October 2019
Greater Mill Creek Ecosystem Restoration Project

Final Initial Study/Negative Declaration and Environmental Assessment (With Edits Incorporated)

Prepared for Redwoods Rising

Final 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)

Availability of Documents

The joint Draft Initial Study/Negative Declaration and Environmental Assessment (ISND/EA) was made available for a 30-day public review at the reference desks of three Humboldt County Library branches (Eureka, Arcata, and McKinleyville), the Humboldt State University Library, and the Del Norte County Library in Crescent City. It was also available at the public information desks of the CDPR Northern Service Center, CDPR North Coast Redwoods District Headquarters office, Redwood National and State Parks Headquarters office, Thomas H. Kuchel Visitor Center, and NPS South Operations Center, as well as on the NPS website (http://parkplanning.nps.gov/greatermillcreek) and CDPR website (https://www.parks.ca.gov/?page_id=980). The Final ISND/EA and all supporting materials will be available by request at the CDPR Northern Service Center and NPS South Operations Center.

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 (as identified in the *Del Norte Coast Redwoods State Park Vegetation Management Plan* prepared by CDPR) 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. As identified in the *Aquatic Habitat Restoration Strategy for Greater Mill Creek Project* Area, 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 2020. The project requirements (standard project requirements/project-specific requirements [SPR/PSRs]) identified in Appendix A have been incorporated into and would be fully implemented as part of the Proposed Action. A complete description of the Proposed Action is included in Section 2.2 of the Draft ISND/EA (with the minor revisions described in this document). The *Del Norte Coast Redwoods State Park Vegetation Management Plan* and *Aquatic Habitat Restoration Strategy for Greater Mill Creek Project Area* are included as Appendices B and C, respectively.

Findings

CDPR and NPS prepared an ISND/EA to assess the Proposed Action's potential impacts on the environment and the significance of those impacts. Based on the ISND/EA, it has been determined that the Proposed Action, incorporative of SPR/PSRs, 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.

Changes to the Draft ISND/EA

The following corrections, additions, and deletions have been made to the Greater Mill Creek Ecosystem Restoration Project Draft ISND/EA. Additions and corrections are underlined; strikeouts indicate a deletion. Minor punctuation, spelling, and grammatical corrections that contribute to ease of understanding, but have no significant impact on the content, have not been noted.

Section 3.1.3, Introduction, Cumulative Impact Scenario (p. 16). The following project was added to the list of past, present, and reasonably foreseeable future projects occurring in the vicinity of the Proposed Action:

- California Condor Reintroduction Project: NPS has partnered with the U.S. Fish and Wildlife Service (USFWS) and Yurok Tribe to reintroduce California condors in the Bald Hills region of Redwood National Park. The California condor was close to extinction in the 1980s. While the population of condors is increasing, the birds still face many environmental challenges. The purpose of the reintroduction program is to further the recovery of the California condor by establishing a new population in the species' historical range in the Pacific Northwest through captive releases at the park, while simultaneously reintroducing condors to Yurok Ancestral Territory. Reintroducing a new population of condors into the biologically diverse ecosystem in Redwood National Park and the surrounding area has the potential to aid in the species' long-term recovery. A draft EA for the project was released for public review in April 2019 and the project is anticipated to be implemented (with the release of the first condors) in fall 2020.

Section 3.6.2, Biological Resources, Proposed Action Impacts (p. 33). The following text was corrected:

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~~ In-water activities have the potential to overlap with the distribution of coastal cutthroat trout, Pacific lamprey, coho salmon, Chinook salmon, and steelhead. ~~and if~~ If activities occur within the wetted stream channel, relocation would be implemented to reduce impacts on these species.

Section 3.6.2, Biological Resources, Proposed Action Impacts (p. 36). The following text was corrected with the revisions to PSR-BIO-8 (described below):

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. 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). The Proposed Action would have a less-than-significant impact on willow flycatchers from noise disturbance or habitat removal.

Section 3.6.2, Biological Resources, Proposed Action Impacts, Cumulative Impacts (p. 40). The following text was revised to include reference to the additional reasonably foreseeable future project noted above:

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. The Proposed Action, in conjunction with the California Condor Reintroduction Project, has the potential to result in improved conditions for the California condor. Foraging areas for condors are in open grasslands, beaches, and smaller meadows, and can be far from primary nesting sites, requiring substantial daily commutes. Condors glide and

soar when foraging, so they depend on reliable air movements and terrain that enables extended soaring flight. They often use open, windy areas where they can run downhill or launch themselves from a cliff edge or exposed branch to get airborne. Condors nest mainly in natural cavities or caves in cliffs, although they sometimes also use trees, such as coast redwood and, historically, the giant sequoia. As the wild population grows, there is the possibility they may return to the redwood groves. With an increase in elk and deer populations, there would eventually be more carcasses providing foraging opportunities for condor, which would be beneficial. Therefore, the Proposed Action, when combined with future actions in the region, would result in a cumulative net benefit to biological resources.

Appendix C, Table 5, Standard Project Requirements and Project-Specific Requirements – The following text was corrected:

Element/ Title	Requirement
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 Draft Mill Creek Vegetation Management Plan [CDPR 2019]) or the *Invasive Plant Management Plan for Redwood National Park* (NPS 2017a), and the Aquatic Invasive Species Management Plan (CDFG 2008).
PSR-BIO-8	**Raptor breeding temporal and spatial buffers.** Prior to the start of project-related work occurring from ~~May~~ February 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.

Six comment letters were received during the Draft ISND/EA public review process. Appendix D includes CDPR and NPS responses to substantive comments received on the Draft ISND/EA. This document, along with the Draft ISND/EA (SCH No. 2019049054), corrected as noted above; Project Requirements; Comments and Responses to Comments; and the Notice of Determination, constitute the Final Negative Declaration for the Greater Mill Creek Ecosystem Restoration Project.

Pursuant to Section 21082.1 of CEQA, CDPR has independently reviewed and analyzed this ISND/EA for the Proposed Action and finds that the document reflects the independent judgement of CDPR. As the CEQA lead agency, CDPR also confirms that the SPR/PSRs detailed in this document are feasible and will be implemented as stated in the ISND/EA.

Shannon Dempsey Date
District Environmental Coordinator
North Coast Redwoods District

Victor Bjelajac
District Superintendent
North Coast Redwoods District

Date

Appendix A
Project Requirements

Appendix A: Project 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 the California Air Resources Board, U.S. Environmental Protection Agency, or 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.
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 *California Department of Fish and Wildlife Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Sensitive Natural Communities* (CDFW 2018a).
PSR-BIO-2	**Special-status plant buffers and avoidance.** Individuals or populations of rare, threatened, endangered plants, or those listed as California Native Plant Society 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 Best Management Practices (within the Draft Mill Creek Vegetation Management Plan [CDPR 2019]) or the *Invasive Plant Management Plan for Redwood National Park* (NPS 2017a), 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 diameter at breast height or larger.

Element/Title	Requirement
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 the U.S. Fish and Wildlife Service in compliance with ESA Section 7 requirements or CESA documents issued by CDFW. 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 February 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.
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. Large wood encountered during excavation of stream crossings would be retained for on-site bank stabilization, in channel to provide habitat, or stockpiled for large wood restoration.
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.

Element/Title	Requirement
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: 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
PSR-BIO-16	**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.
PSR-CULT-1	**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. 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.

Element/Title	Requirement
SPR-CULT-2	**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. 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.
SPR-CULT-3	**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. 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 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. 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.
SPR-CULT-4	**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. 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.
PSR-GEO-1	**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.

Element/Title	Requirement
	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.
PSR-GEO-2	**Consultation with earth sciences/physical sciences professional.** Any ground shaking over magnitude 6.0 in the project vicinity would require park staff to consult with staff of the USGS Earthquake Information Center to understand the source, distance, intensity, and depth of the ground shaking. An earth sciences/physical sciences professional would then determine the need for project area review of roads.
PSR-GEO-3	**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 the table below.
PSR-GEO-4	**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 the table below.
PSR-GEO-5	**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 the National Oceanic and Atmospheric Administration's Fall Transition Season Precipitation and Hydrology Decision Support Service notifications. 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 *Wet Weather Operations Standards for Heavy Equipment Use and Log Hauling for Redwoods Rising* (RNP 2019a) guidelines. 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 *Wet Weather Operations Standards for Heavy Equipment Use and Log Hauling for Redwoods Rising* 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.

Element/Title	Requirement
PSR-GEO-6	**Requirements for existing and new 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.
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-HAZ-1	**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. All primary fuel storage containers (fuel tankers) will be required to have secondary containment and would be stored outside of riparian areas. When long stretches of road are entirely within riparian areas, smaller, portable refueling devices (under 200 gallons) may be used to refuel large equipment. In such cases, drip pads/pans or other protective devices will be placed under the fueling area.

Element/Title	Requirement
PSR-HAZ-2	**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.
PSR-HAZ-3	**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.
SPR-HAZ-4	**Vehicle parking restrictions.** Crews would park vehicles a minimum of 10 feet from flammable material such as dry grass or brush.
SPR-HAZ-5	**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.
PSR-HAZ-6	**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.
PSR-HAZ-7	**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.
SPR-HAZ-8	**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. 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.
PSR-HYDRO-1	**Riparian buffers.** Equipment exclusion zones around riparian corridors would be established as defined in the table below.
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.
SPR-HYDRO-3	**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-

Element/Title	Requirement
	inspected upon re-entry to the park. Decontamination would take place off site upon demobilization.
PSR-HYDRO-4	**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 the table below.
PSR-HYDRO-5	**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.
PSR-HYDRO-6	**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 or collection point 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.
PSR-HYDRO-7	**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.
PSR-HYDRO-8	**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.
SPR-HYDRO-9	**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.
PSR-HYDRO-10	**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.

Element/Title	Requirement
PSR-HYDRO-11	**Water drafting requirements.** If water drafting becomes a necessary component of the proposed project, drafting would be conducted as described in the NMFS *Water Drafting Specifications* (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. If water drafting becomes a necessary component of the proposed project, drafting would be conducted as described in the NMFS *Water Drafting Specifications* (NMFS 2001). These specifications include the following: • 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. • 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	**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.
PSR-HYDRO-13	**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. Skyline cable operations reduce the need for mid-slope roads.
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.

Element/Title	Requirement
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 will be available within portions of their Right of Way.

Notes:
References are included in Appendix J of the Draft ISND/EA.
CDFW: California Department of Fish and Wildlife
CDPR: California Department of Parks and Recreation
CESA: California Endangered Species Act
ESA: Endangered Species Act
ISND/EA: Initial Study/Negative Declaration and Environmental Assessment
MLD: Most Likely Descendant
NAHC: Native American Heritage Commission
NCRD: North Coast Redwoods District
NMFS: National Marine Fisheries Service
NPS: National Park Service
PRC: Public Resources Code
RNSP: Redwood National and State Parks
SHPO: State Historic Preservation Office

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 B
Del Norte Coast Redwoods State Park Vegetation Management Plan

Del Norte Coast Redwoods State Park
Vegetation Management Plan

Final Draft
2019

California State Parks
North Coast Redwoods District
Del Norte Coast Redwoods State Park

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Gavin Newsom
Governor

Wade Crowfoot
Secretary
Natural Resources Agency

Lisa Mangat
Director
California State Parks

California State Parks Mission

The mission of the California Department of Parks and Recreation is 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.

State Park Purpose Statement

The purpose of Humboldt Redwoods State Park is to preserve, protect, and perpetuate the outstanding natural and aesthetic values of the ancient redwood forests and their associated ecosystems found in the lower Eel River watershed. Through careful stewardship, the solitude and grandeur of the park's cathedral-like forests, its inherent wilderness values, and significant cultural features shall remain unimpaired for the enjoyment of current and future generations.

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1 Purpose and Need

1.1 Introduction

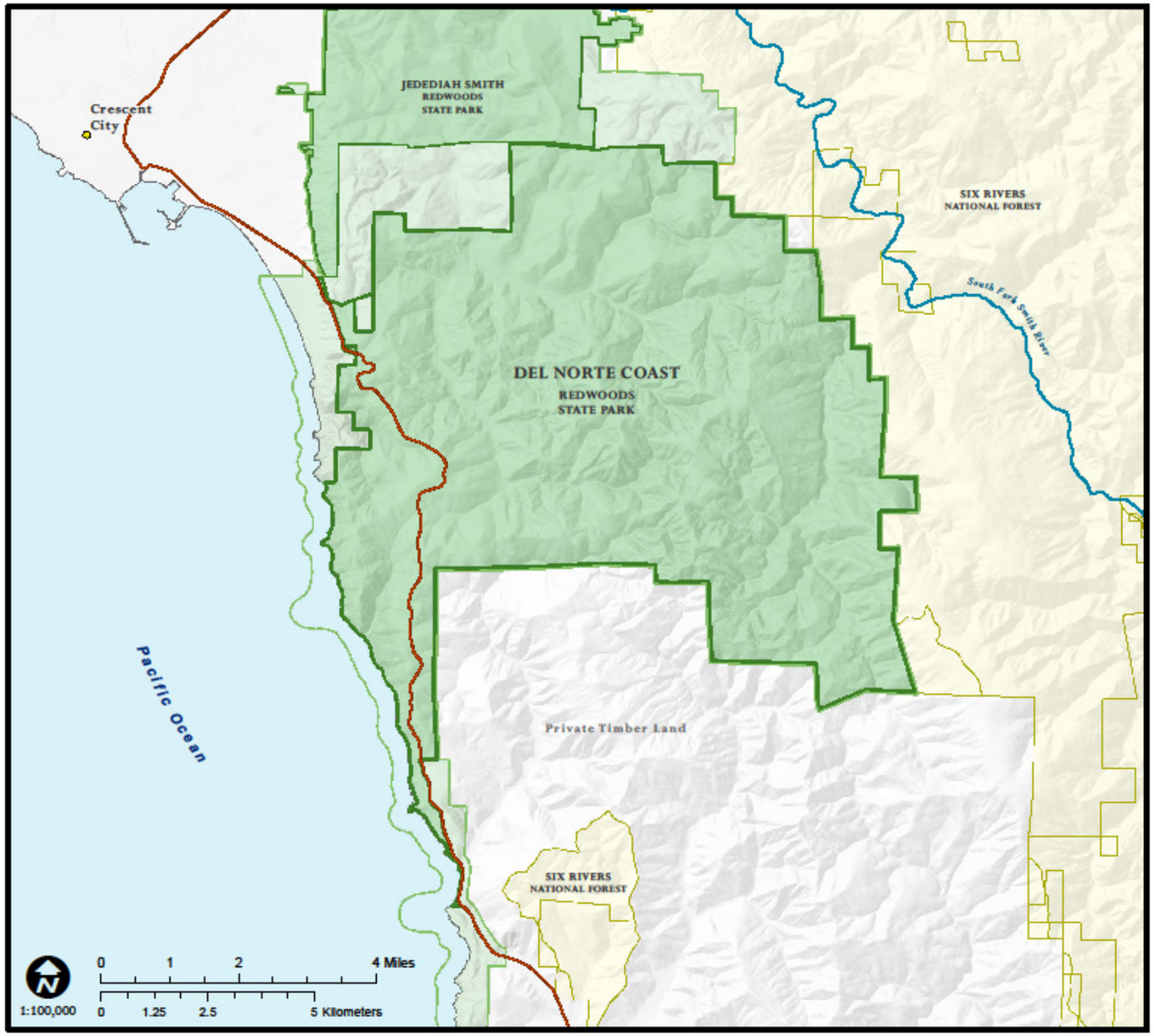
This document provides a framework for the implementation of a vegetation management program at Del Norte Coast Redwoods State Park (DNCRSP). DNCRSP is one of four parks that make up Redwood National and State Parks (RNSP) and is managed under a joint General Management Plan/General Plan (GMP/GP; RNSP 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.

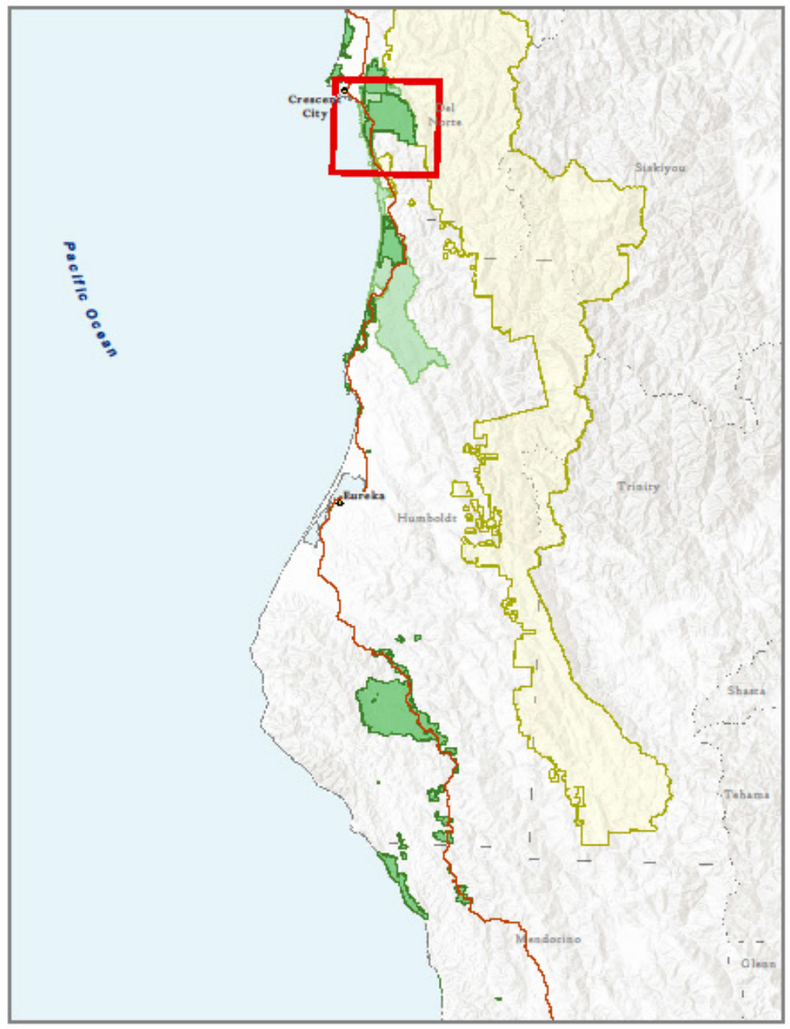
Vegetation, defined as all the plant species of a region and the way those species are arranged (Sawyer and Keeler-Wolf 1995), is fundamental to healthy ecosystem function. Vegetation is influenced by, and is influencing, a combination of factors such as moisture, soil chemistry, temperature and disturbance. Today's ecosystem approach to conservation 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-two units within the North Coast Redwoods District (NCRD) (Map 1-a Location).

Del Norte Coast Redwoods State Park
Vegetation Management Plan - Location

California State Parks
North Coast Redwood District





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

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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 grasslands to convert to shrublands/forests, shrublands to become forests, and forests to become increasingly crowded. 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. Most 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

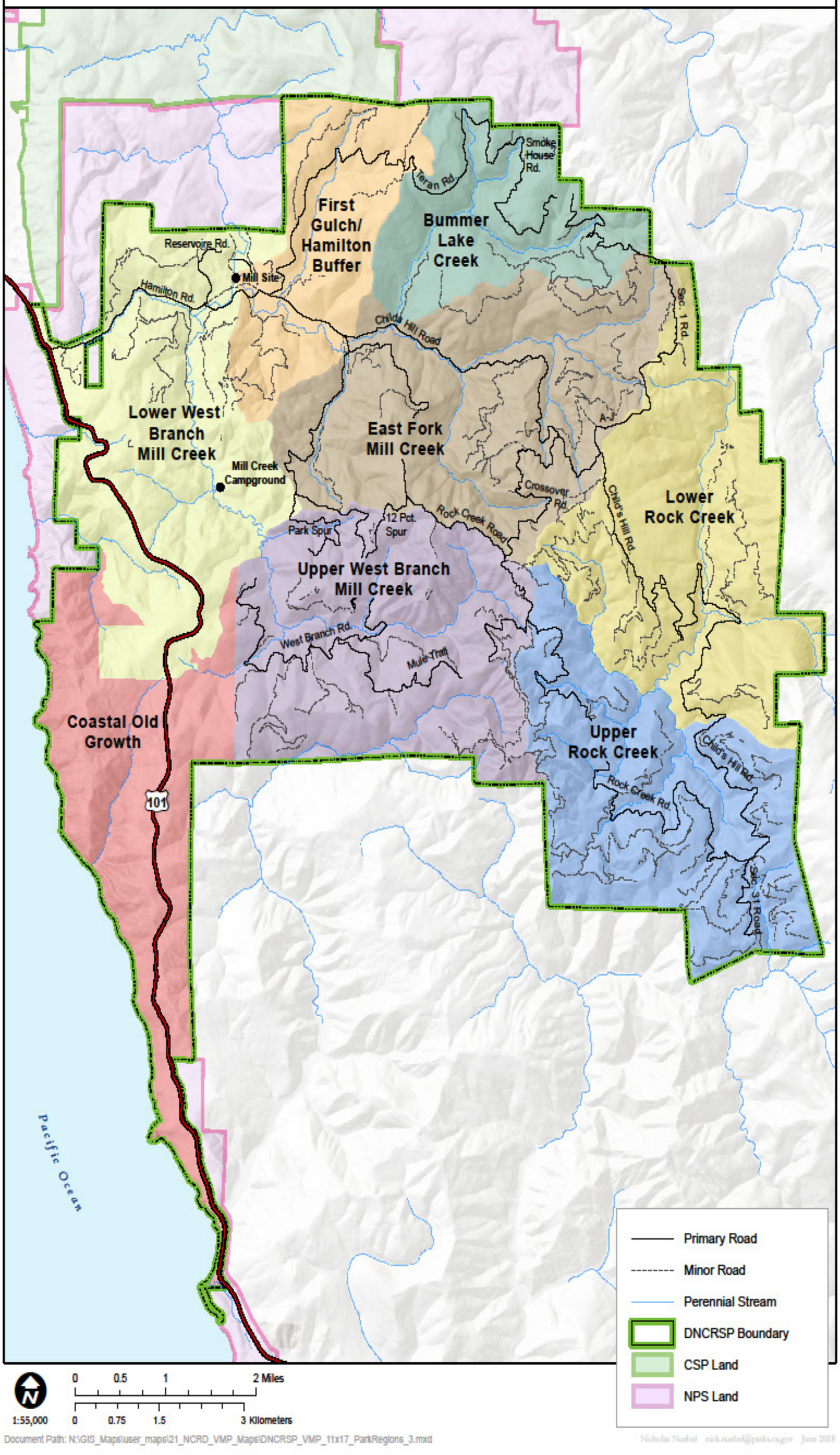
Del Norte Coast Redwoods State Park is located along the northern California coast, approximately 5 miles southeast of Crescent City in Del Norte County (Map 1-a Location). DNCRSP is bordered by Jedediah Smith Redwoods State Park and two small parcels of Redwood National Park to the north, Six Rivers 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).

Del Norte Coast Redwoods State Park
Vegetation Management Plan - Park Regions

California State Parks
North Coast Redwood District



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Nicholas Nuebel nick.nuebel@parks.ca.gov June 2018

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 landslides. 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 2-a).

Table 2-a: 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
haleshead (strike slip)	2.4	145	7.0	No Data
Trindidad (thrust)	4.4	1900	7.5	No Data
Cascadia Subduction Zone (thrust)	40	200-800	9.0	1700

(References: Toppozada, 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 topsoil 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.

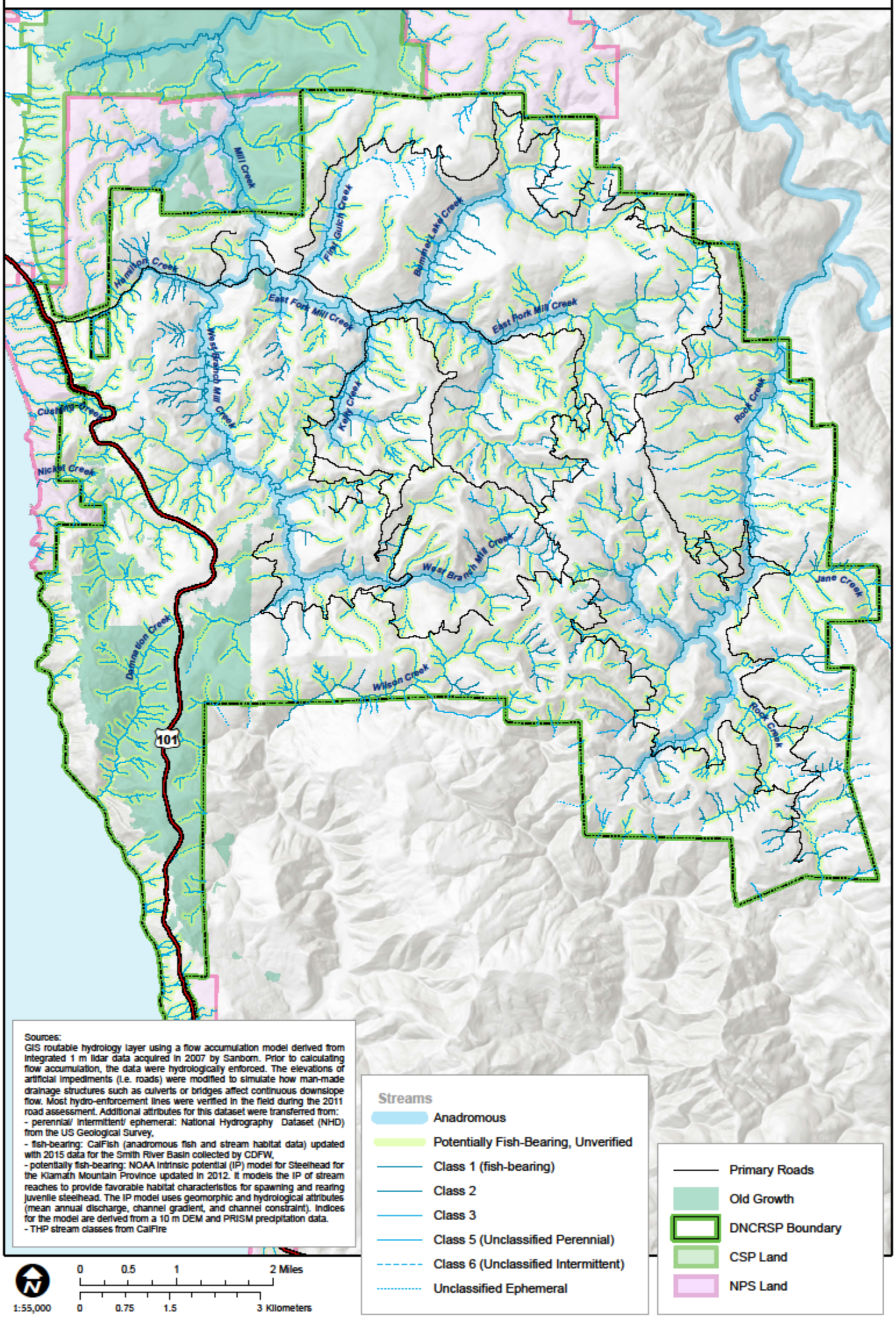
Rock Creek is the second largest watershed in the park spanning 7,735 ac, and entering the South Fork of the Smith River to the east. The headwaters for Turwar and the west fork of Hunter creek begin along the southern boundary of the park and flow through private timberland and the Yurok Reservation 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, 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).

Del Norte Coast Redwoods State Park

Vegetation Management Plan - Hydrology, Anadromy

California State Parks
North Coast Redwood District



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

0 0.5 1 2 Miles
1:55,000 0 0.75 1.5 3 Kilometers

Document Path: N:\GIS_Maps\user_maps\21_NCRD_VMP_Maps\DNCRSP_VMP_11x17_Hydrology_Anadromy_5.mxd

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. For 9 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-Rellim 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 (RNSP 2000, 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 smallpox). 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 (who later formed Hambro – a company still in operation) 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 local 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 sawmill 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 DCNRSP 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 DNCRSP 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 a 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 DCNRSP 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 ¼ 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.

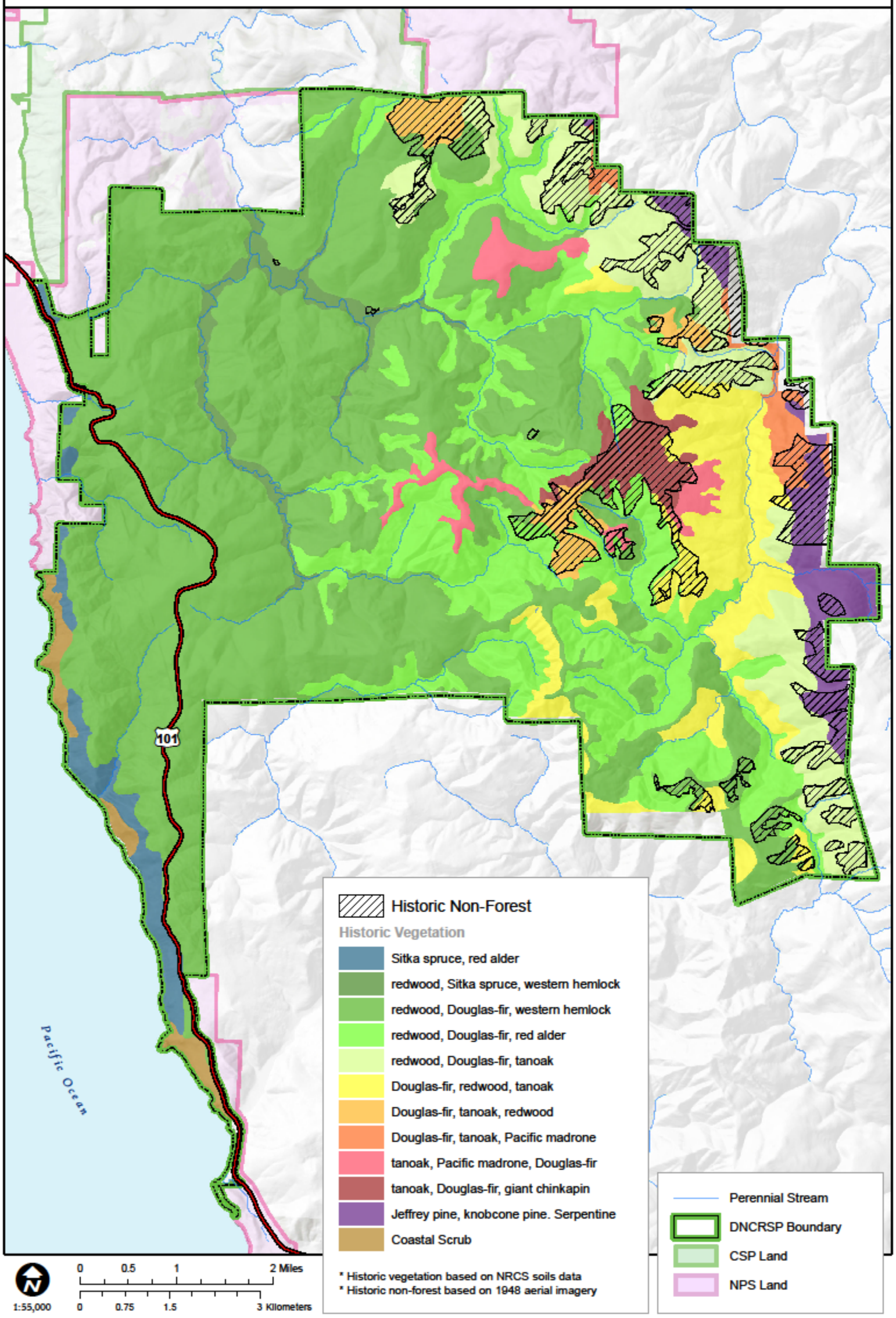
Table 2-b. Historic vegetation typing for non and lightly forested areas identified in 1948 aerial imagery and digitized in ArcMap.

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**

Del Norte Coast Redwoods State Park

Vegetation Management Plan - Historic Vegetation

California State Parks
North Coast Redwood District



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Nicholas Nuebel nick.nuebel@parks.ca.gov June 2018

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.

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, CDPR 2018f) 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, 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

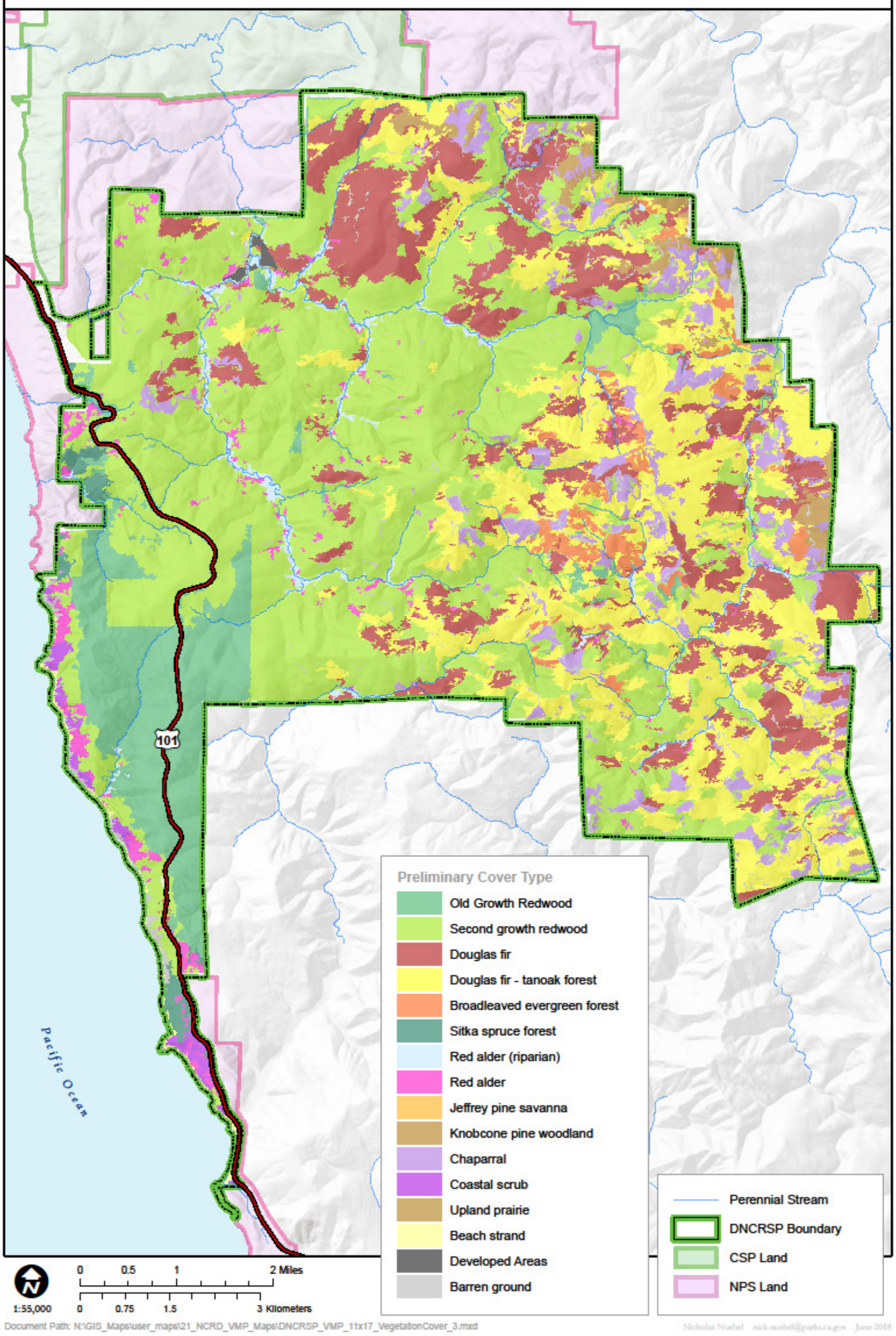
At the time of writing this plan, no parkwide mapping existed that provided up-to-date estimates for the acreage for each cover type or alliance. The draft mapping of cover types and vegetation alliances presented here (Map 2-d Vegetation) is initially based on an Ikonos satellite imagery-based forest stand reclassification project from 2005. 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 where then classified into alliances. This vegetation classification was slightly modified for use in the Vegetation Management Statement for DNCRSP (VMS, CDPR 2011b).

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.

Del Norte Coast Redwoods State Park

Vegetation Management Plan - Vegetation

California State Parks
North Coast Redwood District



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Nicholas Nuebel nick.nuebel@parks.ca.gov June 2018

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**

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 in 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).

Discussions of cover types and alliances below are summarizing data from botanical reports 2003-2017 and the 2011 Vegetation Management Statement (CDPR 2011b), 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 macrophylium*), thimbleberry (*Rubus parviflorus*), salmonberry (*Rubus spectablilis*), 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 occurences 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, broadleafed 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 roadsides 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 broadleafed 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.

Uncommon Tree Species

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 (CNSP 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 broadleafed 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-Orfort-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, Rhodendron 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, sub (c)). Based on records in the NRCD Botanical Survey Database (CDPR 2018a) and the California Natural Diversity Database, RareFind (CDFW 2018) 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, 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 bryophyets 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 (CDPR 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 caryophyllea*), 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 (CDPR 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 ssp.). Recently indian paint brush (Castillija 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 drops 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 boylii*). 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 alascensiscolumbianus*). 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 (CO_2), nitrous oxide (N_2O), 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 CO_2 emissions worldwide.

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.

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, 2018a).

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: RNSP GMP/GP (RNSP 2000), the 2010 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) describes previous restoration efforts 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 4-a).

Table 4-a. 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.

4.1.1.3 Conifer deficient forests

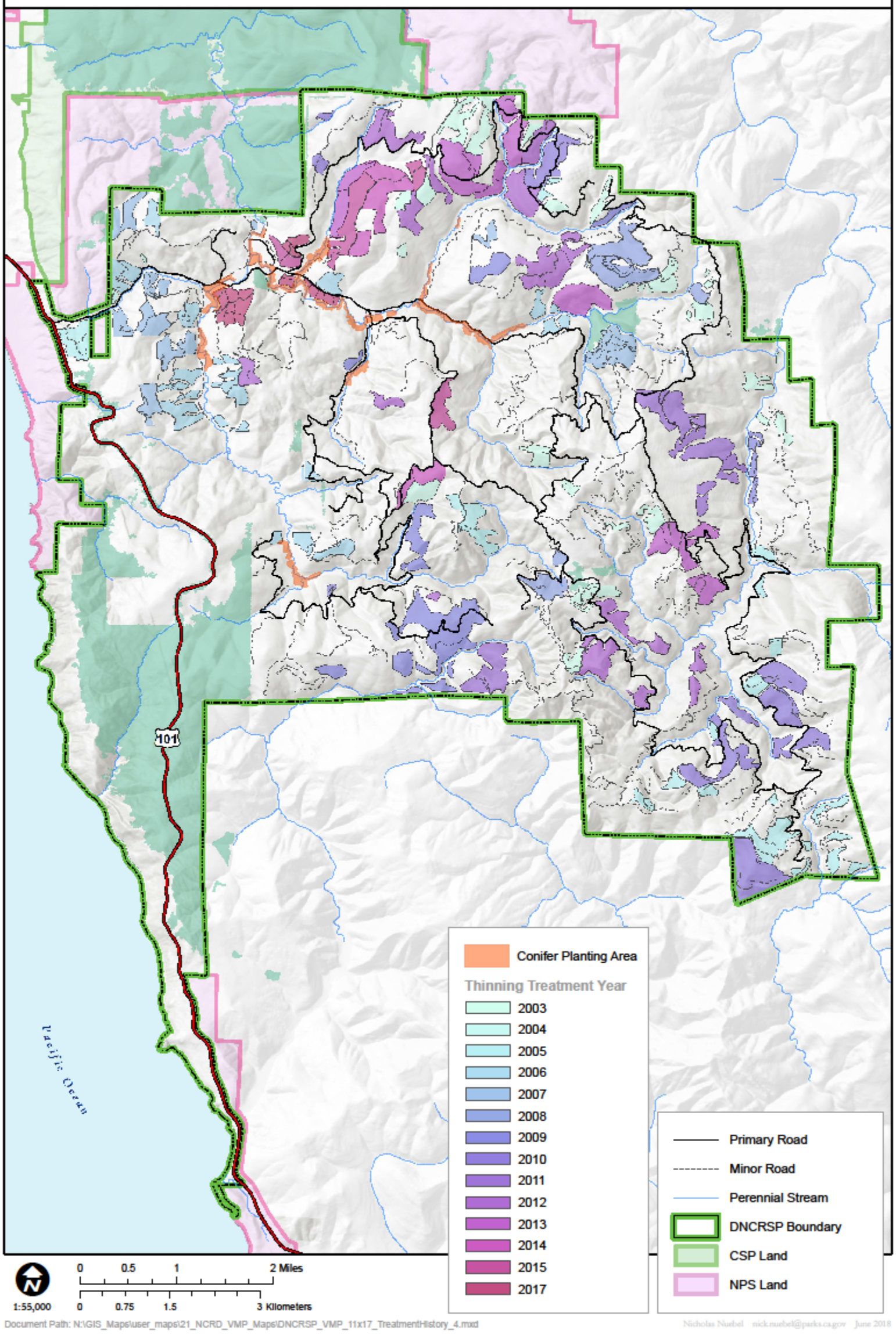
These are forests that are deficient in conifers as compared to pre-logging conditions. There are three main forest conditions that fall into this category:

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.

Del Norte Coast Redwoods State Park
Vegetation Management Plan - Treatment History

California State Parks
North Coast Redwood District



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Nicholas Nuebel nick.nuebel@parks.ca.gov June 2018

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's 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

<u>Silivicultural Methods</u>

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) .

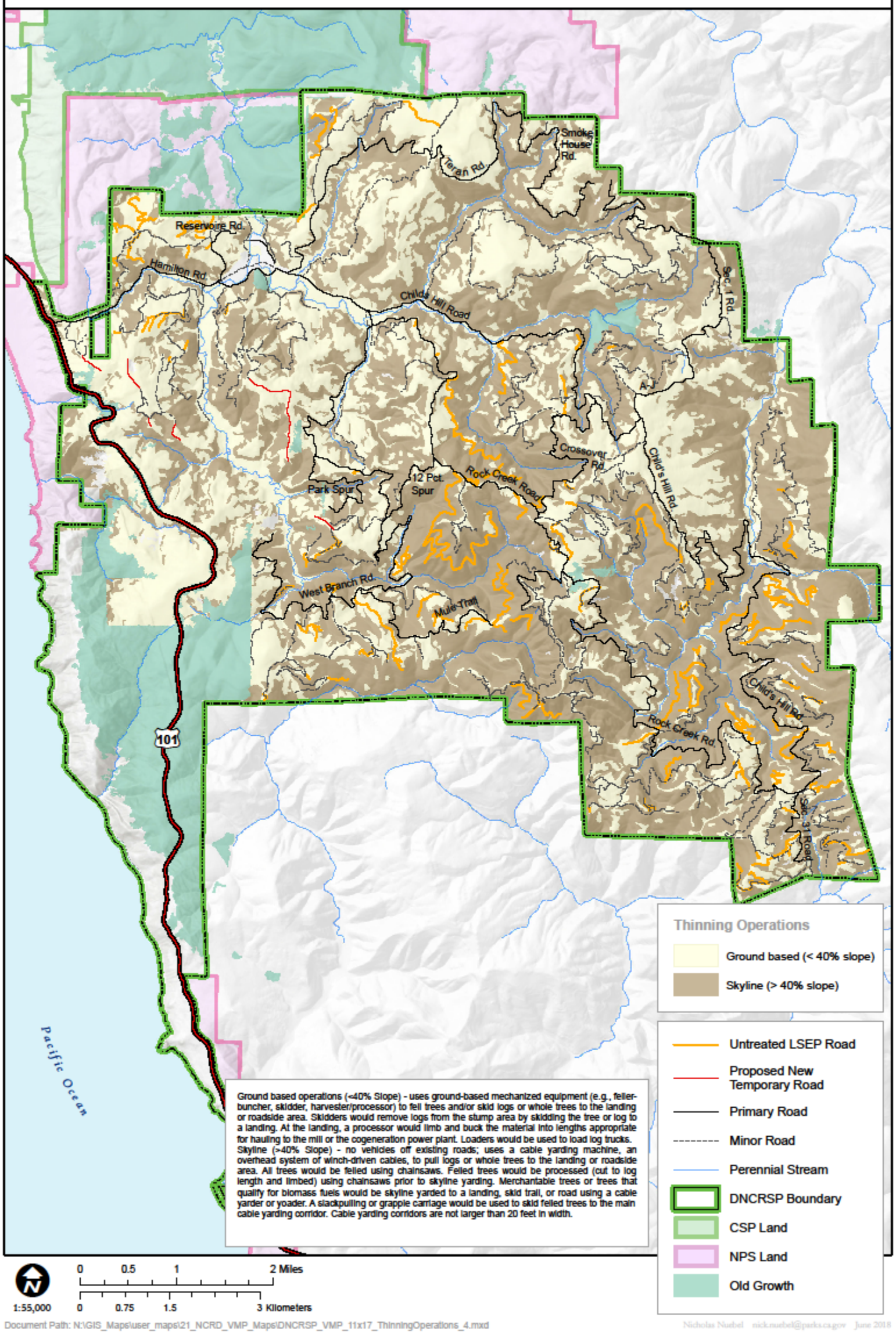
Operational Methods

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 (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**
      Cut-to-length harvesting systems are a variation on traditional ground-based operations. This harvest method is comprised of a harvester and forwarder. This system differs from other whole tree harvesting ground-based mechanized methods in that the harvester fells, processes, and bucks the stems at the stump while the forwarder transports the processed logs to the landing area. This method could be used on slopes up to 85% with a cable tether, except on slopes greater than 40% that lead to a watercourse without sufficient flattening to dissipate water flow and trap sediment.

Del Norte Coast Redwoods State Park
Vegetation Management Plan - Thinning Operations

California State Parks
North Coast Redwood District



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Nicholas Nuebel nick.nuebel@parks.ca.gov June 2018

- **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. 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. 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.

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.

Riparian corridors

As listed in the project requirements Appendix E, Class I streams (as defined by the California Forest Practice Rules 2017 and displayed in Map 2-b Hydrology) will retain a minimum of 60% canopy (post treatment) within 100 feet of the stream and BA reductions will not exceed 40% (PSR-HYDRO-1). Potentially fish-bearing streams (based on intrinsic steelhead potential as displayed in (Map 2-b Hydrology)) will be treated as Class I streams unless fish surveys conducted before treatments show that fish are not present. Class II streams (as defined by the California Forest Practice Rules 2017 and displayed in Map 2-b Hydrology) and seeps, springs, and wet areas that contain Class II attributes will retain a minimum of 60% canopy within 50 feet and and BA reductions will not exceed 40% (PSR-HYDRO-1). Basal area reductions are objectively measurable and translate into the required canopy retention post treatment as evidenced by monitoring data of prior treatments. Slope limitations as described in PSR-GEO-3 will apply along Class I and II streams and thinning will not occur on the steepest of inner gorge slopes. When cable yarding across riparian corridors, trees must be fully suspended in the air when traveling within 100 feet of streams (PSR-HYDRO-4).

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 crow 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 will not be hauled off site but may be used for instream structures (project requirement 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 onsite 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. 2006).
- 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 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 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. 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 underrepresented 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, CDPR 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 Program (CDPR 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.

In 2018, EDRR mapping began at the Park. The program targets 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. If an infestation can be treated with small hand tools in less than 10 minutes, and is not in a sensitive cultural area, it will be treated immediately. Ground disturbance is limited to less than 2 ft. Larger infestations will be mapped and prioritized for future treatment. Depending on future EDRR funding, future survey areas will expand from previously surveyed areas and will include old landings and some abandoned and decommissioned roads.

Treatment projects in and adjacent to sensitive plants species and habitats, roads slated for decommissioning, and equipment storage and landing areas will be prioritized for invasive exotic plant removal, including the following:

- 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. If manual treatment needs to be combined with herbicide treatment, additional environmental compliance will be completed.
- 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 *Phytopthera 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 bleach solution or similar treatment.

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 ensure 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.

Protocols will include, as appropriate, monitoring of sensitive plant and animal species.

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 imperiled 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 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 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:

- A contributing drainage area of ≥100 acres in the Coast Forest District, as measured from the confluence of the receiving Class I watercourse.
- An average active channel width of five feet (5 ft.) or greater near the confluence with the receiving Class I watercourse.

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 number of trees that are cut or thinned. It 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

Yarding - The movement of forest products (e.g. trees) from the point of falling to a landing.

9 Document Contributors

CDPR STAFF – NORTH COAST REDWOODS DISTRICT

Lathrop Leonard	Forester I
Claudia Voigt	Environmental Scientist Environmental
Michelle Forys	Scientist
Nick Nuebel	GIS Specialist
Amber Transou	Natural Resources Program Manager
Greg Collins	Cultural Resources Program Manager
Patrick Vaughan	Engineering Geologist

NPS STAFF – REDWOOD NATIONAL PARK

Judy Wartella	GIS Specialist

SRL STAFF

Laura Lalemand	Forest Ecologist
Andrew Slack	Former Forest Fellow
Richard Campbell	Director of Restoration

Appendix A -

DNCRSP Vascular Plant List (exported from NCRD Botanical Database updated 07112018)

	Scientific Name	Common Name	Family	Native	cultural signifi-cance
Tree (26)	*Abies grandis*	grand fir	Pinaceae	yes	
	Acer circinatum	vine maple	Sapindaceae	yes	
	Acer macrophyllum	big-leafed maple	Sapindaceae	yes	x
	Alnus rubra	red alder	Betulaceae	yes	x
	Arbutus menziesii	madrone	Ericaceae	yes	x
	Chamaecyparis lawsoniana	Port Orford cedar	Cupressaceae	yes	
	Chrysolepis chrysophylla var. chrysophylla	typical golden chinquapin	Fagaceae	yes	x
	Cornus sp.	dogwood	Cornaceae	yes	
	Frangula purshiana ssp. purshiana	California cascara	Rhamnaceae	yes	x
	Fraxinus latifolia	Oregon ash	Oleaceae	yes	
	Morella californica	wax myrtle	Myricaceae	yes	
	Notholithocarpus densiflorus var. densiflorus	tree tanbark	Fagaceae	yes	x
	Picea sitchensis	Sitka spruce	Pinaceae	yes	x
	Pinus attenuata	knobcone pine	Pinaceae	yes	
	Pinus contorta ssp. Murrayana	Lodgepole pine	Pinaceae	yes	x
	Pinus jeffreyi	Jeffrey pine	Pinaceae	yes	
	Pinus lambertiana	sugar pine	Pinaceae	yes	
	Pinus monticola	western white pine	Pinaceae	yes	
	Pimus radiata	Monterrey pine	Pinaceae	no	
	Pseudotsuga menziesii	Douglas-fir	Pinaceae	yes	x
	Quercus chrysolepis	canyon live oak	Fagaceae	yes	
	Sequoia sempervirens	coast redwood	Cupressaceae	yes	x
	Sequoiadendron giganteum	giant sequoia	Cupressaceae	no	
	Thuja plicata	western red cedar	Cupressaceae	yes	
	Tsuga heterophylla	western hemlock	Pinaceae	yes	
	Umbellularia californica	California bay	Lauraceae	yes	x
Shrub (66)	*Amelanchier alnifolia*	northwestern serviceberry	Rosaceae	yes	
	Amelanchier alnifolia var. semiintegrifolia	Pacific Saskatoon serviceberry	Rosaceae	yes	
	Amelanchier utahensis	Utah serviceberry	Rosaceae	yes	
	Arctostaphylos columbiana	Columbia manzanita	Ericaceae	yes	

	Scientific Name	Common Name	Family	Native	cultural signifi-cance
	Arctostaphylos glandulosa subsp. glandulosa	glandular manzanita	Ericaceae	yes	
	Arctostaphylos hispidula	Howell's manzanita	Ericaceae	yes	x
	Arctostaphylos nevadensis	pine-mat manzanita	Ericaceae	yes	x
	Arctostaphylos nortensis	Del Norte manzanita	Ericaceae	yes	x
	Baccharis pilularis ssp. consanguinea	upright coyote-brush	Asteraceae	yes	
	Berberis aquifolium	holly-leaved barberry	Berberidaceae	yes	x
	Berberis aquifolium var. repens	creeping barberry	Berberidaceae	yes	
	Berberis nervosa	Cascade barberry	Berberidaceae	yes	
	Ceanothus integerrimus	deer brush ceanothus	Rhamnaceae	yes	
	Ceanothus pumilus	Siskiyou mat	Rhamnaceae	yes	
	Ceanothus thyrsiflorus var. thyrsiflorus	blue blossom	Rhamnaceae	yes	
	Ceanothus velutinus	tobaccobrush	Rhamnaceae	yes	
	Chimaphila menziesii	little prince's-pine	Ericaceae	yes	
	Chimaphila umbellata	common prince's-pine	Ericaceae	yes	
	Chrysolepis sempervirens	bush golden chinquapin	Fagaceae	yes	
	Corylus cornuta var. californica	hazelnut	Betulaceae	yes	x
	Cotoneaster sp.	cotoneaster	Rosaceae	no	
	Cytisus scoparius	Scotch broom	Fabaceae	no	
	Euonymus occidentalis var. occidentalis	western burning-bush	Celastraceae	yes	
	Frangula californica	California coffee berry	Rhamnaceae	yes	
	Frangula californica ssp. occidentalis	western California coffeeberry	Rhamnaceae	yes	
	Garrya buxifolia	box-leaved silk-tassel	Garryaceae	yes	
	Garrya congdonii	Congdon's silk-tassel	Garryaceae	yes	
	Gaultheria shallon	salal	Ericaceae	yes	x
	Genista monspessulana	French broom	Fabaceae	no	
	Hedera helix	English ivy	Araliaceae	no	
	Holodiscus discolor	creambush ocean-spray	Rosaceae	yes	
	Ilex aquifolium	English holly	Aquifoliaceae	no	
	Juniperus communis	common ground juniper	Cupressaceae	yes	x
	Lonicera hispidula	California pink honeysuckle	Caprifoliaceae	yes	
	Lonicera involucrata	twinberry	Caprifoliaceae	yes	

	Scientific Name	Common Name	Family	Native	cultural signifi-cance
	Menziesia ferruginea	false azalea	Ericaceae	yes	
	Oemleria cerasiformis	oso-berry	Rosaceae	yes	x
	Physocarpus capitatus	Pacific ninebark	Rosaceae	yes	
	Quercus vacciniifolia	huckleberry oak	Fagaceae	yes	
	Rhododendron columbianum	Western labrador tea	Ericaceae	yes	x
	Rhododendron macrophyllum	Pacific rhododendron	Ericaceae	yes	
	Rhododendron occidentalis	western azalea	Ericaceae	yes	
	Ribes bracteosum	stink currant	Grossulariaceae	yes	
	Ribes laxiflorum	trailing black currant	Grossulariaceae	yes	
	Ribes menziesii var. menziesii	Menzies's gooseberry	Grossulariaceae	yes	
	Ribes roezlii	Sierra Nevada gooseberry	Grossulariaceae	yes	x
	Ribes roezlii var. cruentum	Coast Ranges gooseberry	Grossulariaceae	yes	
	Ribes sanguineum var. glutinosum	pink-flowering currant	Grossulariaceae	yes	
	Rosa gymnocarpa var. gymnocarpa	California wood rose	Rosaceae	yes	
	Rubus armeniacus	Himalayan blackberry	Rosaceae	no	
	Rubus laciniatus	cut-leaved blackberry	Rosaceae	no	
	Rubus leucodermis	white-stemmed blackberry	Rosaceae	yes	x
	Rubus parviflorus	thimbleberry	Rosaceae	yes	x
	Rubus spectabilis	salmonberry	Rosaceae	yes	x
	Rubus ursinus	California blackberry	Rosaceae	yes	x
	Salix delnortensis	Del Norte willow	Salicaceae	yes	x
	Salix hookeriana	Hooker's willow	Salicaceae	yes	x
	Salix lasiandra var. lasiandra	Pacific willow	Salicaceae	yes	x
	Salix lasiolepis	arroyo willow	Salicaceae	yes	x
	Salix scouleriana	Scouler's willow	Salicaceae	yes	x
	Salix sitchensis	Sitka willow	Salicaceae	yes	x
	Sambucus racemosa var. racemosa	red elderberry	Adoxaceae	yes	x
	Symphoricarpos mollis	creeping snowberry	Caprifoliaceae	yes	
	Toxicodendron diversilobum	Pacific poison oak	Anacardiaceae	yes	
	Vaccinium ovatum	evergreen huckleberry	Ericaceae	yes	x
	Vaccinium parvifolium	California red huckleberry	Ericaceae	yes	x
Herb (265)	*Achillea millefolium*	yarrow	Asteraceae	yes	x

	Scientific Name	Common Name	Family	Native	cultural signifi-cance
	Achlys californica	California vanilla leaf	Berberidaceae	yes	
	Achlys triphylla ssp. tryphylla	three-leaved vanilla leaf	Berberidaceae	yes	
	Acmispon americanus var. americanus	American bird's-foot-trefoil	Fabaceae	yes	
	Acmispon parviflorus	small-flowered lotus	Fabaceae	yes	
	Adenocaulon bicolor	trail plant	Asteraceae	yes	
	Agoseris grandiflora var. leptophylla	narrow-leaved agoseris	Asteraceae	yes	
	Allium falcifolium	sickle-leaved onion	Alliaceae	yes	
	Allotropa virgata	sugar stick	Ericaceae	yes	
	Anaphalis margaritacea	pearly everlasting	Asteraceae	yes	
	Anemone oregana var. oregana	Oregon anemone	Ranunculaceae	yes	
	Angelica hendersonii	Henderson's angelica	Apiaceae	yes	
	Anisocarpus madioides	forest madia	Asteraceae	yes	
	Aphanes occidentalis	western lady's-mantle	Rosaceae	yes	
	Apocynum androsaemifolium	dogbane	Apocynaceae	yes	
	Aquilegia formosa	western crimson columbine	Ranunculaceae	yes	
	Aralia californica	elk clover	Araliaceae	yes	
	Arnica spathulata	Klamath arnica	Asteraceae	yes	
	Asarum caudatum	western wild ginger	Aristolochiaceae	yes	x
	Asyneuma prenanthoides	western hare-bell	Campanulaceae	yes	
	Bellis perennis	English daisy	Asteraceae	no	
	Boykinia occidentalis	western brook-foam	Saxifragaceae	yes	
	Brodiaea elegans	harvest brodiaea	Themidaceae	yes	
	Calochortus tolmiei	Tolmie’s pussy-ears	Liliaceae	yes	
	Cardamine angulata	seaside bittercress	Brassicaceae	yes	
	Cardamine breweri	Brewer's bitter-cress	Brassicaceae	yes	
	Cardamine californica	California toothwort	Brassicaceae	yes	
	Cardamine nuttallii	Nuttall's toothwort	Brassicaceae	yes	
	Cardamine oligosperma	little bittercress	Brassicaceae	yes	
	Castilleja affinis ssp. affinis	common coastal paintbrush	Orobanchaceae	yes	
	Castilleja affinis ssp. litoralis	Oregon coast paintbrush	Orobanchaceae	yes	
	Castilleja brevilobata	short-lobed paintbrush	Orobanchaceae	yes	
	Castilleja exserta	purple owl's-clover	Scrophulariaceae	yes	
	Centaurium erythraea	European centaury	Gentianaceae	no	

	Scientific Name	Common Name	Family	Native	cultural signifi-cance
	Cerastium arvense	field mouse-eared chickweed	Caryophyllaceae	yes	
	Cerastium glomeratum	broad-leaved mouse-ear chickweed	Caryophyllaceae	no	
	Chamerion angustifolium	narrow-leaved fireweed	Onagraceae	yes	
	Chrysosplenium glechomifolium	Pacific golden-saxifrage	Saxifragaceae	yes	
	Circaea alpina ssp. pacifica	small enchanter's night-shade	Onagraceae	yes	
	Cirsium arvense	Canada thistle	Asteraceae	no	
	Cirsium brevistylum	short-styled thistle	Asteraceae	yes	
	Cirsium vulgare	bull thistle	Asteraceae	no	
	Claytonia sibirica	candy flower	Montiaceae	yes	
	Claytonia sp.	claytonia	Montiaceae	unk	
	Clinopodium douglasii	yerba buena	Lamiaceae	yes	x
	Clintonia andrewsiana	red clintonia	Liliaceae	yes	
	Collinsia linearis	linear-leaved blue-eyed-Mary	Plantaginaceae	yes	
	Collomia heterophylla	variable-leaved collomia	Polemoniaceae	yes	
	Conium maculatum	poison hemlock	Apiaceae	no	
	Corallorhiza maculata	spotted coral root orchid	Orchidaceae	yes	
	Corallorhiza sp.	coral root orchid	Orchidaceae	yes	
	Cordylanthus tenuis	Slender bird's beak	Orobanchaceae	yes	
	Crepis capillaris	smooth hawksbeard	Asteraceae	no	
	Crocosmia x. crocosmiiflora	Monbretia	Iridaceae	no	
	Cypripedium californicum	California lady's-slipper orchid	Orchidaceae	yes	
	Daucus carota	Queen Anne's lace	Apiaceae	no	
	Delairea odorata	Cape ivy	Asteraceae	no	
	Dicentra formosa	western bleeding heart	Papaveraceae	yes	
	Digitalis purpurea	common foxglove	Plantaginaceae	no	
	Dipsacus fullonum	common roadside teasel	Dipsacaceae	no	
	Drymocallis glandulosa	sticky potentilla	Rosaceae	yes	
	Dysphania ambrosioides	Mexican tea	Chenopodiaceae	no	
	Epilobium ciliatum ssp. watsonii	ciliate willowherb	Onagraceae	yes	
	Epilobium minutum	minute willow herb	Onagraceae	yes	
	Erigeron canadensis	Canadian horseweed	Asteraceae	no	
	Erigeron foliosus var. confinis	leafy fleabane-daisy	Asteraceae	yes	

	Scientific Name	Common Name	Family	Native	cultural signifi-cance
	Eriodictyon californicum	yerba santa	Boraginaceae	yes	x
	Eriogonum nudum	naked-stemmed buckwheat	Polygonaceae	yes	
	Eriophyllum lanatum	common woolly-sunflower	Asteraceae	yes	
	Erythronium californicum	California fawn-lily	Liliaceae	yes	
	Erythronium citrinum var. citrinum	lemon fawn-lily	Liliaceae	yes	
	Eucephalus tomentellus	brickellbush aster	Asteraceae	yes	
	Euchiton gymnocephalus	creeping cudweed	Asteraceae	no	
	Euchiton involucratus	star cottonleaf	Asteraceae	no	
	Eurybia radulina	rough-leaved aster	Asteraceae	yes	
	Fritillaria affinis	purple rice-bulbed fritillary	Liliaceae	yes	
	Galium ambiguum ssp. siskiyouense	Siskiyou bedstraw	Rubiaceae	yes	
	Galium aparine	bedstraw	Rubiaceae	yes	
	Galium trifidum ssp. columbianum	Pacific bedstraw	Rubiaceae	yes	
	Galium triflorum	three-flowered bedstraw	Rubiaceae	yes	
	Gamochaeta ustulata	Pacific cudweed	Asteraceae	yes	
	Gentiana affinis var. ovata	Oregon gentian	Gentianaceae	yes	
	Geranium dissectum	cutleaf crane’s-bill	Geraniaceae	no	
	Geranium lucidum	shining geranium	Geraniaceae	no	
	Geranium robertianum	Robert's herb	Geraniaceae	no	
	Geum macrophyllum var. macrophyllum	large-leaved avens	Rosaceae	yes	
	Gilia capitata ssp. Capitata	blue-headed gilia	Polemoniaceae	yes	
	Githopsis specularioides	Common bluecup	Campanulaceae		
	Glechoma hederacea	common ground-ivy	Lamiaceae	no	
	Gnaphalium sp.	cudweed	Asteraceae	unk	
	Goodyera oblongifolia	rattlesnake orchid	Orchidaceae	yes	
	Gratiola ebracteata	Bractless hedge hyssop	Plantaginaceae		
	Hastingsia serpentinicola	Siskiyou rushlily	Agavaceae	yes	
	Heracleum maximum	cow parsnip	Apiaceae	yes	x
	Heuchera micrantha	small-flowered alumroot	Saxifragaceae	yes	
	Hieracium albiflorum	white-flowered hawkweed	Asteraceae	yes	
	Hieracium bolanderi	Bolander's hawkweed	Asteraceae	yes	
	Horkelia sericata	Howell's horkelia	Rosaceae	yes	

	Scientific Name	Common Name	Family	Native	cultural signifi-cance
	Hosackia rosea	rosy lotus	Fabaceae	yes	
	Hydrocotyle ranunculoides	marsh pennywort	Apiaceae	yes	
	Hydrophyllum tenuipes	Pacific waterleaf	Boraginaceae	yes	
	Hypericum perforatum	Klamath weed	Hypericaceae	no	
	Hypochaeris radicata	rough cat's-ear	Asteraceae	no	
	Iris douglasiana	Douglas iris	Iridaceae	yes	
	Iris thompsonii	Thompson's iris	Iridaceae	yes	
	Kopsiopsis hookeri	small groundcone	Orobanchaceae	yes	
	Kopsiopsis strobilacea	California ground-cone	Orobanchaceae	yes	
	Lapsana communis	common nipplewort	Asteraceae	no	
	Lathyrus delnorticus	Del Norte pea	Fabaceae	yes	
	Lathyrus nevadensis var. nevadensis	Sierra Nevada pea	Fabaceae	Yes	
	Lathyrus polyphyllus	many-leaved pea	Fabaceae	yes	
	Lathyrus vestitus var. vestitus	woodland pea	Fabaceae	yes	
	Leucanthemum vulgare	ox-eye daisy	Asteraceae	no	
	Lilium bolanderi	Bolander's lily	Liliaceae	yes	
	Lilium columbianum	Columbia lily	Liliaceae	yes	
	Lilium pardalinum ssp. Pardalinum	California leopard-lily	Liliaceae	yes	
	Lilium pardalinum ssp. Vollmeri	Vollmer's lily	Liliaceae	yes	
	Linum bienne	flax	Linaceae	no	
	Listera banksiana	northwest listera	Orchidaceae	yes	
	Listera cordata	heart-leaved twayblade	Orchidaceae	yes	
	Lomatium howellii	Howell's lomatium	Apiaceae	yes	
	Lomatium macrocarpum	large-fruited lomatium	Apiaceae	yes	
	Lotus corniculatus	broadleaf birdsfoot trefoil	Fabaceae	no	
	Lotus uliginosus	greater lotus	Fabaceae	no	
	Lupinus latifolius	broad-leaved lupine	Fabaceae	yes	
	Lupinus polyphyllus	many-leaved lupine	Fabaceae	yes	
	Lupinus sp.	lupine	Fabaceae	yes	
	Lysichiton americanus	skunk cabbage	Araceae	yes	x
	Lysimachia latifolia	Pacific starflower	Myrsinaceae	yes	
	Madia gracilis	slender madia	Asteraceae	yes	
	Madia sativa	coast tarweed	Asteraceae	yes	

	Scientific Name	Common Name	Family	Native	cultural signifi-cance
	Maianthemum dilatatum	two-leaved false-Solomon's-seal	Ruscaceae	yes	
	Maianthemum racemosum	false Solomon’s seal	Ruscaceae	yes	
	Maianthemum sp.	false lily-of-the-valley	Ruscaceae	yes	
	Maianthemum stellatum	starry false lily-of-the-valley	Ruscaceae	yes	
	Marah oregana	coast man-root	Cucurbitaceae	yes	x
	Medicago polymorpha	bur-clover	Fabaceae	no	
	Melilotus sp.	sweetclover	Fabaceae	no	
	Melissa officinalis	lemon balm	Lamiaceae	no	
	Mentha pulegium	European pennyroyal	Lamiaceae	no	
	Mentha sp.	mint	Lamiaceae	no	
	Mimulus dentatus	coast monkeyflower	Phrymaceae	yes	
	Mimulus floribundus	floriferous mimulus	Phrymaceae	yes	
	Minuartia howellii	Howell's sandwort	Caryophyllaceae	yes	
	Mitellastra caulescens	leafy-stemmed mitrewort	Saxifragaceae	yes	
	Monardella purpurea	serpentine monardella	Lamiaceae	yes	
	Montia fontana	fountain miner's lettuce	Montiaceae	no	
	Montia linearis	candyflower	Montiaceae	yes	
	Montia parvifolia	little-leaved montia	Montiaceae	yes	
	Navarretia squarrosa	skunkweed	Polemoniaceae	yes	
	Nemophila heterophylla	variable-leaved nemophila	Boraginaceae	yes	
	Nemophila parviflora var. parviflora	woodland nemophila	Boraginaceae	yes	
	Nemophila pedunculata	meadow nemophila	Boraginaceae	yes	
	Oenanthe sarmentosa	Pacific water-parsley	Apiaceae	yes	
	Orobanche uniflora	one-flowered broomrape	Orobanchaceae	yes	
	Osmorhiza berteroi	sweet cicely	Apiaceae	yes	
	Osmorhiza purpurea	purple sweet cicely	Apiaceae	yes	
	Oxalis oregana	redwood sorrel	Oxalidaceae	yes	x
	Oxalis suksdorfii	Suksdorf's wood-sorrel	Oxalidaceae	yes	
	Packera bolanderi var. bolanderi	seacoast ragwort	Asteraceae	yes	
	Packera macounii	Siskiyou Mountains ragwort	Asteraceae	yes	
	Pectiantia ovalis	oval-leaved mitrewort	Saxifragaceae	yes	
	Penstemon anguineus	Siskiyou beardtongue	Plantaginaceae	yes	
	Perideridia oregana	Oregon yampa	Apiaceae		

	Scientific Name	Common Name	Family	Native	cultural signifi-cance
	Perideridia sp.	yampa	Apiaceae	yes	
	Petasites frigidus var. palmatus	western colt's foot	Asteraceae	yes	x
	Phacelia bolanderi	Bolander's phacelia	Boraginaceae	yes	
	Phacelia heterophylla	phacelia	Boraginaceae	yes	
	Phacelia sp.	phacelia	Boraginaceae	yes	
	Pinguicula macroceras	horned butterwort	Lentibulariaceae	yes	
	Piperia candida	white-flowered rein orchid	Orchidaceae	yes	
	Pityopus californicus	California pinefoot	Ericaceae	yes	
	Plantago lanceolata	English plantain	Plantaginaceae	no	
	Plantago major	greater plantain	Plantaginaceae	no	x
	Polycarpon tetraphyllum	four-leaved allseed	Caryophyllaceae	no	
	Polygala californica	California milkwort	Polygalaceae	yes	
	Polygonum sp.	knotweed	Polygonaceae	unk	
	Polygonum spergulariiforme	spurry knotweed	Polygonaceae	no	
	Prosartes hookeri	Hooker's fairy bells	Liliaceae	yes	
	Prosartes smithii	Smith's fairy bells	Liliaceae	yes	
	Prunella vulgaris	selfheal	Lamiaceae	unk	
	Prunella vulgaris var. lanceolata	mountain selfheal	Lamiaceae	yes	
	Prunella vulgaris var. vulgaris	common selfheal	Lamiaceae	no	
	Pseudognaphalium beneolens	fragrant pearly everlasting	Asteraceae	yes	
	Pseudognaphalium luteoalbum	cotton-batting-plant	Asteraceae	no	
	Pseudognaphalium stramineum	cotton-batting-plant	Asteraceae	yes	
	Pseudotrillium rivale	false trillium	Melanthiaceae	yes	
	Pyrola asarifolia ssp. bracteata	long-bracted wintergreen	Pyrolaceae	yes	
	Pyrola picta	leafless wintergreen	Ericaceae	yes	
	Ranunculus occidentalis var. occidentalis	western buttercup	Ranunculaceae	yes	
	Ranunculus repens	common creeping buttercup	Ranunculaceae	no	
	Ranunculus sp.	buttercup	Ranunculaceae	unk	
	Ranunculus uncinatus	barbed buttercup	Ranunculaceae	yes	
	Raphanus sp.	charlock	Brassicaceae	no	
	Rorippa curvisiliqua	western cress	Brassicaceae	yes	
	Rumex acetosella	sheep sorrel	Polygonaceae	no	
	Rumex obtusifolius	broad-leaved dock	Polygonaceae	no	
	Rumex sp.	dock	Polygonaceae	unk	

	Scientific Name	Common Name	Family	Native	cultural signifi-cance
	Sagina procumbens	matted pearlwort	Caryophyllaceae	no	
	Sanicula bipinnatifida	purple sanicle	Apiaceae	yes	
	Sanicula crassicaulis	Pacific sanicle	Apiaceae	yes	
	Sanicula laciniata	coast sanicle	Apiaceae	yes	
	Sanicula peckiana	Peck's sanicle	Apiaceae	yes	
	Sanicula sp.	sanicle	Apiaceae	yes	
	Scrophularia californica	California bee plant	Scrophulariaceae	yes	
	Scutellaria antirrhinoides	snapdragon skullcap	Lamiaceae	yes	
	Sedum obtusatum	Sierra stonecrop	Crassulaceae		
	Senecio glomeratus	cut-leaf coast burnweed	Asteraceae	no	
	Senecio jacobaea	tansy ragwort	Asteraceae	no	
	Senecio minimus	coastal burnweed	Asteraceae	no	
	Senecio vulgaris	garden groundsel	Asteraceae	no	
	Sherardia arvensis	blue field madder	Rubiaceae	no	
	Sidalcea asprella ssp. asprella	Sierra foothills checker-bloom	Malvaceae	yes	
	Sidalcea elegans	Del norte checkerbloom	Malvaceae		
	Sidalcea malachroides	maple-leaved checkerbloom	Malvaceae	yes	
	Silene serpentinicola	serpentine catchfly	Caryophyllaceae	yes	
	Sisyrinchium bellum	blue-eyed grass	Iridaceae	yes	
	Sonchus oleraceus	common sow-thistle	Asteraceae	no	
	Sonchus sp.	sow-thistle	Asteraceae	no	
	Spergularia rubra	red sand-spurrey	Caryophyllaceae	no	
	Spergularia sp.	sand-spurrey	Caryophyllaceae	unk	
	Stachys bergii	Berg's hedge-nettle	Lamiaceae	yes	
	Stachys chamissonis	giant coastal hedge-nettle	Lamiaceae	yes	
	Stachys rigida var. rigida	rigid hedge-nettle	Lamiaceae	yes	
	Stachys sp.	hedge-nettle	Lamiaceae	yes	
	Stellaria crispa	curled starwort	Caryophyllaceae	yes	
	Stellaria media	common chickweed	Caryophyllaceae	no	
	Synthyris cordata	cordate snow-queen	Plantaginaceae	yes	
	Taraxacum officinale	dandelion	Asteraceae	no	
	Tauschia glauca	glaucous tauschia	Apiaceae	yes	
	Tauschia kelloggii	Kellogg's tauschia	Apiaceae	yes	

	Scientific Name	Common Name	Family	Native	cultural signifi-cance
	Tellima grandiflora	fringe cups	Saxifragaceae	yes	
	Tolmiea diplomenziesii	pig-a-back plant	Saxifragaceae	yes	
	Torilis arvensis	hedge parsley	Apiaceae	no	
	Toxicoscordion venenosum	deadly zigadenus	Melanthiaceae	yes	
	Tragopogon lamottei	salsify	Asteraceae	no	
	Trifolium dubium	yellow suckling clover	Fabaceae	no	
	Trifolium microcephalum	small-headed clover	Fabaceae	yes	
	Trifolium vesiculosum	arrow-leaved clover	Fabaceae	no	
	Trillium ovatum ssp. ovatum	Western wake robin	Melanthiaceae	yes	
	Triphysaria eriantha ssp. rosea	rosy Johnny-Tuck	Orobanchaceae	yes	
	Triphysaria pusilla	dwarf owl's-clover	Orobanchaceae	yes	
	Triteleia bridgesii	Bridges's triteleia	Themidaceae	yes	
	Urtica dioica	stinging nettle	Urticaceae	yes	x
	Valeriana sitchensis	sitka valerian	Valerianaceae	yes	
	Vancouveria hexandra	northern inside-out flower	Berberidaceae	yes	
	Vancouveria planipetala	redwood ivy	Berberidaceae	yes	
	Veronica americana	American speedwell	Plantaginaceae	yes	
	Veronica anagallis-aquatica	great water speedwell	Plantaginaceae	no	
	Veronica peregrina ssp. xalapensis	hairy purslane speedwell	Plantaginaceae	yes	
	Veronica serpyllifolia ssp. humifusa	bright-blue speedwell	Plantaginaceae	yes	
	Veronica sp.	veronica	Plantaginaceae	unk	
	Vicia americana ssp. americana	American vetch	Fabaceae	no	
	Vicia gigantea	giant vetch	Fabaceae	yes	
	Vicia sativa	common vetch	Fabaceae	no	
	Viola adunca ssp. adunca	western dog violet	Violaceae	yes	x
	Viola cuneata	wedge-leaved violet	Violaceae	yes	
	Viola glabella	stream violet	Violaceae	yes	
	Viola lobata ssp. lobata	yellow pine violet	Violaceae	yes	
	Viola ocellata	western heart's-ease violet	Violaceae	yes	
	Viola sempervirens	redwood violet	Violaceae	yes	
	Whipplea modesta	modesty, yerba de selva	Philadelphaceae	yes	
	Xerophyllum tenax	western bear grass	Melanthiaceae	yes	x
Graminoid (65)	*Agrostis capillaris*	colonial bentgrass	Poaceae	no	

	Scientific Name	Common Name	Family	Native	cultural signifi-cance
	Agrostis sp.	bentgrass	Poaceae	unk	
	Agrostis stolonifera	creeping bentgrass	Poaceae	no	
	Aira caryophyllea	European silver hairgrass	Poaceae	no	
	Anthoxanthum occidentale	California sweet grass	Poaceae	yes	
	Anthoxanthum odoratum	sweet vernal grass	Poaceae	no	
	Avena barbata	slender wild oat	Poaceae	no	
	Briza maxima	rattlesnake grass	Poaceae	no	
	Briza minor	little rattlesnake grass	Poaceae	no	
	Bromus carinatus var. carinatus	California brome	Poaceae	yes	
	Bromus hordeaceus	soft-chess brome	Poaceae	no	
	Bromus vulgaris	narrow-flowered brome	Poaceae	yes	
	Calamagrostis nutkaensis	Pacific reed-grass	Poaceae	yes	
	Carex bolanderi	Bolander's sedge	Cyperaceae	yes	
	Carex concinnoides	northwestern sedge	Cyperaceae	yes	
	Carex echinatus ssp. phyllomanica	coastal stellate sedge	Cyperaceae	yes	
	Carex hendersonii	Henderson’s sedge	Cyperaceae	yes	
	Carex leptopoda	taper fruit short scale sedge	Cyperaceae	yes	
	Carex mendocinensis	Mendocino sedge	Cyperaceae	yes	
	Carex obnupta	slough sedge	Cyperaceae	yes	
	Carex rossii	Ross’ sedge	Cyperaceae	yes	
	Carex serpenticola	serpentine sedge	Cyperaceae	yes	
	Carex sp.	sedge	Cyperaceae	yes	
	Carex subfusca	rusty slender sedge	Cyperaceae	yes	
	Cortaderia jubata	jubata grass	Poaceae	no	
	Cynosurus cristatus	crested dogstail grass	Poaceae	no	
	Cynosurus echinatus	hedgehog dogtail grass	Poaceae	no	
	Cyperus eragrostis	tall flatsedge	Cyperaceae	yes	
	Dactylis glomerata	orchard grass	Poaceae	no	
	Danthonia californica	California oatgrass	Poaceae	yes	
	Deschampsia elongata	elongated hair-grass	Poaceae	yes	
	Elymus glaucus	blue wildrye	Poaceae	yes	
	Festuca arundinacea	tall fescue	Poaceae	no	
	Festuca californica	California fescue	Poaceae	yes	
	Festuca idahoensis	Idaho fescue	Poaceae	yes	

	Scientific Name	Common Name	Family	Native	cultural signifi-cance
	Festuca myuros	rat-tailed fescue	Poaceae	no	
	Festuca occidentalis	western fescue	Poaceae	yes	
	Festuca perennis	perennial rye-grass	Poaceae	no	
	Festuca sp.	fescue	Poaceae	unk	
	Glyceria elata	western tall manna-grass	Poaceae	yes	
	Holcus lanatus	velvet grass	Poaceae	no	
	Isolepis setacea	bristle-leaved bulrush	Cyperaceae	no	
	Juncus bolanderi	Bolander’s rush	Juncaceae	yes	
	Juncus bufonius	toad rush	Juncaceae	yes	
	Juncus effusus ssp. pacificus	soft rush	Juncaceae	yes	x
	Juncus ensifolius	dagger-leaved rush	Juncaceae	yes	
	Juncus xiphioides	iris-leaved rush	Juncaceae	yes	
	Koeleria macrantha	prairie June-grass	Poaceae	yes	
	Luzula comosa	hairy wood rush	Juncaceae	yes	
	Luzula parviflora	small-flowered wood rush	Juncaceae	yes	
	Luzula sp.	wood rush	Juncaceae	yes	
	Luzula subcongesta	Donner wood-rush	Juncaceae	yes	
	Melica geyeri	Geyer's melic	Poaceae	yes	
	Melica harfordii	Harford’s melic	Poaceae	yes	
	Melica sp.	melic	Poaceae	yes	
	Melica subulata	Alaska melic	Poaceae	yes	
	Phalaris arundinacea	reed canary-grass	Poaceae	yes	
	Pleuropogon refractus	nodding semaphore grass	Poaceae	yes	
	Poa annua	annual bluegrass	Poaceae	no	
	Polypogon monspeliensis	rabbitsfoot beardgrass	Poaceae	no	
	Rytidosperma penicillatum	purple-awned wallaby-grass	Poaceae	no	
	Scirpus microcarpus	small-fruited bulrush	Cyperaceae	yes	
	Stipa lemmonii	Lemmon's needle-grass	Poaceae	yes	
	Trisetum cernuum	nodding trisetum	Poaceae	yes	
	Trisetum sp.	trisetum	Poaceae	yes	
Fern and Fern Ally (15)	*Adiantum aleuticum*	western maiden hair fern	Pteridaceae	yes	x
	Aspidotis densa	serpentine lace-fern	Pteridaceae	yes	
	Athyrium filix-femina	lady fern	Dryopteridaceae	yes	

	Scientific Name	Common Name	Family	Native	cultural signifi-cance
	Blechnum spicant	deer fern	Blechnaceae	yes	
	Dryopteris expansa	spreading wood fern	Dryopteridaceae	yes	x
	Dryopteris sp.	wood fern	Dryopteridaceae	yes	
	Equisetum telmateia ssp. braunii	giant horsetail	Equisetaceae	yes	x
	Pentagramma triangularis ssp. triangularis	gold back fern	Pteridaceae	yes	
	Polypodium glycyrrhiza	sweet-licorice fern	Polypodiaceae	yes	
	Polypodium scouleri	leather-leaved polypody	Polypodiaceae	yes	
	Polystichum munitum	sword fern	Dryopteridaceae	yes	x
	Pteridium aquilinum var. pubescens	bracken fern	Dennstaedtiaceae	yes	x
	Selaginella oregana	Oregon spikemoss	Lycopodiaceae	yes	
	Selaginella wallacei	Wallace's spikemoss	Lycopodiaceae	yes	
	Woodwardia fimbriata	western chain fern	Blechnaceae	yes	x
Bryophyte (10)	*Campylopus introflexus*	moss	Dicranaceae	no	
	Dicranum sp.		Dicranaceae	yes	
	Discelium nudum	Discelium moss	Disceliaceae	yes	
	Fissidens crispus		Fissidentaceae	yes	
	Frullania sp.			yes	
	Homalothecium sp.		Brachytheciaceae	yes	
	Hookeria lucens			yes	
	Isothecium sp.	icicle moss	Lembophyllaceae	yes	
	Kindbergia sp.	kindbergia	Brachytheciaceae	yes	
	Leucolepis acanthoneura	leucolepis	Mniaceae	yes	
	Polytrichum sp.	polytrichum	Polytrichaceae	yes	
Lichen (7)					
	Cladonia sp.	cladonia		yes	
	Leptogium palmatum	lichen	Lichen	yes	
	Lobaria sp.	lichen	Lichen	yes	
	Peltigera sp.			yes	
	Sphaerophorus sp.		Lichen	yes	
	Usnea longissima	Methusela’s beard	Lichen	yes	
	Usnea rubicunda	usnea		yes	

Appendix B Sensitive Plant Species in the Assessment Area around DNCRSP

List compiled from a 9-quad search of the CNPS Rare Plant Inventory and the CNDDB 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
Angelica lucida	sea-watch	Coastal Prairie, Coastal Strand, wetland-riparian	4.2	None	None	Potential to occur
Antennaria suffrutescens	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
Anthoxanthum nitens ssp. nitens	vanilla-grass	Meadow & seep | Wetland	2B.3	None	None	Potential to occur
Arabis mcdonaldiana	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
Arctostaphylos hispidula	Howell's manzanita	Chaparral (serpentinite or sandstone)	4.2	None	None	known to occur in the park
Arctostaphylos nortensis	Del Norte manzanita	Chaparral, Lower montane coniferous forest, often serpentinite, above 500m elev.	4.3	None	None	known to occur in the park
Arnica cernua	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
Arnica spathulata	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
Asplenium trichomanes ssp. trichomanes	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
Boechera koehleri	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
Bryoria pseudocapillaris	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 DNCRSP
Bryoria spiralifera	twisted horsehair lichen	North Coast coniferous forest (immediate coast), Usually on conifers	1B.1	None	None	No potential to occur; habitat not present in DNCRSP
Calamagrostis crassiglumis	Thurber's reed grass	Northern Coastal Scrub, Freshwater Wetlands	2B.1	None	None	Potential to occur
Calamagrostis foliosa	leafy reed grass	Coastal bluff scrub, North Coast coniferous forest; elev. 0-1,220m; blooms May-Sep.	4.2	CR	None	Potential to occur
Calicium adspersum	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
Calystegia atriplicifolia ssp. buttensis	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
Cardamine angulata	seaside bittercress	Lower montane coniferous forest, North Coast coniferous forest, Wet areas, streambanks	2B.1	None	None	known to occur in the park
Cardamine nuttallii var. gemmata	yellow-tubered toothwort	Lower montane coniferous forest, North Coast coniferous forest, serpentinite	3.3	None	None	Potential to occur
Carex arcta	northern clustered sedge	Bogs and fens, North Coast coniferous forest (mesic)	2B.2	None	None	Potential to occur
Carex lenticularis var. limnophila	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 DNCRSP
Carex leptalea	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
Carex lyngbyei	Lyngbye's sedge	coastal, salt-marsh	2B.2	None	None	Unlikely to occur
Carex praticola	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
Carex scabriuscula	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
Carex serpenticola	serpentine sedge	Meadow & seep, mesic, serpentinite; elev. 60-1,200m; blooms Mar.-May.	2B.3	None	None	known to occur in the park
Carex viridula ssp. viridula	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
Cascadia nuttallii	Nuttall's saxifrage	North Coast coniferous forest (mesic, rocky); elev. 40-75m; blooms May.	2B.1	None	None	Potential to occur
Castilleja affinis ssp. litoralis	Oregon coast paintbrush	Coastal Strand, Northern Coastal Scrub	2B.2	None	None	known to occur in the park
Castilleja brevilobata	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
Castilleja elata	Siskiyou paintbrush	Bog & fen, Lower montane coniferous forest (seeps); elev. 0-1,750m; blooms May-Aug.	2B.2	None	None	Potential to occur
Chrysosplenium glechomifolium	Pacific golden saxifrage	Redwood Forest, wetland-riparian	4.3	None	None	Potential to occur
Coptis laciniata	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
Cypripedium californicum	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
Cypripedium montanum	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
Darlingtonia californica	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
Dicentra formosa ssp. oregana	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
Discelium nudum	Discelium moss	seaward facing bluffs of eroded clay usually within sight of the ocean	2B.2			known to occur in the park (NPS record)
Erigeron bloomeri var. nudatus	Waldo daisy	Lower montane and upper montane coniferous forest, serpentinite; elev. 600-2300m;	2B.3	None	None	Potential to occur
Erigeron cervinus	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
Eriogonum pendulum	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
Erythronium hendersonii	Henderson's fawn lily	Lower montane coniferous forest; elev. 300-1,600m; blooms Apr.-Jul.	2B.3	None	None	Potential to occur
Erythronium howellii	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
Erythronium oregonum	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
Erythronium revolutum	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
Fissidens pauperculus	minute pocket moss	North Coast coniferous forest (damp coastal soil); elev. 10-1,024m.	1B.2	None	None	Potential to occur
Gentiana setigera	Mendocino gentian	Lower montane coniferous forest, Meadow & seep, mesic, serpentinite; elev. 490-1,065m; blooms Aug.-Sept.	1B.2	None	None	Potential to occur
Gilia capitata ssp. pacifica	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
Gilia millefoliata	dark-eyed gilia	Coastal dunes, 2-30 m	1B.2	None	None	No potential to occur; habitat not present in DNCRSP
Glehnia littoralis ssp. leiocarpa	American glehnia	Coastal dunes, 2-30 m	4.2	None	None	No potential to occur; habitat not present in DNCRSP
Horkelia sericata	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
Hosackia gracilis	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
Iris bracteata	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
Iris innominata	Del Norte County iris	Lower montane coniferous forest (serpentinite); elev. 300-2,000m; blooms May-Jun.	4.3	None	None	Potential to occur
Iris tenax ssp. klamathensis	Orleans iris	Lower montane coniferous forest (often in disturbed areas); elev. 100-1,400m; blooms Apr.-May	4.3	None	None	Potential to occur
Kopsiopsis hookeri	small groundcone	North Coast coniferous forest, open woodland, mixed conifer forest, generally on Gaultheria shallon, occasionally on Arbutus menziesii, Arctostaphylos uva-ursi; elev. 90-885m; blooms Apr-Aug.	2B.3	None	None	known to occur in the park
Lathyrus delnorticus	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
Lathyrus palustris	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
Lewisia oppositifolia	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
Lilium bolanderi	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
Lilium kelloggii	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
Lilium occidentale	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
Lilium pardalinum ssp. vollmeri	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
Listera cordata	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
Lomatium howellii	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
Lomatium martindalei	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
Lycopodium clavatum	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
Lysimachia europaea	arctic starflower	Bog & fen | Meadow & seep | Wetland, Coastal boggy areas. 0-15 m.	2B.2	None	None	Potential to occur
Micranthes marshallii	Marshall's saxifrage	Mixed Evergreen Forest, Yellow Pine Forest, Subalpine Forest, wetland-riparian	4.3	None	None	Potential to occur
Minuartia howellii	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
Mitellastra caulescens	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
Moneses uniflora	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
Monotropa uniflora	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
Oenothera wolfii	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
Oxalis suksdorfii	Suksdorf's wood-sorrel	Broadleafed upland forest, North Coast coniferous forest; elev. 15-700m; blooms May-Aug.	4.3	None	None	known to occur in the park
Packera bolanderi var. bolanderi	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
Packera hesperia	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
Packera macounii	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
Perideridia gairdneri ssp. gairdneri	Gairdner's yampah	Broadleafed upland forest, Chaparral, Coastal prairie, Valley and foothill grassland, Vernal pools, vernally mesic; elev. 0-610m; blooms Jun.-Oct.	4.2	None	None	Potential to occur
Pinguicula macroceras	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
Piperia candida	white-flowered rein orchid	Broadleafed 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
Pityopus californicus	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
Pleuropogon refractus	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
Poa rhizomata	timber blue grass	Lower montane coniferous forest (often serpentinite); elev. 150-1,000m; blooms Apr.-May	4.3	None	None	Potential to occur
Polemonium carneum	Oregon polemonium	Coastal prairie, coastal scrub, lower montane coniferous forest; elev. 0-1,830m; blooms Apr-Sep.	2B.2	None	None	Potential to occur
Potamogeton foliosus ssp. fibrillosus	fibrous pondweed	Shallow water, small streams. 5-1300 m.	2B.3	None	None	Potential to occur
Prosartes parvifolia	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
Pyrrocoma racemosa var. congesta	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
Ramalina thrausta	angel's hair lichen	North Coast coniferous forest	2B.1	None	None	Potential to occur
Ribes laxiflorum	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
Rosa gymnocarpa var. serpentina	Gasquet rose	Chaparral, Cismontane woodland, Serpentinite. Often roadsides, sometimes ridges, streambanks, and openings.	1B.3	None	None	Potential to occur
Sabulina howellii	Howell's sandwort	Chaparral, Lower montane coniferous forest, serpentinite, xeric	1B.3	None	None	Potential to occur
Sagittaria sanfordii	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
Salix delnortensis	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
Sanguisorba officinalis	great burnet	Bogs and fens, Broadleafed upland forest, Meadows and seeps, Marshes and swamps, North Coast coniferous forest, Riparian forest, often serpentinite	2B.2	None	None	Potential to occur
Sanicula peckiana	Peck's sanicle	Chaparral, Lower montane coniferous forest, often serpentinite	4.3	None	None	known to occur in the park
Sedum citrinum	Blue Creek stonecrop	North Coast coniferous forest, Serpentinite; rocky, talus, scree, or boulder crevices; sometimes roadsides	1B.2	None	None	known to occur in the park
Sidalcea elegans	Del Norte checkerbloom	Chaparral, Lower montane coniferous forest, Serpentinite	3.3	None	None	Occurs in serpentine regions near the Park, moderate to high quality habitat present
Sidalcea malachroides	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
Sidalcea malviflora ssp. patula	Siskiyou checkerbloom	Open coastal forest; roadcuts. 5-1255 m.	1B.2	None	None	Potential to occur
Sidalcea oregana ssp. eximia	coast checkerbloom	Near meadows, in gravelly soil. 5-1805 m.	1B.2	None	None	Potential to occur
Silene serpentinicola	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
Streptanthus howellii	Howell's jewelflower	Lower montane coniferous forest (serpentinite, rocky); elev. 305-1,500m; blooms Jul.-Aug	1B.2	None	None	Potential to occur
Tauschia glauca	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
Usnea longissima	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
Vancouveria chrysantha	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
Veratrum insolitum	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
Viola langsdorfii	Langsdorf's violet	Bogs and fens (coastal); 2-10 m	2B.1	None	None	No potential to occur; habitat not present in DNCRSP
Viola primulifolia ssp. occidentalis	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).

Appendix C Natural Communities 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
Alnus rubra (Red alder forest) Alliance	G5S4	**Alnus rubra / Rubus spectabilis – Sambucus racemosa*	*Alnus rubra, Rubus spectabilis, Sambucus racemosa, Salix spp., Boykinia occidentalis, Tolmiea diplomenziesii, Mitellastra caulescens, Pleuropogon refractus, Lysichiton americanus, Carex obnupta*
Chamaecyparis lawsoniana (Port Orford cedar forest) Alliance	G3S3		*Chamaecyparis lawsoniana, Pinus attenuata, Pseudotsuga menziesii*
Notholithocarpus densiflorus (Tanoak forest) Alliance	G4S3	**Notholithocarpus densiflorus – Umbellularia californica*	*Notholithocarpus densiflorus, Pinus attentuata, Pseudotsuga menziesii, Umbellularia californica*
Picea sitchensis (Sitka spruce forest) Alliance	G5S2	**Picea sitchensis – Tsuga heterophylla; *Picea sitchensis / Polystichum munitum*	*Picea sitchensis, Polystichum munitum, Sambucus racemosa var. racemosa, Rubus spectabilis, Tsuga heterophylla, Alnus rubra, Pseudotsuga menziesii, Cotonoeaster sp.*
Pinus attenuata (Knobcone pine forest) Alliance	G4S4	*Pinus attenuata / Arctostaphylos columbiana; Pinus attenuata / Quercus vacciniifolia*	*Pinus attenuata, Festuca idahoensis, Carex concinoides, Quercus vaccinifolia, Arctostaphylos columbiana, Arctostaphylos nortensis, Juniperus communis*
Pinus jeffreyi (Jeffrey pine forest) Alliance	G4S4	*Pinus jeffreyi / Quercus vacciniifolia – Arctostaphylos nevadensis / Festuca idahoensis*	*Pinus jeffreyi, Festuca idahoensis, Arctostaphylos nevadensis, Quercus vaccinifolia, Pinguicula macroceras*
Pseudotsuga menziesii (Douglas fir forest) Alliance	G5S4	*Pseudotsuga menziesii – Chrysolepis chrysophylla – Notholithocarpus densiflorus*	*Pseudotsuga menziesii, Sequoia sempervirens, Notholithocarpus densiflorus, Vaccinium ovatum, Gaultheria shallon, Polystichum munitum, Viola sempervirens*

Alliance	**CDFW Global and State Ranks**	**Associations**	**Common, Exotic, and Sensitive Plant Species Observed in the Project Area**
Pseudotsuga menziesii - Notholithocarpus densiflora (Douglas fir - tanoak forest) Alliance	G4S4	*Pseudotsuga menziesii – Notholithocarpus densiflorus- (Tsuga heterophylla)/ Vaccinium Ovatum*	*Pseudotsuga menziesii, Sequoia sempervirens, Notholithocarpus densiflorus, Vaccinium ovatum, Gaultheria shallon, Polystichum munitum, Viola sempervirens*
Sequoia sempervirens (Redwood forest) Alliance	G3S3	**Sequoia sempervirens – Pseudotsuga menziesii / Vaccinium ovatum; *Sequoia sempervirens – Alnus rubra / Rubus spectabilis*	*Sequoia sempervirens, Pseodotsuga menziesii, Abies grandis, Tsuga heterophylla, Vaccinium ovatum, Polystichum munitum*
Baccharis pilularis (Coyote brush scrub) Alliance	G5S5	*Baccharis pilularis – Ceanothus thyrsiflorus; Baccharis pilularis /* Annual Grass – Herb	*Baccharis pilularis, Cortaderia jubata, Agrostis sp., Hypochaeris radicata, Arctostaphylos columbiana, Ceanothus thyrsiflorus var. thyrsiflorus, Ceanothus velutinus*
Ceanothus thyrsiflorus (Blue blossom chapparal) Alliance	G4S4		
Chrysolepis chrysophylla (Golden chinquapin thickets) Alliance	G2S2		*Chrysolepis chrysophylla, Notholithocarpus densiflorus, Pinus attentuata, Pseudotsuga menziesii, Rhododendron occidentale, Lathyrus delnorticus*
Notholithocarpus densiflorus var. echinoides (Shrub tanoak chaparral) Alliance	G3S3		*Notholithocarpus densiflorus, Pinus attentuata,*
Quercus chrysolepis (Canyon live oak chaparral) Alliance,	G5S5		*Quercus chrysolepis, Notholithocarpus densiflorus, Holodiscus discolor, Rhododendron occidentale*
Quercus vaccinifolia (Huckleberry oak chap.) Alliance	G4S4	*Quercus vaccinifolia*	*Quercus vaccinifolia, Arctostaphylos columbiana, Arctostaphylos nevadensis, Chrysolepis chrysophylla, Juniperus communis*

Alliance	CDFW Global and State Ranks	Associations	Common, Exotic, and Sensitive Plant Species Observed in the Project Area
Rhododendron columbianum (Western Labrador-tea thickets) Alliance	G4S2	*Undescribed associations with an herbaceous cover >50%: Rhododendron columbianum/ Calamagrostis nutkaensis*	*Calamagrostis nutkaensis, Alnus viridus var. sinuata, Blechnum spicant, Rhododendron columbianum, Gaultheria shalon, Hypericum anagalloides, Sphagnum spp.*
Rubus (parviflorus, spectabilis, ursinus) (Coastal brambles) Alliance	G4S3	**Gaultheria shallon – Rubus spectabiis – Rubus parviflorus*	*Rubus spectabilis, Picea sitchensis, Alnus rubra, Vaccinium ovatum, Gaultheria shallon, Carex leptopoda*
Salix lasiolepis (Arroyo willow thickets) Alliance	G4S4		*Salix lasiolepis, Acer macrophyllum, Alnus rubra, Baccharis pilularis*
Carex obnupta (Slough sedge swards) Alliance	G4S3 / OBL	**Carex obnupta*	*Carex obnupta, Alnus rubra, Picea sitchensis, Polystichum munitum, Lysichiton americanus, Rubus sp.*
Darlingtonia californica (California pitcher plant fens) Alliance	G4?S3	*Darlingtonia californica	*Rhododendron columbianum, Gaultheria shalon, Carex obnupta, Rhododendron occidentale, Alnus viridus var. sinuata, cascara, Port-Orfort-cedar*
Festuca idahoensis (Idaho fescue grassland) Alliance	G4S3?	**Festuca idahoensis – Achillea millefolium*	*Festuca idahoensis, Quercus vaccinifolia, Arctostaphylos nevadensis, Pinus jeffreyi, Juniperus communis, Achillea millefolium, Pinguicula macroceras, Ranunculus occidentalis var. occidentalis,*
Scirpus microcarpus (Small-fruited bulrush marsh) Alliance	G4S2 / OBL	*Scirpus microcarpus*	*Scirpus microcarpus, Juncus bolanderi, Cyperus eragrostis, Triteleia bridgesii,*
Typha (angustifolia, domingensis, latifolia) (Cattail marshes) Alliance	G5S5 / OBL		*Typha latifolia, Potentilla anserine ssp. pacifica, Equisetum sp.*

Species	Status	Habitat	Comments
REPTILES AND AMPHIBIANS			
Southern torrent Salamander *Rhacotriton variegatus*	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 DNCRSP & Project Area
Pacific tailed frog *Ascaphus truei*	SSC	Montane hardwood-conifer, redwood, Douglas-fir and ponderosa pine habitats.	Known to occur within DNCRSP
Northern red-legged frog *Rana aurora aurora*	SSC	Humid forests, woodlands, grasslands, and streamside in northwestern California	Known to occur within DNCRSP
Foothill yellow-legged frog *Rana boylii*	SSC	Partly-shaded, shallow streams and riffles with a rocky substrate in a variety of habitats.	Known to occur within DNCRSP and project area
Western pond turtle *Emys marmorata*	SSC	Streams, rivers, and ponds with sandy substrate.	Habitat limited in DNCRSP due to cold water temperatures.
BIRDS			
Bald eagle *Haliaeetus leucocephalus*	FT, SE	Nesting and wintering – ocean shores, lake margins and rivers.	Known to occur within DNCRSP
Marbled murrelet *Brachyramphus marmoratus*	FT, SE	Old-growth redwood dominated forests, up to six miles inland.	Known to occur within DNCRSP
Northern spotted owl *Stix ocidentalis caurina*	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 DNCRSP
Yellow warbler (*Setophaga petechia*)	SSC	Breeds in shrubby thickets and woods, particularly along watercourses and in wetlands.	Potential nesting habitat occurs within DNCRSP but to date only migrants have been detected.
Vaux's swift *Chaetura vauxia*	SSC	Nesting – Redwood, Douglas-fir and other coniferous forests. Nest in large hollow trees and snags often nests in flocks.	Known to occur within DNCRSP
Black swift *Cypseloides niger*	SSC	Nests under waterfalls	No nesting habitat in DNCRSP
Purple martin *Progne subis*	SSC	Nesting – low elevation coniferous forest and woodlands.	Known to occur within DNCRSP
MAMMALS			
Townsend's big-eared bat *Corynorthinus townsendii townsendii*	SSC	Roosts in the open often in limestone caves, lava tubes, mines, buildings, basal hollows etc.	Known to occur within DNCRSP: uses cavities and

			basal hollows in large diameter trees.
Sonoma tree vole *Arborimus pomo*	SSC	Mixed evergreen forests with Douglas-fir	Known to occur within DNCRSP
White-footed vole *Arborimus albipes*	SSC	Mature coastal forests, prefers small, clear streams with dense alder and shrub vegetation.	Potential habitat within DNCRSP
California wolverine *Gulo gulo*	ST	Varity of habitats in North Coast Mountains.	Low probability of occurrence
Humboldt marten *Martes americana humboldtensis*	SCE, SSC	Redwood, Douglas-fir, coniferous forest.	Known to occur within DNCRSP
Pacific fisher – West Coast Distinct Population Segment (DPS) *Pekania pennanti*	SSC	Coniferous forests and deciduous-riparian areas.	Known to occur within DNCRSP
FISH			
Coho salmon *Oncorhynchus kisutch*	FT, SSC	Coastal waters and anadromous streams.	Known to occur within DNCRSP
Summer-run steelhead trout *Oncorhynchus mykiss irideus*	SSC	Coastal waters and anadromous streams	Not documented within DNCRSP.
Coast cutthroat trout *Oncorhynchus clarkia clarkia*	SSC	Coastal streams	Known to occur within DNCRSP
River lamprey *Lampetra ayresi*	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 Project 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 the California Air Resources Board, U.S. Environmental Protection Agency, or 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.
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 *California Department of Fish and Wildlife Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Sensitive Natural Communities* (CDFW 2018a).
PSR-BIO-2	**Special-status plant buffers and avoidance.** Individuals or populations of rare, threatened, endangered plants, or those listed as California Native Plant Society 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 Best Management Practices (within the Draft Mill Creek Vegetation Management Plan [CDPR 2019]) or the *Invasive Plant Management Plan for Redwood National Park* (NPS 2017a), 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 diameter at breast height or larger.

Element/Title	Requirement
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 the U.S. Fish and Wildlife Service in compliance with ESA Section 7 requirements or CESA documents issued by CDFW. 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 February 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.
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. Large wood encountered during excavation of stream crossings would be retained for on-site bank stabilization, in channel to provide habitat, or stockpiled for large wood restoration.
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.

Element/Title	Requirement
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: 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
PSR-BIO-16	**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.
PSR-CULT-1	**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. 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.

Element/Title	Requirement
SPR-CULT-2	**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. 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.
SPR-CULT-3	**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. 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 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. 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.
SPR-CULT-4	**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. 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.
PSR-GEO-1	**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.

Element/Title	Requirement
	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.
PSR-GEO-2	**Consultation with earth sciences/physical sciences professional.** Any ground shaking over magnitude 6.0 in the project vicinity would require park staff to consult with staff of the USGS Earthquake Information Center to understand the source, distance, intensity, and depth of the ground shaking. An earth sciences/physical sciences professional would then determine the need for project area review of roads.
PSR-GEO-3	**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 the table below.
PSR-GEO-4	**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 the table below.
PSR-GEO-5	**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 the National Oceanic and Atmospheric Administration's Fall Transition Season Precipitation and Hydrology Decision Support Service notifications. 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 *Wet Weather Operations Standards for Heavy Equipment Use and Log Hauling for Redwoods Rising* (RNP 2019a) guidelines. 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 *Wet Weather Operations Standards for Heavy Equipment Use and Log Hauling for Redwoods Rising* 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.

Element/Title	Requirement
PSR-GEO-6	**Requirements for existing and new 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.
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-HAZ-1	**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. All primary fuel storage containers (fuel tankers) will be required to have secondary containment and would be stored outside of riparian areas. When long stretches of road are entirely within riparian areas, smaller, portable refueling devices (under 200 gallons) may be used to refuel large equipment. In such cases, drip pads/pans or other protective devices will be placed under the fueling area.

Element/Title	Requirement
PSR-HAZ-2	**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.
PSR-HAZ-3	**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.
SPR-HAZ-4	**Vehicle parking restrictions.** Crews would park vehicles a minimum of 10 feet from flammable material such as dry grass or brush.
SPR-HAZ-5	**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.
PSR-HAZ-6	**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.
PSR-HAZ-7	**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.
SPR-HAZ-8	**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. 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.
PSR-HYDRO-1	**Riparian buffers.** Equipment exclusion zones around riparian corridors would be established as defined in the table below.
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.
SPR-HYDRO-3	**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-

Element/Title	Requirement
	inspected upon re-entry to the park. Decontamination would take place off site upon demobilization.
PSR-HYDRO-4	**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 the table below.
PSR-HYDRO-5	**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.
PSR-HYDRO-6	**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 or collection point 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.
PSR-HYDRO-7	**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.
PSR-HYDRO-8	**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.
SPR-HYDRO-9	**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.
PSR-HYDRO-10	**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.

Element/Title	Requirement
PSR-HYDRO-11	**Water drafting requirements.** If water drafting becomes a necessary component of the proposed project, drafting would be conducted as described in the NMFS *Water Drafting Specifications* (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. If water drafting becomes a necessary component of the proposed project, drafting would be conducted as described in the NMFS *Water Drafting Specifications* (NMFS 2001). These specifications include the following: • 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. • 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	**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.
PSR-HYDRO-13	**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. Skyline cable operations reduce the need for mid-slope roads.
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 will be available within portions of their Right of Way.

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]

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

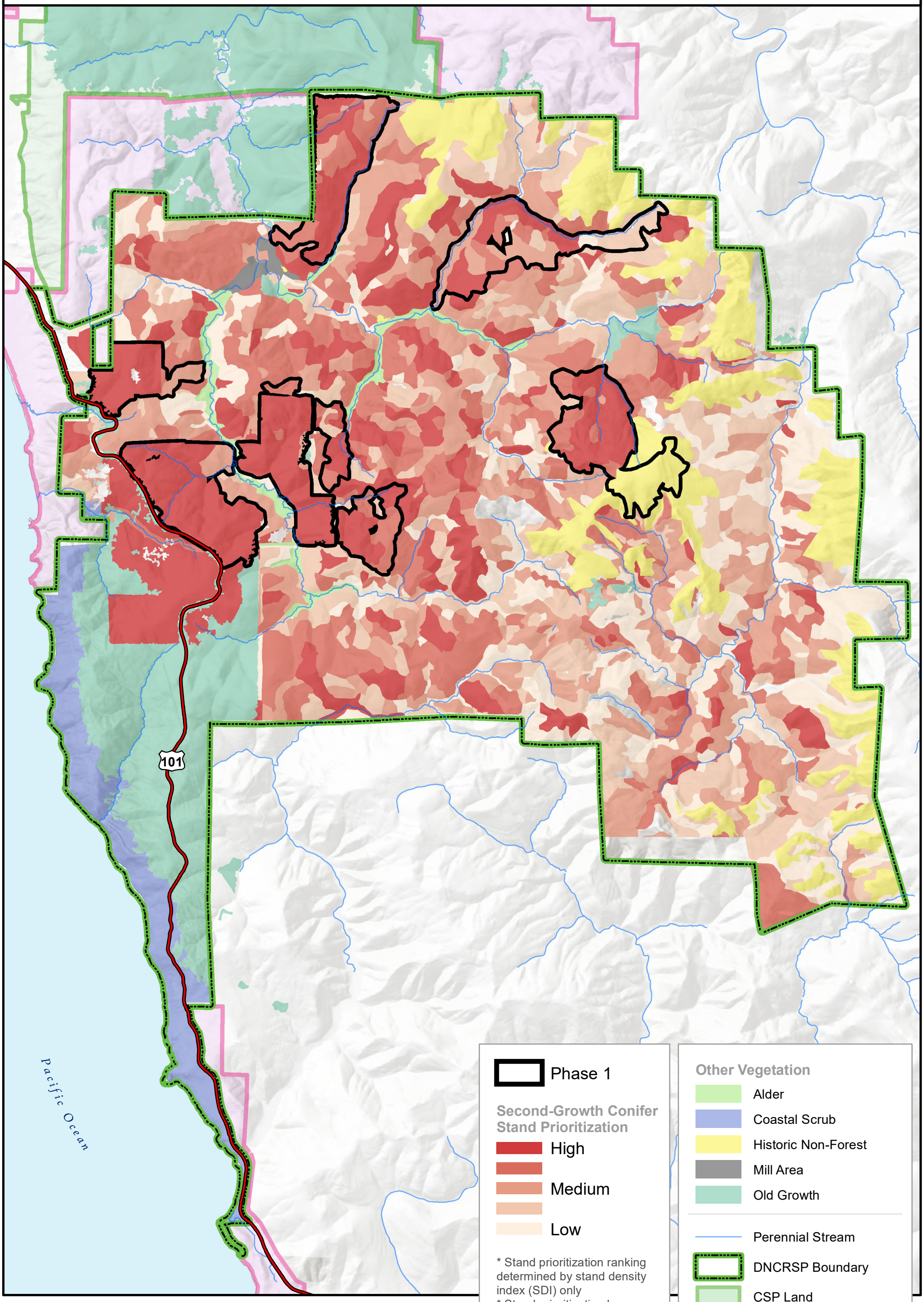
In 2002 Stillwater Sciences prepared a document with management recommendations for the MCA, and established a starting point for forest restoration efforts. It was recommended that the younger stands, ranging from 10-24 years old (as of 2002), should be prioritized for restoration. The first forest 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

Del Norte Coast Redwoods State Park
Vegetation Management Plan - Prioritization

California State Parks
North Coast Redwood District



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Nicholas Nuebel nick.nuebel@parks.ca.gov June 2018

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 Flewlelling, 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.

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

Del Norte Coast RSP EDRR Target List

Species Name	Common Name	Comments
Acacia decurrens	green wattle	no known occurences in park, 1 Calflora occurrence in Jed Smith in 1983,low potential
Acacia dealbata	silver wattle	no known occurences in park, several Calflora occurrences in Jed Smith, low potential
Allium triquetrum	three corner onion	no known occurences in park, occurs along Hwy
Brassica nigra	Black mustard	1 calweedmapper occurence in park mapped in 2012, location quality low
Brassica rapa	Common mustard	2 Calflora occurences in park mapped in 2012 , location quality low
Centaurea calcitrapa	Purple star thistle	no known occurences in park, 1 Calflora occurrence on south side of Klamath River, low potential in SE corner of park
Centaurea diffusa	Diffuse knapweed	1 Calflora occurrence was mapped in 05/18 at Mill site. Check
Centaurea jacea ssp. Pratensis	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
Centaurium erythraea	European centaury	mapped in Park
Cirsium arvense	Canada thistle	known to occur in park
Conium maculatum	poison hemlock	mapped in Park
Cotoneaster spp.	cotoneaster	mapped in Park
Crocosmia crocosmiiflora	garden montbretia	mapped in Park
Delairea odorata	Cape ivy	3 Calflora occurences along Nickel Creek mapped in 2012
Digitalis purpurea	foxglove	mapped in Park
Dipsacus fullonum	common roadside teasel	known to occur in park
Fallopia japonica	Japanese knotweed	no known occurences in park, very few in Del Norte, closest by Trees of Mystery along Hwy 101
Fallopia sachalinensis	Giant knotweed	no known occurences in park, but treated on neighboring NPS land
Foeniculum vulgare	fennel	mapped in Park along Hwy
Geranium dissectum	cutleaf crane's-bill	known to occur in park
Geranium lucidum	shining geranium	mapped in Park
Geranium robertianum	stinky Bob	mapped in Park
Hedera helix	English ivy	mapped in Park
Hirschfeldia incana	Short podded mustard	mapped in Park
Hypericum perforatum	St. Johnswort	mapped in Park
Ilex aquifolium	English holly	mapped in Park
Lathyrus latifolius	everlasting sweetpea	no known occurences in park

Appendix G - EDRR Target List

Lepidium latifolium	perennial pepperweed	no known occurences in park
Linum bienne	flax	mapped in Park
Persicaria wallichii	Himalayan knotweed	no known occurences in park, few in Del Norte, closest by Requa along Hwy 101
Phalaris arundinacea	Reed canary grass	known to occur in park
Raphanus sativus	wild radish	known to occur in park
Senecio jacobaea	tansy ragwort	known to occur in park
Vinca major	periwinkle	no known occurences in park, but mapped on neighboring NPS land (Enderts Beach Trail)

Appendix C
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 (km^2) (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 km^2/ 5,870 acres), West Branch Mill Creek (28.8 km^2/ 7,120 acres), East Fork Mill Creek (43.1 km^2/ 10,660 acres), and Rock Creek (41.8 km^2/ 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 km^2/ 4,960 acres), Wilson Creek (27.4 km^2/ 6,780 acres), and Terwar Creek (14.8 km^2/ 3,655 acres) watersheds, as well as the Nickel and Damnation Creek watersheds (15.5 km^2/ 3,825 acres).

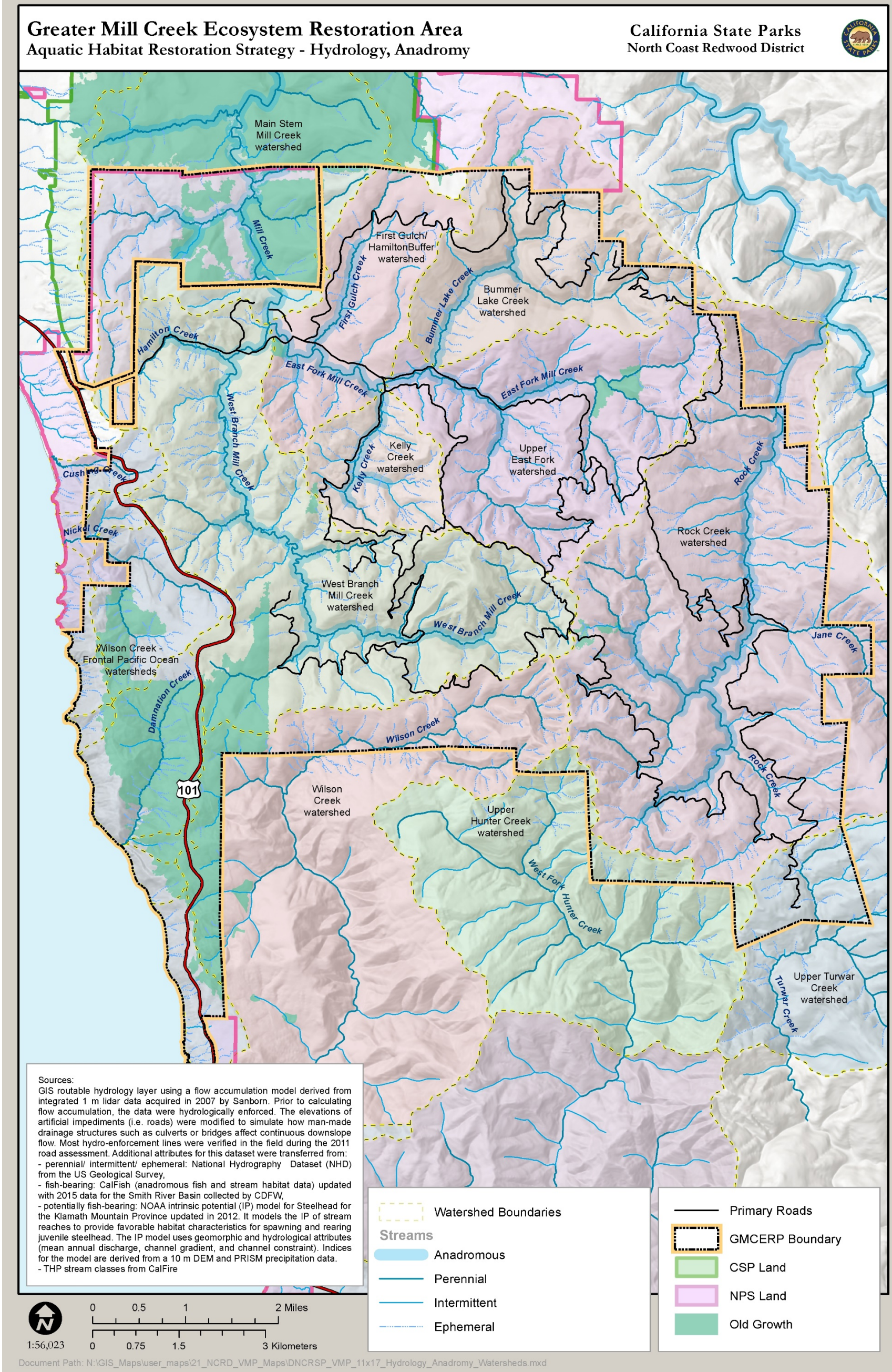

Figure 4. Watershed boundaries, stream locations, and anadromy within the GMC Planning Area.

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, CDPR 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.

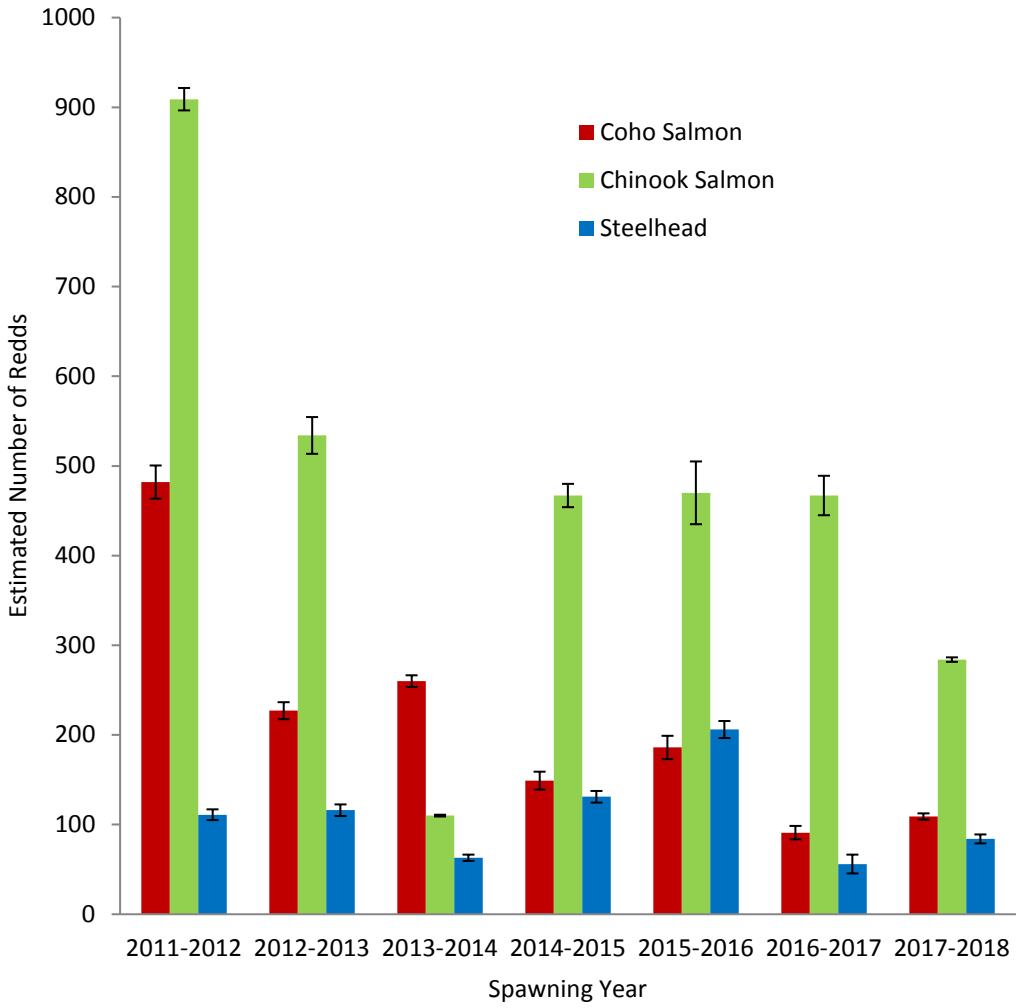

Figure 8. Estimated total number of redds produced in the Mill Creek LCS spawner survey sample frame by species and spawning year, Smith River basin, Del Norte County, CA. Error bars represent 95% confidence intervals around point estimates. Steelhead estimates do not represent the entire steelhead spawning 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.

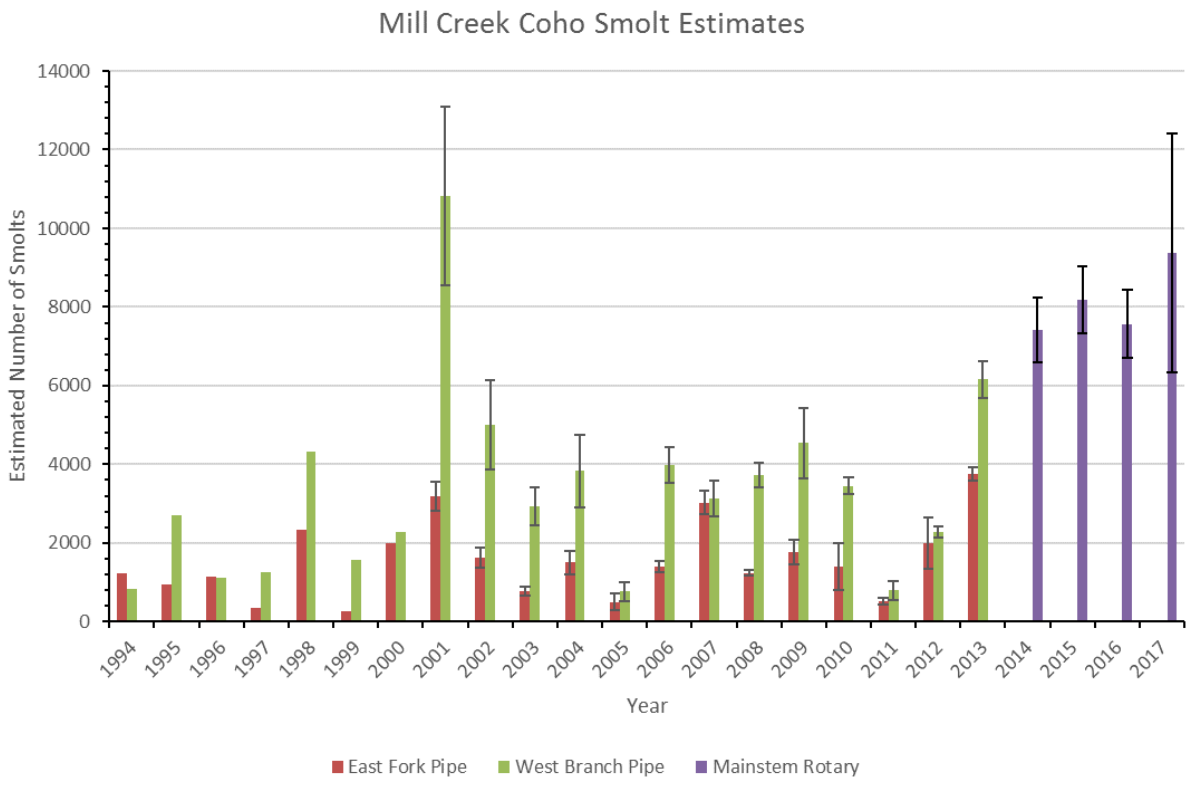

Figure 9. Mill Creek Coho Salmon smolt estimates obtained from outmigrant trapping studies from 1994-2017 from Walkley et al. 2017.

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

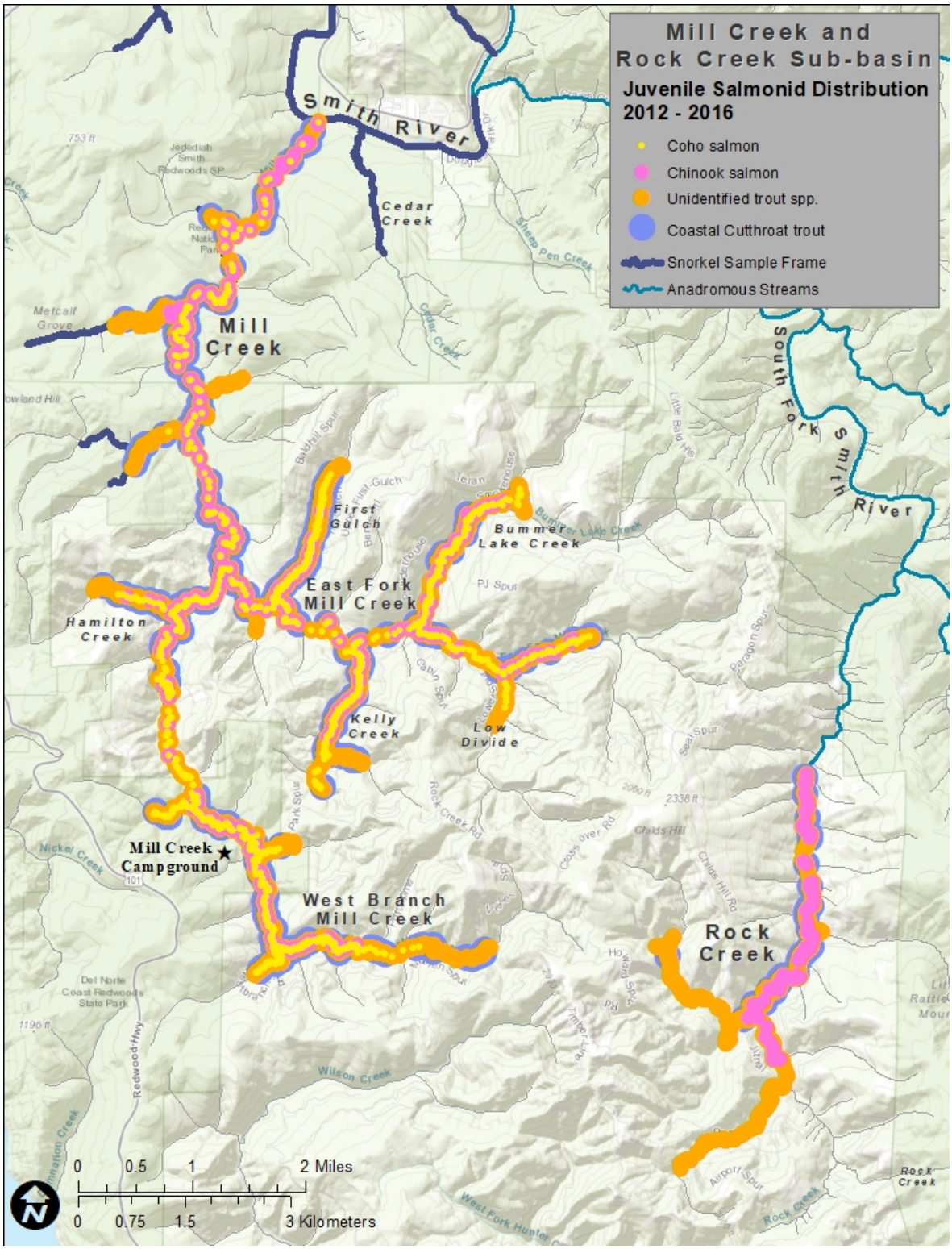

Figure 10. Map showing all salmonid observations during summer snorkel surveys across five years of sampling (2012 – 2016) in Mill Creek and Rock Creek sub-basins. Adapted from Walkley and Garwood 2017.

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.

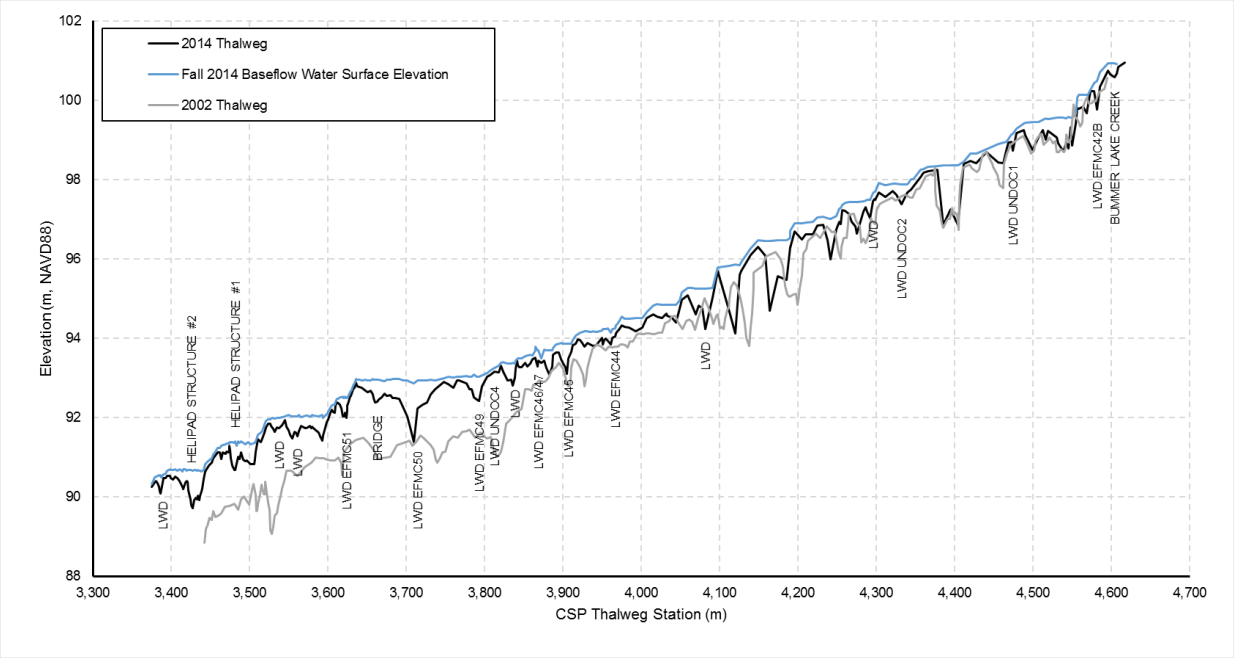

Figure 11. Longitudinal profile of the East Fork Mill Creek from approximately Kelly Creek upstream to Bummer Lake Creek during surveys conducted in 2002 and 2014. Large woody debris (LWD) and prominent landmarks are identified on along the profile (NHE 2015).

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 GMCERP 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. 2017). 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. 2017). 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 have 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				
	CDFW	CDFG/Bio-Geomorphic	Bio-Geomorphic	Helicopter Wood Loading	Total
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 California Department of Fish and Wildlife (CDFW) (Schwabe 1998), following designs from the CDFW's California Salmonid Stream Habitat Restoration Manual (Flosi and Reynolds 1994, Flosi et al. 2010). 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.

CDFW/BioGeomorphic Design Hybrid 2006

This demonstration project was a collaboration between CDPR and 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 to 4 logs, intertwined with riparian trees and rebar (Fiori 2010).

BioGeomorphic Design 2008

In 2008, 14 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

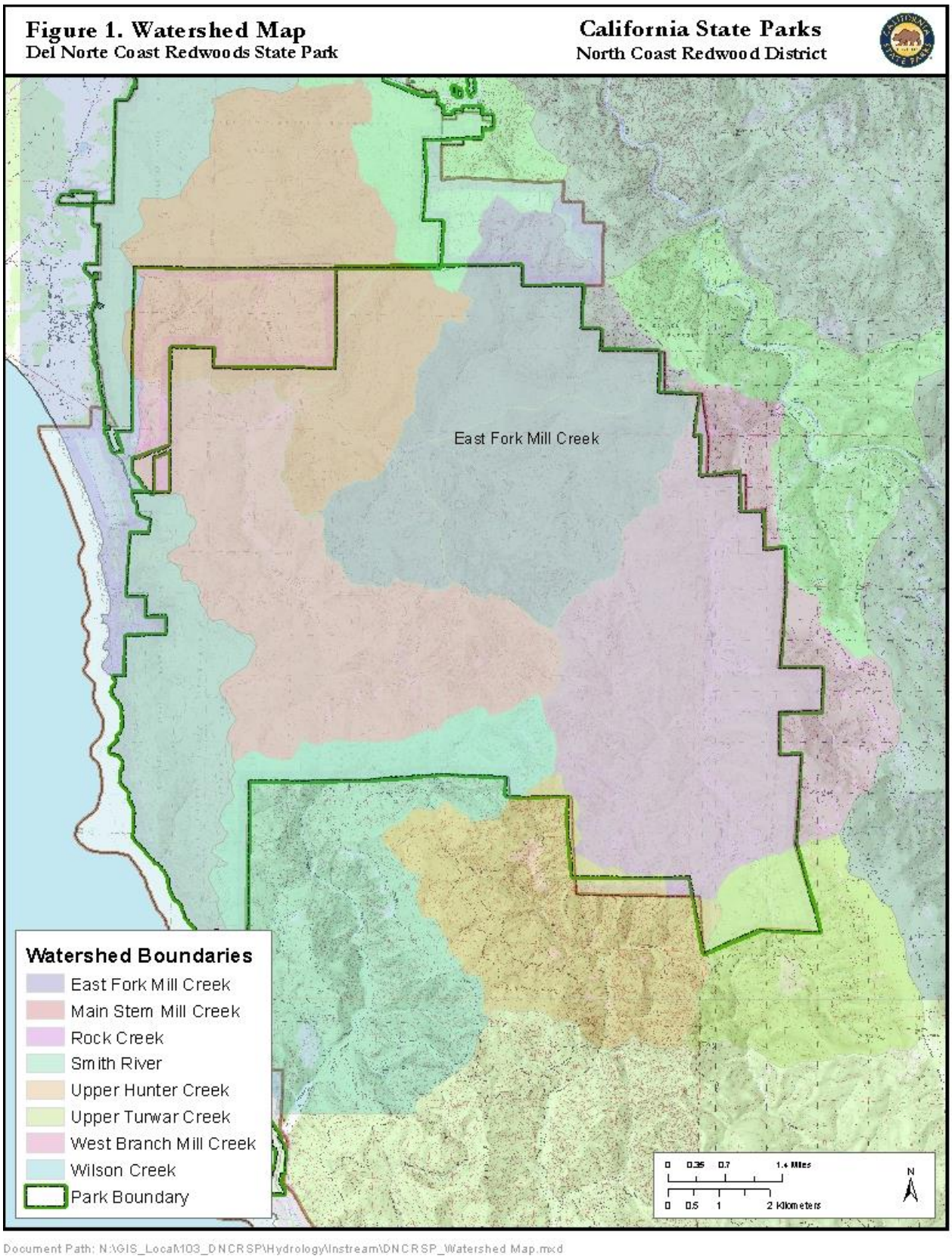

Figure 1. Boundaries of watersheds that are wholly or partially located within Del Norte Coast Redwoods State Park.

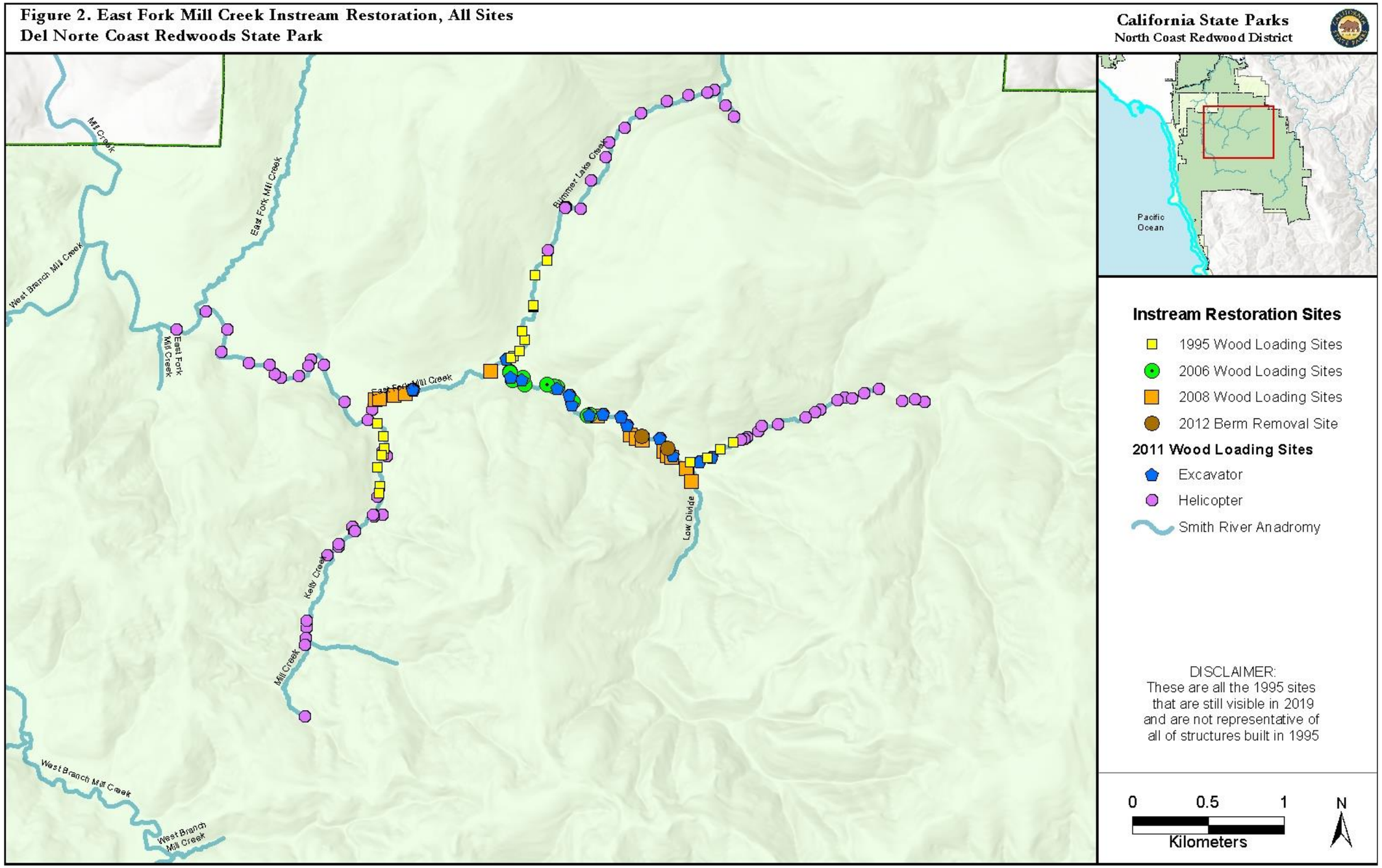

Figure 2. Locations of instream restoration activities in the East Fork Mill Creek from 1995 to 2012.

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 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 mobile wood loading would reoccur approximately every five 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. Wood was loaded at 19 locations; 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 improve habitat and to reduce the likelihood for mobile wood to impact the bridges. Additional jam construction types including meander bend, opposing, deflection, cover and combination structures. 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 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 instream wood structures at 72 locations 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. Most of these structures consisted of 1 to 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 the 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 placed into the channel without any anchoring. 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. (2017, 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 to 15 meters upstream of the structure (Figure 3). Both naturally occurring and constructed wood jams were monitored. The monitoring was designed to

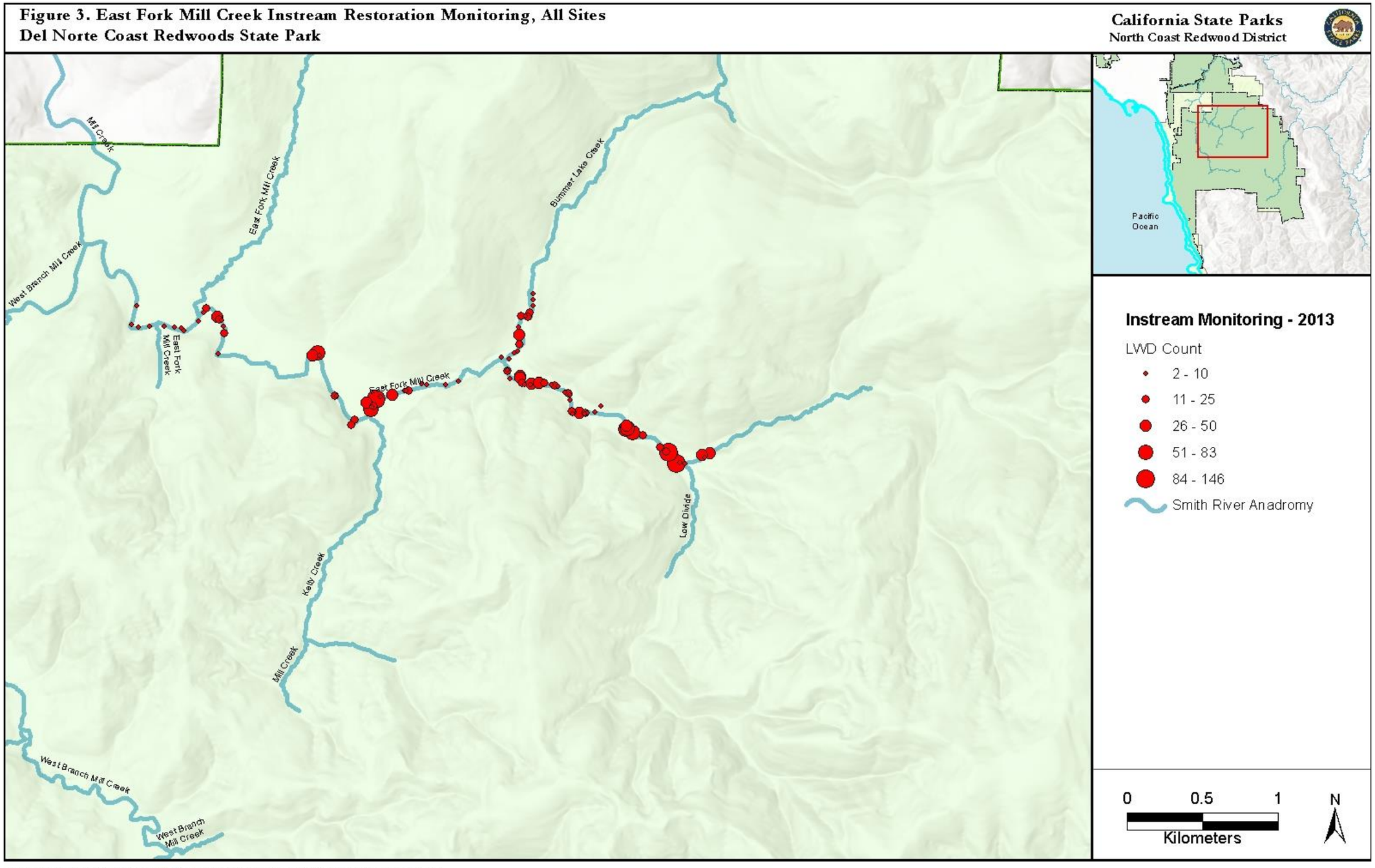

Figure 3. Locations and count of Large Woody Debris (LWD) observed during monitoring surveys in the East Fork Mill Creek in 2013.

occur every 5 to 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 upstream most bridge on Childs Hill Road, prior to the road leaving the lower valley, downstream 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, though 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 serve 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 were documented in this 2013 survey.

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.

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 CDPR georeferenced data.

Long profile monitoring was designed to occur every five 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 Rodriquez (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 D
Responses to Substantive Comments

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Public Involvement

The Greater Mill Creek Ecosystem Restoration Project Draft Initial Study/Negative Declaration and Environmental Assessment (ISND/EA) was made available for a 30-day public review at the reference desks of three Humboldt County Library branches (Eureka, Arcata, and McKinleyville), the Humboldt State University Library, and the Del Norte County Library in Crescent City. It was also available at the public information desks of the California Department of Parks and Recreation (CDPR) Northern Service Center, CDPR North Coast Redwoods District Headquarters office, Redwood National and State Parks Headquarters office, Thomas H. Kuchel Visitor Center, and National Park Service (NPS) South Operations Center, as well as on the NPS website (http://parkplanning.nps.gov/greatermillcreek) and CDPR website (https://www.parks.ca.gov/?page_id=980). NPS and CDPR sent 102 letters and 79 emails announcing the availability of the document for review to federal, tribal, state, and local agencies; elected officials; organizations, businesses, and individuals. Hardcopies of the Draft ISND/EA were also provided to select agencies and organizations. A press release was sent to the Redwoods National Park media list, which includes local and regional newspapers, radio, and television stations. A separate notice was published in the Del Norte Triplicate. All notifications provided the physical and online locations where the Draft ISND/EA was available for review.

Response to Comments

Six comments were received on the Draft ISND/EA. Two comments were posted to the NPS Planning, Environment, and Public Comment (PEPC) website and four comment letters were received via U.S. mail. Four comments supported the Proposed Action as described in the ISND/EA without raising any other concerns, one comment supported the Proposed Action and requested additional information, and one comment asked questions without voicing support or opposition for the Proposed Action. Responses to substantive comments are provided below.

The North Coast Regional Water Quality Control Board acknowledged the agency's support of the Proposed Action and requested additional information related to permitting requirements. The requested information has been included in the permit applications prepared for the Proposed Action.

The Environmental Protection Information Center (EPIC) requested that NPS and CDPR eliminate all mechanical noise within marbled murrelet nesting buffers during the marbled murrelet breeding season. The Proposed Action would comply with all federal and state requirements for protecting marbled murrelet (as required by PSR-BIO-7). Adherence to the work window would only allow work to occur over approximately 1 month per season (September 16 to October 15), which is not enough time to complete the planned work in areas adjacent to marbled murrelet habitat and would cause additional years of disturbance to the adjacent habitat. An overall benefit of the Proposed Action is that it would improve habitat conditions for marbled murrelet in the long term.

EPIC requested that NPS and CDPR evaluate the Proposed Action's impacts on the California condor (*Gymnogyps californianus*). The California Condor Reintroduction Project and associated cumulative impact analysis have been added to Sections 3.1.3 and 3.6.2 of the Final ISND/EA, respectively, in response to EPIC's comment.

EPIC requested more detail on how the most current habitat suitability and connectivity modeling for the Humboldt marten (*Martes caurina humboldtensis*) will be used to determine the on-the-ground vegetation management design and urged NPS and CDPR to conduct treatments in a manner that disperses the activities over space and time to minimize impact on individuals. The Humboldt marten is associated with mid- to advanced successional stands of conifer with complex structure near the ground and dense canopy closure. The forest stands proposed for treatment under the Proposed Action generally do not meet the characteristics preferred by martens. The Proposed Action would thin dense stands, allowing them to develop mid-to advanced successional characteristics and ground vegetation structure at a more rapid rate than if untreated. 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.

EPIC requested that NPS and CDPR coordinate with the Tolowa, Yurok, and other affected tribes regarding the Proposed Action. Significant consultation has occurred with Native American tribes. NPS and CDPR have communicated with the Elk Valley Rancheria, Big Lagoon Rancheria, Karuk Tribe, Resighini Rancheria, Tolowa Dee-ni' Nation, Trinidad Rancheria, and Yurok Tribe. NPS and CDPR have met with interested tribes in person regarding the Proposed Action numerous times beginning in May 2017. Both the Tolowa Dee-ni' Nation and Elk Valley Rancheria were provided the opportunity to send tribal cultural monitors along on the survey that was conducted as part of Phase 1 inventory. A tribal representative from the Elk Valley Rancheria met with archaeologists and CDPR staff during the survey kick-off meeting but did not participate in the archaeological field survey. Consultation under Section 106 of the National Historic Preservation Act was completed on September 18, 2019, with the issuance of the Programmatic Agreement.

Lastly, EPIC encouraged NPS and CDPR to approach implementation of the Proposed Action in a manner that prioritizes resource protection and adaptively incorporates lessons learned. EPIC noted that leaving areas (such as an existing degraded road) as "no-treat" can create opportunities for controls from which future restoration activities can be informed. CDPR has monitored the response of forest stands to thinning treatments associated with the Mill Creek Young Forest Restoration Project that began in 2006. Monitoring information and lessons learned generated from that project helped inform the development of the Proposed Action. For example, it was shown that bear damage is generally higher in forests thinned at high intensities and with a larger proportion of smaller trees (i.e., less than 24 inches diameter at breast height); therefore, forests mostly composed of small-diameter trees may need to be thinned at lower intensities to avoid excessive bear damage. Road decommissioning generally begins at the farthest point out and works back toward the initial point of entry, which requires opening up the degraded road to allow heavy equipment and support vehicle access to the area where decommissioning work begins. It makes sense to conduct restorative vegetation treatments at the same time since the road would already be open. Leaving existing degraded roads intact can result in sediment delivery and significant adverse effects on water quality, instream habitat, and aquatic biota. Given that many studies have been conducted on forest road sediment delivery, NPS and CDPR feel that the potential for impacts far outweigh the minor amount of new information that could be gained by leaving degraded roads intact and using them as controls for monitoring efforts. NPS and CDPR would conduct reporting and monitoring of restoration activities undertaken as part of the Proposed Action. Annual reports, in which progress would be evaluated, would be submitted to regulatory agencies, including the U.S. Army Corps of Engineers, National Marine Fisheries Service, U.S. Fish and Wildlife Service, North Coast Regional Water Quality Control Board, and the California Department of Fish and Wildlife. If any adaptive

approaches to restoration activities are required, these would be determined through agency consultation.