holding highway loads. Structures such as rolling dips may also be installed to limit erosion on roads used during restoration activities. Once forest restoration is complete and access is no longer needed to an area, the final phase will commence where all new and formerly decommissioned/abandoned roads will be removed. Complete fill recovery and drainage structure removal will be implemented along all unneeded roads and landings.

4.1.3.2 Prescribed Fire

Prescribed fire is another forest restoration tool that can be used to thin forests and achieve related management objectives. See chapter 4.3 on the use and implementation of prescribed fire in forested ecosystems.

4.1.3.3 Snag creation, crown manipulation and LWD recruitment

Snag Creation

Trees may be intentionally killed and left standing to create wildlife habitat. Large snags are more useful and last longer as wildlife habitat, so snag creation will be limited to older stands with larger trees. Snags may be created by knocking the tops out of individual trees by dropping other trees into them. Other trees may be girdled by removing bark in a continuous strip around the bole of the tree or slash piles may be burned under selected trees. Girdling is the least preferable method because the exposed wood allows rot to enter the stem rapidly and causes the tree to fall over more quickly than a topped tree or a suppressed tree, however it is often the most economical method. Snag creation may occur as part of a thinning operation or as a stand alone treatment. Tree girdling may also be used as a forest thinning alternative to felling trees and can achieve the same goals of reducing competition and increasing available growing space, however it is generally cost prohibitive to achieve on a large scale. There are several advantages to snag creation over typical forest thinning in certain situations:

- Provides a more gradual disturbance in sensitive areas
- Less alteration and damage to understory vegetation, seedlings, and advanced regeneration
- Less modification to forest floor microclimates
- Minimizes damage to live retention trees
- Limits surface fuel loading by spreading the input of dead fuel over time

- Safer to implement when field crew safety is a concern

Crown manipulation

One aspect in developing late seral forest characteristics is to enhance the structural complexity of the forest canopy. This can be achieved by pruning the crown or cutting the top out of trees. Neighboring trees may be cut to release the pruned tree. Thinning operations may also select retention trees to damage by by felling neighboring trees into their crowns. Damage may be severe enough to knock the top out of some trees, but the goal would generally be to minimize damage to the lower bole of the tree and to retain significant portions of the crown to help the tree recover. The resulting crown damage is intended to create reiterations and other features that will enhance the vertical complexity of the forest. Additionally, some trees may be selected for tree topping or crown manipulation using arborist methods that involve climbing selected trees and pruning the crown (Sillett et al. 2018).

Large woody debris recruitment

Riparian corridors and streams throughout the second-growth forests lack the large wood found in similar habitats near old growth. The Park's vegetation management program lead or chief of natural resources will define if areas are deficient in large woody debris and if dropping trees across the channel will benefit riparian habitat. Trees that are dropped into or across stream channels would not be removed, but their position may be adjusted for use as instream structures (PSR-HYDRO-2).

4.1.3.4 Tree planting

Seed collection, propagation, and tree planting will follow the NCRD policy on genetic integrity:

“In order to maintain the genetic integrity and diversity of native California plants, revegetation or transplant efforts in the State Park System will be from local populations, unless shown by scientific analysis that these populations are not genetically distinct from populations being proposed for use. If local populations have been decimated, the closest, most genetically similar population(s) to that State Park System unit will be used.” (CDPR 2003)

When funding is available, the on site nursery in Mill Creek will be used to propagate and store seedlings until they are ready to be planted. If the Mill Creek nursery is not capable, then seedlings can be propagated in other local and regional nurseries, and preference will be given to local seed sources from DNCRSP as outlined in the genetic integrity guidelines.

Most tree planting activities will occur in conifer deficient stands (see Impaired Stand Types 4.1.1.3), and on recently removed roads to help revegetate these sites. Other tree

planting projects may seek to shift species composition or to introduce plants that are resistant to disease. To mitigate browsing, small protection structures may be used, and regular monitoring of reforestation sites for several years will help ensure higher seedling survival.

Planting areas will be monitored in accordance with the NCRD Monitoring Tree Planting Survival Protocol (CDPR 2018b).

4.1.4 Forest Restoration Monitoring & Adaptive Management

Due to the long period necessary to accomplish restoration towards old-growth forest conditions, a well designed and documented monitoring program is necessary. The overarching NCRD Monitoring and Program Tracking Strategy is discussed in Chapter 5.

Forest Restoration Program success will be monitored using permanent and temporary plots designed to measure survivorship, growth, stand structure, and forest composition through time. In general, each project will be monitored quantitatively and qualitatively until such time that management is convinced that each prescription for a given impaired forest condition is effective and additional data is not needed. At that time, qualitative monitoring may be adopted on future projects of the same nature.

A plot design and survey methods for monitoring changes in stand structure as a result of thinning was developed by NCRD, Redwood National Park, and the Headwaters Bureau of Land Management staff, and has been implemented by all three agencies. NCRD has used this protocol in all projects since 2008, with examples found in DNCRSP and the Cuneo watershed of HRSP (CDPR 2008). Future restoration activities should employ these standards as funding allows or until a more efficient method is developed.

Managers must decide when a treatment is sufficiently different from past treatments to warrant additional monitoring. It is the intent of this program to adapt monitoring procedures in cooperation with other land managers to increase efficiency and so results can be easily compared.

Through trend monitoring the stand inventories will be updated and results will determine if a re-entry is required.

4.2 Uncommon and Sensitive Natural Communities

Most of the uncommon and sensitive plant communities in DNCRSP are found at higher elevations and along ridgelines in the eastern half of the park. These areas comprise a matrix of vegetation communities including Jeffrey pine - Idaho fescue savanna, grasslands, chaparral, mixed pine forests, and *Darlingtonia* fens (see 2.7). The edaphic conditions created by serpentine soils and the role of disturbance, especially fire, greatly influence these communities. However, decades of timber management, altered fire regimes, and successional patterns have resulted in a process of conversion of these

uncommon habitats, including early-seral habitat. The loss of early-seral habitat is also a concern in the surrounding region as most natural areas on neighboring lands are managed for other habitat types including timber production and late-seral habitat (Franklin and Johnson, 2012). In the absence of fire or active management, these uncommon ecosystems experience afforestation and a general increase in woody vegetation. Some of the ecological consequences of this include:

- changes in species richness and composition (Ratajczak et al. 2012).
- loss of landscape heterogeneity and habitat diversity (Franco and Morgan 2007, Sahara et al 2015).
- altered carbon storage and soil chemistry (Jackson et al. 2002, Griffiths et al. 2005).
- shifts in abundance and distribution of wildlife (Krannitz 2007).

Additionally, there are many species of rare plants that persist in the grasslands and savanna, which depend on fire maintaining open grasslands and woodlands (see 2.7.2). It is unknown how extensive prairies historically were within DNCRSP, however, a substantial reduction in both extent (over 90%) and native plant dominance from historic levels may have occurred. The historic non-forested areas identified in 1948 aerial photography (see 2.7.1) fall within the Uncommon Habitat Program. This program also includes the open Jeffrey pine-Idaho fescue savannas that self-perpetuate under a regime of periodic surface fires. Without fire these areas will be encroached by Douglas-fir and chaparral shrub species that shade out the understory. Furthermore, without fire, the density of trees in the savannas could increase and result in a higher risk for uncharacteristically high severity fire. A study in the Little Bald Hills, which borders DNCRSP to the north, modeled woody encroachment and predicted that without treatments, grasslands and savanna will be reduced to 5% of the area within 50 years (Sahara et al. 2015).

Both knobcone pine and chaparral exist in DNCRSP within the matrix of higher elevation broadleafed forest, and both likely established and were historically maintained under a mixed severity fire regime. In the neighboring Klamath mountains, stands of knobcone pine and chaparral tend to occupy patches of recent high severity fire, and can maintain a landscape presence under mixed severity fire regimes (Taylor and Skinner 2003). Knobcone and other pines will not establish new cohorts under fire exclusion. Some of the Park's chaparral has converted to hardwood (Chinquapin, tanoak, madrone with scattered Douglas-fir), and occasionally to Douglas-fir stands.

Serpentine habitats like Idaho fescue savannas are very sensitive to encroachment by invasive species and management of invasive species in these habitats is a priority (see chapter 4.4 Management of non-native species).

As an early successional vegetation type, Darlingtonia fens are also threatened by a densification of shrub species (Sawyer 2006) and encroaching conifers. Because the areas containing these rare plants are relatively small, Sawyer recommends “reducing the number of trees and cutting the shrubs back” by hand in these regions, rather than using fire, which is less predictable. In a case study with U.S. Fish and Wildlife in the Stony Creek parcel of the Siskiyou Land Conservancy (SLC 2011), staff and students cut back shrub species that were engulfing Darlingtonia fens in March 2011. In the Child’s Hill Darlingtonia fen, treatments were done in 2009, 2012, and 2015 with brush cutters and chainsaws. Alder, cascara, coffeeberry and other vegetation immediately encroaching on the Darlingtonia were cut back. An additional buffer was not applied. Slash was pulled out of the fen and left to decompose. The fen was reassessed and retreated in March 2018, new encroachment was mainly from resprouting alder and cascara. Root balls have become bigger and more vigorous, taking up more soil growing space and moisture. Young conifers immediately uphill from the Darlingtonia fen seem to be limiting the water flow into the fen.

As of 2018, no restoration has been done in the Dry Lake Darlingtonia Fen.

4.2.1 Uncommon and Sensitive Natural Communities Objectives

- Maintain and restore species diversity and vegetation structure that accounts for the historical range of variability and the resiliency needed to face future stressors such as climate change and the fire regimes likely to influence DNCRSP in years to come.
- Control conifers and other vegetation encroaching into uncommon and sensitive natural communities where they would not normally occur.
- Facilitate the expansion of underrepresented habitats to more closely resemble the extent that existed prior to logging and fire exclusion.
- Protect and manage sensitive plant populations and vegetation communities in DNCRSP, creating additional habitat and buffering existing habitat for special status plant species.
- Encourage research on sensitive plants and communities.

4.2.2 Uncommon and Sensitive Natural Communities Implementation

Prescribed fire will be the preferred method to restore and maintain uncommon and sensitive vegetation communities, see chapter 4.3 for information of prescribed fire implementation. In most cases treatments will be low intensity surface fires on a flexible rotation of every 3-20 years (Stephens et al 2007) for achieving restoration objectives and limiting further encroachment. It would be more difficult to use higher intensity fires that naturally occur in knobcone pine and chaparral. However, a mixed severity fire regime can be achieved by creating larger burn units with strong containment lines, burning late

in the fall before large rain events and with the use of less aggressive fire suppression techniques. The return interval when prescribing higher intensity fire should be less frequent (20-60 years) than in areas maintained by low intensity fire. Redwood National Park staff successfully implemented prescribed fire in similar habitats in the Little Bald Hills in 2007 (REDW 2007, Minniti 2007) and the Santa Cruz District of State Parks has successfully burned chaparral and knobcone pine. Natural resource staff is identifying high priority areas for delineation into burn units. Historic non-forest areas are used as a guidance for identification of treatment areas. The first identified area is the Child's Hill ridge above one of the Darlingtonia fens.

When prescribed fire is not feasible, additional methods can be used to limit the successional patterns that lead to the loss of savannas and woodlands. In areas that are threatened by encroachment, overcrowding (i.e. higher stem density), or in part have been converted to forest, cutting trees and other woody vegetation, tree girdling and forest thinning methods will be used. Manual brush removal and mastication can be used to contain encroaching shrub species. The focus will be on areas where encroaching vegetation is small (trees under 12" dbh). Cutting larger vegetation in closed canopy forests would need additional development of objectives and review.

In pine savannas, conifers will be cut to retain a maximum of 20 percent canopy cover. All conifer seedlings and saplings will be removed as needed, to temporarily restrict new recruitment.

The few historic non-forest areas where patches of prairie are still intact (e.g. along the Bense trail) will be assessed for conifer removal to maintain prairies and establish prescribed burn units. Project-level compliance for conifer removal on areas over 2 acres or where average tree diameter is over 14" dbh will need additional development of objectives and review.

In Darlingtonia fens and other wetlands, the restoration will have to be done in two phases: First, restoration treatments that manually remove shrubs and trees may be necessary to recover water flow and reduce ladder fuels. The cut trees and shrubs would be manually piled, jackpot or lopped and scattered, depending on fuel-loading conditions. If piles are burnt, they won't be larger than 10x10x5 feet in size and placed away from the dripline of predominant trees and sensitive plant buffer areas. Piles will be burnt under appropriate conditions as described in the burn plan.

Second, as an additional restoration tool, prescribed fire for a burn unit between the fen and Child's Hill Road will be considered. When laying out burn plans, it has to be decided if the Darlingtonia fen itself should be included or protected from fire. Cramer's 2005 study has shown that fire has modest impacts on Darlingtonia fens and provides benefits such as significantly reducing tree and shrub cover without impacting herbaceous and graminoid cover (Cramer 2005). Jules et al. 2011 study showed an initial reduction of plant cover in burned fens immediately following fire, but species density increased by

4-8% four years following fire (Jules et al. 2011). Regular prescribed fire can help maintain species diversity and prevent encroachment. Fire return intervals in fens could be less frequent than in the surrounding chaparral vegetation type. Before any treatment, the fen areas will be assessed for fire use, and if it is determined by park staff that conditions are too dry to support the appropriate low intensity fire, the fen area will be excluded and protected from the surrounding burn unit.

Rare Plants

To establish a current inventory of all sensitive plant taxa and communities, the NCRD maintains a rare plant and a sensitive community Access and GIS database. In addition to the project based floristic surveys, natural resources staff will adapt existing methodology for the monitoring of sensitive plants and select sensitive plant communities that is consistent with Department's Inventorying, Monitoring and Assessment Program (IMAP) protocol. All survey data for sensitive plants and communities will be submitted annually to the California Natural Diversity Database.

4.2.3 Uncommon and Sensitive Natural Communities Monitoring & Management

In addition to project requirements outlined in chapter 4.1, special attention will be given to ensure that management actions do not adversely affect native to non-native plant ratios and monitoring of sensitive habitats will be in accordance with DOM and IMAP guidelines. The duration and spatial extent of monitoring uncommon habitats will be dependent on resource availability. Approaches to monitoring may include assessing encroachment, changes in plant composition, and regeneration success of key species. Monitoring methods may involve the use of photo points, aerial imagery, site surveys, or some combination. Photos should be taken before and after prescribed burning or other restoration treatments to provide visual documentation of treatment effects and changes over time.

4.3 Prescribed Fire and Fire Use

Both human and natural caused fires played an important role in vegetation patterns in and around DNCRSP. This plan proposes to use fire to assist with restoration, reduce the potential for wildfires to enter or leave the Park, and return fire as a natural process to forest, chaparral, and grassland vegetation types. CSP recognizes that in many cases it will not be possible to recreate the prehistoric fire regime except on a limited scale due to concerns about containment, smoke management, and funding constraints. A prescribed fire management plan would be a useful tool for further developing objectives for the Park and individual burn units. This chapter will help set priorities and discuss how and where prescribed fire should be used.

4.3.1 Prescribed Fire and Fire Use Objectives

- Develop a prescribed fire program that promotes resiliency and considers the historic fire regime and local organism's adaptations to fire.
- Reestablish, at the landscape scale and to the greatest extent feasible, the vegetative seral stages, mosaics, and fuel loading that occurred in the Park prior to Euroamerican influence.
- Use prescribed fire on an experimental basis to determine its suitability in assisting with forest restoration objectives.
- Allow fire to influence spatial patterns and vegetation structure across the landscape.
- Look for opportunities to allow late season wildfires to be managed for resource objectives.
- Use prescribed fire to maintain and promote the regeneration of under represented species that benefit from fire

4.3.2 Prescribed Fire and Fire Use Implementation

Burn plans will be written for individual burn units and additional CEQA review will be necessary before implementation. Managers need to consult and comply with the Draft NCRD Prescribed Fire BMPs (CDPR 2018d), DOM section 0313.2, and the Natural Resources Handbook.

Prescriptions will be developed for each individual prescribed fire planning area based upon the unique conditions for that area. California State Parks will use available information about Tolowa burning, experience gained from previous burns, and models that help predict fire behavior, smoke and fire effects as needed.

Prescriptions will be developed which:

- Provide for firefighter and public safety.
- Limit the risk of an escaped fire.
- Limit the potential for a smoke event.
- Provide a range of fire intensities that will achieve the desired fire effects for the unit.

Traditionally, prescribed burns have been conducted during the fire season when it is easy to get fire to ignite and carry. California State Parks have also successfully conducted out of fire season burns during short periods of dry weather following the first significant Fall rains in HRSP and PCRSP, as has Redwood National Park in the bald hills. Burning during the off-season frequently results in low mortality levels of encroaching Douglas-fir along prairie edge. However, this technique has the advantage of being very cost effective as only a very small holding crew is needed, and repeated

burning can add up to substantial progress over time. Redwood National Park found a decrease in native grasses for an extended period after an experimental spring burn in the Bald Hills, therefore spring burns should be avoided in grasslands unless evidence to the contrary is discovered.

Sensitive plants will be protected from adverse fire effects either by installing temporary firelines or altering ignitions patterns as identified in a burn plan. Riparian areas would not be directly ignited, but fire would not be prevented from entering into them. If its determined that the initial fuel loading is too heavy in the riparian area to allow prescribed fire to enter, then handlines or “wet lines” would be temporarily employed to reduce the potential for adverse impacts to stream temperature and water quality.

Fuel loads may also be reduced within or adjacent to burn units or at strategic locations (along roads and ridgelines) to alter fire behavior and reduce the threat of both wild and prescribed fire spread. Fuels reduction may be implemented using masticators (following equipment exclusion zones, and other rules), chainsaws and other hand tools.

4.3.3 Prescribed Fire and Fire use Monitoring & Adaptive Management

The monitoring program for prescribed fire projects will comply with standards found in the DOM section 0313.5 and IMAP guidelines. The following protocols will be used to insure prescribed fires are within prescription, fire weather and behavior are documented, and fire effects are documented. Additional guidance found in IMAP will be used in the planning process.

- Level 1 – Weather and fuel conditions including air temperature, relative humidity, wind speed and direction, fuel moistures and amounts. Monitoring of weather, smoke dispersal and fuel conditions will be assigned to a field observer identified in the incident action plan. The information gathered will be included in the final burn report.
- Level 2 – Fire behavior including flame lengths and rates of spread. Monitoring of fire behavior will be conducted by the Field Observer and included in the final burn report.
- Level 3 – Fire Effects. Monitoring fire effects is usually done to assure that burn objectives are accomplished and that unwanted unintended consequences do not occur. Permanent plots with before and after photos can provide a helpful graphic but may not be sufficient to track important changes over time. Permanent fuels and/or vegetation before and after burning are more appropriate in many circumstances and as funding allows.

4.4 Non-native Plants and Pathogens

One of the major factors contributing to ecosystem change and instability is the spread of invasive species throughout the world (see 2.7.4). However, some invasive non-native

species are so widely distributed and/or so persistent in nature that their complete eradication is not a feasible management goal. Time and energy may be better spent addressing other invasive non-native plant management concerns. Conversely, the negative effects of some species invasions are great enough to warrant eradication, even if the economic cost is high.

When an invasive plant is introduced, the infestation most often starts as a few plants brought in on equipment, along roads, or dispersed by wind or water. Over time, the infestation spreads, and the seed bank becomes larger, increasing operation and management costs over time and potentially decreasing revenue by destroying aesthetics and restricting recreation. The most cost effective way to approach this problem is to remove the new infestation when it is small. The early detection and eradication of newly identified invasions, while still small, is the most effective method of controlling highly invasive non-native plant species and the most cost-effective approach (DOM 0310.7.2, C DPR 2004). Invasions typically follow a pattern of initial invasion followed by a lag time where spread is slow. An Early Detection Rapid Response (EDRR) program has been developed for the Park based on the California State Parks Early Detection and Rapid Response Handbook (CSP 2015c).

4.4.1 Non-native Plants and Pathogens Objectives

- Prevent the establishment of new invasive non-native plant and pathogen populations within the Park, emphasizing CSP's EDRR efforts.
- Prevent the expansion of invasive non-native plant and pathogen populations within the Park, emphasizing CSP's EDRR efforts.
- Prioritize control efforts of existing invasive non-native plant species based upon their potential to spread, especially into sensitive and uncommon habitats and the feasibility of their successful control.
- Control the spread of non-native pathogens utilizing methods that best balance costs and environmental impacts.
- Take prompt and effective action whenever new non-native plant or pathogen populations are identified as having the potential to adversely impact ecological processes.

4.4.2 Non-native Plant Implementation

4.4.2.1 Past Treatments

The Park has highly altered ecosystems and few invasive non-native plant removal projects have been conducted in DNCRSP. EDRR and retreating few existing infestations have been high priorities. The most current districtwide annual report summarizing work related to the management of invasive non-native plant species and recommendations for

future management throughout the NCRD was completed in 2012 (CDPR 2012). Recommendations for each park are classified as High, Medium, or Low priority. The priority levels are based on the size of the invasive non-native species infestations in each park, the feasibility to eradicate the invasive non-native species from the park, the presence of rare or endangered species in the park in relationship to invasive non-native plant infestations, and existing habitat quality of each park. In DNCRSP, the species identified as of most concern for management are jubata grass, Scotch broom, French broom, shining geranium, Robert's geranium (*Geranium robertianum*), English ivy, Himalayan blackberry, tansy ragwort, foxglove (*Digitalis purpurea*), and reed canarygrass. Recommendations for future invasive non-native plant species management focus on small populations of invasive non-native plants that are easily treated and/or threatening sensitive plants and habitats. For DNCRSP, the report recommended the treatment of French broom along the Bense Trail which was identified as threatening to eliminate a population of Suksdorf's sorrel, treatment of a small English ivy infestation near the Hamilton Road main gate and shining geranium coming in from the Highway 101 corridor. As recommended, initial treatment of French broom along the Bense Trail began in 2013. The population of approximately 30 mature French broom plants and many seedlings scattered near the junction with Upper First Gulch was treated with hand tools. The population of 100 Suksdorf's sorrel plants along the Bense trail was conserved, which at the time, was the biggest recorded occurrence in the Park. The French broom has been retreated in an area of 1 ac annually in early spring. Pulled plants without seeds are scattered. If seed pods are present, plants are bagged, piled and burnt at the Mill Site. The Bense Trail area with its valuable patches of prairie (see 2.7.1) was also prioritized as part of the Early Detection Rapid Response in 2018 (see below) and the Himalayan blackberry in this area will be a priority for treatment.

English ivy near the Hamilton Road main gate and shining geranium coming in from the Highway 101 corridor have been treated since 2015 and annual retreatment of all three infestations is a high priority and will continue.

4.4.2.2 Treatment Methods

Proposed non-native plant treatment methods are described in and will be done in conformance with the Draft NCRD Invasive Species Best Management Practices (CDPR 2018c).

Manual Removal Technique: Non-native plants will be removed by hand using hand tools such as a weed wrenches, pulaskis, and shovels. Plants will be dug out of the ground to a depth of no more than 2 ft. For larger plants a brush cutter, hand saw or chainsaw will be used. All removed vegetation will be piled and burned or transported to an appropriate dumping area to be composted or burned at a later date. When feasible, removed native

vegetation may be placed in inconspicuous areas not easily visible to the public and allowed to decompose naturally.

Mechanical Technique: Heavy equipment may be used for the initial treatment of certain large invasive species such as jubata grass. Either a dozer and or excavator will be used to remove target species. A 17 ft heavy equipment exclusion zone will be placed around all sensitive natural and cultural resources.

Flaming/Torching Technique: Flaming/Torching is a removal technique that can effectively control a variety of plant species, without disturbing the ground. A handheld and/or backpack propane torch will be used to burn the target species. Two types of flaming are commonly used: green and black. Green flaming sometime called wilting or blanching utilizes a small torch that is applied just long enough to wilt the plant. Although the plants do not brown and look dead until the next day, this is enough heat to kill many species of plants. Black flaming utilizes the same equipment, but the torch is left on the plant long enough to cause it to incinerate. Both techniques will be utilized to treat multiple invasive non-native plants such as Scotch and French broom seedlings. Flaming will be conducted during the wet season and any necessary permits will be obtained prior to employing this treatment method. Vegetation left after flaming treatments will be left in place.

Mowing/Solarization/Covering: Infestations will first be mowed to the ground with weed whackers and shrubs and small trees (< 8 in dbh) will be cut at the base. Either weed cloth and or black 6 mil plastic tarps or a combination of both will then be placed over the target species and secured with sand bags. If clean chips (free of invasive non-native plant material) can be obtained, they will be placed over the tarping to help keep it in place and reduce the aesthetic impact. Based on the target species the weed cloth and/or plastic tarps will be left in place for at least one year or longer if plants are not completely dead. Species that respond to this treatment method are for example *Lathyrus latifolius* and *Hypericum calycinum*.

4.4.2.3 Early Detection Rapid Response

Thirty four invasive non-native plants species that are either not currently found in the Park or only have a few known infestations spreading from the developed areas into remote areas of the park have been defined as the current target species for this program (Appendix G, EDDR Target Species). As many of these species are not known to have established populations within the Parks, much of the data collected is “absence data” in the form of GPS track logs. Newly identified non-native plant populations will be mapped and evaluated to determine if it is possible to eradicate them. Before resources are expended on the removal of a non-native species the mechanistic cause of the invasion will be evaluated. This will prevent resource management staff from spending time and money on eradicating a species, only to find that the species is indefinitely capable of

reestablishing itself. Both natural and anthropogenic activities that may be indirectly, or directly, facilitating invasions will be evaluated prior to control efforts. Beginning in May 2018, CSP staff and volunteers have been conducting EDRR mapping throughout the Park according to the CSP EDRR GPS Data Collection Protocol for use with Trimble JUNO GPS Units and Cal Flora and Map My tracks applications (CSP 2015c).

In 2018, EDRR mapping began at the Park. The most susceptible corridors (designated trails and use areas in western part of park; maintained roads), and secondary roads in or near sensitive species and habitats were searched for the target species. If an infestation could be treated with small hand tools in less than 10 minutes, and was not in a sensitive cultural area, it was treated immediately. Ground disturbance was less than 2 ft. Bigger infestations were mapped and will be prioritized for treatment. Depending on future EDRR funding, in fiscal year 2018/2019 the survey will include maintained roads and trails that were not covered in fiscal year 2017/2018, including old landings and some abandoned and decommissioned roads.

In addition to treating infestations discovered during EDRR mapping and retreating existing infestations, treatment projects in and adjacent to sensitive plants species and habitats, roads slated for decommissioning, and equipment storage and landing areas are priorities:

- In order to maintain a 50 ft. buffer (free of non-native plants) around the wolf's evening primrose, rattlesnake grass and red sepaled evening primrose will be treated annually by hand.
- The serpentine habitat found in the Park is primarily pristine. However, there are invasive non-native plants along roads in the serpentine habitat (e.g. Jubata grass infestation along Smoke House-5 Rd see 2.7.3) that have the potential to spread further into the sensitive communities there. Jubata grass and other non-native species mapped in this sensitive habitat will be treated as a high priority. Where manual treatment needs to be combined with herbicide treatment it will be done under a separate compliance document.
- An important tool when managing invasive non-native plants is to recognize potential vectors both internal and external. Examples of external vectors that can introduce an invasive plant include animals, wind, water, and park visitors. Internal vectors are related to staff activities and project implementation. Vehicles, equipment, footwear and hand tools have to be cleaned to be free of soil, seeds, and other vegetative matter before entering the park or when traveling to a new area to prevent spread. The use of heavy equipment and staging equipment as well as the creation of landings and use of existing landings at sites where invasive non-native plants already exist increases the risk of spread. To reduce this major vector in the Park, clearing invasive non-native plants from landings prior to use

and after restoration activities are completed is required in the BMPs and is thus a treatment priority.

4.4.3 Pathogen Management Implementation

Pathogens are often spread by people and equipment transporting plant parts or pathogen spores from one site to another. The NCRD BMPs for Invasive Species Management require cleaning and disinfecting equipment including vehicles, boots, chainsaws and other tools before entering the park and when traveling to a new area. Removing soil and plant materials is especially important when leaving an area with known infestations of pathogens.

4.4.3.1 Sudden Oak Death (SOD)

There are no known occurrences of SOD in the Park. However, the spread of *P. ramorum* and *P. lateralis* are significant concerns in DNCRSP because field crews and equipment for maintenance, research, and restoration are often brought into the park from outside sources. Sanitation measures described above are designed to restrict the spread of existing *P. lateralis* infection sites within DNCRSP and also to prevent the introduction of *P. ramorum* to the park.

Park staff will monitor susceptible species for symptoms of SOD. Forest restoration activities will encourage the release of minor species like chinquapin in areas dominated by tanoak, so that if SOD destroys a significant portion of tanoaks in an area, other vegetation will be present to fill the void.

In the event of infestation, the staff will work with the local SOD task force and the UC Cooperative Extension to employ the latest science and recommendations on SOD treatment in this area. If SOD would be detected within 0.5 miles of a project area, all equipment will be cleaned and disinfected before leaving the infected area. Plants, plant parts, or other products of potential SOD hosts, created as part of forest restoration activities will not be moved outside of the park.

4.4.3.2 Port-Orford-cedar root disease

The RNSP Port Orford Cedar Management Plan/EA (RNSP 2004) recommends, where there are small, localized infestation sites in the park, both healthy and diseased POC less than 15 inches in diameter at breast height (dbh) should be killed by girdling or cutting to create an area where there are no POC to serve as new host trees. This action is termed localized sanitation to emphasize that it applies to a localized active infestation. In 2006, CSP started treating Port-Orford-cedar root disease by girdling trees over 6 inches DBH and removing all smaller POC within the four known infection sites in DNCRSP (0.25 ac each). When the POC are killed, the *Phytophthora lateralis* (PL)

spores eventually die but can persist in the soil for as long as ten years, according to the updated recommendations from the US Forest Service (USFS 2011). The sites were kept free of POC seedlings for 10 years to eliminate the pathogen from the infected areas. The most recent re-treatments were done in 2017 and 2018.

POC is a minor component downstream of the Bummer Lake Creek infection sites, and the species is more common downstream from the Rock Creek sites. Further monitoring will determine if *Phytophthora lateralis* is still present in the Park downstream from the four known infection sites and if further treatments are necessary. Forestry staff has been trained to identify symptoms and will also continue to look for dead POC to detect possible new infections and will test for the pathogen. Resistant seedlings have been planted as part of several restoration projects within riparian conifer planting and road removal sites to help spread genetic resistance. No resistant trees were planted within infected areas as this would allow the pathogen to persist within the area. Future Port-Orford-cedar management is also be guided by the RNSP Port-Orford Cedar Management EA (RNSP 2004).

Travel within known infected sites will be avoided during the wet season. If a site needs to be entered in the dry season all dirt and plant materials will be removed from equipment and boots when exiting the site. Equipment will be sprayed with a clorox solution or lysol.

4.4.3.3 White pine blister rust

White pine blister rust has been detected in only a few individual trees within the park. Further monitoring at infected sites will be completed to identify the scope of the infections and assess best management practices and treatment options. Treatments under consideration include the pruning recommended by Maloy (2001): Infected limbs may be cut and removed if WPBR cankers are more than 6 inches away from the main stem, posing a threat to the tree. If WPBR cankers are more than 24 inches from the main stem, they will likely self-prune and are not a threat to the long-term health of the tree. Pruning would be restricted to the lower 6 to 8 feet of the tree and would not remove more than 50 percent of the live branches.

White pine blister rust has been found to be naturalized in North America. Therefore, management efforts have shifted from eradication towards facilitating the survival of white pine species in the presence of the disease. Research on white pine blister rust has identified natural disease resistance in sugar pine and western white pine and improved nursery stock has been developed (USFS 2003). If monitoring should show that there is not adequate regeneration of western white pine in the park, the planting of WPBR-resistant nursery stock trees will be considered.

4.4.4 Non-native Plant and Pathogen Monitoring & Adaptive Management

EDRR inspections may be the most important aspect of monitoring for new infestations of invasive, non-native plants and pathogens. These are generally conducted by personnel trained to identify the species of concern and can be done while conducting other duties such as management unit inspections.

Helicopter flyovers are sometimes used by the US Forest Service and other agencies to detect patches of dead trees that may indicate outbreaks of SOD or other pathogens.

Treated areas generally need to be revisited at least annually for several years, but specific protocols will vary greatly depending on factors such as the species being treated and the length of time that seeds can remain viable in the soil.

4.5 Cultural Vegetation Management

Although the inventory of culturally significant plant communities in DNCRSP is incomplete, the park is known to contain pre-contact cultural vegetation sites for gathering food, medicines, basketry material, canoe and house building material and fishing and hunting, which have been identified by the local Native American community. Oak groves and associated grasslands but also travel corridors have been maintained by Native American burning (see chapters 2.5.1.1 and 2.6). In addition to the practices described in chapter 2.5.1.1, roots and young shoots of the yampa plant (*Perideridia oregana*), salal berries, salmon berries, huckleberries, and the edible bulbs of camas lilies (*Cammasia spec.*, not found in the Park) were collected by Tolowa women during the summer months to supplement and add flavor to the overall diet (Gould 1975, Baker 1981) and many other plants were traditionally collected. The Tolowa and the Yurok tribes are interested in long term maintenance of certain culturally significant vegetation communities. In consultation with the tribes and using and survey results from Baker's ethnobotany study (1981), CSP has identified 54 plant species of cultural significance and marked these species in the park inventory of all vascular plants (Appendix A). Other concerns and desires expressed through tribal consultation relate to site preservation, monitoring and management, maintenance or reestablishment of traditional plant management and gathering, and re-establishment of traditional fire maintenance.

There is a recorded historic orchard located along the old Redwood Highway in the Wilson Creek watershed, and there may be others recorded during future cultural resource investigations, no management actions are proposed here.

4.5.1 Cultural Vegetation Management Objectives

The following are objectives for management of culturally significant plant communities and vegetation features in DNCRSP:

- Develop an inventory for culturally significant plant communities and vegetation features within the Park.
- Provide for the protection, preservation, and management of culturally significant plant communities.
- Reestablish and maintain the relative amount of savannas and other uncommon habitat types that support culturally significant species that existed prior to Euroamerican contact (boundaries and exact acreage may fluctuate, but the overall acreage should remain relatively stable).

4.5.2 Cultural Vegetation Management Implementation

Management actions and planning will consider the protection and restoration of cultural landscapes, ethnographic landscapes, historic, prehistoric, and ethnohistoric resources. These include but are not limited to archeological sites, ethnographic landscapes, homesteads, CCC-era structures, mill sites, historic roads and trails. All actions taken that will affect cultural vegetation features will be evaluated to insure compliance with Departmental Notice No. 2004-02, Cultural Resource Review and Related Procedures.

Inventories will be conducted for significant cultural vegetation features including cultural landscapes, ethnographic landscapes, tanoak orchards and agreed upon species of cultural interest as soon as funding is obtained. Once identified, features will be incorporated into District GIS program. As part of the floristic project surveys, 54 bear grass stands have already been mapped, and the area along the Bense trail towards Little Bald Hills identified as a priority for reintroduction of prescribed fire. Management of these areas is addressed in chapter 4.2 Uncommon habitat types.

Following inventory, culturally significant historic non-forest areas and tanoak orchards will be given priority for treatment. To aid in maintaining or restoring the condition of culturally significant non-forest areas and tanoak orchards in the Park, CSP will use manual measures and prescribed fire to remove encroaching conifers. Conifer trees may be removed by felling with chainsaws or girdling. Residue from conifer removal may be lopped and scattered, manually piled or jackpot and burned, burned during subsequent prescribed fires, or removed to other locations within the Park, depending on fuel-loading conditions. If piles are burnt, they won't be larger than 10x10x5 feet in size and placed away from the dripline of predominant trees and sensitive plant buffer areas (PSR-HAZ-10). Piles will be burnt under appropriate conditions as described in the burn plan. Fuel loads will be reduced to levels that would protect tanoak trees in case of a wildfire. BMPs will be applied to prevent the spread of Sudden Oak Death (see chapter 4.4).

As part of the State's historic preservation effort, CSP issues Native California Indian Gathering Permits (permit number DPR-864) to collect materials in DNCRSP to qualified

persons participating in the maintenance of folklife cf. California Public Resources Code 5020.1(g).

Natural Resource Management staff will coordinate management actions to ensure that the protection of significant cultural vegetation does not conflict with the management of invasive non-native plant infestations.

4.5.3 Cultural Vegetation Management Monitoring & Adaptive Management

No cultural vegetation-monitoring program currently exists. As funding is obtained, monitoring of significant cultural vegetation can be accomplished in several ways:

Vegetative features such as tanoak orchards that are relatively small and discrete, yet still significant, will have a baseline assessment of their condition made during the cultural resources inventory. Reassessments of their condition will be made as warranted based on observations.

5 Monitoring

Monitoring strategies specific to each program area will be implemented under the overall NCRD Monitoring and Program Tracking Strategy. This strategy discusses three types of monitoring for vegetation management projects: compliance monitoring; program or project monitoring; and trend monitoring.

Compliance monitoring is often required under CEQA to assure that the measures and/or mitigations specified in an environmental document for a specific project are adhered to. This type of monitoring is different from project monitoring in that it is not attempting to assess the effectiveness of a project but its compliance with environmental regulation. Compliance monitoring will occur on all vegetation management projects.

Program and project monitoring is required to determine projects effectiveness at meeting program objectives, and to ensure that unintended consequences are not occurring. In addition, good monitoring allows for the best use of adaptive management by allowing managers to adjust procedures and programs based upon sound evidence as soon as results are available. Ensuring that objectives are achieved is basic to all programs; however, monitoring programs can be very expensive and difficult to manage over long periods. Based on the availability of funds:

- a. monitoring protocols will be developed for all program areas using established CSP standards when applicable (refer to WIMS, CDPR IMAP), and Resource Management Handbook).
- b. monitoring will generally occur before and after project implementation, and every five years thereafter until it is deemed unnecessary.

Trend monitoring is used to determine ecological trends and changes not necessarily associated with a management action. IMAP is an example of trend monitoring. This type of monitoring is extremely challenging particularly in old-growth forests due to the slow rates of change and large sample sizes that are normally required. The following concepts will apply to all general monitoring programs:

- Monitoring procedures and data will be integrated into GIS databases.
- Partnerships will be pursued whenever possible to assist with development of scientifically sound methods and analysis, and long-term continuity of efforts.
- Protocols will include, as appropriate, monitoring of sensitive plant and animal species and their habitats.

6 Landscape Scale Priorities and Coordination of Restoration Efforts

6.1 Landscape Scale Considerations

The historic, primary habitat of DNCRSP was contiguous stands of old-growth forest. Other habitats discussed above were important, but less common. DNCRSP and the surrounding area still contain these diverse habitat types, but they have become fragmented and have lost functionality due to logging and other changes in land use. This plan is primarily a vegetation management plan that is not drawn towards single species management, however we also realize that when prioritizing actions that are consistent with the goals of this plan, actions that help imperilled species may in some cases get priority over other actions that are otherwise of similar priority.

Fragmentation can create a greater mosaic of habitats and increase the ecotones that are beneficial to certain organisms, but are less useful to organisms in need of large tracts of contiguous habitat. For example, deer and elk benefit from a mosaic of forest and grassland habitats while the Humboldt marten prefers contiguous old-growth forests. In the case of DNCRSP, fragmentation has decreased the expanse of contiguous old-growth forest and associated organisms. And in some cases isolated habitats are more vulnerable to degradation because of their surrounding conditions. Some of these threats to the landscape include:

- Organisms are less able to disperse or seek refuge during drought or disturbances.
- Seasonal migration and gene flow are hindered, especially for smaller vertebrates and invertebrates.
- Populations become more isolated.
- Edge effects may change microclimates, making areas less suitable for species adapted to those microclimates.

- Edge effects allow easier access to, and higher rates of predation by, corvids and other predators on forest-nesting birds and also higher rates of invasion by exotic plant species.
- Edge effects increase the likelihood of exposure to and invasion by exotic species.
- Organisms requiring large, contiguous blocks of specific habitat types may be absent or too rare for a viable population.
- Adjacent, altered habitat may facilitate the spread of higher intensity fires than would otherwise occur.

Managers are often faced with prioritizing restoration treatments with limited resources for implementation, and thus prioritization should include:

- Coordinating restoration efforts with other projects
- Considering which habitat types are most likely to degrade, fail to recover or recover slowly without intervention.
- Comparing the cost and benefits of different projects (X ac of project A has a similar cost to Y ac of project B)
- Comparing the effectiveness of treatments and time needed to reach benchmarks with and without treatment
- Identifying special status wildlife and plant species present in the general area that might benefit from vegetation management.
- Considering enlarging and buffering rare and high quality habitat or known linkages for imperiled species at species-appropriate spatial scales.

Putting these broad categories of landscape-scale considerations into the context of DNCRSP, the following objectives should guide managers when prioritizing the implementation of specific projects.

- Enhance the development of late-seral habitat and its functional characteristics to provide connectivity between the old-growth in JSRSP and the western most portion of DNCRSP – the two largest tracts of old-growth in the area.
- Treat degraded habitat adjacent to old-growth when needed to reduce edge effects and fuel loads (prevent high severity fire from entering the old-growth), and to improve the functionality and resilience of old-growth forests.
- Use the most current habitat suitability and connectivity modeling for the Humboldt marten to inform vegetation management design and prioritization.
- Treat unnaturally dense conifer forests (see chapter 4.1.3) to avoid forest stagnation and promote tree growth and development of heterogeneous forest conditions.

- Treat relatively old or high quality second-growth conifer forests where late-seral conditions can most rapidly be achieved, and where imperiled species can benefit in the shorter-term.
- Plant conifers in stands along anadromous streams that are conifer deficient compared to pre-logging conditions to improve shading and eventually encourage large woody debris recruitment in stream corridors.

6.2 Cumulative Impacts and Coordination of Restoration Efforts

Implementation of restoration treatments will be evaluated to ensure that they will not result in significant cumulative effects on the environment. By fastidiously sequencing the location and timing of forest restoration activities with other restoration activities across and among watersheds, we will prevent cumulative adverse effects to resources. The other activities likely to be occurring simultaneously are:

- Instream restoration
- Road maintenance and rehabilitation

The cumulative positive effects of forest restoration in a watershed decrease longer-term chronic and periodic catastrophic erosion events and reduce sediment delivery to streams.

In addition to concerns about cumulative impacts, restoration and other activities can affect the efficiency of implementing future projects. For example, the removal of a currently undrivable road will temporarily improve access to an area, but will eventually limit access for future work. Furthermore, trees that are removed as part of a forest restoration, road removal or other project may be useful for additional projects such as the creation of large woody debris structures in degraded anadromous streams. As discussed in the WMP and in the draft Shared Restoration Strategy (Redwoods Rising 2017), all projects and proposals occurring on the property should be coordinated annually, and when applying for grants, to ensure efficiency and integration of restoration priorities. In some cases, moderate priority treatment areas may become high priority treatment areas due to the efficiencies gained by working with other project proponents.

In particular, the road rehabilitation program objectives and priorities will need to be considered when developing final treatment prioritization and implementation locations for a given year or multi-year planning effort. Currently, the road rehabilitation program prioritization is based on the Landscape Stabilization and Erosion Prevention Program (LSEP), road sediment risk assessment developed by the NCRD (CDPR 2005c). In the future, further site assessment and data may be used to develop additional road rehabilitation priorities. Program leads will coordinate to identify overall priority areas for restoration that best meet the objectives of both the forestry and road rehabilitation programs.

The following guidelines will be considered before embarking on any restoration activity:

- No wood will be removed from the property until consideration is given to its usefulness for other restoration projects such as stream habitat improvement or as coarse woody debris on site.
- Forestry and other restoration projects will consider the impact to roads if heavy equipment use may cause damage to roads or other infrastructure. If so, road maintenance or repair may need to be included as part of a restoration project.
- Forest restoration and other potential projects in the area accessed by a given road will be considered when planning and seeking funding for road removal. The cost of maintaining the road for the short term or re-engineering a road for longer term access to restoration sites will need to be compared to the added costs of restoration in the absence of the road. Other considerations include potential risks or environmental impacts of each alternative, and managers may need to consider delaying the removal of a road or treating a forest sooner than otherwise planned to gain efficiencies and/or minimize impacts.
- Changes in vegetation due to road removal will be considered by resource managers. Road and landing removal clears patches of land that may provide opportunities to establish a new cohort of trees in an even aged forest, plant species that are underrepresented in the area or create a gap where early-seral habitat can add heterogeneity to the landscape. In many cases natural regeneration may be sufficient for revegetating an area and may even need to be thinned, whereas in other cases some planting may be desirable to meet restoration objectives and/or limit invasive species establishment.

Obtaining public support for preserving the Park's vegetation and restoration activities is integral to vegetation management success. Interpreting and informing the public about vegetation management programs, projects, and ways to prevent damage to DNCRSP's vegetation is critical to obtaining public support. Natural resources staff will provide the necessary information to interpretative staff to develop a parkwide interpretive program and to facilitate media coverage on ongoing vegetation management projects.

6.3 Implementation Responsibilities

Natural Resource Management staff are responsible for all Natural Resource Program Areas (Forest Restoration and Reforestation, Uncommon and Sensitive Communities, Non-native Plants and Pathogens) and the following implementation responsibilities:

- Development of restoration and revegetation management plans.
- Identify priorities for restoration treatment and appropriate treatment methods (e.g. restoration thinning, revegetation, prescribed fire). Silvicultural treatments will be developed by or under the oversight and approval of a Registered Professional Forester (RPF).

- Obtaining Sector and District approval for projects.
- Identifying, developing, and securing funding for project implementation.
- Development and approval of environmental compliance documents.
- Conducting sensitive plant surveys as required for compliance for natural, cultural, maintenance, and roads and trails projects.
- Work with Park and District staff to avoid or mitigate impacts to sensitive plant populations and communities.
- Compliance monitoring of Park projects to assure that they do not impact sensitive plants and communities and that avoidance and mitigation measures are implemented.
- Pre- and post-project monitoring to determine the success of the project, effects on other natural resources and to employ adaptive management if necessary.
- Analyzing all monitoring data for adaptive management purposes.
- Completing project annual reports.
- Providing Interpretation and Public Information by:
 - Identifying threats to Park's vegetation that need interpretation.
 - Assisting in identifying themes needing interpretation.
 - Providing resource information needed to interpret themes.

A burn boss certified under CSP or the National Wildfire Coordinating Group standards will be responsible for:

- The development of burn plans.
- Implementation of burn plans.

The District Archaeologist in cooperation with Natural Resource staff will be responsible for:

- Developing specifications and supervising cultural vegetation inventories.
- Review of project proposals to insure significant cultural vegetation features are not adversely affected.
- Obtaining funding for cultural vegetation projects.

The District and Sector Superintendents are responsible for:

- Assisting in the identification, development, and securing of funding for implementation of restoration and revegetation projects.
- Developing local support for project implementation.
- Coordinating restoration and revegetation projects with other programs including roads and trails, maintenance, public safety, and interpretative staff.
- Protecting cultural vegetation features from destruction by the public or unintended management actions.

The Maintenance Chief III in charge of the District Maintenance Program is responsible for:

- Providing recommendations for improvement of project specifications.
- Project implementation when assigned.
- Consulting with Natural Resource Management staff regarding the location and protection of sensitive plant populations prior to conducting trail maintenance.
- Consult with Natural Resource Management staff regarding projects that will require sensitive plant surveys so that they may be scheduled in advance.
- Provide funding for sensitive plant surveys for maintenance and road and trail projects.

Redwood Coast Sector, District Staff, and in most cases CAL FIRE will collaborate to:

- Implement prescribed burn projects in accordance with CSP guidelines (outside of the VMP program). The policies and procedures found in section 0312.2 of the CSP Department Operations Manual (DOM, Calif. Dept. Parks and Recreation 2004) and spelled out in the Natural Resource Handbook will be followed when planning and conducting all prescribed fire operations.
- Implement prescribed burn projects carried out as part of the VMP program.

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8 Glossary

Abiotic - Non-living; usually applied to the physical characteristics of biological systems, such as moisture, nutrients, soils, solar radiation, etc.

Biomass Removal - removal of any vegetation from a site and includes tree (e.g. tree extraction), invasive plant, or shrub removal.

Carbon Sequestration - The capture and or storage of carbon in the environment.

Class I streams (as defined by the California Forest Practice Rules 2017) -

- 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 onsite, includes habitat to sustain fish migration and spawning.

Class II streams (as defined by the California Forest Practice Rules 2017) -

- 1) Fish always or seasonally present offsite within 1,000 feet downstream and/or
- 2) Aquatic habitat for nonfish aquatic [vertebrate] species.
- 3) Excludes Class III waters that are tributary to Class I waters.

Class II watercourses are composed of two types - Class II-S (standard) watercourses and Class II-L (large) watercourses. Class II-S watercourses are those classified as Class II watercourses see above, but do not possess the characteristics of a Class II-L watercourse. A Class II-L watercourse has either of the following characteristics:

1. A contributing drainage area of ≥ 100 acres in the Coast Forest District, as measured from the confluence of the receiving Class I watercourse.
2. An average active channel width of five feet (5 ft.) or greater near the confluence with the receiving Class I watercourse. Where field measurements are necessary to make this determination, active channel width measurements shall be taken at approximately fifty foot (50 ft.) intervals beginning at the point where the Class II watercourse intersects the Class I WLPZ boundary and moving up the Class II watercourse for a distance of approximately two-hundred feet (200 ft.). The combined average of these five (5) measurements shall be used to establish the average active channel width. Measurement points may be adjusted based upon site-specific conditions, and should occur at riffle locations and outside the influence of watercourse crossings to the extent feasible.

Debris Slide - A shallow landslide within soil and rock debris, characterized by a displacement along one or several surfaces within a relatively narrow zone. It may take place as a largely unbroken mass or may be disrupted into several units, each consisting of soil and rock debris.

Facultative (FAC) - Wetland indicator status rating, as described in the National List of Plant Species that Occur in Wetlands (Reed 1988), species equally likely to occur in wetlands and non-wetlands. (34–66% Occurrence in wetlands)

Facultative Wetland (FACW) - Usually occur in wetlands but occasionally found in non-wetlands (67–99% Occurrence in wetlands).

Head Scarp - The distinct step along the upslope edge of a landslide along the contact between the displaced material and the main scarp.

Heterogeneity - The quality or state of being heterogeneous (Heterogeneous – made up of a number of elements different from each other, a mixture of dissimilar ingredients).

Hydrology - The science dealing with the properties, distribution, and circulation of water on the surface of the land, in the soil and underlying rock, and in the atmosphere. This term is often confused with hydrogeology, which is the science of groundwater.

Gully - A steeply sided channel caused by concentrated surface runoff erosion. Gullies can usually be identified by their location away from natural stream valleys. Gullies are at least 1 square foot in cross-sectional area.

Late-Seral - The stage in forest development that includes mature and old-growth forests. Functional characteristics of late-seral forests include large decadent trees, a multi layered canopy, snags, and large down logs.

Mass Wasting - All geological processes in which large masses of earth materials, such as rock and soil, move downslope by gravitational forces.

Obligate (OBL) - species occurs almost always (99%) under natural conditions in wetlands.

Runoff - Rainwater flowing on the surface of the ground. Runoff can be generated by rain falling on saturated ground or from heavy rain that cannot soak in fast enough.

Sediment - Silt, sand, clay, and gravel that is moved by water and deposited at some location.

Silviculture - The branch of forestry dealing with the development and care of forests.

Snag - A standing dead or mostly dead tree.

Stand Replacing Fire - A high intensity fire that kills the majority of trees within a stand.

Suffrutescent - of a plant or stem: having a base that is somewhat woody and does not die down each year.

Thinning - Girdling or cutting down selected trees within a stand.

Thinning severity (also known as thinning weight or intensity) - the amount of trees that are cut or thinned, and is often expressed in terms of basal area or volume reduction over a given area. Canopy cover and stem density are also metrics that guide thinning severity, and are often expressed as retention (i.e. percent canopy cover or trees per acre following treatment).

Understory Vegetation - (trees and shrubs) growing under the canopy of larger trees.

Windthrow - The uprooting and overthrowing of trees by the wind

Xeric - Dry, lacking available moisture for organisms to utilize.non-forest

Yarding - The movement of forest products (e.g. trees) from the point of falling to a landing.

Appendix A -

DNCRSP Vascular Plant List (exported from NCRD Botanical Database updated 07112018)

	Scientific Name	Common Name	Family	Native	cultural significance
Tree (26)	<i>Abies grandis</i>	grand fir	Pinaceae	yes	
	<i>Acer circinatum</i>	vine maple	Sapindaceae	yes	
	<i>Acer macrophyllum</i>	big-leafed maple	Sapindaceae	yes	x
	<i>Alnus rubra</i>	red alder	Betulaceae	yes	x
	<i>Arbutus menziesii</i>	madrone	Ericaceae	yes	x
	<i>Chamaecyparis lawsoniana</i>	Port Orford cedar	Cupressaceae	yes	
	<i>Chrysolepis chrysophylla</i> var. <i>chrysophylla</i>	typical golden chinquapin	Fagaceae	yes	x
	<i>Cornus</i> sp.	dogwood	Cornaceae	yes	
	<i>Frangula purshiana</i> ssp. <i>purshiana</i>	California cascara	Rhamnaceae	yes	x
	<i>Fraxinus latifolia</i>	Oregon ash	Oleaceae	yes	
	<i>Morella californica</i>	wax myrtle	Myricaceae	yes	
	<i>Notholithocarpus densiflorus</i> var. <i>densiflorus</i>	tree tanbark	Fagaceae	yes	x
	<i>Picea sitchensis</i>	Sitka spruce	Pinaceae	yes	x
	<i>Pinus attenuata</i>	knobcone pine	Pinaceae	yes	
	<i>Pinus contorta</i> ssp. <i>Murrayana</i>	Lodgepole pine	Pinaceae	yes	x
	<i>Pinus jeffreyi</i>	Jeffrey pine	Pinaceae	yes	
	<i>Pinus lambertiana</i>	sugar pine	Pinaceae	yes	
	<i>Pinus monticola</i>	western white pine	Pinaceae	yes	
	<i>Pinus radiata</i>	Monterrey pine	Pinaceae	no	
	<i>Pseudotsuga menziesii</i>	Douglas-fir	Pinaceae	yes	x
	<i>Quercus chrysolepis</i>	canyon live oak	Fagaceae	yes	
	<i>Sequoia sempervirens</i>	coast redwood	Cupressaceae	yes	x
	<i>Sequoiadendron giganteum</i>	giant sequoia	Cupressaceae	no	
	<i>Thuja plicata</i>	western red cedar	Cupressaceae	yes	
	<i>Tsuga heterophylla</i>	western hemlock	Pinaceae	yes	
	<i>Umbellularia californica</i>	California bay	Lauraceae	yes	x
Shrub (66)	<i>Amelanchier alnifolia</i>	northwestern serviceberry	Rosaceae	yes	
	<i>Amelanchier alnifolia</i> var. <i>semiintegrifolia</i>	Pacific Saskatoon serviceberry	Rosaceae	yes	
	<i>Amelanchier utahensis</i>	Utah serviceberry	Rosaceae	yes	
	<i>Arctostaphylos columbiana</i>	Columbia manzanita	Ericaceae	yes	

	Scientific Name	Common Name	Family	Native	cultural significance
	<i>Arctostaphylos glandulosa</i> subsp. <i>glandulosa</i>	glandular manzanita	Ericaceae	yes	
	<i>Arctostaphylos hispidula</i>	Howell's manzanita	Ericaceae	yes	x
	<i>Arctostaphylos nevadensis</i>	pine-mat manzanita	Ericaceae	yes	x
	<i>Arctostaphylos nortensis</i>	Del Norte manzanita	Ericaceae	yes	x
	<i>Baccharis pilularis</i> ssp. <i>consanguinea</i>	upright coyote-brush	Asteraceae	yes	
	<i>Berberis aquifolium</i>	holly-leaved barberry	Berberidaceae	yes	x
	<i>Berberis aquifolium</i> var. <i>repens</i>	creeping barberry	Berberidaceae	yes	
	<i>Berberis nervosa</i>	Cascade barberry	Berberidaceae	yes	
	<i>Ceanothus integerrimus</i>	deer brush ceanothus	Rhamnaceae	yes	
	<i>Ceanothus pumilus</i>	Siskiyou mat	Rhamnaceae	yes	
	<i>Ceanothus thyrsiflorus</i> var. <i>thyrsiflorus</i>	blue blossom	Rhamnaceae	yes	
	<i>Ceanothus velutinus</i>	tobaccobrush	Rhamnaceae	yes	
	<i>Chimaphila menziesii</i>	little prince's-pine	Ericaceae	yes	
	<i>Chimaphila umbellata</i>	common prince's-pine	Ericaceae	yes	
	<i>Chrysolepis sempervirens</i>	bush golden chinquapin	Fagaceae	yes	
	<i>Corylus cornuta</i> var. <i>californica</i>	hazelnut	Betulaceae	yes	x
	<i>Cotoneaster</i> sp.	cotoneaster	Rosaceae	no	
	<i>Cytisus scoparius</i>	Scotch broom	Fabaceae	no	
	<i>Euonymus occidentalis</i> var. <i>occidentalis</i>	western burning-bush	Celastraceae	yes	
	<i>Frangula californica</i>	California coffee berry	Rhamnaceae	yes	
	<i>Frangula californica</i> ssp. <i>occidentalis</i>	western California coffeeberry	Rhamnaceae	yes	
	<i>Garrya buxifolia</i>	box-leaved silk-tassel	Garryaceae	yes	
	<i>Garrya congdonii</i>	Congdon's silk-tassel	Garryaceae	yes	
	<i>Gaultheria shallon</i>	salal	Ericaceae	yes	x
	<i>Genista monspessulana</i>	French broom	Fabaceae	no	
	<i>Hedera helix</i>	English ivy	Araliaceae	no	
	<i>Holodiscus discolor</i>	creambush ocean-spray	Rosaceae	yes	
	<i>Ilex aquifolium</i>	English holly	Aquifoliaceae	no	
	<i>Juniperus communis</i>	common ground juniper	Cupressaceae	yes	x
	<i>Lonicera hispidula</i>	California pink honeysuckle	Caprifoliaceae	yes	
	<i>Lonicera involucrata</i>	twinberry	Caprifoliaceae	yes	

	Scientific Name	Common Name	Family	Native	cultural significance
	<i>Menziesia ferruginea</i>	false azalea	Ericaceae	yes	
	<i>Oemleria cerasiformis</i>	oso-berry	Rosaceae	yes	x
	<i>Physocarpus capitatus</i>	Pacific ninebark	Rosaceae	yes	
	<i>Quercus vaccinifolia</i>	huckleberry oak	Fagaceae	yes	
	<i>Rhododendron columbianum</i>	Western labrador tea	Ericaceae	yes	x
	<i>Rhododendron macrophyllum</i>	Pacific rhododendron	Ericaceae	yes	
	<i>Rhododendron occidentale</i>	western azalea	Ericaceae	yes	
	<i>Ribes bracteosum</i>	stink currant	Grossulariaceae	yes	
	<i>Ribes laxiflorum</i>	trailing black currant	Grossulariaceae	yes	
	<i>Ribes menziesii</i> var. <i>menziesii</i>	Menzies's gooseberry	Grossulariaceae	yes	
	<i>Ribes roezlii</i>	Sierra Nevada gooseberry	Grossulariaceae	yes	x
	<i>Ribes roezlii</i> var. <i>cruentum</i>	Coast Ranges gooseberry	Grossulariaceae	yes	
	<i>Ribes sanguineum</i> var. <i>glutinosum</i>	pink-flowering currant	Grossulariaceae	yes	
	<i>Rosa gymnocarpa</i> var. <i>gymnocarpa</i>	California wood rose	Rosaceae	yes	
	<i>Rubus armeniacus</i>	Himalayan blackberry	Rosaceae	no	
	<i>Rubus laciniatus</i>	cut-leaved blackberry	Rosaceae	no	
	<i>Rubus leucodermis</i>	white-stemmed blackberry	Rosaceae	yes	x
	<i>Rubus parviflorus</i>	thimbleberry	Rosaceae	yes	x
	<i>Rubus spectabilis</i>	salmonberry	Rosaceae	yes	x
	<i>Rubus ursinus</i>	California blackberry	Rosaceae	yes	x
	<i>Salix delnortensis</i>	Del Norte willow	Salicaceae	yes	x
	<i>Salix hookeriana</i>	Hooker's willow	Salicaceae	yes	x
	<i>Salix lasiandra</i> var. <i>lasiandra</i>	Pacific willow	Salicaceae	yes	x
	<i>Salix lasiolepis</i>	arroyo willow	Salicaceae	yes	x
	<i>Salix scouleriana</i>	Scouler's willow	Salicaceae	yes	x
	<i>Salix sitchensis</i>	Sitka willow	Salicaceae	yes	x
	<i>Sambucus racemosa</i> var. <i>racemosa</i>	red elderberry	Adoxaceae	yes	x
	<i>Symphoricarpos mollis</i>	creeping snowberry	Caprifoliaceae	yes	
	<i>Toxicodendron diversilobum</i>	Pacific poison oak	Anacardiaceae	yes	
	<i>Vaccinium ovatum</i>	evergreen huckleberry	Ericaceae	yes	x
	<i>Vaccinium parvifolium</i>	California red huckleberry	Ericaceae	yes	x
Herb (265)	<i>Achillea millefolium</i>	yarrow	Asteraceae	yes	x

	Scientific Name	Common Name	Family	Native	cultural significance
	<i>Achlys californica</i>	California vanilla leaf	Berberidaceae	yes	
	<i>Achlys triphylla</i> ssp. <i>tryphylla</i>	three-leaved vanilla leaf	Berberidaceae	yes	
	<i>Acmispon americanus</i> var. <i>americanus</i>	American bird's-foot-trefoil	Fabaceae	yes	
	<i>Acmispon parviflorus</i>	small-flowered lotus	Fabaceae	yes	
	<i>Adenocaulon bicolor</i>	trail plant	Asteraceae	yes	
	<i>Agoseris grandiflora</i> var. <i>leptophylla</i>	narrow-leaved agoseris	Asteraceae	yes	
	<i>Allium falcifolium</i>	sickle-leaved onion	Alliaceae	yes	
	<i>Allotropa virgata</i>	sugar stick	Ericaceae	yes	
	<i>Anaphalis margaritacea</i>	pearly everlasting	Asteraceae	yes	
	<i>Anemone oregana</i> var. <i>oregana</i>	Oregon anemone	Ranunculaceae	yes	
	<i>Angelica hendersonii</i>	Henderson's angelica	Apiaceae	yes	
	<i>Anisocarpus madioides</i>	forest madia	Asteraceae	yes	
	<i>Aphanes occidentalis</i>	western lady's-mantle	Rosaceae	yes	
	<i>Apocynum androsaemifolium</i>	dogbane	Apocynaceae	yes	
	<i>Aquilegia formosa</i>	western crimson columbine	Ranunculaceae	yes	
	<i>Aralia californica</i>	elk clover	Araliaceae	yes	
	<i>Arnica spathulata</i>	Klamath arnica	Asteraceae	yes	
	<i>Asarum caudatum</i>	western wild ginger	Aristolochiaceae	yes	x
	<i>Asyneuma prenanthoides</i>	western hare-bell	Campanulaceae	yes	
	<i>Bellis perennis</i>	English daisy	Asteraceae	no	
	<i>Boykinia occidentalis</i>	western brook-foam	Saxifragaceae	yes	
	<i>Brodiaea elegans</i>	harvest brodiaea	Themidaceae	yes	
	<i>Calochortus tolmiei</i>	Tolmie's pussy-ears	Liliaceae	yes	
	<i>Cardamine angulata</i>	seaside bittercress	Brassicaceae	yes	
	<i>Cardamine breweri</i>	Brewer's bitter-cress	Brassicaceae	yes	
	<i>Cardamine californica</i>	California toothwort	Brassicaceae	yes	
	<i>Cardamine nuttallii</i>	Nuttall's toothwort	Brassicaceae	yes	
	<i>Cardamine oligosperma</i>	little bittercress	Brassicaceae	yes	
	<i>Castilleja affinis</i> ssp. <i>affinis</i>	common coastal paintbrush	Orobanchaceae	yes	
	<i>Castilleja affinis</i> ssp. <i>litoralis</i>	Oregon coast paintbrush	Orobanchaceae	yes	
	<i>Castilleja brevilobata</i>	short-lobed paintbrush	Orobanchaceae	yes	
	<i>Castilleja exserta</i>	purple owl's-clover	Scrophulariaceae	yes	
	<i>Centaurium erythraea</i>	European centauray	Gentianaceae	no	

	Scientific Name	Common Name	Family	Native	cultural significance
	<i>Cerastium arvense</i>	field mouse-eared chickweed	Caryophyllaceae	yes	
	<i>Cerastium glomeratum</i>	broad-leaved mouse-ear chickweed	Caryophyllaceae	no	
	<i>Chamerion angustifolium</i>	narrow-leaved fireweed	Onagraceae	yes	
	<i>Chrysosplenium glechomifolium</i>	Pacific golden-saxifrage	Saxifragaceae	yes	
	<i>Circaea alpina ssp. pacifica</i>	small enchanter's night-shade	Onagraceae	yes	
	<i>Cirsium arvense</i>	Canada thistle	Asteraceae	no	
	<i>Cirsium brevistylum</i>	short-styled thistle	Asteraceae	yes	
	<i>Cirsium vulgare</i>	bull thistle	Asteraceae	no	
	<i>Claytonia sibirica</i>	candy flower	Montiaceae	yes	
	<i>Claytonia sp.</i>	claytonia	Montiaceae	unk	
	<i>Clinopodium douglasii</i>	yerba buena	Lamiaceae	yes	x
	<i>Clintonia andrewsiana</i>	red clintonia	Liliaceae	yes	
	<i>Collinsia linearis</i>	linear-leaved blue-eyed-Mary	Plantaginaceae	yes	
	<i>Collomia heterophylla</i>	variable-leaved collomia	Polemoniaceae	yes	
	<i>Conium maculatum</i>	poison hemlock	Apiaceae	no	
	<i>Corallorhiza maculata</i>	spotted coral root orchid	Orchidaceae	yes	
	<i>Corallorhiza sp.</i>	coral root orchid	Orchidaceae	yes	
	<i>Cordylanthus tenuis</i>	Slender bird's beak	Orobanchaceae	yes	
	<i>Crepis capillaris</i>	smooth hawksbeard	Asteraceae	no	
	<i>Crocoshmia x. crocosmiiflora</i>	Monbretia	Iridaceae	no	
	<i>Cypripedium californicum</i>	California lady's-slipper orchid	Orchidaceae	yes	
	<i>Daucus carota</i>	Queen Anne's lace	Apiaceae	no	
	<i>Delairea odorata</i>	Cape ivy	Asteraceae	no	
	<i>Dicentra formosa</i>	western bleeding heart	Papaveraceae	yes	
	<i>Digitalis purpurea</i>	common foxglove	Plantaginaceae	no	
	<i>Dipsacus fullonum</i>	common roadside teasel	Dipsacaceae	no	
	<i>Drymocallis glandulosa</i>	sticky potentilla	Rosaceae	yes	
	<i>Dysphania ambrosioides</i>	Mexican tea	Chenopodiaceae	no	
	<i>Epilobium ciliatum ssp. watsonii</i>	ciliate willowherb	Onagraceae	yes	
	<i>Epilobium minutum</i>	minute willow herb	Onagraceae	yes	
	<i>Erigeron canadensis</i>	Canadian horseweed	Asteraceae	no	
	<i>Erigeron foliosus var. confinis</i>	leafy fleabane-daisy	Asteraceae	yes	

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	<i>Eriodictyon californicum</i>	yerba santa	Boraginaceae	yes	x
	<i>Eriogonum nudum</i>	naked-stemmed buckwheat	Polygonaceae	yes	
	<i>Eriophyllum lanatum</i>	common woolly-sunflower	Asteraceae	yes	
	<i>Erythronium californicum</i>	California fawn-lily	Liliaceae	yes	
	<i>Erythronium citrinum</i> var. <i>citrinum</i>	lemon fawn-lily	Liliaceae	yes	
	<i>Eucephalus tomentellus</i>	brickellbush aster	Asteraceae	yes	
	<i>Euchiton gymnocephalus</i>	creeping cudweed	Asteraceae	no	
	<i>Euchiton involucratus</i>	star cottonleaf	Asteraceae	no	
	<i>Eurybia radulina</i>	rough-leaved aster	Asteraceae	yes	
	<i>Fritillaria affinis</i>	purple rice-bulbed fritillary	Liliaceae	yes	
	<i>Galium ambiguum</i> ssp. <i>siskiyouense</i>	Siskiyou bedstraw	Rubiaceae	yes	
	<i>Galium aparine</i>	bedstraw	Rubiaceae	yes	
	<i>Galium trifidum</i> ssp. <i>columbianum</i>	Pacific bedstraw	Rubiaceae	yes	
	<i>Galium triflorum</i>	three-flowered bedstraw	Rubiaceae	yes	
	<i>Gamochaeta ustulata</i>	Pacific cudweed	Asteraceae	yes	
	<i>Gentiana affinis</i> var. <i>ovata</i>	Oregon gentian	Gentianaceae	yes	
	<i>Geranium dissectum</i>	cutleaf crane's-bill	Geraniaceae	no	
	<i>Geranium lucidum</i>	shining geranium	Geraniaceae	no	
	<i>Geranium robertianum</i>	Robert's herb	Geraniaceae	no	
	<i>Geum macrophyllum</i> var. <i>macrophyllum</i>	large-leaved avens	Rosaceae	yes	
	<i>Gilia capitata</i> ssp. <i>Capitata</i>	blue-headed gilia	Polemoniaceae	yes	
	<i>Githopsis specularioides</i>	Common bluecup	Campanulaceae		
	<i>Glechoma hederacea</i>	common ground-ivy	Lamiaceae	no	
	<i>Gnaphalium</i> sp.	cudweed	Asteraceae	unk	
	<i>Goodyera oblongifolia</i>	rattlesnake orchid	Orchidaceae	yes	
	<i>Gratiola ebracteata</i>	Bractless hedge hyssop	Plantaginaceae		
	<i>Hastingsia serpenticola</i>	Siskiyou rushlily	Agavaceae	yes	
	<i>Heracleum maximum</i>	cow parsnip	Apiaceae	yes	x
	<i>Heuchera micrantha</i>	small-flowered alumroot	Saxifragaceae	yes	
	<i>Hieracium albiflorum</i>	white-flowered hawkweed	Asteraceae	yes	
	<i>Hieracium bolanderi</i>	Bolander's hawkweed	Asteraceae	yes	
	<i>Horkelia sericata</i>	Howell's horkelia	Rosaceae	yes	

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	<i>Hosackia rosea</i>	rosy lotus	Fabaceae	yes	
	<i>Hydrocotyle ranunculoides</i>	marsh pennywort	Apiaceae	yes	
	<i>Hydrophyllum tenuipes</i>	Pacific waterleaf	Boraginaceae	yes	
	<i>Hypericum perforatum</i>	Klamath weed	Hypericaceae	no	
	<i>Hypochaeris radicata</i>	rough cat's-ear	Asteraceae	no	
	<i>Iris douglasiana</i>	Douglas iris	Iridaceae	yes	
	<i>Iris thompsonii</i>	Thompson's iris	Iridaceae	yes	
	<i>Kopsiopsis hookeri</i>	small groundcone	Orobanchaceae	yes	
	<i>Kopsiopsis strobilacea</i>	California ground-cone	Orobanchaceae	yes	
	<i>Lapsana communis</i>	common nipplewort	Asteraceae	no	
	<i>Lathyrus delnorticus</i>	Del Norte pea	Fabaceae	yes	
	<i>Lathyrus nevadensis</i> var. <i>nevadensis</i>	Sierra Nevada pea	Fabaceae	Yes	
	<i>Lathyrus polyphyllus</i>	many-leaved pea	Fabaceae	yes	
	<i>Lathyrus vestitus</i> var. <i>vestitus</i>	woodland pea	Fabaceae	yes	
	<i>Leucanthemum vulgare</i>	ox-eye daisy	Asteraceae	no	
	<i>Lilium bolanderi</i>	Bolander's lily	Liliaceae	yes	
	<i>Lilium columbianum</i>	Columbia lily	Liliaceae	yes	
	<i>Lilium pardalinum</i> ssp. <i>Pardalinum</i>	California leopard-lily	Liliaceae	yes	
	<i>Lilium pardalinum</i> ssp. <i>Vollmeri</i>	Vollmer's lily	Liliaceae	yes	
	<i>Linum bienne</i>	flax	Linaceae	no	
	<i>Listera banksiana</i>	northwest listera	Orchidaceae	yes	
	<i>Listera cordata</i>	heart-leaved twayblade	Orchidaceae	yes	
	<i>Lomatium howellii</i>	Howell's lomatium	Apiaceae	yes	
	<i>Lomatium macrocarpum</i>	large-fruited lomatium	Apiaceae	yes	
	<i>Lotus corniculatus</i>	broadleaf birdsfoot trefoil	Fabaceae	no	
	<i>Lotus uliginosus</i>	greater lotus	Fabaceae	no	
	<i>Lupinus latifolius</i>	broad-leaved lupine	Fabaceae	yes	
	<i>Lupinus polyphyllus</i>	many-leaved lupine	Fabaceae	yes	
	<i>Lupinus</i> sp.	lupine	Fabaceae	yes	
	<i>Lysichiton americanus</i>	skunk cabbage	Araceae	yes	x
	<i>Lysimachia latifolia</i>	Pacific starflower	Myrsinaceae	yes	
	<i>Madia gracilis</i>	slender madia	Asteraceae	yes	
	<i>Madia sativa</i>	coast tarweed	Asteraceae	yes	

	Scientific Name	Common Name	Family	Native	cultural significance
	<i>Maianthemum dilatatum</i>	two-leaved false-Solomon's-seal	Ruscaceae	yes	
	<i>Maianthemum racemosum</i>	false Solomon's seal	Ruscaceae	yes	
	<i>Maianthemum sp.</i>	false lily-of-the-valley	Ruscaceae	yes	
	<i>Maianthemum stellatum</i>	starry false lily-of-the-valley	Ruscaceae	yes	
	<i>Marah oregana</i>	coast man-root	Cucurbitaceae	yes	x
	<i>Medicago polymorpha</i>	bur-clover	Fabaceae	no	
	<i>Melilotus sp.</i>	sweetclover	Fabaceae	no	
	<i>Melissa officinalis</i>	lemon balm	Lamiaceae	no	
	<i>Mentha pulegium</i>	European pennyroyal	Lamiaceae	no	
	<i>Mentha sp.</i>	mint	Lamiaceae	no	
	<i>Mimulus dentatus</i>	coast monkeyflower	Phrymaceae	yes	
	<i>Mimulus floribundus</i>	floriferous mimulus	Phrymaceae	yes	
	<i>Minuartia howellii</i>	Howell's sandwort	Caryophyllaceae	yes	
	<i>Mitellastra caulescens</i>	leafy-stemmed mitrewort	Saxifragaceae	yes	
	<i>Monardella purpurea</i>	serpentine monardella	Lamiaceae	yes	
	<i>Montia fontana</i>	fountain miner's lettuce	Montiaceae	no	
	<i>Montia linearis</i>	candyflower	Montiaceae	yes	
	<i>Montia parvifolia</i>	little-leaved montia	Montiaceae	yes	
	<i>Navarretia squarrosa</i>	skunkweed	Polemoniaceae	yes	
	<i>Nemophila heterophylla</i>	variable-leaved nemophila	Boraginaceae	yes	
	<i>Nemophila parviflora var. parviflora</i>	woodland nemophila	Boraginaceae	yes	
	<i>Nemophila pedunculata</i>	meadow nemophila	Boraginaceae	yes	
	<i>Oenanthe sarmentosa</i>	Pacific water-parsley	Apiaceae	yes	
	<i>Orobanche uniflora</i>	one-flowered broomrape	Orobanchaceae	yes	
	<i>Osmorhiza berteroi</i>	sweet cicely	Apiaceae	yes	
	<i>Osmorhiza purpurea</i>	purple sweet cicely	Apiaceae	yes	
	<i>Oxalis oregana</i>	redwood sorrel	Oxalidaceae	yes	x
	<i>Oxalis suksdorfii</i>	Suksdorf's wood-sorrel	Oxalidaceae	yes	
	<i>Packera bolanderi var. bolanderi</i>	seacoast ragwort	Asteraceae	yes	
	<i>Packera macounii</i>	Siskiyou Mountains ragwort	Asteraceae	yes	
	<i>Pectiantia ovalis</i>	oval-leaved mitrewort	Saxifragaceae	yes	
	<i>Penstemon anguineus</i>	Siskiyou beardtongue	Plantaginaceae	yes	
	<i>Perideridia oregana</i>	Oregon yampa	Apiaceae		

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	<i>Perideridia</i> sp.	yampa	Apiaceae	yes	
	<i>Petasites frigidus</i> var. <i>palmatum</i>	western colt's foot	Asteraceae	yes	x
	<i>Phacelia bolanderi</i>	Bolander's phacelia	Boraginaceae	yes	
	<i>Phacelia heterophylla</i>	phacelia	Boraginaceae	yes	
	<i>Phacelia</i> sp.	phacelia	Boraginaceae	yes	
	<i>Pinguicula macroceras</i>	horned butterwort	Lentibulariaceae	yes	
	<i>Piperia candida</i>	white-flowered rein orchid	Orchidaceae	yes	
	<i>Pityopus californicus</i>	California pinefoot	Ericaceae	yes	
	<i>Plantago lanceolata</i>	English plantain	Plantaginaceae	no	
	<i>Plantago major</i>	greater plantain	Plantaginaceae	no	x
	<i>Polycarpon tetraphyllum</i>	four-leaved allseed	Caryophyllaceae	no	
	<i>Polygala californica</i>	California milkwort	Polygalaceae	yes	
	<i>Polygonum</i> sp.	knotweed	Polygonaceae	unk	
	<i>Polygonum spergulariiforme</i>	spurry knotweed	Polygonaceae	no	
	<i>Prosartes hookeri</i>	Hooker's fairy bells	Liliaceae	yes	
	<i>Prosartes smithii</i>	Smith's fairy bells	Liliaceae	yes	
	<i>Prunella vulgaris</i>	selfheal	Lamiaceae	unk	
	<i>Prunella vulgaris</i> var. <i>lanceolata</i>	mountain selfheal	Lamiaceae	yes	
	<i>Prunella vulgaris</i> var. <i>vulgaris</i>	common selfheal	Lamiaceae	no	
	<i>Pseudognaphalium beneolens</i>	fragrant pearly everlasting	Asteraceae	yes	
	<i>Pseudognaphalium luteoalbum</i>	cotton-batting-plant	Asteraceae	no	
	<i>Pseudognaphalium stramineum</i>	cotton-batting-plant	Asteraceae	yes	
	<i>Pseudotrillium rivale</i>	false trillium	Melanthiaceae	yes	
	<i>Pyrola asarifolia</i> ssp. <i>bracteata</i>	long-bracted wintergreen	Pyrolaceae	yes	
	<i>Pyrola picta</i>	leafless wintergreen	Ericaceae	yes	
	<i>Ranunculus occidentalis</i> var. <i>occidentalis</i>	western buttercup	Ranunculaceae	yes	
	<i>Ranunculus repens</i>	common creeping buttercup	Ranunculaceae	no	
	<i>Ranunculus</i> sp.	buttercup	Ranunculaceae	unk	
	<i>Ranunculus uncinatus</i>	barbed buttercup	Ranunculaceae	yes	
	<i>Raphanus</i> sp.	charlock	Brassicaceae	no	
	<i>Rorippa curvisiliqua</i>	western cress	Brassicaceae	yes	
	<i>Rumex acetosella</i>	sheep sorrel	Polygonaceae	no	
	<i>Rumex obtusifolius</i>	broad-leaved dock	Polygonaceae	no	
	<i>Rumex</i> sp.	dock	Polygonaceae	unk	

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	<i>Sagina procumbens</i>	matted pearlwort	Caryophyllaceae	no	
	<i>Sanicula bipinnatifida</i>	purple sanicle	Apiaceae	yes	
	<i>Sanicula crassicaulis</i>	Pacific sanicle	Apiaceae	yes	
	<i>Sanicula laciniata</i>	coast sanicle	Apiaceae	yes	
	<i>Sanicula peckiana</i>	Peck's sanicle	Apiaceae	yes	
	<i>Sanicula sp.</i>	sanicle	Apiaceae	yes	
	<i>Scrophularia californica</i>	California bee plant	Scrophulariaceae	yes	
	<i>Scutellaria antirrhinoides</i>	snapdragon skullcap	Lamiaceae	yes	
	<i>Sedum obtusatum</i>	Sierra stonecrop	Crassulaceae		
	<i>Senecio glomeratus</i>	cut-leaf coast burnweed	Asteraceae	no	
	<i>Senecio jacobaea</i>	tansy ragwort	Asteraceae	no	
	<i>Senecio minimus</i>	coastal burnweed	Asteraceae	no	
	<i>Senecio vulgaris</i>	garden groundsel	Asteraceae	no	
	<i>Sherardia arvensis</i>	blue field madder	Rubiaceae	no	
	<i>Sidalcea asprella ssp. asprella</i>	Sierra foothills checker-bloom	Malvaceae	yes	
	<i>Sidalcea elegans</i>	Del norte checkerbloom	Malvaceae		
	<i>Sidalcea malachroides</i>	maple-leaved checkerbloom	Malvaceae	yes	
	<i>Silene serpentinicola</i>	serpentine catchfly	Caryophyllaceae	yes	
	<i>Sisyrinchium bellum</i>	blue-eyed grass	Iridaceae	yes	
	<i>Sonchus oleraceus</i>	common sow-thistle	Asteraceae	no	
	<i>Sonchus sp.</i>	sow-thistle	Asteraceae	no	
	<i>Spergularia rubra</i>	red sand-spurrey	Caryophyllaceae	no	
	<i>Spergularia sp.</i>	sand-spurrey	Caryophyllaceae	unk	
	<i>Stachys bergii</i>	Berg's hedge-nettle	Lamiaceae	yes	
	<i>Stachys chamissonis</i>	giant coastal hedge-nettle	Lamiaceae	yes	
	<i>Stachys rigida var. rigida</i>	rigid hedge-nettle	Lamiaceae	yes	
	<i>Stachys sp.</i>	hedge-nettle	Lamiaceae	yes	
	<i>Stellaria crispera</i>	curled starwort	Caryophyllaceae	yes	
	<i>Stellaria media</i>	common chickweed	Caryophyllaceae	no	
	<i>Synthyris cordata</i>	cordate snow-queen	Plantaginaceae	yes	
	<i>Taraxacum officinale</i>	dandelion	Asteraceae	no	
	<i>Tauschia glauca</i>	glaucous tauschia	Apiaceae	yes	
	<i>Tauschia kelloggii</i>	Kellogg's tauschia	Apiaceae	yes	

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	<i>Tellima grandiflora</i>	fringe cups	Saxifragaceae	yes	
	<i>Tolmiea diplomenziesii</i>	pig-a-back plant	Saxifragaceae	yes	
	<i>Torilis arvensis</i>	hedge parsley	Apiaceae	no	
	<i>Toxicoscordion venenosum</i>	deadly zigadenus	Melanthiaceae	yes	
	<i>Tragopogon lamottei</i>	salsify	Asteraceae	no	
	<i>Trifolium dubium</i>	yellow suckling clover	Fabaceae	no	
	<i>Trifolium microcephalum</i>	small-headed clover	Fabaceae	yes	
	<i>Trifolium vesiculosum</i>	arrow-leaved clover	Fabaceae	no	
	<i>Trillium ovatum ssp. ovatum</i>	Western wake robin	Melanthiaceae	yes	
	<i>Triphysaria eriantha ssp. rosea</i>	rosy Johnny-Tuck	Orobanchaceae	yes	
	<i>Triphysaria pusilla</i>	dwarf owl's-clover	Orobanchaceae	yes	
	<i>Triteleia bridgesii</i>	Bridges's triteleia	Themidaceae	yes	
	<i>Urtica dioica</i>	stinging nettle	Urticaceae	yes	x
	<i>Valeriana sitchensis</i>	sitka valerian	Valerianaceae	yes	
	<i>Vancouveria hexandra</i>	northern inside-out flower	Berberidaceae	yes	
	<i>Vancouveria planipetala</i>	redwood ivy	Berberidaceae	yes	
	<i>Veronica americana</i>	American speedwell	Plantaginaceae	yes	
	<i>Veronica anagallis-aquatica</i>	great water speedwell	Plantaginaceae	no	
	<i>Veronica peregrina ssp. xalapensis</i>	hairy purslane speedwell	Plantaginaceae	yes	
	<i>Veronica serpyllifolia ssp. humifusa</i>	bright-blue speedwell	Plantaginaceae	yes	
	<i>Veronica sp.</i>	veronica	Plantaginaceae	unk	
	<i>Vicia americana ssp. americana</i>	American vetch	Fabaceae	no	
	<i>Vicia gigantea</i>	giant vetch	Fabaceae	yes	
	<i>Vicia sativa</i>	common vetch	Fabaceae	no	
	<i>Viola adunca ssp. adunca</i>	western dog violet	Violaceae	yes	x
	<i>Viola cuneata</i>	wedge-leaved violet	Violaceae	yes	
	<i>Viola glabella</i>	stream violet	Violaceae	yes	
	<i>Viola lobata ssp. lobata</i>	yellow pine violet	Violaceae	yes	
	<i>Viola ocellata</i>	western heart's-ease violet	Violaceae	yes	
	<i>Viola sempervirens</i>	redwood violet	Violaceae	yes	
	<i>Whipplea modesta</i>	modesty, yerba de selva	Philadelphaceae	yes	
	<i>Xerophyllum tenax</i>	western bear grass	Melanthiaceae	yes	x
Graminoid (65)	<i>Agrostis capillaris</i>	colonial bentgrass	Poaceae	no	

	Scientific Name	Common Name	Family	Native	cultural significance
	<i>Agrostis sp.</i>	bentgrass	Poaceae	unk	
	<i>Agrostis stolonifera</i>	creeping bentgrass	Poaceae	no	
	<i>Aira caryophyllea</i>	European silver hairgrass	Poaceae	no	
	<i>Anthoxanthum occidentale</i>	California sweet grass	Poaceae	yes	
	<i>Anthoxanthum odoratum</i>	sweet vernal grass	Poaceae	no	
	<i>Avena barbata</i>	slender wild oat	Poaceae	no	
	<i>Briza maxima</i>	rattlesnake grass	Poaceae	no	
	<i>Briza minor</i>	little rattlesnake grass	Poaceae	no	
	<i>Bromus carinatus var. carinatus</i>	California brome	Poaceae	yes	
	<i>Bromus hordeaceus</i>	soft-chess brome	Poaceae	no	
	<i>Bromus vulgaris</i>	narrow-flowered brome	Poaceae	yes	
	<i>Calamagrostis nutkaensis</i>	Pacific reed-grass	Poaceae	yes	
	<i>Carex bolanderi</i>	Bolander's sedge	Cyperaceae	yes	
	<i>Carex concinnoides</i>	northwestern sedge	Cyperaceae	yes	
	<i>Carex echinatus ssp. phyllomanica</i>	coastal stellate sedge	Cyperaceae	yes	
	<i>Carex hendersonii</i>	Henderson's sedge	Cyperaceae	yes	
	<i>Carex leptopoda</i>	taper fruit short scale sedge	Cyperaceae	yes	
	<i>Carex mendocinensis</i>	Mendocino sedge	Cyperaceae	yes	
	<i>Carex obnupta</i>	slough sedge	Cyperaceae	yes	
	<i>Carex rossii</i>	Ross' sedge	Cyperaceae	yes	
	<i>Carex serpenticola</i>	serpentine sedge	Cyperaceae	yes	
	<i>Carex sp.</i>	sedge	Cyperaceae	yes	
	<i>Carex subfusca</i>	rusty slender sedge	Cyperaceae	yes	
	<i>Cortaderia jubata</i>	jubata grass	Poaceae	no	
	<i>Cynosurus cristatus</i>	crested dogstail grass	Poaceae	no	
	<i>Cynosurus echinatus</i>	hedgehog dogtail grass	Poaceae	no	
	<i>Cyperus eragrostis</i>	tall flatsedge	Cyperaceae	yes	
	<i>Dactylis glomerata</i>	orchard grass	Poaceae	no	
	<i>Danthonia californica</i>	California oatgrass	Poaceae	yes	
	<i>Deschampsia elongata</i>	elongated hair-grass	Poaceae	yes	
	<i>Elymus glaucus</i>	blue wildrye	Poaceae	yes	
	<i>Festuca arundinacea</i>	tall fescue	Poaceae	no	
	<i>Festuca californica</i>	California fescue	Poaceae	yes	
	<i>Festuca idahoensis</i>	Idaho fescue	Poaceae	yes	

	Scientific Name	Common Name	Family	Native	cultural significance
	<i>Festuca myuros</i>	rat-tailed fescue	Poaceae	no	
	<i>Festuca occidentalis</i>	western fescue	Poaceae	yes	
	<i>Festuca perennis</i>	perennial rye-grass	Poaceae	no	
	<i>Festuca sp.</i>	fescue	Poaceae	unk	
	<i>Glyceria elata</i>	western tall manna-grass	Poaceae	yes	
	<i>Holcus lanatus</i>	velvet grass	Poaceae	no	
	<i>Isolepis setacea</i>	bristle-leaved bulrush	Cyperaceae	no	
	<i>Juncus bolanderi</i>	Bolander's rush	Juncaceae	yes	
	<i>Juncus bufonius</i>	toad rush	Juncaceae	yes	
	<i>Juncus effusus ssp. pacificus</i>	soft rush	Juncaceae	yes	x
	<i>Juncus ensifolius</i>	dagger-leaved rush	Juncaceae	yes	
	<i>Juncus xiphioides</i>	iris-leaved rush	Juncaceae	yes	
	<i>Koeleria macrantha</i>	prairie June-grass	Poaceae	yes	
	<i>Luzula comosa</i>	hairy wood rush	Juncaceae	yes	
	<i>Luzula parviflora</i>	small-flowered wood rush	Juncaceae	yes	
	<i>Luzula sp.</i>	wood rush	Juncaceae	yes	
	<i>Luzula subcongesta</i>	Donner wood-rush	Juncaceae	yes	
	<i>Melica geyeri</i>	Geyer's melic	Poaceae	yes	
	<i>Melica harfordii</i>	Harford's melic	Poaceae	yes	
	<i>Melica sp.</i>	melic	Poaceae	yes	
	<i>Melica subulata</i>	Alaska melic	Poaceae	yes	
	<i>Phalaris arundinacea</i>	reed canary-grass	Poaceae	yes	
	<i>Pleuropogon refractus</i>	nodding semaphore grass	Poaceae	yes	
	<i>Poa annua</i>	annual bluegrass	Poaceae	no	
	<i>Polypogon monspeliensis</i>	rabbitsfoot beardgrass	Poaceae	no	
	<i>Rytidosperma penicillatum</i>	purple-awned wallaby-grass	Poaceae	no	
	<i>Scirpus microcarpus</i>	small-fruited bulrush	Cyperaceae	yes	
	<i>Stipa lemmonii</i>	Lemmon's needle-grass	Poaceae	yes	
	<i>Trisetum cernuum</i>	nodding trisetum	Poaceae	yes	
	<i>Trisetum sp.</i>	trisetum	Poaceae	yes	
Fern and Fern Ally (15)	<i>Adiantum aleuticum</i>	western maiden hair fern	Pteridaceae	yes	x
	<i>Aspidotis densa</i>	serpentine lace-fern	Pteridaceae	yes	
	<i>Athyrium filix-femina</i>	lady fern	Dryopteridaceae	yes	

	Scientific Name	Common Name	Family	Native	cultural significance
	<i>Blechnum spicant</i>	deer fern	Blechnaceae	yes	
	<i>Dryopteris expansa</i>	spreading wood fern	Dryopteridaceae	yes	x
	<i>Dryopteris sp.</i>	wood fern	Dryopteridaceae	yes	
	<i>Equisetum telmateia ssp. braunii</i>	giant horsetail	Equisetaceae	yes	x
	<i>Pentagramma triangularis ssp. triangularis</i>	gold back fern	Pteridaceae	yes	
	<i>Polypodium glycyrrhiza</i>	sweet-licorice fern	Polypodiaceae	yes	
	<i>Polypodium scoleri</i>	leather-leaved polypody	Polypodiaceae	yes	
	<i>Polystichum munitum</i>	sword fern	Dryopteridaceae	yes	x
	<i>Pteridium aquilinum var. pubescens</i>	bracken fern	Dennstaedtiaceae	yes	x
	<i>Selaginella oregana</i>	Oregon spikemoss	Lycopodiaceae	yes	
	<i>Selaginella wallacei</i>	Wallace's spikemoss	Lycopodiaceae	yes	
	<i>Woodwardia fimbriata</i>	western chain fern	Blechnaceae	yes	x
Bryophyte (10)	<i>Campylopus introflexus</i>	moss	Dicranaceae	no	
	<i>Dicranum sp.</i>		Dicranaceae	yes	
	<i>Discelium nudum</i>	Discelium moss	Disceiaceae	yes	
	<i>Fissidens crispus</i>		Fissidentaceae	yes	
	<i>Frullania sp.</i>			yes	
	<i>Homalothecium sp.</i>		Brachytheciaceae	yes	
	<i>Hookeria lucens</i>			yes	
	<i>Isothecium sp.</i>	icicle moss	Lembophyllaceae	yes	
	<i>Kindbergia sp.</i>	kindbergia	Brachytheciaceae	yes	
	<i>Leucolepis acanthoneura</i>	leucolepis	Mniaceae	yes	
	<i>Polytrichum sp.</i>	polytrichum	Polytrichaceae	yes	
Lichen (7)					
	<i>Cladonia sp.</i>	cladonia		yes	
	<i>Leptogium palmatum</i>	lichen	Lichen	yes	
	<i>Lobaria sp.</i>	lichen	Lichen	yes	
	<i>Peltigera sp.</i>			yes	
	<i>Sphaerophorus sp.</i>		Lichen	yes	
	<i>Usnea longissima</i>	Methusela's beard	Lichen	yes	
	<i>Usnea rubicunda</i>	usnea		yes	

Appendix B Sensitive plant species occurring in the assessment area around Del Norte Coast Redwood SP

List compiled from a 9-quad search of the CNPS Rare Plant Inventory and the CNDDDB RareFind 5 databases for special status plants USGS quadrangles searched include: Childs Hill, Hiouchi, Sister Rocks, Requa, Gasquet, Cant Hook Mountain, High Divide, Klamath Glen, Crescent City and High Divide. CNPS, Rare Plant Program. 2018. Inventory of Rare and Endangered Plants (online edition, v8-02). California Native Plant Society, Sacramento, CA. Website <http://www.rareplants.cnps.org> [accessed 23 March 2018].

Elevation is above 0 or below 3500 feet

known to occur in the park

Scientific Name	Common Name	Ecological Information	Rare Plant Rank	CESA	FESA	Comments
<i>Angelica lucida</i>	sea-watch	Coastal Prairie, Coastal Strand, wetland-riparian	4.2	None	None	Potential to occur
<i>Antennaria suffrutescens</i>	evergreen everlasting	Lower montane coniferous forest (serpentinite); elev. 500-1,600m; blooms Jan.-Jul	4.3	None	None	Occurs in serpentine regions near the Park, moderate to high quality habitat present
<i>Anthoxanthum nitens</i> ssp. <i>nitens</i>	vanilla-grass	Meadow & seep Wetland	2B.3	None	None	Potential to occur
<i>Arabis mcdonaldiana</i>	Mcdonald's rockcress	Lower montane coniferous forest, Upper montane coniferous forest; Rocky outcrops, ridges, slopes, and flats on serpentine; elev. 135-1,800m; blooms May-Jul.	1B.1	CE	FE	Potential to occur
<i>Arctostaphylos hispidula</i>	Howell's manzanita	Chaparral (serpentinite or sandstone)	4.2	None	None	known to occur in the park
<i>Arctostaphylos nortensis</i>	Del Norte manzanita	Chaparral, Lower montane coniferous forest, often serpentinite, above 500m elev.	4.3	None	None	known to occur in the park
<i>Arnica cernua</i>	serpentine arnica	Serpentine Endemic, Lower montane coniferous forest; elev. 500-1,920m; blooms Apr.-Jul.	4.3	None	None	known to occur in the park
<i>Arnica spathulata</i>	Klamath arnica	Serpentine Endemic, Lower montane coniferous forest; elev. 640-1,800m; blooms May-Aug.	4.3	None	None	known to occur in the park
<i>Asplenium trichomanes</i> ssp. <i>trichomanes</i>	maidenhair spleenwort	Lower montane coniferous forest (rocky); elev. 185-200m; blooms May-Jul.	2B.3	None	None	Potential to occur

Scientific Name	Common Name	Ecological Information	Rare Plant Rank	CESA	FESA	Comments
<i>Boechera koehleri</i>	Koehler's stipitate rockcress	Serpentine Endemic, Chaparral, Lower montane coniferous forest, rocky; elev. 155-1,660m; blooms Mar.-Jul.	1B.3	None	None	known from serpentine habitats further away, to the east and northeast of the Park; lower potential to occur
<i>Bryoria pseudocapillaris</i>	false gray horsehair lichen	Coastal dunes (SLO Co.), North Coast coniferous forest (immediate coast), Usually on conifers	3.2	None	None	No potential to occur; habitat not present in DPCRSP
<i>Bryoria spiralifera</i>	twisted horsehair lichen	North Coast coniferous forest (immediate coast), Usually on conifers	1B.1	None	None	No potential to occur; habitat not present in DPCRSP
<i>Calamagrostis crassiglumis</i>	Thurber's reed grass	Northern Coastal Scrub, Freshwater Wetlands	2B.1	None	None	Potential to occur
<i>Calamagrostis foliosa</i>	leafy reed grass	Coastal bluff scrub, North Coast coniferous forest; elev. 0-1,220m; blooms May-Sep.	4.2	CR	None	Potential to occur
<i>Calicium adpersum</i>	spiral-spored guilded-head pin lichen	Restricted to aged bark of conifers, typically old-growth trees over 200 years of age; above 200 m elev.	2B.2	None	None	Potential to occur
<i>Calystegia atriplicifolia</i> ssp. <i>buttensis</i>	Butte County morning-glory	Chaparral, Lower montane coniferous forest, Valley and foothill grassland, rocky, sometimes roadside; above 500m elev.	4.2	None	None	Occurs in serpentine regions near the Park, moderate to high quality habitat present
<i>Cardamine angulata</i>	seaside bittercress	Lower montane coniferous forest, North Coast coniferous forest, Wet areas, streambanks	2B.1	None	None	known to occur in the park
<i>Cardamine nuttallii</i> var. <i>gemmata</i>	yellow-tubered toothwort	Lower montane coniferous forest, North Coast coniferous forest, serpentinite	3.3	None	None	Potential to occur
<i>Carex arcta</i>	northern clustered sedge	Bogs and fens, North Coast coniferous forest (mesic)	2B.2	None	None	Potential to occur
<i>Carex lenticularis</i> var. <i>limnophila</i>	lagoon sedge	Shores, beaches; often gravelly. Bogs and fens, Marshes and swamps, North Coast coniferous forest; 0-6 m	2B.2	None	None	No potential to occur; habitat not present in DPCRSP
<i>Carex leptalea</i>	bristle-stalked sedge	Bogs and fens, meadows and seeps (mesic), marshes and swamps; elev. 0-700m; blooms Mar-Jul.	2B.2	None	None	Potential to occur
<i>Carex lyngbyei</i>	Lyngbye's sedge	coastal, salt-marsh	2B.2	None	None	Unlikely to occur
<i>Carex praticola</i>	northern meadow sedge	Meadows and seeps (mesic); elev. 0-3200m; blooms May-Jul.	2B.2	None	None	Potential to occur

Scientific Name	Common Name	Ecological Information	Rare Plant Rank	CESA	FESA	Comments
<i>Carex scabriuscula</i>	Siskiyou sedge	Lower montane coniferous forest, Meadows and seeps, Upper montane coniferous forest, mesic, sometimes serpentinite seeps; elev. 710-2,345m; bloom May-Jul.	4.3	None	None	Occurs in serpentine regions near the Park, moderate to high quality habitat present
<i>Carex serpenticola</i>	serpentine sedge	Meadow & seep, mesic, serpentinite; elev. 60-1,200m; blooms Mar.-May.	2B.3	None	None	known to occur in the park
<i>Carex viridula</i> ssp. <i>viridula</i>	green yellow sedge	Bogs and fens, Marshes and swamps(freshwater), North Coast coniferous forest (mesic); elev. 0-1,600m; blooms (Jun) Jul-Sep (Nov).	2B.3	None	None	Potential to occur
<i>Cascadia nuttallii</i>	Nuttall's saxifrage	North Coast coniferous forest (mesic, rocky); elev. 40-75m; blooms May.	2B.1	None	None	Potential to occur
<i>Castilleja affinis</i> ssp. <i>litoralis</i>	Oregon coast paintbrush	Coastal Strand, Northern Coastal Scrub	2B.2	None	None	known to occur in the park
<i>Castilleja brevilobata</i>	short-lobed paintbrush	Serpentine Endemic, Lower montane coniferous forest (edges and openings); elev. 120-1,700m; blooms Apr.-Jul.	4.2	None	None	known to occur in the park
<i>Castilleja elata</i>	Siskiyou paintbrush	Bog & fen, Lower montane coniferous forest (seeps); elev. 0-1,750m; blooms May-Aug.	2B.2	None	None	Potential to occur
<i>Chrysosplenium glechomifolium</i>	Pacific golden saxifrage	Redwood Forest, wetland-riparian	4.3	None	None	Potential to occur
<i>Coptis laciniata</i>	Oregon goldthread	Meadows and seeps, North Coast coniferous forest (streambanks)/ Mesic; elev. 0-1,000m; blooms Mar-Apr.	4.2	None	None	Potential to occur
<i>Cypripedium californicum</i>	California lady's-slipper	Serpentine Endemic, Bogs and fens, Lower montane coniferous forest, seeps and streambanks; blooms Apr.-Sept.	4.2	None	None	known to occur in the park
<i>Cypripedium montanum</i>	mountain lady's-slipper	Broadleafed upland forest, Cismontane woodland, Lower montane coniferous forest, North Coast coniferous forest; elev. 185-2,225m; blooms Mar.-Aug.	4.2	None	None	Potential to occur
<i>Darlingtonia californica</i>	California pitcherplant	Bogs and fens, Meadows and seeps, mesic, generally serpentinite seeps; elev. 0-2,585m; blooms Apr.-Jul.	4.2	None	None	known to occur in the park

Scientific Name	Common Name	Ecological Information	Rare Plant Rank	CESA	FESA	Comments
<i>Dicentra formosa</i> ssp. <i>oregana</i>	Oregon bleeding heart	Lower montane coniferous forest (serpentinite); elev. 425-1,485m; blooms Apr.-May.	4.2	None	None	Occurs in serpentine regions near the Park, moderate to high quality habitat present
<i>Discelium nudum</i>	Discelium moss	seaward facing bluffs of eroded clay usually within sight of the ocean	2B.2			known to occur in the park (NPS record)
<i>Erigeron bloomeri</i> var. <i>nudatus</i>	Waldo daisy	Lower montane and upper montane coniferous forest, serpentinite; elev. 600-2300m;	2B.3	None	None	Potential to occur
<i>Erigeron cervinus</i>	Siskiyou daisy	Lower montane coniferous forest (serpentinite); elev. 425-1,485m; blooms Apr.-May.	4.3	None	None	Occurs in serpentine regions near the Park, moderate to high quality habitat present
<i>Eriogonum pendulum</i>	Waldo wild buckwheat	Lower montane coniferous forest, Upper montane coniferous forest, serpentinite; elev. 230-1,000m; blooms Aug.-Sept.	2B.2	None	None	Potential to occur
<i>Erythronium hendersonii</i>	Henderson's fawn lily	Lower montane coniferous forest; elev. 300-1,600m; blooms Apr.-Jul.	2B.3	None	None	Potential to occur
<i>Erythronium howellii</i>	Howell's fawn lily	Lower montane coniferous forest, North Coast coniferous forest, sometimes serpentinite; elev. 200-1,145m; blooms Apr-May.	1B.3	None	None	Potential to occur
<i>Erythronium oregonum</i>	giant fawn lily	Cismontane woodland, meadows and seeps, sometimes rocky serpentinite openings; elev. 100-1,150m; blooms Mar-Jun (Jul).	2B.2	None	None	Occurs in serpentine regions near the Park, high quality habitat present
<i>Erythronium revolutum</i>	coast fawn lily	Bogs and fens, Broadleaved upland forest, North Coast coniferous forest/mesic, streambanks; elev. 0-1,600m; blooms Mar-Jul (Aug).	2B.2	None	None	known to occur in the park
<i>Fissidens pauperculus</i>	minute pocket moss	North Coast coniferous forest (damp coastal soil); elev. 10-1,024m.	1B.2	None	None	Potential to occur
<i>Gentiana setigera</i>	Mendocino gentian	Lower montane coniferous forest, Meadow & seep, mesic, serpentinite; elev. 490-1,065m; blooms Aug.-Sept.	1B.2	None	None	Potential to occur
<i>Gilia capitata</i> ssp. <i>pacifica</i>	Pacific gilia	Coastal bluff scrub, Chaparral (openings), Coastal prairie, Valley and foothill grassland; elev. 5-1,330m; blooms Apr.-Aug.	1B.2	None	None	No potential to occur; habitat not present in DNCRSP

Scientific Name	Common Name	Ecological Information	Rare Plant Rank	CESA	FESA	Comments
<i>Gilia millefoliata</i>	dark-eyed gilia	Coastal dunes, 2-30 m	1B.2	None	None	No potential to occur; habitat not present in DNCRSP
<i>Glehnia littoralis</i> ssp. <i>leiocarpa</i>	American glehnia	Coastal dunes, 2-30 m	4.2	None	None	No potential to occur; habitat not present in DNCRSP
<i>Horkelia sericata</i>	Howell's horkelia	Serpentine Endemic, Chaparral, Lower montane coniferous forest, clay; elev. 60-1,200m; blooms May-Jul.	4.3	None	None	known to occur in the park
<i>Hosackia gracilis</i>	harlequin lotus	Broadleafed upland forest, Coastal bluff scrub, Closed-cone coniferous forest, Cismontane woodland, Coastal prairie, Coastal scrub, Meadows and seeps, Marshes and swamps, North Coast coniferous forest, Valley and foothill grassland, wetlands, roadsides; elev. 0-700m; blooms Mar.-Jul.	4.2	None	None	Potential to occur
<i>Iris bracteata</i>	Siskiyou iris	Broadleafed upland forest, Lower montane coniferous forest, serpentinite; elev. 180-1,070m; blooms May-Jun	3.3	None	None	Occurs in serpentine regions near the Park, moderate to high quality habitat present
<i>Iris innominata</i>	Del Norte County iris	Lower montane coniferous forest (serpentinite); elev. 300-2,000m; blooms May-Jun.	4.3	None	None	Potential to occur
<i>Iris tenax</i> ssp. <i>klamathensis</i>	Orleans iris	Lower montane coniferous forest (often in disturbed areas); elev. 100-1,400m; blooms Apr.-May	4.3	None	None	Potential to occur
<i>Kopsiopsis hookeri</i>	small groundcone	North Coast coniferous forest, open woodland, mixed conifer forest, generally on <i>Gaultheria shallon</i> , occasionally on <i>Arbutus menziesii</i> , <i>Arctostaphylos uva-ursi</i> ; elev. 90-885m; blooms Apr-Aug.	2B.3	None	None	known to occur in the park
<i>Lathyrus delnorticus</i>	Del Norte pea	Lower montane coniferous forest, North Coast coniferous forest, often serpentinite; elev. 30-1,450m; blooms Jun.-Jul.	4.3	None	None	known to occur in the park
<i>Lathyrus palustris</i>	marsh pea	Bogs and fens, Coastal prairie, Coastal scrub, Lower montane coniferous forest, Marshes and swamps, North Coast coniferous forest/mesic; elev. 1-100m; blooms Mar-Aug.	2B.2	None	None	Potential to occur

Scientific Name	Common Name	Ecological Information	Rare Plant Rank	CESA	FESA	Comments
<i>Lewisia oppositifolia</i>	opposite-leaved lewisia	Bogs and fens, Coastal prairie, Coastal scrub, Lower montane coniferous forest, Marshes and swamps, North Coast coniferous forest/mesic; elev. 1-100m; blooms Mar-Aug	2B.2	None	None	Potential to occur
<i>Lilium bolanderi</i>	Bolander's lily	Chaparral, Lower montane coniferous forest, serpentinite; elev. 30-1,600m; blooms Jun.-Jul.	4.2	None	None	known to occur in the park
<i>Lilium kelloggii</i>	Kellogg's lily	Lower montane coniferous forest, North Coast coniferous forest, openings and roadsides; elev. 3-1,300m; blooms May-Aug.	4.3	None	None	Potential to occur
<i>Lilium occidentale</i>	western lily	Bogs and fens, Coastal bluff scrub, Coastal prairie, Coastal scrub, Marshes and swamps (freshwater), North Coast coniferous forest (openings); elev. 2-185m; blooms Jun-Jul.	1B.1	CE	FE	Potential to occur
<i>Lilium pardalinum</i> ssp. <i>vollmeri</i>	Vollmer's lily	Bogs and fens, Meadows and seeps (mesic); elev. 30-1,680m; blooms Jul.-Aug.	4.3	None	None	known to occur in the park
<i>Listera cordata</i>	heart-leaved twayblade	Bogs and fens, lower montane coniferous forest, North Coast coniferous forest; elev. 5-1,370m; blooms Feb-Jul.	4.2	None	None	known to occur in the park
<i>Lomatium howellii</i>	Howell's lomatium	Chaparral, Lower montane coniferous forest, serpentinite; elev. 110-1,705m; blooms Apr.-Jul.	4.3	None	None	known to occur in the park
<i>Lomatium martindalei</i>	Coast Range lomatium	Coastal bluff scrub, Lower montane coniferous forest, Meadow & seep, serpeninite; elev. 240-3,000m; blooms May-Aug.	2B.3	None	None	Potential to occur
<i>Lycopodium clavatum</i>	running-pine	Marshes and swamps, mesic North Coast coniferous forest, lower montane coniferous forests, shady and semi-exposed forest floors, swamps, rarely on trees, forming dense mats; elev. 45-1,225m; produces spores Jun-Aug(Sep)	4.1	None	None	Potential to occur
<i>Lysimachia europaea</i>	arctic starflower	Bog & fen Meadow & seep Wetland, Coastal boggy areas. 0-15 m.	2B.2	None	None	Potential to occur
<i>Micranthes marshallii</i>	Marshall's saxifrage	Mixed Evergreen Forest, Yellow Pine Forest, Subalpine Forest, wetland-riparian	4.3	None	None	Potential to occur
<i>Minuartia howellii</i>	Howell's sandwort	Serpentine endemic; Chaparral, Lower montane coniferous forest, xeric; elev. 550-1000m; blooms Apr.-Jul.	1B.3	None	None	known to occur in the park

Scientific Name	Common Name	Ecological Information	Rare Plant Rank	CESA	FESA	Comments
<i>Mitellastrum caulescens</i>	leafy-stemmed mitrewort	Broadleaved upland forest, lower montane coniferous forest, meadows and seeps, North Coast coniferous forest, mesic habitats, sometimes roadsides; elev. 5-1,700m; blooms Apr-Oct.	4.2	None	None	known to occur in the park
<i>Moneses uniflora</i>	woodnymph	Broadleaved upland forest, North Coast coniferous forest, undisturbed Sitka spruce forest; elev. 100-1,065m; blooms May-Jul.	2B.2	None	None	Potential to occur
<i>Monotropa uniflora</i>	ghost-pipe	Broadleaved upland forest and north coast coniferous forest, shaded damp woods in mixed evergreen forest and redwood forest, in rich humus; elev. 10-550m; blooms Jun-Aug. (Sept).	2B.2	None	None	known to occur in the park
<i>Oenothera wolfii</i>	Wolf's evening-primrose	Coastal bluff scrub, Coastal scrub, Coastal prairie, Lower montane coniferous forest/sandy, usually mesic sites; 3-800m, also inland below 100m; blooms May-Oct	1B.1	None	None	known to occur in the park
<i>Oxalis suksdorfii</i>	Suksdorf's wood-sorrel	Broadleaved upland forest, North Coast coniferous forest; elev. 15-700m; blooms May-Aug.	4.3	None	None	known to occur in the park
<i>Packera bolanderi</i> var. <i>bolanderi</i>	seacoast ragwort	Coastal scrub, North Coast coniferous forest/Sometimes roadsides; elev. 30-650m; wet cliffs, open forest, >200m; blooms Jan.-Aug.	2B.2	None	None	known to occur in the park
<i>Packera hesperia</i>	western ragwort	Serpentine Endemic, Meadow & seep Upper montane coniferous forest, 620-700 m elev.	2B.2	None	None	known from serpentine habitats further away, to the east and northeast of the Park; lower potential to occur
<i>Packera macounii</i>	Siskiyou Mountains ragwort	Chaparral, Lower montane coniferous forest, sometimes serpentinite, often in disturbed areas; elev. 400-915m; blooms Jun.-Jul.	4.3	None	None	known to occur in the park
<i>Perideridia gairdneri</i> ssp. <i>gairdneri</i>	Gairdner's yampah	Broadleaved upland forest, Chaparral, Coastal prairie, Valley and foothill grassland, Vernal pools, vernal mesic; elev. 0-610m; blooms Jun.-Oct.	4.2	None	None	Potential to occur
<i>Pinguicula macroceras</i>	horned butterwort	Serpentine Endemic, Bog & fen, Meadow & seep; elev. 40-1,920m; blooms Apr.-Jun.	2B.2	None	None	known to occur in the park
<i>Piperia candida</i>	white-flowered rein orchid	Broadleaved upland forest, Lower montane coniferous forest, North Coast coniferous forest	1B.2	None	None	known to occur in the park

Scientific Name	Common Name	Ecological Information	Rare Plant Rank	CESA	FESA	Comments
<i>Pityopus californicus</i>	California pinefoot	Broadleafed upland forest, Lower montane coniferous forest, North Coast coniferous forest, Upper montane coniferous forest	4.2	None	None	known to occur in the park
<i>Pleuropogon refractus</i>	nodding semaphore grass	Lower montane coniferous forest, Meadows and seeps, North Coast coniferous forest, Riparian forest	4.2	None	None	known to occur in the park
<i>Poa rhizomata</i>	timber blue grass	Lower montane coniferous forest (often serpentinite); elev. 150-1,000m; blooms Apr.-May	4.3	None	None	Potential to occur
<i>Polemonium carneum</i>	Oregon polemonium	Coastal prairie, coastal scrub, lower montane coniferous forest; elev. 0-1,830m; blooms Apr-Sep.	2B.2	None	None	Potential to occur
<i>Potamogeton foliosus</i> ssp. <i>fibrillosus</i>	fibrous pondweed	Shallow water, small streams. 5-1300 m.	2B.3	None	None	Potential to occur
<i>Prosartes parvifolia</i>	Siskiyou bells	Lower montane coniferous forest, Upper montane coniferous forest, often roadsides, disturbed areas, and burned areas; elev. 700-1,525m; blooms May-Sept.		None	None	Potential to occur
<i>Pyrrocoma racemosa</i> var. <i>congesta</i>	Del Norte pyrrocoma	Serpentine endemic; Chaparral, Lower montane coniferous forest; elev. 200-1,000m; blooms Aug.-Sept.	2B.3	None	None	Occurs in serpentine regions near the Park, moderate to high quality habitat present
<i>Ramalina thrausta</i>	angel's hair lichen	North Coast coniferous forest	2B.1	None	None	Potential to occur
<i>Ribes laxiflorum</i>	trailing black currant	North Coast coniferous forest; sometimes roadsides; elev. 5-1,395m; blooms Mar-Aug.	4.3	None	None	known to occur in the park
<i>Rosa gymnocarpa</i> var. <i>serpentina</i>	Gasquet rose	Chaparral, Cismontane woodland, Serpentine. Often roadsides, sometimes ridges, streambanks, and openings.	1B.3	None	None	Potential to occur
<i>Sabulina howellii</i>	Howell's sandwort	Chaparral, Lower montane coniferous forest, serpentinite, xeric	1B.3	None	None	Potential to occur
<i>Sagittaria sanfordii</i>	Sanford's arrowhead	Marsh & swamp Wetland, In standing or slow-moving freshwater ponds, marshes, and ditches. 0-605 m.	1B.2	None	None	Potential to occur
<i>Salix delnortensis</i>	Del Norte willow	Serpentine Endemic; Riparian forest	4.3	None	None	known to occur in the park

Scientific Name	Common Name	Ecological Information	Rare Plant Rank	CESA	FESA	Comments
<i>Sanguisorba officinalis</i>	great burnet	Bogs and fens, Broadleaved upland forest, Meadows and seeps, Marshes and swamps, North Coast coniferous forest, Riparian forest, often serpentinite	2B.2	None	None	Potential to occur
<i>Sanicula peckiana</i>	Peck's sanicle	Chaparral, Lower montane coniferous forest, often serpentinite	4.3	None	None	known to occur in the park
<i>Sedum citrinum</i>	Blue Creek stonecrop	North Coast coniferous forest, Serpentine; rocky, talus, scree, or boulder crevices; sometimes roadsides	1B.2	None	None	known to occur in the park
<i>Sidalcea elegans</i>	Del Norte checkerbloom	Chaparral, Lower montane coniferous forest, Serpentine	3.3	None	None	Occurs in serpentine regions near the Park, moderate to high quality habitat present
<i>Sidalcea malachroides</i>	maple-leaved checkerbloom	Woodlands and clearings near coast; often in disturbed areas. 0-730 m.	4.2	None	None	known to occur in the park
<i>Sidalcea malviflora</i> ssp. <i>patula</i>	Siskiyou checkerbloom	Open coastal forest; roadcuts. 5-1255 m.	1B.2	None	None	Potential to occur
<i>Sidalcea oregana</i> ssp. <i>eximia</i>	coast checkerbloom	Near meadows, in gravelly soil. 5-1805 m.	1B.2	None	None	Potential to occur
<i>Silene serpentinicola</i>	serpentine catchfly	Chaparral Lower montane coniferous forest Serpentine openings, gravelly or rocky soils. 120-765 m.	1B.2	None	None	known to occur in the park
<i>Streptanthus howellii</i>	Howell's jewelflower	Lower montane coniferous forest (serpentine, rocky); elev. 305-1,500m; blooms Jul.-Aug	1B.2	None	None	Potential to occur
<i>Tauschia glauca</i>	glaucous tauschia	Lower montane coniferous forest (gravelly, serpentinite); elev. 80-1,700m; blooms Apr.-Jun.	4.3	None	None	known to occur in the park
<i>Usnea longissima</i>	Methuselah's beard lichen	Oldgrowth Grows in the "redwood zone" on tree branches of a variety of trees, including big leaf maple, oaks, ash, Douglas-fir, and bay. 45-1465 m in California.	4.2	None	None	known to occur in the park
<i>Vancouveria chrysantha</i>	Siskiyou inside-out-flower	Chaparral, Lower montane coniferous forest, serpentinite; elev. 120-1,500m; blooms Jun.	4.3	None	None	Occurs in serpentine regions near the Park, moderate to high quality habitat present
<i>Veratrum insolitum</i>	Siskiyou false-hellebore	Chaparral, Lower montane coniferous forest, clay; elev. 45-1,635m; blooms Jun.-Aug.	4.3	None	None	Occurs in serpentine regions near the Park, moderate to high quality habitat present

Scientific Name	Common Name	Ecological Information	Rare Plant Rank	CESA	FESA	Comments
<i>Viola langsdorfii</i>	Langsdorf's violet	Bogs and fens (coastal); 2-10 m	2B.1	None	None	No potential to occur; habitat not present in DNCRSP
<i>Viola primulifolia</i> ssp. <i>occidentalis</i>	western white bog violet	Bog & fen Marsh & swamp Wetland, Streamside flats and bogs; serpentine soils. 120-855 m.	1B.2	None	None	No potential to occur; habitat not present in DNCRSP

CNPS Rarity Codes

1A. Plants Presumed Extirpated in California and Either Rare or Extinct Elsewhere

1B. Plants Rare, Threatened, or Endangered in California and Elsewhere.

2A. Plants Presumed Extirpated in California, But More Common Elsewhere

2B. Plants Rare, Threatened, or Endangered in California, But More Common Elsewhere

3. Plants About Which More Information is Needed – A Review List

4. Plants of limited distribution – a watch list.

CNPS Threat rank

1 – Seriously threatened in CA (high degree/immediacy of threat).

2 – Moderately threatened in CA (moderate degree/immediacy of threat).

3 – Not very threatened in CA (low degree/immediacy of threat).

Natural communities (alliances, associations) occurring within DNCRSP

 = currently designated as S3 or rarer

Alliance	CDFW Global and State Ranks	Associations	Common, Exotic, and Sensitive Plant Species Observed in the Project Area
<i>Alnus rubra</i> (Red alder forest) Alliance	G5S4	* <i>Alnus rubra</i> / <i>Rubus spectabilis</i> – <i>Sambucus racemosa</i>	<i>Alnus rubra</i> , <i>Rubus spectabilis</i> , <i>Sambucus racemosa</i> , <i>Salix</i> spp., <i>Boykinia occidentalis</i> , <i>Tolmiea diplomenziesii</i> , <i>Mitellastra caulescens</i> , <i>Pleuropogon refractus</i> , <i>Lysichiton americanus</i> , <i>Carex obnupta</i>
<i>Chamaecyparis lawsoniana</i> (Port Orford cedar forest) Alliance	G3S3		<i>Chamaecyparis lawsoniana</i> , <i>Pinus attenuata</i> , <i>Pseudotsuga menziesii</i>
<i>Notholithocarpus densiflorus</i> (Tanoak forest) Alliance	G4S3	* <i>Notholithocarpus densiflorus</i> – <i>Umbellularia californica</i>	<i>Notholithocarpus densiflorus</i> , <i>Pinus attenuata</i> , <i>Pseudotsuga menziesii</i> , <i>Umbellularia californica</i>
<i>Picea sitchensis</i> (Sitka spruce forest) Alliance	G5S2	* <i>Picea sitchensis</i> – <i>Tsuga heterophylla</i> ; * <i>Picea sitchensis</i> / <i>Polystichum munitum</i>	<i>Picea sitchensis</i> , <i>Polystichum munitum</i> , <i>Sambucus racemosa</i> var. <i>racemosa</i> , <i>Rubus spectabilis</i> , <i>Tsuga heterophylla</i> , <i>Alnus rubra</i> , <i>Pseudotsuga menziesii</i> , <i>Cotonoeaster</i> sp.
<i>Pinus attenuata</i> (Knobcone pine forest) Alliance	G4S4	<i>Pinus attenuata</i> / <i>Arctostaphylos columbiana</i> ; <i>Pinus attenuata</i> / <i>Quercus vacciniifolia</i>	<i>Pinus attenuata</i> , <i>Festuca idahoensis</i> , <i>Carex concinoides</i> , <i>Quercus vacciniifolia</i> , <i>Arctostaphylos columbiana</i> , <i>Arctostaphylos nortensis</i> , <i>Juniperus communis</i>
<i>Pinus jeffreyi</i> (Jeffrey pine forest) Alliance	G4S4	<i>Pinus jeffreyi</i> / <i>Quercus vacciniifolia</i> – <i>Arctostaphylos nevadensis</i> / <i>Festuca idahoensis</i>	<i>Pinus jeffreyi</i> , <i>Festuca idahoensis</i> , <i>Arctostaphylos nevadensis</i> , <i>Quercus vacciniifolia</i> , <i>Pinguicula macroceras</i>
<i>Pseudotsuga menziesii</i> (Douglas fir forest) Alliance	G5S4	<i>Pseudotsuga menziesii</i> – <i>Chrysolepis chrysophylla</i> – <i>Notholithocarpus densiflorus</i>	<i>Pseudotsuga menziesii</i> , <i>Sequoia sempervirens</i> , <i>Notholithocarpus densiflorus</i> , <i>Vaccinium ovatum</i> , <i>Gaultheria shallon</i> , <i>Polystichum munitum</i> , <i>Viola sempervirens</i>

Alliance	CDFW Global and State Ranks	Associations	Common, Exotic, and Sensitive Plant Species Observed in the Project Area
<i>Pseudotsuga menziesii</i> - <i>Notholithocarpus densiflora</i> (Douglas fir - tanoak forest) Alliance	G4S4	<i>Pseudotsuga menziesii</i> – <i>Notholithocarpus densiflorus</i> - (<i>Tsuga heterophylla</i>)/ <i>Vaccinium Ovatum</i>	<i>Pseudotsuga menziesii</i> , <i>Sequoia sempervirens</i> , <i>Notholithocarpus densiflorus</i> , <i>Vaccinium ovatum</i> , <i>Gaultheria shallon</i> , <i>Polystichum munitum</i> , <i>Viola sempervirens</i>
<i>Sequoia sempervirens</i> (Redwood forest) Alliance	G3S3	* <i>Sequoia sempervirens</i> – <i>Pseudotsuga menziesii</i> / <i>Vaccinium ovatum</i> ; * <i>Sequoia sempervirens</i> – <i>Alnus rubra</i> / <i>Rubus spectabilis</i>	<i>Sequoia sempervirens</i> , <i>Pseudotsuga menziesii</i> , <i>Abies grandis</i> , <i>Tsuga heterophylla</i> , <i>Vaccinium ovatum</i> , <i>Polystichum munitum</i>
<i>Baccharis pilularis</i> (Coyote brush scrub) Alliance	G5S5	<i>Baccharis pilularis</i> – <i>Ceanothus thyrsiflorus</i> ; <i>Baccharis pilularis</i> / Annual Grass – Herb	<i>Baccharis pilularis</i> , <i>Cortaderia jubata</i> , <i>Agrostis sp.</i> , <i>Hypochaeris radicata</i> , <i>Arctostaphylos columbiana</i> , <i>Ceanothus thyrsiflorus var. thyrsiflorus</i> , <i>Ceanothus velutinus</i>
<i>Ceanothus thyrsiflorus</i> (Blue blossom chaparral) Alliance	G4S4		
<i>Chrysolepis chrysophylla</i> (Golden chinquapin thickets) Alliance	G2S2		<i>Chrysolepis chrysophylla</i> , <i>Notholithocarpus densiflorus</i> , <i>Pinus attenuata</i> , <i>Pseudotsuga menziesii</i> , <i>Rhododendron occidentale</i> , <i>Lathyrus delnorticus</i>
<i>Notholithocarpus densiflorus</i> var. <i>echinoides</i> (Shrub tanoak chaparral) Alliance	G3S3		<i>Notholithocarpus densiflorus</i> , <i>Pinus attenuata</i> ,
<i>Quercus chrysolepis</i> (Canyon live oak chaparral) Alliance,	G5S5		<i>Quercus chrysolepis</i> , <i>Notholithocarpus densiflorus</i> , <i>Holodiscus discolor</i> , <i>Rhododendron occidentale</i>
<i>Quercus vaccinifolia</i> (Huckleberry oak chap.) Alliance	G4S4	<i>Quercus vaccinifolia</i>	<i>Quercus vaccinifolia</i> , <i>Arctostaphylos columbiana</i> , <i>Arctostaphylos nevadensis</i> , <i>Chrysolepis chrysophylla</i> , <i>Juniperus communis</i>

Alliance	CDFW Global and State Ranks	Associations	Common, Exotic, and Sensitive Plant Species Observed in the Project Area
<i>Rhododendron columbianum</i> (Western Labrador-tea thickets) Alliance	G4S2	Undescribed associations with an herbaceous cover >50%: <i>Rhododendron columbianum</i> / <i>Calamagrostis nutkaensis</i>	<i>Calamagrostis nutkaensis</i> , <i>Alnus viridus</i> var. <i>sinuata</i> , <i>Blechnum spicant</i> , <i>Rhododendron columbianum</i> , <i>Gaultheria shalton</i> , <i>Hypericum anagalloides</i> , <i>Sphagnum</i> spp.
<i>Rubus</i> (<i>parviflorus</i> , <i>spectabilis</i> , <i>ursinus</i>) (Coastal brambles) Alliance	G4S3	* <i>Gaultheria shallon</i> – <i>Rubus spectabiis</i> – <i>Rubus parviflorus</i>	<i>Rubus spectabilis</i> , <i>Picea sitchensis</i> , <i>Alnus rubra</i> , <i>Vaccinium ovatum</i> , <i>Gaultheria shallon</i> , <i>Carex leptopoda</i>
<i>Salix lasiolepis</i> (Arroyo willow thickets) Alliance	G4S4		<i>Salix lasiolepis</i> , <i>Acer macrophyllum</i> , <i>Alnus rubra</i> , <i>Baccharis pilularis</i>
<i>Carex obnupta</i> (Slough sedge swards) Alliance	G4S3 / OBL	* <i>Carex obnupta</i>	<i>Carex obnupta</i> , <i>Alnus rubra</i> , <i>Picea sitchensis</i> , <i>Polystichum munitum</i> , <i>Lysichiton americanus</i> , <i>Rubus</i> sp.
<i>Darlingtonia californica</i> (California pitcher plant fens) Alliance	G4?S3	* <i>Darlingtonia californica</i>	<i>Rhododendron columbianum</i> , <i>Gaultheria shalton</i> , <i>Carex obnupta</i> , <i>Rhododendron occidentale</i> , <i>Alnus viridus</i> var. <i>sinuata</i> , <i>cascara</i> , <i>Port-Orfort-cedar</i>
<i>Festuca idahoensis</i> (Idaho fescue grassland) Alliance	G4S3?	* <i>Festuca idahoensis</i> – <i>Achillea millefolium</i>	<i>Festuca idahoensis</i> , <i>Quercus vaccinifolia</i> , <i>Arctostaphylos nevadensis</i> , <i>Pinus jeffreyi</i> , <i>Juniperus communis</i> , <i>Achillea millefolium</i> , <i>Pinguicula macroceras</i> , <i>Ranunculus occidentalis</i> var. <i>occidentalis</i> ,
<i>Scirpus microcarpus</i> (Small-fruited bulrush marsh) Alliance	G4S2 / OBL	<i>Scirpus microcarpus</i>	<i>Scirpus microcarpus</i> , <i>Juncus bolanderi</i> , <i>Cyperus eragrostis</i> , <i>Triteleia bridgesii</i> ,
<i>Typha</i> (<i>angustifolia</i> , <i>domingensis</i> , <i>latifolia</i>) (Cattail marshes) Alliance	G5S5 / OBL		<i>Typha latifolia</i> , <i>Potentilla anserine</i> ssp. <i>pacifica</i> , <i>Equisetum</i> sp.

Species	Status	Habitat	Comments
REPTILES AND AMPHIBIANS			
Southern torrent Salamander <i>Rhacotriton variegatus</i>	SSC	Springs, seeps, and streams in coastal redwood, Douglas-fir, mixed conifer, montane riparian and montane hardwood-conifer habitats, old growth forest.	Known to occur within DPCRSP & Project Area
Pacific tailed frog <i>Ascaphus truei</i>	SSC	Montane hardwood-conifer, redwood, Douglas-fir and ponderosa pine habitats.	Known to occur within DPCRSP
Northern red-legged frog <i>Rana aurora aurora</i>	SSC	Humid forests, woodlands, grasslands, and streamside in northwestern California	Known to occur within DPCRSP
Foothill yellow-legged frog <i>Rana boylei</i>	SSC	Partly-shaded, shallow streams and riffles with a rocky substrate in a variety of habitats.	Known to occur within DPCRSP and project area
Western pond turtle <i>Emys marmorata</i>	SSC	Streams, rivers, and ponds with sandy substrate.	Habitat limited in DPCRSP due to cold water temperatures.
BIRDS			
Bald eagle <i>Haliaeetus leucocephalus</i>	FT, SE	Nesting and wintering – ocean shores, lake margins and rivers.	Known to occur within DPCRSP
Marbled murrelet <i>Brachyramphus marmoratus</i>	FT, SE	Old-growth redwood dominated forests, up to six miles inland.	Known to occur within DPCRSP
Northern spotted owl <i>Stix occidentalis caurina</i>	FT, ST	Old-growth forest or mixed stands of old-growth and mature trees. Occasionally in younger forests with patched of big trees.	Known to occur within DPCRSP
Yellow warbler <i>(Setophaga petechia)</i>	SSC	Breeds in shrubby thickets and woods, particularly along watercourses and in wetlands.	Potential nesting habitat occurs within DPCRSP but to date only migrants have been detected.
Vaux's swift <i>Chaetura vauxia</i>	SSC	Nesting – Redwood, Douglas-fir and other coniferous forests. Nest in large hollow trees and snags often nests in flocks.	Known to occur within DPCRSP
Black swift <i>Cypseloides niger</i>	SSC	Nests under waterfalls	No nesting habitat in DPCRSP
Purple martin <i>Progne subis</i>	SSC	Nesting – low elevation coniferous forest and woodlands.	Known to occur within DPCRSP
MAMMALS			
Townsend's big-eared bat <i>Corynorhinus townsendii townsendii</i>	SSC	Roosts in the open often in limestone caves, lava tubes, mines, buildings, basal hollows etc.	Known to occur within DPCRSP: uses cavities and

			basal hollows in large diameter trees.
Sonoma tree vole <i>Arborimus pomo</i>	SSC	Mixed evergreen forests with Douglas-fir	Known to occur within DNCRSP
White-footed vole <i>Arborimus albipes</i>	SSC	Mature coastal forests, prefers small, clear streams with dense alder and shrub vegetation.	Potential habitat within DNCRSP
California wolverine <i>Gulo gulo</i>	ST	Variety of habitats in North Coast Mountains.	Low probability of occurrence
Humboldt marten <i>Martes americana humboldtensis</i>	SCE, SSC	Redwood, Douglas-fir, coniferous forest.	Known to occur within DNCRSP
Pacific fisher – West Coast Distinct Population Segment (DPS) <i>Pekania pennanti</i>	SSC	Coniferous forests and deciduous-riparian areas.	Known to occur within DNCRSP
FISH			
Coho salmon <i>Oncorhynchus kisutch</i>	FT, SSC	Coastal waters and anadromous streams.	Known to occur within DNCRSP
Summer-run steelhead trout <i>Oncorhynchus mykiss irideus</i>	SSC	Coastal waters and anadromous streams	Not documented within DNCRSP.
Coast cutthroat trout <i>Oncorhynchus clarkia clarkia</i>	SSC	Coastal streams	Known to occur within DNCRSP
River lamprey <i>Lampetra ayresi</i>	SSC	Coastal waters and anadromous streams	Known to occur within DNCRSP

FE – Federally Endangered, FT – Federally Threatened, FPT – Federally Proposed Threatened; SE – State Endangered, ST – State Threatened, SCE - State Candidate Endangered, SCT – State Candidate Threatened; SSC – California Species of Special Concern

List generated from Rarefind 5 (05/24/18) and District databases. Quads searched on Rarefind; Cant Hook Mtn, Childs Hill, Crescent City, Gasquet, Hiouchi, Hurdygurdy Butte, Klamath Glen, Requa, Ship Mountain, Sister Rocks, and Summit Valley. Species which appeared on Rarefind but for which obviously will not occur in the project area (e.g. tufted puffin, western snowy plover), due to lack of habitat, were omitted.

Appendix E
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Table E1
SPRs and PSRs

Element/Title	Requirement
SPR-AIR-1	Equipment maintenance. All diesel- and gasoline-powered equipment engines would be maintained in good condition, in proper tune (according to manufacturer’s specifications), and in compliance with all state and federal requirements.
PSR-AIR-2	Watering to minimize fugitive dust. Prior to use of roads and/or landings for hauling and yarding activities, sufficient water must be applied to the area to be disturbed to minimize fugitive dust emissions. Exposed areas would not be overwatered such that watering results in runoff. Water would not be sprayed on bridge running surfaces. Water sources and drafting specifications would be identified per permit requirements. Alternatively, unpaved areas subject to hauling and yarding activities could be stabilized through the effective application of gravel or treated with biodegradable dust suppressant. Any dust suppressant product used must be environmentally benign (i.e., non-toxic to plants and shall not negatively impact water quality) and its use shall not be prohibited by CARB, USEPA, or the State Water Resources Control Board.
SPR-AIR-3	Idling restrictions. All motorized heavy equipment would be shut down when not in use. Idling of equipment and haul trucks would be limited to 5 minutes.
PSR-AIR-4	Fugitive dust-related excavation/grading restrictions. Excavation and grading activities on road removal sites would be suspended when fugitive dust from project activities might obscure driver visibility on public roads.
PSR-AIR-5	Naturally Occurring Asbestos (NOA) soil watering. Prior to any ground disturbance in a unit located in serpentinitic soils (soils that contain NOA), or vehicle or equipment travel on roads either constructed through, or rocked with NOA gravel, as identified in the WMP [CDPR 2011a]), the ground would be sufficiently wetted to prevent fugitive dust emissions. Sufficient ground wetting may be accomplished either by transporting water to the project area or by conducting project activities during the wet season when soil moisture conditions are adequate. Exposed areas would not be overwatered such that watering results in runoff. To minimize track-out (i.e., mud from truck tires that is deposited on the dry road surface after leaving the wetted portion of the road): 1) road wetting would stop 500 feet from the end of the NOA portion to allow the mud to track off over the existing dry NOA area; or 2) the last 500 feet of NOA rocked gravel road would be capped with non-NOA-containing gravel so NOA track-out can occur over the capped area and not spread to the uncontaminated portions of road. In addition, all heavy equipment would be rinsed of NOA soil prior to leaving the asbestos containing work area to prevent track-out.
SPR-BIO-1	Pre-implementation special-status plant surveys. Prior to the start of project activities, and when the plants are in a phenological stage conducive to positive identification, a qualified botanist would conduct surveys for special-status plant species and sensitive communities throughout the project area if deemed necessary by a Park plant ecologist. Surveys would be conducted in conformance with the <i>California Department of Fish and Wildlife Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Sensitive Natural Communities</i> (CDFW 2018a).

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Element/Title	Requirement
PSR-BIO-2	Special-status plant buffers and avoidance. Individuals or populations of rare, threatened, endangered plants, or those listed as CNPS Ranks 1 and 2, would be avoided where feasible with an appropriate buffer delineated by high-visibility flagging. Personnel would be instructed to keep project activities out of the flagged areas. The buffer size would be 25 feet unless agreed otherwise with regulatory agencies. If avoidance of special-status plants is not possible, then CDFW would be consulted to determine a mutually agreeable strategy to minimize project impacts.
SPR-BIO-3	Invasive plant and pathogen control. All project activities that could spread invasive non-native plants and pathogens are subject to the Draft NCRD Invasive Species BMPs (within the VMP [CDPR 2019a]) or the <i>Invasive Plant Management Plan for Redwood National Park</i> (NPS 2017), and the Aquatic Invasive Species Management Plan (CDFG 2008).
PSR-BIO-4	Suppressed and intermediate tree management. In all forest restoration units, a minimum of three suppressed trees, intermediate trees, or snags (unless they pose a risk to worker safety), in any combination, would be left per acre.
PSR-BIO-5	Tree retention. Thinning projects would retain all trees that are 30 inches DBH or larger with two exceptions: trees up to 38 inches DBH may be cut 1) to release trees of underrepresented species; and 2) in stands where the average tree diameter is 28 inches (or greater) DBH. In both cases, the largest trees (80th percentile) would be retained.
PSR-BIO-6	Timing restrictions and surveys for nesting migratory birds. In general, project activities that modify or disturb vegetation would not occur during the peak nesting season (May 1 to June 30) to avoid nesting migratory birds. If modification or disturbance to vegetation is deemed necessary at any time during the typical bird breeding period (May 1 to July 31), an RNSP biologist would conduct weekly breeding bird surveys within the area of potential disturbance. If occupied nests are detected, work would either be suspended until the birds have fledged, or a spatial buffer would be applied to protect the nest. The size of the spatial buffer would be determined by the RNSP biologist based on the species found and the nest site specifics.
PSR-BIO-7	Special-status bird surveys and restrictions. All special-status bird survey requirements, habitat modification, and normal operating season restrictions for all project activities would be implemented in conformance with all minimization measures and requirements identified in the Biological Opinion issued by USFWS in compliance with ESA Section 7 requirements or CESA documents issued by the California Department of Fish and Wildlife. Special-status birds includes those that are state and federally listed as threatened or endangered and state-listed species of special concern.
PSR-BIO-8	Raptor breeding temporal and spatial buffers. Prior to the start of project-related work occurring from May 1 through July 31, the on-site inspector/monitor would be responsible for implementing raptor temporal and spatial buffers around observed nests. No project activities would occur within temporal and spatial buffer zones. Temporal buffers are temporary buffers established around nest sites that restrict operations during the species critical nesting period. Spatial buffers are permanent habitat retention buffers established around a species nest site. Until the nest site is determined to be no longer active (normally after 3 years of no use), habitat modification is not allowed within the spatial buffer.

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Element/Title	Requirement
PSR-BIO-9	<p>Large wood placement restrictions. Cable and rebar would not be used to anchor large wood in streams. Large wood is expected to be dynamic in the channel and may break loose and deposit naturally at downstream sites. However, no large wood would be placed within 300 feet upstream of bridges without being reviewed and approved by a California-licensed professional engineer. If mobile large wood accumulates within 300 feet upstream of a bridge and is deemed a potential threat to the bridge, a California-licensed professional engineer would evaluate the debris and make recommendations for stabilization or removal.</p>
PSR-BIO-10	<p>Large wood retention requirements. Any large wood encountered during excavation of stream crossing would be retained primarily on site as mulch or used in channel to provide habitat.</p>
SPR-BIO-11	<p>Tree protection. Equipment operators conducting work would be required to avoid striking residual old growth trees or trees identified by park staff.</p>
PSR-BIO-12	<p>Fish and amphibian management. All fish and amphibian survey requirements, habitat modification, and operational restrictions for all project activities would be implemented in conformance with all minimization measures and requirements identified in the Biological Opinion issued by NMFS in compliance with ESA Section 7 requirements and CDFW CESA requirements.</p>
PSR-BIO-13	<p>Mulching exposed soils. All areas of exposed soils resulting from instream large wood placement shall be mulched with native fuel cover, or in pasture or grass-dominated areas, seeded with native seed mixes to minimize the delivery of sediment into the adjacent stream.</p>
PSR-BIO-14	<p>Foothill yellow-legged frog surveys. Surveys for foothill yellow legged frogs shall be conducted within 5 days of any operations being conducted in streams that exhibit surface flow. The surveys shall extend a distance of 100 feet upstream and downstream of the project site. CDFW would be notified if any frogs are observed within the survey reach. Appropriate actions shall be taken to avoid or minimize take of these species under the direction of CDFW. These actions include, but shall not be limited to, installation of exclusion fencing, removal and relocation, and daily pre-implementation surveys to ensure frogs have not reoccupied the project site during periods of inactivity.</p>
PSR-BIO-15	<p>Wildlife tree retention. All designated wildlife trees would be retained that are associated with forest thinning. A wildlife tree would have one or more of the following characteristics:</p> <ol style="list-style-type: none"> 1. Large lateral branches: greater than 5 inches in diameter 2. Cavities: wood voids with (estimated) small-to-medium interior dimensions and an entrance opening of at least 1.5 inches suitable for use by a variety of small mammal and bird species 3. Hollow: Wood voids with (estimated) large interior dimension and a large (6 inches or larger) entrance opening suitable for use by a variety of small mammal and bird species 4. Decay: Extensive decayed wood as evidence by large and/or extensive fungal fruiting bodies (conk), lichen, cavity entrances, and sloughing wood and/or bark 5. Broken top: Trees with a minimum diameter at the ordinal break of 12 inches or larger 6. Multiple tops: Trees with two or more leaders near the top of the tree that provide opportunities for resting, denning, or nesting 7. Snag top: Trees where the top the tree is dead with the lowest portion of the dead top is at least 12 inches in diameter

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Element/Title	Requirement
PSR-BIO-16	<p>Protection of equipment access routes through wetlands. If access is necessary during implementation, crane mats or other appropriate cover material would be placed along the heavy equipment access routes that cross wetland or herbaceous-dominated (pasture/grasslands) areas.</p>
PSR-BIO-17	<p>Planting tree seedlings. Within 3 years of the winter following implementation, on all road removal crossings, tree seedlings would be planted within 100 feet of the channel centerline on 20-foot centers in a random distribution according to an appropriate species composition as determined by a qualified forester. Tree seedling stock would conform to NCRD genetic integrity guidelines.</p>
PSR-CULT-1	<p>Historical and archaeological resource inventories. Proposed project areas would be inventoried for the presence or absence of historical and archaeological resources prior to operations within the project area and reports would be submitted to and reviewed by the NCRD Archaeologist. PRC 5024 compliance documentation would be completed. A report would be prepared by a qualified archaeological consultant with direct oversight by the NCRD Archaeologist prior to any project activities. Any cultural resources identified during the inventory would be recorded and flagged with a 30-foot buffer (or as needed based on topography and access points to protect the find). CDPR reserves the right to alter this measure through the PRC 5024 process.</p> <p>This requirement would only apply to projects with no NPS involvement. Projects with NPS involvement, where compliance with Section 106 is required, would follow the process described in the Section 106 Programmatic Agreement.</p>
SPR-CULT-2	<p>Suspend work for the inadvertent discovery of an archaeological resource. In the unlikely event that previously undocumented archaeological resources, including but not limited to flaked stone artifacts (arrowheads or flakes), shellfish, bone, deposits of old bottles and cans, and wooden or rock structural debris, are encountered during project implementation, work in that location would be immediately suspended until an archaeologist meeting the Secretary of the Interior’s standards has evaluated the find in consultation with the SHPO, Yurok Tribe, Tolowa Dee-ni’ Nation, and Elk Valley Rancheria, as appropriate.</p> <p>This requirement would only apply to projects with no NPS involvement. Projects with NPS involvement, where compliance with Section 106 is required, would follow the process described in the Section 106 Programmatic Agreement.</p>
SPR-CULT-3	<p>Stop work for inadvertent discovery of human remains. For ground-disturbing activities, in the event that human remains or suspected human remains are discovered, work would cease immediately within 100 feet of the find (or as needed based on topography and access points to protect the find) and the project manager/site supervisor would notify the Cultural Resources Program Manager of the NCRD and the District Superintendent. The human remains and/or funerary objects would not be disturbed and would be protected by covering with soil or other appropriate methods. The District Superintendent (or authorized representative) would notify the County Coroner (in accordance with Section 7050.5 of the California Health and Safety Code) and NAHC. The District Superintendent (or authorized representative) would also notify the local tribal representative. The County Coroner would determine whether the human bone is of Native American origin.</p> <p>If the Coroner determines the remains represent Native American interment, the NAHC would be consulted to identify the MLD and appropriate disposition of the remains. Work would not resume in the area of the find until proper disposition is complete (PRC Section 5097.98). No human remains or funerary objects would be cleaned, photographed, analyzed, or removed from the place of discovery prior to determination and consultation with the MLD. If it is determined that the find indicates a sacred or religious site, the site would be</p>

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Element/Title	Requirement
	<p>avoided to the maximum extent practicable. Formal consultation with the SHPO and review by the NAHC, as well as appropriate tribal representatives, would occur as necessary to define additional site mitigation or future restrictions.</p> <p>This requirement would only apply to projects with no NPS involvement. Projects with NPS involvement, where compliance with Section 106 is required, would follow the process described in the Section 106 Programmatic Agreement. Additional procedures may also apply to projects on NPS-owned lands under the Native American Graves Protection and Repatriation Act.</p>
SPR-CULT-4	<p>Aerial suspension removal requirements within a culturally sensitive area. If forest thinning activities are proposed within a culturally sensitive area (an archaeological site, tribal cultural resource, or historical site described in PSR-CULT-1), downed and other forest debris would be removed by aerial suspension; no portion of logs, slash, or debris would be dragged across the surface.</p> <p>This requirement would only apply to projects with no NPS involvement. Projects with NPS involvement, where compliance with Section 106 is required, would follow the process described in the Section 106 Programmatic Agreement.</p>
PSR-GEO-1	<p>Unstable area buffer. Within a 50-foot-wide buffer around unstable areas (areas that appear to have recent soil movement, as evidenced by characteristics such as conifers with excessive sweep, tilted stumps, scarps, cracks, hummocky or benched terrain, or slide debris) regardless of percent slope, no trees would be cut. Unstable areas would be marked by park staff with training and expertise in geologic and watershed processes.</p> <p>Landslides within a project area would be mapped by park staff; this would trigger evaluation and approval for use by an earth sciences/physical sciences professional if the feature is related to travel routes or operations. Heavy equipment and/or vehicles or one-end cable yarding would not be allowed to cross areas of instability (as defined above) without approval from an earth sciences/physical sciences professional.</p>
PSR-GEO-2	<p>Consultation with professional geologist. Before any treatment year, and over the life of this plan, a professional geologist would be consulted for management recommendations in the following cases: 1) the Smith River near Crescent City (11532500) stream gage operated by USGS has peak flows in excess of 140,000 cubic feet per second; 2) an earthquake epicenter of moment magnitude 5 to 5.9 occurs within 10 miles of the proposed treatment block, moment magnitude 6 to 6.9 occurs within 20 miles of the proposed treatment block, moment magnitude 7 or greater occurs within 50 miles of the proposed treatment block, or the southern segment of the Cascadia Subduction Zone has fault rupture; or 3) wildland fire burns within the sub-watershed of the proposed treatment block.</p>
PSR-GEO-3	<p>Slope limitations for traditional ground-based equipment. Traditional ground-based equipment would be limited to slopes less than 40%. Operations within the riparian management zone would be restricted as described in Table E2.</p>
PSR-GEO-4	<p>Slope limitations for cable-assisted thinning operations. Cable-assisted equipment (e.g., tethered harvesters and forwarders) may be allowed on slopes up to 85%. Equipment would stay on designated trails covered with a minimum of 6 inches of slash. Operations within the riparian management zone would be restricted as described in Table E2.</p>

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PSR-GEO-5	<p>Winterization requirements and timing restrictions on activities causing soil erosion. Project work would typically be completed during the normal operating season between June 15 and October 15. If more than 0.5 inch of rain is forecast during the normal operating season, project operations would temporarily cease and sites would be winterized. Within riparian management zones, areas with disturbed soils must be stabilized prior to the beginning of the winter period subject to extensions provided by dry weather, and/or prior to the sunset if the National Weather Service forecast is a “chance” (30% or more) of rain within the next 24 hours, or at the conclusion of operations, whichever is sooner. Implementation activities may continue past the end of the normal operating season if the work can be completed within a window of dry weather as predicted by NOAA’s Fall Transition Season Precipitation and Hydrology Decision Support Service notifications.</p> <p>Work sites, including roads and landings, would be winterized before the end of the normal operating season. Winterization includes: 1) grading exposed road and landing surfaces to allow water to freely drain across them without concentrating, ponding or rilling; 2) installing rolling dips/drains to drain steeper sections of road; 3) clearing clogged drainage ditches or culverts; 4) installing silt fences and other erosion control devices where necessary to convey concentrated water across exposed road and landing surfaces; 5) removing road-stream crossings that do not meet 100-year flood discharge standard for flow, sediment, and debris; and 6) mulching all exposed soil surfaces beyond road driving surface. Operations may be started prior to the normal operating season when the soil is dry throughout the entire top 8 inches of the profile, as evidenced by the field guide for soil moisture described in the <i>Wet Weather Operations Standards for Heavy Equipment Use and Log Hauling for Redwoods Rising</i> (RNP 2019a) guidelines.</p> <p>Roads and landings used outside of the normal operating season or after significant rain events would be winterized. Prevention measures would occur before damage occurs, or the area would be avoided until it is sufficiently dry for use. All road use would comply with the Park Seasonal Road Use Policy (March 11, 2011, version or later), and <i>Wet Weather Operations Standards for Heavy Equipment Use and Log Hauling for Redwoods Rising</i> guidelines, which prohibit any road use that would cause rutting or other road deformation. Roads not currently listed as all season may be brought up to that standard if winter travel is necessary.</p>
PSR-GEO-6	<p>Requirements for existing and used landings. Existing landings that were constructed for commercial logging operations prior to park establishment would be used when practicable. Reopening old landings would include shrub and small tree removal, minimal grading, and stump removal. New landings (fewer than two per 50 acres) may need to be constructed for yarding equipment. New landings would be located outside of geologically unstable areas, and the grade would not exceed 15%. Individual landings would not be larger than 0.25 acre. New landings or equipment pull outs would not be placed within 100 feet of streams except where existing roads occur within this threshold distance and there is no other place to land logs. The total number of landings created within 100 feet of a stream would not cumulatively make up more than 35% of the total number of new landings needed in the project area. Existing roads and skid trails would be used to access the break-in-slope where cable yarders can set up. Landings would be kept to the minimum size needed to accomplish the job and existing road and skid trail surfaces would be used as much as practicable.</p>

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PSR-GEO-7	<p>Road removal and erosion control. Brush, trees, rootwads, and other organic debris removed during excavation and clearing of project areas would be collected, stockpiled, and placed on slopes adjacent to live streams or other locations where fine sediment may be mobilized and has potential to enter the stream system. If there is not enough vegetative debris at a particular work site to achieve the amount of ground cover specified, vegetative debris may be moved from nearby, less erosionally sensitive work sites. In the event that imported material (such as straw or shredded redwood bark) is needed, RNSP would purchase and deliver it as close as possible by truck to the area needed. Materials would be selected to comply with RNSP guidelines to minimize introduction of exotic plant species and interference with re-establishment of native forest species.</p>
PSR-GEO-8	<p>Cable and ground-based yarding one-end log suspension minimum. Cable and ground-based yarding would be restricted to the use of equipment capable of maintaining a minimum of one-end log suspension to reduce surface disturbance.</p>
PSR-GEO-9	<p>Evaluation of existing roads/landings for reuse. Existing roads and landings proposed for reuse would be evaluated. Any cracks or other signs of instability or erosion potential would be evaluated by an earth sciences/physical sciences professional who would provide reconstruction or maintenance prescriptions necessary for the intended purpose of reuse.</p>
PSR-GEO-10	<p>Monitor equipment operations at road construction and/or removal sites. At road reconstruction and/or removal sites, a qualified inspector trained in road rehabilitation or removal would monitor equipment operation. Heavy equipment operators would be cautioned to minimize their exposure to unstable slopes that may occur naturally or result from the earthmoving process.</p>
PSR-GEO-11	<p>Skid trail erosion control measures. On skid trails with no measurable fill cross section, tire tracks, skidding ruts, and other depressions and surface irregularities would be removed and restored to a non-sediment delivery status. Erosion control measures such as outsloping (preferred) or water bars in conjunction with slash placement on skid trails and disturbed soils would be implemented where the potential exists for erosion and delivery of sediment to waterbodies, floodplains, and wetlands. Slash generated from forest restoration would be spread uniformly as mulch.</p>
PSR-GEO-12	<p>Wet weather operations. All roads and landings must be adequately rocked (with compacted Class 2 1.5-inch aggregate base) and winterized to be considered for use during wet weather. No ground-based yarding operations would occur during wet weather as defined in the <i>Wet Weather Operations Standards for Heavy Equipment Use and Log Hauling in Redwood National and State Parks</i> guidelines.</p>
PSR-GEO-13	<p>Restrictions on new road and landing alignments. All new road and/or landing alignments and subsequent construction would be supervised by an earth sciences/physical sciences professional. Grades would never exceed 15% and never exceed 10% for more than 500 continuous feet. No roads would be constructed on slopes over 50%. Riparian Management Zones would be avoided whenever possible.</p>
PSR-HYDRO-1	<p>Riparian buffers. Equipment exclusion zones around riparian corridors would be established as defined in Table E2.</p>
PSR-HYDRO-2	<p>Use of dropped trees as instream structures. Trees that are dropped into or across stream channels would not be removed, but their position may be adjusted for use as instream structures.</p>

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Element/Title	Requirement
SPR-HYDRO-3	<p>Equipment decontamination. Decontamination of heavy equipment would occur prior to delivery onto park lands. Heavy equipment would be thoroughly power washed prior to delivery to the park. Equipment would be free of woody and organic debris, soil, grease, and other foreign matter. The engine compartment, cab, and other enclosed spaces would also be free of the aforementioned debris. Equipment would be thoroughly inspected by an agency representative upon delivery and may be rejected if, in the opinion of the representative, the equipment does not meet decontamination standards. If a piece of equipment is removed from the park for unrelated work or work not identified as part of implementation, it would be re-inspected upon re-entry to the park. Decontamination would take place off site upon demobilization.</p>
PSR-HYDRO-4	<p>Cable yarding across perennial streams. When cable yarding across perennial streams, trees must be fully suspended in the air when traveling near streams, as defined in Table E2.</p>
PSR-HYDRO-5	<p>Timing restrictions for road reconstruction and/or removal. Road reconstruction and/or removal work would generally occur outside of the rainy season (June 15 through October 15). On roads where potential sediment delivery to streams exists, restoration activities after October 15 would only proceed according to permit conditions established in consultation with regulatory agencies. If periods of dry weather are predicted after October 15, small additional work items may be done with regulatory agency approval, if they can be completed within the window of dry weather. RNSP would have materials to sufficiently mulch bare work areas on site. Work would be conducted so that no more than 1 half-day would be required to finish all earth moving and mulching work. All access roads would be winterized prior to any additional earth moving tasks.</p>
PSR-HYDRO-6	<p>In-water work area isolation requirements. Stream crossing excavations and/or culvert replacements would take place in dry channels or in channels where stream flow is diverted around the excavation sites to reduce turbidity. In crossings where flow is sufficient to be intercepted, a small diversion dam would be built upstream and stream flow piped around the worksite and discharged into the stream below the worksite. In crossings where the stream flow is too low to be captured and diverted, filter structures would be installed downstream to filter turbid discharge from the worksite. The project inspector would monitor the structures to prevent failures. All temporary berms, ponds, and piping would be completely removed at the completion of excavations or culvert replacement</p>
PSR-HYDRO-7	<p>Drainage structure and stream crossing maintenance requirements. On roads where vehicle or heavy equipment access is required for forest restoration, culverts, water bars, and other damaged or non-functional drainage structures would be repaired or replaced. All stream crossings proposed for reconstruction and left over winter would be designed to convey the 100-year flood discharge including wood debris and sediment loads. Crossings through fish bearing streams would allow for fish passage throughout their lifecycle if they are to remain in place over winter. Bridges and supporting structures would be designed by a California-licensed professional engineer.</p>
PSR-HYDRO-8	<p>Erosion control adjacent to stream channels. At road reconstruction and/or removal sites, disturbed soil adjacent to stream channels would receive mulch coverage with brush and trees (generated during the clearing phase of rehabilitation work) to reduce sheet erosion. Coverage would be heaviest adjacent to the stream or where no native mulch buffer exists downslope between disturbed soil and a stream channel. If needed, hand crews would cut and lop upright branches to further increase ground contact and/or spread finer mulch over small bare areas. Similarly, duff laden with seed, nutrients, and fungi may be collected and scattered. Care would be taken not to impact source areas.</p>

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SPR-HYDRO-9	<p>Removal requirements for wet roads. At road removal sites, cutbanks exposing seeps or springs would not be recontoured. Instead, the entire embankment fill adjacent to the wet area would be exported to dry sections. An outsloped cutbench would extend along all wet road sections.</p>
PSR-HYDRO-10	<p>Stream crossing monitoring. Selected stream crossing sites would be photo-documented following treatment to enable rough-estimate quantitative assessment of post-treatment adjustments according to monitoring protocols. Stream crossing sites would be reviewed in the field during the first winter following treatment to identify any deficiencies in treatment or treatment techniques.</p>
PSR-HYDRO-11	<p>Water drafting requirements. If water drafting becomes a necessary component of the proposed project, drafting would be conducted as described in the NMFS <i>Water Drafting Specifications</i> (NMFS 2001). Screening devices would be used for water drafting pumps to minimize removal of aquatic species, including juvenile fish, amphibian egg masses, and tadpoles, from aquatic habitats. Drafting sites would be planned to avoid adverse effects to special-status aquatic species and associated habitat, in-stream flows, and depletion of pool habitat.</p> <p>If water drafting becomes a necessary component of the proposed project, drafting would be conducted as described in the NMFS <i>Water Drafting Specifications</i> (NMFS 2001). These specifications include the following:</p> <ul style="list-style-type: none"> • Screening devices no greater than 3/32 inch would be used for water drafting pumps to avoid removal of aquatic species, including juvenile fish, amphibian egg masses, and tadpoles, from aquatic habitats. • Drafting sites would be planned to avoid adverse effects to special-status aquatic species and associated habitat, in-stream flows, and depletion of pool habitat. • All drafting sites would occur outside of occupied coho habitat. • Seek streams and pools where water is deep and flowing, as opposed to streams with low flow and small isolated pools. • Pumping rate shall not exceed 350 gallons per minute (gpm). • The pumping rate shall not exceed 10% of the stream flow as measured by a visual observation of water level in relation to a moss line or rock to determine if stream level is dropping due to pumping. • Operators shall keep a log on the truck containing the following information: Operator’s Name, Date, Time, Pump Rate, Filling Time, Screen Cleaned (Y or N), Screen Condition, and Comments.
PSR-HYDRO-12	<p>Avoid trees contributing to stream bank stability. No trees that contribute to stream bank stability or are within an inner gorge (as determined by an earth sciences/physical sciences professional) would be felled.</p>
PSR-HYDRO-13	<p>Cable yarding requirements. Cable yarding corridors would not be larger than 20 feet in width. Stumps or trees (second-growth only) would be used as tail holds. Guylines for the yarder would be anchored to old-growth stumps (not trees) or second-growth stumps or trees surrounding the landing. Skyline operations pull logs fully or partially suspended from the ground, resulting in minimal ground disturbance.</p>
PSR-HAZ-1	<p>Equipment storage, servicing, and fueling limitations. All equipment would be stored, serviced, and fueled at least 150 feet from any stream channel and 50 feet outside of riparian areas and away from unstable slopes. Fuel tankers would be stored outside of riparian areas. When long stretches of road are entirely within riparian areas, smaller refueling devices (under 200 gallons) may be used to refuel large equipment. In such cases, drip pads/pans or other protective devices may be placed under the fueling area.</p>

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PSR-HAZ-2	<p>Spill prevention, monitoring, and response requirements. All equipment, including hand tools, heavy equipment, and cable yarding equipment, would be checked daily for leaks and equipment with leaks would not be used until leaks are repaired. RNSP staff would ensure a spill kit is maintained on site at all times. Additionally, contractors would equip each piece of heavy equipment with a spill response kit. Should leaks develop in the field, they would be repaired immediately, or work with that equipment would be suspended until repairs are made. In the event of any spill or release of any chemical in any physical form on or immediately adjacent to the project sites or within the project area during operations, the contractor would immediately notify the appropriate RNSP staff (e.g., the project inspector). All contaminated water, sludge, spill residue, or other hazardous compounds would be contained and disposed of outside the boundaries of the project area at a lawfully permitted or authorized destination.</p>
PSR-HAZ-3	<p>Equipment requirements for spark arrestors and fire extinguishers. All equipment would be required to include spark arrestors or turbo chargers that eliminate sparks in exhaust and to have fire extinguishers on site. One shovel or one serviceable fire extinguisher would be in the immediate vicinity of all persons operating chain saws during the dry season. All heavy equipment would be required to carry a 10-pound fire extinguisher with a valid inspection tag.</p>
SPR-HAZ-4	<p>Vehicle parking restrictions. Crews would park vehicles a minimum of 10 feet from flammable material such as dry grass or brush.</p>
SPR-HAZ-5	<p>Radio dispatch requirements in case of fire. RNSP personnel would have a RNSP radio at the park unit which allows direct contact with a centralized dispatch center to facilitate the rapid dispatch of control crews and equipment in case of a fire.</p>
PSR-HAZ-6	<p>Road access requirements. All project roads with active operations must be made passable as soon as reasonable and practicable for emergency vehicles and Park staff.</p>
PSR-HAZ-7	<p>Fire hazard reduction requirements. All felled trees would be brought to the ground and would not be left suspended or hanging in crowns of other trees. Slash would be lopped and scattered to within 3 feet of ground when determined necessary by the project manager or their designee for short-term fire hazard reduction.</p>
SPR-HAZ-8	<p>Inadvertent discovery of unknown material spillage. If there is discovery of unknown spillage from, or free product discovered on or adjacent to the project sites, work would be halted or diverted from the immediate vicinity of the find, and the RNSP hazardous materials coordinator would be contacted. Hazardous materials, if present, would be contained and removed from the site prior to resumption of work.</p> <p>Removal of all contaminants, including sludge, spill residue, or containers, would be conducted following established procedures and in compliance with all local, state, and federal regulations and guidelines regarding the handling and disposal of hazardous materials.</p>
PSR-HAZ-9	<p>NOA notification requirements. To prevent exposure to asbestos dust, workers would be informed of areas where asbestos is present in the roads and unpaved areas subject to vehicle traffic would be kept adequately wetted. Signs would be posted at endpoints of identified NOA road segments to alert users.</p>
PSR-HAZ-10	<p>Burning specifications. Burn piles of removed vegetation would not be larger than 10 feet by 10 feet by 5 feet in size and placed away from the dripline of predominant trees and sensitive plant buffer areas and Riparian Management Zones. Piles would be burned under appropriate conditions as described in the burn plan. A burn permit would be obtained prior to pile burning any removed vegetation. Burning would occur on burn days only or with approval from Cal Fire and NCUAQMD.</p>

Appendix E
Standard Project Requirements and Project-Specific Requirements

Element/Title	Requirement
PSR-NOISE-1	Notification requirements to off-site noise-sensitive receptors. Written notification of project activities would be provided to all off-site noise-sensitive receptors (e.g., residential land uses) located within 1,500 feet of work locations. Notification would include anticipated dates and hours during which activities are anticipated to occur and contact information of the project representative, including a daytime telephone number.
SPR-NOISE-2	Power equipment use and maintenance requirements. All powered heavy equipment and power tools would be used and maintained according to manufacturer specifications. All diesel- and gasoline-powered equipment would be properly maintained and equipped with noise-reduction intake and exhaust mufflers and engine shrouds, in accordance with manufacturers' recommendations.
PSR-UTIL-01	Utility Right of Way notification requirements. The utility company would be notified 5 days before material is hauled that limited road access would be available within portions of their Right of Way.

Appendix E
Standard Project Requirements and Project-Specific Requirements

Table E2
Greater Mill Creek Riparian Management Zones

Watercourse Type	Fish bearing (may be perennial or intermittent) and perennial non-fish bearing		Non-fish bearing and evidence of scour or deposition (intermittent or ephemeral)		
Inner Zone Width ¹	30 feet from confined channel, or channel migration zone		30 feet or to break in slope or other feature that prevents sediment delivery to watercourse, whichever is less		
Inner Zone Canopy Cover Retention ²	80%		60%		
Inner Zone Restrictions	EEZ, no tree removal		EEZ, no tree removal		
Outer Zone Width ¹	130 feet from outer edge of inner zone		20 feet from outer edge of inner zone		
Outer Zone Canopy Cover Retention ²	60%		60%		
Outer Zone Slope	More than 35%	Less than 35%	More than 85%	35 to 85%	Less than 35%
Outer Zone Restrictions	EEZ	EEZ, unless sediment delivery is prevented by a break in slope or another barrier such as a bench ³	EEZ	EEZ, except tethered equipment that does not increase sediment delivery potential over one-end, cable suspension systems	EEZ, unless sediment delivery is prevented by a break in slope or another barrier such as a bench ³

Notes:

1. Zone width measured in slope distance.
2. Canopy cover averaged across 1,000-foot sections of streams.
3. If there is a bench or break in slope that is closer and prevents sediment delivery, then the outer zone can be less than 160 feet from the stream channel.

Appendix F. Forest Restoration Strategy

This forest restoration strategy, summarizes past forest restoration treatments in DNCRSP and prioritizes areas for treatment based on the best available information on current stand conditions and the ability of these stands to meet goals discussed in the vegetation management plan.

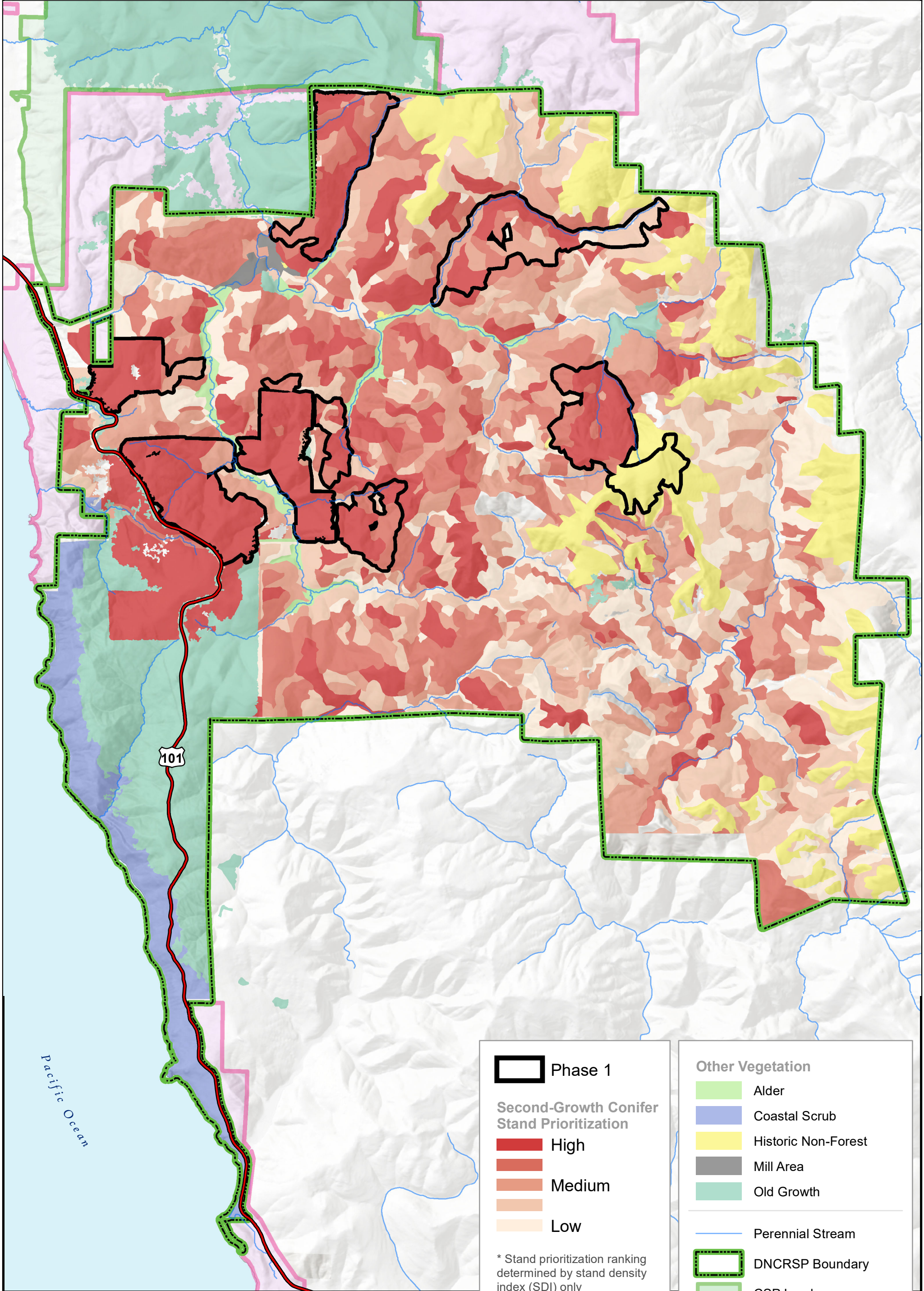
1 Previous Forest Restoration Activities

1.1 Previous Forest Thinning Activities

In 2002 Stillwater Sciences prepared a document with management recommendations for the MCA, and established a starting point for forest restoration efforts. It was recommended that the younger stands, ranging from 10-24 years old (as of 2002), should be prioritized for restoration. The first forest thinning treatment occurred in 2003 and was an experiment comparing relatively high severity (thinning to low tree densities) treatments to limit the need for further treatments once roads were removed (O'Hara et al. 2010). During the first few years after acquisition, forest thinning projects were funded by SRL and the WCB. In addition, Mill Creek provided the opportunity for researchers to experiment and research the effectiveness of forest restoration methods. Results from these studies indicated that thinning was effective in accelerating tree growth, and adding complexity to simplified stands (O'Hara et al. 2010, O'Hara et al. 2012, Dagley et al. 2018). Thinning treatments were initially small (100 - 200 ac per year) and permitted for CEQA under a categorical exemption until a more complete assessment of forest conditions was underway.

In 2006 forest restoration then fell under a Mitigated Negative Declaration and the Forest Ecosystem Restoration and Protection Project was initiated (FERPP, CDPR 2005a). The project originally proposed treatment across 3,502 ac (1,418 ha) of the highest priority stands that were established between 1980-1993, and most of this proposed area had been treated by 2012 (approximately 3,100 ac or 88%). The Young Forests Restoration Plan (YFRP, CDPR 2011a) succeeded the FERPP in 2012, and proposed thinning treatments on 2,325 ac of the youngest stands (established between 1994-2000). By the end of 2018, a total of approximately 5,470 ac have been treated (Map A). All stands thinned to date had a minimum of 500 trees per ac prior to treatment (DBH over 1.5") and most were conifer dominated.

Initial research on forest thinning at Mill Creek informed many of the subsequent prescriptions. The two main forest thinning techniques that have been implemented at Mill Creek include spacing thinning and localized release. These two prescriptions



Phase 1

Second-Growth Conifer Stand Prioritization

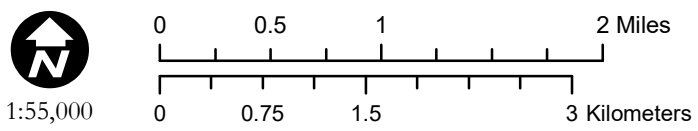
- High
- Medium
- Low

* Stand prioritization ranking determined by stand density index (SDI) only
* Stand prioritization layer derived using CSP boundaries of DNCRSP

Other Vegetation

- Alder
- Coastal Scrub
- Historic Non-Forest
- Mill Area
- Old Growth

- Perennial Stream
- DNCRSP Boundary
- CSP Land
- NPS Land



Appendix F - Forest Restoration Strategy

account for over 95% of the total acres treated since 2003. Spacing thinning was modeled after the pre-commercial thinning (14-foot spacing) that occurred when the property was managed for timber production, and was effective in promoting growth until commercial thinning or a final harvest could occur. Spacing thinning for forest restoration was modified to select the largest and healthiest trees and retain desired species (primarily redwood and underrepresented species). Spacing was generally to a 16 or 20 foot spacing and occasionally a combination of the two. The goal was to reduce (or in 2003 to potentially eliminate) the need for additional entries that may be unpopular with stakeholders and difficult to implement because access would be limited due to road removal.

Another forest thinning treatment at Mill Creek was localized release, a type of variable density method. This treatment called for crews to cut circles with a 25-foot (or in some stands 30-foot) radius, leaving only the three best trees, retained 12x12 foot spacing in areas between two circles, and the areas between three or four circles were left unthinned. The localized release prescription was initially used on a smaller scale than the spacing thinnings because the prescription had never been tried. Over time the prescription was used on a larger scale and eventually became the most commonly used treatment. Its popularity is mainly due to its ability to create more heterogeneity than the spacing treatments, it is more efficient to implement because of the skip areas that do not need to be cut and the skip areas may help mitigate bear damage which is excessive where tree density is lowest and in released redwoods (O'Hara et al. 2012, Dagley et al 2018).

The remaining treatments were implemented on a much smaller scale, and included conifer maintenance and variable density thinning based on a randomized grid. The conifer maintenance is a low severity treatment that cuts hardwoods around individual conifers, but leaves most of the stand untreated. The randomized grid, implemented in 2003, was based on a method first tried in the Pacific Northwest (Carey 2003).

California State Parks and the Smith River Alliance (SRA) worked in tandem to secure the necessary funding to carry out forest restoration at Mill Creek. The cost of restoration treatments has been affected by many factors. State Parks has found efficiencies in using contract over in-house crews for implementation, localized release over spacing thinnings, and no mark thinnings over marking trees for cutting. Other variables affecting cost have included amount of roadside fuels treatment needed, the number of contractors bidding on jobs, changes in guest worker hiring rules and fuel prices.

Permanent monitoring plots have been established and remeasured to compare the effectiveness of various treatments and controls (O'Hara et al. 2010, O'Hara et al. 2012, CDPR 2015a, Dagley et al 2018). Our observations and analysis show that

thinning is an effective tool for increasing species diversity in the understory, shifting species composition and improving tree growth and forest health. Thinning to lower tree densities improves growth rates over high density treatments but can also lead to excessive regeneration and higher bear damage, especially in redwoods. Leaving redwood basal sprouts can act as a buffer against bear damage and increase structural heterogeneity and thinning productivity. Some bear damage may be desirable as it can add decadence, but too much can hinder the development of old-growth attributes. Bear damage is also more common along access routes such as roads and is less common in trees more than a few feet in diameter (Perry 2016).

1.2 Previous Reforestation/ Tree Planting

In 2006 an onsite nursery was established to provide local trees for restoration projects. Redwood and other conifer seedlings were planted as part of certain restoration projects and in areas where natural regeneration was inadequate (e.g. on slopes of recently removed roads and stabilized landslides). From 2006 to 2012, CDPR employees and volunteers planted over 21,000 conifers. Most of the conifers were planted in riparian areas adjacent to anadromous streams that had been converted from conifer to alder dominant forests during logging or along stream crossings when roads were removed. Restoring riparian areas is of particular importance since the area lacked sufficient wood to provide the complex stream habitat present before logging. Short-term remedies involved placing wood in the streams, but the conifer planting program's goal was also to restore conifer dominance to eventually provide late-seral habitat, and allowing natural recruitment of large woody debris to the streams to improve habitat for coho and other aquatic species.

Seedlings planted in openings (such as removed roads) generally do well, but often struggle when competing with brush and when growing under alders and other vegetation. Elk also ate many seedlings growing in alder forests, but their impact varied greatly. Planting larger seedlings (0.8 gallon pots or larger), protecting seedlings from browse and revisiting seedlings to remove falling debris and to assess the need for vegetation management are all critical components to consider when planting riparian areas. The nursery is clearly an effective educational and outreach tool that brought in students and others from all over the region. It has directly connected local communities to Mill Creek, and engaged visitors in active land stewardship and ecological restoration. The success of restoration projects at Mill Creek is dependent on public support, and acknowledging the nursery as an education and outreach tool may rationalize the benefits of maintaining operations better than as a planting resource alone.

2 Restoration Targets

2.1 LMU concept

Landscape Management Units (LMU) can be used to delineate forests into units based on topographic features, distance from the coast, and aspect that can drive vegetation in some regions. The LMU tool developed by U.C. Davis (Boynton, 2015) parses the landscape by three slope position classes (ridgetop, midslope, canyon bottoms) and three aspect classes (northern 330° to 120°, southern 150° to 300°, neutral 120° to 150° and 300° to 330°) to create nine LMUs. For aspect classes, ranges were defined by the amount of solar radiation each class receives, and for slope position classes distinctions were made based on expected changes in soil type and moisture content. In systems where vegetation is strongly driven by topography and aspect, LMUs can help provide species composition and stand density restoration targets that are site appropriate, resulting in forests types/vegetation communities that are more resistant and resilient to disturbance and better able to persist with future climate change (Millar et al., 2007).

2.2 Long-term Targets based on LMUs

In DNCRSP, vegetation is driven by temperature-moisture gradients, soil, and disturbance patterns (see chapter 2.7), and thus is strongly influenced by topography and aspect. Because of this, we can use LMUs in combination with historic reconstruction research and soils data to help identify priority areas for restoration and/or to set appropriate long-term forest management goals and targets for species composition and stand densities (Table 1). LMUs at DNCRSP are split fairly equally between northern and southern aspects, 48% and 51% respectively, with very few in the neutral aspect classes (1%). The canyon bottom slope position class makes up 39% of the LMUs, the mid-slope class 28%, and the ridgetop class makes up the remaining 33%.

Table 1. Landscape Management Units (LMUs) summarized for all of DNCRSP.

LMU	Area (ac)	% of Park
Neutral		
Canyon	118	0.5

Slope	0	0
Ridge	120	0.5
Northern		
Canyon	4483	17.8
Slope	3825	15.2
Ridge	3656	14.5
Southern		
Canyon	5319	21.1
Slope	3165	12.6
Ridge	4520	17.9

2.3 Short-term Targets

Immediate or short-term restoration targets include reductions in stand density, increases in tree growth rates and tree size, in stand heterogeneity, and in understory development. Site specific treatment prescriptions will be developed for individual treatment areas based on the objectives of the treatment, and will account for LMU attributes, the vegetation that historically occupied similar LMUs and what is likely to thrive there in years to come.

3 Stand Prioritization for Conifer Dominated Stands

3.1 Prioritization by Stand Impairment

The primary considerations for prioritizing unnaturally dense conifer stands for treatment will be based on impediments to tree growth (and therefore progression towards old forest habitat), species composition, landscape scale considerations and coordination with other projects (chapter 5.2). Treating areas where tree growth is most impaired will generally get the highest priority for treatment, but treating adjacent stands or forests where access will soon be restricted may also take priority as long as the stand is impaired. Impediments to tree growth is most often measured with stand density index (SDI) (Reineke, 1933) or other measures of relative density and stand uniformity.

Conifer dominated stands with a closed, relatively uniform overstory canopy or stands where stand density index is approaching the zone of imminent competition mortality (Drew and Flewelling, 1979, Powell, 1999, Berrill and O'Hara 2009, Berrill et al 2013) are high priorities for treatment. This chapter discusses the current best assessment of stand density and impairment, based on two remote sensing efforts.

For stands initiated before 1980 that have at least 100 conifer trees per ac (as defined by Stimpson inventory data), we improved the stand prioritization model discussed in the Watershed Management Plan. In this model stand density index (SDI) and the coefficient of variation of heights of the lidar point cloud (CV) were analyzed to determine where tree growth and progression towards late-seral habitat would be most hindered by stand conditions.

Stand density index integrates tree size and density for a stand providing an indicator of crowding and where growth of individual trees is most impeded. Although, this forest metric was traditionally best suited to even-aged, single species stands with little variation in tree size, recent efforts have been made to adapt SDI to more multi-age and multi-species stands (Shaw, 2000, Shaw 2006). By calculating SDI on an individual tree basis, and then summing the values to come up with an estimation of SDI for the entire stand, we were able to better represent the crowded condition for previously harvested conifer dominated stands. In general, greater SDI values equate to greater stand crowding and impairment resulting in a higher priority.

CV was calculated to get an indication of the variability in the height of vegetation in each stand. Stands with a relatively uniform canopy (low CV) are likely to consist of trees of uniform size where no trees are expressing dominance. The lack of large, dominant trees is an indication that no trees have emerged from the canopy to get significantly more light than their neighbors and therefore no trees are growing rapidly (Oliver and Larson 1996, O'Hara and Oliver 1999).

To get a more accurate assessment of forest conditions, we improved the stand boundary map described in the WMP to better delineate forests of uniform conditions. We also developed 3 new models for predicting SDI in conifer dominant areas whose date of birth was older than 1980. We used a subset of conifer-dominated ground plots from the original dataset and the same lidar data as in the WMP to develop new models for predicting SDI. Our results showed that SDI v3 was the best predictor of SDI. We validated the model by inventorying 14 stands that, according to our model, covered the range of predicted SDI values and had a significant conifer component. We compared stand inventory values to the model results and found that the model did not accurately predict SDI values, but it did predict the relative SDI value when compared to other stands sample with an r-square of 93%.

We then broke the stands into five groups with equal acreage based on SDI and ranked them by growth impairment (high SDI values = high priority for treatment to

improve growth), repeating this for CV where low CV values = high priority for treatment to improve growth and encourage canopy differentiation. For each conifer dominated stand, SDI and CV rankings were summed to determine each stand's prioritization rank based on stand conditions (Table 2, Map A). This prioritization based on stand impairment represents the most current information on which stands are in the greatest need for treatment to improve site conditions and will be considered along with landscape scale priorities and coordination with other restoration activities and priorities (chapter 5) to decide treatment areas and prescriptions for a given year. Additional remote sensing data is currently being analysed and much of this work will be followed up by ground surveys of specific, high priority areas before treatments commence. As new data becomes available, the priorities for treatment may need to be adjusted to account for the improved understanding of forest conditions.

Table 2. Prioritization ranks for conifer dominated stands initiated before 1980 based on stand condition scores (stand density index and canopy variability).

Priority Based on Stand Impairment	Rank
Very High	9-10
High	7-8
Medium	5-6
Low	3-4
Very Low	2

Approximately 9,400 ac of forest plantations have been planted since 1980 and 5,500 of these ac were treated prior to 2019. Most of the remaining areas were found to be low priority for treatment when they were surveyed (2006-2011) due to low tree densities, but a few areas (portions of SWA, NWG, NWZ and NEL) were not treated because they could not be effectively treated under the existing CEQA that did not allow trees over 12" DBH to be cut. All areas in this age class are likely to need treatment in coming years, though most are a lower priority than the stands initiated before 1980 (since none of these older stands have been treated). The lidar model did not predict SDI accurately in this younger age class, probably because the lidar was unable to distinguish the trees from shrubs that were of similar height. We used the vibrant forest model (Silvia Terra 2017) to rank these younger stands by SDI (Table 3). Canopy variability could not be used for this assessment since many of the stands have been

thinned since the last lidar flight. Initial analysis of the vibrant forest model attests to it being a useful predictor of stand impairment. But it has not been scrutinized as closely as the lidar model, therefore further stand exams are necessary.

Table 3. Prioritization ranks for conifer dominated stands initiated since 1979 based on stand condition scores

Priority Based on SDI for Stands initiated since 1979	Rank
Very High	5
High	4
Medium	3
Low	2
Very Low	1

3.2 Prioritization based on Old-Growth Proximity, Connectivity, and Residual Tree Presence

As outlined in our draft Shared Restoration Strategy (Redwoods Rising 2017), the first guiding principles for restoration treatments are to protect, enhance, and connect the existing stands of old-growth. To address this objective, prioritization will also consider a stand's position on the landscape. In this prioritization (Table 4), stands closest to old-growth and those that can provide connectivity between disparate old-growth stands will get priority over stands not associated with old growth. By improving forest conditions adjacent to old-growth forests and connecting fragmented old growth, we can offer greater protection to these very limited forest and habitat types. Research suggests that treatments in a 200 meter buffer adjacent to old-growth coast redwood forests could minimize negative edge effects (Russell & Jones, 2001) and increase forest resilience to disturbance such as wildfire, wind, exotic species invasion, and impacts from future climatic change (Millar et al., 2007). Improving stand conditions adjacent to old-growth will not only directly improve forest conditions and habitat quality for these second-growth stands, but will further protect the adjacent old-growth forest and with time will expand the amount of continuous, suitable habitat and travel corridors for wildlife species, and steward forests with greater carbon holding capacity.

Appendix F - Forest Restoration Strategy

Tall, residual trees are scattered throughout DNCRSP. We used the lidar canopy height model to identify all trees over 55 m tall and are significantly taller than neighboring trees. A subset of these have complex or old forest features that make them a priority for protection as wildlife habitat. CSP will evaluate these trees to prioritize treatments needed to protect and enhance habitat surrounding these trees, including efforts to establish connectivity between old-growth habitat.

Additional ranking points were given to areas that provide connectivity between old-growth forest, that are adjacent to old-growth, or that contain residual trees. Total ranking will also be increased for areas immediately downhill from old-growth forest to mitigate the risk that a fire started in degraded habitat might affect uphill stands.

Table 4. Prioritization ranks for conifer dominated stands based on landscape factors.

Priority Landscape Factors	Value added to the impairment rank
Stands within 200 meters of old growth	1
Stands downhill from and within 200 meters of old growth	1
Stands containing residual trees that are adding complexity to the stand structure	1
Stands that are on an identified corridor that can provide connectivity between fragmented old-growth	1

Appendix G - EDRR Target Species

Del Norte Coast RSP EDRR Target List

Species Name	Common Name	Comments
<i>Acacia decurrens</i>	green wattle	no known occurrences in park, 1 Calflora occurrence in Jed Smith in 1983, low potential
<i>Acacia dealbata</i>	silver wattle	no known occurrences in park, several Calflora occurrences in Jed Smith, low potential
<i>Allium triquetrum</i>	three corner onion	no known occurrences in park, occurs along Hwy
<i>Brassica nigra</i>	Black mustard	1 calweedmapper occurrence in park mapped in 2012, location quality low
<i>Brassica rapa</i>	Common mustard	2 Calflora occurrences in park mapped in 2012, location quality low
<i>Centaurea calcitrapa</i>	Purple star thistle	no known occurrences in park, 1 Calflora occurrence on south side of Klamath River, low potential in SE corner of park
<i>Centaurea diffusa</i>	Diffuse knapweed	1 Calflora occurrence was mapped in 05/18 at Mill site. Check
<i>Centaurea jacea</i> ssp. <i>Pratensis</i>	meadow knapweed	1 Calflora occurrence was mapped in 06/18 on Bummer Lake Rd. Check, 1 2014 NPS occurrence Just south of parking area on beach opposite the closed hostel south of Wilson Creek
<i>Centaureum erythraea</i>	European centaury	mapped in Park
<i>Cirsium arvense</i>	Canada thistle	known to occur in park
<i>Conium maculatum</i>	poison hemlock	mapped in Park
<i>Cotoneaster</i> spp.	cotoneaster	mapped in Park
<i>Crococsmia crocosmiiflora</i>	garden montbretia	mapped in Park
<i>Delairea odorata</i>	Cape ivy	3 Calflora occurrences along Nickel Creek mapped in 2012
<i>Digitalis purpurea</i>	foxglove	mapped in Park
<i>Dipsacus fullonum</i>	common roadside teasel	known to occur in park
<i>Fallopia japonica</i>	Japanese knotweed	no known occurrences in park, very few in Del Norte, closest by Trees of Mystery along Hwy 101
<i>Fallopia sachalinensis</i>	Giant knotweed	no known occurrences in park, but treated on neighboring NPS land
<i>Foeniculum vulgare</i>	fennel	mapped in Park along Hwy
<i>Geranium dissectum</i>	cutleaf crane's-bill	known to occur in park
<i>Geranium lucidum</i>	shining geranium	mapped in Park
<i>Geranium robertianum</i>	stinky Bob	mapped in Park
<i>Hedera helix</i>	English ivy	mapped in Park
<i>Hirschfeldia incana</i>	Short podded mustard	mapped in Park
<i>Hypericum perforatum</i>	St. Johnswort	mapped in Park
<i>Ilex aquifolium</i>	English holly	mapped in Park
<i>Lathyrus latifolius</i>	everlasting sweetpea	no known occurrences in park

Appendix G - EDRR Target Species

<i>Lepidium latifolium</i>	perennial pepperweed	no known occurrences in park
<i>Linum bienne</i>	flax	mapped in Park
<i>Persicaria wallichii</i>	Himalayan knotweed	no known occurrences in park, few in Del Norte, closest by Requa along Hwy 101
<i>Phalaris arundinacea</i>	Reed canary grass	known to occur in park
<i>Raphanus sativus</i>	wild radish	known to occur in park
<i>Senecio jacobaea</i>	tansy ragwort	known to occur in park
<i>Vinca major</i>	periwinkle	no known occurrences in park, but mapped on neighboring NPS land (Enderts Beach Trail)

Appendix G

Draft Aquatic Habitat Restoration Strategy for Greater Mill Creek Project Area

Aquatic Habitat Restoration Strategy for Greater Mill Creek Project Area April 2019



California Department of Parks and Recreation

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APPENDIX

Appendix A. East Fork Mill Creek Instream Restoration and Monitoring, A Summary Report 1994-2019, Del Norte Coast Redwoods State Park.

Introduction

Ancient coast redwoods are the foundation of a distinctive forest ecosystem found near the Pacific Coast of northern California. Giant trunks, intricate canopies, and dynamic wood-loaded streams are refugia for a diverse ecosystem, and are an essential component to healthy watersheds and the global carbon cycle. At a rapid pace, nearly all the historic redwood range was harvested (at least once) and converted into second-growth stands or non-forest uses. This conversion resulted in a suite of unintended and deleterious consequences that mobilized forward thinking conservationists, like Save the Redwoods League and others, and led to the formation of Redwood National and State Parks (RNSP) to protect this superlative ecosystem. Together, these parks form a 133,000 acre biosphere that preserve the majority of the world's remaining old-growth coast redwoods and over 80,000 acres of legacy managed timberlands in need of repair. Given the sweeping changes to the landscape over the last century, contemporary conservationists and land managers look to restore forest and stream ecosystems to protect remaining old-growth, improve the health of young forests, and restore important ecological processes.

Purpose

RNSP's statement of purpose is, "to share in the perpetual stewardship of ancient coast redwood forests, streams, coastal ranges, and coastline; for the enjoyment, education, and inspiration of people forever; with a commitment to watershed-scale restoration of damaged landscapes." After almost 25 years of cooperative management, RNSP managers and conservation partners alike acknowledged the need to collaboratively support and contribute essential resources to achieve restoration goals at a larger scale. In response, Redwood National Park (RNP), the North Coast Redwoods District of California State Parks, and Save the Redwoods League initiated Redwoods Rising in 2018, a collaborative focused on the restoration of redwood ecosystems at an unprecedented scale.

Redwoods Rising builds upon the momentum of past restoration efforts in RNSP. Forest restoration and aquatic restoration will continue, but in a more holistic, integrated approach and at landscape-scale. Two pilot locations, Greater Prairie Creek and Greater Mill Creek (GMC) have been selected for initial coordinated restoration. This document summarizes the aquatic habitat restoration component for the GMC area, which includes Del Norte Coast Redwoods State Park (DNCRSP) and adjacent portions of Redwood National Park (Figure 1).

Planning and Environmental Compliance

The Redwood General Management Plan/General Plan (RNSP 2000) and its amendment (CDPR 2010) guide the management of four parks; Jedidiah Smith Redwoods State Park, DNCRSP, Prairie Creek Redwoods State Park and Redwood National Park, which are cooperatively managed as RNSP. The *Mill Creek Interim Management Recommendations* (Stillwater 2002) provided guidance for the most recent addition to RNSP until 2010, when the Redwood General Plan was amended and DNCRSP, officially, more than doubled in size.

The Mill Creek Watershed Management Plan (WMP, CDPR 2011) was developed alongside the General Plan Amendment (GPA) to provide for watershed management at DNCRSP. Specifically, the purpose of the WMP was to provide a sufficiently detailed analysis to initiate watershed-related natural resources restoration, protection, and monitoring in the Mill Creek Addition of DNCRSP. The Plan focused on sediment control and reduction, forest recovery toward resilient late-seral conditions, and monitoring. Ecological and logistical merits for a watershed approach to restoration are detailed in the WMP, which highlights how thoughtful, coordinated restoration can allow multiple goals to be achieved, by simultaneously or strategically sequencing projects.

As attempts to organize the broad range of watershed impairments and potential solutions in one comprehensive document can become unwieldy, the WMP acknowledged the potential need to tier or parse out specific restoration components for additional detail. The broad stroke of the watershed plan is helpful to identify commonalities and overlaps in restoration disciplines. To avoid redundancy, finer detailed plans can incorporate restoration actions by reference where they have previously been sufficiently detailed. For example, the *DNCRSP Vegetation Management Plan* (VMP) (CDPR 2019) addresses a suite of vegetation management needs that includes riparian plantings, silvicultural management, and invasive vegetation removal. Roads with high potential for failure and sediment delivery, have been addressed under the *Landscape Stabilization and Erosion Prevention Plan* (LSEPP), and future road and trail developments will be addressed under a *Roads and Trails Management Plan*. This aquatic restoration strategy builds on, and integrates these existing planning, compliance, and restoration efforts and provides additional detail to restore natural hydrologic processes, primarily by implementing large wood restoration projects in the GMC planning area. This plan was developed in coordination with the Smith River Alliance (SRA) and California Department of Fish and Wildlife (CDFW) Environmental Scientist, Justin Garwood.

The Mill Creek Advisory Committee (MCAC) plays an integral advisory role in the restoration of the Mill Creek addition within the GMC. Voting members of the MCAC include representatives from CDFW, Save the Redwoods League, California Coastal Conservancy, the California Wildlife Conservation Board, and the Del Norte County Board of Supervisors. Other participants include RNP, Smith River Alliance, National Oceanic Atmospheric Administration (NOAA)/National Marine Fisheries Service (NMFS), Elk Valley Rancheria, and the Tolowa Dee-ni' Nation. The purpose of the MCAC is to advise California Department of Parks and Recreation (CDPR) on the long-term management of the Mill Creek Area (MCA), consistent with the primary goal for the acquisition, which is to restore late seral forest characteristics and associated natural functions that maximize benefits to the salmonid species of its streams and wildlife associated with late seral forest. It is our hope that the committee will continue to provide valuable restoration and management guidance for the MCA and by proxy, the GMC planning area.



Figure 1. The Greater Mill Creek Planning Area, located within the Redwood National and State Parks, Del Norte County, California.

Due to a decrease in abundance, reduction in distribution, and overall degraded habitat, the Southern Oregon/Northern California Coast (SONCC) coho salmon (*Oncorhynchus kisutch*) population is listed as threatened under federal and state endangered species acts (Federal Register 1997, CDFW 2002). The Mill Creek Watershed was acquired, in part, to protect one of California's most productive and extant coho salmon populations. Although Mill Creek supports the most productive coho population in the Smith River Basin, populations are still significantly lower than historic numbers (NOAA 2014). Substantial timber harvest and related road construction occurred throughout the project area between 1850 and 2000, leaving a landscape of failing culverts, increased sediment delivery, and reduced floodplain connectivity that has reduced the resilience and function of natural processes in the aquatic ecosystem. Action is required to restore habitat functionality and connectivity, as well as to ensure that water quality and other natural resource values are maintained or enhanced under park management.

Aquatic Habitat Impairments

Timber harvest and inadequate post-harvest planting and management of riparian zones has altered floristic composition and structure of the riparian areas within GMC. Riparian forests in the Mill Creek watershed were once old-growth redwood forests with a narrow band of alders along creek edges, similar to Bull Creek in Humboldt Redwoods State Park (Figure 2). The overstory of the old growth was composed of redwoods (over 75% of the trees) with varying amounts of western redcedar (*Thuja plicata*), Port Orford cedar (*Chamaecyparis lawsoniana*), Sitka spruce (*Picea sitchensis*), grand fir (*Abies grandis*) and in slightly drier areas, Douglas fir (*Pseudotsuga menziesii*). Post-harvest planting efforts did not occur in many of the earlier timber harvests and failed in other attempts, allowing the narrow alder strip adjacent to streams to expand into the formerly conifer dominant riparian areas (Figure 3). The Rock Creek watershed is similar to Mill Creek watershed in that alders were historically found adjacent to the creeks, with old-growth conifer forests next to the alders. However, the steeper terrain and different edaphic conditions resulted in a generally narrower riparian forest and alders more quickly giving way to forests composed of redwood, Port Orford cedar and Douglas fir.

In both watersheds the lack of large conifers has resulted in less shading of watercourses and a lack of large wood recruitment into streams. Relic infrastructure in and adjacent to the floodplain, including bank armoring, has resulted in channel confinement and reduced floodplain connectivity. The transportation network has altered bank stability and sediment delivery, and in a few remaining instances, impeded fish passage. Large wood removal from the stream channel (especially in East Fork Mill Creek) and timber harvest in the riparian zone has reduced the quality and quantity of large wood (LW) within the channel and floodplain resulting in an overall simplified system. These actions have produced aquatic habitats deficient in complexity and resilience.



Figure 2. Coniferous riparian forest, Bull Creek, Humboldt Redwoods State Park. February 1962, CDPR.



Figure 3. Alder dominated riparian forest, East Fork Mill Creek. March 2008, CDPR.

In summary, aquatic habitats in GMC have been degraded by the following:

1. Riparian forest alterations and deficiencies.
2. Relic infrastructure from industrial timber management operations.
3. Reduced in-channel and floodplain structural complexity.

Restoration Goals

The following aquatic habitat goals have been identified to address impairments for the GMC planning area:

Improve Fish Habitat

- Improve dynamic geomorphic processes that create and renew salmonid habitat to allow for self-sustaining habitat.
- Improve summer rearing habitat, promoting increased pool frequency and depth.
- Increase in-channel low velocity refugia and winter rearing habitat for all flows.
- Increase off-channel rearing habitat at winter base flows and higher flows.
- Improve spawning habitat.
- Increase in-channel and floodplain wood storage to increase roughness, trap, and sort coarse sediment, create obstructions to force scour and/or deposition and deflect flows to increase channel sinuosity.
- Increase in-channel complexity and improve fish passage.
- Remove human-made barriers to fish passage.

Restore Floodplain Function

- Increase floodplain roughness to reduce velocities and increase fine sediment deposition on floodplains during high flows.
- Create large wood structures of whole mature trees that will naturally mobilize, recruit, and retain wood in the active channel and floodplain.
- Increase floodplain connectivity (i.e. remove floodplain infrastructure and increase side channel and off-channel connectivity).
- Protect, improve, and connect the channel with wetlands and adjacent floodplains.
- Increase the resilience of floodplains to environmental change and effects of past land use.
- Establish off-channel habitat for aquatic species.

Expand and Improve Riparian Forest

- Reestablish native riparian forests and manage or eliminate non-native species
- Improve riparian function.
- Increase high quality wildlife habitats.
- Provide future large wood recruitment.
- Maintain, protect, and improve habitat values, ecological health and function while long-term recovery takes place.

The WMP, VMP, and the LSEPP have begun to address many of the identified impairments and subsequent goals to improve fish habitat, restore floodplain function, and expand/improve riparian forests. This document provides additional detail to support implementation of large wood projects to address degradation associated with in-channel and floodplain homogeneity. Large wood and wood jams play an important role in geomorphic functions that shape channel form and sediment dynamics (i.e., storage, transport, and deposition rate) (Naiman et al. 2002, Flannery et al. 2017). Large wood creates diverse habitat with deep pools, sorted gravels, velocity refuge, and complex cover from predators, all of which are vital for salmonids (Quinn and Roni 2001, Opperman 2005).

Under this strategy, large wood will be placed to improve habitat function by creating areas of lower velocity during higher flows, providing additional instream cover, scouring pools, sorting gravels, metering sediment, and facilitating floodplain connectivity and off-channel habitat. Large wood re-introduction (also known as loading) is intended to re-establish natural processes and conditions that will restore channel and habitat complexity. The proposed placement of large wood, in streams and on the floodplain, aims to reestablish processes that create and sustain physical and biologic complexity. Wood placement is proposed for Mill Creek, East Fork Mill Creek, West Branch Mill Creek, and Rock Creek and their tributaries.

Wood loading will aim to reach natural historic levels that will create and sustain natural geomorphic functions and complex instream habitat. Due to widespread modification of rivers across the Pacific Northwest, particularly redwood dominated forests, there is a paucity of data available to determine desired representative conditions as a restoration benchmark. Wood loading will be determined for each sub-basin (i.e., East Fork Mill Creek, West Branch Mill Creek) within GMC. Recent wood surveys in both Mill Creek and Prairie Creek provide a starting baseline to guide loading efforts (Garwood and Deibner-Hanson 2017). Wood densities in Upper Prairie Creek (Garwood and Deibner-Hanson 2017) provide a guide for restoration goals, as this stream reach flows through an old-growth Coast-redwood forest (Table 1). However, the active channel width of Upper Prairie Creek is smaller than many of the streams in the GMC project area. Therefore, Upper Prairie Creek serves as a minimum loading goal and adaptive management will be needed to determine when sufficient wood loading has been conducted to accomplish the project goals and objectives.

In the near term (50 or more years) large wood is proposed to be imported from other areas within the watershed to meet restoration objectives, but re-establishing native riparian forests will eventually allow for natural recruitment of large wood into the system. Large wood 2 feet in diameter and 50 feet in length has been set as the minimum target size of facilitated instream wood to maximize persistence. It is possible to grow trees this size onsite in 50 years, but it may take longer due to the difficult growing conditions in some areas. Brush slows young seedling growth and is difficult to control. Additionally, seedling growth may be slow due to low light conditions resulting from an overstory of alders. Previous plantings in the MCA project area

have also been plagued with animals browsing the top leader of seedlings thus slowing their growth.

Wood in a stream channel is naturally mobilized and broken down through hydrologic and decomposition processes. Retention of wood naturally varies based on wood size, species, and location. Decay rates (depletion rate) of wood are higher for deciduous species than conifer species (Roni et al. 2015). Additionally, as the stream channel increases, retention time of wood decreases. In larger streams wood is less stable and depletion is caused by export of wood; compared to smaller streams where decay is the primary driver in depletion (Roni et al. 2015). In large rivers, residence time of wood can range from 1 year, due to mobilization, to over 1000 years, due to sediment capture and burying (Curran 2010, Hyatt and Naiman 2001). Wood structures with “key pieces” of wood (i.e., wood that remains independently stable, even throughout large floods) can capture mobilized wood and lead to creation of logjams (Roni et al. 2015, Flannery et al. 2017) and thereby increase retention.

The VMP outlines restoration actions to improve aquatic habitats by thinning and planting, while maintaining a canopy cover at or above 60% to protect aquatic resources. Conifer seedlings must grow taller than surrounding brush to provide assurance that thinning will not encourage a greater response from the understory brush and outcompete the seedlings. Once a sufficient number of conifer trees over 24” are established in riparian habitats, instream wood can be obtained onsite. Thinning these stands will provide onsite large wood in the interim, while also promoting late seral conditions. Placement of large wood structures will be discontinued, once the forest matures to a level of decadence that promotes natural wood recruitment.

Habitat Condition

The GMC Planning Area, approximately 122.8 square kilometers (km²) (34,080 acres) falls primarily within the stable geology of the Smith River Basin. There are four main stream reaches within the GMC Planning Area: mainstem Mill Creek (23.8 km²/ 5,870 acres), West Branch Mill Creek (28.8 km²/ 7,120 acres), East Fork Mill Creek (43.1 km²/ 10,660 acres), and Rock Creek (41.8 km²/ 10,340 acres) (Figure 4). Within each main reach there are smaller reaches, tributaries, which will have their own restoration and wood loading goals. The Mill Creek Watershed, the largest watershed in the GMC planning area, includes the East Fork (Kelly Creek, First Gulch, and Bummer Lake) and the West Branch sub-basins. Based on NOAA intrinsic potential stream layer (Agrawal et al. 2005), the average stream gradient of mainstem Mill Creek is 0.5%. Excluding tributaries, the East Fork average is 1.4% and the West Branch average is 1.6%. The intrinsic potential portion of Rock Creek has an average stream gradient of 2.8%. The GMC Planning Area also comprises the upper portions of the Hunter Creek (20.0 km²/ 4,960 acres), Wilson Creek (27.4 km²/ 6,780 acres), and Terwar Creek (14.8 km²/ 3,655 acres) watersheds, as well as the Nickel and Damnation Creek watersheds (15.5 km²/ 3,825 acres).

Greater Mill Creek Ecosystem Restoration Area
 Aquatic Habitat Restoration Strategy - Hydrology, Anadromy

California State Parks
 North Coast Redwood District

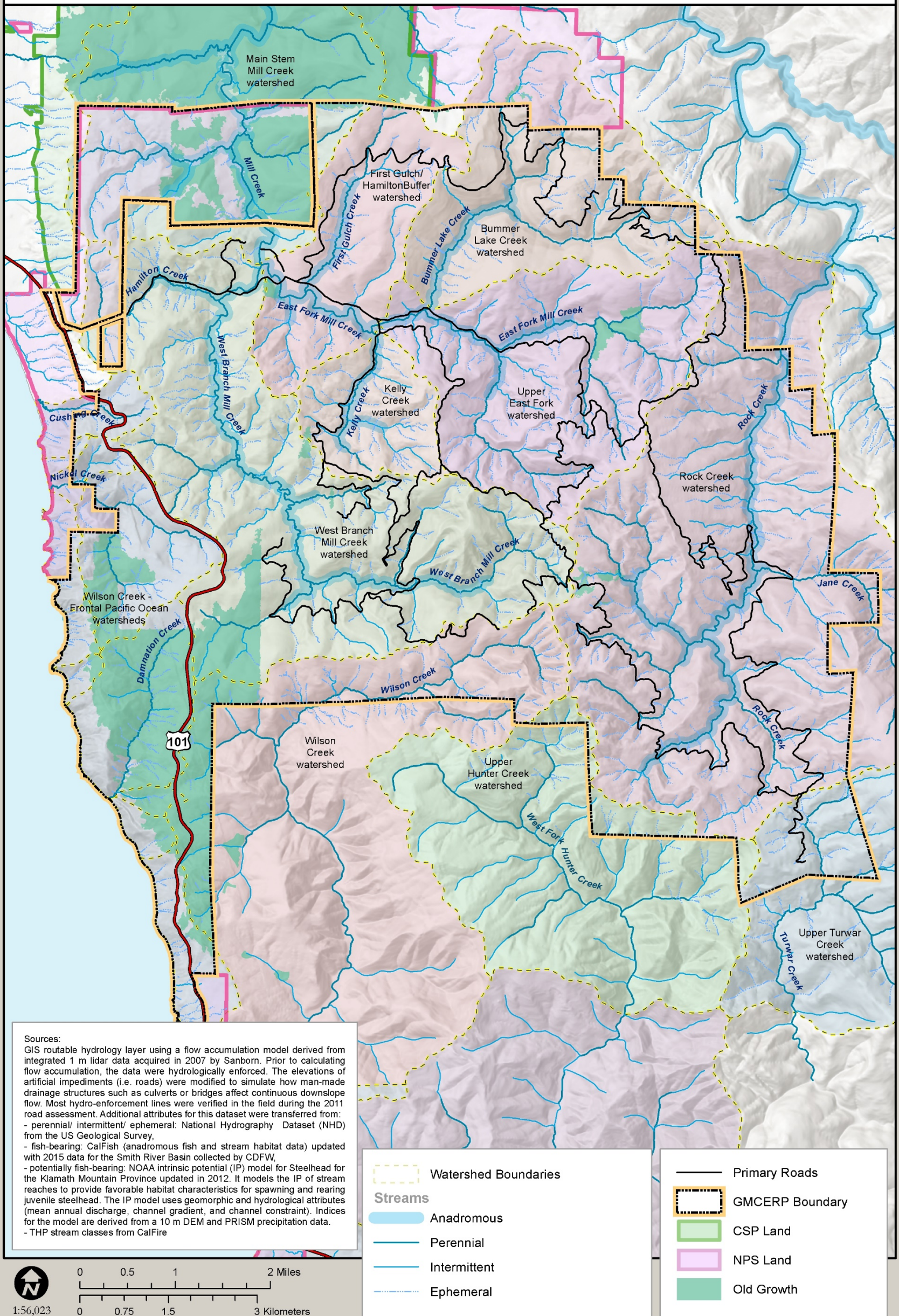


Figure 4. Watershed boundaries, stream locations, and anadromy within the GMC Planning Area.

Table 1. Summary statistics of large wood (LW) inventories performed in Mill Creek and Prairie Creek. Table adapted from Garwood and Deibner-Hanson 2017.

Basin	Reach	Reach Length (km)	Large Wood (LW) Count (pieces)	LW Count (pieces/km)	Volume (m3)	Volume (m3/km)	"XL" LW (piece/km)
MILL CREEK	East Fork Mill	6.5	1551	231.1	496.4	75.9	17.6
	West Branch Mill	9.2	2661	289.5	1049.9	114.2	21.8
	Mainstem Mill	9.3	1033	111.3	862.5	92.9	14.7
Totals:		25.0	5,245	631.9	2,408.8	283.0	54.1
PRAIRIE CREEK	Upper Prairie Creek	13.7	3906	284.4	1144.4	83.3	25.8
	Lower Prairie Creek	4.7	1430	304.6	255.1	53.8	8.2
	Totals:	18.4	5,336.0	589.0	1,399.4	137.1	34

The mainstem of Mill Creek flows north, through RNP and Jedediah Smith Redwoods State Park to the Smith River at Stout Grove. Rock Creek, the second largest watershed in the park enters the South Fork Smith River to the east of Mill Creek. Minor portions of the GMC area drain toward the Klamath River or toward offshore waters of RNSP. The headwaters for Turwar and the west fork of Hunter Creek begin along the southern boundary of the park and flow through private timberland and the Yurok Reservation before draining into the Klamath River. Drainages on the western side of the park that flow directly into the Pacific Ocean include Damnation Creek, Nickel Creek, Cushing Creek and portions of Wilson Creek. Evidence of recent logging is ubiquitous on the landscape, yet areas of high quality resource value persist throughout the planning area.

Typical of the Northern California Coast, the GMC area is characterized by steep, mountainous terrain with elevations ranging from 21-710 m above mean sea level in Mill Creek and up to 1,007 m in Rock Creek. Hillslope gradients average from 18 to 26 degrees. The Coast Range Thrust Fault, strikes north-northwest through the Rock Creek watershed, forming the boundary between the Coast Ranges and the Klamath Mountains. The majority of the GMC

area is located within the marine Franciscan Complex consisting of interbedded greywacke (sandstone), shale and conglomerate (Aalto and Harper 1982). In the Rock Creek sub-basin near the divide of these two mountain ranges (Figure 5), the bedrock is composed of Pre-Nevadan rocks, including highly sheared serpentinite and peridotite (Aalto and Harper 1982).

Aquatic biodiversity within the planning area is high, especially in Mill Creek, due to its low gradients and proximity to the lower Smith River. Numerous native fish, herpetofauna, and freshwater mussels are present in the sub-basin (Walkley and Garwood 2017). Anadromous and resident salmonid populations occur in all four main stream reaches within GMC (*see* below for Summer Juvenile Abundance and Distribution Monitoring – Existing). Mill Creek, one of the most productive salmonid tributaries of the Smith River, hosts Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), steelhead (*O. mykiss irideus*), coastal cutthroat trout (*O. clarki clarki*), and occasionally chum salmon (*O. keta*). Steelhead frequently migrate upstream of barriers that would hinder Chinook and coho salmon, and resident cutthroat are present above most anadromous barriers in the watershed. Pacific lamprey (*Entosphenus tridentatus*) are also known to spawn and rear in Mill Creek and its tributaries (Walkley et al. 2017). Mill Creek is the most important spawning tributary for coho salmon in the Smith River (Walkley and Garwood 2017).

Approximately 50.8 km (31.5 miles [mi]) of known spawning and rearing habitat are used by anadromous salmonids in the Mill Creek watershed (Figure 4; Garwood and Larson 2014 and Walkley and Garwood 2017). Approximately 15.8 km (9.8 mi) is located in the West Branch sub-basin and 17.6 km (10.9 mi) in the East Fork sub-basin. In most of the fish-bearing reaches of the mainstem and East Fork, shallow bedrock is present with limited floodplain connectivity related to confinement by bedrock or artificial fill (i.e., roads, berms, and fill at the mill site). The fish bearing reaches of West Branch are predominantly alluvial with a relatively broad active floodplain.

Rock Creek supports anadromous populations of Chinook salmon and steelhead, as well as anadromous and resident populations of coastal cutthroat trout. Resident populations of coastal cutthroat trout are present in the upper reaches of the watershed, whereas the lower reaches likely support both resident and anadromous cutthroat. Rock Creek contains habitat suitable for coho salmon though they have not been documented since 1994 (Garwood 2012). Pacific lamprey are likely in Rock Creek, as the watershed is of sufficient size and gradient that suitable habitat is expected to be available (Reid and Goodman 2016). Rock Creek contains 15.5 km (9.6 mi) of anadromous stream. Rock Creek stream channel morphology is dominated by large boulders and more bedrock controls than the historically wood-rich Mill Creek.

See Sections 1.4, 2.1, 2.2, 2.3 of the Mill Creek Property Local Watershed Plan (CDPR 2011) for additional information that contributes to the current condition. In general, the GMC area provides high quality, productive aquatic habitats; however, restoration is required to address the potential deleterious impacts of historic logging.



Figure 5. Watershed Divide. The view of the watershed divide between the Mill Creek and Rock Creek watersheds, taken from Little Bald Hills. Red Mountain and Rattlesnake Mountain are seen to the south, with Childs Hill to the southeast. June 2018, Henri Holbrook, CDPR.

Large Wood Restoration to Date

Approximately 170 instream wood structures have been constructed in the EFMC over the last 25 years, 121 of these were installed by CDPR (Appendix A; CDPR 2019). Appendix A contains a summary of large wood restoration and monitoring in the EFMC between 1994-2019.

In the 1990s CDFW recognized the importance of dynamic stream channels with large woody debris in sustaining healthy watersheds and aquatic diversity. In 1995, the California Conservation Corps (CCC) installed instream large woody debris (LWD) and boulder structures at 49 sites along the East Fork. In 2006, CSP, in partnership with CDFW, constructed more complex and experimental wood jams at 12 sites along the East Fork. Funding was provided by the Wildlife Conservation Board (WCB), and the project received a positive review from the CDFW, leading to additional funding and projects in the East Fork watershed. In 2008, 14 instream structures were installed with an average of 27 LW pieces (up from 1-4 pieces in earlier projects) per structure. The Coastal Conservancy and the American Reinvestment and Recovery Act (ARRA) funded the construction of LW structures at 19 additional sites and placement of mobile heliwood at 72 locations along the East Fork (CDPR 2019). This funding also provided an opportunity for research on instream structure design, involving master's students at Humboldt State University (Benegar 2011). Results have shown that more complex structures, with a higher volume and piece count of LWD, were more effective than simpler structures in restoring the desired conditions for fish habitat (e.g. more scour pools, larger and deeper pools, accumulation of spawning gravels, and overall habitat heterogeneity). Furthermore, research shows the intended function of these wood loading efforts persist more

than ten years after their implementation (Rodriquez 2018). In 2012, C DPR constructed 4 more engineered log jams and reconnected the historic floodplain with the current channel (CDPR 2012). In total, there are 98 documented large wood structures and 72 sites where mobile wood was dropped via helicopter to improve instream and off-channel habitat in East Fork Mill Creek. Nevertheless, wood volumes recently documented in the East Fork Mill Creek are still low when compared to reference streams (Garwood and Deibner-Hanson 2017).

Proposed Large Wood Restoration

Large wood placement is proposed for all four main reaches of the GMC, Mill Creek, East Fork Mill Creek, West Branch Mill Creek, and Rock Creek, and their tributaries, as wood becomes available from stockpiles or other restoration projects (i.e., road removal and vegetation management). Riparian conifers and hardwoods would also be planted to provide future large wood for natural recruitment to the channel (DNCRSP VMP 2019). In a given year, no more than 20 structures will be constructed per stream reach; quantity will be determined by wood availability, logistical constraints, and access locations. Where appropriate, structures will include a mixture of large, medium, and small volume stems with a target of 1 to 100 stems per structure. Whole tree materials (>15" diameter) will be incorporated between riparian trees or existing structures to mimic natural wood jams. Periodically, wood may be placed within the active channel and along floodplain reaches to augment wood loading, until natural recruitment and delivery processes become self-sustaining. Considerations for large wood placements include, current stream morphology, spacing for fish utilization; equipment access and an assessment of effects to the streambed, floodplain, and downstream infrastructure, such as bridges and roads. Where opportunities exist, hardwoods will be placed in channel in such a way to promote continued persistence, while providing cover for aquatic species. Project avoidance and minimization measures will be included in the Federal and California Endangered Species Act consultation.

Large wood criteria and operational methods include the following:

- Single or multiple pieces of large wood, ideally with the rootwad attached, will be wedged between riparian trees or other existing structures to anchor the wood in place. The large wood should function similarly to riparian trees that have fallen naturally into the stream and will have the potential to create pools.
- Large wood will be positioned using heavy equipment (e.g., loader, excavator) and/or labor crews utilizing chainsaws, and grip hoists (Figure 6). Crane mats may be utilized if adjacent road access is lacking and soil conditions warrant their use. Work will be conducted in the late summer or early fall when site conditions are most likely to be dry.
- The target size for the large wood to be placed in the channel is greater than 2 feet in diameter and 50 feet in length with the rootwad attached (placing the rootwad in the channel will increase its function and ability to create channel complexity). However, based on availability of wood, a variety of wood sizes will be used.

- Cable and rebar will not be used to anchor large wood due to safety risks and aesthetic concerns. Large wood is expected to be dynamic in the channel and may break loose and deposit naturally at downstream sites. As such, LW will not be placed upstream of at risk infrastructure without consultation with an engineering geologist.
- Where access with construction equipment is not possible, helicopters will be used to place wood in target locations.
- Large alders will be pushed or pulled into the channel from the bank with roots remaining attached to the banks if possible. These trees would recruit wood and provide instream cover and velocity refugia. Selective removal of riparian trees by pushing or pulling them into the stream will not create large openings in the canopy.



Figure 6. A large wood structure installation in East Fork Mill Creek. September 2008, CDPR.



Figure 7. Examples of pre (A) and post (B) large wood installation, and after one winter season post installation (C). Adapted from Benegar 2011.

Existing and Recommended Monitoring

Mill Creek and Rock Creek both provide important habitat for the Smith River salmonid populations (Walkley and Garwood 2017). Mill Creek in particular has long been recognized as a critical salmonid spawning and rearing system; and fisheries monitoring efforts have been in place in the sub-basin since 1980. Additionally, fish monitoring has been conducted in Rock Creek off and on since 1994. Over the years, these efforts have been undertaken by multiple groups and sampling methodologies. Spatial extents, survey efforts, and protocols have varied in response to changing monitoring goals.

Since 2011, survey efforts have become more comprehensive with implementation of protocols developed by CDFW under the Coastal Monitoring Program (CMP). The CMP presents a means whereby standardized methodologies and protocols are utilized to collect biological data within a standardized sample frame, enabling data to be compared both within and across watersheds. It also facilitates the creation of long term biological and habitat datasets to track population trends. CDFW earmarks CMP funds for monitoring threatened or endangered fish populations. Thus, CMP funding within the GMC area is largely limited to Mill Creek because it supports the primary coho salmon population within the Smith River. Recent monitoring under CMP protocols includes an assessment of four metrics: abundance, productivity, spatial structure, and diversity. To implement these protocols, monitoring is comprised of three main survey efforts: spawner surveys, downstream migrant trapping, and summer snorkel surveys. Because of variations in the past and current monitoring efforts, there is no single synthesis of all long-term Mill Creek fisheries data. However, Walkley et al. (2017) provides a comparison of all 25 years of downstream migrant trapping data.

Large wood plays a key role in natural stream processes that sort sediments and create aquatic habitats. Multiple metrics can be used to evaluate sediment transport, substrate embeddedness, and overall channel condition. While various hydrologic and topographic surveys have been conducted in the GMC area, no routine or uniform surveys have been conducted to monitor the condition of stream habitat, channel profile, or sediment load. The USGS collected suspended sediment, bedload, turbidity and water flow data at various locations in Mill Creek from water year 1975 to 1981 (USGS 2018), however, water conditions varied from critically dry to extremely wet during this short survey period. Carroll and Robison (2007) surveyed wood density and pool frequency in the East Fork and West Branch Mill Creek. However, these surveys were only conducted along a single 1000 m study reaches in each stream. The longitudinal profile of the East Fork has been collected for past RNP and State Parks projects with some overlap between projects. Rellim Redwood Company conducted fisheries habitat and channel morphology surveys in 1994 across 9 miles of Rock Creek and its tributaries following protocols established by CDFW (Flosi and Reynolds 1991).

All of these surveys provide some baseline data to guide restoration planning and illuminate important data gaps to fill as restoration projects are implemented. Collection of highly accurate spatial biological and physical data using standardized and repeatable methodologies is recommended to track baseline trends and evaluate restoration success. Adaptive management is recommended to guide continued wood loading efforts until riparian forests can sustain natural recruitment, thereby making wood placement unnecessary. Future monitoring efforts will be collaboratively coordinated to facilitate long term biological and physical data that can be cross-referenced to identify spatial and temporal trends, especially in light of restoration actions.

Spawner Surveys - Existing

In the fall of 2011, SRA and CDFW initiated an intensive coho salmon monitoring program funded by the Fisheries Restoration Grant Program (FRGP) to assess coho salmon abundance throughout the Smith River basin, including in Mill and Rock Creeks. The initial five-year adult and juvenile monitoring program was the largest aquatic survey conducted in the Smith River basin implementing standardized CDFW CMP methodologies. These surveys included repeated surveys, used mark-recapture to estimate redd abundance (as a surrogate for adult abundance), and also recorded numbers of live adults and uniquely tagged carcasses (Walkley and Garwood 2017). These surveys confirmed that Mill Creek, and in particular the West Branch and East Fork sub-basins, are the primary producers of coho salmon in the Smith River basin (Walkley and Garwood 2017). Since 2016/2017, CDPR has assisted CDFW and SRA in continuing the surveys. Redd estimates were highest in 2011/2012, coincident with the highest annual number of observed adult coho salmon, and lowest in 2016/2017 (Figure 8). These annual variations may be further exacerbated by the drought conditions experienced in California from 2011 to 2017.

Spawner Surveys - Recommended

Spawner surveys and resultant adult abundance estimates are crucial components to any aquatic restoration program. Using existing spawner survey methods, future monitoring efforts should expand census area and monitoring reaches to include Rock Creek.

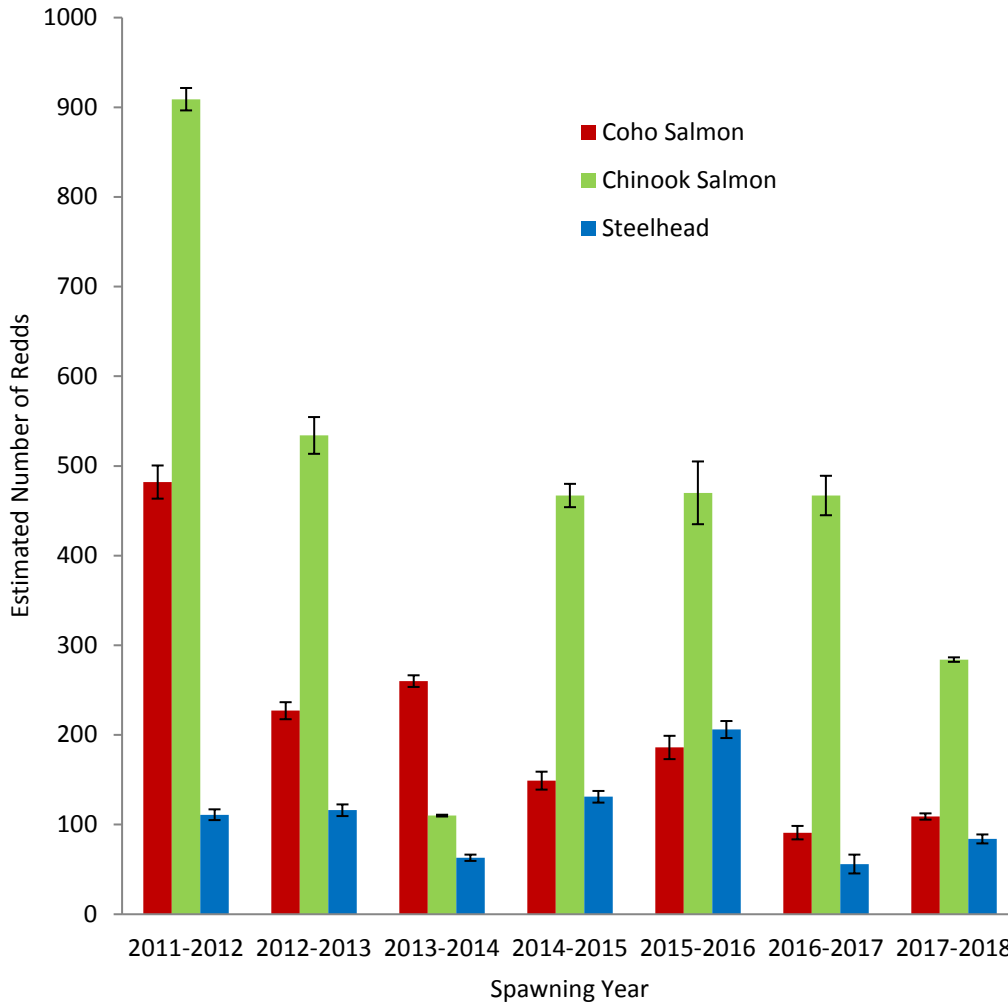


Figure 8. Estimated total number of redds produced in the Mill Creek LCS spawner survey sample frame by species and spawning year, Smith River basin, Del Norte County, CA. Error bars represent 95% confidence intervals around point estimates. Steelhead estimates do not represent the entire steelhead spawning season since surveys ended in March of each year. 2011-2016 data from Walkley and Garwood 2017; 2016-2018 Garwood et al. 2018 (in prep.)

Downstream Migrant Monitoring - Existing

The Mill Creek salmonid outmigrant trapping program is one of California’s longest running smolt trapping programs and was initiated in 1994 by Rellim Redwood Company in response to coho salmon entering endangered species candidacy for the SONCC ESU (Rellim Redwood Company 1994, Howard and McLeod 2005, McLeod and Howard 2010, Larson 2013, Walkley et al. 2017). From 1994 through 2013, channel spanning pipe traps were installed each spring near the mouths the East Fork Mill Creek and West Branch Mill Creek to estimate smolt production for coho salmon, steelhead, and coastal cutthroat trout and provide annual counts of young-of-the-year (YOY) Chinook salmon, YOY coho salmon, and other fishes. While pipe traps are generally very efficient at capturing juvenile fish, they are susceptible to blowing out at high flows resulting in lost trapping time; while also hindering movement of upstream and

downstream migrating adults. Furthermore, these traps were not intercepting individuals that emigrated into and reared within mainstem Mill Creek prior to trap installation (early emigrants). CDFW took over the trapping effort in 2014 and replaced the pipe traps with a floating rotary screw trap located approximately 7 kilometers downstream of the Mill Creek forks. Additionally, CDFW and other partners installed and operated three passive integrated tag (PIT) antennas and conducted fall tagging efforts of juvenile coho salmon to investigate key life-history traits such as overwinter survival rates and early emigration of juvenile coho salmon out of Mill Creek.

Annual smolt abundance was estimated separately for the East Fork and West Branch prior to 2014 (pipe traps); however, after 2014 (rotary screw trap) annual abundance estimates were made for the Mill Creek basin because of the change in trapping location (Walkley et al. 2017). Outmigrant spring coho salmon smolt abundance was higher in the West Branch for all but two years between 1994 and 2013 (Figure 9). Average coho smolt abundance estimates for 2014-2017 was roughly 40% higher than the average coho smolt abundance for 1994-2013, which suggests that a greater proportion of the basin's spring outmigrating coho salmon are being accounted for with the new trap location (Walkley et al. 2017). PIT tag array detections in Mill Creek and the Smith River estuary revealed a significant proportion of coho salmon emigrate before the spring. Walkley et al. (2017) report a minimum of 15.2-26.2% of detected fall tagged coho salmon were detected passing PIT tag arrays prior to the rotary screw trap installation during 2013-2016.

Downstream Migrant Monitoring - Recommended

Operationally, reducing the number of traps has resulted in a single Mill Creek spring outmigrant estimate for a given species instead of the separate West Branch and East Fork estimates prior to 2014. Determining smolt abundance estimates for specific drainages within GMC could aid in evaluating salmonid response to restoration action, however, current methods are lacking. Therefore, continued operation of the existing Mill Creek rotary screw trap is recommended to obtain smolt estimates.

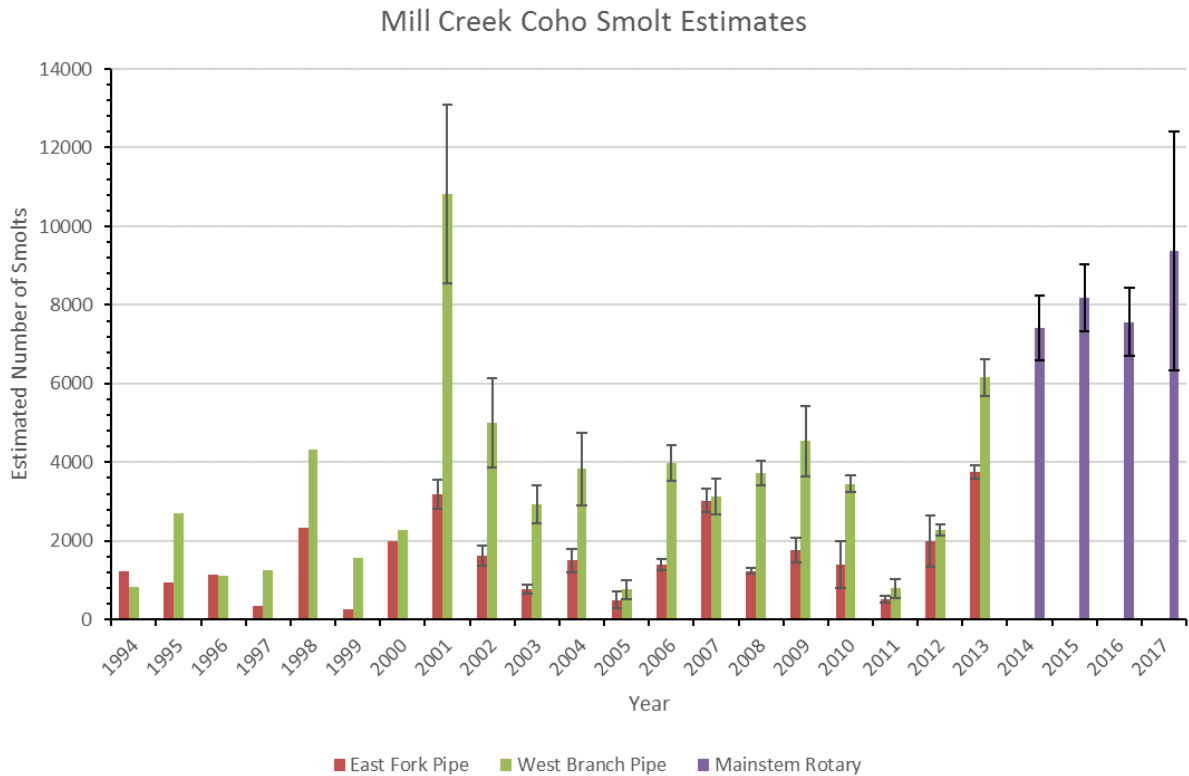


Figure 9. Mill Creek Coho Salmon smolt estimates obtained from outmigrant trapping studies from 1994-2017 from Walkley et al. 2017.

Summer Juvenile Abundance and Distribution Monitoring - Existing

Juvenile summer abundance and spatial distribution in the GMC has been derived from snorkel survey counts standardized via either electroshocking (Hankin and Reeves 1988) or multiple independent dive passes (Larson 2013, Walkley and Garwood 2017, Garwood et al. 2019 *in prep*). Summer abundance estimates of juvenile coho salmon and other salmonids in the GMC were generated from 1994 through 2011 by the Rellim Redwood Company and the Mill Creek Fisheries Monitoring Program and are summarized in Larson (2013). Population estimates were made for four distinct habitats: slow pools, deep pools, runs and riffles. Excluding years with unreliable estimates, summer juvenile coho salmon estimates ranged from 2,659 (2010) to 24,527 (2005) in the West Branch and 1,556 (2010) to 12,067 (2005) in the East Fork. Summer juvenile coho salmon abundance estimates were higher in the West Branch for all years except 2009 (Larson 2013).

Beginning in the summer of 2012, SRA and CDFW implemented snorkel surveys to estimate summer spatial distribution of coho salmon and other salmonids throughout a randomly selected set of reaches with pools defined as the primary sampling unit (see Walkley and Garwood 2017 for methods). The sample frame for this effort encompasses the entire Smith River basin, including Mill Creek and Rock Creek, and incorporates both reach-level and pool-level occupancy while accounting for imperfect detection rates. Not all reaches in the GMC area are

surveyed annually by this effort. Figure 10 outlines the Mill Creek and Rock Creek sample frame and provides a summary of juvenile salmonid observations made from 2012 through 2016.

Summer Juvenile Abundance and Distribution Monitoring - Proposed

Juvenile salmonids are often easier to detect and count across a landscape than adults. Thus, instituting a census of summer spatial distribution reaches in the GMC (similar to the Mill Creek spawning reach census) or at least identifying, a panel of key index reaches to sample annually will likely prove useful for both identifying degraded areas in need of restoration and evaluating the success of habitat restoration projects.

Sediment Transport and Embeddedness Monitoring - Existing

Increased suspended sediment can negatively impact salmonid health. The suspended sediment surveys conducted by USGS in Mill Creek in the 1970's occurred while the watershed was managed for industrial logging. Total average sediment yield during this period (1975-1981) was 140 tons/km² (400 tons/mi²). Of the total load, 60% was suspended sediment, 30% dissolved load, and 10% bedload (Madej et al. 1986). Based on equations developed by Newcombe and Jensen (1996), results found that even the highest measurements of suspended sediments were sub-lethal to salmonids under the various flows monitored during this monitoring period (CDPR 2011). Additionally, Madej et al. (1986) reported that Mill Creek produced one to two orders of magnitude less suspended sediment than other North Coast watersheds during a similar period of recorded.

Embeddedness is the measure of the extent to which large particles (i.e., boulders, cobble, gravel) are surrounded or buried by fine sediment. Fine sediment can negatively impact survival of developing salmonid eggs buried in stream substrates (Lapointe et al. 2004). Field experiments by Suttle et al. (2004) showed decreased growth and survival of steelhead parr with increased levels of embeddedness. Substrate embeddedness in Mill Creek and Rock Creek is low compared to other North Coast watersheds of similar size (Rellim Redwood Company 1995, CDPR 2011).

Sediment Transport and Embeddedness Monitoring - Proposed

Future sediment monitoring should evaluate effects of LW loading and other restoration actions on sediment transport and substrate embeddedness within the GMC area. Pebble count surveys will be conducted to assess embeddedness using the Particle Size Distribution and Particle Embeddedness v1.0 (Bouwes and Rentmeester 2014). Water quality probes and surface water temperature probes will be deployed at various locations to be determined.

Longitudinal Profile, Cross Section, and LW Monitoring - Existing

Topographic surveys can detect changes instream gradients, facies, pool frequency, depth, and wood loading through time. The longitudinal profile of the East Fork Mill Creek was surveyed in 2002 and 2014. The 2014 surveys extended approximately 1200 m, from near the

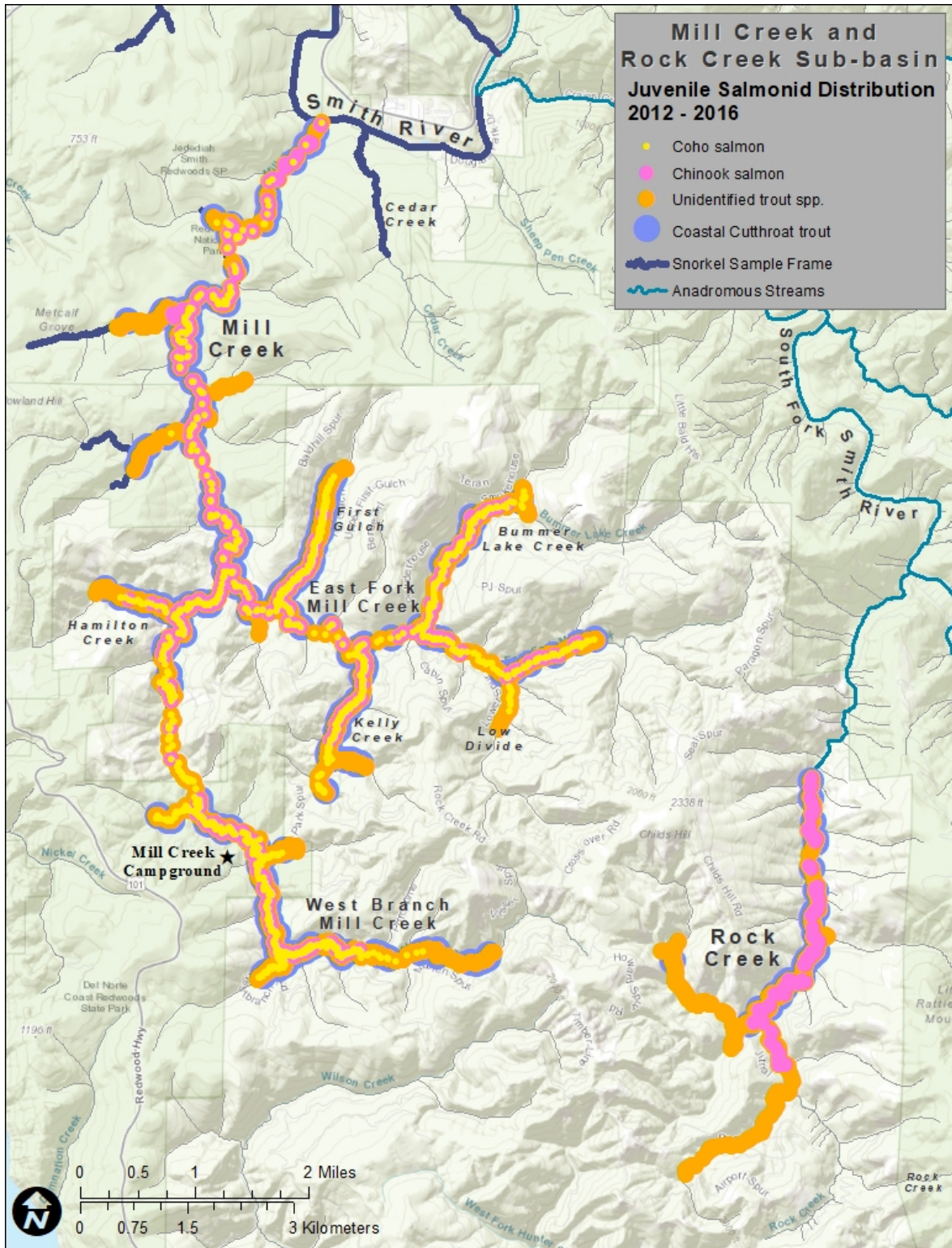


Figure 10. Map showing all salmonid observations during summer snorkel surveys across five years of sampling (2012 – 2016) in Mill Creek and Rock Creek sub-basins. Adapted from Walkley and Garwood 2017.

confluence with Kelly Creek upstream to the confluence with Bummer Lake Creek. The 2002 surveys completely overlap this section and extended further upstream and downstream of this area. The 2002 data used an arbitrary vertical datum while the 2014 survey used known elevations and locations using geographic information systems. While steps were taken to compare these two data sets, large variation in the two surveys near station 3,818 are evident and may be due to an error in the 2002 data set (NHE 2015, Figure 11). No longitudinal survey data has been collected in Rock Creek, however Rellim Redwood Company (1994) reported that 48% of the 9 miles surveyed in Rock Creek were pools. The majority of these pools had a maximum depth of at least 2 feet.

Carrol and Robison (2007) found pools to be spaced 1.8 and 3.2 bankfull widths in the West Branch and East Fork, respectively. Bankfull widths ranged from 17 to 21 m in their study areas and showed that pool frequency increased with increased wood loading. This study suggests that a fivefold increase of large wood frequency (pieces per 100 m) is needed in the East Fork Mill Creek in order to reach conditions equal to Prairie Creek; the reference reach located in an old growth dominated forest. During the 2014 longitudinal survey, LWD was recorded, including notes of past restoration installed log structures.

Longitudinal Profile, Cross Section, and LW Monitoring - Proposed

Survey control points were established in 2014 and should be used in future topographic surveys and mapping to allow for comparisons across all surveys. Establishing a repeatable survey area and surveying baseline conditions of stream conditions in both Mill Creek and Rock Creek is recommended, prior to additional wood loading to assess impacts of restoration actions.

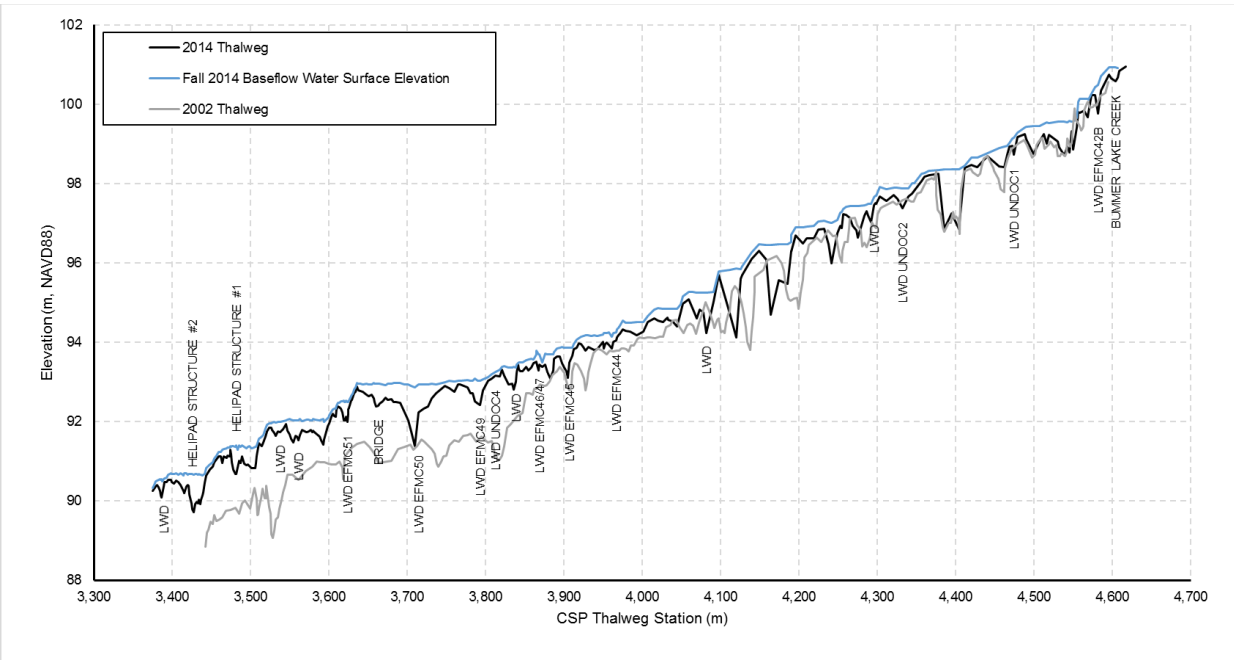


Figure 11. Longitudinal profile of the East Fork Mill Creek from approximately Kelly Creek upstream to Bummer Lake Creek during surveys conducted in 2002 and 2014. Large woody debris (LWD) and prominent landmarks are identified on along the profile (NHE 2015).

Conclusion

With the implementation of the Redwoods Rising Greater Mill Creek Ecosystem Restoration Program, and specifically the information within this Aquatic Habitat Restoration Strategy, stream habitat conditions within the Redwoods Rising GMERP are intended to improve. Other CDPR programs are in process to fulfill the goals and objectives of this plan so the strategy discussed is focused on large wood. Because this effort is anticipating to extend many years, monitoring as described above will also allow for adaptive management during implementation of program actions.

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Appendix A

East Fork Mill Creek Instream Restoration and Monitoring, A Summary Report 1994 – 2019, Del Norte Coast Redwoods State Park

California Department of Parks and Recreation, North Coast Redwoods District

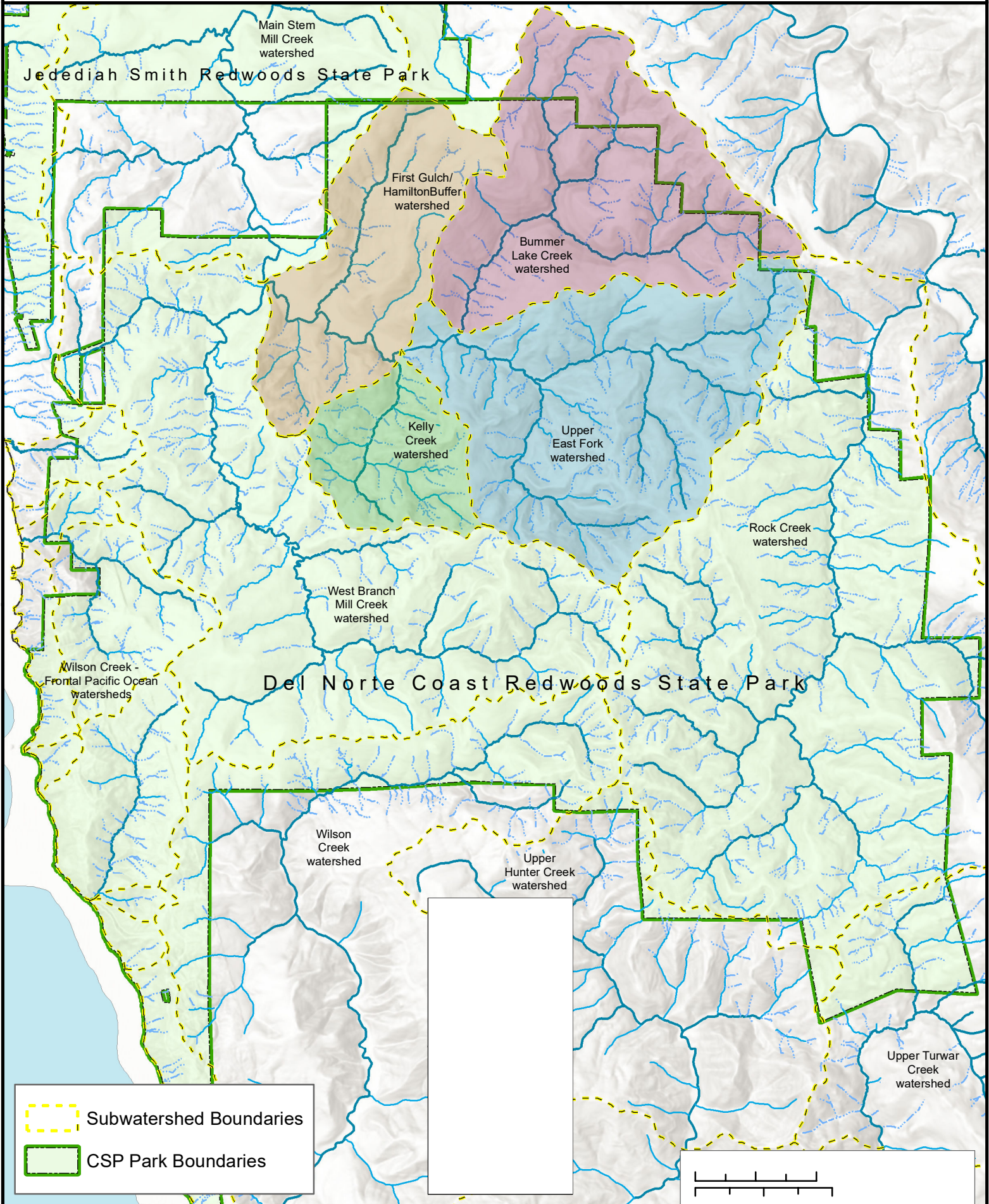
March 2019

INTRODUCTION

This report provides a 25-year summary of instream restoration and monitoring efforts between 1994 and 2019 in the East Fork Mill Creek (EFMC) Watershed, Del Norte Coast Redwoods State Park (DNCRSP, Figure 1). Information in this report is based on the following sources: Benegar 2011, Fiori 2010, Fiori 2012, Flannery et al. 2017, Pryor 2015, Rodriguez 2018; and California Department of State Parks (CDPR) North Coast Redwoods District databases.

The Mill Creek Addition of DNCRSP was acquired in 2002, in part, to protect one of California's most productive coho salmon (*Oncorhynchus kisutch*) populations. Past timber harvest and related road construction in the Addition left a landscape of failing culverts, increased sediment delivery, reduced heterogeneity, and lost ecosystem function. In DNCRSP, large woody debris (LWD; also referred to as large wood) was routinely removed from streams until 1992 (Fiori 2010). Wood removal was intended to improve fish passage and stream stability, however this practice has since been abandoned and efforts have been underway to restore wood levels.

LWD produced by standing and fallen trees plays an important role in the form and function of stream ecosystems, particularly for salmonid populations (summarized in Flannery et al. 2016). LWD are logs, root wads, and branches that fall into a stream where it helps to stabilize banks and alter geomorphic features (Flannery et al. 2016). Intensive logging and deliberate stream clearing removed much of the LWD and recruitment trees, converting a structurally complex conifer forest to a simplified alder dominated forest. The wood produced by the resultant alder stands is less persistent and of less value in the biogeomorphic systems that support salmon (Fiori 2010). Monitoring results in Fiori (2010) suggest the most direct approach to influence salmon recovery is through sub-watershed scale biogeomorphic designed wood loading and comprehensive upslope restoration. A progression of instream restoration projects has been implemented in the EFMC Watershed over the last 25 years with the primary goal of promoting ecosystem function and the development of high value habitat to benefit fish and wildlife. This document summarizes the evolution of instream restoration in EFMC to date, and may be used to guide future LWD placement and monitoring.



INSTREAM RESTORATION & ENHANCEMENT EFFORTS

Instream restoration efforts in the EFMC are summarized in Table 1 and are depicted in Figure 2.

Table 1. EFMC LWD Sites by Year Constructed and Design Approach

Year Constructed	Design Approach				Total
	CDFW	CDFG/Bio-Geomorphic	Bio-Geomorphic	Helicopter Wood Loading	
1995	49				49
2006		12			12
2008			14		14
2011			19	72	91
2012			4		4
Total	49	12	37	72	170

CDFW 1994/1995

The goal of this project was to install several large wood and boulder structures in locations throughout the Mill Creek Watershed to improve rearing habitats for juvenile salmonids (Fiori 2010). The project was conducted by the California Conservation Corps (CCC) with field oversight by CDFG (Schwabe 1998), following designs from the CDFW's California Salmonid Stream Habitat Restoration Manual (Flosi and Reynolds 1994). In 1995, a total of 49 sites (Table 1, Figure 2) were constructed within the EFMC watershed (Schwabe 1998). Structures typically consisted of 1 to 4 logs, ballasted and anchored to imported rock and/or riparian trees with cable and bolts.

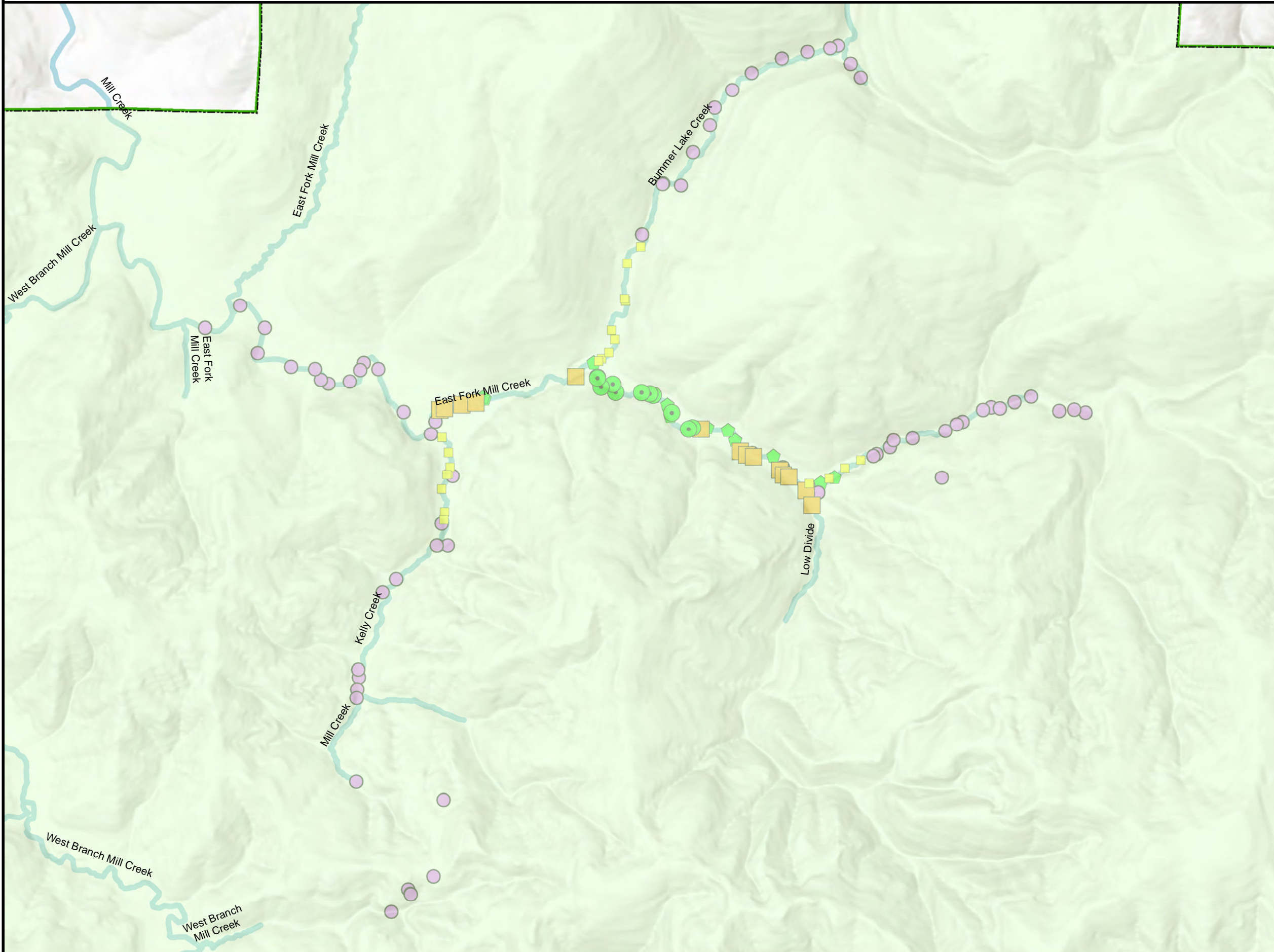
CDFG/BIOGEOMORPHIC DESIGN HYBRID 2006

This demonstration project was a collaboration between CDPR and California Department of Fish and Wildlife (CDFW) to evaluate the performance and stability of complex wood jams (CWJ). CWJ are biogeomorphic features designed to mimic the form and function of naturally occurring log jams without requiring the need of imported rock or anchoring hardware for stability (Fiori 2010). During the 2006 operating season, 12 CWJ sites were created (Table 1, Figure 2). Typical installations consisted of 1-4 logs, intertwined with riparian trees and rebar (Fiori 2010).

BIOGEOMORPHIC DESIGN 2008

In 2008, 13 CWJ were installed in the EFMC (Table 1, Figure 2). Restoration objectives consisted of increasing hydraulic complexity; increasing floodplain connection; creating pools, foraging, resting, and cover habitat for salmonids; trapping and sorting sediments; and creating key jams to wrack mobile wood (Benegar 2011). Each CWJ was designed to mimic naturally occurring log jams without the requirement of imported

Figure 2. East Fork Mill Creek Instream Restoration, All Sites
Del Norte Coast Redwoods State Park



Legend

- 1994_Wood Loading Sites
- 2006 Wood Loading Sites
- 2008 Wood Loading Sites

2011 Wood Loading Sites

InstallationType

- ◆ Excavator
- Helicopter
- 2012_Berm

— SmithAnadromy2015



rock or anchoring hardware for stability. In addition, they were designed to interact with variations in stream flow, hydraulic forces, floodplain morphology, and dominant sediment transport regime (Benegar 2011). Numerous factors such as fish utilization, equipment access, and an assessment of potential effects to the geomorphology of the streambed, floodplain and downstream infrastructure (e.g. bridges) were considered (Benegar 2011).

The 2008 CWJ sites were constructed with an excavator using multiple large diameter key stems -or, the structural pieces with attached root wads. Most large key stems were installed with the lower bole of the tree and root wad placed in the active channel. Stems were then woven between standing trees in the riparian zone to limit displacement during high flows. Once the key stems were in place, additional logs and branches were incorporated into the structures to add complexity and cover and to mimic naturally occurring wood jams. Anchoring hardware was used at one site upstream of the Rock Creek Road Bridge to increase the safety of the infrastructure (Fiori 2010)

A variety of jam types were constructed including deflector, opposing, constrictor, and underflow. Sites often consisted of multiple structures and sometimes of different jam types. Diagrams of these structures can be found in Benegar (2011).

The 2008 project also reintroduced mobile wood within the anadromous reaches of the EFMC. Mobile wood, or enrichment, consisted of small diameter (approximately 6-20 inches) and relatively short (15-20 feet) pieces of wood that were placed in the active stream channel from low impact access points that would become mobilized with winter flows. This mobile wood would then be captured by the CWJ and supplement the structures. It was anticipated that this enrichment would reoccur approximately every 5 years depending on natural wood inputs and condition of the structures thereby extending the life of the structure.

BioGeomorphic Design 2011

The biogeomorphic instream restoration of 2011 was a continuation of the 2008 work and used similar construction techniques. Thirteen (13) CWJ's were constructed, 2 existing CWJ received wood augmentation, and mobile wood was deployed at 4 locations (Table 1, Figure 2).

The 2011 CWJs were intended to be relatively stable and function over the range of flows that occur within the main channel and flood prone surfaces. The wood loading features were designed and constructed to: 1) increase instream habitat complexity (pool depth and cover), 2) improve spawning gravel sorting and availability, 3) meter sediment and wood transport, and 4) increase floodplain connectivity and off-channel habitat complexity (Fiori 2012).

Two CWJ structures were constructed as bar apex jams at strategic locations to improve stream connectivity with two historic high flow channels. Channel spanning log jams were constructed at locations approximately 700 feet upstream of the Bummer

Lake Creek and the Upper EFMC bridges to reduce potential risk to bridges from mobile wood. Additional jam types including meander bend, opposing, deflection, cover and combination structures were constructed. The number of key logs used in structures ranged from 1 to 20. A large amount of smaller (diameter and length) stems and brush were incorporated into the construction of these jams (Fiori 2012). Several key logs and smaller pieces of wood and brush were added to augment two pre-existing CWJs (one from 2006 and one from 2008). Based on field observations of the performance of the existing features, it was determined that wood augmentation was needed to improve jam performance at the site and reach scales (Fiori 2012).

In addition, single to multiple logs were placed within the floodplain to provide habitat and enhance aquatic conditions during high flow events. The intent of these were to remain in the floodplain where they would provide additional habitat; however, it was acknowledged that they may be transported into the active channel. This was the first attempt to provide CWJ completely outside of the active channel.

Fifteen pole size logs (approximately 15 feet long with a 6 to 20 inch top diameter) were placed within the active channel at four mobile wood enrichment sites, for a total of 60 pieces. This wood was positioned so that it would be transported during high flows downstream into existing structures where it would rack naturally and increase habitat complexity and biogeomorphic function.

HELICOPTER STRUCTURES 2011

In 2011, California State Parks installed 72 instream structures utilizing a helicopter (Table 1, Figure 2). Structures were installed in areas not easily reachable by excavator. Sites were primarily up and downstream of the 2008 and 2011 biogeomorphic sites on the EFMC and in upper Bummer Lake Creek and Kelly Creek - tributaries to the EFMC.

Structures placed on the EFMC were designed to meet many of the same functions of the 2008 and 2011 biogeomorphic projects. At these sites, ground crews would direct the helicopter to specific sites and instruct the pilot on log placement and numbers. When possible, the root wad and lower bole of the stems were placed in the channel and the upper portions were placed on the floodplain thus providing greater stability to the structures. These sites had anywhere from 2 to 4 stems installed. Fifteen (15) structures were installed downstream of the Rock Creek Road Bridge and 20 were placed upstream of the last (most upstream) Childs Hill Road Bridge.

Structures installed in Bummer Lake and Kelly creeks were placed at the pilot's discretion. The pilot was given instructions on the way to install the structures and the goals of the project and was then allowed to use his judgement on the placement. This was done to save time and costs and to prevent the helicopter and flight crew from having down time while ground crews traveled between dispersed sites with limited access. The pilot was instructed to drop the root wad or larger end of the stem into the riparian zone over the stream and then fly upstream until he could negotiate the log into the creek. If possible, the pilot was told to try to drop the upper part of the stem on the

bank. This would place the root wad or larger end of the log downstream to help anchor the log(s). Most of these structures consisted of 1-2 logs.

As with the other projects, logs were obtained from road removal projects within the Mill Creek Watershed. Logs were staged at the deck area adjacent to the Rock Creek Road Bridge. Most of these stems had root wads. Once these stems were utilized, the helicopter pilot was then instructed to collect logs from older road removal projects. Sufficient funding was available to continue operations; however, there was not a sufficient supply of logs and therefore the operations were halted early.

2012 BERM REMOVAL

Two constructed berms on channel right of the EFMC, upstream of Bummer Lake Creek confluence were removed with heavy equipment in 2012 (Figure 2). The material was end hauled to a disposal site. The purpose of this project was to allow bankfull discharge events to reactivate the floodplain in this area. Approximately 4 trees growing in the berm were knocked over and placed against channel left. These trees were not anchored into existing riparian vegetation and were just placed into the channel. It was assumed that they would be sorted by the stream.

2012-PRESENT

No instream restoration work has been conducted in EFMC from 2012 to present.

BIOGEMORPHIC INSTREAM MONITORING EFFORTS

2009 Benegar – Evaluation of Constructed Wood Jams

As part of the 2008 biogeomorphic installations, CDPR funded a graduate student to examine the effectiveness of the CWJ as compared to simplistic designs. Benegar (2011) investigated if the CWJ, which incorporated whole tree materials and an increased wood piece count and greater volume, was more efficient at creating the hydraulic conditions necessary for increasing instream complexity, geomorphic function, and aquatic habitat quality.

Benegar (2011) concluded that CWJ were more effective than simple fish habitat structures in 1) increasing percentage pool cover; 2) increasing pool habitat; 3) enhancing salmon spawning gravels; and 4) increasing habitat heterogeneity. In addition, CWJ were found to be more effective at racking additional mobile wood thereby increasing the percentage of pool cover (Benegar 2011). This work is presented in Benegar (2011) and Flannery et al. (2018, née Benegar).

2013 INSTREAM MONITORING

In 2013, CDPR conducted post implementation monitoring of the placement of LWD within the EFMC. Monitoring followed Montgomery (2008), and included photo points approximately 10-15 meters upstream of the structure. Both naturally occurring and constructed wood jams were monitored. The monitoring was designed to occur every 5-

**East Fork Mill Creek Instream Restoration and Monitoring, A Summary Report 1994 - 2019,
Del Norte Coast Redwoods State Park.**

10 years to track both naturally occurring log jams, persistence of the constructed jams, and to track mobile wood movement through EFMC.

Approximately 5.4 kilometers of stream was surveyed from the last bridge on Childs Hill Road prior to road leaving the lower valley, to the last bridge on EFMC before the confluence with West Branch Mill Creek (Figure 3). This included the area of the EFMC where most of the instream restoration had occurred. The lower 0.5 kilometers of Bummer Lake Creek was also surveyed

Out of the 5.4 km area surveyed in the EFMC, there were 41 sites classified as natural recruitment and 80 classified as constructed sites. These constructed sites were difficult to distinguish between the various years and an attempt was made to differentiate between the 2006, 2008, and 2011 sites. In some circumstances there were multiple structures per site. In other circumstances, the wood was transported and racked onto sites downstream. The 80 constructed sites serves as a point-in-time effort to estimate the amount of wood at specific locations in 2013. There may have been more sites initially constructed and have been buried or transported.

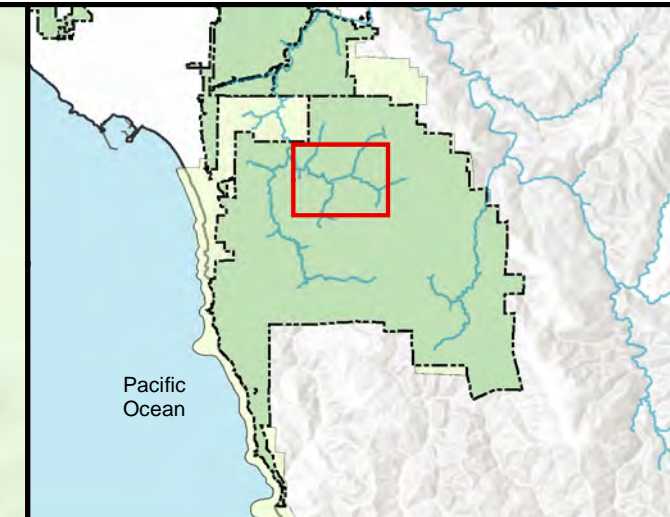
In 2013, EFMC had approximately 7-8 natural recruitment sites and 15 constructed sites per kilometer. The natural sites are considered an underestimate as there was a large amount of submerged wood that was likely missed or difficult to sample accurately and floodplain wood that was not sampled. The determining factor for natural recruitment and recruitment into a CWJ was if the naturally occurring wood was racked onto a CWJ. Generally, the natural recruitment wood was material that was undercut and subsequently fell in. If this wood traveled and was racked onto a CWJ, it was incorporated into the CWJ wood count estimate. Of the sites classified as natural recruitment, it was difficult to determine if logs were transported from riparian zones or engineered jams upstream. Surveyors would look for evidence of mechanical transport, i.e. marks from helicopter or excavator picking it up as well as look for openings in the riparian canopy where a helicopters could have placed wood. It was difficult to differentiate naturally recruited wood from helicopter placed and subsequently transported wood.

The lower 0.5 kilometers of Bummer Lake Creek was surveyed. Six (6) CDFW design constructed structures with associated cables and bolts, and 6 sites that are believed to have been naturally recruited as they were not in the area where helicopter operations occurred in 2011

2014 EAST FORK MILL CREEK LONGITUDINAL PROFILE

In the fall of 2014, CDPR, with technical assistance from Northern Hydrology & Engineering, established a georeferenced longitudinal profile along the EFMC. The reach extended from the confluence of Bummer Creek and EFMC and continued approximately 100 meters downstream of the Rock Creek Road Bridge. This reach was chosen as it had a well-defined upper limit and because it included the bedrock control on the EFMC. It also includes some of the excavator constructed engineered log jams and a couple of helicopter assisted log jams at the lower extent.

Figure 3. East Fork Mill Creek Instream Restoration Monitoring, All Sites Del Norte Coast Redwoods State Park



Legend

**2013 Instream Monitoring
Count_LWD**

- 2 - 10
- 11 - 25
- 26 - 50
- 51 - 83
- 84 - 146
- SmithAnadromy2015



**East Fork Mill Creek Instream Restoration and Monitoring, A Summary Report 1994 - 2019,
Del Norte Coast Redwoods State Park.**

The project generated topographic data associated with pool frequency, depth, riffle length, and LWD. A formal report was not generated, however, the data is summarized in GIS and Excel workbook files. Data from a 2003 longitudinal profile surveyed by National Parks Service was also included, but could not be directly compared with 2014 survey due to discrepancies in stationing (Pryor 2015). The 2003 NPS profile was based off of an arbitrary vertical datum that was not georeferenced. Due to the lack of georeferenced control points the NPS data experienced elevational deviations as they went further downstream resulting in the data from the area of the Rock Creek Road Bridge downstream being incomparable with the 2014 CSP georeferenced data.

Long profile monitoring was designed to occur every 5 years to assess long term changes in the stream profile and performance of wood structures.

2016 RODRIGUEZ - PERSISTENCE OF STREAM RESTORATION WITH LARGE WOOD

In 2016, Rodriguez (2018) revisited Benegar's (2011) study sites to compare channel change and large wood attributes 8 years later. Rodriguez (2018) found an overall increase in floodplain connectivity, bankfull width, and lower channel gradient leading to an increase in hydraulic complexity. Rearing habitat for juvenile salmonids were further enhanced by trapping and sorting sediments and exposing spawning habitat (Rodriguez 2018). The results reported by Rodriguez (2018) supported several of the long term goals of the 2008 biogeomorphic project.

2016-PRESENT

No biogeomorphic monitoring has been conducted from 2017 to present.

Compiled by: John E. Harris & Walter Mackelburg, California State Parks, North Coast Redwoods District.

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Appendix H

Alternatives Considered but Eliminated

Appendix H: Alternatives Eliminated from Further Consideration

CDPR and NPS considered the alternatives described in the following subsections to restore ecosystems in the project area and determined that these alternatives either do not meet the purpose and need for the Proposed Action, are inconsistent with approved general plans, or that CDPR and NPS do not currently have the authority to pursue these alternatives.

Lop-and-Scatter Only

A lop-and-scatter only alternative would involve lop-and-scatter operations throughout the entire project area, with no biomass removal. This alternative was dismissed because it would increase fire hazard from increased fuels on the ground and would prohibitively increase the costs of restoration. It would not meet management objectives for forest restoration or fire management in the project area and was not carried forward for full analysis.

Low-intensity Thinning from Below

A basal area reduction of 25 to 30% (low-intensity thin from below) was considered. Results from past thinning efforts in the project area show that thinning from below would not release the dominant and co-dominant trees because this method concentrates on cutting trees in the intermediate and suppressed crown classes. Low-intensity thinning from below would not generate the growth response desired to accelerate the development of old-growth characteristics in as short a time as the Proposed Action. Therefore, this alternative would not meet the Proposed Action purpose and need and was not carried forward for full analysis.

Removal of Crossings Only (on NPS Land)

This alternative would involve removing blocked stream crossings but retaining all roadways on NPS land. This would reduce the amount of fill removed as part of partial road removal activities; however, it would leave in roadways that would continue to erode and cause sedimentation issues in the watershed. Therefore, this alternative would not meet the Proposed Action purpose and need and was not carried forward for full analysis.

Reduced Project Area (on CDPR Land)

CDPR and NPS considered an alternative consisting of a smaller project area, including only Phase 1. A smaller project area would not accomplish the stated ecosystem restoration objectives; therefore, this alternative was not carried forward for full analysis.

Appendix I
Photographs

Appendix I: Photographs

Photograph 1

Previously logged second growth forest (top) compared to neighboring old-growth (bottom) in the Prairie Creek Redwoods State Park



Photograph 2

Construction of large woody debris structure in the East Fork of Mill Creek, showing conditions before construction (left) and the same stretch following construction (right)



Photograph 3

A large aquatic habitat structure in Mill Creek following the first rain



Photograph 4

An excavator places large wood into an aquatic habitat structure in Mill Creek. Large wood pieces are interlocked with existing trees on the stream bank to secure the structure



Photograph 5

A helicopter transports and places a piece of large wood that will augment previously constructed structures in Mill Creek watershed



Photograph 6

A smaller large wood structure provides essential habitat for anadromous fish in Mill Creek



Photograph 7

A remaining logging road slowly erodes away, putting sediment into streams



Photograph 8

A young second-growth forest grows around a large stump that was left following a timber harvest



Photograph 9

Coho salmon



Photograph 10
Marten



Photograph 11

Abandoned roads are not usable by vehicles or heavy equipment. Because they have not been maintained, they erode during storm events and contribute large inputs of sediment to the streams. These roads will be upgraded for forest restoration access, then removed when restoration in the area is completed



Photograph 12

An excavator removes a stream crossing by digging down to the original buried stream channel. The fill is placed on the road, where a bulldozer pushes it out to an adjacent cutbench to be stabilized and recontoured into the hillslope



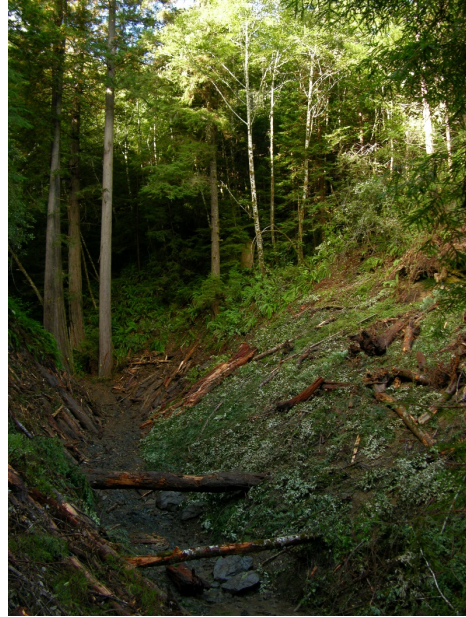
Photograph 13

Excavation team at work. An excavator and bulldozer work together on a stretch of road to recontour natural hillslope topography and drainage patterns



Photograph 14

The same stream crossing after treatment; the stream banks are shaped to the existing hillslope above and below the removed road. Vegetation and logs that were removed from the road prism are spread over the surface as mulch



Photograph 15

An example of a young, overly dense forest being thinned to improve growth and maintain forest health



Photograph 16

A series of photos showing an area before, immediately after, and 11 years after treatment. The forest shown in the left part of the photos was not thinned for comparison



Photograph 17

As part of ground-based operations, a skidder pulls cut trees to a small landing where they are processed and loaded onto a haul truck



Photograph 18

Prescribed fire being used to reduce fuel loads and slow encroachment



Appendix J

Special-Status Species Tables

Appendix J: Special-Status Species Tables

Table J-1
Database Query Results of Special-Status Fish and Wildlife in the GMC Project Region

Common Name Scientific Name	Query Sources	Status Federal/ State	Distribution in California	Habitat Association	Likelihood to Occur in Project Area
Mollusk					
Western pearlshell mussel <i>Margaritifera falcata</i>	CNDDDB	-/- ¹	Widely distributed throughout coastal streams and large rivers; primarily north of Big Sur	Clear, nutrient-poor, cool, highly oxygenated, low-mineralized, and moderate-to-fast flowing water; found in gravel, lodged between cobbles, boulders, bedrock, or areas of coarse sand	High: known to occur in project area
Fish					
Pacific lamprey <i>Entosphenus tridentatus</i>	State parks	-/SSC	Widely distributed throughout coastal streams and large rivers; primarily north of Big Sur	Spawning occurs in gravel and cobble substrates located in in pool tail-outs or low-gradient riffles; larval rearing generally occurs in low-velocity, silty backwater areas	High: known to occur in project area
River lamprey <i>Lampetra ayresii</i>	State parks	-/SSC	Documented in lower Sacramento-San Joaquin River system: Napa River, Sonoma Creek, Alameda Creek, tributaries to the San Francisco Bay, and lower Sacramento and San Joaquin rivers; Salmon Creek, Russian River, Eel River	Spawning occurs in gravel and cobble substrates located in in pool tail-outs or low-gradient riffles; larval rearing generally occurs in low-velocity, silty backwater areas	High: known to occur in project area

¹ The western pearlshell mussel is not a special-status species; however, it is on the CDFW Special Animals List (CDFW 2018d), has a state ranking of critically imperiled, and was incorporated into this document at the request of CDFW during the agency scoping process held by Redwoods Rising.

Common Name Scientific Name	Query Sources	Status Federal/ State	Distribution in California	Habitat Association	Likelihood to Occur in Project Area
Green sturgeon: southern DPS <i>Acipenser medirostris</i>	CNDDDB, NMFS	FT/SSC	San Francisco, San Pablo, Suisun, and Humboldt bays; Sacramento–San Joaquin Delta, Sacramento and Klamath rivers	Spawns in pools of large freshwater river mainstems with cool water and cobble, clean sand, or bedrock; in San Francisco Bay, adults tend to use water depths less than 33 feet to swim near the surface or forage along the sea floor	None: habitat not present within project area
Longfin smelt <i>Spirinchus thaleichthys</i>	CNDDDB	FPT/ST, SSC	San Francisco estuary from Rio Vista or Medford Island in the Delta as far downstream as South Bay; concentrated in Suisun, San Pablo, and North San Francisco bays; historical populations in Humboldt Bay, Eel River estuary, and Klamath River estuary	Adults in large bays, estuaries, and nearshore coastal areas; migrate into freshwater rivers to spawn; salinities of 15–30 ppt; may be found in smaller river tributaries with mouths close to estuaries	None: habitat not present in project area
Eulachon southern DPS <i>Thaleichthys pacificus</i>	CNDDDB	FT/–	Skeena River in British Columbia (inclusive) south to the Mad River in Northern California (inclusive)	Anadromous fish that has been recorded in the Smith River estuary and lowest portions of the river to spawn; few to no individuals currently use the estuary; most of their life is spent in the ocean	None: habitat not present in project area
Coho salmon, southern Oregon/northern California (SONCC) ESU <i>Oncorhynchus kisutch</i>	CNDDDB, NMFS	FT/ST	Punta Gorda north to the Oregon border	Streams; spawns in gravel riffles	High: known to occur in project area
Chinook salmon, SONCC ESU <i>Oncorhynchus tshawytscha</i>	NMFS	FT/–	Cape Blanco, Oregon to and including the Klamath River and its tributaries downstream of the Trinity River	Coastal rivers and streams; spawns in gravel riffles	High: known to occur in project area

Common Name Scientific Name	Query Sources	Status Federal/ State	Distribution in California	Habitat Association	Likelihood to Occur in Project Area
Steelhead, Klamath Mountain Province DPS <i>Oncorhynchus mykiss irideus</i>	CNDDDB, NMFS	-/SSC	Elk River, Oregon to and including the Klamath River basin	Streams; spawns in gravel riffles	High: known to occur in project area
Coastal cutthroat trout <i>Oncorhynchus clarkii clarkii</i>	CNDDDB	-/SSC	Small, low-gradient coastal streams and estuaries from northern Oregon to the Eel River, California	Spawns in shaded streams with water temperatures below 18°C and small gravel	High: known to occur in project area
Tidewater goby <i>Eucyclogobius newberryi</i>	CNDDDB, USFWS	FE/SSC	San Diego County north to the mouth of the Smith River in Del Norte County	Coastal lagoons and the uppermost zone of brackish large estuaries; prefer sandy substrate for spawning, but can be found on silt, mud, or rocky substrates; can occur in water up to 15 feet in lagoons and within a wide range of salinity (0 to 42 ppt)	None: habitat not present in project area
Amphibians					
Southern torrent salamander <i>Rhyacotriton variegatus</i>	CNDDDB	-/SSC	Coastal drainages from near Point Arena in Mendocino County to the Oregon border	In and adjacent to cold, permanent, well-shaded mountain springs, waterfalls, and seeps with rock substrate	High: known to occur in project area
Pacific tailed frog <i>Ascaphus truei</i>	CNDDDB	-/SSC	Coastal Mendocino County north to the Oregon border, with an isolated population in Shasta region	In and adjacent to cold, clear, moderate- to fast-flowing perennial mountain streams in conifer forest	High: known to occur in project area

Common Name Scientific Name	Query Sources	Status Federal/ State	Distribution in California	Habitat Association	Likelihood to Occur in Project Area
Northern red-legged frog <i>Rana aurora</i>	CNDDDB	-/SSC	Ranges from Mills Creek in Mendocino County to Oregon border	Breeds in still or slow-moving water with emergent and overhanging vegetation, including wetlands, wet meadows, ponds, lakes, and low-gradient, slow-moving stream reaches with permanent pools; uses adjacent uplands for dispersal and summer retreat	High: known to occur in project area
Foothill yellow-legged frog <i>Rana boylei</i>	CNDDDB	-/SCT, SSC	From the Oregon border along the coast to the Transverse Ranges, and south along the western side of the Sierra Nevada Mountains to Kern County; a possible isolated population in Baja, California	Shallow tributaries and mainstems of perennial streams and rivers, typically associated with cobble or boulder substrate	High: known to occur in project area
Reptiles					
Western pond turtle <i>Emys marmorata</i>	CNDDDB	-/SSC	From the Oregon border along the coast ranges to the Mexican border, and west of the crest of the Cascades and Sierras	Permanent, slow-moving fresh or brackish water with available basking sites and adjacent open habitats or forest for nesting	Low: habitat is limited in project area due to low water temperatures

Common Name Scientific Name	Query Sources	Status Federal/ State	Distribution in California	Habitat Association	Likelihood to Occur in Project Area
Birds					
White-tailed kite <i>Elanus leucurus</i>	eBird	-/SFP	Year-round resident; found in nearly all lowlands of California west of the Sierra Nevada mountains and the southeast deserts	Lowland grasslands and wetlands with open areas; nests in trees near open foraging area	Moderate: observed near the mouth of Mill Creek
Bald eagle <i>Haliaeetus leucocephalus</i>	CNDDDB	FD, BGEPA/SE, SFP	Permanent resident and uncommon winter migrant; found nesting primarily in Butte, Lake, Lassen, Modoc, Plumas, Shasta, Siskiyou, and Trinity Counties	Large bodies of water or rivers with abundant fish; uses snags or other perches; nests in advanced-successional conifer forest near open water	High: known to forage in project area
Northern harrier <i>Circus cyaneus</i>	eBird	-/SSC	Year-round resident; scattered throughout California; in the northwest, nests largely within coastal lowlands from Del Norte County south to Bodega Head in Sonoma County, inland to Napa County	Nests, forages, and roosts in wetlands or along rivers or lakes, but also in grasslands, meadows, or grain fields	Low: suitable habitat not present in project area
Golden eagle <i>Aquila chrysaetos</i>	eBird	BGEPA/SFP	Uncommon permanent resident and migrant throughout California, except center of Central Valley	Open woodlands and oak savannas, grasslands, chaparral, sagebrush flats; nests on steep cliffs or medium to tall trees	Low: infrequently observed; may fly over or forage in project area, but no suitable nesting habitat
American peregrine falcon <i>Falco peregrinus anatum</i>	eBird	FD/SD, SFP	Most of California during migrations and in winter; nests primarily in the Coast Ranges, northern Sierra Nevada mountains, and other mountainous areas of northern California	Wetlands, woodlands, cities, agricultural lands, and coastal area with cliffs (and rarely broken-top predominant trees) for nesting; often forages near water	High: foraging only

Common Name Scientific Name	Query Sources	Status Federal/ State	Distribution in California	Habitat Association	Likelihood to Occur in Project Area
Western snowy plover <i>Charadrius alexandrinus nivosus</i>	CNDDDB, USFWS	FT (Pacific coastal population)/SSC (coastal and interior populations)	Nests in locations along the California coast, including the Eel River in Humboldt County; nests in the interior of the state in the Central Valley; Klamath Basin; Modoc Plateau; and Great Basin, Mojave, and Colorado deserts; winters primarily along coast	Barren to sparsely vegetated beaches, barrier beaches, salt- evaporation pond levees, and shores of alkali lakes; also nests on gravel bars in rivers with wide flood plains; needs sandy, gravelly, or friable soils for nesting	None: habitat not present in project area
Marbled murrelet <i>Brachyramphus marmoratus</i>	CNDDDB, USFWS	FT/SE	In California, mostly concentrated on coastal waters near Del Norte and Humboldt counties, and in lesser numbers near San Mateo and Santa Cruz counties; winter throughout nesting range, and in small numbers in southern California	Most time spent on the ocean; nests inland in old-growth conifers with suitable platforms, especially redwood or Douglas-fir forests near coastal areas	High: known to occur in project area
Northern spotted owl <i>Strix occidentalis caurina</i>	USFWS	FT/ST, SSC	Northwestern California south to Marin County, and southeast to the Pit River area of Shasta County	Typically found in older forested habitats; nests in complex stands dominated by conifers, especially coastal redwood, with hardwood understories; some open areas are important for foraging	High: known to occur in project area
Vaux's swift <i>Chaetura vauxi</i>	eBird	-/SSC	Summer resident of northern California; nests in the Coast Ranges from Sonoma County north and very locally south to Santa Cruz County; also found in the Sierra Nevada and possibly in the Cascade Range	Redwood and Douglas fir habitats with large snags, especially forest with larger basal hollows and chimney trees	High: known to occur in project area

Common Name Scientific Name	Query Sources	Status Federal/ State	Distribution in California	Habitat Association	Likelihood to Occur in Project Area
Olive-sided flycatcher <i>Contopus cooperi</i>	eBird	-/SSC	Uncommon to common summer resident throughout California except in deserts, the Central Valley, and other lowland areas	Primarily advanced-successional conifer forests with open canopies	High: known to occur in project area
Willow flycatcher <i>Empidonax traillii</i>	eBird	-/SE	In the Sierra Nevada and Cascade ranges; nests as far south as San Diego County; confirmed breeding along the Eel River, and in mesic clear-cuts in northern Humboldt County	Dense, brushy thickets within riparian woodland, often dominated by willows or alder, near permanent standing water; uses brushy, early-succession forests (e.g., clear-cuts) in the Pacific Northwest	High: known to occur in project area
Yellow warbler <i>Setophaga petechial</i>	eBird	-/SSC	Summer resident; nests in most of California, except most of the Central Valley, high Sierras, and Mojave and Colorado deserts	Open-canopy, deciduous riparian woodland close to water, along streams or wet meadows	High: known to occur in project area
Purple martin <i>Progne subis</i>	CNDDDB	-/SSC	Throughout California	Cavity nesters in large trees or bridges, old buildings, upper slopes of hilly terrains, low canopy near nests	High: known to occur in project area
Mammals					
Sonoma tree vole <i>Arborimus pomo</i>	CNDDDB	-/SSC	Along the North Coast from Sonoma County north to the Oregon border, generally along the fog belt	Humid, coastal coniferous forests with Douglas fir, grand fir, western hemlock, bishop pine, or Sitka spruce	High: known to occur in project area
White-footed vole <i>(Arborimus albipes)</i>	CNDDDB	-/SSC	Between Humboldt and Del Norte counties	Humid mature coastal redwood, Douglas-fir, and riparian forests, with a preference to areas near small streams with dense alder and shrubs	Moderate: known to occur in Jedediah Smith Redwood State Park

Common Name Scientific Name	Query Sources	Status Federal/ State	Distribution in California	Habitat Association	Likelihood to Occur in Project Area
Townsend's big-eared bat <i>Corynorhinus townsendii</i>	CNDDDB	-/SSC	Throughout California, found in all but subalpine and alpine habitats; details of distribution not well known	Most abundant in mesic habitats; also found in oak woodlands, desert, vegetated drainages, and caves or cave-like structures (including basal hollows in large trees, mines, tunnels, and buildings)	Moderate: potential habitat in project area in basal hollows of large trees
Pallid bat <i>Antrozous pallidus</i>	CNDDDB	-/SSC	Throughout California, except for elevations above 9,842 feet in the Sierra Nevadas	Roosts in rock crevices, tree hollows, mines, caves, and a variety of vacant and occupied buildings; feeds in a variety of open woodland habitats	Moderate: potential habitat in project area in basal hollows of large trees
Humboldt marten <i>Martes caurina humboldtensis</i>	CNDDDB	-/SE, SSC	Coastal redwood zone from the Oregon border south to Fort Ross, Sonoma County	Mid- to advanced-successional stands of conifers with complex structure near the ground and dense canopy closure	High: known to occur in project area
Fisher <i>Pekania pennanti</i> West Coast DPS	State parks	-/ST (southern Sierra Nevada population only), SSC	Two widely separated regions: the northern Coast Range and Klamath Province, and the southern Sierra Nevadas	Dense advanced-successional conifer forests, with complex forest structure; den in hollow trees and snags	High: known to occur in project area

Notes:

BGEPA: federally protected under the Bald and Golden Eagle Protection Act

CRPR: California Rare Plant Ranks

FC: federal candidate species

FD: federally delisted

FE: listed as endangered under the federal Endangered Species Act

FPT: federally proposed as threatened

FT: listed as threatened under the federal Endangered Species Act

ppt: parts per thousand

SCE: State Candidate Endangered

SD: State Delisted

SE: listed as endangered under the California Endangered Species Act

SFP: California Department of Fish and Wildlife Fully Protected species

SONCC: Southern Oregon/Northern California Coast

SSC: California Species of Special Concern

ST: listed as threatened under the California Endangered Species Act

Table J-2
Database Query Results of Special-Status Plants in the Project Region

Common Name <i>Scientific Name</i>	Query Sources	Status Federal/ State/CRPR	Habitat Association ¹	Likelihood to Occur in Project Area
Pink sand-verbena <i>Abronia umbellata</i> var. <i>breviflora</i>	CNPS, CNDDB	-/-/1B.1	Coastal dunes. 0 to 10 meters (0 to 35 feet). June to October.	None
Sea-watch <i>Angelica lucida</i>	CNPS	-/-/4.2	Coastal bluff scrub, coastal dunes, coastal scrub, and coastal salt marshes and swamps. 0 to 150 meters (0 to 490 feet). May to September.	Moderate
Evergreen everlasting <i>Antennaria suffrutescens</i>	CNPS	-/-/4.3	Lower montane coniferous forest (serpentinite). 500 to 1600 meters (1640 to 5250 feet). January to July.	Moderate
Vanilla-grass <i>Anthoxanthum nitens</i> ssp. <i>nitens</i>	CNPS, CDFW	-/-/2B.3	Meadows and seeps (mesic). 1500 to 1895 meters (4920 to 6215 feet). April to July.	Moderate
McDonald's rockcress <i>Arabis mcdonaldiana</i>	CNPS	FE/SE/1B.1	Serpentinite in lower montane coniferous forest and upper montane coniferous forest. 135 to 1,800 meters (440 to 5,905 feet). May to July.	Moderate
Howell's manzanita <i>Arctostaphylos hispidula</i>	CNPS	-/-/4.2	Serpentinite or sandstone in chaparral. 120 to 1,250 meters (390 to 4,100 feet). March to April.	Moderate
Del Norte manzanita <i>Arctostaphylos nortensis</i>	CNPS	-/-/4.3	Often serpentinite in chaparral and lower montane coniferous forest. 500 to 800 meters (1,640 to 2,625 feet). February.	High
Serpentine arnica <i>Arnica cernua</i>	CNPS	-/-/4.3	Serpentinite in lower montane coniferous forest. 500 to 1,920 meters (1,640 to 6,300 feet). April to July.	High
Klamath arnica <i>Arnica spathulata</i>	CNPS	-/-/4.3	Lower montane coniferous forest (serpentinite). 640 to 1800 meters (2095 to 5905 feet). May to August.	High
Maidenhair spleenwort <i>Asplenium trichomanes</i> ssp. <i>trichomanes</i>	CNPS, CDFW	-/-/2B.1	Lower montane coniferous forest (rocky). 185 to 200 meters (605 to 655 feet). May to July.	Moderate
Koehler's stipitate rockcress <i>Boechera koehleri</i>	CNPS, CDFW	-/-/1B.3	Serpentinite and rocky areas in chaparral and lower montane coniferous forest. 155 to 1,660 meters (505 to 5,445 feet). (March) April to July.	Moderate

Common Name <i>Scientific Name</i>	Query Sources	Status Federal/ State/CRPR	Habitat Association ¹	Likelihood to Occur in Project Area
False gray horsehair lichen <i>Bryoria pseudocapillaris</i>	CNPS	-/-/3.2	Usually on conifers in coastal dunes in San Luis Obispo County and along the immediate coast in North Coast coniferous forest. 0 to 90 meters (0 to 295 feet).	Moderate
Twisted horsehair lichen <i>Bryoria spiralifera</i>	CNPS, CDFW	-/-/1B.1	Usually on conifers along the immediate coast in North Coast coniferous forest. 0 to 30 meters (0 to 100 feet).	Moderate
Thurber's reed grass <i>Calamagrostis crassiglumis</i>	CNPS, CNDDDB	-/-/2B.1	Mesic areas in coastal scrub and freshwater marshes and swamps. 10 to 60 meters (30 to 195 feet). May to August.	Moderate
Leafy reed grass <i>Calamagrostis foliosa</i>	CNPS	-/-/4.2	Rocky areas in coastal bluff scrub and north coast coniferous forest. 0 to 1,220 meters (0 to 4,005 feet). May to September.	Moderate
Spiral-spored guided-head pin lichen <i>Calicium adpersum</i>	CNPS, CDFW	-/-/2B.2	Often restricted to old-growth bark of conifers that are over 200 years in age in lower montane coniferous forest and north coast coniferous forest. 0 to 2000 meters (0 to 6562 feet).	Moderate
Alaska cedar <i>Callitropsis nootkatensis</i>	CNPS	-/-/4.3	Upper montane coniferous forest. 650 to 2500 meters (2,130 to 8,200 feet).	Moderate
Butte County morning-glory <i>Calystegia atriplicifolia</i> ssp. <i>buttensis</i>	CNPS, CDFW	-/-/4.2	Rocky areas and sometimes roadsides in chaparral, lower montane coniferous forest, and valley and foothill grassland. 565 to 1,524 meters (1,850 to 5,000 feet). May to July.	Moderate
Seaside bittercress <i>Cardamine angulata</i>	CNPS, CDFW	-/-/2B.2	Wet areas, streambanks in lower montane coniferous forest and north coast coniferous forest. 25 to 915 meters (80 to 3,000 feet). (January) March to July.	Moderate
Nuttall's toothwort <i>Cardamine nuttallii</i> var. <i>gemmata</i>	CNPS, CDFW	-/-/3.3	Serpentinite in lower montane coniferous forest and north coast coniferous forest. 100 to 700 meters (325 to 2,295 feet). April to May (June).	Moderate
Northern clustered sedge <i>Carex arcta</i>	CNPS, CDFW	-/-/2B.2	Bogs and fens, mesic areas in north coast coniferous forest. 60 to 1,400 meters (195 to 4,595 feet). June to September.	None
Lagoon sedge <i>Carex lenticularis</i> var. <i>limnophila</i>	CNPS, CNDDDB	-/-/2B.2	Shores, beaches; and often in gravelly areas in bogs and fens, marshes and swamps, and north coast coniferous forest. 0 to 6 meters (0 to 20 feet). June to August.	None

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Bristle-stalked sedge <i>Carex leptalea</i>	CNPS	-/-/2B.2	Bogs and fens, mesic areas in meadows and seeps, and marshes and swamps. 0 to 700 meters (0 to 2,295 feet). March to July.	Moderate
Lyngbye's sedge <i>Carex lyngbyei</i>	CNPS, CDFW	-/-/2B.2	Brackish or freshwater marshes and swamps. 0 to 10 meters (0 to 35 feet). April to August.	None
Northern meadow sedge <i>Carex praticola</i>	CNPS, CNDDDB	-/-/2B.2	Mesic areas in meadows and seeps. 0 to 3,200 meters (0 to 10,500 feet). May to July.	Moderate
Siskiyou sedge <i>Carex scabriuscula</i>	CNPS	-/-/4.3	Mesic areas and sometimes serpentinite seeps in lower montane coniferous forest, meadows and seeps, and upper montane coniferous forest. 710 to 2,345 meters (2,325 to 7,695 feet). May to July.	Moderate
Serpentine sedge <i>Carex serpenticola</i>	CNPS, CDFW	-/-/2B.3	Mesic and serpentinite areas in meadows and seeps. 60 to 1,200 meters (195 to 3,935 feet). March to May.	Moderate
Green yellow sedge <i>Carex viridula</i> ssp. <i>viridula</i>	CNPS, CNDDDB	-/-/2B.3	Bogs and fens, freshwater marshes and swamps, and mesic areas in north coast coniferous forest. 0 to 1,600 meters (0 to 5,250 feet). (June) July to September (November).	Moderate
Nuttall's saxifrage <i>Cascadia nuttallii</i>	CNPS, CDFW	-/-/2B.1	North coast coniferous forest (mesic, rocky). 40 to 75 meters (130 to 245 feet). May.	Moderate
Short-lobed paintbrush <i>Castilleja brevilobata</i>	CNPS	-/-/4.2	Serpentinite and edges and openings in lower montane coniferous forest. 120 to 1,700 meters (390 to 5,575 feet). April to July.	High
Siskiyou paintbrush <i>Castilleja elata</i>	CNPS, CDFW	-/-/2B.2	Often serpentinite areas in bogs and fens and seeps in lower montane coniferous forest. 0 to 1,750 meters (0 to 5,740 feet). May to August.	Moderate
Oregon coast paintbrush <i>Castilleja litoralis</i>	CNPS, CNDDDB	-/-/2B.2	Sandy areas in coastal bluff scrub, coastal dunes, and coastal scrub. 15 to 100 meters (45 to 330 feet). June to July.	None
Pacific golden saxifrage <i>Chrysoplenium glechomifolium</i>	CNPS	-/-/4.3	Streambanks, sometimes seeps, sometimes roadsides in north coast coniferous forest, and riparian forest. 10 to 455 meters (30 to 1,495 feet). February to June (July).	High
Greenland cochlearia <i>Cochlearia groenlandica</i>	CNPS, CDFW	-/-/2B.3	On basaltic sea stack in coastal bluff scrub. 0 to 50 meters (0 to 165 feet). May to July.	None

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Oregon goldthread <i>Coptis laciniata</i>	CNPS, CNDDDB	-/-/4.2	Mesic areas in meadows and seeps and streambanks north coast coniferous forest. 0 to 1,000 meters (0 to 3,280 feet). (February) March to May (September to November).	Moderate
California lady's slipper <i>Cypripedium californicum</i>	CNPS	-/-/4.2	Seeps and streambanks and usually serpentinite in bogs and fens and lower montane coniferous forest. 30 to 2,750 meters (95 to 9,020 feet). April to August (September).	Moderate
Mountain lady's slipper <i>Cypripedium montanum</i>	CNPS	-/-/4.2	Broadleafed upland forest, cismontane woodland, lower montane coniferous forest, and north coast coniferous forest. 185 to 2,225 meters (605 to 7,300 feet). March to August.	Moderate
California pitcherplant <i>Darlingtonia californica</i>	CNPS	-/-/4.2	Mesic areas and generally serpentinite seeps in bogs and fens and meadows and seeps. 0 to 2,585 meters (0 to 8,480 feet). April to August.	High
Oregon bleeding heart <i>Dicentra formosa</i> ssp. <i>oregana</i>	CNPS	-/-/4.2	Serpentinite in lower montane coniferous forest. 425 to 1,485 meters (1,390 to 4,870 feet). April to May.	Moderate
Naked flag moss <i>Disclium nudum</i>	CNPS, CNDDDB	-/-/2B.2	Soil, on clay banks in coastal bluff scrub. 10 to 50 meters (30 to 165 feet).	Moderate
Cascade downingia <i>Downingia willamettensis</i>	CNPS	-/-/2B.2	Cismontane woodland lake margins, valley and foothill grassland lake margins, and vernal pools. 15 to 1,110 meters (45 to 3,640 feet). June to July (September).	Moderate
Black crowberry <i>Empetrum nigrum</i>	CNPS, CDFW	-/-/2B.2	Coastal bluff scrub, coastal prairie. 10 to 200 meters (30 to 655 feet). April to June.	Moderate
Waldo daisy <i>Erigeron bloomeri</i> var. <i>nudatus</i>	CNPS	-/-/2B.3	Serpentinite in lower montane coniferous forest, upper montane coniferous forest. 600 to 2,300 meters (1,965 to 7,545 feet). June to July.	Moderate
Siskiyou daisy <i>Erigeron cervinus</i>	CNPS	-/-/4.3	Lower montane coniferous forest and meadows and seeps. 25 to 1,900 meters (80 to 6,235 feet). June to August.	Moderate
Del Norte buckwheat <i>Eriogonum nudum</i> var. <i>paralinum</i>	CNPS, CNDDDB	-/-/2B.2	Coastal bluff scrub and coastal prairie. 5 to 80 meters (15 to 260 feet). (June) August to September.	Moderate

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Waldo wild buckwheat <i>Eriogonum pendulum</i>	CNPS, CDFW	-/-/2B.2	Serpentinite in lower montane coniferous forest, and upper montane coniferous forest. 230 to 1,000 meters (750 to 3,280 feet). August to September.	Moderate
Bluff wallflower <i>Erysimum concinnum</i>	CNPS, CDFW	-/-/1B.2	Coastal bluff scrub, coastal dunes, coastal prairie. 0 to 185 meters (0 to 605 feet). February to July.	Moderate
Henderson's fawn lily <i>Erythronium hendersonii</i>	CNPS, CDFW	-/-/2B.3	Lower montane coniferous forest. 300 to 1,600 meters (980 to 5,250 feet). April to July.	Moderate
Howell's fawn lily <i>Erythronium howellii</i>	CNPS, CDFW	-/-/1B.3	Sometimes serpentinite in lower montane coniferous forest and north coast coniferous forest. 200 to 1,145 meters (655 to 3,755 feet). April to May.	Moderate
Giant fawn lily <i>Erythronium oregonum</i>	CNPS, CDFW	-/-/2B.2	Sometimes serpentinite, rocky, openings in cismontane woodland, and meadows and seeps. 100 to 1,150 meters (325 to 3,775 feet). March to June (July).	Moderate
Coast fawn lily <i>Erythronium revolutum</i>	CNPS, CNDDDB	-/-/2B.2	Mesic areas and streambanks in bogs and fens, broadleaved upland forest, and north coast coniferous forest. 0 to 1,600 meters (0 to 5,250 feet). March to July (August)	Moderate
Siskiyou aster <i>Eucephalus glabratus</i>	CNPS	-/-/4.3	Rocky openings in lower montane coniferous forest, upper montane coniferous forest. 120 to 2,705 meters (390 to 8,875 feet). July to September.	Moderate
Minute pocket moss <i>Fissidens pauperculus</i>	CNPS, CNDDDB	-/-/1B.2	Damp coastal soil in north coast coniferous forest. 10 to 1,024 meters (30 to 3,360 feet).	Moderate
Mendocino gentian <i>Gentiana setigera</i>	CNPS, CDFW	-/-/1B.2	Mesic areas in lower montane coniferous forest and meadows and seeps. 335 to 1,065 meters (1095 to 3,495 feet). (April to July) August to September.	Moderate
Pacific gilia <i>Gilia capitata ssp. pacifica</i>	CNPS, CDFW	-/-/1B.2	Coastal bluff scrub, openings in chaparral, coastal prairie, and valley and foothill grassland. 5 to 1,665 meters (15 to 5,465 feet). April to August.	Moderate
Dark-eyed gilia <i>Gilia millefoliata</i>	CNPS, CDFW	-/-/1B.2	Coastal dunes. 2 to 30 meters (5 to 100 feet). April to July.	None
American glehnia <i>Glehnia littoralis ssp. leiocarpa</i>	CNPS	-/-/4.2	Coastal dunes. 0 to 20 meters (0 to 65 feet). May to August.	None

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Short-leaved evax <i>Hesperevax sparsiflora</i> var. <i>brevifolia</i>	CNPS, CDFW	-/-/1B.2	Sandy areas in coastal bluff scrub, coastal dunes, coastal prairie. 0 to 215 meters (0 to 705 feet). March to June.	Moderate
Howell's horkelia <i>Horkelia sericata</i>	CNPS	-/-/4.3	Serpentinite and clay in chaparral and lower montane coniferous forest. 60 to 1,280 meters (195 to 4,200 feet). May to July.	High
Harlequin lotus <i>Hosackia gracilis</i>	CNPS	-/-/4.2	Wetlands and roadsides in broadleaved upland forest, coastal bluff scrub, closed to cone coniferous forest, cismontane woodland, coastal prairie, coastal scrub, meadows and seeps, marshes and swamps, north coast coniferous forest, and valley and foothill grassland. 0 to 700 meters (0 to 2,295 feet). March to July.	Moderate
Siskiyou iris <i>Iris bracteata</i>	CNPS	-/-/3.3	Serpentinite in Broadleaved upland forest and Lower montane coniferous forest. 180 to 1,070 meters (590 to 3,510 feet). May to June.	Moderate
Del Norte County iris <i>Iris innominata</i>	CNPS	-/-/4.3	Serpentinite in lower montane coniferous forest. 300 to 2,000 meters (980 to 6,560 feet). May to June.	High
Orleans iris <i>Iris tenax</i> ssp. <i>klamathensis</i>	CNPS	-/-/4.3	Often in disturbed areas in lower montane coniferous forest. 100 to 1,400 meters (325 to 4,595 feet). April to May.	Moderate
Thompson's iris <i>Iris thompsonii</i>	CNPS	-/-/4.3	Openings, usually mesic areas, often serpentinite, often edges, and sometimes roadsides and streambanks in lower montane coniferous forest, north coast coniferous forest. 90 to 600 meters (295 to 1,970 feet). (March to April) May to June (July to August).	Moderate
Small groundcone <i>Kopsiopsis hookeri</i>	CNPS, CNDDDB	-/-/2B.3	North coast coniferous forest. 90 to 885 meters (295 to 2,905 feet). April to August.	Moderate
Perennial goldfields <i>Lasthenia californica</i> ssp. <i>macrantha</i>	CNPS, CDFW	-/-/1B.2	Coastal bluff scrub, coastal dunes, coastal scrub. 5 to 520 meters (15 to 1,705 feet). January to November.	Moderate
Del Norte pea <i>Lathyrus delnorticus</i>	CNPS	-/-/4.3	Often serpentinite areas in lower montane coniferous forest and north coast coniferous forest. 30 to 1,450 meters (95 to 4,755 feet). June to July.	High
Seaside pea <i>Lathyrus japonicus</i>	CNPS, CNDDDB	-/-/2B.1	Coastal dunes. 1 to 30 meters (0 to 100 feet). May to August.	None

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Marsh pea <i>Lathyrus palustris</i>	CNPS	-/-/2B.2	Mesic areas in bogs and fens, coastal prairie, coastal scrub, lower montane coniferous forest, marshes and swamps, north coast coniferous forest. 1 to 100 meters (0 to 330 feet). March to August.	Moderate
Beach layia <i>Layia carnosa</i>	CNPS, CNDDDB	FE/SE/1B.1	Coastal dunes and sandy areas in coastal scrub. 0 to 60 meters (0 to 195 feet). March to July.	None
Opposite-leaved lewisia <i>Lewisia oppositifolia</i>	CNPS, CDFW	-/-/2B.2	Mesic areas in lower montane coniferous forest. 300 to 1,220 meters (980 to 4,005 feet). April to May (June).	Moderate
Bolander's lily <i>Lilium bolanderi</i>	CNPS	-/-/4.2	Serpentinite in chaparral and lower montane coniferous forest. 30 to 1,600 meters (95 to 5,250 feet). June to July.	High
Kellogg's lily <i>Lilium kelloggii</i>	CNPS	-/-/4.3	Openings, roadsides in Lower montane coniferous forest, North Coast coniferous forest. 3 to 1300 meters (5 to 4265 feet). May to August.	Moderate
Western lily <i>Lilium occidentale</i>	CNPS, CDFW, USFWS	FE/SE/1B.1	Bogs and fens, coastal bluff scrub, coastal prairie, coastal scrub, freshwater marshes and swamps, openings in north coast coniferous forest. 2 to 185 meters (5 to 605 feet). June to July.	Moderate
Vollmer's lily <i>Lilium pardalinum</i> ssp. <i>vollmeri</i>	CNPS	-/-/4.3	Bogs and fens, mesic areas in meadows and seeps. 30 to 1,680 meters (95 to 5,510 feet). (June) July to August.	Moderate
Heart-leaved twayblade <i>Listera cordata</i>	CNPS	-/-/4.2	Bogs and fens, lower montane coniferous forest, and north coast coniferous forest. 5 to 1,370 meters (15 to 4,495 feet). February to July.	High
Howell's lomatium <i>Lomatium howellii</i>	CNPS	-/-/4.3	Serpentinite in chaparral, lower montane coniferous forest. 110 to 1,705 meters (360 to 5,595 feet). April to July.	High
Coast Range lomatium <i>Lomatium martindalei</i>	CNPS, CDFW	-/-/2B.3	Coastal bluff scrub, lower montane coniferous forest, meadows, and seeps. 240 to 3,000 meters (785 to 9,845 feet). May to June (August).	Moderate
Running-pine <i>Lycopodium clavatum</i>	CNPS, CNDDDB	-/-/4.1	Often edges, openings, and roadsides and mesic areas in lower montane coniferous forest, marshes and swamps, mesic areas in north coast coniferous forest. 45 to 1,225 meters (145 to 4,020 feet). June to August (September).	Moderate
Arctic starflower <i>Lysimachia europaea</i>	CNPS, CDFW	-/-/2B.2	Coastal areas in bogs and fens and meadows and seeps. 0 to 15 meters (0 to 50 feet). June to July.	Moderate

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Marshall's saxifrage <i>Micranthes marshallii</i>	CNPS	-/-/4.3	Rocky streambanks in riparian forest. 90 to 2,130 meters (295 to 6,990 feet). March to August.	Moderate
Leafy-stemmed miterwort <i>Mitellastris caulescens</i>	CNPS	-/-/4.2	Mesic areas and, sometimes roadsides in broadleaved upland forest, lower montane coniferous forest, meadows and seeps, north coast coniferous forest. 5 to 1,700 meters (15 to 5,575 feet). (March) April to October.	High
Woodnymph <i>Moneses uniflora</i>	CNPS, CNDDDB	-/-/2B.2	Broadleaved upland forest, north coast coniferous forest. 100 to 1,100 meters (325 to 3,610 feet). May to August.	Moderate
Ghost-pipe <i>Monotropa uniflora</i>	CNPS, CNDDDB	-/-/2B.2	Broadleaved upland forest, north coast coniferous forest. 10 to 550 meters (30 to 1,805 feet). June to August (September).	Moderate
Wolf's evening-primrose <i>Oenothera wolfii</i>	CNPS, CNDDDB	-/-/1B.1	Sandy and usually mesic areas in coastal bluff scrub, coastal dunes, coastal prairie, and lower montane coniferous forest. 3 to 800 meters (5 to 2,625 feet). May to October.	Moderate
Suksdorf's wood-sorrel <i>Oxalis suksdorfii</i>	CNPS	-/-/4.3	Broadleaved upland forest and North Coast coniferous forest. 15 to 700 meters (45 to 2,295 feet). May to August.	High
Seacoast ragwort <i>Packera bolanderi</i> var. <i>bolanderi</i>	CNPS, CDFW	-/-/2B.2	Sometimes roadsides in coastal scrub, north coast coniferous forest. 30 to 650 meters (95 to 2,135 feet). (January to April) May to July (August).	Moderate
Western ragwort <i>Packera hesperia</i>	CNPS, CDFW	-/-/2B.2	Serpentinite in meadows and seeps and upper montane coniferous forest. 500 to 2,500 meters (1,640 to 8,200 feet). April to June.	Moderate
Siskiyou Mountains ragwort <i>Packera macounii</i>	CNPS	-/-/4.3	Sometimes serpentinite and often in disturbed areas in chaparral, and lower montane coniferous forest. 400 to 915 meters (1,310 to 3,000 feet). June to July.	Moderate
Gairdner's yampah <i>Perideridia gairdneri</i> ssp. <i>gairdneri</i>	CNPS	-/-/4.2	Vernally mesic in broadleaved upland forest, chaparral, coastal prairie, valley and foothill grassland, vernal pools. 0 to 610 meters (0 to 2,000 feet). June to October.	Moderate
Sand dune phacelia <i>Phacelia argentea</i>	CNPS, CDFW	-/-/1B.1	Coastal dunes. 3 to 25 meters (5 to 80 feet). June to August.	None
Horned butterwort <i>Pinguicula macroceras</i>	CNPS, CDFW	-/-/2B.2	Serpentinite in bogs and fens. 40 to 1,920 meters (130 to 6,300 feet). April to June.	High

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White-flowered rein orchid <i>Piperia candida</i>	CNPS, CNDDDB	-/-/1B.2	Sometimes on serpentinite in broadleaved upland forest, lower montane coniferous forest, and north coast coniferous forest. 30 to 1,310 meters (95 to 4,300 feet). (March) May to September.	High
California pinefoot <i>Pityopus californicus</i>	CNPS	-/-/4.2	Mesic areas in broadleaved upland forest, lower montane coniferous forest, north coast coniferous forest, and upper montane coniferous forest. 15 to 2,225 meters (45 to 7,300 feet). (March to April) May to August.	Moderate
Nodding semaphore grass <i>Pleuropogon refractus</i>	CNPS	-/-/4.2	Mesic areas in lower montane coniferous forest, meadows and seeps, and north coast coniferous forest, riparian forest. 0 to 1,600 meters (0 to 5,250 feet). (March) April to August.	High
Timber blue grass <i>Poa rhizomata</i>	CNPS	-/-/4.3	Often serpentinite in lower montane coniferous forest. 150 to 1,000 meters (490 to 3,280 feet). April to May.	Moderate
Oregon polemonium <i>Polemonium carneum</i>	CNPS, CNDDDB	-/-/2B.2	Coastal prairie, coastal scrub, and lower montane coniferous forest. 0 to 1,830 meters (0 to 6,005 feet). April to September.	Moderate
Fibrous pondweed <i>Potamogeton foliosus</i> ssp. <i>fibrillosus</i>	CNPS, CDFW	-/-/2B.3	Assorted shallow freshwater marshes and swamps. 5 to 1,300 meters (15 to 4,265 feet).	Moderate
Siskiyou bells <i>Prosartes parvifolia</i>	CNPS, CDFW	-/-/1B.2	Often roadsides, disturbed areas, and burned areas in lower montane coniferous forest, upper montane coniferous forest. 700 to 1,525 meters (2,295 to 5,005 feet). May to September.	Moderate
Del Norte pyrrocoma <i>Pyrrocoma racemosa</i> var. <i>congesta</i>	CNPS, CDFW	-/-/2B.3	Serpentinite in chaparral and lower montane coniferous forest. 200 to 1,000 meters (655 to 3,280 feet). August to September.	Moderate
Angel's hair lichen <i>Ramalina thrausta</i>	CNPS, CDFW	-/-/2B.1	On dead twigs and other lichens in north coast coniferous forest. 75 to 430 meters (245 to 1,410 feet).	Moderate
Trailing black currant <i>Ribes laxiflorum</i>	CNPS	-/-/4.3	Sometimes roadsides in north coast coniferous forest. 5 to 1,395 meters (15 to 4,575 feet). March to July (August).	Moderate
Tracy's romanzoffia <i>Romanzoffia tracyi</i>	CNPS, CDFW	-/-/2B.3	Rocky areas in coastal bluff scrub, coastal scrub. 15 to 30 meters (45 to 100 feet). March to May.	Moderate

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Gasquet rose <i>Rosa gymnocarpa</i> var. <i>serpentina</i>	CNPS, CDFW	-/-/1B.3	Serpentinite and often roadsides, sometimes ridges, streambanks, and openings in chaparral and cismontane woodland. 400 to 1,725 meters (1,310 to 5,660 feet). April to June (August).	Moderate
Howell's sandwort <i>Sabulina howellii</i>	CNPS, CDFW	-/-/1B.3	Serpentinite and xeric areas in chaparral and lower montane coniferous forest. 550 to 1,000 meters (1,800 to 3,280 feet). April to July.	Moderate
Sanford's arrowhead <i>Sagittaria sanfordii</i>	CNPS, CDFW	-/-/1B.2	Assorted shallow freshwater marshes and swamps. 0 to 650 meters (0 to 2,135 feet). May to October (November).	Moderate
Del Norte willow <i>Salix delnortensis</i>	CNPS	-/-/4.3	Serpentinite in riparian forest. 90 to 500 meters (295 to 1,640 feet). April to May.	Moderate
Great burnet <i>Sanguisorba officinalis</i>	CNPS, CDFW	-/-/2B.2	Often serpentinite in bogs and fens, broadleaved upland forest, meadows and seeps, marshes and swamps, north coast coniferous forest, and riparian forest. 60 to 1,400 meters (195 to 4,595 feet). July to October.	Moderate
Peck's sanicle <i>Sanicula peckiana</i>	CNPS	-/-/4.3	Often serpentinite in chaparral and lower montane coniferous forest. 150 to 800 meters (490 to 2,625 feet). March to June.	Moderate
Blue Creek stonecrop <i>Sedum citrinum</i>	CNPS, CNDDDB	-/-/1B.2	North coast coniferous forest. 1,050 to 1,280 meters (3,440 to 4,200 feet). June.	Moderate
Del Norte checkerbloom <i>Sidalcea elegans</i>	CNPS	-/-/3.3	Serpentinite in chaparral and lower montane coniferous forest. 215 to 1,365 meters (705 to 4,480 feet). May to July.	Moderate
Maple-leaved checkerbloom <i>Sidalcea malachroides</i>	CNPS, CNDDDB	-/-/4.2	Often in disturbed areas in broadleaved upland forest, coastal prairie, coastal scrub, north coast coniferous forest, and riparian woodland. 0 to 730 meters (0 to 2,395 feet). (March) April to August.	High
Siskiyou checkerbloom <i>Sidalcea malviflora</i> ssp. <i>patula</i>	CNPS, CNDDDB	-/-/1B.2	Often roadcuts in coastal bluff scrub, coastal prairie, and north coast coniferous forest. 15 to 880 meters (45 to 2,885 feet). (April) May to August.	Moderate
Coast checkerbloom <i>Sidalcea oregana</i> ssp. <i>eximia</i>	CNPS, CDFW	-/-/1B.2	Lower montane coniferous forest, meadows and seeps and north coast coniferous forest. 5 to 1,340 meters (15 to 4,395 feet). June to August.	Moderate
Scouler's catchfly <i>Silene scouleri</i> ssp. <i>scouleri</i>	CNPS, CNDDDB	-/-/2B.2	Coastal bluff scrub, coastal prairie and valley and foothill grassland. 0 to 600 meters (0 to 1,970 feet). (March to May) June to August (September).	Moderate

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Serpentine catchfly <i>Silene serpentinicola</i>	CNPS, CNDDDB	-/-/1B.2	Serpentinite openings and gravelly or rocky areas in chaparral and lower montane coniferous forest. 145 to 1,650 meters (475 to 5,415 feet). May to July.	Moderate
Howell's jewelflower <i>Streptanthus howellii</i>	CNPS, CDFW	-/-/1B.2	Serpentinite, rocky areas in lower montane coniferous forest. 305 to 1500 meters (1000 to 4920 feet). July to August.	Moderate
Glaucous tauschia <i>Tauschia glauca</i>	CNPS	-/-/4.3	Gravelly, serpentinite areas in lower montane coniferous forest. 80 to 1,700 meters (260 to 5,575 feet). April to June.	Moderate
Coastal triquetrella <i>Triquetrella californica</i>	CNPS, CNDDDB	-/-/1B.2	Soil in coastal bluff scrub and coastal scrub. 10 to 100 meters (30 to 330 feet).	Moderate
Methuselah's beard lichen <i>Usnea longissima</i>	CNPS, CNDDDB	-/-/4.2	On tree branches; usually on old growth hardwoods and conifers in broadleaved upland forest and north coast coniferous forest. 50 to 1,460 meters (160 to 4,790 feet).	Moderate
Little-leaved huckleberry <i>Vaccinium scoparium</i>	CNPS, CDFW	-/-/2B.2	Rocky areas in subalpine coniferous forest. 1,036 to 2,200 meters (3,395 to 7,220 feet). June to August.	None
Siskiyou inside-out flower <i>Vancouveria chrysantha</i>	CNPS	-/-/4.3	Serpentinite in chaparral, lower montane coniferous forest. 120 to 1,500 meters (390 to 4,920 feet). June.	Moderate
Siskiyou false-hellebore <i>Veratrum insolitum</i>	CNPS	-/-/4.3	Clay in chaparral and lower montane coniferous forest. 45 to 1,635 meters (145 to 5,365 feet). June to August.	Moderate
Langsdorf's violet <i>Viola langsdorffii</i>	CNPS, CDFW	-/-/2B.1	Coastal bogs and fens. 2 to 10 meters (5 to 35 feet). May to July.	None
Alpine marsh violet <i>Viola palustris</i>	CNPS, CNDDDB	-/-/2B.2	Coastal bogs and fens, and mesic areas in coastal scrub. 0 to 150 meters (0 to 490 feet). March to August.	Moderate
Western white bog violet <i>Viola primulifolia</i> ssp. <i>occidentalis</i>	CNPS, CDFW	-/-/1B.2	Serpentinite bogs and fens and marshes and swamps. 100 to 990 meters (325 to 3,250 feet). April to September.	None

Common Name <i>Scientific Name</i>	Query Sources	Status Federal/ State/CRPR	Habitat Association¹	Likelihood to Occur in Project Area
Sensitive Natural Communities				
Coastal and Valley Freshwater Marsh	CNDDDB	G3/S2.1	Marsh and swamp Wetland	High
Coastal Brackish Marsh	CNDDDB	G2/S2.1	Marsh and swamp Wetland	None
Darlingtonia Seep	CNDDDB	G4/S3.2	Bog and fen Wetland	High
Northern Coastal Salt Marsh	CNDDDB	G3/S3.2	Estuarine marsh and swamp Wetland	None

Notes:

1. Months in parentheses are uncommon.

CNPS Threat Rank 0.1: Seriously threatened in California (high degree/immediacy of threat)

CNPS Threat Rank 0.2: Fairly threatened in California (moderate degree/immediacy of threat)

CNPS Threat Rank 0.3: Not very threatened in California (low degree/immediacy of threats or no current threats known)

CRPR List 1B: Plants rare, threatened, or endangered in California and elsewhere

CRPR List 2B: Plants rare, threatened, or endangered in California, but more common elsewhere

CRPR List 4: Plants of limited distribution, a watch list

FE: Listed as endangered under the federal Endangered Species Act

FT: Listed as threatened under the federal Endangered Species Act

FPT: Federally proposed as threatened

FC: Federal candidate species

FD: Federally delisted

G2: Imperiled — At high risk of extinction due to very restricted range, very few populations (often 20 or fewer)

G3: Vulnerable — At moderate risk of extinction or elimination due to a restricted range, relatively few populations (often 80 or fewer)

G4: Apparently Secure — Uncommon but not rare; some cause for long-term concern due to declines or other factors; i.e., there is some threat, or somewhat narrow habitat.

SE: Listed as endangered under the California Endangered Species Act

ST: Listed as threatened under the California Endangered Species Act

SCE: State Candidate Endangered

SD: State Delisted

SSC: California Species of Special Concern

S2: Imperiled in the state because of rarity due to very restricted range, very few (fewer than 20) populations

S3: Vulnerable in the state due to a restricted range, relatively few (fewer than 80) populations

Appendix K

List of Preparers

Appendix K: List of Preparers

California Department of Parks and Recreation

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Brian Merrill
Lathrop Leonard
Greg Collins
Claudia Voigt
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National Park Service

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Mark Andre

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Appendix L
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Appendix L: References

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