Chalk Mountain Comprehensive Late Successional Reserve Assessment (CLSRA) and Rock Creek Watershed Analysis

Hat Creek Ranger District
Lassen National Forest

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Introduction

In 1994 the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the range of the Northern Spotted Owl (ROD) was signed by the Secretaries of Agriculture and Interior. The ROD directs the management of Federal lands throughout the range of the northern spotted owl. The ROD established seven different land allocations, each with a set of Standards and Guidelines (S&Gs).

As part of the ROD a Late Successional Reserve (LSR) was established in the Chalk Mt./Rock Creek area of the Shasta National Forest. This area is administered by the Shasta-Trinity National Forests and the Lassen National Forest. The purpose of an LSR is to serve as habitat reserves for late-successional and old-growth related species including the northern spotted owl. These reserves, when fully functional, provide the quantity and quality of old growth forest habitat in a distribution sufficient to avoid foreclosure of future management options; provide habitat for populations of species that are associated with late-successional forest; and they help to ensure that late-successional species diversity will be conserved (ROD pg. B-5). Prior to beginning habitat-altering activities, the Federal land management agencies are to prepare a management assessment for each LSR. The purpose of this assessment is to analyze how well the LSR is performing its function and to direct habitat work towards achieving LSR goals.

Also as part of the ROD an Aquatic Conservation Strategy (ACS) was developed to "maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands." (ROD pg. B-9). The ACS established riparian reserves to direct land use through standards and guidelines along streams, lakes and wetlands. The ACS also established procedures for evaluating process operating in specific watersheds. This procedure is known as Watershed Analysis.

Goal and Objectives

The goal of this document is twofold. First it is to provide a *COMPREHENSIVE* assessment of how well the Chalk Mt. LSR (C-45) functions at providing habitat for late-successional species and how well it functions as a link in the LSR system. Secondly, it is to provide a watershed analysis for the Rock Creek Watershed.

The objectives of this document are to :

- analyze existing late successional conditions within the LSR
- consider potential existing threats to the LSR's function
- examine the Rock Creek watershed's ecological functionality
- provide a foundation for habitat improvement projects

General Description of the LSR

Location and management

The Chalk Mt. Late-Successional Reserve is centered on approximately latitude 41° 01' north and longitude 121° 47' west. (See map 1) It includes parts of Township 37N, Range 1East, Township 37N, Range 2East, Township 36N, Range 1East, Township 36N, Range 2East MDBM. This LSR is located entirely within Shasta County, California and is located approximately 40-45 miles northeast of Redding and 5 miles North-northeast of Burney. The total area within the LSR is 36,560 acres. The LSR is managed by the Shasta-Trinity National Forest and the Lassen National Forest. Table 1 details land management within the LSR:

Table 1 - Acres by Administrative Unit

Administrative Agency	Acres
Shasta-Trinity	21,255
Lassen	13,275
Privately-owned	2,030
Total:	36,560

The LSR is bisected north-south by the Pit River. The Pit River is a large tributary to the Sacramento River. The Pit River watershed is in excess of 3.1 million acres. The Chalk Mountain LSR represents 1.2% of the Pit River basin, while the Rock Creek Watershed comprises 0.3% of the Pit River basin.

Topography

The Chalk Mt. LSR lays astride the crest of the southern Cascade Range. Topography is dominated by the Pit River canyon and by the nearby, notably higher terrain at Chalk Mountain and the ridges and plateaus north and northeast of Chalk Mountain. Terrain features are generally rolling due to erosion over thousands of years. The exceptions are the major perennial drainages (Pit River, Rock Creek, Canyon Creek, Deep Creek) which tend to be highly incised with steep to very steep side slopes and relatively high stream gradients. Elevation varies from approximately 2100 feet at Hagen Flat to 5880 feet two miles to the east-northeast at the top of Chalk Mountain. Map 2 and Map 3 provide graphic representations of the slope and aspect. Map 1 displays topographic contours and land survey lines.

Geology

Geology for the LSR is mapped only at small scale from available sources (Young, 1996).The area south of the Pit River is mainly composed of Pliocene volcanic pyroclastics and basalt. North of the Pit River (in the Rock Creek area), the underlying formation is mainly Tertiary volcanic andesite, up to the Jakes Spring contour, with more recent Miocene volcanic basalts on Chalk Mountain and on the higher elevations in the Rock Creek basin. Pliocene nonmarine formations (including diatomite) occur on the north and south sides of the Pit River near Lake Britton, mostly east of the east side of the Rock Creek watershed's draining divide.

Some diatomaceous earth formations extend west of the Rock Creek watershed , south of Jake Spring. Downstream from Rock Creek pockets of Eocene non-marine "conglomerates" occur near the western boundary of the LSR, near Hagen Flat with a secondary pocket near Swift Creek.

The oldest rocks exposed in the lower Pit River canyon are largely andesite but also include breccias and tuffs. There is a mid layer of lacustrine sediment and diatomite strata that is exposed on the western and eastern edges of the LSR (Alexander, 1995). The diatomite is responsible for Chalk Mountain's name. Higher elevation rocks are primarily basalts of apparently Pliocene and Quaternary origins.

There is some evidence of mass wasting evident on the west slope of Chalk Mt. West of Rock Creek, the terrain south of the Summit Lake Road (37N02 Rd.) includes many dormant slumps and slides, particularly on the steep ground in lower Screwdriver, Poison, and Underground Creeks. A report for the 1982 Pancrea timber sale (Vansusteren and Haskins 1981) described the are from Ruling Creek to Screwdriver Creek as follows:

> *Accelerated downcutting has created engorged channels in [the Poison and Screwdriver Creek drainages], with undercut sideslopes and resultant sliding and instability....Area is underlain by interbedded Tertiary basalt and volcanic mudflows. ...Large dormant translational landslides are present within the sale area. The slides have detached from the canyon rim and are slowly moving down the canyon wall toward the river. The large translational slides are presently dormant, however, [and they] remain vulnerable to land disturbing activities such as roading and logging.*

There are some areas of soil slippage in the Rock Creek drainage, but this appears to be associated with poor road construction and layout. In the northwestern portion of the LSR, a 1968 report for the Boundary timber sale (ca. 1970), mentions unstable ground on sedimentary, "shale-like" material mainly west of road 37N04 in sections 21 and 22 in the headwaters of Nelson Creek, south of the Pit River. Several specialist memos were prepared for the Zig Zag timber sale (ca. 1980). The soil scientist memo (Lanspa, 1978) mentions instability along Canyon Creek. The hydrologist memo (Ranken, 1978) describes unstable areas in Deep Creek's watershed. The tributaries on the east side of Bales Mountain are deeply incised with eroding banks and numerous, small slides. The channel bottoms are stable, but deep soils make sideslopes very erodible. There is a large slide just below the 4,000 ft. contour on the east side of Deep Creek. The most unstable areas were never entered for timber harvesting, and the lower portions of the Deep Creek and Canyon Creek watersheds (and to a lesser degree in the lower Rock Creek watershed) remain inaccessible to all but the most determined hikers and are essentially undisturbed.

Soils

Soils within the LSR are variable. Soils found within the LSR include Entisols, Inceptisols, Andissols, Mollisols, Vertisols and Alfisols. (Alexander, 1995). Soils range from young to moderately old and are primarily the result of organic acid and bicarbonate weathering, leaching of dissovables, translocation of clay and accumulation of organic matter. Practically all of the soils are well to excessively drained.

Outside of the steep inner gorge areas in the Pit River canyon, soils in the Rock Creek watershed have a low to moderate erosion hazard rating, except for localized pockets of diatomite(diatomaceous earth), which can have a high erosion hazard when they are without ground cover and on slopes steeper than 15-20%. Site quality varies from Site I to Site IV and V. Average site quality on the areas with less than 40% slope is probably II, with the low sites occurring on some of the shallow soiled and/or steep areas that include an oak component in their vegetation, particularly on areas with a southern or southwestern aspect. Hydrological soil groups are mainly "B:, i.e. with moderately low runoff potential. Some of the very rocky areas in the Pit River canyon have hydrologic group "D" soils, with high runoff potential, because rain does not infiltrate well into steep, shallow-soiled, rocky areas. The inner gorge in the lower reaches of Rock Creek is rocky and shallow-soiled, with some sites that can grow only shrubs and grass.

In the rest of the LSR, soils tend to be deeper than in the Rock Creek watershed, mostly because they are underlain by older geology and because rainfall is somewhat higher. Specialist's reports in the Shasta-Trinity files repeatedly mention deep soils in the Nelson and Screwdriver Creek areas, which are occasionally undercut and destabilized by incising stream channels. Most of the flat to gentle sloped areas on volcanics are site I or II. The steeper ground sloping down into the Nelson Creek drainage is site III. Steep areas in the Pit River Canyon and in Deep Creek and Canyon Creek are mostly shallow-soiled and rocky, with some unstable areas having unconsolidated bedrock materials and very steep slopes. Some of the local pockets of conglomerate and sediments in the western part of the LSR include dormant slides and slumps. While most of the soils are hydrologic group "B", some of the steep Pit River canyon slopes are "C", because of shallow soil and increased runoff potential. Erosion hazard is mostly low to moderate, except for some soil groups with ashy soils or soils derived from sediments, which have a high erosion hazard. Areas where high erosion hazard, ashy soils occur on relatively gentle slopes are on the plateau area immediately south of Summit Lake, on some of the flat ground wet of road 37N30 (in the Nelson Creek watershed) and on the plateau between Deep and Canyon Creeks Some isolated areas of diatomite occur east of Screwdriver Creek and south of Jake Spring, and they probably have a high erosion hazard on their steeper slopes.

Climate

The Chalk Mt. Late-Successional Reserve lies within the Hat Creek Rim subsection of the Southern Cascades Section of the Mediterranean Regime Mountains division as mapped by Goudey and Smith (Goudey and Smith, 1994). The LSR is adjacent to the Eastern Klamath Mountains subsection and section. Thus the LSR is somewhat transitional between typical Klamath province and the Southern Cascades type. Because the LSR is astride the Cascade crest, rainfall and temperature regimes vary rather widely. For instance, the upper Rock Creek watershed receives approximately 70 inches of precipitation/year. The area of the LSR nearest to Lake Britton may receive about 40 inches. Most of the precipitation falls in winter with the amount falling as snow dependent on elevation. Some precipitation may occur during the summer in association with thunderstorms. However, this is less, proportionately, than for areas farther to the east (e.g. Modoc Plateau). It should be noted that these precipitation "averages" are derived primarily from this century's records. Reconstruction of state rainfall records through dendrochronology indicates that the period since 1890 has been one of "precipitation surplus" (Fritts and Gordon 1980 pg. 40)

Air Quality

The Chalk Mountain LSR and its included Rock Creek watershed are in a compliance area for setting air quality objectives. Management activity effects, including smoke from prescribed burning and fugitive dust from use of area roads, skidding timber, and mining of diatomite must meet EPA *de minimis* standards. The nearest Class I airshed area is the Thousand Lakes Wilderness, over 18 miles South of the LSR. The LSR is downwind from the Redding urban area.

Aquatic Resources and Fisheries

Water Uses

A memo for the Sumet Timber sale (Ranken 1983) notes that there are no filed water rights in the Chalk Mountain area and lists the local beneficial uses of water as hydroelectric power production, recreation, and fishery and wildlife sustenance. The Lassen National Forest water rights database lists no diversions or impoundments in the Rock Creek watershed, but water is occasionally used from Rock Creek for dust abatement on local road systems and for fire suppression. The Pacific Gas and Electric Company (PG&E) has numerous impoundments and diversions along the Pit River, including three dams in. or immediately adjacent to, the LSR. Pit 3 dam (Lake Britton) was built in 1925; Pit 4 dam was built in 1927; and Pit 5 was built in 1994.

The Pit 3 diversion included up to 25 cfs from Rock Creek (WESCO, 1985). A small dam in Rock Creek once diverted flows less than the pipe's capacity of 25 cfs to a closed pipe that spilled into the top of the Pit 3 aqueduct, on the east side of its "bridge" section over Rock Creek. That diversion was abandoned around 1987, and only a few pieces of the dam remain at the original Rock Creek point of diversion. Thus the last 1/2 mile of Rock Creek was dewatered by diversion during the spring though fall seasons from about 1927 to 1987. In 1987, as part of the Pit 3,4,5 relicensing terms, PG&E was required to maintain 150 cfs during the summer in the Pit River between Pit 3 dam and Pit 4 dam (Pit 3 reach). Prior to that year the Pit 3 reach barely flowed during the summer, sustained only by seepage from springs along the river, by leakage from the Pit 3 aqueduct and by subsurface flows from intermittent tributaries.

Water Quality

Information on water quality in the streams tributary to the Pit River is very limited. Some data has been gathered for Rock Creek as part of the mandated Biological Monitoring Program of the Pit 3,4,5 project. Considerable information exists for conditions within the Pit River. See Young, 1996, for a summary of the water quality and flow information available.

Fisheries and Aquatic Species

Stream surveys were performed in 1977 and 1978 for many, if not all, of the tributaries to the Pit River. PG&E has carried out a biological monitoring program for the mainstem of the Pit River and for the lower section of Rock Creek as part of their FERC licensing requirements for the Pit 3,4,5 hydroelectric project. Salmonid species as listed in PG&E's Biological Compliance Monitoring Program 1993 report include rainbow and brown trout. Other species present include Sacramento squawfish, hardhead, Sacramento sucker, and Pit sculpin. These species may be found in the mainstem of the Pit River as well as some of its tributaries. Other fish species that may appear in the Pit River in this analysis area are Tuleperch, California roach, and speckled dace.

Amphibians found include the Pacific chorus frog and Cascades frog. Crayfish are present in the Pit River but the majority are probably the introduced signal crayfish (*Pacifastacus leniusculus*) or another introduced species, *Orconectes virilis*. The endangered Shasta crayfish (*Pacifasticus fortis*) is present in the Pit River and its tributaries between Hat Creek and Fall River. The Shasta crayfish occur in "cool, clear, spring-fed lakes, rivers, and streams, usually at or near a spring inflow source where waters show relatively little annual fluctuation in temperature and remain cool during the summer." (USDI 1988) This habitat type does not appear to occur within the LSR or the Rock Creek watershed. Shasta crayfish are not expected to occur and are not known to have occurred within the analysis area.

Rock Creek Watershed Area

The Rock Creek watershed analysis area contains two primary creeks and their territories along with a portion of the main stem of the Pit River and its canyon. The two primary creeks within the WA area are Rock Creek and Screwdriver Creek. Rock Creek is the primary tributary to the Pit River between the Pit 3 Dam (Lake Britton) and the Pit 3 Powerhouse at the upper end of Pit 4 Reservoir. The lower sections of Rock Creek are spawning areas for trout and native fish. Rock Creek is primarily a high gradient stream. It has two primary tributaries: the North Fork and Peavine Creek. Peavine Creek has a lower gradient especially in it's headwater area which originates on NFS land. The main stem of Rock Creek, along with the North Fork, originate on private industrial timberland north of the LSR.

Screwdriver Creek enters Pit 4 Reservoir just below the Pit 3 powerhouse. It is a relatively small stream which does not contribute significantly to spawning. It is a high gradient stream with one minor tributary, Poison Creek. Both Poison Creek and Screwdriver Creek are wholly contained within NFS land with the exception of the last several hundred feet of Screwdriver Creek where it passes across PG&E land owned in association with the power facilities at Pit 3 Powerhouse/Pit 4 Reservoir.

The soils within the Rock Creek Drainage on National Forest System lands were mapped at the suborder or family level during the 1995 Ecological Unit Inventory (EUI). For further information on soil specifics within the Rock Creek drainage consult the EUI. The Ecological Types that were determined during the EUI are shown in Appendix 1. The location of the ET polygons suitable for sustaining conifer stands are displayed in map 2.

Fisheries and Aquatic Resources within the Rock Creek Watershed

Approximately 3.5 to 4 miles of the Pit River falls within the boundaries of the Rock Creek Watershed Analysis area. Additionally Peavine Creek, the mainstem of Rock Creek, all of Poison Creek, and all of Screwdriver Creek are located within this same area. Peavine Creek is a tributary to Rock Creek, Poison Creek is a tributary to Screwdriver Creek, and both Rock and Screwdriver Creeks drain into the Pit River. Numerous unnamed tributaries also drain this analysis area, though most are intermittent or ephemeral. According to the information found in the Rock and Screwdriver Creek Aquatic Resource Inventory of 1995, fish species found in Rock Creek are rainbow and brown trout. Screwdriver Creek contained only rainbow trout and Pit sculpin. Cascades frogs were found in the lower portion of Rock Creek.

Habitat inventories for aquatic species were conducted in 1994 to provide baseline information for Rock and Screwdriver Creeks. This work was contracted to a private consultant who used the protocols developed by the Forest Service. This report is on file at the Lassen National Forest Supervisor's Office in Susanville.

The habitat surveys and inventories found the following information and conditions about Screwdriver and Rock Creeks.

Rock Creek
Aquatic habitat appeared to be in good condition, with roads and culverts creating most of the problem areas. Few dispersed campsites are along the mainstem of the stream mostly adjacent to roads. Cattle use along some of the low gradient stretches of Rock Creek and some of the other unnamed tributaries is evident. All

of the above activities have resulted in varying degrees of degradation to the stream channel and associated aquatic habitat.

Fish habitat consists mostly of step runs and low-gradient riffles. Few pools were encountered during habitat typing. Low depth pools though, appear frequent in the step run habitats, with cover for fish available in the form of boulders and overhanging vegetation. Habitat surveys also noted a lack of woody debris in the main channel. Reasons for the lack of wood may include high water velocities in this steep gradient stream, and in the upper stretches of Rock Creek, large woody debris appears to stay mainly on the slope due to tree and vegetative density.

Screwdriver Creek

Stream surveys from 1977 and 1978 indicate marginal fish habitat. Rainbow trout were found from the confluence of the Pit River and Screwdriver Creek to approximately one mile upstream. Few trout were seen, and were mostly of small size. Similar findings were made in the 1994 survey, and Pit sculpin were also present. Numerous fish migration barriers were noted in all surveys. Natural barriers were most common, and human-caused barriers (culverts) were also present. All surveys noted instability throughout the stream, as this creek is high gradient and flows through a mostly unstable canyon.

Cattle use was not evident during any of the surveys. Each survey noted deposition of fines and sands in pools and riffles, and timber harvest activities were evident in the same locations. The 1994 survey noted a road in close proximity to the stream at 0.9 miles above the confluence with the Pit River is closed to vehicle traffic and the area is recovering.

Historical and Current Vegetative Conditions

The Chalk Mt. LSR is an area where disjunct foothill plant species come together with westside species and eastside species in the Cascade Province. Much of the LSR is covered with mixed conifer with higher elevation slopes dominated by white fir. Lower slopes are dominated by pine or oak depending on soils and aspect.

Historical Information

Prior to the arrival of European settlers, the vegetation was heavily influenced by frequent fires. Skinner completed two studies of fire return intervals within the LSR. (Skinner 1996) These studies were conducted on Chalk Mt. and determined fire return intervals from the period prior to 1850 to approximate 4-25 years with a median interval of 10 years at one site and 13 years at the other site.[1].

The pattern of frequent fires kept understories open, favored fire resistant species, favored grasses and forbs, and kept canopies high. Ignitions were probably a combination of lightning-caused and human-caused sources. Human-caused fires were probably frequent in the oak-dominated lower elevations. Lightning was probably a more frequent cause at higher elevations. However, given the long, continuous west-southwest slopes from the Big Bend area up into the higher elevations of the LSR it may have been a frequent event for fire to travel out of the oak belt into the white fir forest at the upper elevations.

During the late 1800's the fire regime began to shift. A large fire is believed to have started in the Big Bend area and burned to McCloud Flats. This fire may be responsible for current stand origination in much of the LSR. This can be seen by the prevalence of 80-130 year old stands within the LSR and adjacent forested lands. Also during this time period Native American ignitions would have drastically decreased as settlers and miners entered the area. This time period also saw the arrival of large herds of sheep and cattle. Impacts from grazing reduced the forb component and favored the brush/shrub component. Intensive grazing may have also stimulated regeneration of conifers by preparing seedbeds.

The early 1900's brought the establishment of the National Forests and the beginning of fire suppression. The first 3/4s of this century was also a period of increased precipitation[2]. The effects of reduced fire frequency, and increased precipitation, promoted the establishment of shade-tolerant, more mesic forest cover. This increased total canopy density, increased the abundance of shade tolerant white fir and reduced the presence or dominance of the fire resistant ponderosa pine, sugar pine, Douglas-fir and incense-cedar.

During the lower precipitation periods of the late 1970s and early 1990s the area responded with increased overstory conifer mortality rates, apparently as a result of moisture stress and competition for available moisture. Conifer mortality also increased in ecotone areas adjacent to abrupt soil changes. For example in the Rock Creek watershed there are several ecotones of conifer/white oak. In most of these ecotones there was significant mortality of all conifers. The result was a shrinking of the area dominated by conifers and an expansion of the oak type.

[1] The Iron Canyon Watershed to the northwest had a fire return interval of 8-20 years. Estimates of return intervals in the east side types are more typically on the order of 4-15 years. See Agee 1993 or Agee 1994 for an excellent discussion of eastside fire regimes.

[2] Fritts and Gordon(1980) based their conclusion on tree-ring research. These conclusions are also supported by data gathered during archeological investigations at Lake Britton. (Cleland, 1995). See Figure 1 which shows the climatic fluctuations for California as described by Fritts and Gordon.

Current Conditions

Information on current vegetative conditions was obtained from two sources. Because the LSR is managed by two National Forests that are organizationally within separate sub-Regional provinces [3][footnote], vegetative information updating is handled on different schedules. Information used was the most current available for each Forest. The Shasta-Trinity administered portion of the LSR was vegetation mapped in the early 1980's as part of the first round of Forest LMP efforts. These vegetation maps were derived from aerial photos, had a minimum mapping unit of 10 acres and collected timber data only on lands managed by the Shasta-Trinity NF. Typing was into timber classes with limited information on density of tree crowns. These maps were digitized and hand updated on an irregular basis.

The Lassen National Forest data is from recently delivered GIS data obtained through the Remote Sensing Lab in Sacramento. This data is derived from 1991 Landsat imagery with ground-truthing in 1993-1994. The minimum mapping unit is 2.5 acres with vegetation typed into CalVeg types and classes. Because of the differences in the data sources some analysis had to be limited. CalVeg cover types were easily defined for both data sets but vegtypes were not possible to match exactly. There is also some discrepancy between the two data sets on tree size and density due to different mapping methods. Information was combined for this analysis with these constraints in mind.

Approximately 1,200 acres or about 3% of the LSR had no vegetation mapping. Over 960 acres of the unmapped land can be accounted for by private land within the Shasta-Trinity data set. Thus approximately 240 acres were left unmapped due to gaps in the coverage between the two datasets. This is approximately 0.6% of the total area within the LSR. Use of aerial photos, and personal knowledge of the LSR, allowed the assessment team to "fill-in" these gaps during analysis.

Chalk Mt. Late-Successional Reserve

The discussion of vegetation within this section of the assessment is broken into 5 parts:

- Vegetation and Cover type
- Size and density
- Spatial Arrangement
- Riparian Vegetation
- Special Structural Elements

Vegetation and Cover Type

Vegetation ranges from canyon live oak with annual grass understory on south facing slopes within the Pit River canyon to dense stands of white fir at higher elevations. Most of the conifer-capable[4] ground is of relatively good site quality for growing of conifers. Soils are often relatively deep, there is adequate precipitation, and a long growing season. The predominant cover type is conifer (CalVeg

[3] Shasta-Trinity NF is considered to be part of the Klamath Province. The Lassen NF is considered to be part of the Sierra-Cascade province. Mapping projects such as the Landsat derived data delivered to the Lassen in 1996 are scheduled on a provincial basis.

[4] The site index within the area covered by the Rock Creek EUI varies from 50-115. The assessment team members with cultural and silvicultural backgrounds felt that the area west of the Rock Creek EUI area has generally higher capability and site index due to higher precipitation amounts.

covertype). Table 2 shows vegetation by CalVeg covertype existing within the LSR.

Table 2 - Acres by CalVeg Covertype

CalVeg Covertype	Acres	Percent of Mapped Area
Conifer	27,902	79.3
Hardwood	4,777	13.6
Chaparral/Shrub	1,789	5.1
Non-forested	714	2.0
Total mapped vegetation	35,183	100

Of primary interest within the LSR is the conifer cover type. Table 3 shows the approximate distribution by conifer type. Appendix 2 displays a "crosswalk" between the CalVeg and Timber Types used for this assessment.

Table 3 - Acres of CalVeg Conifer Vegetation type

CalVeg Vegetation type	Acres	Percent of Conifer Area
Mixed Conifer	4,953	17.8
Mixed Conifer - Fir	6,082	21.8
Mixed Conifer - Pine	14,289	51.2
Ponderosa Pine	1,680	6.0
Lodgepole Pine	107	0.4
Gray Pine	791	2.8
Total mapped vegetation	27,902	100

The conifer cover type includes the gray pine vegetation type. This type is generally not used by species thought of as "conifer dependent". Gray pine is a very open, more shrub-dominated vegetation type found on drier sites. Although technically a conifer type gray pine will be excluded in further analysis of the conifer cover type because it functions as more of a brush-type tnan as a conifer-type.

The segregation of mixed conifer into three types is an artifact of the two different data sets used for vegetation inventory. For more discussion of the differences in the data sets see the introductory discussion for this section, above.

As can be clearly seen in Map 5, mixed conifer is the dominant vegetation type within the LSR. The predominance of the mixed conifer-pine type (see table 3 above) is consistent with the frequent historical fire return interval.[5]

Size and Density

Within the LSR the primary focus is late-successional conditions. These conditions generally require large trees (size class 4 and greater), and relatively high density or canopy cover (>40%). There are also specific element requirements for decadence, such as down logs, snags, mechanical defect, and other structural

[5] See the section on historical vegetative disturbance above for further discussion of historical fire return intervals.

characteristics. These specific elements are best addressed during smaller scale analysis such as NEPA analysis performed prior to project implementation. Thus these elements will not be discussed in depth in this document. However, see below for a short discussion on current conditions of these elements.

The most common tree size within the LSR is size class 3 (12-24" DBH). This is consistent with stand origination dates of 60-120 years ago. Map 6 shows the size distribution of conifers within the entire LSR. Notice that the largest size class (Size class 4; 24"+ DBH) covers only about 1/5 of the area currently covered with conifers.

Spatial Arrangement

Maps 5, 6, and 7 show the arrangement by cover type, tree size, and stand density. Note that conifer cover is dissected by the Pit River, and Rock Creek. Conifer cover is generally well distributed across the LSR except on the south-facing, north wall of the Pit River Canyon. Stands of large trees are much more limited in scope and have a more discontinuous distribution. Large-size trees are primarily located on the north-facing, south wall of the Pit River Canyon, and in the upper reaches of the Rock Creek watershed.

Riparian Vegetation

Intermittent and perennial drainages are usually covered in dense streamside riparian vegetation with willow, cottonwood, vine maple and mountain alder being dominant and providing a closed canopy over much of the riparian zone. Big leaf maple and white alder are also present. Aspen is represented in the Peavine Creek drainage and cottonwood is found along the mainstem of the Pit River. *Trillium ovatum* ssp. *oettingeri* is the only Forest Service "Sensitive" plant found within the LSR. It occurs in wet, heavily shaded riparian areas. It is known to occur within the Peavine Creek watershed.

There are no Federally listed, "Threatened" or "Endangered", nor any Federally proposed "Threatened" or "Endangered" plant species within the LSR or wtihin the rock Creek watershed.

Special Structural Elements

Information on the current status of special structural elements such as snags, down logs, and other elements is some what limited. Because there has been no harvest during the last 4 years within the LSR, most of these elements have increased in number and density. Amoung results of the extended drought from 1987-1994, were an increase in tree mortality which subsequently increased levels of snags and down logs. A strong wind event in late 1995 caused extensive blowdown through the LSR. The blowdown was primarily white fir located in previously entered stands. Amounts felled ranged from single trees to "jackstrawed" pockets containing 10-20 trees.

Rock Creek Watershed Area

The WA area contains the driest sites within the LSR. It also has fewer clearcuts than the remaining portion of the LSR. There are also few large contiguous areas of large size class trees. Table 4 shows the distribution of vegetation type by size class within the WA area for all ownerships.

Table 4 - Acres by Size Class and Conifer Vegetation type

Size	Mixed Conifer-Fir	Mixed Conifer Pine	White Fir	Ponderosa Pine
1	0	95	0	0
2	8	186	0	45
3	3,572	9,064	5	1,214
4	700	611	0	357
N		24	0	0
0		0	0	0
	4,280	9,980	5	1,616

The Peavine Creek riparian area has been altered during the last century due to cattle grazing, road construction, dispersed recreation, fire exclusion, and timber harvest. Alterations include changes in species composition and structural changes in both vegetation form and stream channel morphology.

Species composition has probably changed in several ways. Intensive cattle grazing has altered the herbaceous layer resulting in a decrease in palatable graminoides (such as various sedges (*Carex* spp) and grasses) that would be expected here and an increase in dominance by less palatable species such as primrose monkeyflower (*Mimulus primuloides*) and bulrushes (*Scirpus* spp) in the wettest areas. The herbaceous species on drier ground tend to be dominated by non-native weeds, including bull thistle (*Cirsium vulgare*), woolly mullein (*Verbascum thapsus*), or dandelion (*Taraxacum officinale*), along with an excessive amount of bare ground. Bare ground (along with fire exclusion) in wetter areas has also contributed to an increase in certain woody species, such as alder and lodgepole at the expense of herbaceous species. Within the dispersed campsite areas human use, vehicles and cattle have also contributed to bare soil and soil compaction leading to more bare ground.

Structural conditions within the herbaceous layer have been altered as well, producing a distinct lack of plant height at seasons' end. This affects reproduction (since flowering culms are snipped off, eliminating seed set), erosion control/waterflows, and nutrient cycling from the lack of residual foliage. In addition to clipped vegetation, stunted plant growth within the riparian area may reflect compacted soils from both cattle trampling on wet soils and vehicle traffic (including logging, landings, and dispersed camping). Soil compaction also affects the water infiltration rate and subsequent release rate from the meadow area.

Structural channel conditions have also been altered, resulting in a broadened channel from cattle trampling, and berming and disturbance from roads and skid trails in the riparian areas.

The Sensitive plant Salmon Mountain wakerobin (*Trillium ovatum* ssp. *oenttingeri*) occurs in riparian areas on Peavine Creek. It is currently limited to thickets under vine maple and alders. This restriction may be due to the protection afforded by the tall shrubs from cattle grazing or trampling, or may be due to spring sun and summer shade conditions produced under the deciduous canopy, or a combination of both.

History and Description of Land Use

Recreation

Most recreation is associated with the Pit River. The Pit 3 reach has special fishing regulations and is moderately utilized during the fishing season. (See Table 5 - Fishing effort during 1992) There is also light use of the river by kayakers and rafters. The upland areas of the LSR are utilized during the appropriate hunting seasons by hunters in search of deer (Zones C-2 and C-3), elk (Burney Special hunt), black bear, wild turkey, and occasionally quail.

Table 5 - Fishing Effort during 1992 for the Pit 3, 4, 5 Project

Number of Parties	April	May	June	July	Aug	Sept	Oct	Nov.
Weekend/Holiday	185	233	108	95	40	55	96	37
Weekday	31	99	38	31	19	22	30	8
Weekend/Holiday	92.5	23.3	13.5	10.6	6.7	6.9	10.7	7.4
Weekday	31	14.4	5.4	6.2	3.8	3.7	3.8	4.0
Combined	61.8	18.6	9.5	8.4	5.3	5.3	7.3	5.7

Developed Recreation

Although the LSR is bisected by the Pit River, below the Pit 3 dam, the developed recreation in both the LSR and Rock Creek is minimal. There is one semi-developed campground, Deep Creek Campground, located on the southern shore of the Pit River on the western side of the LSR, and outside of the Rock Creek watershed. It consists of 5-10 sites, and two pit toilets. This campground is no longer managed as a developed campground and the existing facilities are expected to degrade over time.

Dispersed Recreation

There are user established areas along the Pit #3 reach road where vehicles have created parking areas for fishing, camping and other recreational use along the Pit River. These are most prominent at: Delucci Ridge, Rock Creek intersection with the Pit River and in the flatter areas between the Pit 4 Dam and Pit 4 Powerhouse.

See map 8 for dispersed recreation concentration areas.

These sites have no facilities associated with them. Because there are no sanitation facilities, the areas are often plagued with trash, toilet paper, abandoned belongings (tables, chairs, BBQs, etc.), and sometimes larger items (refrigerators, car parts, etc.). Because of the recreationists' desire to be close to water, these sites, and their associated undeveloped roadways sometimes create streamside and meadow damage by compaction, erosion, double roads to avoid wet areas, removal of streamside vegetation, and water contamination (i.e. food, soap, fuel).

Trails

The Pacific Crest Trail traverses through the northern portion of the LSR for a distance of approximately ten miles. This trail is maintained, as funding is available, and is moderately used.

Rock Creek Watershed Area

There are no developed recreation sites within the Rock Creek watershed area. There is considerable dispersed recreation at the junction of Rock Creek and the Summit Lake road (37N02). There is both day use and camping in this area. The upper portions of Rock Creek have some day angler use. There is also some dispersed camping in the Peavine Creek area primarily during deer hunting season. This dispersed use is primarily within the riparian zone of Peavine Creek. One dispersed site is approximately 1 acre in size and has a long history of use. This site is highly compacted, has bare soil adjacent to the creek and is also used as a loafing area by cattle. The Pacific Crest Trail also traverses the watershed.

Lands

Over 2500 acres of land within the LSR were previously owned by industrial timber companies. Most of these lands were obtained during land exchanges in the late 1980s. This has left National Forest system lands within the LSR mostly consolidated. The remaining private lands in section T37N, R1E, Sec 36 have various owners and homes, thus are probably not available nor desirable as National Forest System lands.

There is a 560 acre in-holding within the LSR boundary in the vicinity of Long Valley Mountain in T36N, R2E Sections 1, 11, & 12 MDM. These lands are owned by Fruit Growers Supply Co., with whom a satisfactory land exchange has not been concluded. If the opportunity arises, these lands would be logical to acquire, as they are surrounded by NFS lands.

Just north of the Pit #4 reservoir in T36N, R2E, Sections 4 & 9, MDM there are 106.82 acres of land that became private in 1916 under the Forest Homestead Protection Act.

From a land ownership perspective the isolated 120 acre National Forest parcel in T36N, R2E, Section 14 MDM may be desirable to be disposed of in a land exchange.

Restricted National forest Lands within the LSR project boundary are:

1. 160 acres of land in T37N, R2E, Section 35 S1/2SE, E1/2 SW; MDM These are withdrawn under the June 10, 1920 Power Withdrawl Act for powerlines, telephone lines, and transmission lines as a part of PG&E's Pit #3,4,5 hydroelectric facility.
2. 4,978 acres along the river, and occasionally up side drainages in portions of T36N, R2E, Sections 1-3, 4, 7-11, 16-20 MDM. These lands are also restricted due to the Pit #3,4,5 facility and it's appurtenant structures (adits, tunnels, etc.).

Special Uses

The following special use permit areas are within this project boundary. These uses (other than the FERC license area) are of limited size , and are thus easily avoidable when designing projects.

Two warning sirens and three danger signs are located in T36N, R2E, Sections 1&2 MDM, on the shoulder of the Pit 3 Reach Road. These devices are to warn the public in case of a catastrophic failure of the rubber crest gates on the Pit #3 dam.

A PG&E passive reflector station for PG&E communications of the Pit #3,4,5 hydroelectric facility is located in T36N, R2E, Section 3, NW 1/4 MDM.

Although it is not under a special use permit, the portions of the Pit #3 and #4 hydroelectric facilities within the LSR boundary are under the auspices of the Federal Energy Regulatory Commission (FERC) license. This is discussed further in the "Fish/Hydrology" section.

Rock Creek Watershed Area

With the exception of the Pit 3,4,5 hydroelectric project and its associated special uses there are no special uses within the Watershed Area.

Mining

There is evidence of all three kinds of mining activity within the LSR boundary: locatable, common variety, and leasables.

Locatable Minerals

These are considered as "valuable" minerals that can be "claimed" such as gold, silver, etc; and do not require the payment of a royalty for mineral extraction. There are 14 mining claims within the LSRA boundaries listed in the 1995 mine claim list from BLM. The majority of these are for diatomaceous earth (DE). DE is a thick accumulation of diatoms up to hundreds of feet deep on what was once an inland sea. The mineral is used for filtration of products (beer, wine, swimming pool filters, etc.), as a pesticide, absorbent, and other uses. Depending on the end use of the material, it can also be considered a common variety material (such as when used as a cement additive for silica). Because the end use of the material is not known until a plan of operations is filed, and since most claimants keep their claims valid through annual assessment work, not through the filing of a plan of operations, it is not known if these claims are valid locatable claims or common variety materials. Determination of claim validity thus is dependent on the use proposed in the Plan of Operations.

It is important to distinguish between a locatable and common variety mineral since the Forest Service cannot deny the removal of a locatable mineral, as this is not discretionary under the 1872 mining law. However, the Forest Service does maintain the ability to require mitigation measures to reduce any effects from locatable mineral extraction. Extraction of common variety minerals (discussed further below) is discretionary; therefore, the Forest Service deciding officer could deny the extraction of common variety materials if there are detrimental resource effects that outweigh the benefit of the mineral removal.

Since there are a number of mining claims within the LSR, it is critical for any future management activities to be coordinated with the mining claimant, as they have some surface rights, such as removal of timber to construct on site mining related structures. In cases where the mining claim pre-dates the 1955 Surface Resources Act, the claimant has additional rights to the surface resources. The government could be required to provide timber in the future to a mining claimant to replace what was removed, if the claimant could show the timber was necessary for on-site mining structures or use. Because the mining law is very complicated in regard to surface rights, the procedures outlined in sections 5 & 6 of the Surface Resources Act PL 167) must be followed to determine who has the surface rights.

Common Variety Minerals

These are common minerals (i.e. sand, gravel, cinder, etc.) that can be sold by the government and return a royalty to the treasury. There are several existing cinder pits in the LSR. Most were developed for construction of the Forest Service roads in their vicinity. Ones that are no longer needed should be identified and have reclamation plans developed for putting them "back to bed". The pits to remain open have not been identified at this time.

Leasable Minerals

Examples of leasable minerals are: coal, phosphate, oil, gas, sulfates, geothermal, etc. In the case of the LSR, much of the area was under two applications to May Petro Inc. for oil and gas lease until the applications were withdrawn in 1989. Since then, there have been no current leasable minerals pending action in the LSR.

Rock Creek Watershed Area

Most of the portion of the watershed north of the Pit River and east of Screwdriver Creek are under diatomaceous earth claim. See the discussion above for further information.

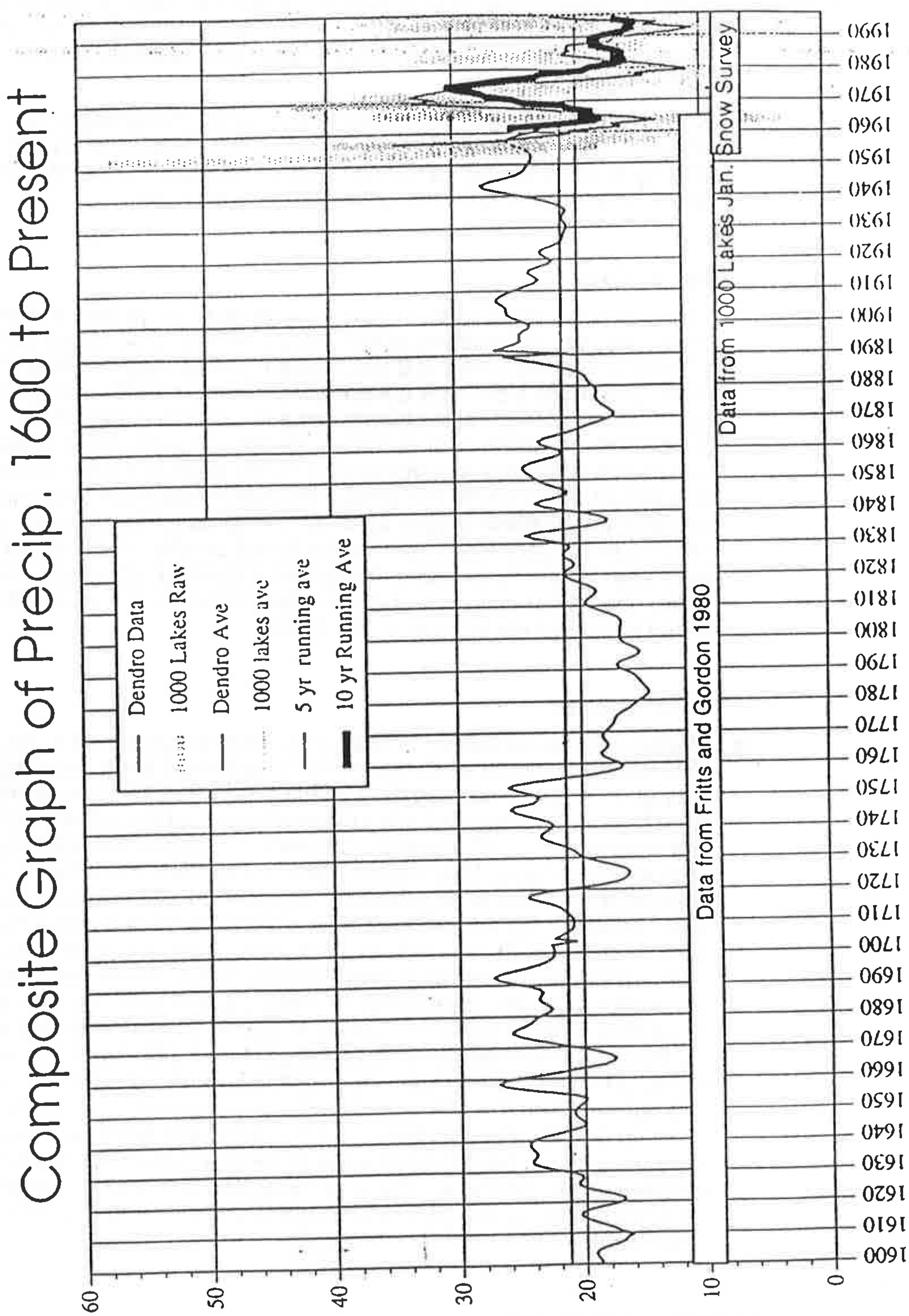
History of Disturbance

Fire History

Prior to 1900

It is well documented that Native American burning practices shaped the landscape in much of the west prior to European settlement. Evidence exists that Native Americans were using fire adjacent to what is now the LSR to manage for acorn production in what is now the Lake Britton area and probably in what is now the Big Bend area. (Cleland, 1995). It must be assumed that these fires occasionally spread into the conifer stands within the LSR. At the higher elevations most fires were probably lightning-caused. During the period between 1730 and 1850 fire return intervals were within the 4-25 year range (Skinner 1996). This time period (1730-1850) contained periods of both above and below average precipitation within the state of California. (Fritts and Gordon 1980). Precipitation patterns for the last 400 years can be seen in Figure 1. This relatively frequent fire history favored shade intolerant conifer species such as ponderosa pine, sugar pine, and large Douglas-fir. Understory vegetation, especially fire intolerant species, would have been much less prevalent.

Figure 1 - Composite Graph of Precipitation 1600 to Present.



The community of Big Bend was established in 1860. Ranchers and shepherds may have intensively grazed cattle and sheep in the LSR during this period until establishment of the Shasta National Forest in 1905. It was a common practice for ranchers and shepherds to burn vast acreage during the fall of the year to encourage growth of herbaceous forage. This practice resulted in the reduction of older forests.

Some fires during this period were very large. Newspaper accounts tell of a 150,000 acre fire in 1872 that burned west of Big Bend. There are also sketchy reports of other fires from the same era. This could account for the similar age and size of many ofthe conifers within much of the LSR.

1900 to 1940

The presence of grasses, in part as a result of large fires in the 1800's, made the area attractive to ranchers looking to graze livestock. Notes attached to range allotment reports from 1916 (Pit Ranger District records) indicate that much of the north end of the LSR was covered with young conifer reproduction. With construction of the Pit River hydroelectric projects in the 1920s, the microclimate in the bottom of the Pit river canyon probably became more moist. Certainly, riparian vegetation was strongly affected as some stretches were flooded and others dewatered. Also during this period fire suppression became much more aggressive. Conifers began to close canopies and conditions were created that favored the regeneration of shade tolerant conifer species such as white fir. Forest fuels also began to increase during this climatilogically wet period. (insert climate table). Exact fire history records for this period were lost in a fire at the Shasta National Forest warehouse in the 1970s.

1940 to present

Effective fire suppression greatly reduced the number of acres burned within the LSR during this period. Between 1974 and 1994 there were 10 lightning-caused fires and 2 human caused fires within the LSR. Only two of these were considered large fires. A 300 acre lightning-caused fire occurred in the Underground Creek drainage during 1987. Another 300 acre fire clipped the southeast corner of the LSR at Long Valley Mountain in 1990. Large fires have been relatively frequent outside of the LSR during the last 20 years. In 1977, several large, stand-replacing fires (Pondosa, Scarface) burned in excess of 50,000 acres each less than 20 miles to the east of the LSR. In 1987, large fires occurred extensively around northern California; the Lost Fire 30 miles to the southeast, burned 20,000 acres with stand replacing intensities. In 1990 a 5,000 acre fire with stand replacing intensities burned south of Burney in stands very similar to those within the southern and eastern portions of the LSR. In 1992, the Fountain Fire (64,000 acres, 90% with stand replacing intensities) burned within 1 mile of the southern edge of the LSR. This demonstrates a trend toward increasing frequency of high-intensity, stand replacing fires. The predominant direction of spread for all of these large fires was from the southwest to the northeast with the prevailing southwesterly wind flow. The only exception was the Underground Creek fire in the LSR, which occurred in a wind-sheltered location, and spread directly up and downslope ("ran to the topography").

Harvest Practices

Harvest of conifers was limited within the LSR prior to the end of World War II. Some harvest did occur in association with the establishment of construction camps and hydroelectric facilities within the Pit River Canyon in the 1920's and 1930's. Although impacts in these locations was high, most of the LSR was probably not significantly affected. The strong demand for publicly-owned timber in the 70's and 80's resulted in many clearcuts within what is now the LSR. For a variety of reasons most of these are located in the Summit Lake area and within the Deep Creek drainage area off of the Hatchet Mountain Rd. These former clearcuts are now plantations with varying mixtures of conifers and brush species. The formerly private parcels were also heavily harvested, often more so than adjacent NFS lands such that landlines were clearly evident on aerial photography.

Late-Successional Species

For a list of expected late-successional species refer to Appendix 6. Several species found within the LSR are "high profile" species due to their status as listed species within the context of the Endangered Species Act. Information on occurrence of these species is given below.

Northern Spotted Owl

Occurrence of this species has primarily been observed in two areas:

along the north-facing slopes of the Pit River Canyon

the northern plateau area of the LSR north of the Summit Lake Road (37N02) and east of the Peavine road (37N30).

Table 6 displays survey effort information. Observation locations are displayed in Map 9. Table 6 also groups the observations for Poison Creek and Underground Creek together. This is due to the close proximity (0.5 miles) of the observation locations. It appears to the team biologist that several individual birds appear to have utillized the area at different times. The observations of single individuals were followed up with mousing attempts and reproductive status or pair status has never been confirmed. It is also possible that birds were drawn to the survey crews from either of the areas (e.g. Poison Creek responded to Underground or Poison Creek call points).

To separate areas of repeated owl use from areas of single observations the designation "activity center" is applied to areas where spotted owls observed in two or more consecutive years or where nesting pairs are located in a single year. It appears that there are 4 currently used activity centers. One is located on the south edge of the LSR near Canyon creek (Pit Canyon Activity Center or AC), two are located in the headwaters of Poison and Underground Creeks (Poison AC and Underground AC), and recent information indicates that there is an activity center in Section 20, T37N, R2E. (Frog Pond AC). As noted above the Poison and Underground Activity centers may, in fact, be one activity center.

Table 6 - Owl Inventory and Monitoring

Place	82	87	88	89	90	91	92	93	94	95	96
Pit Canyon.		M	M	P	Y	Y				F	P
Pit 4 Owl	U			A	A	A					N
Poison Creek Underground Ck. (SOHA #83)	U	N	N	N	N	M	M	N	N	F	F
Camp Nine Flat	U		N	N							
Frog Pond										U	U
E Fk Nelson Ck				M							

M = Male F = Female A = Adult P = Pair Y=Young U = detection unknown sex/age N = called No obs

Northern Spotted Owl Habitat

Nesting Habitat

Suitable nesting habitat for northern spotted owls is considered to be "multilayered, coniferous stands of mature timber with greater than 70% canopy closure, at least 40% of that in trees greater than 21 inches DBH and with obvious decadence." (MacFarlane, 1992: pg 22). Most northern spotted owl nest sites observed on public lands have been located in old-growth or mature forests. In addition, the proportion of older seral stage forest surrounding nests has been significantly greater than it was in surrounding random sites in the same area (USDI, 1992 pg. 19). For the purposes of this analysis, nesting habitat is considered suitable if DBH is at least 24" and crown closure is at least 70%. This definition is used due to the nature of the data available for analysis. The data used for analysis was classified with DBH being split at the 24" size. Stands of 20-24" diameter trees cannot be separated from 12-16" DBH trees within the utilized databases.

Habitat with trees greater than 24" is limited to about 20% (~5,700 acres) of the area currently covered with conifers within the LSR. Of this 20% with greater than 24" DBH, only ~2,100 acres have greater than 70% canopy closure. Thus less than 8% of the conifer covered area within the LSR is suitable for spotted owl nesting[6]. Mapping of suitable nesting habitat (see Map 10) indicates that most of the nesting habitat is in relatively small patches.

Table 7 shows the amount of nesting habitat within 1.3 miles of the activity centers within the LSR. The Frog Pond, Poison Creek, and Underground Creek ACs are lumped because their 1.3 mile radius areas overlap.

Foraging and Dispersal Habitat

Spotted owl feeding habitat appears to be variable but is characterized by high canopy closure and complex structure (USDI, 1992 pg. 20). Foraging and dispersal habitat appears to be primarily mixed conifer stands greater than 11" DBH with greater than 40% canopy closure. Within the LSR there is approximately 14,600 acres of foraging and dispersal habitat or 57% of the existing conifer covered area. Dispersal habitat is well distributed, and is generally continuous along a north-south axis through the center of the LSR. Outside of the LSR satellite photography and local knowledge indicate generally continuous dispersal habitat to the north and northwest. There is no dispersal habitat to the south due to the Fountain Fire. Dispersal is limited to the east by the transition to the xeric Modoc Plateau ecological section (Goudey 1994). Dispersal to the west is limited by the transition to the Central Valley foothills and the oak savannah lands northeast of Redding.

Table 7 - Acres by Habitat category for Activity Centers within the LSR.

Activity Center	Nesting and Roosting Habitat within 1.3 mi.	Acres of Foraging Habitat within 1.3 mi.	Distance to next closest AC (miles)
Pit Canyon	186 acres / 5.5%[7]	1702 acres/ 50.3%	2.2
Frog Pond Poison Creek Undergound Creek	775 acres / 11.1%	4008 acres / 57.5%	2.9
Pit 4[8]	228 acres / 6.7%	1235 acres / 36.3%	1.8

[6] The actual amount is almost certainly less. This typing does not account for other habitat elements such as snag and down logs that are necessary for spotted owl habitat to truly be suitable.

[7] % equals the amount of habitat divided by the area within the 1.3 mile analysis area times 100.

[8] Actual habitat amounts are slightly higher as there is a gap in the vegetation coverage within this activity center. Approximately 95 acres were unmapped. Most of this unmapped area is privately owned timber land unsuitable for spotted owls. There is a small amount (<40 acres) of National Forest System land that was unmapped that does appear to contain some suitable habitat.

Bald Eagle

There are three known bald eagle nesting territories within the LSR. Two territories are near the Pit 4 reservoir. One territory is adjacent to the Pit 5 reservoir. Use of the LSR area by this species is closely associated with the reservoir system along the Pit River. The Pit 3 reach is utilized by the Pit 3 Powerhouse pair, Pit 4 Reservoir by the Pit Rim pair; and the Pit 5 reservoir by the Hagen Flat pair. Juvenile and immature bald eagles also utilize the canyon for winter roosting and foraging.

Bald eagles in and adjacent to the LSR have been extensively studied over the past 10+ years as part of monitoring of changes associated with flow regime alterations within the Pit 3,4,5 hydroelectric projects. These studies, documented in Jenkins 1992, have shown that in the region around the LSR, eagles nest primarily in large to very large ponderosa pine or Douglas-fir. Nests average less than 500 meters from water but may be up to 1000 meters away. Nests within Jenkins study were located in trees that had the following characteristics:

Tree Height m (ft)	DBH cm (in)	Nest height m (ft)
mean 45.9 (151) range 22.5-67.0 (74-220)	mean 112 (44) range 78-165 (31-65)	mean 40.1 range 22.5-66.4 (74 - 217)

N = 16

Potential nesting habitat within the LSR exists in several locations besides the currently occupied territories. Potential nest trees exist along both sides of the Pit River within the Pit 3 reach. This area may be limited by prey availability and by the high angler use. Other potential nesting habitat likely occurs near the confluence of Canyon Creek and the Pit River. This area probably has some of the lowest fishing pressure along the river within the LSR. Access to this area is very difficult and thus the area has a low level of human disturbance.

Bald Eagles within Jenkin's study area downstream of Lake Britton (Pit 3 reach through Pit 6 reservoir) were primarily dependent on one species for prey: Sacramento sucker. Altogether, in Jenkin's study, fish made up approximately 70% of the prey remain biomass. Birds, primarily waterfowl, made up another 23% of the prey remains and mammals made up less than 10% of the prey biomass.

This data clearly shows the dependence of bald eagles on a close proximity to the mainstem of the Pit River. Management that changes the availability of nest trees within 500 meters of the river and its reservoirs could have detrimental effects to bald eagles. Also, changes to streamflow regimes and stream conditions detrimental to Sacramento sucker would have a harsh effect on bald eagle foraging success.

Peregrine Falcon

Information on peregrine use of the LSR and the Rock Creek watershed is very sensitive in nature. This information is on file at the Shasta Lake Ranger Station and at the Hat Creek Ranger District and will not be included in this document due to the relatively small size of the LSR.

California Red-legged frog

No red-legged frog sightings have been recorded within the LSR. This area may lie northeast of the known distribution of this species. This frog inhabits quiet pools of streams, marshes and occasionally ponds with cold, slow-moving or standing water with extensive emergent aquatic vegetation. (Zeiner 1988)

Species of Management Concern

Survey and Manage Species

Plants

No survey and manage plants are known or suspected to occur within the LSR.

Amphibians

The Shasta salamander is the only S&M amphibian species that may inhabit the LSR. Existence of Shasta salamanders is unlikely within the LSR, since Shasta salamanders appear to require limestone outcrops and there are no limestone outcrops within the LSR. No specific surveys have been conducted to date in the LSR. Stream survey work of a general nature was conducted in 1995 in the Rock Creek watershed. No Shasta salamanders were noted.

Birds

There are no known great gray owl observations from within the LSR. Observations have occurred to the south of the Fountain Fire on land administered by the Hat Creek and Almanor Ranger Districts of the Lassen NF. It does not appear that the necessary habitat elements for great gray owl nesting habitat exist within the LSR.

Mammals

There are no red-tree voles within the LSR. The five survey and manage bat species all could potentially occur within the LSR. These species are:

- fringed myotis bat
- silver-haired bat
- long-eared bat
- long-legged bat
- pallid bat

No surveys have been conducted, nor are there any known sites within the LSR. All five species use caves, mines, buildings, crevices, hollow trees, snags under bark or dense foliage near water for roosting and nursery colonies. Silver-haired, long-eared, and long-legged bats prefer older forests where loose bark, snags, hollow trees or dense foliage are present. The fringed and pallid bats appear to be more closely associated with early seral stage and open forests.

Mollusks and Arthropods

Based on information in the 1995 survey and manage database, no known sites occur within the LSR. Extremely limited information is available for most of these species. There have been no specific surveys of the LSR for survey and manage species in this group.

Other species of concern found within the LSR

Goshawk

Goshawks are known to occur within and adjacent to the LSR. Known nest sites are limited to one site on the south side of the Pit River Canyon south of the Pit 4 dam. This species appears to prefer single story (as opposed to multistory) late-successional conditions.

Fisher and Marten

These large mustelids are thought to be dependent on dense older conifer vegetation. It is unknown if these species exist within the LSR. Surveys using remote triggered cameras have been conducted within the LSR in 1994, 1995, and 1996 without detecting these species. Habitat appears to be present on both sides of the Pit River and the appears to be an adequate prey base. It can be assumed that there is a high likelihood of one or both of these species being present within the LSR.

Late-Successional Species Extirpated

The only species known to have been extirpated from the LSR that can reasonably be presumed to have been present prior to European settlement are grizzly bears and wolves. These large, wide-ranging carnivores were eliminated from California in the late 1800s. There are no plans to reintroduce these species into the state. Efforts to do so would be highly controversial and are not likely to occur.

California condors may have utilized the far western portion of the LSR as nesting or roosting areas because of the available cliff walls and easy access to the oak savannah lands immediately to the west. This is supposition as there is no existing information that condors regularly utilized the area. The area is not considered as part of the range in the 1994 draft Recovery Plan for the California condor. (USDI 1994).

LSR Functionality - Synthesis and interpretation

Issues and Key Questions

As part of the Watershed Analysis process the assessment team developed a list of issues and key questions for the purpose of focusing the analysis of the Rock Creek watershed. This is a standard part of the watershed analysis process per the Federal Guide to Watershed Analysis (Regional Ecosystem Office, 1995).The analysis team used these issues and questions not just to analyze conditions within the Rock Creek watershed but also to assist with the assessment of the LSR 's functionality. It is the team's feeling that use of these questions strengthened the analysis and provided "sideboards" or "waypoints" for keeping the analysis "focused" or "on track." The questions and the Team's response are listed below.

Which management activities and naturally occurring events, continue to adversely affect aquatic habitat and riparian ecosystems? Management activities that are having adverse effects across the LSR and the Rock Creek watershed are primarily the management of the road system, grazing management and management of dispersed recreation.

Road impacts are generally healing with the decreased road system use associated with the cessation of logging and wood cutting. Within the Rock Creek watershed approximately $500,000 of restoration work has been identified to fix road associated sedimentation problems. Additional restoration work needs to occur in the other watersheds of the LSR but have not been analyzed as of this date and await further watershed analysis.

Grazing has impacted the riparian conditions in the low-gradient portions of Peavine Creek. These impacts are detailed in the vegetation disturbance discussion above. Changes to grazing management have been spurred by this analysis. Allotment planning has been accelerated for the allotment affecting this LSR due to the analysis of this assessment team.

Recreational impacts are relatively minor but are intertwined with grazing impacts in the Peavine Creek area. See below for a full discussion.

What are the optimum transportation needs for management and use of the watershed, balanced with the needs of the LSR and riparian reserves? As part of the LSR fire management plan critical fire access roads were identified. Prior to this analysis, a need for safety improvements to the Pit River Rd. (FR 50) had been identified. These improvements are needed due to increasing human use of the Pit 3 reach as a result of the stabilized releases and establishment of a "blue-ribbon" trout fishery. Further analysis of road requirements will be completed at the NEPA analysis phase and during later iterations of this assessment.

Is habitat present for riparian obligate species that occupy the riparian reserves. What conditions need to be improved? At the beginning of the analysis the team was unsure of the amounts and condition of riparian vegetation within the watershed. At this time it appears that riparian vegetation is generally present and in good condition. Some low gradient areas need improvements to reduce impacts of grazing (Peavine Creek primarily) but most riparian areas are recovering from past impacts, if any. Conifer encroachment within riparian zones may be a larger issue in the near future but was not addressed in this iteration.

Is the existing level of human use compatible with ROD objectives? Generally, yes. Human use is primarily concentrated within the Pit 3 reach and is of limited duration elsewhere. Some form of trail construction may be needed within the Pit 3 reach to stabilize angler-created trails and channel use. This will be addressed at a later date probably through the NEPA analysis process.

What opportunities exist to provide forest products consistent with LSR objectives? See the treatment criteria section below. The team determined that there was a large potential for projects that could enhance habitat conditions within the near future and provide timber to purchasers.

How does mining potentially affect late successional characteristics and riparian reserve objectives within the watershed and potentially other resources? See the section below and the Forest Hydrologist's report in Appendix 3 for a discussion of some of the potential impacts of mining. Impacts are potentially severe to the eastern portion of the LSR but are generally indeterminate at this time.

What are the appropriate treatments for the matrix sections within the watershed? The team recommends that treatment of these areas should be the same as treatments within the LSR, however, this decision will be made as a result of NEPA analysis by the pertinent line officer. The team feels that due to the shortfall of late-successional conditions within the LSR that it is appropriate and prudent to manage these limited, adjacent, publicly-owned lands in a manner that may aid recovery efforts for the northern spotted owl by providing additional future habitat within and adjacent to the area of concern for spotted owl subspecies connectivity.

How can the threat of stand-replacing wildfire be mitigated? Impacts due to stand-replacing fires was the number one concern of the assessment team. The fire management plan directly addresses these potential impacts. The treatment criteria also addresses this threat but in an implied if not direct manner.

How much of the ground is physically capable of being manipulated? See table 8 below. This was a concern at the beginning of the assessment that "treatable"• ground was extremely limited and in such a pattern as to render habitat projects unviable. Analysis shows adequate contiguous ground with moderate to low slopes to make commercial, tractor-based operations feasible. Also see map 2 for the spatial distribution of operable ground based on slope.

Table 8 - Acres by Slope Class within the LSR

Slope Class	Acres	% of LSR
Low (015%)	9,435	26
Moderate (16-35%)	14,069	39%
Steep (36-55%)	8,261	23%
Very Steep (56%+)	4,583	13%

Are TES species and their habitats connected to other watersheds? It appears that TES species have adequate connections to the north, at this time. The team assumes that because the intervening lands between the LSR and other areas managed by the Shasta-Trinity NF are privately-owned timberland, that these private lands will be maintained in forested cover adequate to dispersal. This assumption currently appears adequate but future market and management changes may make this assumption false.

• treatable is somewhat equivalent to "tractor accessable". Some areas could be treated by helicopter or cable system, other areas that are within the usual or customary range of tractor operations may be unsuitable due to erosive soil conditions. Generally, the team's concern was: Is there sufficient tractor-ground available to provide for commercial operations? The answer appears to be yes.

If connections are currently available to the north and northwest, connections to the south are absent. The Fountain fire essentially eliminated the connection for conifer-dependent species to the south. See the vegetation history section above for more detail.

Late Successional Conditions

While the key questions and issues helped focus the assessment, the main goal was an evaluation of the functionality of the LSR at achieving late-successional conditions. The Historical and Current Vegetative Section, as well as the late-successional species section, detail the current conditions within the LSR. In summary, late-successional conditions are limited within the LSR. Late-successional conditions exist on the south wall of the Pit River Canyon due to the deep shading effect of the steep north slope and due to the general inaccessibility. There are also small patches of late-successional conditions in the north end of the LSR. (See maps 6 and 7) Most of the LSR is in a transitional immature timber phase. Approximately 60% of the mixed conifer and ponderosa pine vegetation types are less than 24" DBH. Vegetation within the three spotted owl activity centers located north of the Pit River is mostly smaller, relatively dense, mixed conifer (See maps 11, 12, 13). Most of these stands are relatively young with average stand ages varying between 50 and 90 years old based on data gathered for the Rock Creek EUI (Alexander 1995). Except for the late-successional stands on the south wall of the Pit River canyon, late-successional stands appear to be remnant stands and are generally small and separated by younger timber stands. Based on existing vegetation patterns it appears that approximately 70% of the LSR may have the potential to support late-successional conifer vegetation.

Aquatic Conservation Strategy

Status of the ACS Components

Riparian Reserves

Considering the LSR's geomorphology, topography, and soils, guidelines for riparian reserves detailed in the ROD will provide adequate protection of riparian reserves, as at least interim amendments to the Lassen National Forest and Shasta-Trinity National Forests land and resource management plans. At this time, those guidelines appear sufficient to assure implementation of the Aquatic Conservation Strategy in the LSR. Vegetation in riparian reserves is improving or in good condition except for the area in the headwaters of Peavine Creek. This area of Peavine Creek has thinned riparian hardwoods, reduced ground cover and some flattened channel segments. This has been caused by a combination of grazing, dispersed recreation use, and past timber harvest practices. Riparian vegetation in Section 20 above the headwaters of Screwdriver Creek (the "frog pond area") shows alteration of the vegetative mosaic with browseways, openings, and some "churned" areas. Because of their importance as impacts, the effects of grazing and dispersed recreation are addressed further below.

Recreation use

Recreational use is both spatially and temporally distributed. Most recreational use is associated with the Pit 3 reach and the portion of the Pit 4 reach in the vicinity of Deep Creek campground. This use is heaviest in the early portion of fishing season (last weekend of April until mid June). This use does not appear to have major direct impacts on late successional components. There is some creation of trails within the riparian reserves but these trails are very small and limited in length and impact. Human presence may affect use patterns of some species (i.e. bald eagles) but this disruption is limited both by time and access. Changes in flow regimes could significantly alter human use patterns. Increased flows may greatly increase the use of the Pit River for whitewater recreational activities. This could introduce a human presence into areas that currently have virtually no human use.

Additionally, there is some impact to riparian reserves from dispersed campsites along Rock and Peavine Creeks. Several dispersed campsites are located within the Peavine Creek riparian zone and have caused compaction, disturbance and may be contributing sediment and human waste to the stream. Impacts from these campsites are generally limited to the duration of deer hunting season.

Dispersed sites along Rock Creek have been more associated with longer term presence. The dispersed sites along Rock Creek often attract "residential" campers who are using the sites while working on nearby logging operations or seasonally at the mills in Burney. Sanitation and trash are continuing problems at these sites.

Dispersed recreation thus has the effect of sometimes disrupting the ability of the riparian reserves to act as migration corridors. However, there is virtually no use of these areas during the winter months.

Grazing

Portions of the LSR have been subject to grazing by cattle and sheep for a period in excess of 100 years. Impact of this activity has primarily been limited due to the high gradient, rocky, condition of most of the streamcourses. Some streamcourses, particularly the main stem of the Pit River, Deep Creek, and Canyon Creek are inaccessible to grazing livestock. Impacts have primarily been limited to the relatively flat portions of Peavine Creek in the north end of the LSR. Impacts from grazing may have occurred in other areas of the LSR, but these impacts are minor and scattered.

The Peavine Creek riparian area has been altered during the last century due to cattle grazing, road construction, fire exclusion, and timber harvest. Alterations include changes in species composition and structural changes in both vegetation form and stream channel morphology.

Species composition has probably changed in several ways. Intensive cattle grazing has altered the herbaceous layer resulting in a decrease in palatable graminoides (such as various sedges (*Carex* spp) and grasses) that would be expected here and an increase in dominance by less palatable species such as primrose monkeyflower (*Mimulus primuloides*) and bulrushes (*Scirpus* spp) in the wettest areas. The herbaceous species on drier ground tend to be dominated by non-native weeds, including bull thistle (*Cirsium vulgare*), woolly mullein (*Verbascum thapsus*), or dandelion (*Taraxacum officinale*), along with an excessive amount of bare ground. Bare ground (along with fire exclusion) in wetter areas has also contributed to an increase in certain woody species, such as alder and lodgepole at the expense of herbaceous species.

Structural conditions within the herbaceous layer have been altered as well, producing a distinct lack of plant height at seasons' ends. This affects reproduction (since flowering culms are snipped off, eliminating seed set), erosion control/waterflows, and nutrient cycling from the lack of residual foliage. In addition to clipped vegetation, stunted plant growth within the riparian area may reflect compacted soils from both cattle trampling on wet soils and vehicle traffic (including logging, landings, and dispersed camping). Soil compaction also affects the water infiltration rate and subsequent release rate from the meadow area.

Structural channel conditions have also been altered, resulting in a broadened channel from cattle trampling, and berming and disturbance from roads and skid trails in the riparian areas.

The Sensitive plant Salmon Mountain wakerobin (*Trillium ovatum* ssp. *oenttingeri*) occurs in riparian areas on Peavine Creek. It is currently limited to thickets under vine maple and alders. This restriction may be due to the protection afforded by the tall shrubs from cattle grazing or trampling, or may be due to spring sun and summer shade conditions produced under the deciduous canopy, or a combination of both.

Riparian functionality is basically intact. Improvements need to be made to some road related conditions and grazing operations modified within the Peavine Creek area. Both of these actions are expected to occur within the expected lifetime of this assessment. (5-10 years).

Key Watersheds

There are no key watersheds within the LSR. Rock Creek is not considered a Key Watershed. It does contain some attributes of Tier 2 Key Watersheds: it is an important source of high quality water to the Pit River, and it contributes significantly to the wild trout fishery in the Pit 3 Reach.

Watershed Analysis

This document is also a watershed analysis for the Rock Creek watershed. A preliminary watershed assessment of restoration needs within the Rock Creek watershed was completed in 1995. See the following section for details. The other watersheds within the LSR, (Nelson Creek, Deep Creek, and Roaring Creek) have not been analyzed with the watershed analysis process.

Watershed Restoration

Road System Improvements

During the summer and fall of 1994 an on-the-ground watershed assessment was undertaken of the approximately 70 miles of roads in the Rock Creek area. The objective of the watershed analysis was to minimize the impacts of roads in the area. This could be accomplished by the identification and prioritization of roads' impacts and subsequently the implementation of watershed restoration projects to correct the problems or eliminate the impacts.

The assessment was conducted by an experienced Geotechnical Engineer, Gordon Keller, PE. Keller followed the guidelines established in the Forest Ecosystem Management Assessment Team (FEMAT) Report, Appendix H of Restoration of Watersheds and Riparian Ecosystems, the ROD, and the Federal Agency Guide for Watershed Analysis.

Identified impacts within the study area include riparian area degradation and sedimentation and subsequent degradation of water quality in area streams from roadway surface runoff and inadequate roadway drainage; from disturbed cut, fill and materials borrow areas; from poorly constructed and or inadequate capacity drainage crossings; from local instability areas et. Other impacts and associated problems include degradation to riparian areas and fish habitat, as well as cumulative watershed impact from the area road system.

Most work identified for watershed improvement consists of upgrading, repairing, and maintaining the roadway prism and surface, roadway drainage, and stream crossings on the existing transportation system, particularly on the 29 miles of main or collector road system into area. The identified work was prioritized for restoration treatment into three groups, in descending order of stream and riparian area impact. Priority I and Priority II work items have immediate, direct, or potentially severe impacts on live streams and riparian areas. Priority III work involves " hillslope" restoration on roads relatively high in the watershed or some distance from a live drainage.

A listing of the proposed watershed/road projects is contained in Appendix 4. The Priority 1 projects have been queued for funding. However, restoration moneys have been limited for the Lassen. As of FY 96, none of these projects have been funded.

Recreational Impacts

Recreational impacts can be contained through appropriate law enforcement contacts in many cases. The law enforcement branch is aware of these problems and has stepped up enforcement. Additional analysis of impacts will need to be completed in concurrence with range management improvements to maximize the reduction of human impacts in the Peavine Creek area.

Grazing Improvements

Improvements to grazing impacts are being pursued through the Grazing Allotment Management Plan review process. A variety of improvements were being analyzed at the time of this document's preparation including fencing to reduce impacts within the Peavine Creek area. The existing permit expires in 1998 and analysis of additional improvements are expected to occur as part of the NEPA analysis associated with the permit renewal process.

Fire Management Plan

Introduction

The goal of the Fire Management Plan is to guide suppression and fuels management activities in such a way that the retention and development of late-successional conditions within the LSR is enhanced. To achieve this goal, strategic fuel zones were developed by an interagency/interdisciplinary team. The fire management plan also emphasizes aggressive suppression of wildfires, an active program of prescribed fire, and maintenance of fire access roads. For information on the Fire History of the Chalk Mt. LSR and adjacent lands consult the History and Description of Land Use section.

Current Fire Suppression

The Chalk Mt. LSR is administered by two National Forests and protected from wildfire by the State of California. The California Department of Forestry and Fire Protection (CDF) was designated as the fire protection agency as part of an agreement between the State of California and the Federal government to balance the acres of public and private land protected from wildfire by state and federal agencies. CDF's fire mission is one of suppression. Due to this, a confine/contain suppression strategy within the LSR would be inappropriate. The relatively small size (37,000+ acres) and adjacency of high value private lands (private timberlands, residential areas, hydroelectric facilities) also preclude the use of confine/contain suppression strategies. Currently, fire suppression forces closest to the LSR are shown in the following table:

Resource Type	Location	Agency	Travel Time
Engines	Pondosa	CDF	20-30 minutes
	Johnson Park	CDF	15-20 minutes
	Big Bend	CDF	10 minutes
	Big Bend	USFS	10 minutes
Dozer	Johnson Park	CDF	20-30 minutes
Helicopter	Beiber	CDF	30-45 minutes
Air Tanker	Redding AAB	CDF/USFS	30-45 minutes
Crew	Ingot (Sugar Pine)	CDF	45-60 minutes

Detection of fires is primarily from lookouts located to the east (Soldier Mt. 8 miles away), to the south (Burney Mt. 11 miles) and to the northwest (Grizzly Peak 6 miles). Lookouts are also supplemented by aerial detection during periods of lightning. However, detection of fires within the Pit River Canyon is difficult. There is no lookout that can see into the canyon, and much of the canyon cannot be seen from the main canyon bottom road.

In some localities public reports of fires are the main detection source. Because most of the LSR is difficult to see from populated areas, and because there is no telephone or cellular phone coverage within most of the LSR, reporting of fires by the public is limited primarily until fires become relatively large and easily observed from the surrounding communities.

This leaves aerial detection as the primary effective method of locating small fires. As previously noted aerial detection is only used during lightning activity. Thus fires starting low in canyons have the ability to go undetected for relatively long periods of time until they generate sufficient smoke to be seen from the various lookouts or adjacent communities.

Future Suppression Actions

The Chalk Mt. LSR faces the risk of stand replacing wildfire, both internally and externally. Suppression must be rapid and effective to protect the limited late-successional habitat currently available. At the same time, suppression must not "destroy the village in order to save it." The section below details important actions and constraints that need to be implemented to achieve the goals of the LSR.

Suppression Force Access

To maintain current suppression abilities, good road access is needed to assist in detection and in rapid attack of fires when they are small and easily attacked. To ensure access the roads shown on Map 8 were designated for maintenance as access roads. The roads to be included are:

36N14K
37N70
36N28Y
37N30
37N02
37N67Y
37N05

These roads would be periodically brushed (5-10 years); annually rocks/small slides, and down logs would be removed from the road surface. A helispot would be maintained in section 3 on the western edge of the LSR. This helispot would provide the ability to move firefighters rapidly into the Chalk Mt. and Pit River canyon areas where road access is poor. Dozers would be limited to slopes less than 40%. Water drafting access would be maintained at the Summit Lake Road/Rock Creek crossing; Rock Creek/Rock Creek Road crossing and at the reservoirs along the Pit River. Water drafting would be limited so that at least a 2 cfs flow would be maintained

Fire Suppression Facilities

Incident base camps and incident command posts should be located outside of the LSR. There are few opportunities within the LSR to locate these large, busy facilities. Spike camps, and staging areas should be located outside of the LSR to reduce impacts.

Fire Aviation

Aircraft should be managed with an eye towards minimizing the period of impact. This can usually best be accomplished through aggressive suppression that obtains aerial resources quickly, uses them effectively, and releases them promptly. Aircraft use within the Pit River Canyon must be carefully considered due to the dangerous environment of limited airspace, the presence of wires, and turbulent wind conditions. There are no suitable locations for base heliports within the LSR. A major helispot site exists within section 3 on the western edge of the LSR (T36N, R1E). There are few opportunities for other helispots with road access within the LSR. Because the wildfire threat is high it is not imperative that owl activity centers be avoided. Eagle territory overflignts should be avoided during June and early July (7/15).

Dispatching

Both National Forests and the Shasta Ranger Unit of CDF need to work closely to assure that timely information is provided between the agencies. CDF will notify the Forests of fires that escape or may potentially escape initial attack so that a resource advisor may be provided to the incident commander in a timely manner. The Forests will provide CDF with updated maps that highlight sensitive areas such as activity centers and eagle territories.

Fuels Management

The Chalk Mt.. LSR contains a wide range of vegetative conditions. For a detailed discussion refer to the section Historical and Current Vegetative Conditions. Table 9 displays the major fuel types and their representative models.

Table 9 - VegType/Fuel Model Crosswalk

Fuel Descriptive type/ CalVeg type	Fuel Model
Closed Canopy Forest Mixed Conifer Pine Mixed Conifer Fir	10
Plantations <30 yrs	6
Modified Fuel Zones Ponderosa Pine	11
Oak Woodlands Oregon White Oak	9

Fuel Loadings and Risk

Areas of highest risk for stand replacing fire are plantations, dense pine stands on poorer sites, conifer stands on steeper slopes with southwest aspects, and conifer stands with high levels of fuel accumulation particularly in sizes larger than 3" diameter.

Plantations

Most of the 1,920 acres of plantations within this LSR are located in the vicinity of Summit Lake or along the Bunchgrass Road (36N41.2). Plantations function as large brush fields until they reach sufficient height to shade out competing vegetation and lengthen their boles sufficiently to allow insulation between ground fire and crowns. This condition generally occurs when the trees reach 6-8" DBH, or greater, depending on the density of the stand. During the period in which plantations function as large brushfields they may be modeled as Fuel Model 6. This model has much higher intensities, higher rates of spread, and suffers higher rates of tree mortality than adjacent older timber. This fuel type can reach intensities and rates of spread that can easily overwhelm suppression forces and rapidly put at risk adjacent areas of late-successional conditions.

Some of these effects can be mitigated by aggressive cultural practices to control encroaching brush species and accelerating development of late-successional conditions. Treatments such as brush crushing, hand clearing, and thinning and pruning will protect plantations and expedite late-successional forest development out of this dangerous fuel model. These treatments also break fuel bed continuity, thus reducing rate of spread, intensity and resistance to control. The benefits of plantation management are great and are reflected within the treatment criteria section.

Dense pine stands on poorer sites

Ponderosa pine and Jeffrey pine stands growing on the eastern edge and southeastern corner of the LSR are located on poor site ground (SI =50 or less). Many of these stands originated near the turn of the last century (1890-1910). This has left these stands with high numbers of stems per acre. In some cases fire exclusion has also been responsible for the increased quantity of competitive shrub species. These factors cause these stands to have high mortality rates during drought years and thus produce high fuel loadings. These stands may effectively be considered for fire behavior modeling as slash types (fuel model 12).

Mitigations of this risk might include thinning to reduce competition and control mortality, salvage of excess fuel loadings, and light underburning to recycle nutrients and control fine fuels and competitive shrubs.

Conifer stands on steep, southwest slopes

These stands are at risk due to the increased intensities and rates of spread likely to occur under conditions of alignment of wind, topography and solar insolation. When direct sun, wind and slope are aligned, the factors responsible for fire spread and intensity are maximized. Stands in these locations may have very low survival rates during late season fires unless tree crowns are a considerable distance off the ground and the understory is very open with light fuel loadings. However as slope increases these stands have a lower effective canopy height and thus more likely to suffer fatal quantities of crown scorch during a fire.

These stands will have the highest rates of spread within the LSR of any of the conifer stands. They are found primarily on the southwest slope of Chalk Mt.. and below the Peavine Road in the headwater area of the E. fork of Nelson Creek. The stands on the southwest slope of chalk also have light flashy fuels located below them in the form of grass/brush/live oak vegetation complex.

There are few practical mitigations to this condition. Hand piling, thinning and pruning may be effective but are difficult and very expensive to accomplish. These treatments may not be possible on slopes in excess of 60%. Some underburning may be successful in reducing fuel loading under these vulnerable stands.

Areas with large fuels accumulations

Areas of blowdown and other pockets of high fuel loadings of large material create pockets of high intensity. This can often generate enough heat to cause torching or crowning. Crowning and torching can cause spotting, sometimes to long distances, greatly increasing the complexity of the fire suppression task. Spotting also effectively raises the rate of spread of the fire. Heavy fuel concentrations also increase the duration of heating (residence time) which can increase mortality.

Mitigation is usually simple and effective when material is of a merchantable size and condition. Salvage logging can control these pockets and reduce this risk. Mechanical treatments such as piling and burning or masticating/crushing may be effective in some limited instances. Mechanical treatments and salvage operations are often limited to slopes of less than 35-40%

Risks from outside of the LSR

The community of Big Bend lies at the foot of Chalk Mt. just west of the LSR. This rural community has the potential to be the source of a major fire. A fire starting at a rural residence could easily become established in the mixed brush/oak vegetation in which the community resides. Strong diurnal wind patterns would push the fire toward the LSR. Depending on wind conditions, the fire would travel up either the E. Fork of Nelson Creek, over the slip out at Yellow Slides or be funneled up the Pit River Canyon. Any of these courses would directly threaten the late-successional habitats that are located along the crest or just east of the crest. Fire spread into the canyon would threaten all of the late-successional habitat within the canyon, potentially affecting 1 peregrine, 3 bald eagle, and 2 or more spotted owl activity centers if allowed to spread just halfway through the LSR.

Fires starting east of the LSR are less likely to pose a threat to the LSR due to the prevailing southwest wind. There is little threat of fire spreading into the LSR from the south due to the large reduction in available fuel caused by the Fountain Fire.

Risks from within the LSR

Risks within the LSR are primarily associated with either human use areas or lightning. Lightning is more likely to affect the upper elevational areas of the LSR. Human use is primarily concentrated along the riparian areas with the exception of the private in-holding area just west of Summit Lake. Fires may potentially start along the Pit River road (FR 50) or at one of the dispersed sites located off of this road. Most of the dispersed sites off the FR 50 Road are located within riparian habitats that have moist microclimates and would normally have the lowest rates of spread and intensity. However, fires could start in several locations along the FR 50 Road, where the road climbs out of the riparian influence and travels through the flashy fuels higher on the mountainside. These areas could quickly develop a high intensity fire with rapid spread rates on a normal summer day.

Fires may also originate from dispersed sites located along Rock and Peavine Creeks. Mostly these sites are located either in heavily riparian influenced areas or in relatively flat open areas less subject to high spread rates.

Large Fire Management Strategy

To reduce the threat of large fires destroying most or all of the late-successional conditions within the LSR, this plan proposes a system of modified fuel zones to reduce the continuity of fuels while still attempting to maintain connectivity along the vital north/south axis of the LSR.

Fuel modification zones

Two fuel modification zones should be implemented (see Map 14) These zones would serve to reduce fuel continuity, provide locations where firelines could be anchored, provide safe locations for burnout/firing operations, locations where crown fires could drop out of the canopy, and areas where air attack effectiveness is maximized. One zone (Peavine FMZ) runs from the northern boundary of the LSR along the Peavine Road (38N10) southward to Summit Lake, and then further south to the southeast corner of Chalk Mt. where it is anchored to the natural fuel breaks along the Pit River canyon. A second zone (Deep Creek FMZ) would run along both sides of the Bunchgrass Road (36N41) separating the Deep Creek Drainage from the Canyon Creek drainage.

The Peavine FMZ would vary in width from several hundred feet wide at it's anchor point on the Pit River Canyon wall to potentially 1500 feet wide in Section 30, south of Summit Lake. The width would vary with conditions and would be designed to take advantage of existing slope breaks and road access. Vegetation within the zone would be managed to achieve a shaded condition dominated by large fire resistant conifers. Canopy closure would vary between 40-60%, trees remaining would be the largest available with pine and Douglas-fir as the preferred retention species due to their resistance to fire. Prescribed fire could be used as an additional tool to reduce ladder fuels and ground fuels. Hardwoods would be retained to provide diversity within the FMZ. Snags would be maintained primarily at the locations farthest from roads and access points, in order to enhance firefighter safety. Snag retention would aim at leaving at least 2 snags per acre averaged across the FMZ with the largest snags available being retained. In the Summit Lake area the FMZ would pass through areas currently in plantations. Cultural maintenance activities would be of highest priority in these areas to accelerate growth of conifer stands out of the vulnerable plantation stage.

The Deep Creek FMZ would have the same structural profile as the Peavine FMZ. The Deep Creek FMZ would not be as wide as the Peavine FMZ as it is primarily located on a cooler north-facing slope. Width would probably vary from 200 feet each side of the road to 350 feet each side depending on conditions. The Deep Creek FMZ is anchored on the south at the Forest boundary, south of the edge of the Pit River canyon. The FMZ follows the Bunchgrass Road (36N41.2) downslope between Deep Creek and Canyon Creek. The northern terminus of the Deep Creek FMZ is at the end of the 36N41.2 road approximately 0.3 miles from the Pit River.

FMZ treatment modeling

A preliminary sample of twenty plots were placed within the Peavine FMZ with the resulting data processed using the Forest Inventory and Analysis System (FIAS). This sample area appears to be representative of the timbered portion of this FMZ. The purpose of the sampling was to validate and quantify the proposed treatment of the FMZ.

Sampling found an existing basal area of 296 square feet/acre. Existing total canopy cover equals 89.5% with overstory canopy cover equaling 55%. Existing fuel loading is about 25 tons/acre and there were 6 snags/acre greater than 15" DBH. Two alternative treatments were examined. One treatment maintained a multi-storied structure, the other treatment modeled a single-story structure. Table 10 shows the variation between the treatments. These treatments are for illustrative purposes only. Any treatment actually implemented would be the result of further analysis based on more extensive stand inventory and analysis, NEPA analysis, and consultation.

Table 10 - Potential Treatment Comparison

Parameter	Treatment 1	Treatment 2
Goal	Multi-layered Canopy	Single layer canopy
Residual Basal Area after treatment	256 sq. ft./ac.	206 sq. ft./ac.
Suppressed Trees removed -Trees per acre (%)	132 (100%)	132 (100%)
Intermediate Trees removed -Trees per acre (%)	31 (50%)	62 (100%)
Codominate Trees removed -Trees per acre (%)	14 (25%)	14 (25%)

As can be seen treatment #2 would provide a better stand for modifying fire behavior. Ladder fuels are completely removed, the residual stand is composed almost entirely of large trees. In order to better understand the response of the residual stand, the stand structure data was processed using the Forest Vegetation Simulator (FVS) to model stand structure over a 30 year period. The results of this simulation are shown in Table 11 below.

Table 11 - Growth simulation for 3 potential treatments

	No Treatment				Treatment #1				Treatment #2			
Time	TPA	BA	DBH	CC	TPA	BA	DBH	CC	TPA	BA	DBH	CC
5/96	278	299	14	89.5	278	299	14	89.5%	278	299	14	89.5%
Post Harvest	278	299	14	89.5	106	224	19.7	54.9%	53	206	26.8	45.3%
PH +10 years	253	329	15.4	93	103	248	21	59.1%	51	223	28.3	47.8%
PH +20 years	231	356	16.8	96	100	270	22.3	62.8%	49	238	29.7	50.0%
PH +30 years	213	381	18.1	99	97	292	23.5	66.4%	48	251	31	51.8%

Notes to the table: TPA = trees per acre; BA = square feet of basal area/acre; DBH= diameter at breast height in inches; CC = total canopy closure; PH = post-harvest

Note that the projected canopy closure stays above 40% for all three scenarios. Also note the extremely high basal area achieved under the "no treatment" option. Stands with this level of stocking are very susceptible to collapse during drought conditions due to the high level of moisture stress. Local experience during the 87-94 drought saw stands with this level of stocking often having very extreme mortality rates which created extreme fuel loadings and loss of habitat. Notice that the simulator also predicts a level of mortality as indicated by the declining Trees per acre with time. This mortality would provide snags and down woody debris. Also note that the more intensive treatment #2 achieves very large tree sizes (ave. diameter 31") within 30 years with a total basal area within 20% of that currently existing.

Fuel loading Management

Fuel loadings within the remainder of the LSR may contribute to large stand replacing fires when these loadings reach heavy levels. Heavy fuel loadings cause rapid escalation of fire intensity, resistance to control and create extreme fire behavior (spotting, crowning) much sooner. Heavy fuel loadings increase residence time which increases tree mortality. Possibly the most difficult task within the LSR is to find the proper balance between fuel loading conditions and late-successional conditions that maximize habitat for late-successional species.

Because of the current lack of extensive late-successional conditions there is less tolerance available for loss of late-successional stands.

Blowdown

Blowdown pockets often create areas of much higher fire intensities than surrounding forest. These pockets may cause long range spotting and cause fire to become established within the crowns. As with other heavy fuel concentrations, residence time is increased and may cause increased tree mortality through soil heating and duration of energy release. For the purpose of this analysis a pocket consists of 3 or more trees (larger than 12" at the large end) lying on the ground within 100 feet of each other. These pockets should be salvaged where possible and residual slash (limbs, tops) handpiled in openings, and burned, in order to reduce this risk. Large down log elements will still be maintained through the LSR because:

a) Not all logs will be within pockets. Some blowdown will occur as single trees. Other falling trees and snags will be unmerchantable and will be left. This should provide more than adequate down log levels.

b) Some areas are not treatable due to isolation from road systems (e.g. Canyon Creek drainage) or are on land too steep for removal (i.e. on slopes greater than 40%) or too small for helicopter or cable removal.

c) existing down logs will continue to provide this habitat element for very long periods of time and falling snags will continue to add to the down log component.

Individual Tree Mortality

There will be no harvest of individual tree mortality with two exceptions.

1. where it provides a clear hazard to public safety(as defined by FS Manual and ROD direction)
2. within 100 feet of the roads servicing the FMZs.

This will ensure sufficient supply of snags and down logs over time throughout the LSR.

Extensive Tree Mortality

Extensive tree mortality may occur through the synergistic effects of drought, overstocking, and insect or disease epidemics. Extensive tree mortality can occur as a high level of individual tree mortality that is widely distributed or as areas of total tree mortality.

Areas of wide spread individual tree mortality will be analyzed on a case-by-case basis. The complexities of balancing fuel loading considerations, and habitat considerations are high. Analysis of these complexities is highly dependent on knowledge of existing conditions. Analysis and prescription of treatments for these conditions in this document is inappropriate because the conditions cannot be known in advance.

Role of Habitat Improvement Projects

Although not strictly designed for managing fuel loadings, projects designed for accelerating attainment of late-successional conditions can have a beneficial impact on the risk of large catastrophic fires. Treatments such as precommercial and commercial thinning remove ladder fuels, breakup fuel continuity, and reduce fuel loadings. Thus improvement projects contribute not only increased quantity of late-successional conditions but increase the probability that the treated stands will be unaffected by catastrophic fire.

Prescribed Fire within the LSR

Prescribed fire will be important for several purposes within the LSR. Prescribed fire will be used to maintain conditions within the non-conifer vegetation types. Underburning would be an appropriate tool for maintenance of the fuel modification zone and as a light treatment within some stands to manage fuel loadings. These treatments are discussed in more detail below.

Any burning within the LSR will be done in a manner to meet air quality standards and guidelines for the State of California and Shasta County. Smoke created from a prescribed fire program will be less of an impact to the LSR because the prescribed fire will burn under conditions favorable for good smoke dispersal. In the event of a wildfire, smoke could impact the LSR because weather may not be favorable for smoke dispersion. Any burning completed will have to comply with Forest Service manual direction concerning prescribed burn plan preparation and implementation.

Fire in non-conifer vegetation types

In order to maintain the oak dominated vegetation types fire needs to be reintroduced into the stand dynamics. Fire traditionally maintained these vegetation types in a savannah-like condition. Low intensity fire also stimulated the production of additional food resources (increased mast production) and increased cavities for other species[10]. With the exclusion of fire, encroachment of conifers, increased brush growth and increased decadence have placed these vegetation types at risk for high intensity fires and return to early seral conditions. Repeated prescribed fire application can ameliorate these conditions.

Fire can also be used within the canyon live oak vegetation belt within the Pit River canyon to break up the long upslope continuity of fuels from the canyon bottom to the conifer belt at the higher elevations.

Several areas in the Rock Creek watershed have soils incapable of sustaining conifer stands. These areas primarily support continuous fuels of *Ceanothus*. In order to prevent these brushfields from being the source of a major fire that spreads into the adjacent conifer stands the *Ceanothus* should be treated periodically by crushing and/or burning in order to reduce decadence and continuity.

[10] Cavity formation is primarily an indirect effect of fires. Fire removes dead branches leaving a scar susceptible to decay organisms and as an entry point for cavity creators.

Underburning

Application of low intensity underburning within the FMZ will maintain the effectiveness of the zone. Light burns can be prescribed that primarily remove the light flashy fuels while maintaining the heavy fuels. Species such as goshawk that benefit from open understories will benefit from this activity directly. Underburning may also be warranted within stands outside of the FMZ. Conditions when underburning is appropriate outside the FMZ include:

large tree stands where overstory cover is becoming marginal due to advanced stand senescence. Underburning may be useful as a control for competing vegetation and allow for conifer reproduction to occur naturally.

young pole stands where self-pruning and high canopy closure are rapidly increasing the quantity of fine fuels. Underburning would reduce fine fuels, prune lower branches, and provide a measure of randomness in spacing of residual trees.

Criteria for Treatment

Assumptions to the Treatment Criteria

Connectivity to the south has been broken.

The connection between the California subspecies and the northern subspecies has been recognized as "critically important". (Verner et al 1992 p 38) The draft recovery plan for the northern spotted owl (USDI 1992) recognized "A narrow band (about 20 miles wide)...[as] an obstacle to owl movement between the California Cascades and the northern Sierra Nevada." In 1992, the Fountain Fire burned 64,000 acres between the communities of Burney and Round Mountain. This fire paralleled SR 299E and was located primarily on privately owned timberlands. The high intensity of the fire caused total stand replacement. Salvage efforts after the fire removed a very high percentage (estimated >90%) of the merchantable size (10"+ DBH) material within 18 months of the fire. This has resulted in an area 15+ miles long and 7 miles wide devoid of dispersal habitat across the primary connectivity route between the two owl subspecies. In essence, totally severing the "narrow band" of habitat noted in the draft recovery plan. Connectivity further to the east of the Fountain Fire is unlikely because the habitat is primarily eastside pine, gray pine and agricultural lands. Dispersal west of the Fountain Fire would be dependent on dispersal through a mixture of oak savannah, gray pine, and manzanita shrublands. Dispersal of spotted owls through either of these routes is very unlikely.

The LSR's prime function, at the Provincial scale, is to provide connectivity with California Spotted Owl.

Because of it's location as the farthest southeast LSR and the only LSR adjacent to the range of the California spotted owl, the Chalk Mt. LSR plays a unique role in ensuring connectivity between the two subspecies. (see Map 15). It provides refugia and a 'stepping stone' between refugia to the northeast, north, and northwest. The Chalk Mt. LSR is of moderate size but is not expected to contribute as habitat for numerous pairs of owls. The ISC report predicted the future expected pairs for this LSR as 4.(ISC pg. 329) other LSRs of similar size generally had a predicted owl pair figure that was much higher (7-25)

The LSR is not functional, at the provincial scale, because of the broken connection.

Because of the large gap created by the Fountain Fire, connectivity between California and northern subspecies appears to have been broken. Although the Chalk Mt. LSR will function as a refugia, it may also be acting as a demographic sink. Chalk Mt., with it's limited connections to the south is at the 'end of the road' until the connectivity to the south becomes re-established. Dispersing individuals are unlikely to reach suitable nesting habitat except to the north, and west-northwest.

The connection will be broken for 30-40 years.

The break in connection caused by the Fountain Fire is expected to last a relatively short time. Much of the fire area is relatively high site (good tree growing ground), has been replanted and is being aggressively managed for new conifer growth. Team members with experience in managing adjacent lands (Coakley, Dominguez) estimate the fire area may recover to dispersal habitat (50% in 11" DBH trees with 40% canopy cover) in 30-40 years.

The LSR could be treated more aggressively near term.

Because the connectivity chain is broken, treatments that otherwise might disrupt connectivity would not cause further disruption. This is assumed only for treatments that require less time to return to functional connectivity than it will take for the major connectivity disruption (Fountain Fire) to heal. This assumption means that habitat projects may be more aggressive in treating habitat, taking short term degradation, in order to achieve late-successional conditions more quickly.

Any projects within the LSR would maintain north-south connectivity within the LSR.

Because there is also a necessity to maintain connectivity within the LSR and to provide habitat for existing late-successional species, projects will be designed to maintain these existing features.

Short-term enhancement project goals would include reduction of edge, and lowering perimeter:area ratios for nesting/roosting habitat.

Habitat improvement projects will be designed to improve habitat in the long term. This means increasing the size of individual blocks of late-successional habitat. Improvements will work toward the reduction of fragmentation over time. This means that during the time period for which this analysis is in place, there will be few treatments that create hard edges. Examples include regeneration cutting in the form of group selections, seed steps, or clearcuts.

Criteria Key

The following Criteria Key was designed to assist interdisciplinary teams in determining the appropriate treatments for upland areas on ground capable of growing conifers. The key strives to meet the two main objectives of management for this LSR:

- Maintain and increase the amount of late-successional habitat
- Protect late-successional habitat from loss due to stand-replacing wildfire.

The key utilizes the information gathered during this assessment, combined with the assumptions listed above, and the knowledge and experience of the assessment team to provide a guide to treatments. The assessment team also determined the areas most likely to need treatment. These areas are discussed in the following section, Identification of Specific Areas for Treatment.

Within Identified fuel modification zone

Fuels loading acceptable[11]

- Overstory Size >24"
  - Canopy cover 40-70%
    - No understory
      - Overstory >30" ave. DBH
        - *LS conditions present Low Priority* — *Treatment #1 (T-1)*
      - Overstory <30" ave. DBH
        - *Analyze for actions to increase overstory DBH* — *T-2*
    - Understory Present
      - Conifer understory
        - *analyze for thinning potential* — *T-3*
      - Other understory
        - *analyze for other treatment (burn, crush, pile etc.)* — *T-4*
  - Canopy cover not 40-70%
    - No understory
      - Overstory Canopy >70%
        - *Consider opening of canopy to reduce canopy-canopy fire spread* — *T-5*
      - Canopy <40%
        - *Analyze for actions to increase canopy closure* — *T-6*
    - Understory Present
      - Conifer understory
        - *analyze for thinning potential* — *T-7*
      - Other understory
        - *analyze for other treatment (burn, crush, pile etc.)* — *T-4*
- Overstory Size <24"
  - Canopy cover 40-70%
    - Slope <40%
      - *Priority for thinning* — *T-7*
    - Slope >40%
      - *consider hand treatments* — *T-8*
  - Canopy cover not 40-70%
    - Canopy cover >70%
      - Slope <40%

[11] The level of fuel loading that is "acceptable" varies depending on slope, aspect, value of the site as late-successional, and with other factors. The acceptable loading level would be determined individually for each site by the interagency, interdisciplinary team during NEPA phase analysis and during Level 1 Endangered Species Act consultation. Appendix 8 gives an example of acceptability by photo series page.

Priority for thinning T-3
Slope >40%
consider hand treatments T-8
Canopy Cover <40%
Competing vegetation
control competitors T-4
Little competing vegetation
analyze for treatments to raise canopy cover T-9

Fuels loading not acceptable
Area not in LS condition
Fuel loading primarily large logs
salvage T-10
Fuel loading primarily <6" diameter
Slope <40%
Priority for pile, underburn T-11, 12
Slope >40%
consider hand treatments T-12, 13
Fuel loading primarily ladder fuels
Thin T-3
Area within LS condition
Fuel loading primarily large logs
Reduce jackpots by salvaging clusters; leave individual logs T-10
Fuel loading primarily <6" material
Priority for underburn T-12
Fuel loading primarily ladder fuels
Thin T-3

Not within Identified fuel modification zone

Fuels loading acceptable
Overstory Size >24"
Canopy cover 40-70%
No understory
Overstory >30" ave. DBH
LS conditions present - consider underburn to stimulate second vegetation layer T-1, 14
Overstory <30" ave. DBH
Analyze for actions to increase overstory DBH Low priority for treatment T-2, 3
Understory Present
Overstory >30" ave. DBH
Conifer understory
LS conditions present Low priority for treatment T-1
Other understory
LS conditions present Low priority for treatment T-1
Overstory <30" ave. DBH
Conifer understory
LS conditions present Low priority for treatment T-1
Other understory
LS conditions present Low priority for treatment T-1

- Canopy cover not 40-70%
  - No understory
    - Overstory Canopy >70%
      - *LS conditions present Low priority for treatment* T-1
    - Canopy <40%
      - *Analyze for actions to increase canopy closure* T-6, 14, 15
  - Understory Present
    - Overstory Canopy >70%
      - Conifer understory
        - *LS conditions present Low priority for treatment* T-1
      - Other understory
        - *analyze for other treatment (burn, crush, pile etc.)* T-16
    - Overstory Canopy <40%
      - *Analyze for actions to increase canopy closure and control competing vegetation* T- 6, 8, 12, 15
- Overstory Size <24"
  - Canopy cover 40+%
    - Slope <40%
      - *Priority for thinning* T-17
    - Slope >40%
      - *consider hand treatments underburning* T-8, 12
  - Canopy cover <40%
    - Competing vegetation
      - *control competitors* T-12, 15, 16
    - Little competing vegetation
      - *analyze for treatments to raise canopy cover* T-6, 9, 14, 15

Fuels loading not acceptable

- Area not in LS condition
  - Fuel loading primarily large logs
    - *salvage* T-10
  - Fuel loading primarily <6" diameter
    - Slope <40%
      - *Priority for pile, underburn* T-11, 12
    - Slope >40%
      - *consider hand treatments* T-12, 13
  - Fuel loading primarily ladder fuels
    - *Thin* T-17
- Area within LS condition
  - Fuel loading primarily large logs
    - *Reduce jackpots by salvaging clusters; leave individual logs* T-10
  - Fuel loading primarily <6" material
    - *Priority for underburn* T-14
  - Fuel loading primarily ladder fuels
    - *LS conditions present Low priority for treatment* T-1

A Description of Proposed Treatments

T-1 No treatment.

T-2 Treatments would be aimed at increasing overstory diameter and tree size. This may include some **thinning thru the diameter classes**, if stand is at upper end of canopy closure range (near 70%). In these instances, treatment would be very light. Stands near bottom of canopy closure range would probably be left untreated; exception may be to induce variable tree spacing, or to provide increased size to a safety zone.

Goal	Increase overstory diameter
Materials Removed	
Species	Conifers
Canopy position	Throughout canopy to acheive desired canopy closure
Residual Material	
Species	Conifers
Basal Area	Subserviant to attaining other constraints (e.g. canopy cover)
Log Retention	Maintain CWD guidelines for FMZ
Snag Retention	Guidelines for FMZ; snags gouped mid-slope away from roads
Other Requirements	Thinning aimed at increasing overstory size while maintaining 40-70% canopy closure

T-3 **Thin from below**; reduce understory to maintain FMZ goals of providing reduced ladder fuels, reduced fuel loading.

Goal	FMZ establishment, maintenance
Materials Removed	
Species	Conifers
Canopy position	Understory layers only
Residual Material	
Species	Conifers
Basal Area	Desired (65-75% of normal); free to grow for 20 yrs.
Log Retention	Maintain CWD guidelines for FMZ
Snag Retention	Guidelines for FMZ; snags gouped mid-slope away from roads
Other Requirements	Thinning aimed at decreasing ladder fuels while maintaining 40-70% canopy closure

T-4 Where operable, **mechanical mastication**, or **crushing** would be used to reduce fuel accumulations and reduce ladder fuel effects of understory vegetation or to remove competing shrub competition. Where slopes are greater than 40%, or hand crews are available would **hand thin, pile and burn**.

Goal	FMZ establishment, maintenance
Materials Removed Species Canopy position	 Non-conifer shrubs, oaks; vine maple Shrub and understory layer
Residual Material Species Log Retention Snag Retention	 Conifers, hardwood trees: oaks, big-leaf maple Maintain CWD guidelines for FMZ Guidelines for FMZ; snags gouped mid-slope away from roads
Other Requirements	Large logs would be avoided. Handpiles would take advantage of existing openings to reduce collateral damage.

T-5 **Thin codominants** to provide non-continuous canopy closure to increase efficacy of aerial attack. This would also be a relatively light treatment. Spacing is relatively uniform in order to acheive desired combination of shading and openess.

Goal	FMZ establishment, maintenance
Materials Removed Species Canopy position	 Conifers Throughout canopy to acheive desired canopy closure
Residual Material Species Basal Area Log Retention Snag Retention	 Conifers Desired (65-75% of normal); free to grow for 20 yrs; constrained by canopy closure Maintain CWD guidelines for FMZ Guidelines for FMZ; snags grouped mid-slope away from roads, away from ridgeline
Other Requirements	Spacing relatively uniform, primarily restricted to ridge top, upper 1/3 of slope within FMZ, maintain 65-75% canopy closure

T-6 Look for ways of increasing conifer canopy closure; **fertilization, reduction of competing herbaceous** or shrub layers, **interplanting**.

Goal	Increase overstory canopy closure
Materials Removed Species Canopy position	 Shrubs, grasses N/A
Residual Material Species Log Retention Snag Retention	 Conifers, oaks, big-leaf maple Maintain CWD guidelines for FMZ Guidelines for FMZ; snags gouped mid-slope away from roads
Other Requirements	Planting where plantation will not cause problems for maintenance treatments such as underburning

T-7 If total canopy closure >70%, **thin from below** to acheive **maximal growth** consistent with the FMZ goals. Spacing is relatively uniform in order to acheive desired combination of shading and openess. If canopy closure is less than 40% there would probably be no treatment.

Goal	FMZ establishment, maintenance
Materials Removed Species Canopy position	 Conifers Throughout canopy to acheive desired canopy closure
Residual Material Species Basal Area Log Retention Snag Retention	 Conifers Desired (65-75% of normal) Maintain CWD guidelines for FMZ Guidelines for FMZ; snags gouped mid-slope away from roads
Other Requirements	Thinning aimed at increasing overstory size while maintaining 40-70% canopy closure

T-8 Because total fuel loading is acceptable and because canopy closure is limited, this site is a candidate for **chainsaw cut, pile and burn**. Clumps of small(<10") trees could be thinned; small trees could be removed from under the drip line of larger trees. This would reduce competition and eliminate ladder fuels.

Goal	Increase overstory diameter
Materials Removed Species Canopy position	 Conifers suppressed understory
Residual Material Species Basal Area Log Retention Snag Retention	 Conifers Subserviant to attaining other constraints (e.g. ladder fuel removal) Maintain CWD guidelines for FMZ Guidelines for FMZ; snags gouped mid-slope away from roads
Other Requirements	Thinning aimed at maintaining overstory component by reducing direct understory competition; reduction of ladder fuels within the FMZ

T-9 These sites may be the result of poor soils or recent disturbance. If the disturbance is on-going human related such as a dispersed recreation site, or cattle loafing area, the **ID team should examine** the site and the on-going action for consistency with the ROD and design corrective actions. Actions may involve barriers, fencing or planting.

Goal	Establish large tree cover
Materials Removed Species Basal Area Canopy position	 None
Residual Material Species Log Retention Snag Retention	 N/A N/A N/A
Other Requirements	

T-10 Treatments are aimed at reducing large log fuel loading to the acceptable level. **Salvage logging** is preferred when the material to be removed is merchantable.

Goal	Decrease large log (12"-40" dia.) fuel loading
Materials Removed Species Basal Area Canopy position	 Conifers On Forest floor
Residual Material Species Log Retention Snag Retention	 Conifers, hardwoods Maintain CWD guidelines for FMZ Guidelines for FMZ; snags gouped mid-slope away from roads
Other Requirements	Retain hollow logs, retain sufficient hard logs to provide a gradation of decay classes (10-30% hard depending on existing log loadings). Treatment considers snags as future down logs.

T-11 These areas have high fuel loadings. In areas with the highest fuel loadings, and where the ground is sufficiently open to provide equipment access without undue damage to residuals, **machine pile and burn** material.

Goal	Decrease medium (6-12" dia.) and small (1-6" Dia) fuel loading.
Materials Removed Species Canopy position	 Slash, brush On forest floor.
Residual Material Species Log Retention Snag Retention	 Conifers, hardwoods Maintain CWD guidelines for FMZ Guidelines for FMZ; snags gouped mid-slope away from roads
Other Requirements	Treatment aimed at reducing 1-6" diameter woody debris to acceptable levels

T-12 **Underburning** is an appropriate treatment where: fuels are sufficiently light, or residual trees sufficiently large. Burning will only be used when it will not reduce canopy closure below the desired range.

Goal	Decrease small (1-6") and fine (<1") fuel loading, reduce competing shrub layer, increase forb and grass component.
Materials Removed Species Canopy position	 Small woody debris, slash, grass, forbs, hardwoods, conifers On forest floor, shrub layer, understory
Residual Material Species Log Retention Snag Retention	 Trees, fire adapted shrub species Maintain CWD guidelines for FMZ Protect snags as possible through variable firing techniques, fireline around snags is probably inappropriate due to ground disturbance and ineffectiveness.
Other Requirements	Limited mortality to overstory. Season of burn critical to avoid adverse impacts. Late winter, or fall burning preferred.

T-13 This treatment is very similar to T-8. However the emphasis would be **hand piling and burning of down material** as opposed to piling of standing material. Distribution and arrangement of fuels will determine whether T-12 or T-13 is appropriate.

Goal	Decrease medium (6-12" dia.) and small (1-6" Dia) fuel loading.
Materials Removed Species Basal Area Canopy position	 Conifers suppressed understory
Residual Material Species Log Retention Snag Retention	 Conifers Maintain CWD guidelines for FMZ Guidelines for FMZ; snags gouped mid-slope away from roads
Other Requirements	Thinning aimed at maintaining overstory component by reducing direct understory competition; reduction of ladder fuels within the FMZ

T-14 Low intensity underburn is used to expose mineral soil and stimulate understory growth.

Goal	Decrease small (1-6") and fine (<1") fuel loading, expose mineral soil
Materials Removed Species Basal Area Canopy position	 Conifers, existing fine and small fuels N/A forest floor
Residual Material Species Log Retention Snag Retention	 Conifers Maintain large logs Protect snags as possible through variable firing techniques, fireline around snags is probably inappropriate due to ground disturbance and ineffectiveness
Other Requirements	Limited mortality to overstory. Season of burn critical to avoid adverse impacts. Late winter, or fall burning preferred.

T-15 Mechanical site prep and plant to increase conifer presence. Plant a mixture of conifer species appropriate for the site.

Goal	Decrease medium (6-12" dia.) and small (1-6" Dia) fuel loading, expose mineral soil, re-establish conifers
Materials Removed Species Basal Area Canopy position	 shrub species, existing fine and small fuels N/A shrub layer
Residual Material Species Log Retention Snag Retention	 Conifers Maintain large logs Protect snags as possible
Other Requirements	Limited damage to existing conifer and hardwood overstory. Pile in openings to reduce damage during burning.

T-16 Control of non-conifer vegetation that is constraining succession on conifer sites. Treatments are highly variable and are carefully tailored to the site.

Goal	Increase conifer cover, reduce brush presence
Materials Removed Species Basal Area Canopy position	 Manzanita, oak, vine maple, *Ceanothus* N/A shrub layer
Residual Material Species Log Retention Snag Retention	 Conifers Maintain large logs Protect snags as possible.
Other Requirements	Protect existing conifers that provide multi-layering, overstory or recruitment as snags.

T-17 Thin from below to acheive **maximal growth** without sacrificing future late-successional conditions. Utilizes variable spacing to maintain a variety of densities. Mechanical deformities and minor disease infections are not cause for individual tree removal. Similar to T-7.

Goal	Increase conifer growth rates, reduce time to attain late-successional conditions.
Materials Removed Species Canopy position	 Conifers Understory first
Residual Material Species Log Retention Snag Retention	 Conifers Maintain CWD guidelines Snags maintained consistent with acceptable levels
Other Requirements	Thinning aimed at increasing overstory size while maintaining 60% canopy closure. Limited removal for mechanical defomities, basal scarring.

Identification of Specific Areas for Treatment

As mentioned in the previous section, the assessment team identified areas that appear to need treatment. The team utilized personal knowledge of the LSR, the knowledge gathered during this assessment, knowledge gathered as a part of other assessments (e.g. the Keller Report, Appendix 4) and suggestions from cooperating agencies and the local American Indian tribe, to outline areas within the LSR that should be analyzed through the project-scale, NEPA process.

Conditions that the team felt were important to treat were:

- fuel modification zones
- previously identified watershed restoration projects
- habitat that is of moderate size with potential for devloping late-successional tree sizes within a few (2-3) decades of treatment
- areas with small size timber that is heavily overstocked.

The criteria for treatment key, when combined with the potential areas for treatment, provides the NEPA interdisciplinary teams with a vision of how to acheive the goals of the LSR. Map 16 shows where these potential project areas are located within the LSR. Projects are predominantly located in the eastern half of the LSR because of the higher information level available. The Rock Creek Watershed Analysis provided this greater database of knowledge. The remainder of the LSR will probably provide a similar level of project opportunity when watershed analysis is completed for the other watersheds. Other analyses, such as transportation planning, and stream restoration planning, will also provide future potential projects in the areas of the LSR outside of the Rock Creek watershed.

Potential Project Descriptions and Objectives

Project	Existing condition	Treatment Objective	Treatments
Cayton Allotment Operating Plan	Cattle are utilizing riparian reserves, and the LSR	Manage livestock use	
Bird Blowdown	Pockets of blowdown timber are creating unacceptable fuels buildup	Reduce fuel laoding to acceptable level	Salvage logging T-10
Peavine FMZ NEPA analysis (Legume EA)	Heavy, continuous forest cover extends across the central ridge of the LSR contributing to high risk of losing entire northern portion of the LSR to stand-replacing wildfire.	Reduce fuel loadings within an area to provide firefighter safety and effectiveness see Fire Mgt. Plan	Thinning, Underburning T-1, T-3, T-4, T-5, T-6, T-7, T-8, T-11, T-12
Deep Creek FMZ NEPA analysis	Two large pockets of suitable habitat are inaccessible for fire suppression. An existing road and existing older plantations provide a break in fuel continuity.	Reduce fuel loadings along the access road to provide firefighter safety and effectiveness see Fire Mgt. Plan	Thinning, Underburning T-1, T-3, T-4, T-5, T-6, T-7, T-8, T-11, T-12

Project	Existing condition	Treatment Objective	Treatments
Plantation maintenance projects	Conifer or competing vegetation is overly dense and slowing growth of young trees	Increase tree growth to obtain large tree sizes as quickly as possible.	Thinning, brushing T-8, T-12, T-15, T-16, T-17
Frog Pond Habitat Improvement Project (Leap EA)	Stands are less than desirable diameter, basal area is excessive. Some areas with single canopy layer.	Increase tree growth to attain LS conditions as quickly as possible	Thinning T-12, T-13, T-16, T-17
North Fork of Rock Ck. Crossing	Improper road design contributing to sedimentation in Rock Creek	Correct problem,	replace low-water crossing with bottomless culvert
PG&E Penstock access Road	Improper road design contributing to sedimentation in Rock Creek	Correct problem	Correct drainage problems with culverts; use reduction
37N02 Crossing sediment reduction	Improper road design contributing to sedimentation in Rock Creek	Correct problem,	Rebuilld crossing
37N30B crossing reconstruction	Improper road design contributing to sedimentation in Rock Creek	Correct problem,	Rebuild crossing
A spur rehab/culvert replacement	Improper road design contributing to sedimentation in Rock Creek	Correct problem,	Replace culverts, fix road drainage
Rock Creek Road realignment	Current road alignment is causing excessive sedimentation to Rock Creek	Attain new rright-of-way. Close and rehabilitate old road.	Closure of road, ripping, recontouring.
Habitat improvement. North Slope of Chalk Mt.	Stands are less than desirable diameter, basal area is excessive. Some areas with single canopy layer.	Increase tree growth to attain LS conditions as quickly as possible. Introduce second tree layer	Thinning T-12, T-13, T-16, T-17
Habitat improvement. N. of FR 50 Rd	Plantations in the Under fire need maintenance, other wild stands may be undersized and overstocked.	Maximize plantation growth, maintain or grow large trees in wild stands.	Thinning, brushing T-8, T-12, T-13, T-15, T-16, T-17
Transportation planning	Appears that there may be excessive roads existing on the Shasta-Trinity administered portion of the LSR. May be some roads delivering excessive sediments to the affected watersheds.	Examine road system, Design/propose corrections	Typical watershed improvement projects such as road decommissioning, road realignment, culvert replacement
Stream Restoration	Culverts and other structures are affecting aquatic species movement	Correct problems	Implement culvert replacement as needed

Project	Existing condition	Treatment Objective	Treatments
South Rim Habitat Improvement Project	Dry pine site appears to be overstocked and is suffering overstory mortality,	Reduce competition, attempt to maintain large conifer component	Thinning, piling of brush T-8, T-12, T-13, T-15, T-16, T-17
Camp 9 Habitat Improvement Project	Small diameter pine stands with high stocking levels	Increase tree growth to attain LS conditions as quickly as possible.	Thinning, T-8, T-12, T-13, T-15, T-16, T-17
Bear Grass rehabilitation project	Bear grass is declining in quantity and quality for Native American use	Rejuvenate bear grass	Utilize burning, and Native American experience to rejuvenate beargrass
Slope Stability Analysis	Examine areas of slope stability on the Shasta Trinity.	Determine if treatments are necessary	
Prescribed Fire Applications within non-conifer vegetation.	White oak stands, grasslands, brushfields are senescent and have high levels of stocking above what can be sustained. Mast production is curtailed by competition	Reduce competition increase mast and seed production; maintain high nutritional value forage for wildlife	Underburning, brush crush and burn.

Implementation Schedule

Action	Nature of Action	Implementing Agency	Target Date
Cayton Allotment Operating Plan	Update grazing actions within the Allotment	Hat Creek RD, LNF	In Progress, revisions by 5/97
Bird Blowdown	Removal of high hazard fuel loading	Hat Creek RD, LNF	10/1/96
Peavine FMZ NEPA analysis (Legume EA)	Project design, analysis and layout for FMZ implementation	Hat Creek RD, LNF	FY 97
Deep Creek FMZ NEPA analysis	Project design, analysis and layout for FMZ implementation	Shasta-McCloud Unit of SHF	Unknown pending funding
Plantation maintenance projects	Brush removal, thinning	Shasta-McCloud Unit of SHF	On-going
Frog Pond Habitat Improvement Project (Leap EA)	Project design, analysis, and layout to improve NSO habitat characteristics	Hat Creek RD, LNF	FY 97
North Fork of Rock Ck. Crossing	Construction of bottomless culvert crossing as identified in Keller Report	Hat Creek RD, LNF	Unknown pending funding

Action	Nature of Action	Implementing Agency	Target Date
PG&E Penstock access Road	Road closure as previously identified	PG&E	
37N02 Crossing sediment reduction	culvert armor as identified in Keller Report	Hat Creek RD, LNF	Unknown pending funding
37N30B crossing reconstruction	Remove road fill and armor crossing as identified in Keller Report	Hat Creek RD, LNF	Unknown pending funding
A spur rehab/culvert replacement	Sediment reduction project as identified in Keller Report	Hat Creek RD, LNF	Unknown pending funding
Rock Creek Road realignment	Close, scarify and waterbar 1.7 miles of road as identified in Keller Report	Hat Creek RD, LNF	Unknown pending funding
Habitat improvement.	Thin wild stands on the north slope of Chalk Mtn.	Shasta-McCloud Unit of SHF	FY 98 or 99
Habitat improvement.	Thin and improve stands north of FR 50 road.	Shasta-McCloud Unit of SHF	FY 99 or later
Transportation planning	Inventory and prioritize road restoration and decommissioning projects on SHF	Shasta-McCloud Unit of SHF	FY 97 or 98
Stream Restoration	Implement projects such as culvert replacement in Roaring Creek	Shasta-McCloud Unit of SHF	FY 98
South Rim Habitat Improvement Project	Project design, analysis, and layout to improve NSO habitat characteristics	Hat Creek RD, LNF	FY 99
Camp 9 Habitat Improvement Project	Project design, analysis, and layout to improve NSO habitat characteristics	Hat Creek RD, LNF	FY 01
Bear Grass rehabilitation project	Prescribed burning to rejuvenate bear grass for Native American use	Shasta-McCloud Unit of SHF	Unknown pending funding
Slope Stability Analysis	Map unstable areas within the Deep Creek and Canyon Creek drainages	Shasta-McCloud Unit of SHF	FY 97
Prescribed Fire Applications outside the FMZ	Project design, analysis, and layout for underburning, and other prescribed fire.	Hat Creek RD, LNF Shasta-McCloud Unit of SHF	FY 97 (LNF) Unknown pending funding (SHF)

Monitoring Plan

Monitoring is an essential component of natural resource management because it provide s information on the relative success of management strategies. Monitoring may be broken down into three different categories:

Implementation monitoring
Effectiveness monitoring
Validation monitoring.

Implementation monitoring is currently completed as part of the monitoring directed to occur by the Forest Plan. No additional implementation monitoring needs to occur.

Effectiveness monitoring is aimed at verification of desired results. For the purposes of this plan it is also aimed at providing trigger points for future actions. Effectiveness monitoring has three primary areas: Human Use, Vegetative Trends, Other conditions.

Human Use monitoring has a primary goal of detecting changes in use of the LSR that may affect the underlying assumptions contained within this assessment. Specific monitoring actions to be pursued are:

Action	Who	Where	How often
Road Use	PG&E	Pit River Road	Annually during fishing season
Dispersed Site Use	LNF/SHF	Across LSR	Annually

Vegetative trend data will be collected through a variety of means to determine if vegetation is proceeding along favorable directions. Specific actions include:

Action	Who	Where	How often
Monitor quantity of Late-successional stands	Forests		When new vegetation layer data collected; approx. 5-10yrs.
Riparian Zone Cond.	Forests	Peavine Ck. Other areas	Annually 3-5 years
Hardwood Health	Forests	Riparian Zones	3-5 years
Photo Points			
Peavine Creek	LNF	Peavine Creek	Annually
Fuel Mod Zones	Forests	Within Zones, along roads and interior of zone	3-5 years
Dispersed Recreation Sites - quanity and quality trend monitoring	Forests; PG&E for project associated use.	Along Rock Creek, Peavine Creek, Pit River	3-5 years
Plantation treatment effectiveness	Forests		3-5 years

Other Condition monitoring actions determine trends in species populations, vertebrate population presence, and status of improvements.

Action	Who	Where	How often
Culvert/Stream crossing inspection	FS Engineering	Across LSR	Annually
Inspection of potential slide areas for movement	Forest geologists/hydrologists	Nelson Creek Canyon Creek Deep Creek	Annually or as needed
Bald eagle nesting success	PG&E	Along mainstem of Pit	Annually
Spotted Owl activity	Forest biologists	at known activity centers	variable - dependent on project implementation activities otherwise every 3rd year
Peregrine activity	Shasta-T Biologists	at known location	Annually
Fish/Frog pop. studies	PG&E (Fish)	Rock Creek Deep Creek	as determined by tech review team
Fish/Frog pop. studies	FS biologists (frog)	Rock Creek	every 3rd year

Appendices

Appendix 1 - Ecologic Unit Inventory

Rock Creek Area
Ecological Unit Inventory

Hat Creek Ranger District

Prepared for

Lassen National Forest
Pacific Southwest Region
Forest Service
United States Department of Agriculture

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1. INTRODUCTION

Wise land use is based on ecological principles. It requires knowledge of all aspects of natural environments, or ecosystems and landscapes. This report describes ecological units at the landscape scale (Landtype Association, Order 3) for the Rock Creek Area, Hat Creek Ranger District, Lassen National Forest, California.

1.1 THE ECOLOGICAL UNIT INVENTORY APPROACH

An ecosystem is the basic unit of ecology (Evans 1956). All organisms in a "natural area" (Cain 1947), or environment, along with the rock, soil, water, and atmosphere that they inhabit, comprise an ecosystem. Rowe (1988) stressed the importance of the commonly neglected abiotic aspects of "natural areas" by referring to them as "terrain ecosystems." Ecosystems, or "natural areas," can be identified and described at different levels of detail (Evans 1956; Cain 1947). It is convenient, in ecological mapping, to consider ecosystems as relatively homogeneous natural plant communities on specific landforms with specific soils, and to consider landscapes as delineable geographic features (map polygons) containing one or more ecosystems.

Ecosystems differ from one place to another. They must be described and characterized for land management planning. If a planning area spans more than one relatively homogeneous ecosystem, which is the usual case, the ecosystems, or the landscapes they are in, must be located on a map. And the ecosystems must be classified to make a legend for the map. That is the role of ecological mapping, or ecological unit inventory (USDA, Forest Service Handbook 2090.11), which is essential for prudent and effective land management planning. Ecological management is the current policy of federal land management agencies in the U.S.A.

Ecological unit maps are basic information for ecological management. Mapping is essential, because plot data alone do not provide the spatial information necessary for planning. Soils, vegetation, and other ecosystem components have generally been mapped separately; whole ecosystems, including both abiotic and biotic aspects, have seldom been the objects of mapping. The methods of mapping *whole* ecosystems might be considered a refinement of land systems inventory, as described by Christian (1958) and Wertz and Arnold (1972).

1.1.1 The Nature of Ecological Map Units

The units of ecological mapping (EUI) are geobiotic landscape units. The most basic landscape elements are *ecological types* (ETs), or ecosystems. These landscape elements, however, include more of the lithosphere than is common ecological practice for ecosystems. Each ET has a unique combination of geology, landform, soil, and natural plant communities. Both soils and vegetation are dependent upon the geology (lithology), landforms (relief and drainage), climate, and plant and animal genetic pools (Major 1951). Thus, the spatial distribution patterns of the soil and vegetation components of ecosystems are similar. Landform and soil boundaries are generally natural plant community boundaries. If natural plant communities, rather than current vegetation, are the plant components of ETs, the community boundaries generally correspond to landform and soil boundaries. Animal communities are not considered in mapping, because it is assumed that the natural plant community is a more basic and permanent biotic feature of ecosystems.

Each map delineation, or polygon, of EUI is assigned to an ecological map unit (EMU). Thus, an EMU is a map unit class represented by one or more delineations on aerial photographs and maps (Alexander 1994).

In smaller scale (larger area) EUI, where the smallest delineations are > 5 hectares, few delineations and EMUs that represent them contain just one ET that is dominant. Therefore, the EMUs of small-scale mapping are generally *associations* of ETs, because the ETs can usually be delineated separately on detailed maps where the smallest delineations are about two hectares. This meaning of *associations* is from soil survey in which the map unit components are only soil series, or other classes of soils, rather than ETs.

1.1.2 Forest Service EUI Hierarchy

Regional and national land management planners are interested in fitting ecological map units into a system with broadly defined units that can be shown on small-scale maps of large regions, larger than counties or Forests. The Forest Service has adopted an Ecoregion hierarchy proposed by Bailey (1980), even though it lacks some essential features of EUI. The categories, or levels of detail in the hierarchy, are Domain-Division-Province-Section-Subsection, and below Subsection - Landtype Association and Landtype. Bailey (1980) differentiated and named Ecoregion units at all levels down to the section level in the hierarchy, based on climate. Only recently have Ecoregion subsections been proposed for California. The criteria for the subsections are generally geology and climate; they are still being refined in California.

This EUI of the Rock Creek area is at the land-type association level of detail. All of it is in Ecoregion subsection M261Dj, Hat Creek Rim, of the Southern Cascades Section.

2. METHODS OF INVENTORY

Distinct topographic features and vegetation types larger than about 25 acres (10 ha) if contrasting, or larger than 50 acres (20 ha) if noncontrasting, were delineated on aerial photographs. Vegetation types delineated prior to field checking were differentiated by physiognomy. The main physiognomic classes were forest, shrubs, and grassland. White oak woodland was separated from conifer, or conifer and black oak, forest.

Provisional ETs were postulated after a brief field visit to each EMU, and plots (0.1 acre) were selected to represent ETs. ETs were characterized and described from one complete plot description in each and from unrecorded field observations and informal notes.

After field work was completed and a final legend was chosen, delineations (polygons) were transferred to 1:24,000 topographic maps of the Burney Falls, Skunk Ridge, and Burney Quadrangles.

Lithology was described and identified by codes (Haskins and Chatoian 1993); landforms were described and presumed processes were identified by codes (Haskins and Chatoian 1993); soils were described utilizing standard terminology (Soil Survey Division Staff 1993) and classified to the family level (Soil Survey Staff 1994), although only subgroups were generally identified in ET names; potential natural plant communities were described and identified at the series or a lower level, but not at the plant association level.

3. NATURAL RESOURCES OF THE AREA

3.1 ECOREGION SECTION AND SUBSECTION

All of the Rock Creek area is in the Hat Creek Rim Subsection (M261Dj) of the Southern Cascades Section. There are three parts to the EUI area that is named by the Rock Creek area, which is the largest of the three parts: Rock Creek area north of the Pit River, between Screwdriver Creek and Lake Britton; Long Valley Mountain area south of the Pit River and west of Long Valley Mountain; and Cayton Flat area north of Lake Britton. This area of three parts is between the Soldier Mountain Fault, which is north of the Hat Creek Rim and separates this area of the Southern Cascades from the Modoc Plateau Section of the Basin and Range Province on the east, and the Klamath Mountains Section, which is only a few miles west of the Rock Creek area. The Southern Cascades Section is narrow in the Rock Creek area, where the breadth of the Cascade Range is constricted by the Klamath Mountains on the west.

3.2 GEOLOGY

Geology is the story of the earth as interpreted by its rocks and surficial deposits. It begins with the oldest rocks and is continuing today. The southern Cascade Range, south of central Washington, is a very thick pile of Cenozoic volcanic rocks. There were two major episodes of deposition (McDonald 1966; Hammond 1979): (1) a Western Cascade Group and (2) a High Cascade Group. The Western Cascade Group consists of Eocene to early Pliocene andesite and andesitic to rhyodacitic volcanoclastic deposits, with little basalt. These deposits are slightly to moderately deformed, with strata dipping about 5 to 45°, and they are faulted and fractured, locally. The High Cascade Group is much thinner, on the order of 0.5 km thick. It consists of Pliocene and Quaternary basalt and mafic andesite that has not been deformed. There are some stratovolcanoes, such as Mt. Shasta, with more silicic volcanic rocks.

Rocks exposed in the canyon of the Pit River below Lake Britton are largely andesite but include andesitic to more silicic breccias, tuff-breccias, and tuffs (see Figure 1). There are thick clastic lacustrine sediment and diatomite strata in the upper part of this sequence. The diatomite is at least middle Pliocene, or older, based on diatomes identified in the diatomite (Aune 1964). These volcanic rocks and lacustrine deposits are the parent materials of soils on the hilly bench or plateau on the north side of the Pit River canyon, from Screwdriver Creek to Delucci Ridge and the north side of Lake Britton. Landforms on this bench, or plateau, have been eroded over thousands of years and are no longer flat; they are called hills where steep and hillocks where gently sloping to moderately steep. EMUs 351, 352, 353, and 354 are on these hills and hillocks.

Rocks above the Delucci Ridge bench or plateau are mafic volcanic rocks that are designated Miocene basalt on the Alturas Sheet (Gay and Aune 1958) and Pliocene basalt on the Westwood Sheet (Lydon, et al., 1960) of the Geologic Map of California. They are represented by several flows, both north and south of the Pit River, that have been modified by erosion but still have nearly level plateau and bench surfaces. The plateaus and benches appear to be undissected flow surfaces; each bench being bounded below by the edge of the flow it is on and above by the edge of a flow that partly covered that flow. There is a sequence of plateaus and benches represented from low to high by EMUs 321 and 322, 332, 334, and 336.

Rocks designated Miocene basalt (Gay and Aune 1958) overlay those of the Pit River sequence, at least on the north side of Lake Britton. If the Miocene age is correct, then volcanic rocks and lacustrine deposits of the Pit River sequence must belong in the Western Cascade Group (Hammond 1979). This is likely true even if the basalt north of the Pit River is Pliocene rather than Miocene. Basalt above the Pit River sequence, both north and south of the River are more typical of the High Cascade Group, which is Pliocene and Quaternary, rather than of the Western Cascade Group.

Mass wasting is common in all ETs with steep and very steep slopes, but colluvial deposits are predominant only in EMUs 330 and 339 in the inner-gorge of the Pit River. They are mainly talus and debris flow deposits there. There is a conspicuous slump in EMU 353 (SW ¼ of sec. 17, 37N, R3E) where Cayton Creek has cut deeply into diatomite, causing it to collapse under the edge of the basalt of Cayton Flat.

Fluvial deposits were mapped along the Pit River (EMU 360), around the edge of Goose Valley (EMU 361), along Peavine Creek (EMU 362), and in small basins on the plateau east of Peavine Creek (EMU 363). Sediments in the small basins may be mostly or partly lacustrine.

3.3 CLIMATE

The climate of Rock Creek EUI area ranges from warm continental at lower altitudes to cold continental at higher altitudes. An isohyetal map (USGS 1969) indicates a mean annual precipitation range from about 40 inches at lower altitudes north of Lake Britton to about 70 inches in the upper part of the Rock Creek watershed. Most of the precipitation falls as snow, during winter months. There are a few thunder storms in late spring and early summer.

3.4 SOILS

Soils of the Rock Creek area range from young on floodplains to moderately old on gently sloping plateaus and broad ridges. The main processes of soil development are organic acid and bicarbonate weathering, leaching of dissolved constituents, translocation of clay from the surface to the subsoil, and accumulation of organic matter. Soils were described by USDA terminology (Soil Survey Division Staff 1993) and mapped and classified at the suborder or family level, although only subgroups appear in the ET names. The soils are Entisols, Inceptisols, Andisols, Mollisols, Vertisols, and Alfisols (Soil Survey Staff 1994). Practically all of them are well to excessively well drained, with only minor exceptions, except in EMU 363.

Climate is an important factor as indicated by an altitude sequence of relatively mature soils on basalt from 3200 feet with precipitation about 40 inches/year to 5200 feet with precipitation about 70 inches/year. Soils in the sequence are, from lower to higher elevations, Vitrandic Palexeralfs - Andic Palexeralfs - Andic Palehumults - Ultic Haploxerands - Humic Haploxerands. This sequence might be extended to Vitrandic Argixerolls on the lower end and to Melanoxerands on the upper end. Ultic Argixerolls and Typic and Pachic Melanoxerands were mapped in adjacent areas (Ferrari et al., 1992), but none were found in the Rock Creek EUI.

Figure 1. Major geologic units of the Rock Creek area.

Aa Andesitic rocks of very steep Pit River inner-gorge slopes.

Ab Andesitic rocks and sediments, including diatomite, of gently sloping to moderately steep and steep slopes.

B Basaltic rocks of very gentle to gently sloping flow surfaces and steep flow edges and canyon sides.

3.5 VEGETATION

Potential natural plant communities (PNCs) were mapped and designated at the series and lower levels, but not at the plant association level. At the series level, natural plant communities are based on the overstory vegetation, only. Understory vegetation is considered at the plant association level in more detail than is possible in an order 3 EUI.

Vegetation and its distribution is dependent on climate and soils. Potential natural plant community species composition varies in a continuum along temperature and precipitation gradients related to altitude and other geographic features. Definite potential natural plant community boundaries are generally related to soil or slope aspect differences. For example, in the low hills, or hillocks, of EMUs 352 and 354, Leptic Haploxererts with white oak/wedgeleaf ceanothus/annual grass are found only on hill summits and south-facing slopes in sandstone, at the same altitude where Typic Argixerolls with white oak/greenleaf manzanita are found on north-facing slopes in sandstone and only Vitrandic Xerochrepts with mixed conifer--black oak are found on slopes in diatomite.

A climatic sequence of potential natural plant communities related to elevation is most clearly and completely indicated by vegetation of deep well drained soils on basalt or andesite. The community sequence is, from lower to higher altitude, white oak/annual grass; ponderosa pine--black oak; mixed conifer--black oak; white fir--black oak; and white fir/bush chinquapin.

Definitions of PNCs mapped in the Rock Creek EUI are given in Table 1. Table 2 contains a list of common plant species names utilized in this report and corresponding taxonomic names.

TABLE 1 POTENTIAL NATURAL PLANT COMMUNITY (PNC) DEFINITIONS (BASED ON CROWN COVER AREA/TOTAL AREA, AND REGENERATION POTENTIAL).

PNC Name	Definition
Barren	plant cover < 1%
Birchleaf Mtn. Mahogany/Annual Grass	tree cover < 10% shrub cover > 10%, dominant shrub is birchleaf mountain mahogany annual grass cover > 20%
Canyon Live Oak	tree cover > 50%, predominantly canyon live oak conifers < 5%
Douglas-Fir–Canyon Live Oak	Douglas-fir > 40%, no more than 1 other conifers > 5% canyon live oak > 10%
Marsh	nonforest, predominantly herbaceous, vegetation of wet areas
Mixed Conifer—Black Oak	tree cover > 75% each of 3 or more mixed conifer species[a] > 5% each black oak > 10%
Ponderosa Pine–Black Oak	ponderosa pine > 40%, no more than 1 other conifer > 5% black oak > 10%
Ponderosa Pine–White Oak	ponderosa pine > 20%, no other conifer > 10% white oak > 20%, black oak < 10%
Riparian	riparian (stream-side) plant cover > 75%
Riparian/Barren	riparian (stream-side) plant cover > 5% plant cover absent > 25%
White Fir–Black Oak	tree cover > 75% white fir > 20%, no more than 1 other conifer > 10% white predominant conifer in understory black oak > 5%
White Fir/Bush Chinquapin	white fir > 60%, no more than 1 other conifer > 10% black oak < 5% bush chinquapin dominant shrub
White Fir/Vine Maple	white fir > 60%, no more than 1 other conifer > 10% black oak < 5% vine maple dominant shrub
Wedgeleaf Ceanothus/Annual Grass	tree cover < 10% shrub cover > 20%, predominantly wedgeleaf ceanothus annual grass > 40%, unless limited by disturbance

TABLE 1 (continued)

PNC Name	Definition
White Oak/Annual Grass	white oak > 40% shrubs < 20% annnual grass > 20%
White Oak/Birchleaf Mountain Mahogany	oak trees > 10%, all or predominantly white oak shrubs > 40%, predominantly birchleaf mountain mahogany annual grass < 40%
White Oak/Birchleaf Mtn. Mahogany/ Annual Grass	oak trees > 10%, all or predominantly white oak shrubs > 20%, predominantly birchleaf mountain mahogany annual grass > 40%
White Oak/Deerbrush	trees > 60%, predominantly white oak conifers < 5% shrubs > 5%, predominantly deerbrush, or deerbrush and skunkbrush
White Oak/Greenleaf Manzanita	trees > 20%, predominantly white oak shrubs > 40%, predominantly greenleaf manzanita
White Oak/Skunkbrush	white oak > 20% shrubs > 20%, predominantly skunkbrush
White Oak/Wedgeleaf Ceanothus/Annual Grass	white oak > 10% shrubs > 20%, predominantly wedgeleaf ceanothus forbs > 20%, predominantly annual grass

[a] Mixed conifer species, in this area: ponderosa pine, incense-cedar, Douglas-fir, sugar pine, and white fir.
[b] Riparian plant cover: trees, shrubs, and herbs on, or adjacent to, floodplains

TABLE 2 PLANTS REFERRED TO BY COMMON NAME.

Common Name	Taxonomic Name
alder (shrub)	*Alnus incana ssp. tenuifolia*
alder (tree)	*Alnus rhombifolia*
ash (*see* Oregon ash)	
aspen	*Populus tremuloides*
Bach's downingia	*Downingia bacigalupii*
birchleaf mountain mahogany	*Cercocarpus betuloides*
bitter-cherry	*Prunus emarginata*
black oak	*Quercus kelloggii*
bush chinquapin	*Chrysolepis sempervirens*
canyon live oak	*Quercus chrysolepis*
cheatgrass	*Bromus tectorum*
cottonwood	*Populus balsamifera ssp. trichocarpa*
deerbrush	*Ceanothus integerrimus*
Douglas-fir	*Pseudotsuga menziesii*
greenleaf manzanita	*Arctostaphylos patula*
incense-cedar	*Calocedrus decurrens*
juniper, western	*Juniperus occidentalis occidentalis*
Japanese chess	*Bromus japonicus*
Jeffrey pine	*Pinus jeffreyi*
little prince's pine	*Chimaphila menziesii*
lodgepole pine	*Pinus contorta*
mountain misery	*Chamaebatia foliolosa*
mountain whitethorn	*Ceanothus cordulatus*
Oregon ash	*Fraxinus latifolia*
ponderosa pine	*Pinus ponderosa*
Ross sedge	*Carex rossii*
rush	*Juncus* sp.
sedge	*Carex* sp.
serviceberry, western	*Amalanchier utahensis*
skunkbrush	*Rhus trilobata*
snowbrush	*Ceanothus velutinus*
soft chess	*Bromus hordeaceous*
spiraea	*Spiraea douglasii*
spreading snowberry	*Symphoricarpus mollis*
sqwawcarpet	*Ceanothus prostratus*
sugar pine	*Pinus lambertiana*
vine maple	*Acer circinatum*
wedgeleaf ceanothus	*Ceanothus cuneatus*
white oak	*Quercus garryana garryana*
willow	*Salix* sp.
white fir	*Abies concolor*
white-veined wintergreen	*Pyrola picta*
yampah	*Perideridia (bolanderi?)*

4. ECOLOGICAL MAP UNITS

A complete EMU designation number consists of the subsection code plus the local code assigned for the EUI of the Rock Creek area (for example, M261Dj-330), but only the local codes are generally utilized in this report. The maps of EMUs are on 1:24,000 scale USGS topograhic map sheets, which are on file at the Lassen National Forest.

Each Ecological Mapping Unit is given a local name for convenience, such as, Pit River Nonforested Inner-Gorge. Most EMUs contain more than one Ecological Type. For example, EMU 330 contains:

<u>EMU</u> PIT RIVER NONFORESTET INNER-GORGE, 60 to 85% Slopes

<u>ET</u> Andesite Inner-Gorge - Pachic Haploxerolls - White Oak/Skunkbrush

and

<u>ET</u> Andesite Inner-Gorge - Lithic Xerorthents - Birchleaf Mountain Mahogany/annual grass

and

<u>ET</u> Andesite Inner-Gorge - Mollic Haploxeralfs - White Oak/Deerbrush

The EMU name contains a local area name followed by the representative Ecological Types, with the ETs being separated by the word *and.* The EMU name also includes the slope range in percent. Thus, the complete name for an EMU contains the ETs, slope gradient. For example, EMU 330 in Table 3 is:

330 PIT RIVER NONFORESTED INNER-GORGE, 60-85% slopes: Andesite Inner-Gorge - Pachic Haploxerolls - White Oak/Skunkbrush *and* Andesite Inner-Gorge - Lithic Xerorthents - Birchleaf Mountain Mahogany/annual grass *and* Andesite Inner-Gorge - Mollic Haploxeralfs - White Oak/Deerbrush.

For convenience, the EMU numbers were grouped by lithology as follows:

Group	Lithology Primary/Secondary
320–339	igneous extrusive/basalt and andesite
350–359	*interbedded* igneous extrusive/andesite and basalt *and* sedimentary/conglomerate, sandstone, and diatomite
360–369	unconsolidated/alluvium (and lacustrine)

TABLE 3 ECOLOGICAL MAP UNIT LEGEND

Code	General Name, Slope Gradient: Geology - Soils - Plant Community (PNC)
321	CAYTON FLAT NONFOREST, 0–12% slopes: basalt plateau - Lithic Ruptic-Haplic Argixerolls - wedgeleaf ceanothus/annual grass, *and* basalt plateau - Vitrandic Haploxeralfs - white oak/annual grass, *and* basalt plateau - Vitrandic Palexeralfs - ponderosa pine–black oak
322	CAYTON FLAT FOREST, 0–12% slopes: basalt plateau - Vitrandic Palexeralfs - ponderosa pine-–black oak, *and* basalt plateau - Vitrandic Haploxeralfs - white oak/annual grass, *and* basalt plateau - Lithic Ruptic-Haplic Argixerolls - wedgeleaf ceanothus/annual grass
330	PIT RIVER NONFORESTED INNER-GORGE, 60–85% slopes: andesite inner-gorge - Pachic Haploxerolls - white oak/skunkbrush, *and* andesite inner-gorge - Lithic Xerorthents - birchleaf mountain mahogany/annual grass, *and* andesite inner-gorge - Mollic Haploxeralfs - white oak/deerbrush
331	JAKE SPRING MOUNTAIN SIDESLOPE, 25–60% slopes: andesite or basalt mountain sideslopes - Vitrandic Haploxeralfs - mixed conifer--black oak, *and* andesite or basalt mountain sideslopes - Vitrandic Palexeralfs - mixed conifer--black oak
332	JAKE SPRING PLATEAU, 6–30% slopes: andesite or basalt plateau - Vitrandic Palexeralfs - mixed conifer--black oak, *and* andesite or basalt mountain sideslopes - Vitrandic Haploxeralfs - mixed conifer--black oak
333	SUMMIT LAKE MOUNTAIN SIDESLOPE, 25–60% slopes: andesite or basalt mountain sideslopes - Humic Haploxerands - white fir—black oak, *and* andesite or basalt mountain sideslopes - Andic Haplohumults - white fir—black oak
334	SUMMIT LAKE PLATEAU, 6–30% slopes: andesite or basalt plateau - Andic Paleohumults - white fir—black oak, *and* andesite or basalt mountain sideslopes - Andic Haplohumults - white fir—black oak
335	SQUAW FLAT MOUNTAIN SIDESLOPE, 25–60% slopes: andesite or basalt mountain sideslopes - Humic Haploxerands - white fir/vine maple, *and* andesite or basalt mountain sideslopes - Humic Haploxerands - white fir/bush chinquapin
336	SQUAW FLAT PLATEAU, 6–30% slopes: andesite or basalt plateau - Humic Haploxerands - white fir/bush chinquapin, *and* andesite or basalt plateau - Ultic Haploxerands - white fir/bush chinquapin, *and* andesite or basalt plateau - Humic Haploxerands - white fir/vine maple
337	JAKE SPRING NONFOREST, 25–60 slopes: andesite or basalt mountain sideslopes - Typic Argixerolls - white oak/birchleaf mountain mahogany/annual grass, *and* andesite or basalt mountain sideslopes - Ultic Argixerolls - white oak/birchleaf mountain mahogany, *and* andesite or basalt mountain sideslope - Lithic Argixerolls - wedgeleaf ceanothus/annual grass
339	PIT RIVER FORESTED INNER-GORGE, 60–85% slopes: andesite inner-gorge - Typic Xerochrepts - Douglas-fir--canyon live oak, *and* andesite inner-gorge - Lithic Mollic Haploxeralfs - canyon live oak, *and* andesite inner-gorge - fragmental colluvium - barren
351	DELUCCI NONFORESTED SIDESLOPES, 25–60% slopes: andesite or basalt hill slopes - Lithic Argixerolls - wedgeleaf ceanothus/annual grass, *and* andesite or basalt hill slopes - Typic Argixerolls -

Code	General Name, Slope Gradient: Geology - Soils - Plant Community (PNC)
	white oak/birchleaf mountain mahogany/annual grass, *and* andesite or basalt hill slopes - Ultic Argixerolls - white oak/birchleaf mountain mahogany, *and* clastic sedimentary hill slopes - Typic Argixerolls - white oak/greenleaf manzanita
352	DELUCCI NONFORESTED HILLOCKS, 3–30% slopes: andesite or basalt hillocks - Typic Argixerolls - white oak/birchleaf mountain mahogany/annual grass, *and* clastic sedimentary hillocks - Typic Argixerolls - white oak/greenleaf manzanita, *and* sandstone hillocks - Leptic Haploxererts - white oak/wedgeleaf ceanothus/annual grass
353	DELUCCI FORESTED HILLS, 25–60% slopes: andesite or basalt hill slopes - Vitrandic Haploxeralfs - mixed conifer--black oak, *and* diatomite hill slopes - Vitrandic Xerochrepts - mixed conifer--black oak, *and* clastic sedimentary hill slopes - Vitrandic Haploxeralfs - mixed conifer--black oak
354	DELUCCI FORESTED HILLOCKS, 3–30% slopes: andesite or basalt hillocks - Vitrandic Haploxeralfs - mixed conifer--black oak, *and* diatomite hillocks - Vitrandic Xerochrepts - mixed conifer--black oak, *and* andesite or basalt over clastic sedimentary hillocks - Vitrandic Xerochrepts - mixed conifer--black oak
360	PIT RIVER ALLUVIAL FLATS, 0–3% slopes: stream terraces - Xerochrepts & Haploxerolls - mixed conifer--black oak, *and* stream terraces - Haploxeralfs & Xerochrepts - mixed conifer--black oak
361	GOOSE VALLEY FAN SKIRT, 1–6% slopes: bajada fan skirt - Haploxeralfs - ponderosa pine--white oak
362	PEAVINE CREEK FLOODPLAIN, 0–3% slopes: floodplain - Umbrepts - riparian
363	SQUAW FLAT BASIN, 0–1% slopes: basin-fill - Aquepts - marsh

5. ECOLOGICAL MAP UNIT AND ECOLOGICAL TYPE DESCRIPTIONS

The Ecological Map Units (EMUs) are described in numerical order. Each EMU description contains a brief description of the map unit, including lithology, followed by descriptions of the Ecological Types (ETs) that occur in the map unit. The ET description consists of information about the geomorphology, soil, and plant community. The EMU composition is outlined in Table 4 (Ecological Map Unit Composition) and the ET descriptions follow in this chapter. Areas of EMUs are listed in Table 5.

TABLE 4 ECOLOGICAL MAP UNIT COMPOSITION

Map Unit[a] Slope Grad. Ecoregion and Alt.(ft)	Ecol. Type no.[b]	Area	Slope Aspect,Grad.	Lith.[c] Pri./Sec.	Geomorph.[d] Type-Proc.	Soil Class	Plant Community
321	CAYTON FLAT NONFOREST						
0-12%	1	60%	all, 1-6%	V/B	F-EH	Lithic Ruptic-Haplic Argixerolls	Wedgeleaf Ceanothus/Annual Grass
M261Dj	2	20%	all, 2-9%	V/B	F-EH	Vitrandic Haploxeralfs	White Oak/Annual Grass
3120-3400	3	10%	all, 2-12%	V/B	F-EH	Vitrandic Palexeralfs	Ponderosa Pine--Black Oak
	Incl.	10%					
322	CAYTON FLAT FOREST						
0-12%	1	60%	all, 2-12%	V/B	F-EH	Vitrandic Palexeralfs	Ponderosa Pine--Black Oak
M261Dj	2	20%	all, 2-9%	V/B	F-EH	Vitrandic Haploxeralfs	White Oak/Annual Grass
3100-3440	3	10%	all, 1-6%	V/B	F-EH	Lithic Ruptic-Haplic Argixerolls	Wedgeleaf Ceanothus/Annual Grass
	Incl.	10%					
330	PIT RIVER NONFORESTED INNER-GORGE						
60-85%	1	40%	S, 60-85%	V/A,B	MW-FL	Pachic Haploxerolls	White Oak/Skunkbrush
M261Dj	2	20%	S, 60-85%	V/A,B	F-EH	Lithic Xerorthents	Birchleaf Mtn. Mahogany/Annual Grass
2400-3400	3	20%	N,E 60-85%	V/A,B	MW-FL	Mollic Haploxeralfs	White Oak/Deerbrush
	Incl.	20%					
331	JAKE SPRING MOUNTAIN SIDESLOPE						
25-60%	1	70%	all, 30-60%	V/A,B	UHS	Vitrandic Haploxeralfs	Mixed Conifer Black Oak
M261Dj	2	20%	all, 25-45%	V/A,B	F-EH	Vitrandic Palexeralfs	Mixed Conifer Black Oak
3040-4040	Incl.	10%					
332	JAKE SPRING PLATEAU						
6-30%	1	80%	all, 6-25%	V/A,B	F-EH	Vitrandic Palexeralfs	Mixed Conifer Black Oak
M261Dj	2	15%	all, 15-30%	V/A,B	F-EH	Vitrandic Haploxeralfs	Mixed Conifer Black Oak
3280-4000	Incl.	5%					

TABLE 4 (continued)

Map Unit[a] Slope Grad. Ecoregion and Alt.(ft)	Ecol. Type no.[b]	Area	Slope Aspect,Grad.	Lith.[c] Pri./Sec.	Geomorph.[d] Type-Proc.	Soil Class	Plant Community
333	SUMMIT LAKE MOUNTAIN SIDESLOPE						
25-60%	1	40%	all, 30-60%	V/A,B	UHS	Humic Haploxerands	White Fir/Black Oak
M261Dj	2	40%	all, 25-60%	V/A,B	UHS'	Andic Haplohumults	White Fir/Black Oak
320-5040	Incl.	20%					
334	SUMMIT LAKE PLATEAU						
6-30%	1	70%	all, 6-25%	V/A,B	F-EH	Andic Palehumults	White Fir/Black Oak
M261Dj	2	20%	all, 15-30%	V/A,B	F-EH	Andic Haplohumults	White Fir/Black Oak
3560-5060	Incl.	10%					
335	SQUAW FLAT MOUNTAIN SIDESLOPE						
25-60%	1	70%	N, 30-60%	V/A,B	UHS	Humic Haploxerands	White Fir/Vine Maple
M261Dj	2	20%	all, 25-45%	V/A,B	F-EH	Humic Haploxerands	White Fir/Bush Chinquapin
3920-5280	Incl.	10%					
336	SQUAW FLAT PLATEAU						
6-30%	1	40%	all, 6-25%	V/A,B	F-EH	Humic Haploxerands	White Fir/Bush Chinquapin
M261Dj	2	40%	all, 6-25%	V/A,B	F-EH	Ultic Haploxerands	White Fir/Bush Chinquapin
4920-5360	3	15%	N, 15-30%	V/A,B	F-EH	Humic Haploxerands	White Fir/Vine Maple
	Incl.	5%					
337	JAKE SPRING NONFOREST						
25-60%	1	40%	S, 25-45%	V/A,B	F-EH	Typic Argixerolls	White Oak/Birchleaf Mountain Mahogany/Annual Grass
M261Dj	2	30%	S, 30-60%	V/A,B	UHS	Ultic Argixerolls	White Oak/Birchleaf Mountain Mahogany
3000-3640	3	20%	S, 30-60%	V/A,B	UHS	Lithic Argixerolls	Wedgeleaf Ceanothus/Annual Grass
	Incl.	10%					

TABLE 4 (continued)

Map Unit[a] Slope Grad. Ecoregion and Alt.(ft)	Ecol. Type no.[b]	Area	Slope Aspect,Grad.	Lith.[c] Pri./Sec.	Geomorph.[d] Type-Proc.	Soil Class	Plant Community
339	PIT RIVER FORESTED INNER-GORGE						
60-85%	1	40%	N, 60-85%	V/A,B	MW-FL	Typic Xerochrepts	Douglas-Fir/Canyon Live Oak
M261Dj	2	20%	all, 70-85%	V/A,B	MW-FL	Lithic Mollic Haploxeralfs	Canyon Live Oak
2400-3720	3	20%	all, 70-85%	V/A,B	MW-F,T	fragmental colluvium	Barren
	Incl.	20%					
351	DELUCCI NONFORESTED SIDESLOPES						
25-60%	1	30%	S, 30-60%	V/A,B	UHS	Lithic Argixerolls	Wedgeleaf Ceanothus/Annual Grass
M261Dj	2	20%	S, 25-45%	V/A,B	F-EH	Typic Argixerolls	White Oak/Birchleaf Mountain Mahogany/Annual Grass
2920-3520	3	20%	S, 30-60%	V/A,B	UHS	Ultic Argixerolls	White Oak/Birchleaf Mountain Mahogany
	4	20%	S, 25-45%	S/CG,SS	UHS	Typic Argixerolls	White Oak/Greenleaf Manzanita
	Incl.	10%					
352	DELUCCI NONFORESTED HILLOCKS						
3-30%	1	40%	S, 3-30%	V/A,B	F-EH	Typic Argixerolls	White Oak/Birchleaf Mountain Mahogany/Annual Grass
M261Dj	2	30%	all, 6-30%	S/CG,SS	F-EH	Typic Argixerolls	White Oak/Greenleaf Manzanita
2880-3600	3	10%	S, 3-25%	S/SS	UHS	Leptic Haploxererts	White Oak/Wedgeleaf Ceanothus/Ann. Grass
	Incl.	20%					
353	DELUCCI FORESTED HILLS						
25-60%	1	40%	all, 30-60%	V/A,B	UHS	Vitrandic Haploxeralfs	Mixed Conifer--Black Oak
M261Dj	2	30%	all, 25-60%	S/DI	F-EH	Vitrandic Xerochrepts	Mixed Conifer--Black Oak
2880-3800	3	20%	all, 25-60%	S/CG,SS	UHS	Vitrandic Haploxeralfs	Mixed Conifer--Black Oak
	Incl.	10%					

TABLE 4 (continued)

Map Unit[a] Slope Grad. Ecoregion and Alt.(ft)	Ecol. Type no.[b]	Area	Slope Aspect,Grad.	Lith.[c] Pri./Sec.	Geomorph.[d] Type-Proc.	Soil Class	Plant Community
354	DELUCCI FORESTED HILLOCKS						
3-30%	1	30%	all, 3-30%	V/A,B	F-EH	Vitrandic Haploxeralfs	Mixed Conifer--Black Oak
M261Dj	2	30%	all, 3-30%	S/DI	F-EH	Vitrandic Xerochrepts	Mixed Conifer--Black Oak
2720-3640	3	30%	all, 3-30%	V/A,B over S/DI	F-EH	Vitrandic Xerochrepts	Mixed Conifer--Black Oak
	Incl.	10%					
360	PIT RIVER ALLUVIAL FLATS						
0-3%	1	40%	-, 1-3%	U/AL	F-ST	Xerochrepts and Haploxerolls	Mixed Conifer--Black Oak
M261Dj	2	30%	-, 1-3%	U/AL	F-ST	Haploxeralfs and Xerochrepts	Mixed Conifer--Black Oak
2400-2620	Incl.	30%					
361 1-6% M261Dj 3210-3230	GOOSE VALLEY FAN SKIRT			U/AL	F-BA	Haploxeralfs	Ponderosa Pine--White Oak
362 0-3% M261Dj 4760-4860	PEAVINE CREEK FLOODPLAIN			U/AL	F-FP	Umbrepts	Riparian
363 0-1% M261Dj 4820	SQUAW FLAT BASIN			U/AL	F-BO	Aquepts	Marsh

TABLE 4 (continued)

Map Unit[a] Slope Grad. Ecoregion and Alt.(ft)	Ecol. Type no.[b]	Area	Slope Aspect,Grad.	Lith.[c] Pri./Sec.	Geomorph.[d] Type-Proc.	Soil Class	Plant Community

a. Map unit number, followed by its name, which is an aggregation of names for ecological types in the map unit, on the same line; range of slope gradients on the second line; Ecoregion subsection on the third line; and range of altitudes (meters) on the fourth line.
b. Ecological type number 1 through 2 or 3 within each EMU. Incl.= inclusions.
c. Lithological primary/secondary codes. S/CG, conglomerate; S/DI, diatomite; S/SS, sandstone; U/AL, alluvium; V/A,B, andesite and/or basalt; V/B, basalt. Refer to Appendix A[e].
d. Geomorphic type-processes codes. F-BA, bajada; F-BO, bolson; F-EH, fluvial-eroding slope; F-FP, fluvial-flood plain; F-ST, stream terrace; MW-F,T, mass wasting-falls, talus; MW-FL, mass wasting-flow; UHS, many processes, none predominant. Refer to Appendix B[e].
e. Haskins and Chatoian (1993). *Geology Data Standards for Ecological Unit Inventories of the Pacific Southwest Region.*

TABLE 5 AREA OF THE ECOLOGICAL MAP UNITS

EUI #	Acres	Hectaers
321	617	247
322	763	305
3330	822	329
331	2,133	853
332	2,155	862
333	1,722	689
334	1,082	433
335	1,039	416
336	2,134	854
337	841	336
338	685	274
351	375	150
352	490	196
353	952	381
354	941	376
360	250	100
361	31	12
362	62	25
363	11	4
Total	17,105	6,842

ECOLOGICAL MAP UNIT AND ECOLOGICAL TYPE DESCRIPTIONS

321 - CAYTON FLAT NONFOREST, 0–12% slopes

EMU 321 is on a gently to very gently sloping volcanic plateau surrounding Cayton Valley and extending northward. It is terminated on the south by the Pit River canyon.
The bedrock

Lithology—basalt or andesite. This is a late Cenozoic, possibly Miocene (Gay et al. 1958) flow rock that is most likely basalt. Basalt bedrock is very permeable, because of vertical parting to form columnar structure. Most runoff is through the bedrock, rather than overland. Therefore, there are few distinct stream courses on the plateau. There are some small closed basin in which alluvium or lacustrine sediment has accumulated - they are inclusions that are too small to map separately from the upland areas on the plateau.

Map Unit Composition

- 60% ET 321-1 - basalt plateau : Lithic Ruptic-Haplic Argixerolls : wedgeleaf ceanothus/annual grass
- 20% ET 321-2 - basalt plateau : Vitrandic Haploxeralfs : white oak/annual grass
- 10% ET 321-3 - basalt plateau : Vitrandic Palexeralfs : ponderosa pine–black oak
- 10% Inclusions: Lithic Haploxerolls on basalt with annual grass and sparse wedgeleaf ceanothus; moderately deep Haploxerolls on basalt with sparse white oak, wedgeleaf ceanothus, and annual grass; and fine-textured Alfisols in small closed basins with annual herbs.

ET 321-1

basalt plateau : Lithic Ruptic-Haplic Argixerolls : wedgeleaf ceanothus/annual grass

Geomorphology—Fluvial/Eroding Hill Slopes. The landform is a gently sloping volcanic plateau. Fluvial erosion by overland flow of water is the predominant geomorphic process. Chemical denudation by weathering and leaching is also an important geomorphic processes in this ET.

Soils—Lithic Ruptic-Haplic Argixerolls. They are loamy-skeletal, oxidic, mesic Lithic Ruptic-Haplic Argixerolls. These are very shallow A-Bt-R profile soils with a lithic contact to bedrock at 10–50 cm depth. They range from very shallow (10–18 cm deep) without argillic horizon to shallow (18–50 cm deep) with argillic horizon in 1–3 meter cycles. They are well drained.

Representative Pedon RC12 – W½ sec. 17, T37N, R3E, Burney Falls Quadrangle.

Classification:	loamy-skeletal, oxidic, mesic Lithic Ruptic-Haplic Argixeroll
Altitude:	3,260 feet
Slope:	concave (linear along contour) E 4% smooth
Surface Stoniness:	10% gravel, 7% cobbles, 2% "stones", no boulders
Oi	Scattered leaves of shrubs, oak trees, and grass.

A1	0–3 cm; dark reddish brown (5YR 3/3) gravelly loam, reddish brown (5YR 5/5) dry; weak, fine and medium, subangular blocky; slightly hard, slightly sticky, nonplastic; few very fine roots; slightly acid; abrupt, smooth boundary.
A2	3–16 cm; dark reddish brown (5YR 3/3) loam, yellowish red (5YR 5/6) dry; moderate, medium subangular blocky; hard, slightly sticky, slightly plastic; very few very fine and fine roots; moderately to slightly acid; clear, wavy boundary.
Bt	16–38 cm; dark reddish brown (5YR 3/4) extremely gravelly clay loam, yellowish red (5YR 4/6) dry; moderate fine subangular blocky; firm, sticky, plastic; few very fine and fine roots; moderately acid; discontinuous horizon, abrupt, irregular boundary to R-horizon.
R	16/38–40+ hard, highly fractured vesicular basalt at depths ranging from 16 to 38 cm within one to three meters horizontally.

Potential Natural Plant Community—wedgeleaf ceanothus/annual grass. The cover is open shrub and moderately dense grass among the shrubs. It is at least 20% wedgeleaf ceanothus and generally a little birchleaf mountain mahogany. White oak is sparse (< 10%). Soft chess and Japanese chess are common grasses. Annual forbs and cheatgrass, or downy bromegrass, are abundant following burning and other site disturbances.

Plants at representative site RC12.

Tree cover, 5%: *Quercus garryana*, 5%. Shrub cover, 40%: *Ceanothus cuneatus*, 30%; and *Cercocarpus betuloides*, 10%. Forb cover, 15%; *Blepharipappus scaber*, 7%; *Monardella lanceolata*, 3%; *Polygonum bidwelliae*, 2%; *Epilobium brachycarpum*, 1%; *Achillea millefolium*, 1%; *Allium* sp, 1%; and *Clarkia rhomboidea* and *Gilia* sp, each < 1%. Graminoid cover, 8%: *Bromus hordeaceus*, 5%; *Bromus japonicus*, 2%; *Bromus tectorum*, 1%; and *Elymus elymoides* < 1%. Many annual forbs were dry and unidentifiable when the site was described on 11 August 1995.

ET 321-2

basalt plateau: Vitrandic Haploxeralfs : white oak–annual grass

Geomorphology–Fluvial/Eroding Hill Slopes. The landform is a gently sloping volcanic plateau. Fluvial erosion by overland flow of water is the predominant geomorphic process. Chemical denudation by weathering and leaching is also an important geomorphic processes in this ET.

Soils —Vitrandic Haploxeralfs. They are moderately deep loamy-skeletal and deep fine-loamy, oxidic, mesic Vitrandic Haploxeralfs. These are moderately deep to deep A-Bt-Cr or R profile soils with a lithic or a paralithic contact to weathered bedrock at 50–150 cm depth. They are well drained.

Representative Pedon RC13 – S½, S½, sec. 8, R37N, R3E, Burney Falls Quadrangle.

Classification:	fine-loamy, oxidic, mesic Vitrandic Haploxeralfs
Altitude:	3,200 feet
Slope:	concave (linear along contour) N 8% smooth
Surface Stoniness:	10% gravel, no cobbles, "stones" < 1%, boulders, 1%
Oi	1–0 cm; loose oak and grass leaves.
A1	0–5 cm; dark reddish brown (5YR 3/3) loam, reddish brown (5YR 5/4) dry; moderate, fine granular; soft, slightly sticky, slightly plastic; few very fine roots; slightly acid; clear smooth boundary.

A2	5–21 cm; dark reddish brown (5YR 3/3) loam, reddish brown (5YR 5/4) dry; weak, very fine subangular blocky; slightly hard, friable, sticky, slightly plastic; few fine and medium roots; slightly acid; gradual, smooth boundary.
Bt1	21–52 cm; dark reddish brown (5YR 3/4) gravelly clay loam; moderate, fine subangular blocky; slightly hard, firm, sticky, plastic; discontinuous thin coatings on ped faces; few fine, medium, and coarse roots; slightly acid; gradual, smooth boundary.
Bt2	52–80 cm; dark reddish brown (2.5YR 3/4) gravelly clay loam; weak, medium subangular blocky; very firm, sticky, plastic; continuous thin coatings on ped faces; very few fine, medium, and coarse roots; moderately acid; diffuse boundary.
BC	80–105+ cm; reddish brown (5YR 4/4) very gravelly clay loam; massive; very firm, sticky, plastic; very few fine and medium roots; strongly acid.

Potential Natural Plant Community—white oak–annual grass. The cover is open white to semi-dense oak woodland with dense annual grass among the trees and less than 20% wedgeleaf ceanothus and birchleaf mountain mahogany. Soft chess is a common and abundant grass. Annual forbs and cheatgrass, or downy bromegrass, are abundant following burning and other site disturbances.

Plants at representative site RC13.

Tree cover, 60%: *Quercus garryana*, 60%. Shrub cover, 12%: *Ceanothus cuneatus*, 10; and *Cercocarpus betuloides*, 2%. Forb cover, 10%; *Epilobium brachycarpum*, 3%; *Monardella lanceolata*, 4%; *Erigeron inornatus*, 2%; and *Clarkia rhomboidea* < 1%. Graminoid cover, 40%: *Bromus hordeaceus*, 20%; *Bromus tectorum*, 10%; *Vulpia myuros*, 10%; *Achnatherum* sp, 1%; and *Bromus japonicus* and *Elymus elymoides*, each < 1%. White oak seedlings present in understory.

ET 321-3 = ET 322-1

322 - CAYTON FLAT FOREST, 0–12% slopes

EMU 322 is on a gently to very gently sloping volcanic plateau surrounding Cayton Valley and extending northward. It is terminated on the south by the Pit River canyon. The bedrock

Lithology—basalt or andesite. This is a late Cenozoic, possibly Miocene (Alturas sheet, Calif. Div. Mines & Geology) flow rock that is most likely basalt. Basalt bedrock is very permeable, because of vertical parting to form columnar structure. Most runoff is through the bedrock, rather than overland. Therefore, there are few distinct stream courses on the plateau. There are some small closed basins in which alluvium or lacustrine sediment has accumulated—they are inclusions that are too small to map separately from the upland areas on the plateau.

Map Unit Composition

- 60% ET 321-1 - basalt plateau : Vitrandic Palexeralfs : ponderosa pine–black oak
- 20% ET 321-2 - basalt plateau : Vitrandic Haploxeralfs : white oak/annual grass
- 10% ET 321-3 - basalt plateau : Lithic Ruptic-Haplic Argixerolls : wedgeleaf ceanothus/annual grass
- 10% Inclusions: deep Haploxeralfs on basalt with ponderosa pine–black oak; and fine-textured Alfisols in basin-fill with annual herbs.

ET 322-1

basalt plateau: Vitrandic Palexeralfs : ponderosa pine–black oak

Geomorphology—Fluvial/Eroding Hill Slopes. The landform is a gently sloping volcanic plateau. Fluvial erosion by overland flow of water is the predominant geomorphic process. It may be effective, however, only after a catastrophic event, such as a forest fire, that leads to the loss of forest litter covering the soils. Chemical denudation by weathering and leaching is also an important geomorphic processes in this ET.

Soils—Vitrandic Palexeralfs. They are fine-loamy, oxidic, mesic Vitrandic Palexeralfs that would be in the Jimmerson Series if they were in a mixed, rather than an oxidic, family. These are very deep A-Bt-Cr profile soils with a lithic or a paralithic contact to weathered bedrock below 150 cm depth. They are well drained.

Representative Pedon RC04 – E½, SE/¼, sec. 7, R37N, R3E, Burney Falls Quadrangle.

Classification:	fine-loamy, oxidic, mesic Vitrandic Palexeralfs
Altitude:	3,320 feet
Slope:	convex (linear along contour) E 9% smooth
Surface Stoniness:	10% gravel, cobbles 1%, "stones" < 1%, no boulders
Oi	3–0 cm; loose over weakly matted pine needles and broad leaves.
A	0–8 cm; dark reddish brown (5YR 3/2) loam, reddish brown (5YR 5/3) dry; moderate, fine granular; soft, slightly sticky, nonplastic; common very fine roots; slightly hydrophobic; neutral; clear wavy boundary.
AB	8–18 cm; dark reddish brown (5YR 3/3) loam; weak, fine and medium subangular blocky; firm, slightly sticky, slightly plastic; common fine and medium roots; slightly acid to neutral; gradual, smooth boundary.
Bt1	18–48 cm; dark reddish brown (5YR 3/4) clay loam; moderate, fine and medium subangular blocky; very firm, sticky, slightly plastic; discontinuous thin coatings on ped faces; few fine, medium, and coarse roots; slightly acid; diffuse boundary.
Bt2	48–90 cm; dark reddish brown (2.5YR 4/4) clay loam; moderate, fine and medium subangular blocky; very firm, very sticky, plastic; continuous thin coatings on ped faces; few fine, medium, and coarse roots; moderately acid; diffuse boundary.
BC	90–110+ cm; reddish brown (5YR 4/4) gravelly clay loam; weak, fine and medium, subangular blocky; very firm, very sticky, plastic; very few fine and medium roots; continuous thin coatings on ped faces; color of Truog pH indicator fades.

Potential Natural Plant Community—Ponderosa pine–black oak. The cover is dense conifer forest, with at least 10% black oak and sparse squawcarpet and greenleaf manzanita. Deerbrush and many herbaceous plants are common in successional stages of this potential natural plant community.

Plants at representative site RC04.

Tree cover, 80%: *Pinus ponderosa*, 50%; *Libocedrus decurrens*, 10%; and *Quercus kelloggii*, 20%. Shrubs cover, 6%: *Arctostaphylos patula*, 2%; *Ceanothus prostratus*, 3%; and *Ceanothus integerrimus*, 1%. Forb cover, 12%; *Polygala cornuta cornuta*, 10%; *Galium bolanderi*, 1%; *Hieracium albiflorum*, 1%; and *Clarkia rhomboidea*, *Eriogonum nudum*, *Calystegia* sp, and *Lathyrus* or *Vicia* sp, each < 1%. Graminoid cover, 6%: *Festuca occidentalis*, 2%; *Elymus elymoides*, 1%; *Carex multicaulis*, 1%; *Achnatherum occidentalis*, 1%; *Bromus orcuttianus* < 1%; and *Festuca californica* < 1%. Black oak and incense-cedar seedlings present in understory. A few large Douglas-fir and sugar pine trees are present near site RC04.

ET 322-2 = ET 321-2

ET 322-3 = ET 321-1

330 - PIT RIVER NONFORESTED INNER-GORGE, 60–85% slopes

EMU 330 is on very steep slopes of the Pit River inner-gorge. The inner-gorge is characterized by linear slopes that have gradients near the angle of repose for the material on the slopes. That happens to be about 72–85% for the volcanic rocks in this EMU. Less steep slopes on talus and finer colluvium at the foot of the long linear slopes are relatively short. Alluvial fans that spread over the edges of terraces and floodplain at the bottom of the inner-gorge are relatively inextensive. The altitude range is 2,400–3,400 feet (730–1,040 m) and the mean annual precipitation is about 50–60 inches (125–150 cm).

Lithology—middle to late Tertiary andesite and basalt flow rock and andesitic and more silicic breccias and tuff-breccias. These rocks may belong in the western Cascade group (McDonald 1966) which ranges in age from Eocene to early Pliocene (Hammon 1979).

Map Unit Composition

- 40% ET 330-1 - andesite inner-gorge : Pachic Haploxerolls : white oak/skunkbrush
- 20% ET 330-2 - andesite inner-gorge : Lithic Xerorthents : birchleaf mountain mahogany/annual grass
- 20% ET 330-3 - andesite inner-gorge : Mollic Haploxeralfs : white oak deerbrush
- 20% Inclusions: benches and terraces with mixed conifer–black oak; talus with canyon live oak; and colluvial footslopes with mixed conifer (predominantly Douglas-fir, ponderosa pine, and incense-cedar trees) and black oak

ET 330-1

andesite inner-gorge : Pachic Haploxerolls : white oak/skunkbrush

Geomorphology—Mass Wasting/Flow. The landform is inner-gorge sideslopes that are in the Pit River canyon. These slopes are very steep and mostly linear in profile. Debris flow is the predominant geomorphic process.

Soils—Pachic Haploxerolls. They are loamy-skeletal, mixed, thermic Pachic Haploxerolls. These are very deep A–C profile soils in colluvium of volcanic rocks. They are somewhat excessively well drained.

Representative Pedon RC09 – middle, sec. 1, R36N, R2E, Burney Falls Quadrangle.

Classification:	loamy-skeletal, mixed, thermic Pachic Haploxerolls
Altitude:	2,720 feet
Slope:	convex S 72% smooth
Surface Stoniness:	60% gravel, 10% cobbles, 2% "stones", boulders < 1%
Oi	1–0 cm; loose leaves of shrubs, oak trees, and grass.
A1	0–21 cm; very dark grayish brown (10YR 3/2) extremely gravelly loam, dark brown (10YR 4/3) dry; moderate, fine granular; slightly hard, slightly sticky, slightly plastic; common very fine and few fine and medium roots; slightly acid; clear wavy boundary.
A2	21–60 cm; dark brown (10YR 3/3) extremely gravelly loam, brown (10YR 5/3) dry; moderate, very fine subangular blocky; very friable, slightly sticky, slightly plastic; common fine, medium, and coarse roots; neutral; diffuse boundary.

A3	60–90 cm; dark brown (10YR 3/3) extremely gravelly loam, brown (10YR 5/3) dry; weak, very fine subangular blocky; very friable, slightly sticky, slightly plastic; few fine, medium, and coarse roots; neutral; gradual, smooth boundary.
C	90–150+ cm; dark yellowish brown (10YR 3/4) extremely gravelly loam, yellowish brown (10YR 5/4) dry; massive; friable, slightly sticky, slightly plastic; very few fine and medium roots; neutral.

Potential Natural Plant Community—White oak/skunkbrush. The cover is open oak woodland, with at least 20% white oak and 10% skunkbrush. Birchleaf mountain mahogany and other shrubs are generally present, skunkbrush is the dominant one. There is a dense cover of annual grass among the trees and shrubs.

Plants at representative site RC09.

Tree cover, 30%: *Quercus garryana*, 30%. Shrub cover, 30%: *Rhus trilobata*, 25%; *Cercocarpus betuloides*, 3%; *Cercis occidentalis*, 2%; and *Toxicodendron diversilobum* < 1%. Forb cover, 10%; dry annual forbs. Graminoid cover, 60%: dry, unidentified annual grasses, presumably *Vulpia* sp or spp, 40%; *Bromus tectorum*, 20%; *Bromus diandrus* < 1%. Identification of the dried-up annual herbs was not attempted at this site.

ET 330-2

andesite inner-gorge : Lithic Xerorthents : birchleaf mountain mahogany/annual grass

Geomorphology—Fluvial/Eroding Hillslopes. The landform is inner-gorge sideslopes that are in the Pit River canyon. These slopes are very steep and mostly linear in profile. Erosion by overland flow of water is the predominant geomorphic process.

Soils—Lithic Xerorthents. They are loamy-skeletal, mixed, nonacid, thermic Lithic Xerorthents. These are shallow A-Bw-R profile soils on andesite or basalt that range to Lithic Xerochrepts where deeper than 25 cm and to Lithic Haploxerolls where the A horizon is thicker. They are somewhat excessively well drained.

Representative Pedon RC11 – NW¼, NW¼, sec. 6, R36N, R3E, Burney Falls Quadrangle.

Classification:	loamy-skeletal, mixed, nonacid, thermic Lithic Xerorthents
Altitude:	2,870 feet
Slope:	linear SSE 80% rocky
Surface Stoniness:	40% gravel, 15% cobbles, 5% "stones", 2% boulders
Oi	1–0 cm; scattered shrub leaves and grass.
A	0–4 cm; dark brown (7.5YR 3/2) very gravelly loam, brown (7.5YR 5/3) dry; moderate, very fine subangular blocky; slightly hard, slightly sticky, nonplastic; very few very fine roots; slightly acid; abrupt, wavy boundary.
Bw	4–16 cm; dark brown (7.5YR 3/4) very gravelly loam, brown (7.5YR 5/4) dry; moderate, very fine, subangular blocky; slightly hard, slightly sticky, slightly plastic; few very fine and fine roots; slightly acid; abrupt, irregular boundary.
Cr/R	16–25+; hard andesite in slightly hard matrix that is harder within 50 cm depth.

Potential Natural Plant Community—Birchleaf mountain mahogany/annual grass. The cover is discontinuous shrub, sparse white oak trees, and moderately dense annual grass. The shrub cover is mountain mahogany > 10% and no more than 20% skunkbrush, wedgeleaf ceanothus, or any other shrub species. The annual grasses are mainly rattail fescue and soft chess, and cheatgrass where the ground has been eroded or disturbed in other ways.

Plants at representative site RC11.

Tree cover, 6%: *Quercus garryana*, 5%; *Juniperus occidentalis*, 1%. Shrub cover, 50%: *Rhus trilobata*, 20%; *Cercocarpus betuloides*, 20%; *Ceanothus cuneatus*, 6%; *Cercis occidentalis*, 1%; and *Chrysothamnus* sp, 1%. Forb cover, 8%: *Monardella lanceolata*, 5%; Asteraceae, 2%; *Centaurea solstitialis*, 1%. Graminoid cover, 20%; *Vulpia myuros*, 10%; *Bromus hordeaceus*, 5%; *Bromus tectorum*, 5%; *Bromus diandrus* < 1%.

ET 330-3

andesite inner-gorge : Mollic Haploxeralfs : white oak/deerbrush

Geomorphology—Mass Wasting/Flow. The landform is inner-gorge sideslopes that are in the Pit River canyon. These slopes are very steep and mostly linear in profile. Debris flow is the predominant geomorphic process, but slopes have been stable long enough for argillic horizons to develop.

Soils—Mollic Haploxeralfs. They are loamy-skeletal, mixed, mesic Mollic Haploxeralfs. These are very deep A-Bt profile soils in colluvium of volcanic rocks. They are well drained.

Representative Pedon RC10 – E½, NE¼, sec. 1, R36N, R2E, Burney Falls Quadrangle.

Classification:	loamy-skeletal, mixed, mesic Mollic Haploxeralfs
Altitude:	2,800 feet
Slope:	linear E 75% smooth
Surface Stoniness:	10% gravel, 5% cobbles, 2% "stones", boulders < 1%
Oi	2–0 cm; loose leaves of oak trees.
A	0–5 cm; dark brown (7.5YR 3/3) gravelly loam, brown (7.5YR 5/3) dry; strong, fine granular; soft, slightly sticky, slightly plastic; few very fine roots; neutral; clear smooth boundary.
AB	5–30 cm; dark brown (7.5YR 3/4) gravelly loam, brown (7.5YR 5/4) dry; moderate, fine subangular blocky; friable, slightly sticky, slightly plastic; common fine and medium roots; slightly acid; gradual, smooth boundary.
2Bt1	30–70 cm; dark brown (7.5YR 3/4) very gravelly clay loam; moderate, fine subangular blocky; friable, sticky, plastic; common thin coatings on ped faces; common fine and medium and few coarse roots; moderately acid; diffuse boundary.
2Bt2	90–150+ cm; dark brown (7.5YR 3/4) very gravelly clay loam; moderate, fine subangular blocky; friable, sticky, plastic; discontinuous thin coatings on ped faces; common fine, medium, and coarse roots; moderately acid.

Potential Natural Plant Community—White oak/deerbrush. The cover is dense white oak woodland, with at least 2% deerbrush. Although other shrub species are generally present and one or more may be more prevalent than deerbrush, deerbrush is the indicator of this plant association. Deerbrush is commonly an indicator of timber sites, but there conifers are sparse in this plant association. There is a dense cover of annual grass among the trees and shrubs.

Plants at representative site RC10.

Tree cover, 80%: *Quercus garryana*, 80%; *Pinus ponderosa*, 1%; *Quercus chrysolepis*, 1%. Shrub cover, 15%: *Rhus trilobata*, 5%; *Ceanothus integerrimus*, 5%; *Amelanchier utahensis*, 2%; *Cercocarpus betuloides*, 2%; *Lonicera interrupta*, 1%; and *Toxicodendron diversilobum*, 1%. Forb cover, 3%; *Galium bolanderi*, 1%; *Epilobium brachycarpum*, 1%; and *Clarkia rhomboidea* and *Erigeron* sp, each < 1%. Graminoid cover, 8%: *Bromus tectorum*, 5%; *Bromus diandrus*, 1%; and *Elymus glaucus*, 2%. White oak seedlings are common in the understory.

331 - JAKE SPRING MOUNTAIN SIDESLOPE, 25–60% slopes

EMU 331 is on steep mountain sideslopes above the inner-gorge of the Pit River and, on the north side of the River, above the Delucci hillocks. The altitude range is 3,040–4,040 feet (930–1,230 m), and the mean annual precipitation is 50–60 inches (125–150 cm).

Lithology—andesite or basalt. These are late Tertiary basalt and andesite flows and possibly some andesitic to silicic breccias and tuff-breccias.

Map Unit Composition

70% andesite or basalt mountain sideslopes : Vitrandic Haploxeralfs : mixed conifer–black oak

20% andesite or basalt mountain sideslopes : Vitrandic Palexeralfs : mixed conifer–black oak

10% Inclusions: rock outcrop; and shallow soils with conifers, black oak, and shrubs

ET 331-1

andesite or basalt mountain sideslopes : Vitrandic Haploxeralfs : mixed conifer–black oak

Geomorphology—Undifferentiated Hill (Mountain) Slopes. The landform is steep mountain sideslopes. Mass wasting by flow, fluvial erosion by overland flow of water, and chemical erosion by weathering and leaching are all important geomorphic processes in this ET.

Soils—Vitrandic Haploxeralfs. They are loamy-skeletal, oxidic, mesic Vitrandic Haploxeralfs. These are very deep A-Bt-R or A-Bt-Cr profile soils with a lithic or a paralithic contact to weathered bedrock at 60–150 cm depth. They are well drained.

Representative Pedon RC25 – NE/¼, NE/¼, sec. 14, R36N, R2E, Burney Quadrangle.

Classification:	loamy-skeletal, oxidic, mesic Vitrandic Haploxeralfs
Altitude:	3,620 feet
Slope:	linear (linear along contour, also) W 40% smooth
Surface Stoniness:	15% gravel, 3% cobbles, "stones" < 1%, no boulders
Oi	4–0 cm; loose over weakly matted conifer needles and oak leaves.
A1	0–3 cm; dark reddish brown (5YR 3/3) gravelly sandy loam, brown (7.5YR 5/3) dry; moderate, very fine granular; soft, slightly sticky, nonplastic; few very fine roots; moderately hydrophobic; slightly acid; abrupt, wavy boundary.
A2	3–24 cm; dark reddish brown (5YR 3/4) gravelly sandy loam, reddish brown (5YR 5/5) dry;moderate, very fine subangular blocky; friable, slightly sticky, nonplastic; common fine and medium roots; slightly hydrophobic; moderately to slightly acid; gradual, smooth boundary.
AB	24–42 cm; reddish brown (5YR 4/4) very gravelly loam, light reddish brown (5YR 6/4) dry; moderate, very fine subangular blocky; friable, slightly sticky, nonplastic; common fine, medium, and coarse roots; nonhydrophobic; moderately acid; gradual, smooth boundary.

Bt1	42–75 cm; reddish brown (5YR 4/4) very gravelly loam, light reddish brown (5YR 6/5) dry; moderate fine and medium subangular blocky; firm, slightly sticky, slightly plastic; few thin coatings on ped faces; few fine, medium, and coarse roots; moderately acid; diffuse boundary.
Bt2	75–105 cm; reddish brown (5YR 4/4) very gravelly clay loam, light reddish brown (5YR 6/5) dry; weak, medium subangular blocky; firm, sticky, slightly plastic; common thin coatings on ped faces; very few fine and medium roots; moderately acid; abrupt, irregular boundary.
R	105+ cm; hard, fractured andesite or basalt.
Note:	Some stones weathered soft in B horizon, others still hard but with soft weathering rinds.

Potential Natural Plant Community—Mixed conifer--black oak. The cover is dense conifer forest, with at least 10% black oak. Shrubs and herbaceous plants are scarce, although deerbrush and many herbaceous plants are common in successional stages of this potential natural plant community.

Plants at representative site RC25.

Tree cover, 80%: *Pseudotsuga menziesii*, 40%; *Pinus ponderosa*, 1%; *Pinus lambertiana* < 1%; *Libocedrus decurrens*, 3%; and *Quercus kelloggii*, 20%. Shrub cover, 10%: *Chamaebatia foliolosa*, 10%. Forb cover, 6%: *Trientalis latifolia*, 3%; *Polygala cornuta*, 2%; *Galium bolanderi*, 1%; and *Clarkia rhomboidea* < 1%. Graminoid cover, 5%: *Festuca californica*, 5%; *Bromus orcuttianus* < 1%; and *Carex multicaulis* < 1%. Douglas-fir, ponderosa pine, sugar pine, incense-cedar, and black oak seedlings present in understory.

ET 331-2

andesite or basalt plateau : Vitrandic Palexeralfs : mixed conifer–black oak

Geomorphology—Fluvial-Eroding Hill (Mountain) Slopes. The landform is moderately steep to marginally steep mountain ridgetops, benches, and sideslopes. Fluvial erosion by overland flow of water is the predominant geomorphic process. It may be effective, however, only after a catastrophic event, such as a forest fire, that leads to the loss of forest litter covering the soils. Chemical denudation by weathering and leaching is also an important geomorphic processes in this ET.

Soils—Vitrandic Palexeralfs. They are fine-loamy, oxidic, mesic Vitrandic Palexeralfs that would be in the Jimmerson Series if they were in a mixed, rather than an oxidic, family. These are very deep A-Bt-Cr profile soils with a paralithic contact to weathered bedrock below 150 cm depth. They are well drained.

Pedon at site RC06 in ET 332-1 is representative of these soils.

Potential Natural Plant Community—Mixed conifer–black oak. The cover is dense conifer forest, with at least 10% black oak. Shrubs and herbaceous plants are scarce, although deerbrush and many herbaceous plants are common in successional stages of this potential natural plant community.

Vegetation at site RC06 in ET 332-1 is representative of this plant community.

332 - JAKE SPRING PLATEAU, 6–30% slopes

EMU 332 is on broad mountain ridges and the lowest of a series of broad benches or plateaus above the Delucci hillocks, north of the Pit River. It occurs at comparable altitudes south of the Pit River. The altitude range is 3,280–4,000 feet (1,000–1,200 m), and the mean annual precipitation is 50–60 inches (125–150 cm).

Lithology—andesite or basalt. These are late Tertiary basalt and andesite flows and possibly some andesitic to silicic breccias and tuff-breccias.

Map Unit Composition

80% andesite or basalt plateau : Vitrandic Palexeralfs : mixed conifer–black oak
15% andesite or mountain sideslopes : Vitrandic Haploxeralfs : mixed conifer–black oak
5% Inclusions: rock outcrop; and shallow soils with conifers, black oak, and shrubs

ET 332-1

andesite or basalt plateau : Vitrandic Palexeralfs : mixed conifer–black oak

Geomorphology—Fluvial/Eroding Hill (Mountain) Slopes. The landform is a gently sloping to moderately steep mountain ridgetops, benches, plateaus, and sideslopes. Fluvial erosion by overland flow of water is the predominant geomorphic process. It may be effective, however, only after a catastrophic event, such as a forest fire, that leads to the loss of forest litter covering the soils. Chemical denudation by weathering and leaching is also an important geomorphic processes in this ET.

Soils—Vitrandic Palexeralfs. They are fine-loamy, oxidic, mesic Vitrandic Palexeralfs that would be in the Jimmerson Series if they were in a mixed, rather than an oxidic, family. These are very deep A-Bt-Cr profile soils with a paralithic contact to weathered bedrock below 150 cm depth. They are well drained.

Representative Pedon RC06 – NW/¼, NE/¼, sec. 26, R37N, R2E, Burney Falls Quadrangle.

Classification:	fine-loamy, oxidic, mesic Vitrandic Palexeralfs
Altitude:	3,580 feet
Slope:	linear (convex along contour) ESE 27% smooth
Surface Stoniness:	20% gravel, cobbles < 1%, no "stones", no boulders
Oi	3–0 cm; loose over weakly matted pine and Douglas-fir needles.
A	0–9 cm; dark reddish brown (5YR 3/3) gravelly loam, brown (7.5YR 5/3) dry; moderate, fine granular; slightly hard, slightly sticky, nonplastic; few very fine, fine, and medium roots; slightly hydrophobic; moderately acid; clear wavy boundary.
AB	9–27 cm; dark reddish brown (5YR 3/4) loam; weak, fine granular; friable, slightly sticky, slightly plastic; common fine, medium, and coarse roots; strongly acid; gradual, smooth boundary.
Bt1	27–54 cm; dark reddish brown (5YR 3/4) clay loam; moderate, fine subangular blocky; firm, sticky, plastic; continuous thin coatings on ped faces; few fine, medium, and coarse roots; moderately acid; diffuse boundary.

Bt2	54–90 cm; dark reddish brown (5YR 3/4) clay loam, with few fine black mottles; moderate, very fine subangular blocky; very firm, sticky, plastic; continuous thin coatings on ped faces; very few fine and medium roots; slightly acid; gradual, wavy boundary.
BC	90–150+ cm; reddish brown (5YR 4/4) gravelly clay loam; massive; extremely firm, very sticky, plastic; very few fine and medium roots; moderately acid.
Note:	Some stones weathered soft in B horizon, others still hard but with soft weathering rinds.

Potential Natural Plant Community—Mixed conifer–black oak. The cover is dense conifer forest, with at least 10% black oak. Shrubs and herbaceous plants are scarce, although deerbrush and many herbaceous plants are common in successional stages of this potential natural plant community.

Plants at representative site RC06.

Tree cover, 95%: *Pseudotsuga menziesii*, 40%; *Pinus ponderosa*, 20%; *Pinus lambertiana*, 10%; *Libocedrus decurrens*, 10%; and *Quercus kelloggii*, 15%. No shrubs. Herb cover, 1%; *Polygala cornuta*, *Carex rossii*, and *Carex multicaulis*, each < 1%. Black oak, Douglas-fir, ponderosa pine, and incense-cedar seedlings present in understory.

ET 332-2

andesite or basalt mountain sideslopes : Vitrandic Haploxeralfs : mixed conifer–black oak

Geomorphology—Fluvial-Eroding Hill (Mountain) Slopes. The landform is moderately steep ridgetops and mountain sideslopes. Fluvial erosion by overland flow of water is the predominant geomorphic processes in this ET, although chemical denudation by weathering and leaching is important, too.

Soils—Vitrandic Haploxeralfs. They are loamy-skeletal, oxidic, mesic Vitrandic Haploxeralfs. These are moderately deep to deep A-Bt-R or A-Bt-Cr profile soils with a lithic or a paralithic contact to weathered bedrock at 60–150 cm depth. They are well drained.

Pedon at site RC25 in ET 331-1 is representative of these soils.

Potential Natural Plant Community—Mixed conifer–black oak. The cover is dense conifer forest, with at least 10% black oak. Shrubs and herbaceous plants are scarce, although deerbrush and many herbaceous plants are common in successional stages of this potential natural plant community.

Vegetation at site RC25 in ET 331-1 is representative of this plant community.

333 - SUMMIT LAKE MOUNTAIN SIDESLOPES, 25–60% slopes

EMU 333 is on steep mountain sideslopes above or on the north side of ridges, benches or plateaus of the Jake Spring Plateau EMU. The altitude range is 3,320 to 5,040 feet (1,010–1,540 m), and the mean annual precipitation is 55–65 inches (140–165 cm).

Lithology—andesite or basalt. These are late Tertiary basalt and andesite flows and possibly some andesitic to silicic breccias and tuff-breccias.

Map Unit Composition

40%	andesite or basalt mountain sideslopes : Humic Haploxerands : white fir–black oak
40%	andesite or basalt mountain sideslopes : Andic Haplohumults : white fir–black oak
20%	Inclusions: rock outcrop; shallow soils with conifers, black oak, and shrubs on steep slopes; and very deep Andic Palehumults with white fir and black oak on moderately steep slopes

ET 333-1

andesite or basalt mountain sideslopes : Humic Haploxerands : white fir–black oak

Geomorphology—Undifferentiated Hill (Mountain) Slopes. The landform is steep mountain sideslopes. Mass wasting by flow, fluvial erosion by overland flow of water, and chemical erosion by weathering and leaching are all important geomorphic processes in this ET.

Soils—Humic Haploxerands. They are medial-skeletal, mesic Humic Haploxerands that are similar to the Depner Series of Typic Haploxerands. These are moderately deep to deep A-Bw-Cr profile soils with a lithic or a paralithic contact to weathered bedrock at 50–150 cm depth. They are well drained.

Representative Pedon RC20 – W½, sec. 8, R37N, R2E, Burney Falls Quadrangle.

Classification:	medial-skeletal, mesic Humic Haploxerands
Altitude:	4,760 feet
Slope:	linear (linear along contour, also) SSE 60% smooth
Surface Stoniness:	20% gravel, 10% cobbles, 5% "stones", 2% boulders
Oi	6–2 cm; loose over matted conifer needles and oak leaves.
Oe	2–0 cm; fragmented, weathered, conifer needles and humus.
A	0–5 cm; very dark brown (7.5YR 2/2) gravelly sandy loam, dark brown (7.5YR 4/3) dry; strong, very fine granular; soft, slightly sticky, nonplastic; common very fine and few fine roots; very highly hydrophobic; neutral; clear, wavy boundary.
AB	5–21 cm; dark brown (7.5YR 3/2) very gravelly sandy loam, brown (7.5YR 5/3) dry; moderate, very fine, subangular blocky; very friable; slightly sticky, nonplastic; common fine, medium, and coarse roots; highly hydrophobic; slightly acid; gradual, smooth boundary.
Bw	21–65 cm; dark brown (7.5YR 3/3) very gravelly sandy loam, brown (7.5YR 5/4) dry; weak, fine, subangular blocky; very friable; slightly sticky, nonplastic; common fine, medium, and coarse roots; slightly hydrophobic; moderately acid; gradual, smooth boundary.

BC	65–90 cm; dark brown (7.5YR 3/4) extremely gravelly sandy loam, brown (7.5YR 5/5) dry; massive; very friable; slightly sticky, nonplastic; few fine and medium roots; strongly acid; abrupt, irregular boundary.
Cr	90–100+ cm; andesite or basalt weathered soft; fractures > 30 cm apart.

Potential Natural Plant Community—White fir–black oak. The cover is dense conifer forest, with at least 15% white fir and 5% black oak. White fir is a dominant or codominant conifer and there are white fir seedlings in the understory. Shrubs and herbaceous plants are scarce, although shrubs and many herbaceous plants are common in successional stages of this potential natural plant community.

Plants at representative site RC20.

Tree cover, 90%: *Abies concolor*, 15%; *Pseudotsuga menziesii*, 15%; *Pinus ponderosa*, 15%; *Pinus lambertiana* 15%; *Libocedrus decurrens*, 15%; *Quercus kelloggii*, 10%; and *Cornus nuttallii*, 5%. Shrub cover, < 1%: *Amelanchier utahensis* and *Symphorocarpus mollis*. Forb cover, 5%: *Campanula prenanthoides*, 1%; and *Galium bolanderi, Epilobium brachycarpum, Apocynum androsaemifolium, Clarkia rhomboidea, Hieracium albiflorum, Phacelia* sp, and *Penstemon* sp, each < 1%. Graminoid cover, 2%: *Carex rossii*, 2%; *Bromus orcuttianus* < 1%; and *Melic aristata* < 1%. Five mixed conifer species are about equally abundant, and all have seedlings in the understory. White fir trees are more dominant on north and east-facing slopes than on this site that is transitional to mixed conifer–black oak.

ET 333-2

andesite or basalt mountain sideslopes : Andic Haplohumults : white fir–black oak

Geomorphology—Undifferentiated Hill (Mountain) Slopes. The landform is steep mountain sideslopes. Mass wasting by flow, fluvial erosion by overland flow of water, and chemical erosion by weathering and leaching are all important geomorphic processes in this ET.

Soils—Andic Haplohumults. They are loamy-skeletal, mixed, mesic Andic Haplohumults and Palehumults. These are moderately deep to very deep A-Bt-Cr profile soils with a paralithic contact to weathered bedrock at 60 to > 150 cm depth. The only difference between the Haplohumults and Palehumults is depth to bedrock. Apparently, the Palehumults, which are deeper than 150 cm, are in colluvium. They are well drained.

Representative Pedon RC23 – middle, sec. 31, R37N, R2E, Skunk Ridge Quadrangle.

Classification:	loamy-skeletal, mixed, mesic Andic Palehumult
Altitude:	4,360 feet
Slope:	linear (linear along contour, also) ENE 42% smooth
Surface Stoniness:	5% gravel, 1% cobbles, "stones" < 1%, boulders < 1%
Oi	5–0 cm; loose over weakly matted conifer needles
A1	0–7 cm; very dark brown (7.5YR 2/2) sandy loam, dark brown (7.5YR 4/2) dry; strong, very fine granular; soft, slightly sticky, nonplastic; few very fine roots; highly hydrophobic; moderately acid; clear, smooth boundary.
A2	7–22 cm; very dark brown (7.5YR 2/3) gravelly sandy loam, dark brown (7.5YR 4/3) dry; moderate, very fine, subangular blocky parts to very fine granular; soft, very friable, slightly sticky, nonplastic; common very fine, fine, medium, and coarse roots; highly hydrophobic; slightly acid; clear, wavy boundary.

AB	22–58 cm; dark brown (7.5YR 3/4) gravelly sandy loam, brown (7.5YR 5/4) dry; moderate, fine, subangular blocky; friable; slightly sticky, nonplastic; common fine, medium, and coarse roots; slightly hydrophobic; moderately acid; gradual, smooth boundary.
Bt1	58–115 cm; dark brown (7.5YR 3/4) very gravelly clay loam, brown (7.5YR 5/4) dry; weak, medium, subangular blocky; firm; sticky, plastic; discontinuous coatings on ped faces; few fine, medium, and coarse roots; strongly acid; diffuse boundary.
Bt2	115–155+ cm; dark brown (7.5YR 3/4) very gravelly clay loam; massive; firm; sticky, plastic; very few fine and medium roots; very strongly acid.
Note:	stones hard in A horizon, hardness decreasing with depth, stones slightly hard in B horizon.

Potential Natural Plant Community—White fir–black oak. The cover is dense conifer forest, with at least 15% white fir and 5% black oak. White fir is a dominant or codominant conifer and there are white fir seedlings in the understory. Shrubs and herbaceous plants are scarce, although shrubs and many herbaceous plants are common in successional stages of this potential natural plant community.

Plants at representative site RC23.

Tree cover, 90%: *Abies concolor*, 60%; *Pseudotsuga menziesii*, 5%; *Pinus ponderosa*, 5%; *Pinus lambertiana* 5%; *Libocedrus decurrens*, 10%; *Quercus kelloggii*, 5%; and *Cornus nuttallii*, 10%. Shrub cover, 5%: *Pachistima myrsinites*, 2%; *Rosa gymnocarpa*, 2%; and *Ribes* sp, 1%. Forb cover, 3%: *Chimaphila umbellata*, 1%; *Pyrola picta*, 1%; *Asarum* sp, 1%; and *Chimaphila menziesii*, *Trientalis latifolia*, and *Galium* sp, each < 1%. Graminoid cover, < 1%: *Bromus orcuttianus*. Ferns, < 1%: *Pteridium aquilinum* < 1%. White fir, incense-cedar, and dogwood seedlings are common in the understory.

334 - SUMMIT LAKE PLATEAU, 6–30% slopes

EMU 334 is on broad ridges, benches, and plateau above the ridges, benches, and plateau of the Jake Spring Plateau EMU. The altitude range is 3,560–5,060 feet (1,085–1,540 m), and the mean annual precipitation is 55–65 inches (140–165 cm).

Lithology—andesite or basalt. These are late Tertiary basalt and andesite flows and possibly some andesitic to silicic breccias and tuff-breccias.

Map Unit Composition

70%	andesite or basalt plateau : Andic Palehumults : white fir--black oak
20%	andesite or basalt mountain sideslopes : Andic Haplohumults : white fir–black oak
10%	Inclusions: rock outcrop; shallow soils with conifers, black oak, and shrubs on steep slopes; and Ultic Haploxerands with white fir and black oak on moderately steep slopes

ET 334-1

andesite or basalt plateau : Andic Palehumults : white fir–black oak

Geomorphology—Eroding Hill (Mountain) Slopes. The landforms are gently sloping broad ridges and benches. The benches are old flow surfaces bounded by steep slopes on both upper and lower edges. Fluvial erosion by overland flow of water, and chemical erosion by weathering and leaching are the most important geomorphic processes in this ET.

Soils—Andic Palehumults. They are fine-loamy, oxidic, mesic Andic Palehumults that grade to Andic Palexeralfs (Wyntoon taxajunct) at lower altidude. These are very deep A-Bt-Cr profile soils with a paralithic contact to weathered bedrock below 150 cm depth. They are well drained.

Representative Pedon RC08 – W½, W½, sec. 28, R37N, R2E, Burney Falls Quadrangle.

Classification:	fine-loamy, oxidic, mesic Andic Palehumult
Altitude:	4,580 feet
Slope:	convex (convex along contour, also) WSW 26% smooth
Surface Stoniness:	10% gravel, 2% cobbles, 2% "stones", 1% boulders
Oi	4–1 cm; loose over weakly matted conifer needles
Oe	1–0 cm; weathered and blackened fragments of conifer needles, and humus
A1	0–9 cm; dark reddish brown (5YR 3/2) sandy loam, reddish brown (5YR 5/3) dry; strong, very fine granular; soft, very friable, slightly sticky, nonplastic; common very fine roots; highly hydrophobic; moderately acid; clear, wavy boundary.
A2	9–21 cm; dark reddish brown (5YR 3/3) sandy loam; strong, very fine, granular; very friable, slightly sticky, nonplastic; common fine, medium, and coarse roots; highly hydrophobic; slightly acid; gradual, smooth boundary.
AB	21–42 cm; dark reddish brown (5YR 3/4) gravelly loam; weak, very fine, subangular blocky parts to moderate, very fine granular; very friable; slightly sticky, nonplastic; common fine, medium, and coarse roots; moderately hydrophobic; moderately acid; pH 9.5 in NaF; clear, smooth boundary.
Bt1	42–66 cm; reddish brown (2.5-5YR 4/4) gravelly loam; moderate, fine, subangular blocky; firm; sticky, slightly plastic; common, thin coatings on ped faces; few fine and medium roots; strongly acid; gradual, smooth boundary.

Bt2	66–98 cm; reddish brown (5YR 4/4) clay loam; weak, medium, subangular blocky; firm; sticky, plastic; discontinuous, thin coatings on ped faces and continuous, moderately thick coatings in tubular pores; very few fine and medium roots; very strongly acid; diffuse boundary.
BCt	98–150 cm; reddish brown (5-7.5YR 4/4) gravelly clay loam; weak, coarse, subangular blocky; friable; sticky, plastic; continuous, thin coatings on ped faces; very few fine and medium roots; extremely acid; abrupt, irregular boundary.
Cr	150–160+ cm; andesite or basalt weathered soft; continuous black stains on fractures.
Note:	stones hard above 66 cm, weathered soft below 66 cm depth.

Potential Natural Plant Community—White fir–black oak. The cover is dense conifer forest, with at least 15% white fir and 5% black oak. White fir is a dominant or codominant conifer and there are white fir seedlings in the understory. Shrubs and herbaceous plants are scarce, although shrubs and many herbaceous plants are common in successional stages of this potential natural plant community.

Plants at representative site RC08.

Tree cover, 90%: *Abies concolor*, 25%; *Pseudotsuga menziesii*, 25%; *Pinus ponderosa*, 5%; *Pinus lambertiana* 10%; *Libocedrus decurrens*, 10%; and *Quercus kelloggii*, 15%. Shrub cover, 3%: *Rosa gymnocarpa*, 2%; *Ribes* sp, 1%; and *Symphorocarpus mollis*, *Amelanchier utahensis*, *Pachistima myrsinites*, and *Prunus emarginata*, each < 1%. Forb cover, 1%: *Chimaphila umbellata*, *Pyrola picta*, *Asarum* sp, *Campanula prenanthoides*, *Galium bolanderi*, *Polygala cornuta*, and *Smilacena* sp, each < 1%. Graminoid cover, 1%: *Carex rossii*, 1%; and *Festuca californica*, *Bromus ciliatus*, and *Achnatherum* sp, each < 1%. White fir, incense-cedar, Douglas-fir, sugar pine, ponderosa pine, and black oak seedlings are common in the understory. Mountain whitethorn is abundant on skid trails near site RC23.

ET 334-2

andesite or basalt mountain sideslopes : Andic Haplohumults : white fir–black oak

Geomorphology—Fluvial- Eroding Hill (Mountain) Slopes. The landform is steep mountain sideslopes. Fluvial erosion by overland flow of water is the dominant geomorphic process in this ET, although chemical erosion by weathering and leaching is an important geomorphic processes, too.

Soils—Andic Haplohumults. They are loamy-skeletal, mixed, mesic Andic Haplohumults and Palehumults. These are moderately deep to very deep A-Bt-Cr profile soils with a paralithic contact to weathered bedrock at 60 to > 150 cm depth. The only difference between the Haplohumults and Palehumults is depth to bedrock. Apparently, the Palehumults, which are deeper than 150 cm, are in colluvium. They are well drained.

Pedon at site RC23 in ET 333-2 is representative of these soils.

Potential Natural Plant Community—White fir–black oak. The cover is dense conifer forest, with at least 15% white fir and 5% black oak. White fir is a dominant or codominant conifer and there are white fir seedlings in the understory. Shrubs and herbaceous plants are scarce, although shrubs and many herbaceous plants are common in successional stages of this potential natural plant community.

Vegetation at site RC23 in ET 333-2 is representative of this plant community.

335 - SQUAW FLAT MOUNTAIN SIDESLOPE, 25–60% slopes

EMU 335 is on steep mountain sideslopes above or on the north side of ridges, benches or plateaus of the Summit Lake Plateau EMU. The altitude range is 3,920 to 5,280 feet (1,190–1,610 m), and the mean annual precipitation is 60–70 inches (150–180 cm).

Lithology—andesite or basalt. These are late Tertiary basalt and andesite flows and possibly some andesitic to silicic breccias and tuff-breccias.

Map Unit Composition

- 70% andesite or basalt mountain sideslopes : Humic Haploxerands : white fir/vine maple
- 20% andesite or basalt mountain sideslopes : Humic Haploxerands : white fir/bush chinquapin
- 10% Inclusions: rock outcrop; shallow soils with conifers and shrubs on steep slopes; and deep to very deep Ultic Haploxerands with white fir on moderately steep slopes

ET 335-1

andesite or basalt mountain sideslopes : Humic Haploxerands : white fir/vine maple

Geomorphology—Undifferentiated Hill (Mountain) Slopes. The landform is steep mountain sideslopes. Mass wasting by flow, fluvial erosion by overland flow of water, and chemical erosion by weathering and leaching are all important geomorphic processes in this ET.

Soils—Humic Haploxerands. They are medial-skeletal, frigid Humic Haploxerands. These are very deep A-Bw-Cr profile soils with a lithic or a paralithic contact to weathered bedrock at 50 to > 150 cm depth. They are well drained.

Representative Pedon RC01 – SE¼, sec. 18, R37N, R2E, Skunk Ridge Quadrangle.

Classification:	medial-skeletal, frigid Humic Haploxerand
Altitude:	4,880 feet
Slope:	linear (linear along contour, also) WNW 45% smooth
Surface Stoniness:	5% gravel, 1% cobbles, 1% "stones", 1% boulders
Oi	5–0 cm; matted fir and pine needles (L-layer, 3 cm) over weathered leaf fragments (F-layer, 2 cm).
A1	0–4 cm; very dark brown (7.5YR 2/2) loam, dark brown (7.5YR 3/3) dry; strong, very fine granular; soft, slightly sticky, nonplastic; few very fine roots; very highly hydrophobic; strongly acid; abrupt, smooth boundary.
A2	4–16 cm; very dark brown (7.5YR 2/2) loam; strong, very fine granular; very friable, slightly sticky, nonplastic; common very fine and fine roots; highly hydrophobic; moderately acid; gradual, smooth boundary.
AB	16–48 cm; dark brown (7.5YR 3/2) gravelly loam; strong, very fine granular; very friable; slightly sticky, nonplastic; many fine, medium, and coarse roots; moderately hydrophobic; strongly to moderately acid; gradual, smooth boundary.
Bw	48–72 cm; dark brown (7.5YR 3/4) very gravelly loam; strong, very fine granular; very friable; slightly sticky, nonplastic; common fine, medium, and coarse roots; slightly hydrophobic; strongly acid; clear, wavy boundary.
Cr	72–110+ cm; highly fractured (cracks 5 to 10 cm apart) andesite or basalt weathered soft.

Potential Natural Plant Community—White fir/vine maple. The cover is dense conifer forest, with at least 15% white fir and no more than 5% black oak. White fir is a dominant or codominant conifer and there are white fir seedlings in the understory. Vine maple is generally present and more abundant than bush chinquapin. Herbaceous plants are scarce, although shrubs and many herbaceous plants are common in successional stages of this potential natural plant community.

Plants at representative site RC01.

Tree cover, 80%: *Abies concolor*, 60%; *Pseudotsuga menziesii*, 15%; *Pinus lambertiana* 5%; *Quercus kelloggii*, 5%; *Populus tremuloides*, 1%; and *Cornus nuttallii*, 2%. Shrub cover, 15%: *Chrysolepis sempervirens*, 3%; *Acer circinatum*, 10%; *Salix scouleriana*, 2%; *Amelanchier utahensis*, 1%; and *Symphorocarpus mollis*, *Ceanothus velutinus*, *Pachistima myrsinites*, *Rosa gymnocarpa*, *Rubus parviflorus*, and *Ribes* sp, each < 1%. Forb cover, 5%: *Chimaphila menziesii*, 2; *Pyrola picta*, 2%; *Galium aparine*, 1%; and *Veratrum californicum*, *Phacelia* sp, and *Lilium* sp, each < 1%. Graminoid cover, 2%: *Carex rossii*, 2%; *Festuca californica* < 1%; and *Melic aristata* < 1%. Ferns, 1%: *Pteridium aquilinum*. White fir seedlings are common in understory. This is a moist site, but not a wet one, even though corn lily is present.

ET 335-2

andesite or basalt plateau : Humic Haploxerands : white fir/bush chinquapin

Geomorphology—Eroding Hill (Mountain) Slopes. The landform is moderately steep broad mountain ridges, benches, and sideslopes. Fluvial erosion by overland flow of water and chemical erosion by weathering and leaching are important geomorphic processes in this ET. Fluvial erosion is dependent on burning, or other disturbance, to remove the cover of forest litter.

Soils—Humic Haploxerands. They are medial, frigid Humic Haploxerands. These are very deep A-Bw-Cr profile soils with a lithic or a paralithic contact to weathered bedrock at 60 to > 150 cm depth. They are well drained.

Pedon at site RC03 in ET 336-1 is representative of these soils.

Potential Natural Plant Community—White fir/bush chinquapin. The cover is dense conifer forest, with at least 15% white fir and no more than 5% black oak. White fir is a dominant or codominant conifer and there are white fir seedlings in the understory. Bush chinquapin is generally present and more abundant than vine maple. Herbaceous plants are scarce, although shrubs and many herbaceous plants are common in successional stages of this potential natural plant community.

Vegetation at site RC03 is representative of this plant community.

336 - SQUAW FLAT PLATEAU, 6–30% slopes

EMU 336 is on broad ridges, benches, and plateau above the ridges, benches, and plateau of the Summit Lake Plateau EMU. The altitude range is 4,920 to 5,360 feet (1,500–1,630 m), and the mean annual precipitation is 60–70 inches (150–180 cm).

Lithology—andesite or basalt. These are late Tertiary basalt and andesite flows and possibly some andesitic to silicic breccias and tuff-breccias.

Map Unit Composition

40%	andesite or basalt plateau : Humic Haploxerands : white fir/bush chinquapin
40%	andesite or basalt plateau : Ultic Haploxerands : white fir/bush chinquapin
15%	andesite or basalt mountain sideslopes : Humic Haploxerands : white fir/vine maple
5%	Inclusions: rock outcrop; shallow soils with white fir and shrubs on moderately steep slopes; and riparian areas along drainage ways

ET 336-1

andesite or basalt plateau : Humic Haploxerands : white fir/bush chinquapin

Geomorphology—Eroding Hill (Mountain) Slopes. The landform is gently sloping to moderately steep broad mountain ridges and small plateaus. Fluvial erosion by overland flow of water and chemical erosion by weathering and leaching are important geomorphic processes in this ET. Fluvial erosion is dependent on burning, or other disturbance, to remove the cover of forest litter.

Soils—Humic Haploxerands. They are medial and medial over loamy-skeletal (Revit Series), frigid Humic Haploxerands. These are very deep A-Bw-Cr profile soils with a lithic or a paralithic contact to weathered bedrock at 60 to > 150 cm depth. They are well drained.

Representative Pedon RC03 – NW¼, sec. 18, R37N, R2E, Skunk Ridge Quadrangle.

Classification:	medial, frigid Humic Haploxerand
Altitude:	5,100 feet
Slope:	linear (convex along contour) S 8% smooth
Surface Stoniness:	5% gravel, cobbles < 1%, 1% "stones", 2% boulders
Oi	10–5 cm; matted fir needles.
Oe	5–0 cm; weathered conifer needle fragments and humus; few very fine roots..
A	0–15 cm; very dark brown (7.5YR 2/2) loam, dark brown (7.5YR 3/3) dry; strong, very fine granular; very friable; slightly sticky, nonplastic; common very fine, fine, and medium roots; highly hydrophobic; strongly acid; gradual, smooth boundary.
AB	15–38 cm; dark reddish brown (5YR 2/3) loam, reddish brown (5YR 4/3) dry; weak, very fine and fine, subangular blocky; very friable; slightly sticky, nonplastic; common fine, medium, and coarse roots; moderately hydrophobic; very strongly to strongly acid; clear, smooth boundary.
Bw	38–58 cm; dark reddish brown (5YR 3/3) gravelly loam, reddish brown (5YR 4/4) dry; weak, fine, subangular blocky; friable; slightly sticky, nonplastic; few fine, medium, and coarse roots; slightly hydrophobic; very strongly acid; gradual, smooth boundary.

BC	58–72 cm; dark reddish brown (2.5YR 3/4) very gravelly loam, reddish brown (5YR 5/4) dry; massive; friable; slightly sticky, nonplastic; very few fine and medium roots; slightly hydrophobic; extremely acid; abrupt, irregular boundary.
Cr	72–80+ cm; andesite or basalt weathered soft.

Potential Natural Plant Community—White fir/bush chinquapin. The cover is dense conifer forest, with at least 15% white fir and no more than 5% black oak. White fir is a dominant or codominant conifer and there are white fir seedlings in the understory. Bush chinquapin is generally present and more abundant than vine maple. Herbaceous plants are scarce, although shrubs and many herbaceous plants are common in successional stages of this potential natural plant community.

Plants at representative site RC03.

Tree cover, 75%: *Abies concolor*, 70%; *Pinus lambertiana* 5%; and *Populus tremuloides*, 2%. Shrub cover, 35%: *Chrysolepis sempervirens*, 30%; *Acer circinatum*, 3%; *Salix scouleriana*, 2%; *Amelanchier utahensis*, 2%; *Quercus kelloggii*, 1%; *Rubus parviflorus* < 1%; and *Ribes* sp < 1%. Forb cover, 2%: *Chimaphila menziesii*, 1; and *Pyrola picta*, 1%. Ferns, 5%: *Pteridium aquilinum*. White fir seedlings are present in understory. Black oak is a shrub at this site; it is not excepted to become a tree. Spreading dogbane and sedge are present in disturbed areas near site RC03.

ET 336-2

andesite or basalt plateau : Ultic Haploxerands : white fir/bush chinquapin

Geomorphology—Fluvial-Eroding Hill (Mountain) Slopes. The landforms are gently sloping broad ridges and benches. The benches are old flow surfaces bounded by steep slopes on both upper and lower edges. Fluvial erosion by overland flow of water, and chemical erosion by weathering and leaching are the most important geomorphic processes in this ET.

Soils—Ultic Haploxerands. They are medial over fine-loamy, frigid Ultic Haploxerands. These are deep to very deep A-Bt-Cr profile soils with a paralithic contact to weathered bedrock below 100 or 150 cm depth. They are well drained.

Representative Pedon RC24 – N½, sec. 20, R37N, R2E, Skunk Ridge Quadrangle.

Classification:	medial over fine-loamy, frigid Ultic Haploxerands
Altitude:	4,880 feet
Slope:	convex (convex along contour, also) N 12% smooth
Surface Stoniness:	10% gravel, 3% cobbles, 2% "stones", 1% boulders
Oi	6–2 cm; loose over weakly matted conifer needles
Oe	2–0 cm; weathered fragments of conifer needles, and humus
A1	0–8 cm; very dark reddish brown (5YR 2/2) gravelly sandy loam, dark reddish gray (5YR 4/2) dry; strong, very fine granular; soft, slightly sticky, nonplastic; few very fine roots; very highly hydrophobic; strongly acid; clear, smooth boundary.
A2	8–20 cm; dark reddish brown (5YR 2/3) gravelly sandy loam, reddish brown (5YR 4/3) dry; strong, very fine, granular; very friable, slightly sticky, nonplastic; common very fine, fine, medium, and coarse roots; moderately hydrophobic; moderately acid; clear, wavy boundary.

AB	20–35 cm; dark reddish brown (2.5YR 3/4) gravelly sandy loam, reddish brown (5YR 5/4) dry; weak, very fine, subangular blocky; very friable; slightly sticky, nonplastic; common fine, medium, and coarse roots; slightly hydrophobic; moderately acid; pH 11.4 in NaF; gradual, smooth boundary.
Bt1	35–54 cm; yellowish red (5YR 4/6) gravelly sandy clay loam; moderate, medium, subangular blocky; friable; slightly sticky, slightly plastic; few, thin coatings on ped faces; few fine, medium, and coarse roots; strongly acid; gradual, smooth boundary.
Bt2	54–90 cm; strong brown (7.5YR 5/6) very gravelly clay loam; weak, coarse, subangular blocky; firm; sticky, plastic; discontinuous, thin strong brown (5-7.5YR 4/6 dry) coatings on ped faces; very few fine, medium, and coarse roots; very strongly acid; diffuse boundary.
BC	90–150+ cm; yellowish brown (10YR 5/6) very gravelly clay loam; massive; firm, sticky, plastic; very few fine and medium roots; Truog pH indicator color fades to colorless.
Note:	stones are hard in A horizon, with increased weathering downward to soft stones in lower part of B horizon.

Potential Natural Plant Community—White fir/bush chinquapin. The cover is dense conifer forest, with at least 15% white fir and no more than 5% black oak. White fir is a dominant or codominant conifer and there are white fir seedlings in the understory. Shrubs, other than bush chinquapin, and herbaceous plants are scarce, although shrubs and many herbaceous plants are common in successional stages of this potential natural plant community.

Plants at representative site RC24.

Tree cover, 90%: *Abies concolor*, 80%; *Pinus ponderosa*, 5%; and *Pinus lambertiana* 5%; Shrub cover, 10%: *Chrysolepis sempervirens*, 10%; and *Pachistima myrsinites* < 1%. Forb cover, 5%: *Chimaphila umbellata*, 3%; *Chimaphila menziesii*, 1%; and *Pyrola picta* < 1%, and *Hieracium albiflorum* < 1%. White fir seedlings are present in the understory. The stand was thinned several years before it was described.

ET 336-3

andesite or basalt mountain sideslopes : Humic Haploxerands : white fir/vine maple

Geomorphology—Fluvial-Eroding Hill (Mountain) Slopes. The landforms are gently sloping broad ridges to moderately slopes at the edges of plateaus and benches. The benches are old flow surfaces bounded by steep slopes on both upper and lower edges. Fluvial erosion by overland flow of water, and chemical erosion by weathering and leaching are the most important geomorphic processes in this ET.

Soils—Humic Haploxerands. They are medial-skeletal, frigid Humic Haploxerands. These are very deep A-Bw-Cr profile soils with a lithic or a paralithic contact to weathered bedrock at 50 to > 150 cm depth. They are well drained.

Pedon at site RC01 is representative of these soils.

Potential Natural Plant Community—White fir/vine maple. The cover is dense conifer forest, with at least 15% white fir and no more than 5% black oak. White fir is a dominant or codominant conifer and there are white fir seedlings in the understory. Vine maple is generally present and more abundant than bush chinquapin. Herbaceous plants are scarce, although shrubs and many herbaceous plants are common in successional stages of this potential natural plant community.

Vegetation at site RC01 is representative of this plant community.

337 - JAKE SPRING NONFOREST, 25–60% slopes

EMU 337 is on steep mountain sideslopes above the Delucci hillocks. The landform is similar to that of Jake Spring Mountain Sideslope (EMU 331), but EMU is almost exclusively on or about south or southwest-facing slopes, rather than on or about north or northeast-facing slopes. The altitude range is 3,000 to 3,640 feet (910–1110 m), and the mean annual precipitation is about 40–60 inches (100–150 cm).

Lithology—andesite or basalt. These and late Tertiary basalt and andesite flows, and some andesitic to silicic breccias and tuff-breccias.

Map Unit Composition

- 40% andesite or basalt mountain sideslopes : Typic Argixerolls : white oak/birchleaf mountain mahogany/annual grass
- 30% andesite or basalt mountain sideslopes : Ultic Argixerolls : white oak/birchleaf mountain mahogany
- 20% andesite or basalt mountain sideslopes : Lithic Argixerolls : wedgeleaf ceanothus/ annual grass
- 10% Inclusions: rock outcrop; and Lithic Haploxerolls with shrubs and annual grass

ET 337-1

basalt or andesite mountain sideslopes : Typic Argixerolls : white oak/birchleaf mountain mahogany/annual grass

Geomorphology—Eroding Hill (Mountain) Slopes. The landform is steep mountain sideslopes. Fluvial erosion by overland flow of water is the most important geomorphic processes in this ET.

Soils—Typic Argixerolls. They are loamy-skeletal, mixed, mesic Typic Argixerolls. These are moderately deep to deep A-Bt-R or A-Bt-Cr profile soils with a lithic or a paralithic contact to weathered bedrock between 50 and 150 cm depth. They are well drained.

Pedon at site RC18 in ET 352-1 is representative of the soils in this ET.

Potential Natural Plant Community—white oak/birchleaf mountain mahogany/annual grass. The cover is sparse white oak trees, open shrub, and annual grass among the shrubs. The shrubs are predominantly birchleaf mountain mahogany. Rattail fescue, soft chess, and Japanese chess are common grasses.

Vegetation at site RC18 in ET 352-1 is representative of that in this plant community.

basalt or andesite mountain sideslopes : Ultic Argixerolls : white oak/birchleaf mountain mahogany

Geomorphology—Undifferentiated Hill (Mountain) Slopes. The landform is steep mountain sideslopes. Mass wasting by flow and fluvial erosion by overland flow of water are both important geomorphic processes in this ET.

Soils—Ultic Argixerolls. They are fine-loamy and loamy-skeletal, mixed, mesic Ultic Argixerolls. These are deep to very deep A-Bt-C profile soils > 100 cm deep in colluvium. They are well drained.

Representative Pedon RC07 – middle, sec. 26, R37N, R2E, Burney Falls Quadrangle.

Classification:	fine-loamy, mixed, mesic Ultic Argixerolls
Altitude:	3,480 feet
Slope:	convex (convex along contour, also) N 27% smooth
Surface Stoniness:	10% gravel, 5% cobbles, 2% "stones", 1% boulders
Oi	2–0 cm; loose shrub leaves
A1	0–4 cm; dark brown (7.5YR 3/2) gravelly silt loam, brown (7.5YR 4/3) dry; moderate, fine granular; slightly hard, sticky, slightly plastic; few very fine roots; slightly acid; abrupt, smooth boundary.
A2	4–18 cm; dark brown (7.5YR 3/2) gravelly silt loam, brown (10YR 5/3) dry; weak, fine and medium, subangular blocky; slightly hard, sticky, slightly plastic; common very fine, fine, and medium roots; slightly acid; clear, wavy boundary.
2BAt	18–48 cm; dark brown (7.5YR 3/3) gravelly clay loam; moderate, very fine and fine, subangular blocky; firm; sticky, plastic; discontinuous, thin coatings on ped faces; few fine, medium, and coarse roots; moderately acid; clear, smooth boundary.
3Bt	48–88 cm; dark brown (7.5YR 3/4) silty clay loam; moderate, fine and medium, subangular blocky; very firm; very sticky, plastic; continuous, thin coatings on ped faces; very few fine and medium roots; moderately acid; gradual, smooth boundary.
3BCt	88–110+ cm; dark yellowish brown (10YR 4/4) silty clay loam; moderate, fine subangular blocky; very firm; sticky, plastic; continuous, moderately thick coatings on ped faces; moderately to slightly acid.

Potential Natural Plant Community—white oak/birchleaf mountain mahogany. The cover is open white oak woodland, dense shrub, and grass among the shrubs. The shrubs are predominantly birchleaf mountain mahogany and lesser amounts of wedgeleaf ceanothus and greenleaf manzanita. Japanese chess and western fescue are common grasses.

Plants at representative site RC07.

Tree cover, 20%: *Quercus garryana*. Shrub cover, 70%: *Cercocarpus betuloides*, 40%; *Ceanothus cuneatus*, 20%; *Arctostaphylos patula*, 10%; and *Prunus subcordata* < 1%. Forb cover, < 1%: *Epilobium brachycarpum*, *Clarkia rhomboidea*, and Cichoreae. Graminoid cover, 25%: *Bromus japonicus*, 20%; *Festuca occidentalis*, 5%; and *Elymus glaucus* < 1%.

ET 337-3

basalt or andesite mountain sideslopes : Lithic Argixerolls : wedgeleaf ceanothus/annual grass

Geomorphology—Undifferentiated Hill (Mountain) Slopes. The landform is steep mountain and canyon sideslopes. Mass wasting by flow and fluvial erosion by overland flow of water are both important geomorphic processes in this ET.

Soils— Lithic Argixerolls. They are loamy-skeletal, mixed, mesic Lithic Argixerolls. These are shallow A-Bt-R profile soils with hard bedrock at about 18 to 50 cm depth. They are well drained.

Representative Pedon RC19 – E½, sec. 18, R37N, R3E, Burney Falls Quadrangle.

Classification:	loamy-skeletal, mixed, mesic Lithic Argixerolls
Altitude:	3,080 feet
Slope:	convex (convex along contour, also) S 32% smooth
Surface Stoniness:	20% gravel, 10% cobbles, 3% "stones", no boulders
Oi	1–0 cm; loose shrub leaves and grass; sediment washed down slope has accumulated in a heap on the upslope side of each shrub.
A	0–9 cm; dark brown (7.5YR 3/2) gravelly loam, brown (10YR 4/3) dry; weak, medium, prismatic; cracks at ground surface 2 to 3 mm wide in late August; very hard, slightly sticky, slightly plastic; few very fine roots; neutral; clear, wavy boundary.
Bt	9–22 cm; dark brown (7.5YR 3/3) very gravelly clay loam; moderate, medium, prismatic; very hard; sticky, plastic; few fine roots; slightly acid; abrupt, irregular boundary.
R	22+ cm; hard andesite or basalt.

Potential Natural Plant Community—wedgeleaf ceanothus/annual grass. The cover is open shrub and dense grass among the shrubs. The shrubs are predominantly wedgeleaf ceanothus and lesser amounts of birchleaf mountain mahogany. Soft chess and rattail fescue are common grasses.

Plants at representative site RC19.

Tree cover, 0%. Shrub cover, 40%: *Cercocarpus betuloides*, 10%; *and Ceanothus cuneatus*, 30%. Forb cover, 5%: *Epilobium brachycarpum* 2%; and many species dried and unidentifiable in late August. Graminoid cover, 50%: *Bromus hordeaceus*, 40%; *Vulpia myuros*, 10%; and *Bromus diandrus*, < 1%.

Note: Less soft chess and larger proportion of rattail fescue in eroded spots.

339 - PIT RIVER FORESTED INNER GORGE, 60–85% slopes

EMU 339 is very steep slopes of the Pit River inner-gorge. The inner-gorge is characterized by linear slopes that have gradients near the angle of repose for the materials on the slopes. That happens to be about 72–85% for the volcanic rocks in this EMU. Less steep slopes on talus and finer colluvium at the foot of long linear slopes are relatively short. Alluvial fans that spread over terraces and floodplains at the bottom of the inner-gorge are relatively nonextensive. The altitude range is 2,400 to 3,720 feet (730–1,130 m), and the mean annual precipitation is 50–60 inches (125–150 cm).

Lithology—middle to late Tertiary andesite and basalt flow rock and andesitic and more silicic breccias and tuff-breccias. These rocks may belong to the western Cascade group (McDonald, 1966) which ranges in age from Eocene to early Pliocene Hammond (1979).

Map Unit Composition

40%	ET 339-1 - andesite inner-gorge : Typic Xerochrepts : Douglas-fir--canyon live oak
20%	ET 339-2 - andesite inner-gorge : Lithic Mollic Haploxeralfs : canyon live oak
20%	ET 339-3 - andesite inner-gorge : fragmental colluvium : barren
20%	Inclusions: Lithic Xerorthents or Lithic Haploxerolls with canyon live oak and shrubs on spur ridges; and Typic or Dystric Xerorthents with Douglas-fir--canyon live oak on recent colluvium.

ET 339-1

andesite inner-gorge : Typic Xerochrepts : Douglas-fir–canyon live oak

Geomorphology—Mass Wasting/Flow. The landform is inner-gorge sideslopes that are in the Pit River canyon. These slopes are very steep and mostly linear. Debris flow is the predominant geomorphic processes in this ET.

Soils—Typic Xerochrepts. They are loamy-skeletal, mixed, mesic Typic Xerochrepts. These are very deep A-Bw-C or A-Bt-C profile soils > 150 cm deep in colluvium. The gradual and slight clay increase downward into the Bt horizon, where it is present, is generally insufficient to make it an argillic horizon. The soils are somewhat excessively well drained.

Representative Pedon RC2 – NW¼, sec. 11, R36N, R2E, Burney Quadrangle.

Classification:	loamy-skeletal, mixed, mesic Typic Xerochrept
Altitude:	3,040 feet
Slope:	linear (linear along contour, also) N 85%
Surface Stoniness:	60% gravel, 15% cobbles, 5% "stones", 2% boulders
Oi	2–0 cm; loose over slightly matted conifer needles and broad leaves
A	0–5 cm; dark brown (7.5YR 3/3) very gravelly loam, brown (10YR 5/3) dry; strong, fine granular; soft, slightly sticky, nonplastic; few very fine roots; moderately hydrophobic; strongly to moderately acid; clear, smooth boundary.
AB	5–14 cm; dark brown (7.5YR 3/4) very gravelly loam, pinkish gray (7.5YR 6/3) dry; moderate, fine granular; soft, slightly sticky, nonplastic; common very fine, fine, and medium roots; nonhydrophobic; moderately acid; gradual, smooth boundary.

BA	14–45 cm; dark brown (7.5YR 3/4) very gravelly loam; moderate, very fine, subangular blocky; very friable, slightly sticky, nonplastic; common fine, medium, and coarse roots; moderately to slightly acid; diffuse boundary.
Bt	44–110+ cm; brown (7.5YR 4/4) extremely gravelly loam; moderate, fine subangular blocky; friable, sticky, slightly plastic; few, thin coatings on ped faces; few fine, medium, and coarse roots; slightly acid; gradual, smooth boundary.
Note:	all stones hard, negligible weathering rinds.

Potential Natural Plant Community—white oak/birchleaf mountain mahogany/annual grass. The cover is open white oak woodland, dense shrub, and grass among the shrubs. The shrubs are predominantly birchleaf mountain mahogany and lesser amounts of wedgeleaf ceanothus and greenleaf manzanita. Japanese chess and western fescue are common grasses.

Plants at representative site RC27.

Tree cover, 80%: *Pseudotsuga menziesii*, 60%; *Abies concolor* < 1%; *Pinus lambertiana* < 1%; *Quercus chrysolepis*, 20%; *Quercus kelloggii*, 5%; *Acer macrophyllum*, 5%; and *Cornus nuttallii*, 1%. Shrub cover, 7%: *Symphoricarpos mollis*, 3%; *Ceanothus integerrimus*, 1%; *Toxicodendron diversiloba*, 2%; *Rosa gymnocarpa*, 1%; *Chamaebatia foliolosa*, 1%; and *Ribes* sp, 1%. Forb cover, 4%: *Trientalis latifolia*, 3%; and *Epilobium brachycarpum, Polygala cornuta, Galium bolanderi, Campanula prenanthoides, Hieracium albiflorum*, and *Saxifraga* sp, each < 1%. Graminoid cover, 2%: *Festuca californica*, 2; and *Carex multicaulis* < 1%. Ferns, 1%. *Polysticum* sp.

ET 339-2

andesite inner-gorge : Lithic Mollic Haploxeralfs : canyon live oak

Geomorphology—Mass Wasting/Flow. The landform is inner-gorge sideslopes that are in the Pit River canyon. These slopes are very steep and mostly linear. Debris flow is the predominant geomorphic processes in this ET, although there may be appreciable fluvial erosion by overland flow of water, too. Ground surfaces are commonly sufficiently stable for argillic horizons to form in the shallow soils.

Soils—Lithic Mollic Haploxeralfs. They are loamy-skeletal, mixed, mesic Lithic Mollic Xerochrepts. These are shallow A-Bt-R profile soils with hard bedrock at 18–50 cm depth. They are somewhat excessively well drained.

Representative Pedon RC26 – NW¼, sec. 11, R36N, R2E, Burney Quadrangle.

Classification:	loamy-skeletal, mixed, mesic Lithic Mollic Haploxeralf
Altitude:	3,080 feet
Slope:	linear (convex along contour) W 82%
Surface Stoniness:	40% gravel, 10% cobbles, 3% "stones", 1% boulders
Oi	2–0 cm; discontinuous layer of loose oak leaves
A	0–5 cm; dark brown (7.5YR 3/2) very gravelly loam, grayish brown (10YR 5/2) dry; moderate, fine granular; soft, slightly sticky, nonplastic; few very fine roots; highly hydrophobic; slightly acid to neutral; abrupt, wavy boundary.
AB	5–14 cm; dark brown (7.5YR 3/3) very gravelly loam, brown (7.5YR 5/3) dry; weak, medium, subangular blocky; slightly hard, sticky, slightly plastic; common fine and medium roots; slightly hydrophobic; moderately to slightly acid; clear, wavy boundary.

Bt1	14–28 cm; reddish brown (5YR 4/3) extremely gravelly clay loam; moderate, fine, subangular blocky; firm, sticky, plastic; common fine, medium, and coarse roots; moderately to slightly acid; gradual, smooth boundary.
Bt2	28–42 cm; reddish brown (5YR 4/4) extremely gravelly clay loam; moderate, very fine subangular blocky; firm, sticky, plastic; continuous, thin coatings on ped faces; common fine, medium, and coarse roots; moderately to slightly acid; abrupt, irregular boundary.
R	42+ cm; highly fractured andesite, fractures 10–30 cm apart.
Note:	depth to bedrock ranges from 32 to 52 cm in hand-dug pit.

Potential Natural Plant Community—Canyon Live Oak. The cover is dense canyon live oak forest, with sparse black oak. There is very little understory.

Plants at representative site RC26.

Tree cover, 85%: *Quercus chrysolepis*, 80%; *Quercus kelloggii*, 5%; and *Pinus ponderosa*, 1%. Shrub cover, 2%: *Symphoricarpos mollis* < 1%; and *Toxicodendron diversiloba*, 2%. Forb cover, 0%. Graminoid cover, < 1%: *Carex multicaulis* < 1%.

ET 339-3

andesite inner-gorge : fragmental colluvium : barren

Geomorphology—mass wasting/talus. These are angular rock fragments that have accumulated on very steep slopes and on foot slopes below rock outcrop. They are small boulders, or "stones", cobbles, and pebbles; few are large boulders > 60 cm across.

Soils—Xerorthents. No soils were described in this ET. Where there is enough fine earth (particle < 2 mm) between the coarser rock fragments to classify the soils, they are expected to be fragmental, mixed, mesic Typic or Dystric Xerorthents.

Potential Natural Plant Community—barren. There are lichens on the rock fragments but no vascular plants, except near the margins of some patches of fragmental colluvium. Those margins are colonized by sparse stands of naked buckwheat and few other herbaceous plants.

351 - DELUCCI NONFORESTED SIDESLOPES, 25–60% slopes

EMU 351 is on steep hill and canyon sideslopes. The canyons are cut in an eroded and no longer level bench between the inner-gorge of the Pit River below and late Cenozoic basalt and andesite flows above. The altitude range is 2,920–3,520 feet (890–1,070 m) and the mean annual precipitation is 40–60 inches (100–150 cm).

Lithology—Late Cenozoic strata of volcanic rock, conglomerate, sandstone, and diatomite. Most of the volcanic rock is andesite or basalt. The conglomerate and sandstone have predominantly volcanic clasts. At least some of the diatomite is early Pliocene or older (Aune 1964). It is white, weathering to a buff color.

Map Unit Composition

- 30% ET 351-1 - andesite or basalt hill slopes : Lithic Argixerolls : wedgeleaf ceanothus/annual grass
- 20% ET 351-2 - andesite or basalt hill slopes : Typic Argixerolls : white oak/birchleaf mountain mahogany/annual grass
- 20% ET 351-3 - andesite or basalt hill slopes : Ultic Argixerolls : white oak/birchleaf mountain mahogany
- 20% ET 351-4 - clastic sedimentary hill slopes : Typic Argixerolls : white oak/greenleaf manzanita
- 20% Inclusions: andesite or basalt rock outcrop; Lithic Xerorthents with shrubs and grass on very steep andesite or basalt hill slopes; and very deep Haploxerolls in colluvium on steep sideslopes and on colluvial footslopes.

ET 351-1

andesite or basalt mountain sideslopes : Lithic Argixerolls : wedgeleaf ceanothus/annual grass

Geomorphology—Undifferentiated Hill (Mountain) Slopes. The landform is steep mountain and canyon sideslopes. Mass wasting by flow and fluvial erosion by overland flow of water are both important geomorphic processes in this ET.

Soils—Lithic Argixerolls. They are loamy-skeletal, mixed, mesic Lithic Argixerolls. These are shallow A-Bt-R profile soils with hard bedrock at about 18–50 cm depth. They are well drained.

Pedon at site RC19 in ET 337-3 is representative of the soils in this ET.

Potential Natural Plant Community—wedgeleaf ceanothus/annual grass. The cover is open shrub and dense grass among the shrubs. The shrubs are predominantly wedgeleaf ceanothus and lesser amounts of birchleaf mountain mahogany. Soft chess and rattail fescue are common grasses.

Vegetation at site RC19 in ET 337-3 is representative of this plant community.

ET 351-2

andesite or basalt mountain sideslopes : Typic Argixerolls : white oak/birchleaf mountain mahogany/annual grass

Geomorphology—Eroding Hill (Mountain) Slopes. The landform is steep mountain sideslopes. Fluvial erosion by overland flow of water is the most important geomorphic processes in this ET.

Soils—Typic Argixerolls. They are loamy-skeletal, mixed, mesic Typic Argixerolls. These are moderately deep to deep A-Bt-R or A-Bt-Cr profile soils with a lithic or a paralithic contact to weathered bedrock between 50 and 150 cm depth. They are well drained.

Pedon at site RC18 in ET 352-1 is representative of the soils in this ET.

Potential Natural Plant Community—white oak/birchleaf mountain mahogany/annual grass. The cover is sparse white oak trees, open shrub, and annual grass among the shrubs. The shrubs are predominantly birchleaf mountain mahogany. Rattail fescue, soft chess, and Japanese chess are common grasses.

Vegetation at site RC18 in ET 352-1 is representative of that in this ET.

ET 351-3

andesite or basalt mountain sideslopes : Ultic Argixerolls : white oak/birchleaf mountain mahogany

Geomorphology—Undifferentiated Hill (Mountain) Slopes. The landform is steep mountain sideslopes. Mass wasting by flow and fluvial erosion by overland flow of water are both important geomorphic processes in this ET.

Soils—Ultic Argixerolls. They are fine-loamy and loamy-skeletal, mixed, mesic Ultic Argixerolls. These are deep to very deep A-Bt-C profile soils > 100 cm deep in colluvium. They are well drained.

Pedon at site RC07 in ET 337-2 is representative of the soils at this site.

Potential Natural Plant Community—white oak/birchleaf mountain mahogany. The cover is open white oak woodland, dense shrub, and grass among the shrubs. The shrubs are predominantly birchleaf mountain mahogany and lesser amounts of wedgeleaf ceanothus and greenleaf manzanita. Japanese chess and western fescue are common grasses.

Vegetation at site RC07 in ET 337-2 is representative of that in this ET.

ET 351-4

clastic sedimentary hill slopes : Typic Argixerolls : white oak/greenleaf manzanita

Geomorphology —Undifferentiated Hill Slopes. The landform is steep hill sideslopes. Mass wasting by flow and fluvial erosion by overland flow of water are both important geomorphic processes in this ET.

Soils—Typic Argixerolls. They are fine-loamy to loamy-skeletal, mixed, mesic Typic Argixerolls. These are moderately deep to deep A-Bt-Cr profile soils with a paralithic contact to soft conglomerate, sandstone, or diatomite between 50 and 150 cm depth. They are well drained.

Pedon at site RC17 in ET 352-2 is representative of these soils.

Potential Natural Plant Community—white oak/greenleaf manzanita. The cover is open white oak trees and dense shrub. The shrubs are predominantly greenleaf manzanita.

Vegetation at site RC17 in ET 352-2 is representative of that in this plant community.

ET 352 - DELUCCI NONFORESTED HILLOCKS, 3–30% slopes

EMU 352 is on gently sloping to moderately steep hillocks. Hillocks are hills with relatively little vertical relief. They are on an eroded and no longer level bench between the inner-gorge of the Pit River below and late Cenozoic basalt and andesite flows above. The altitude range is 2,880 to 3,600 feet (880–1,100 m) and the mean annual precipitation is 50–60 inches (100–150 cm).

Lithology–Late Cenozoic strata of volcanic rock, conglomerate, sandstone, and diatomite. Most of the volcanic rock is andesite or basalt. The conglomerate and sandstone have predominantly volcanic clasts. At least some of the diatomite is early Pliocene or older (Aune 1964). It is white, weathering to a buff color.

Map Unit Composition

- 40% ET 352-1 - andesite or basalt hillocks : Typic Argixerolls : white oak/birchleaf mountain mahogany/annual grass
- 30% ET 352-2 - clastic sedimentary hillocks : Typic Argixerolls : white oak/greenleaf manzanita
- 10% ET 352-3 - sandstone hillocks : Leptic Haploxererts : white oak/wedgeleaf ceanothus/annual grass
- 20% Inclusions: andesite or basalt rock outcrop; Lithic Argixerolls on moderately steep andesite or basalt slopes with shrubs and annual grass; and moderately deep Vitrandic Xerochrepts on diatomite with mixed conifers and black oak

ET 352-1

andesite or basalt hillocks : Typic Argixerolls : white oak/birchleaf mountain mahogany/annual grass

Geomorphology—Eroding Hill (Mountain) Slopes. The landform is steep mountain sideslopes. Fluvial erosion by overland flow of water is the most important geomorphic processes in this ET.

Soils—Typic Argixerolls. They are loamy-skeletal, mixed, mesic Typic Argixerolls. These are moderately deep to deep A-Bt-R or A-Bt-Cr profile soils with a lithic or a paralithic contact to weathered bedrock between 50 and 150 cm depth. They are well drained.

Representative Pedon RC18 – NW¼, SW¼, sec. 34, R37N, R2E, Burney Falls Quadrangle.

Classification:	loamy-skeletal, mixed, mesic Typic Argixerolls
Altitude:	3,320 feet
Slope:	convex (convex along contour, also) N 27% smooth
Surface Stoniness:	10% gravel, 5% cobbles, 2% "stones", 1% boulders
Oi	2–0 cm; loose shrub leaves and grass
A1	0–7 cm; dark brown (7.5YR 3/2) loam, brown (10YR 4/3) dry; moderate, very fine, subangular blocky; slightly hard, slightly sticky, slightly plastic; few very fine roots; neutral; clear, wavy boundary.

A2	7–26 cm; dark brown (7.5YR 3/2) very gravelly loam, brown (10YR 4/3) dry; moderate, fine, subangular blocky; friable, slightly sticky, slightly plastic; common very fine, fine, and medium roots; slightly acid; gradual, smooth boundary.
Bt1	26–48 cm; dark brown (7.5YR 3/4) very gravelly clay loam; moderate, medium, subangular blocky; firm; sticky, plastic; discontinuous, thin coatings on ped faces; few fine, medium, and coarse roots; moderately to slightly acid; gradual, smooth boundary.
Bt2	48–76 cm; brown (7.5YR 3/4) extremely gravelly sandy clay loam; moderate, medium, subangular blocky; firm; sticky, plastic; continuous, moderately thick coatings on ped faces; very few fine and medium roots; moderately acid; abrupt, irregular boundary.
Cr	76+; hard volcanic rock in a matrix weathered soft.

Potential Natural Plant Community—white oak/birchleaf mountain mahogany/annual grass. The cover is sparse white oak trees, open shrub, and annual grass among the shrubs. The shrubs are predominantly birchleaf mountain mahogany. Rattail fescue, soft chess, and Japanese chess are common grasses.

Plants at representative site RC18.
Tree cover, 10%: *Quercus garryana*, 10. Shrub cover, 50%: *Cercocarpus betuloides*, 40%; *Ceanothus cuneatus*, 5%; and *Arctostaphylos patula*, 5%. Forb cover, 1%: *Epilobium brachycarpum*, 1%. Graminoid cover, 60%: *Vulpia myuros*, 40%; *Bromus hordeaceus*, 15%; and *Bromus japonicus*, 5%.

ET 352-2

clastic sedimentary hillocks : Typic Argixerolls : white oak/greenleaf manzanita

Geomorphology—Fluvial-Eroding Hill Slopes. The landform is gently sloping to moderately steep hill sideslopes. Fluvial erosion by overland flow of water is the dominant geomorphic processes in this ET.

Soils—Typic Argixerolls. They are fine-loamy to loamy-skeletal, mixed, mesic Typic Argixerolls. These are moderately deep to deep A-Bt-Cr profile soils with a paralithic contact to soft conglomerate, sandstone, or diatomite between 50 and 150 cm depth. They are well drained.

Representative Pedon RC17 – W½, SE¼, sec. 35, R37N, R2E, Burney Falls Quadrangle.

Classification:	fine-loamy, mixed, mesic Typic Argixerolls
Altitude:	2,920 feet
Slope:	convex (convex along contour, also) NNE 46% smooth
Surface Stoniness:	5% gravel, cobbles < 1%, no "stones", no boulders
Oi	3–0 cm; loose shrub and oak leaves
A	0–8 cm; dark brown (7.5YR 3/3) silt loam, brown (7.5YR 4/3) dry; fine, granular; soft; sticky, slightly plastic; common very fine roots; neutral; clear, wavy boundary.
AB	8–24 cm; dark brown (7.5YR 3/3) gravelly silty clay loam, brown (7.5YR 4/4) dry; moderate, fine, subangular blocky; slightly hard, friable, sticky, plastic; common fine, medium, and coarse roots; moderately acid; gradual, smooth boundary.
Bt	24–46 cm; dark brown (7.5YR 3/4) gravelly clay loam; moderate, medium, subangular blocky; firm; sticky, plastic; discontinuous, thin coatings on ped faces; few fine, medium, and coarse roots; slightly acid; gradual, smooth boundary.
BC	46–58 cm; brown (7.5YR 4/4) very gravelly sandy clay loam; massive; firm; sticky, plastic; few fine and medium roots; slightly acid; abrupt, irregular boundary.

2Cr	58–60+ moderately fractured (cracks 10–30 cm apart) buff-colored diatomite.
Note:	pebbles from conglomerate > 90% mafic volcanic rock.

Potential Natural Plant Community—white oak/greenleaf manzanita. The cover is open white oak trees and dense shrub. The shrubs are predominantly greenleaf manzanita.

Plants at representative site RC17.

Tree cover, 40%: *Quercus garryana*, 40. Shrub cover, 80%: *Arctostaphylos patula*, 60%; *Prunus emarginata*, 10%; *Amelanchier utahensis*, 1%. Forb cover, < 1%: *Clarkia rhomboidea*. Graminoid cover, < 1%: *Carex multicaulis*.

ET 352-3

sandstone hillocks : Leptic Haploxererts : white oak/wedgeleaf ceanothus/annual grass

Geology—late Cenozoic sandstone. These clastic sedimentary rocks are soft sandstones with clasts of predominantly volcanic rock fragments.

Geomorphology—Undifferentiated Hill Slopes. The landform is gentle to moderately steep hill summit and sideslopes. Mass wasting by soil creep and fluvial erosion by overland flow of water are both important geomorphic processes in this ET.

Soils—Leptic Haploxererts. They are fine, montmorillonitic, mesic Leptic Haploxererts. These are moderately deep A-AC-Cr profile soils with a paralithic contact to soft sandstone between 50 and 100 cm depth. Vertical cracks open several millimeters wide during late summer. The soils are well drained.

Representative Pedon RC02 – NE¼, SE¼, sec. 35, R37N, R2E, Burney Falls Quadrangle.

Classification:	fine, montmorillonitic, mesic Leptic Haploxererts
Altitude:	3,040 feet
Slope:	convex (convex along contour, also) ESE 16% smooth
Surface Stoniness:	1% gravel, cobbles < 1%, no "stones", no boulders
Oi	1–0 cm; discontinuous layer of loose oak leaves
A1	0–7 cm; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; moderate, medium, subangular blocky and moderate, fine, granular; hard, very sticky, plastic; few very fine roots; slightly acid; clear, smooth boundary.
A2	7–42 cm; very dark grayish brown (10YR 3/2) clay; strong, coarse, prismatic; vertical cracks 3 mm wide and oblique slickensides; extremely firm, very sticky, very plastic; few fine and medium and very few coarse roots; slightly acid; gradual, smooth boundary.
AC	42–65 cm; dark yellowish brown (10YR 3/4) clay loam, dark brown (7.5YR 3/2) on ped faces; moderate, coarse, prismatic; vertical cracks 1 mm wide and oblique slickensides; very firm, very sticky, plastic; very few fine and medium roots; neutral; abrupt, irregular boundary.
Cr	65–80+ cm; buff-colored sandstone, pale brown (10YR 7/4) dry, with common, medium 7.5YR 5/6 and few, fine 7.5YR 3/2 mottles; horizontal stratification; roots along vertical cracks; neutral.
Note:	stones (sparse) are subangular to round mafic volcanic rock.

Potential Natural Plant Community—white oak/wedgeleaf ceanothus/annual grass. The cover is sparse to open white oak trees and open shrub. The shrubs are predominantly wedgeleaf ceanothus. Yampah is a characteristic herbaceous plant in this ET.

Plants at representative site RC02.

Tree cover, 20%: *Quercus garryana*, 20. Shrub cover, 40%: *Ceanothus cuneatus*, 40%; and *Lonicera* sp < 1%. Forb cover, 6%: *Perideridia (bolanderi?)*, 3%; *Blepharipappus scaber*, 2%; *Hesperolinon micranthum*, 1%; and *Clarkia rhomboidea*, *Epilobium brachycarpum*, and *Calystegia* sp, each < 1%. Graminoid cover, 22%: *Bromus japonicus*, 20%; *Elymus elymoides*, 2%; and *Achnatherum occidentalis* < 1%. Many forbs had dried and were unidentifiable when the site was described in August, 1995.

353 - DELUCCI FORESTED HILLS, 25–60% slopes

EMU 353 is on steep hill and canyon sideslopes. The canyons are cut in an eroded and no longer level bench between the inner-gorge of the Pit River below and late Cenozoic basalt and andesite flows above. The altitude range is 2,880–3,800 feet (890–1160 m) and the mean annual precipitation is 40–60 inches (100–150 cm).

Lithology—Late Cenozoic strata of volcanic rock, conglomerate, sandstone, and diatomite. Most of the volcanic rock is andesite or basalt. The conglomerate and sandstone have predominantly volcanic clasts. At least some of the diatomite is early Pliocene or older (Aune 1964). It is white, weathering to a buff color.

Map Unit Composition

- 40% ET 353-1 - andesite or basalt hill slopes : Vitrandic Haploxeralfs : mixed conifer—black oak
- 30% ET 353-2 - diatomite hill slopes : Vitrandic Xerochrepts : mixed conifer–black oak
- 20% ET 353-3 - clastic sedimentary hill slopes : Vitrandic Haploxeralfs : mixed conifer–black oak
- 10% Inclusions: very deep Vitrandic Haploxeralfs and Vitrandic Palexeralfs in old colluvium.

ET 353-1

andesite or basalt hill slopes : Vitrandic Haploxeralfs : mixed conifer-black oak

Geomorphology—Undifferentiated Hill (Mountain) Slopes. The landform is steep hill and canyon sideslopes. Mass wasting by flow, fluvial erosion by overland flow of water, and chemical denudation by weathering and leaching are all important geomorphic processes in this ET.

Soils—Vitrandic Haploxeralfs. They are loamy-skeletal, oxidic, mesic Vitrandic Haploxeralfs. These are moderately deep to deep A-Bt-R or A-Bt-Cr profile soils with a lithic or a paralithic contact to weathered bedrock between 60 and 150 cm depth. They are well drained.

Pedons at sites RC14 in ET 354-1 and RC25 in ET 331-1 are representative of these soils.

Potential Natural Plant Community—Mixed conifer-black oak. The cover is mixed conifer forest, with at least 5% black oak trees. Shrubs and herbaceous plants are scarce, although deerbrush and many herbaceous plants are common in successional stages of this potential natural plant community. Mountain misery has invaded many sites.

Plants at sites RC14 in ET 354-1 and RC25 in ET 331-1 are representative of those in ET 353-1.

ET 353-2

diatomite hill slopes : Vitrandic Xerochrepts : mixed conifer–black oak

Geomorphology—Fluvial-Eroding Hill Slopes. The landform is steep hill and canyon sideslopes. Fluvial erosion by overland flow of water is the predominant geomorphic processes in this ET.

Soils—Vitrandic Xerochrepts. They are fine-loamy, mixed, mesic Vitrandic Xerochrepts. These are moderately deep to deep A-Bw-Cr profile soils with a paralithic contact to soft bedrock between 50 and 100 cm depth. They are well drained.

Representative Pedon RC16 – E½, W½, sec. 3, R36N, R2E, Burney Falls Quadrangle.

Classification:	loamy-skeletal, mixed, oxidic Vitrandic Xerochrepts
Altitude:	3,400 feet
Slope:	convex (convex along contour, also) SSW 38% smooth
Surface Stoniness:	5% gravel, no cobbles, no "stones", no boulders
Oi	4–0 cm; loose over slightly matted pine and Douglas-fir needles
A1	0–3 cm; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; strong, fine, granular; soft; slightly sticky, slightly plastic; few very fine roots; slightly hydrophobic; moderately acid; abrupt, wavy boundary.
A2	3–14 cm; dark grayish brown (10YR 4/3) silt loam, white (10YR 8/2) dry; massive; soft, slightly sticky, slightly plastic; common very fine, fine, and medium roots; slightly hydrophobic; slightly acid; clear, smooth boundary.
Bw	14–38 cm; dark grayish brown (10YR 4/3) gravelly silt loam, white (10YR 8/2) dry; weak, very fine, subangular blocky; soft, very friable, slightly sticky, slightly plastic; common fine, medium, and coarse roots; strongly acid; gradual, smooth boundary.
BC	38–68 cm; light brown (7.5YR 6/4) gravelly silt loam, with few, fine yellowish brown (10YR 5/6) mottles; weak, fine, subangular blocky; very friable, slightly sticky, slightly plastic; few fine, medium, and coarse roots; very strongly acid; abrupt, irregular boundary.
Cr	68–80+ cm; buff colored, slightly hard lithologically, highly fractured (cracks < 10 cm apart) diatomite; roots and yellowish red (5YR 4/6 moist) coatings in fractures.

Potential Natural Plant Community—Mixed conifer-black oak. The cover is mixed conifer forest, with at least 5% black oak trees. Shrubs and herbaceous plants are scarce, although deerbrush and many herbaceous plants are common in successional stages of this potential natural plant community. Mountain misery has invaded many sites.

Plants at representative site RC16.

Tree cover, 95%: *Pseudotsuga menziesii*, 20; *Pinus ponderosa*, 20%; *Pinus lambertiana*, 20%; *Calocedrus decurrens*, 20%; *Abies concolor*, 1%; *Quercus kelloggii*, 10%. Shrub cover, 5%: *Chamaebatia foliolosa*, 5%. Forb cover, 3%: *Polygala cornuta*, 2%; *Galium bolanderi*, 1%; and *Apocynum androsaemifolium* < 1%. Graminoid cover, 4%: *Festuca californica*, 3%; *Achnatherum nelsonii*, 1%; and *Bromus* sp, < 1%.

ET 353-3

clastic sedimentary hill slopes : Vitrandic Haploxeralfs : mixed conifer–black oak

Geomorphology–Undifferentiated Hill (Mountain) Slopes. The landform is steep hill and canyon sideslopes. Mass wasting by flow, fluvial erosion by overland flow of water, and chemical denudation by weathering and leaching are all important geomorphic processes in this ET.

Soils–Vitrandic Haploxeralfs. They are loamy-skeletal, oxidic, mesic Vitrandic Haploxeralfs. These are moderately deep to deep A-Bt-Cr profile soils with a paralithic contact to weathered bedrock between 60 and 150 cm depth. They are well drained.

Representative Pedon RC21 – SE¼, NW¼, sec. 22, R37N, R2E, Burney Falls Quadrangle.

Classification:	loamy-skeletal, mixed, oxidic Vitrandic Xerochrepts
Altitude:	3,600 feet
Slope:	convex (linear along contour) W 52% smooth
Surface Stoniness:	15% gravel, 2% cobbles, 1% "stones", no boulders
Oi	3– cm; loose over slightly matted conifer needles and oak leaves
A1	0– cm; dark reddish brown (5YR 3/3) gravelly sandy loam, dark brown (7.5YR 4/4) dry; strong, fine, granular; soft; slightly sticky, nonplastic; common very fine roots; slightly hydrophobic; slightly acid; abrupt, wavy boundary.
A2	4–2 cm; dark reddish brown (5YR 3/3) sandy loam, brown (7.5YR 5/4) dry; moderate, very fine, subangular blocky; soft, slightly sticky, nonplastic; few very fine roots; slightly hydrophobic; slightly moderately acid; clear, smooth boundary.
AB	12–2 cm; dark reddish brown (5YR 3/4) very gravelly loam, reddish brown (5YR 5/5) dry; moderate, very fine, subangular blocky; very friable, slightly sticky, nonplastic; common fine, medium, and coarse roots; moderately acid; gradual, smooth boundary.
Bt1	32–5 cm; dark reddish brown (5YR 3/4) very gravelly sandy clay loam, brown (5YR 5/4) dry; fine, subangular blocky; friable, sticky, slightly plastic; few, thin coatings on ped faces; few fine and medium roots; strongly acid; diffuse boundary.
BC	75–30 cm; brown (7.5YR 4/5) extremely gravelly sandy clay loam; weak, medium, subangular blocky; friable, sticky, slightly plastic; many, thin coatings on ped faces; very few fine and medium roots; strongly acid; abrupt, irregular boundary.
Cr	130–35+ cm; hard stones (rounded pebbles, cobbles, and "stones") in weakly consolidated sandy matrix; cement apparently clay and possibly silica, no effervescence in 10% HCl.
Note:	stones lithologically hard, soft weathering rind thickness increases with depth in soil.

Potential Natural Plant Community—Mixed conifer-black oak. The cover is mixed conifer forest, with at least 5% black oak trees. Shrubs and herbaceous plants are scarce, although deerbrush and many herbaceous plants are common in successional stages of this potential natural plant community.

Plants at representative site RC21.

Tree cover, 90%: *Pseudotsuga menziesii*, 50; *Pinus ponderosa*, 15%; *Calocedrus decurrens*, 10%; *Abies concolor*, 5%; *Quercus kelloggii*, 15%. Shrub cover, none. Forb cover, 2%: *Iris* sp, 1%; and *Galium bolanderi, Chimaphila umbellata, chimaphila menziesii, Clarkia rhomboidea, Campanula prenanthoides, Hieracium albiflorum*, and *Penstemon* sp, each < 1%. Graminoid cover, 2%: *Festuca californica*, 2%; and *Carex multicaulis* < 1%. Deerbrush along road.

354 - DELUCCI FORESTED HILLOCKS, 3–30% slopes

EMU 354 is on gently sloping to moderately steep hillocks. Hillocks are hills with relatively little vertical relief. They are on an eroded and no longer level bench between the inner-gorge of the Pit River below and late Cenozoic basalt and andesite flows above. The altitude range is 2,720 to 3,640 feet (830–980 m) and the mean annual precipitation is 50–60 inches (100–150 cm).

Lithology–Late Cenozoic strata of volcanic rock, conglomerate, sandstone, and diatomite. Most of the volcanic rock is andesite or basalt. The conglomerate and sandstone have predominantly volcanic clasts. At least some of the diatomite is early Pliocene or older (Aune 1964). It is white, weathering to a buff color.

Map Unit Composition

- 30% ET 354-1 - andesite or basalt hillocks : Vitrandic Haploxeralfs : mixed conifer–black oak
- 30% ET 354-2 - diatomite hillocks : Vitrandic Xerochrepts : mixed conifer–blackoak
- 30% ET 354-3 - andesite or basalt over clastic sedimentary hillocks : Vitrandic Xerochrepts : mixed conifer–black oak
- 10% Inclusions: very deep Vitrandic Haploxeralfs and Vitrandic Palexeralfs on old surfaces

ET 354-1

andesite or basalt hillocks : Vitrandic Haploxeralfs : mixed conifer-black oak

Geomorphology—Fluvial-Eroding Hill Slopes. The landform is hillocks, or gently sloping to moderately steep hills with low relief. Mass wasting by flow, fluvial erosion by overland flow of water, and chemical denudation by weathering and leaching are all important geomorphic processes in this ET.

Soils—Vitrandic Haploxeralfs. They are loamy-skeletal, oxidic, mesic Vitrandic Haploxeralfs. These are moderately deep to deep A-Bt-R or A-Bt-Cr profile soils with a lithic or a paralithic contact to weathered bedrock between 60 and 150 cm depth. They are well drained.

Representative Pedon RC14 – SE¼, SE¼, sec. 35, R37N, R2E, Burney Falls Quadrangle.

Classification:	loamy-skeletal, mixed, oxidic Vitrandic Haploxeralfs
Altitude:	3,020 feet
Slope:	convex (convex along contour, also) W 4% smooth
Surface Stoniness:	25% gravel, 2% cobbles, 1% "stones", boulders < 1%
Oi	5–2 cm; loose over slightly matted pine and Douglas-fir leaves
Oe	2–0 cm; matted, weathered conifer needle fragments, and humus
A1	0–7 cm; dark reddish brown (5YR 3/3) gravelly loam, brown (7.5YR 5/4) dry; moderate, fine, granular; soft; slightly sticky, nonplastic; few fine and medium roots; slightly hydrophobic; slightly acid; clear, wavy boundary.

A2	7–16 cm; dark reddish brown (5YR 3/3) gravelly loam, brown (7.5YR 5/4) dry; moderate, very fine, subangular blocky; slightly hard, friable, slightly sticky, slightly plastic; common fine and medium roots; moderately to slightly acid; gradual, smooth boundary.
AB	16–36 cm; reddish brown (2.5YR 4/4) very gravelly loam; moderate, fine, subangular blocky; friable, sticky, slightly plastic; common fine, medium, and coarse roots; slightly acid; gradual; smooth boundary.
Bt	36–70 cm; reddish brown (5YR 4/4) very gravelly clay loam; moderate, medium, subangular blocky; very firm; very sticky, plastic; discontinuous, thin coatings on ped faces and moderately thick coatings in tubular pores; few fine and medium roots; slightly acid; diffuse boundary.
BCt	70–110+ cm; reddish brown (5YR 4/5) very gravelly clay loam; weak, medium, subangular blocky; very firm; very sticky, plastic; few, thin coatings on ped faces; few fine and medium roots; slightly acid.
Note:	thickness of soft weathering rinds, negligible in A horizon, increases with depth in B horizon.

Potential Natural Plant Community—Mixed conifer-black oak. The cover is mixed conifer forest, with at least 5% black oak trees. Shrubs and herbaceous plants are scarce, although deerbrush and many herbaceous plants are common in successional stages of this potential natural plant community. Mountain misery has invaded many sites.

Plants at representative site RC14.

Tree cover, 95%: *Pseudotsuga menziesii*, 60; *Pinus ponderosa*, 10%; *Pinus lambertiana*, 5%; *Calocedrus decurrens*, 5%; *Quercus kelloggii*, 15%; *Quercus chrysolepis* < 1%. Shrub cover, < 1%: *Rosa* sp. Forb cover, < 1%: *Polygala cornuta*. Graminoid cover, < 1%: *Festuca californica*. Note: *Chamaebatia foliolosa* is present on a similar site nearby, and *Apocynum androsaemifolium* is common along a road.

ET 354-2

diatomite hillocks : Vitrandic Xerochrepts : mixed conifer–black oak

Geomorphology—Fluvial-Eroding Hill Slopes. The landform is steep hill and canyon sideslopes. Fluvial erosion by overland flow of water is the predominant geomorphic processes in this ET.

Soils—Vitrandic Xerochrepts. They are fine-loamy, mixed, mesic Vitrandic Xerochrepts. These are moderately deep to deep A-Bw-Cr profile soils with a paralithic contact to soft bedrock between 50 and 100 cm depth. They are well drained.

Pedon at site RC16 in ET 353-2 is representative of these soils.

Potential Natural Plant Community—Mixed conifer-black oak. The cover is mixed conifer forest, with at least 5% black oak trees. Shrubs and herbaceous plants are scarce, although deerbrush and many herbaceous plants are common in successional stages of this potential natural plant community. Mountain misery has invaded many sites.

Plants at representative site RC16 in ET 353-2 are representative of those in this PNC.

ET 354-3

andesite or basalt over clastic sedimentary hillocks : Vitrandic Xerochrepts : mixed conifer–black oak

Geomorphology—Fluvial-Eroding Hill Slopes. The landform is hillocks, or gently sloping hills of low relief. Fluvial erosion by overland flow of water is the predominant geomorphic processes in this ET, although chemical denudation by weathering and leaching is an important process, too.

Soils—Vitrandic Xerochrepts. They are fine-loamy, mixed, mesic Vitrandic Xerochrepts. These are moderately deep to very deep A-Bw-Bt-Cr profile soils with a paralithic contact to soft bedrock between 60 and 150 cm depth, or deeper. Sandstone and diatomite are commonly interstratified. Subsoil horizons in diatomite are generally cambic and those in sandstone are generally argillic horizons. They are well drained.

Representative Pedon RC15 – N½, NE¼, sec. 3, R36N, R2E, Burney Falls Quadrangle.

Classification:	fine-loamy, mixed, mesic Vitrandic Xerochrept
Altitude:	3,200 feet
Slope:	convex (convex along contour, also) N 14% smooth
Surface Stoniness:	5% gravel, no cobbles, no "stones", no boulders
Oi	2–0 cm; loose fir needles and oak leaves over slightly matted fir needles
A1	0–5 cm; dark reddish brown (5YR 3/4) gravelly loam, light brown (7.5YR 6/4) dry; moderate, very fine, subangular blocky; soft; slightly sticky, slightly plastic; few very fine and fine roots; very slightly hydrophobic; moderately acid; abrupt, smooth boundary.
A2	5–16 cm; dark reddish brown (5YR 3/4) gravelly loam, light brown (7.5YR 6/4) dry; moderate, very fine, subangular blocky; friable; slightly sticky, slightly plastic; common fine, medium, and coarse roots; slightly acid; clear, wavy boundary.
Bw	16–38 cm; reddish brown (5YR 4/4) gravelly loam, light reddish brown (5YR 6/4) dry; weak, medium, subangular blocky; friable; very friable, slightly sticky, slightly plastic; few fine, medium, and coarse roots; slightly acid; clear, wavy boundary.
2Bw1	38–64 cm; brown (7.5YR 5/4) silt loam, pink (7.5YR 8/4) dry; massive; friable, slightly sticky, slightly plastic; few fine and medium roots; moderately acid; clear, wavy boundary.
2Bw2	64–75 cm; brown (7.5YR 5/4) silty clay loam, strong brown (7.5YR 5/6) on ped faces; weak, medium, subangular blocky; friable, sticky, plastic; few, thin coatings on ped faces; few fine and medium roots; strongly acid; abrupt, smooth boundary.
3Bt	75–86 cm; yellowish brown (10YR 5/4) clay loam, brown (7.5YR 4/4) on ped faces; moderate, medium, platy; firm, very sticky, plastic; many, thin coatings on ped faces; very few fine and medium roots; moderately acid; abrupt, smooth boundary.
4Bw	86–100 cm; brown (7.5YR 5/4) silt loam; massive; friable, slightly sticky, slightly plastic; very few fine and medium roots; strongly acid; abrupt, smooth boundary.
	100–145+ cm; alternate layers of sandstone with Bt horizons and diatomite with Bw horizons.
Note:	the silt loam in Bw horizons is highly dilatant.

Potential Natural Plant Community—Mixed conifer-black oak. The cover is mixed conifer forest, with at least 5% black oak trees. White oak trees may be present, but they are sparse. Deerbrush and many herbaceous plants are common in successional stages of this potential natural plant community. Mountain misery has invaded many sites.

Plants at representative site RC15.

Tree cover, 80%: *Pseudotsuga menziesii*, 40; *Pinus ponderosa*, 5%; *Pinus lambertiana*, 5%; *Calocedrus decurrens*, 10%; *Abies concolor* < 1%; *Quercus kelloggii*, 15%; *Quercus garryana*, 5%. Shrub cover, 2%: *Ceanothus integerrimus*, 2%; and *Chamaebatia foliolosa* < 1%. Forb cover, 6%: *Silene lemmonii*, 2%; *Polygala cornuta*, 1%; *Galium bolanderi*, 1%; *Hieracium albiflorum*, 1%; and *Trientalis latifolia, Campanula prenanthoides, Clarkia rhomboidea, Epilobium brachycarpum, Apocynum androsaemifolium*, and *Lathyrus* or *Vicia* sp, each < 1%. Graminoid cover, 8%: *Festuca californica*, 5%; *Vulpia myuros*, 2; *Elymus glaucus*, 1%; and *Dactylis glomerata, Elymus elymoides*, and *Carex multicaulis*, each < 1%. Fern cover, < 1%: *Polysticum* sp.

360 - PIT RIVER ALLUVIAL PLAINS, 0–3% slopes

EMU 360 is on nearly level alluvial plains along the Pit River. It includes stream channel, flood plain, and terraces. Flooding has been regulated by a dam and diversion of water from Lake Britton to Pit 3 powerhouse via an aqueduct, reducing the floodplain by converting it to low terrace. The altitude range is 2,400–2,620 feet (730–800 m) and the mean annual precipitation is 50–60 inches (100–150 cm).

Lithology—Unconsolidated/alluvium. The alluvium is predominantly from volcanic rock. It is recent (Holocene), and possibly late Pleistocene on low terraces. High terraces that are more definitely Pleistocene are inclusions in EMUs 330 and 339.

Map Unit Composition

- 40% ET 360-1 - stream terraces : Xerochrepts & Haploxerolls : mixed conifer–black oak
- 30% ET 360-2 - stream terraces : Haploxeralfs & Xerochrepts : mixed conifer–black oak
- 30% Inclusions: stream channel with alder trees, willow trees and shrubs, and sedges, and, along floodplain margins, cottonwood trees; abandoned channels and floodplain with alder and ash trees and sedges; rock outcrop; Xerochrepts or Haploxeralfs with mixed conifer–black oak–white oak on risers between terraces; and, on the upland sides of terraces, steeply sloping to moderately steep colluvium and alluvial fan

ET 360-1

stream terraces : Xerochrepts & Haploxerolls : mixed conifer--black oak

Geomorphology—Fluvial-Stream Terrace. The landform is nearly level stream terraces. These are low terraces, generally < 10 meters above floodplain. The current geomorphic processes are chemical denudation by weathering and solution loss, deposition of colluvium and alluvial fan sediment on the inner sides of terraces, and fluvial erosion by overland flow of water on the outer edges of terraces.

Soils—Xerochrepts & Haploxerolls. These are deep, well to somewhat excessively well drained soils. None of them were described in this EUI. They are mostly loamy-skeletal, mixed, mesic Typic Xerochrepts and Fluventic or Typic Haploxerolls.

Potential Natural Plant Community—Mixed conifer–black oak. The cover is mixed conifer forest, with at least 5% black oak trees. This is practically a Douglas-fir–black oak plant community, because conifers other than Douglas-fir are sparse. Deerbrush and many herbaceous plants are common in successional stages of this potential natural plant community.

ET 360-2

stream terrace : Haploxeralfs & Xerochrepts : Mixed Conifer–Black Oak

Geomorphology—Fluvial-Stream Terrace. The landform is nearly level stream terraces. These are relatively high terraces, generally > 5 meters above floodplain. The current geomorphic processes are chemical denudation by weathering and solution loss, deposition of colluvium and alluvial fan sediment on the inner sides of terraces, and fluvial erosion by overland flow of water on the outer edges of terraces. Very steep colluvial deposits along the inner sides of terraces were included in EMUs 330 and 339, rather than in this EMU.

Soils—Haploxeralfs & Xerochrepts. These are deep soils, well-drained soils. None were described in this EUI. They are mostly loamy-skeletal, mixed mesic Mollic or Ultic Haploxeralfs and Typic Xerochrepts.

Potential Natural Plant Community—Mixed conifer–black oak. The cover is mixed conifer forest, with at least 5% black oak trees. This is practically a Douglas-fir–black oak plant community, because conifers other than Douglas-fir are sparse. Deerbrush and many herbaceous plants are common in successional stages of this potential natural plant community.

361 - GOOSE VALLEY FAN SKIRT, 1–6% slopes

bajada fan skirt : Haploxeralfs : ponderosa pine–white oak

EMU 361 is on very gently sloping alluvial skirt around the margin of Goose Valley in the Burney quadrangle. The altitude range is 3,210–3,230 feet (980–985 m) and the mean annual precipitation is about 45–55 inches (115–140 cm).

Lithology—Unconsolidated/alluvium. The alluvium is from volcanic rock. It is a Quaternary deposit.

Geomorphology—Fluvial-Bajada Fan Skirt. The landform is alluvial fan skirting the margin of a large flat in the center of the Goose Valley basin. The current geomorphic processes are chemical denudation by weathering and solution loss, deposition of alluvial fan sediment, and fluvial erosion by overland flow of water. Predominance of soils with argillic horizons indicate that the deposition and erosion processes have not been very active recently, during the Holocene.

Soils—Haploxeralfs. These are very deep loamy-skeletal and fine-loamy, mixed, mesic Vitrandic Haploxeralfs similar to those in the Hambone and Boardburn Series of Ultic Haploxeralfs (Ferrari et al. 1992). They are well drained soils that grade downslope to the somewhat poorly drained Winnibulli Series of soils (Ferrari et al. 1992). None of them were described in this EUI.

Potential Natural Plant Community—Ponderosa pine–white oak. The cover is conifers and white oak forest, shrubs, and grass. The conifers are mostly ponderosa pine, little incense-cedar, and very little white fir. The shrubs are deerbrush, greenleaf manzanita, skunkbrush, and mountain misery. Grasses include cheatgrass, rattail fescue, and needlegrass.

362 - PEAVINE CREEK FLOODPLAIN, 0–3% slopes

floodplain : Umbrepts : riparian

EMU 362 is on nearly level to very gently sloping floodplains. The altitude range is 4,760–4,860 feet (1,450–1,480 m) and the mean annual precipitation is about 65–70 inches (165–180 cm).

Lithology—Unconsolidated/alluvium. The alluvium is from volcanic rock. It is Quaternary deposits, probably Holocene in at least the uppermost part.

Geomorphology—Fluvial-Floodplain. The landform is nearly level to very gently sloping floodplain. The current geomorphic processes are stream erosion and deposition of sediment.

Soils—Umbrepts (and Fluvents). These are very deep soils with little development other than the incorporation of organic matter and formation of soil structure. None of them were described in this EUI. Apparently, most of the soils are fine loamy or fine silty, mixed, frigid Fluventic or Andic Xerumbrepts. Soils in much of the area have been disturbed drastically by mechanical displacement and compaction. Fluvents are minor components of this EMU, occurring along and adjacent to stream channels.

Potential Natural Plant Community—Riparian. The vegetative cover includes lodgepole pine, aspen, and white fir trees, willow and alder shrubs, and herbaceous plants. Spiraea is present, too.

363 - SQUAW FLAT BASIN, 0–1% slopes

basin-fill : Aquepts : marsh

EMU 363 is on practically level small basin bottom. The altitude is about 4,820 feet (1,485 m) and the mean annual precipitation is about 65 inches (165 cm).

Lithology—Unconsolidated/alluvium. The alluvium is basin-fill from volcanic rock. It is Quaternary deposits, probably Holocene in at least the uppermost part. Much of the sediment may have been deposited from standing, rather than moving, water. The distinction between alluvium and lacustrine deposit is blurred in these small basins. That distinction is avoided by referring to the sediments as basin-fill.

Geomorphology—Fluvial-Bolson. The landform is practically level small basin bottom. The current geomorphic processes are predominantly deposition of sediment and also erosion by overland flow of water.

Soils—Aquepts. These are very deep, poorly drained soils. Most of them have thick O and A horizons. They are fine silty, mixed, frigid Humaquepts and presumably Endoaquepts. None of them were described in this EUI.

Potential Natural Plant Community—Marsh. The vegetative cover is predominantly sedges and in some places grasses along with sedges. Bach's downingia is common. Spiraea occurs in clumps. Willows and lodgepole pine are common around the edges of the basins.

6. MANAGEMENT INTERPRETATIONS

6.1 WATERSHED: SOILS AND HYDROLOGY

Precipitation, watershed relief, terrain topography, and the infiltration capacities and dissemination of water in soils determine the disposition of surface water. The Hydrological Group (National Soil Survey Interpretations Handbook, 618.03-19) is a crude gage of the role of a soil in regulating the rate of runoff. There are three classes, or groups (Table 6): A, low runoff potential; B, moderately low runoff potential; C, moderately high runoff potential; and D, high runoff potential.

The delivery of sediment to lakes and streams depends on runoff and erosion. Also, soil loss from surface erosion reduces soil quality and ecological productivity. Soil erosion is generally predicted from precipitation (erosivity), slope and topographic relief, soil erodibility, and soil cover factors. A standard index of erodibility is the K-factor (National Soil Survey Interpretations Handbook, 618.03-11): Kf for the fine earth (particles < 2 mm) and Kw for the whole soil, including rock fragments (Table 5). The soil erosion hazard rating (FSH 2509.22, form R5-2500-14) groups relative soil loss potentials into four classes: low, moderate, high, and very high. Each soil was assigned to one of these classes, assuming organic cover to be absent (Table 6).

6.2 TIMBERED AREAS

Tree growth and basal area are indicators of forest productivity for timber. Trees were cored and heights were measured at representative sites with suitable trees. Timber site index was calculated from an equation presented in Wensel et al. (1987); an equation that has been incorporated into the California Conifer Timber Output Simulator (CACTOS). Basal area was estimated around each plot center, utilizing a 20-factor prism. Tree growth data are presented in Table 7, and the approximate site index for each timbered ET is given in Table 8.

Forest floor fuel loads (forest residue class) are indicated by codes, and each class is represented by a photograph in a guide to the codes (Blonski and Schramel, 1981). Classification of forested sites was accompished by comparing each site to pictures in the guide to find the closest match. The forest residue codes for all timbered ETs are listed in Table 7.

TABLE 6 HYDROLOGIC GROUP, SURFACE SOIL ERODIBILITY, AND EROSION HAZARD RATING

Ecol. Type	Slope Gradient (%)	AWC[a] (cm/m)	Hydro. Group[b]	Erodibility Kf	Erodibility Kw	Soil Erosion Hazard Rating[c]
321-1	1-6	3-6	C	0.32	0.20	VH
-2	2-9	8-16	B	0.30	0.26	H
-3	2-12	16-18	B	0.22	0.20	H
322-1	2-12	16-18	B	0.22	0.20	H
-2	2-9	8-16	B	0.30	0.26	H
-3	1-6	3-6	C	0.32	0.20	VH
330-1	60-85	4-8	B	0.22	0.04	VH
-2	60-85	1-3	D	0.32	0.12	VH
-3	60-85	8-12	B	0.26	0.16	VH
331-1	30-60	7-12	B	0.12	0.08	VH
-2	25-45	16-18	B	0.16	0.10	VH
332-1	6-25	16-18	B	0.16	0.10	H
-2	15-30	7-12	B	0.12	0.08	VH
333-1	30-60	6-10	Bh	0.08	0.02	VH
-2	25-60	10-16	Bh	0.08	0.06	VH
334-1	6-25	17-19	Bh	0.14	0.10	H
-2	15-30	10-16	Bh	0.08	0.06	VH
335-1	30-60	9-14	Ah	0.10	0.09	VH
-2	25-45	12-16	Ah	0.12	0.10	VH
336-1	6-25	12-16	Ah	0.12	0.10	H
-2	6-25	12-16	Bh	0.10	0.08	H
-3	15-30	9-14	Ah	0.10	0.09	VH
337-1	25-45	5-9	B	0.32	0.20	VH
-2	30-60	16-19	B	0.32	0.14	VH
-3	30-60	2-5	C	0.36	0.20	VH
339-1	60-85	5-7	B	0.18	0.08	VH
-2	70-85	1-4	D	0.18	0.06	VH
-3	70-85	< 1	A	nil	nil	L
351-1	30-60	2-5	D	0.36	0.20	VH
-2	25-45	5-9	B	0.32	0.20	VH
-3	30-60	16-19	B	0.32	0.14	VH
-4	25-45	8-13	B	0.32	0.25	VH
352-1	3-30	5-9	B	0.32	0.20	VH
-2	6-30	8-13	B	0.32	0.25	VH
-3	3-25	8-17	D	0.36	0.36	H
353-1	30-60	8-10	B	0.24	0.12	VH
-2	25-60	9-18	B	0.34	0.30	VH
-3	25-60	6-8	B	0.18	0.16	VH

TABLE 6 (continued)

Ecol. Type	Slope Gradient (%)	AWC[a] (cm/m)	Hydro. Group[b]	Erodibility Kf	Erodibility Kw	Soil Erosion Hazard Rating[c]
354-1	3-30	8-10	B	0.24	0.12	H
-2	3-30	9-18	B	0.34	0.30	VH
-3	3-30	11-20	B	0.26	0.14	VH
360-1	1-3	6-10	B	0.16	0.06	L
-2	1-3	9-14	B	0.24	0.12	M
361	1-6	6-12	B	0.27	0.18	H
362	0-3	20-22	B	0.16	0.15	M
363	0-1	21-24	D	-	-	L[d]

[a] Plant available water holding capacity, or 0.1 to 1.5 MPa water retention difference, in 1 m of soil or to bedrock < 1 m deep. The broad ranges are mainly because of depth ranges.

[b] Lower case h indicates highly hydrophobic soils that are at least one class lower when rain falls on dry soil. A = very low runoff, B = low runoff, C = moderate runoff, and D = high runoff.

[c] EHR ranges are mainly because of slope gradient ranges. H = high, L = low, M = moderate, VH = very high.

[d] Erosion hazard rated low with O-horizon, moderately high without O-horizon.

TABLE 7 TREE GROWTH DATA AND NATURAL FOREST RESIDUE AT REPRESENTATIVE ET SITES

Site	ET	Species	Cored Tree DBH (in.)	Cored Tree Age (yr.)	Height (ft.)	Forest SI[a]	Residue[b]
RC01	335-1	WF	20	56	90	82	1-WF-4
		WF	20	41	86	109	
RC03	336-1	WF	25	51	112	116	2-WF-4
		WF	27	53	113	113	
RC04	322-1	PP	13	56	67	58	3-PP-3
		PP	17	64	61	46	
		PP	14	58	66	55	
RC05	331-1	PP	17	85	88	57	2-MP-4
		PP	19	93	74	44	
		PP	12	62	53	39	
RC06	332-1	PP	17	93	104	66	3-MP-4
		PP	23	102	127	80	
RC08	334-1	WF	14	58	68	57	3-MF-4
		WF	19	66	92	73	
		WF	13	52	70	66	
RC14	354-1	PP	13	85	85	55	2-MP-3
		DF	16	57	108	100	
		DF	14	64	75	58	
RC15	354-3	DF	10	49	48	44	2-MP-3
		DF	23	68	102	80	
RC16	353-2	PP	20	114	94	53	2-MP-4
		SP	10	56	58	48	
RC20	333-1	PP	64	(300)[d]	202	(114)	3-MF-4
		DF	20	81	105	73	
RC21	353-3	PP	20	126	96	53	3-MP-4
		DF	17	69	85	64	
		DF	14	69	81	60	
RC22	333[c]	WF	8	53	44	36	2-MP-3
		WF	13	77	61	39	
RC23	333-2	WF	9	66	50	35	2-MF-4
		WF	30	117	125	74	
RC24	336-2	WF	21	58	118	109	1-MF-4
		WF	21	59	105	94	
RC25	331-1	DF	14	49	72	72	2-MP-3
		DF	8	39	48	57	
RC27	339-1	DF	14	75	81	56	2-MP-4
		DF	19	79	96	67	

[a] Timber site index, or height above breast-height, for a breast-height age of 50 years (Wensel et al., 1987). A 300 year age was assumed to compute values in parenthesis.

[b] Blonski and Schramel 1981.

[c] ET inclusion, not a major ET.

[d] Assumed age of an old, uncored tree.

TABLE 8 TIMBER SITE INDEX[a] FOR EACH ECOLOGICAL TYPE

	ET within EMU[b]			
EMU	1	2	3	4
321	-	-	50	
322	50	-	-	
330	-	-	-	
331	60	70	-	
332	70	60		
333	70	80		
334	70	80		
335	90	115		
336	115	100	90	
337	-	-	-	
339	60	-	-	
351	-	-	-	-
352	-	-	-	
353	60	50	60	
354	60	50	60	
360	nd	nd	-	
361	nd			
362	nd			

[a] Timber site index based on tree height above breast height for a breast-height age of 50 years (Wensel et al., 1987).

[b] Nontimber ETs are indicated by dashed line (-); and nd = not determined, or no data.

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Appendix 2 - CalVeg / R5 Timber Type Crosswalk

CalVeg/R5 Timber Type Crosswalk

This table compares the vegetation types used by the two data sets[1] from which the analysis was made. These type crosses were based on local knowledge of the assessment team comparing mapped types with known field conditions.

Cal Veg Type	Corresponding R5 Types
Mixed Conifer Types	
MC-P	CX PPDF DFPP
MC-F	WF WFPP DF
Ponderosa Pine	
PP	PP
White Fir	
WF	WF

[1] 1) Remote Sensing Lab - CalVeg Types and 2)Shasta-Trinity LRMP database - R5 Timber Types

Appendix 3 - Forest Hydrologist Report

Watershed Report
for
Chalk Mountain Late Seral Reserve

...covering National Forest lands and included portions of the Pit River and its tributary basins

Lassen National Forest — Hat Creek Ranger District

Shasta-Trinity National Forests — Shasta Lake Ranger District

L. Stephen Young
Forest Hydrologist
Lassen N.F.

June 20, 1996

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Watershed Report for Chalk Mountain LSR

Introduction

This report is a summary watershed analysis for the Chalk Mountain LSR. More information is available for the Rock Creek watershed on the Lassen N.F., where recently-completed watershed improvement needs inventory [Keller 1995] and a contracted ecological unit inventory [Alexander 1996] have added more detailed assessments. Considering the integrated need for a watershed analysis foundation to accompany the initial LSR plan, this is a "first round" attempt to analyze the watershed situation for all lands within the LSR. Considering present and future funding and priorities on the Lassen and Shasta-Trinity National Forests, it will be some time before a more elaborate analysis can be done.

Characterization

Context

The Pit River is a large tributary to the Sacramento River system in Northern California. Before the construction of numerous flood control and hydroelectric dams on the upper Sacramento and its tributary Pit River basin, the Pit River was an important inland anadromous fishery in California, particularly during drought periods. The Pit River now joins the Sacramento River at Lake Shasta. The lowest stream gauge in the Pit River system is approximately 5 miles upstream from the Pit River Arm of Lake Shasta, 4.1 miles west of the town of Montgomery Creek. Two creeks join the Pit River downstream from the gauge, and several more even smaller creeks are tributary to the Pit River Arm of Lake Shasta. The drainage area above that gauge is 4,952 square miles (excluding Goose Lake Basin, which only infrequently contributes to the North Fork Pit River) [USGS 1995]. The Chalk Mountain LSR represents 1.2% of the Pit River drainage, and the Rock Creek watershed is 0.3%.

The Chalk Mountain LSR is important because of its position on the southeastern boundary of the northern spotted owl plan area, and because it is a habitat link to the California spotted owl territories to the south. The best old growth stands in the LSR exist in inaccessible, undisturbed reaches of stream canyons tributary to the Pit River. Implementation of the Aquatic Conservation Strategy is important to protect and enhance both these stands and their associated riparian reserve areas. The LSR includes three large, perennial creeks that offer unobstructed, high quality flows to the Pit River. Their lower reaches are reference condition "refugia" for riparian zone and aquatic habitats, only diminished in quality by sediment loading from upstream areas. Some sediment loading is declining as old harvest units revegetate and stabilize. Further sediment reductions are expected as a consequence of proposed watershed restoration activities on the LSR road system.

Transportation system

The recommended transportation system in the LSR and in the Rock Creek watershed is expected to eventually be reduced to a key arterial/collector network that will provide access for fire protection, tending of stands less than 80 years old, fuels management activities, and salvage logging conducted under the ROD guidelines to enhance or protect existing or developing old growth stands. **The desired LSR transportation system has not yet been described by staff or approved by line officers.**

In the Rock Creek watershed, a geotechnical engineering report [Keller 1995] recommended approximately $500,000 in improvements in the transportation system, ranging from replacement or upgrading of streamcrossings to decommissioning of spur roads. [*Summarize Keller's recommendations in more detail??*]

The current status of the road system and any associated restoration needs on the Shasta-Trinity NF portion of the LSR have not been assessed. Some spur roads should be decommissioned, and some stream crossings likely need to be upgraded, to conform to the Aquatic Conservation Strategy. One memo in the Shasta-Trinity NF watershed files [Bacon 1981] noted adverse bank and streambed scouring in upper Roaring Creek, due to poor culvert installation. (Roaring Creek drains to the southwest from Bales Mountain, south of the Pit River.)

Air Quality

The Chalk Mountain LSR and its included Rock Creek watershed are in a compliance area for setting air quality objectives. Management activity effects, including smoke from prescribed burning and fugitive dust from use of area roads, skidding timber, and mining of diatomite must meet EPA *de minimis* standards. The nearest Class I airshed area is the Thousand Lakes Wilderness, over 18 miles south of the LSR. The LSR is downwind from the Redding urban area.

Climate

Precipitation in the Rock Creek watershed averages 60 inches per year [Ranz 1969], mostly in the form of warm snowpack above 4,000 feet elevation and as rain or intermittent snowpack below 4,000 feet. Rain on snow events occur, but they are only occasional flood sources. Summer thunderstorms do occur in the LSR's drainages and on nearby Chalk Mountain, but lightning caused fires have been infrequent. Precipitation drops rapidly to the east, from 75"–80" at Chalk Mountain, around 75" inches in the headwaters of Nelson Creek, to 60" in the middle of the Rock Creek drainage, to approximately 50" near Lake Britton. Precipitation is around 70" in the upper Rock Creek drainage. One memo [Ranken 1983] speculated that there is also a concentrating effect of precipitation in the Chalk Mountain/Deep Creek reach of the Pit River Canyon, noting that "...Rainfall within the Pit River Canyon is very high with an average of over 100 inches per year."

Temperature data are not widely available for the microclimates and topographic zones in the LSR. Climatological stations [NCDC 1990] that offer relevant data to generalize the upland plateaus and possibly the canyon bottom are described in **Table 1**. Their precipitation data are outlined in **Table 2**, and their temperature regimes are summarized in **Figure 1** [Hydrosphere 1996]. Aspect and elevation are particularly important variables in defining the LSR's range of microclimates, and the existing old growth stands and intact riparian reserves tend to maintain their own moister, cooler microclimates. Also, the climatic monitoring sites (weather stations) do not accurately represent temperature or humidity regimes in the deeply incised canyons tributary to the Pit River canyon. While some of the mid slope areas in the LSR may have temperature regimes similar to the reported data, the riparian zones in Rock Creek, for example, are likely cooled more rapidly by down canyon cool air drainage than are nearby midslope areas of comparable elevation.

Topography

Topography for the Chalk Mountain LSR is dominated by the Pit River canyon and by the nearby, notably higher terrain at Chalk Mountain and the ridges and plateaus north and northeast of Chalk Mountain. The plateau south of the Pit River canyon lies mostly at 3,500 ft to 4,000 ft. elevation, rising to 5,105 ft at Bales Mountain and 5,496 ft. on Bunchgrass Mountain, along the Deep Creek basin boundary. Elevations in the bottom of the Pit River canyon range from approximately 2,760 feet on Lake Britton, to 2,620 feet at the base of the Pit 3 dam, to 2,560 feet at the Rock Creek confluence, to 2,160 feet at the Deep Creek confluence, to 2,040 feet at the western boundary for the LSR. Chalk Mountain rises to 5,888, less than two miles from the gaging station at Ruling Creek (2,366), at the Pit River confluence. The average, continuous slope from the gage to the peak is 37%, with some much steeper pitches up the canyon wall. In many drainages, deep soils on unconsolidated volcanic parent materials have combined with steep gradients to deeply incise streambeds, and side slopes are unstable.

Geology

Geology for the Rock Creek watershed and for the nearby Chalk Mountain LSR is mapped only at small scale from available sources [Lydon 1960] and [Gay and Aune 1958]. The mapped information is very generalized, and it is not particularly useful for project work, except as a starting point. The area south of the Pit River is mainly composed of Pliocene volcanic pyroclastics and basalt. North of the Pit River (in the Rock Creek area), the underlaying formation is mainly Tertiary volcanic andesite, up to the Jakes Spring contour, with more recent Miocene volcanic basalts on

Table 1—Climatological Stations near Chalk Mountain LSR[1]

Station	Sta. No.	Elevation (Ft.)	Location rel. to LSR	Relevance
Buckhorn	1149	3,800	7 mi. S of Bales Mountain	Indicator for plateau on s. side of Pit River, for headwater zone of Deep Creek, and somewhat for mid elevations on Chalk Mountain
Burney	1214	3,130	8 mi. SE of LSR	Indicator for plateau area s. of Pit R. & somewhat for mid elevations in Rock Creek basin.
Hat Creek PH 1	3824	3,015	7 mi. ESE of LSR	Temp indicator for plateau s. of Pit R. & somewhat for mid elevations in Rock Creek basin. Precip. data of secondary value.
Pit River PH1	6944	2,880	8 mi E of Pit3 dam	Temp indicator for some Pit R canyon conditions. Precip data of marginal value, because of rapid eastward drop in precip.
Pit River PH5	6946	1,458	4 mi. W (downstream) from Big Bend	Temp indicator for lower Pit R. canyon. Precip data useful only for verification of canyon concentration hypothesis, when compared to broad coverage isohyetal map with long term average precip.

1 Based on National Climatic Center, 1990.

Chalk Mountain and on the higher elevations in the Rock Creek basin. Pliocene non marine formations (including diatomite) occur on the north and south sides of the Pit River near Lake Britton, mostly east of the east side of the Rock Creek watershed's draining divide. Some diatomaceous earth formations extend west of the Rock Creek watershed, south of Jake Spring. Downstream from Rock Creek, pockets of Eocene non-marine "conglomerates" occur near the western boundary of the LSR, near Hagen Flat with a secondary pocket near Swift Creek.

In the Ecological Unit Inventory for the Rock Creek watershed [Alexander 1996], the geology for the Rock Creek area was described in more detail:

> Rocks exposed in the canyon of the Pit River below Lake Britton are largely andesite to more silicic breccias, tuff-breccias, and tuffs.... There are thick clastic lacustrine sediment and diatomite strata in the upper part of this sequence...from Screwdriver Creek to the Delucci Ridge bench...(form) hills where steep and hillocks where gently sloping to moderately steep. Rocks above the Delucci Ridge bench...are mafic volcanic ...Miocene basalts...represented both north and south of the Pit River, that have been modified by erosion but still have nearly level plateau and bench surfaces. ...volcanic rocks and lacustrine deposits of the Pit River sequence must belong to (the older Western Cascade Group). Basalt above the Pit River sequence (i.e. on the highlands north and south of the gorge) are formed from (more recent lava flows).

Table 2—Precipitaton Data from Climatological Stations near Chalk Mountain LSR[1]

Station	Sta. No.	Period of Record	Mean annual precip. (in)	+1 S.D.[2] precip (in)	Extreme high precip (year: in)	-1 S.D. precip (in)	Extreme low precip (year: in.)
Buckhorn	1149	1948–1995	66.098	83.687	*1983*: 110.290	48.509	*1976*: 32.140
Burney	1214	1948–1992	27.537	34.143	*1983*: 43.850	20.931	*1949*: 14.270
Hat Creek PH 1	3824	1949–1995	18.822	23.624	*1983*: 29.000	14.020	*1976*: 6.980
Pit River PH1	6944	1972–1995	18.914	24.621	*1983*: 28.190	13.207	*1976*: 8.230
Pit River PH5	6946	1948-1995	74.426	95.881	*1983*: 138.840	52.971	*1976*: 28.680

1 Based on Hydrosphere [1996].

2 Sixty eight percent of the years would total between ±1 S.D. in their precip.

West of the Rock Creek basin, the terrain south of the Summit Lake road includes many dormant slumps and slides, particularly on the steep ground in lower Screwdriver, Poison, and Underground Creeks. A report for the 1982 Pancrea timber sale [Vansusteren and Haskins 1981] described the area from Ruling Creek to Screwdriver creek as follows:

> ...Accelerated downcutting has created engorged channels in (the Poison and Screwdriver Creek drainages), with undercut sideslopes and resultant sliding and instability. ...Area is underlain by interbedded Tertiary basalt and volcanic mudflows. ...Large dormant translational landslides are present within the sale area. The slides have detached from the canyon rim and are slowly moving down the canyon wall toward the river. The large translational slides are presently dormant, however, (and they) remain vulnerable to land disturbing activities such as roading and logging.

In the northwestern portion of the LSR, a 1968 report for the Boundary timber sale (ca. 1970) mentions unstable ground on sedimentary, "shale-like" material, mainly west of road 37N04 in sections 21 and 22 in the headwaters of Nelson Creek. South of the Pit River, several specialist memos were prepared for the Zig Zag timber sale (ca. 1980). The soil scientist memo [Lanspa 1978] mentions instability along Canyon Creek. The hydrologist memo [Ranken 1978] describes unstable areas in Deep Creek's watershed. The tributaries on the east side of Bales Mountain are deeply incised, with eroding banks and numerous, small slides. The channel bottoms are stable, but deep soils make sideslopes very erodible. There is a large slide just below the 4,000 ft contour on the east side of Deep Creek. The most unstable areas were never entered for timber harvesting, and the lower portions of the Deep Creek and Canyon Creek watersheds (and to a lesser degree in the lower Rock Creek watershed) remain inaccessible to all but the most determined hikers and are essentially undisturbed.

Figure 1A—Burney Temperature regimes (Station #1214, 1948–1992)

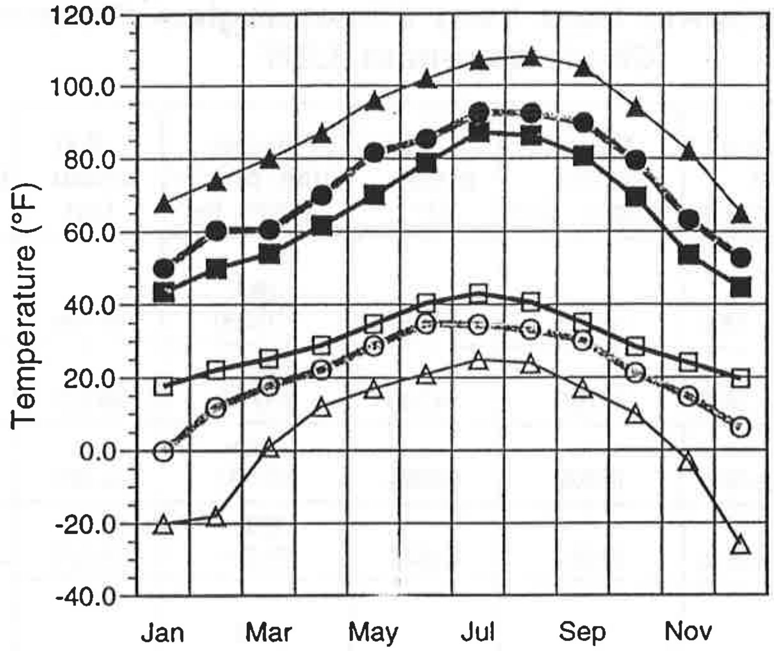
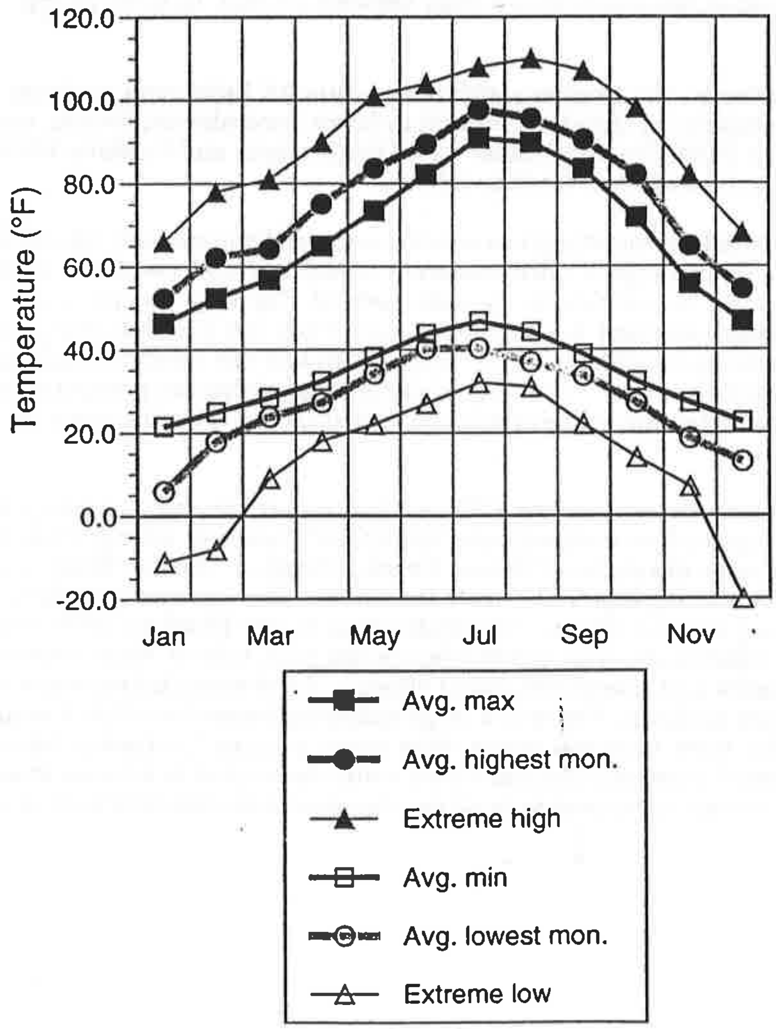


Figure 1B—Hat Cr. PH 1 Temperature regimes (Station #3284, 1948–1995)



Soils

Soils information is derived from Order III soil resource inventories conducted on the Lassen National Forest [Kliewer and O'Hare 1994] and on the Shasta-Trinity National Forests [Lanspa 1993]. Soils reflect bedrock geology, local topography and climate acting on the landform materials over time, along with vegetation effects.

Outside of the steep, inner gorge areas in the Pit River canyon, soils in the Rock Creek watershed have a low to moderate erosion hazard rating, except for localized pockets of diatomite, which can have a high erosion hazard when they are without ground cover and on slopes steeper than 15%–20%. (However, most of the diatomite-based timber stands are site II.) Site quality varies from Site I to Site IV and V. Average site quality on the areas with less than 40% slope is probably II, with the low sites occurring on some of the shallow soiled and/or steep areas that include an oak component in their vegetation, particularly on areas with a southern or southwestern aspect. Hydrological soil groups are mainly "B," i.e. with moderately low runoff potential. Some of the very rocky areas in the Pit River canyon have hydrologic group "D" soils, with high runoff potential, because rain does not infiltrate well into steep, shallow-soiled, rocky areas. The inner gorge in the lower reaches of Rock Creek is rocky and shallow-soiled, with some sites that can grow only shrubs and grass.

In the rest of the LSR, soils tend to be deeper than in the Rock Creek watershed, mostly because they are underlain by older geology and because rainfall is somewhat higher. Specialists reports in the Shasta-Trinity files repeatedly mention deep soils in the Nelson and Screwdriver Creek areas, which are occasionally undercut and destabilized by incising stream channels. Most of the flat to gentle sloped areas on volcanics are site I or II. The steeper ground, sloping down into the Nelson Creek drainage is site III. Steep areas in the Pit River Canyon and in Deep Creek and Canyon Creek are mostly shallow-soiled and rocky, with some unstable areas having unconsolidated bedrock materials and very steep slopes. Some of the local pockets of conglomerate and sediments in the western part of the LSR include dormant slides and slumps. While most of the soils are hydrologic group "B," some of the steep Pit River canyon slopes are "C," because of shallow soil and increased runoff potential. Erosion hazard is mostly low to moderate, except for some soil groups with ashy soils or soils derived from sediments, which have a high erosion hazard. Areas where high erosion hazard, ashy soils occur on relatively gentle slopes are on the plateau area immediately south of Summit Lake, on some of the flat ground west of road 37N30 (in the Nelson Creek watershed) and on the plateau between Deep and Canyon Creeks. Some isolated areas of diatomite occur east of Screwdriver Creek and south of Jake Spring, and they probably have a high erosion hazard on their steeper slopes.

For the Rock Creek watershed and some additional, nearby National Forest lands, additional soil and vegetative information was developed in an ecological unit inventory completed in 1995 [Alexander 1996]. That inventory described lithology, geomorphology, soils, and potential natural vegetation for 19 ecological mapping units. Each mapping unit included one or more ecological types. Alexander described three types of erosion in the EUI area: (1) Fluvial erosion by overland flow of water, particularly on old, eroded plateaus and terraces; (2) Mass wasting by flows (i.e. landslides, debris flows, slumps, and raveling); and (3) Chemical denudation by weathering and leaching.

Watershed Report for Chalk Mountain LSR

Issues and Key Questions (from LSR planning team)

- Which management activities and naturally occurring events continue to adversely affect aquatic habitat and riparian ecosystems?
- What are the optimum transportation needs for management and use of the watershed, balanced with the needs of the LSR and riparian reserves? [Possible alternative wording: *What is the appropriate transportation system needed to support long term management and protection for the Chalk Mountain LSR?*]
- Is habitat present for riparian obligate species that occupy the riparian reserves? What conditions need to be improved?
- Is the existing level of human use compatible with ROD objectives?
- How does mining potentially affect late successional characteristics and riparian reserve objectives within the watershed and potentially other resources?
- What are the appropriate treatments for the matrix sections within the watershed?
- How much of the ground is physically capable of being manipulated?

Current Conditions

Water resources

Water uses

A memo for the Sumet Timber sale [Ranken 1983] notes that there are no filed water rights in the Chalk Mountain area and lists the local beneficial uses of water as hydroelectric power production, recreation, and fishery and wildlife sustenance. The Lassen National Forest water rights database lists no diversions or impoundments in the Rock Creek watershed, but water is occasionally used from Rock Creek for dust abatement on local road systems and for fire suppression. The Pacific Gas and Electric Company has numerous impoundments and diversions along the Pit River, including three dams in the LSR. Pit 3 dam (Lake Britton) was built in 1925; Pit 4 dam was built in 1927; and Pit 5 was built in 1944 [TES 1993]. Diversions at Pit 5 started on May 1, 1944 [Jorgensen 1971].

The Pit 3 diversion included up to 25 cfs from Rock Creek [WESCO 1985] . A small dam in Rock Creek once diverted flows less than the pipe's capacity of 25 cfs to a closed pipe that spilled into the top of the Pit 3 aqueduct, on the east side of its "bridge" section over Rock Creek. That diversion was abandoned around 1987, and only a few pieces of the dam remain at the original Rock Creek point of diversion. Thus, the last 1/2 mile of Rock Creek was dewatered by diversion during the spring through fall seasons, from about 1927 to 1987. In 1987, as part of a relicensing agreement, P.G. & E. was required to maintain 150 cfs during the summer in Pit River reaches between Pit 3 dam and Pit 4 dam. Prior to that year, the "Pit 3 reach" of the Pit River barely flowed during the summer, sustained only by seepage from springs along the river, by leakage from the Pit 3 aqueduct, and by subsurface flows from intermittent tributaries.

Water quantity and flood flows

Figures 2A and 2B show statistical high and low flow frequencies[1] for the Pit River at Big Bend gauging station, based on long term USGS records [Hydrosphere 1996]. For Figure 2A (high flows), the best curve to use would be that for the full period of record, since peak flows are not sen-

1. Statistical data are based on Log-Pearson Type III distribution analysis, using the DF, Duration-Frequency Analysis Program, v. 1.0 from Hydrosphere Data Products, Inc. (1994). Per the hydrosphere user manual, "DF is consistent with Water Resources Council Bulletin 15 and USGS Bulletin 17B and provides similar analytical capability and identical results to USGS program A193."

Figure 2A—Average maximum daily flow frequencies from various periods of gauging station record (1910–present), Pit River at Big Bend (USGS # 11363000)

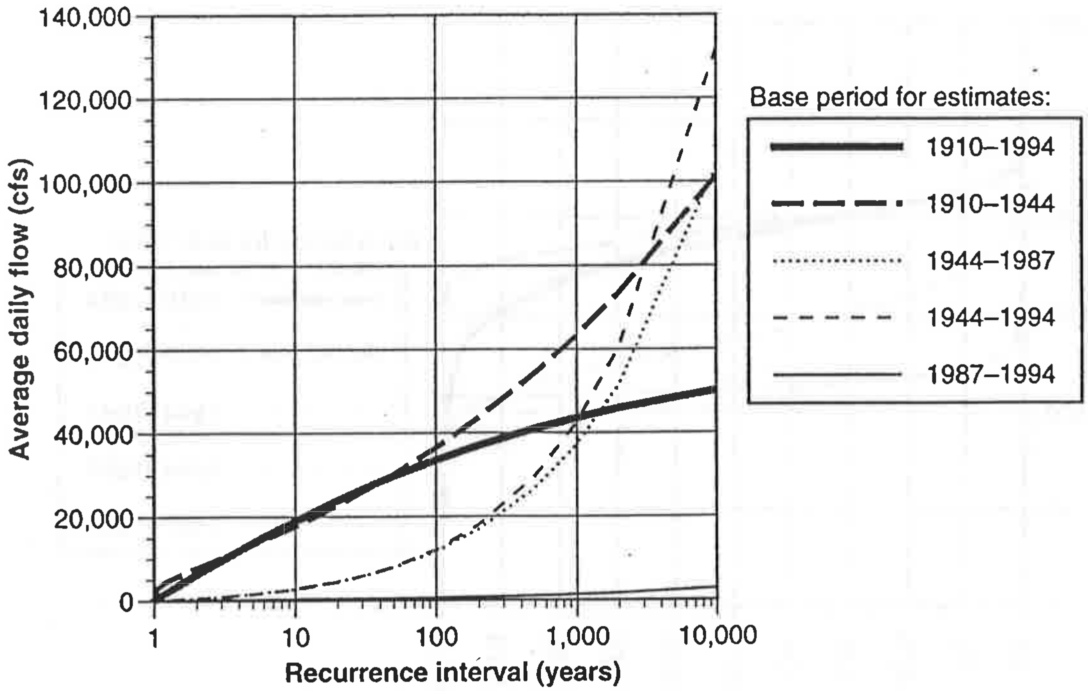


Figure 2B—Average minimum daily flow frequencies from various periods of gauging station record (1910–present), Pit River at Big Bend (USGS # 11363000)

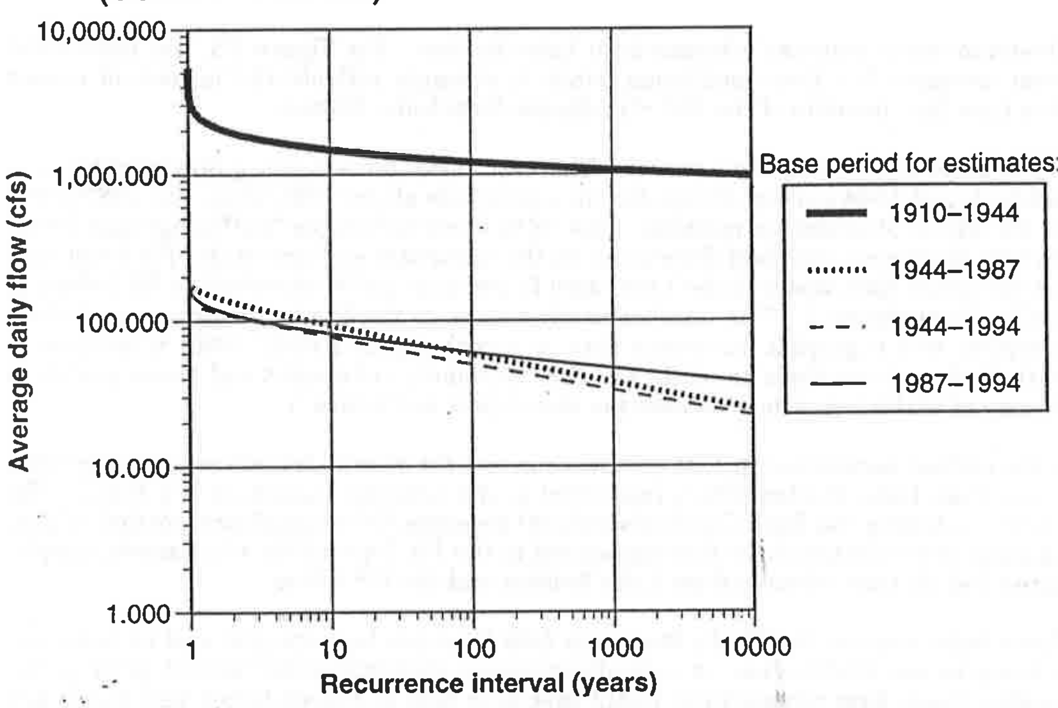
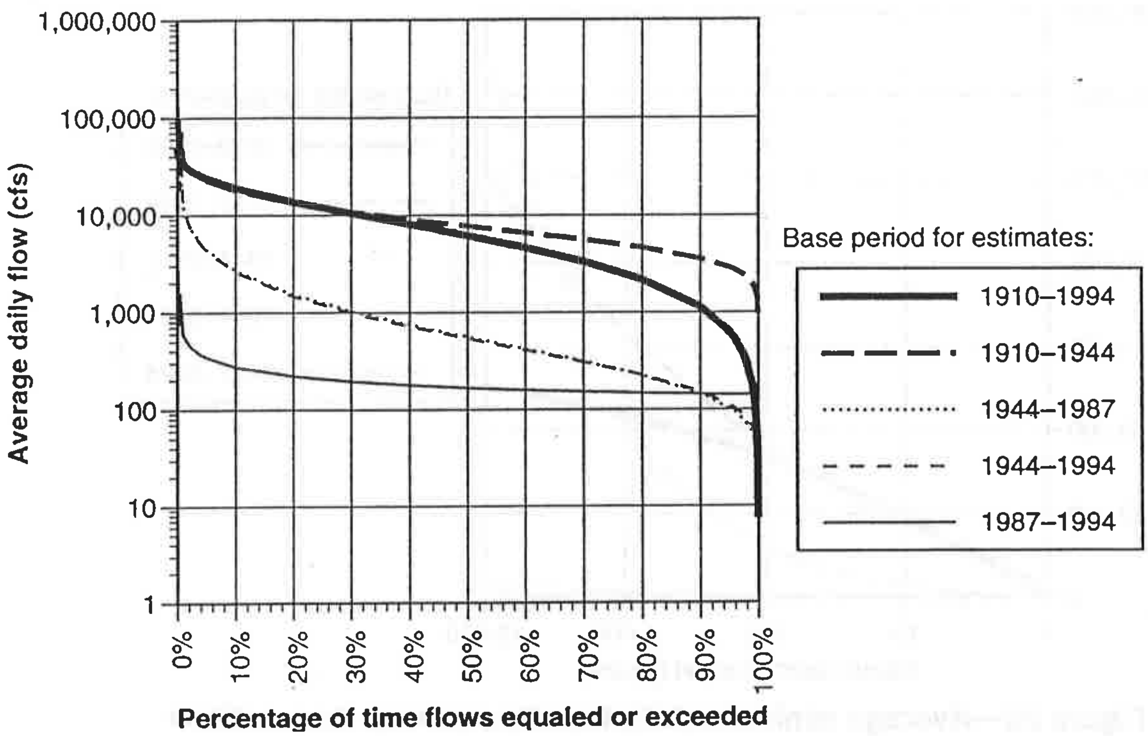


Figure 2C—Flow duration curves for various periods of gauging station record, Pit River at Big Bend (USGS #11363000)



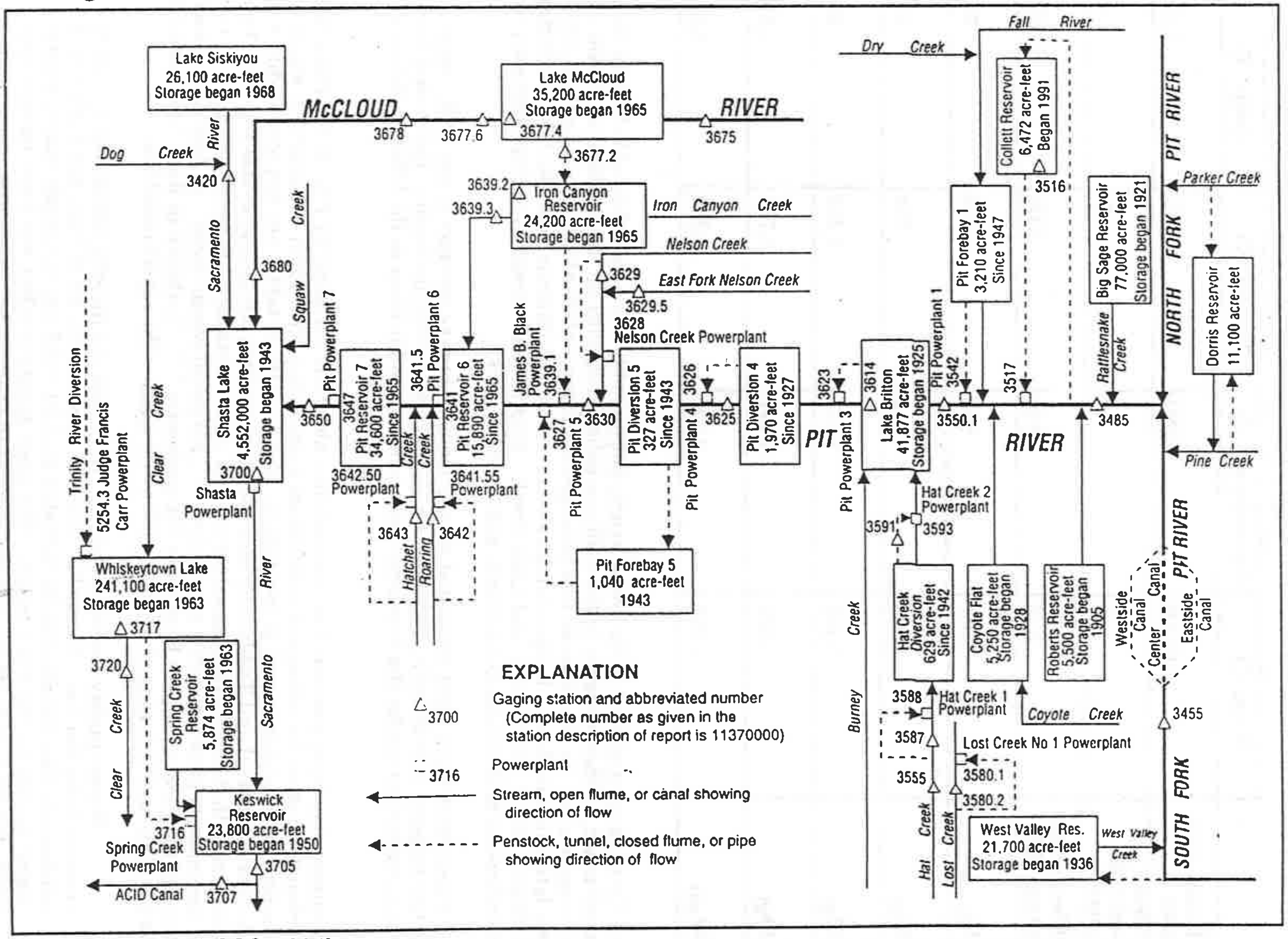
sitive to minor diversions or to summer releases from Lake Britton. For Figure 2B, the 1987–1994 curve probably best assesses low flow conditions, since it strongly reflects the impact of recent droughts, as well as base flow benefits of the 150 cfs releases from Lake Britton.

Figure 2C is a set of flow duration curves. The best curve for assessing flow durations is probably the coincident post 1944 curves, except for time intervals above 90%, when the 1987–1994 curve would show the effects of upstream releases. Post 1940 flows reflect the "buffering" and delaying effects of upstream impoundments and diversions on the upstream sections of the Pit River and its tributaries, but the gauge does **not** include 1,040 acre ft. per year (AFA) diverted at Pit 5 dam to Pit Forebay 5 and Pit Powerhouse 5. The number of diversions in the Pit River system and their relationship is complex, and a graphic summary from a recent report [USGS 1995] is needed to understand the various diversions, their amounts and the relationship of gauges and power plants to diversion sites. A copy of that schematic is included in this report as **Figure 3**.

Based on the station narratives in that publication, the Pit River's tributary area increases by 104 square miles, from Lake Britton (Pit 3 reservoir) to the gauging station at Big Bend. The Chalk Mountain LSR (including the Rock Creek watershed) accounts for a significant portion of that drainage area and most of the natural base flow increment to the Pit 3-4 and Pit 4-5 reaches, supplementing the required 150 cfs base releases from Lake Britton and the Pit 4 dam.

The Pit River tributaries in the Chalk Mountain LSR have not been gauged and no tributary flow data are archived in the USGS files. A consultant report [WESCO 1985] issued prior to the 1987 changes in main stream dam release rates noted that base flow in Nelson Creek was 15 cfs and in 30 cfs in Kosk Creek (west of the LSR). Based on flows estimated in some of the stream surveys done in the 1970's, base flows for Rock Creek are in the 10–15 cfs range; East Fork Nelson Creek would be 2–5 cfs; Canyon Creek would be 5 cfs; and Deep Creek would be around 10 cfs. Under-

Figure 3—Diversions and storage in Pit and McCloud River systems



After Figure 27 [USGS 1995]

Table 3—Characteristics of some Pit River tributaries, Chalk Mountain LSR

		Rock Cr.	Screwdriver Cr.	Canyon Cr.	Deep Cr.
	Basin area (ac)	10,300	2,990	2,605	1,755
	Mean annual precip	60	65	68	70
	Elev. index (avg., Mft)	3.77	3.62	3.66	3.59
Est. flood flows (cfs)	Q_5	1,331	516	478	355
	Q_{10}	2,054	819	764	572
	Q_{25}	3,109	1,293	1,218	924
	Q_{50}	4,131	1,791	1,702	1,310
	Q_{100}	5,783	2,509	2,382	1,834

ground Creek is intermittent in its lowest reach, but probably has a base flow of 2–5 cfs in its lowest perennial reach. Other streams in the LSR are ephemeral, with no fish habitat and little obligate riparian vegetation. In the Cascade volcanics, groundwater contributions are particularly important to base, late summer flows. Large springs sustain numerous streams near the LSR, including Fall River, Rising River, Hat Creek, and Lost Creek. Smaller mid-elevation springs certainly sustain summer flows in Rock Creek, Deep Creek, and Canyon Creek.

Some flood flows were estimated for the major tributary streams in the LSR, using a small watershed formula [USGS 1973] developed for nearby Sierra Nevada basins. Estimated flood flows and basin characteristics for the four main tributaries to the Pit River in the LSR are shown in Table 3.

Water quality has been monitored at various sites along the Pit River by P.G. & E. Their five year comprehensive report for biological compliance monitoring [TES 1993] summarized water quality and temperature measurements in two tables. Copies of those tables are included **Table 4** (Water quality data summary) and **Table 5** (Water temperature data summary) in this report. The report also mentioned that Rock Creek dissolved oxygen concentrations "...ranged from 5.8 to 11.4 mg/L, which corresponds to 54% to 109% saturation." "...Electrical conductivity...in Rock Creek was lower (than in the Pit River), ranging from 49 to 130 µmhos/cm." "...Turbidity in Rock Creek ranged from <0.5 to 1.6 NTU and TSS ranged between <0.5 to 4.0 mg/L." The report noted that

> Water quality conditions in the Pit 3 reach are directly influenced by Conditions in Lake Britton. Except for the area between the Pit 3 Dam and Rock Creek confluence, the 150-cfs release initiated in July 1987 has not significantly altered water quality in the Pit 3 reach. The most apparent affect has been immediately below the Pit 3 dam, which was dewatered prior to release. In addition, the (relative) influence of spring accretion flows in the area above the confluence with Rock Creek has been reduced, and any localized cooling of the system by these inflows has therefore been negated. On the other hand, the release has created a more stable water

Table 4—Summary of Water Quality Sampling, 1987–1992 [1]

Station Locations		Temp. (°C)	DO (mg/L)	DO saturation (%)	pH	Electrical conductivity (µ mho/cm)	Turbidity (NTU)	TSS (mg/L)
Pit River below Pit 3 Dam (62.0 km)	Maximum	22.2	10.8	120	8.8	157	8.2	9.0
	Minimum	11.8	6.6	71	6.3	115	0.9	<0.3
	Average	14.9	8.9	96	8.1	141	2.7	<3.0
	# of samples	27	27	27	27	27	27	27
Pit River above Rock Cr. confluence (57.0 km)	Maximum	20.0	10.6	126	8.6	152	5.9	10.0
	Minimum	10.5	6.6	71	6.1	70	<0.5	<0.3
	Average	15.8	9.1	100	8.2	134	<1.9	<2.4
	# of samples	27	27	27	27	27	27	26
Rock Creek near mouth (56.8 km)	Maximum	19.2	11.4	109	8.5	130	1.6	4.0
	Minimum	6.5	5.8	65	6.4	49	<0.5	<0.3
	Average	15.1	8.6	94	7.9	96	<0.7	<1.1
	# of samples	27	27	27	27	26	27	24
Pit River above Pit 3 Powerhouse (52.6 km)	Maximum	21.0	11.6	131	8.8	154	5.0	11.0
	Minimum	10.8	6.4	69	6.5	121	<0.5	<0.3
	Average	15.8	9.3	103	8.1	140	<1.6	<2.3
	# of samples	27	27	27	27	26	27	26
Pit River below Pit 4 Dam (49.7 km)	Maximum	21.2	9.6	109	8.8	168	8.0	6.5
	Minimum	12.8	4.6	54	6.7	122	<0.5	<0.3
	Average	18.0	8.2	94	8.2	149	<2.5	<3.0
	# of samples	27	27	27	27	26	27	27

[1] After Table 5-82 [TES 1993]

Table 5—Summary of Water Temperatures, 1987–1992 [1]

Station Locations		1987 pre-release	1987 post-release	1988	1989	1990	1991	1992	Six year summary
Pit River below Pit 3 Dam (62.0 km)	Daily maximum	23.1	16.0	17.0	16.2	16.9	17.0	16.7	23.1
	Daily minimum	13.7	13.5	12.6	13.1	12.3	13.7	13.9	12.3
	Mean	15.9	14.9	14.8	15.1	15.1	15.5	15.6	15.2
	Std. Dev. of mean	1.6	0.4	1.0	0.6	1.2	0.9	0.6	1.0
	Average daily range	1.8	0.8	0.7	0.4	0.4	0.3	0.4	0.6
	Extreme of daily range	0.9-4.6	0.3-1.8	0.3-1.2	0.2-1.0	0.1-0.6	0.1-0.7	0.1-0.7	0.1-7.1
Pit River above Rock Cr. confluence (57.0 km)	Daily maximum	21.9	17.6	NA	18.5	18.7	18.8	18.8	21.9
	Daily minimum	14.9	13.9	NA	12.2	11.8	12.4	12.9	11.8
	Mean	18.4	15.2	NA	15.3	15.3	15.9	16.0	15.8
	Std. Dev. of mean	1.0	0.5	NA	0.7	1.1	0.7	0.7	1.2
	Average daily range	3.7	2.7	NA	3.0	3.0	3.0	2.8	3.0
	Extreme of daily range	1.5-5.2	0.9-3.6	NA	1.1-4.0	1.3-3.8	1.5-4.1	0.7-3.9	0.7-5.2
Rock Creek near mouth (56.8 km)	Daily maximum	20.1	20.8	21.1	19.7	20.6	19.9	19.7	21.1
	Daily minimum	10.1	11.9	7.1	10.0	5.7	10.2	11.8	5.7
	Mean	15.8	15.4	16.0	15.4	14.3	15.7	16.1	15.6
	Std. Dev. of mean	1.4	1.1	2.5	1.1	2.6	1.4	1.3	1.8
	Average daily range	3.4	2.6	3.7	3.1	4.4	3.1	2.7	3.2
	Extreme of daily range	0.6-5.1	1.2-4.2	1.3-6.4	0.9-5.6	1.8-6.1	1.5-5.4	1.3-3.7	0.6-6.4
Pit River above Pit 3 Powerhouse (52.6 km)	Daily maximum	20.0	18.4	19.3	19.2	18.8	18.9	18.9	21.0
	Daily minimum	14.0	13.4	11.3	12.7	10.0	12.4	13.1	10.0
	Mean	17.2	15.7	15.6	15.7	15.3	16.0	16.2	15.9
	Std. Dev. of mean	0.8	0.6	1.3	0.7	1.4	0.7	0.8	1.0
	Average daily range	2.8	2.7	3.1	3.1	2.9	3.0	2.8	3.0
	Extreme of daily range	1.3-3.4	1.4-4.4	1.4-4.2	1.6-3.9	1.0-3.9	1.5-4.1	0.8-3.5	0.8-4.4
Pit River below Pit 4 Dam (49.7 km)	Daily maximum	21.0	20.7	21.0	20.4	21.6	20.9	20.9	21.6
	Daily minimum	15.6	15.4	11.7	15.6	13.3	15.4	15.2	13.3
	Mean	18.4	18.0	18.6	18.2	18.3	18.6	18.6	18.4
	Std. Dev. of mean	1.0	1.0	1.7	0.8	1.7	1.0	1.0	1.3
	Average daily range	1.5	1.1	1.2	1.1	1.0	1.0	1.0	1.1
	Extreme of daily range	0.7-2.5	0.4-2.4	0.4-3.1	0.3-2.1	0.4-2.2	0.2-1.8	0.2-1.8	0.2-2.5

1 After Table 5-83 [TES 1993]

quality regime throughout the entire Pit 3 reach, which before comprised distinct sections with different water quality conditions. In spite of these changes, water quality conditions are similar to conditions (previously) documented....

The report concluded that

> Other than differences related to variations in hydrologic and meteorologic conditions, stream and reservoir temperatures observed since 1987 were similar. ...The current 150-cfs release has created relatively stable thermal and water quality conditions throughout the Pit 3 reach. Overall, the Pit River immediately downstream of Lake Britton continues to exhibit cool stream temperatures with small daily variations, reflecting the mass of cool water drawn on by the low level release from Lake Britton. Stations further downstream tend to exhibit slightly warmer temperatures due to heating by solar influences. The warmest temperatures in the Pit 2 reach occur upstream of Pit 3 Powerhouse. Stream temperatures observed at all stations generally fall within the range predicted by stream temperature models used during the bald eagle and fish study in 1984....

Additional water quality monitoring in 1994 and 1995 measured similar water quality values. The 1995 report [TES 1996] described similar values and noted that

> ...(water quality) Results in 1995 were consistent with those obtained during the 1987–94 BCMP's...and the Bald Eagle and Fish Study.... In spite of some variability in hydrologic and meteorological conditions, continuously recorded stream temperatures observed during the 1995 monitoring program were similar to the previous 8 years of monitoring (1987-1994). ...the Pit River immediately downstream of Lake Britton continues to exhibit cool stream temperatures with small daily variations, reflecting the mass of cool water drawn on by the low-level release from Lake Britton. ...Stations further downstream tend to exhibit slightly warmer temperatures because of heating by ambient (primarily solar) influences. Temperatures observed in 1995 were generally warmer than those measured in 1994. this is attributable to the above normal precipitation that occurred in 1995 and the occurrence of late season runoff....

Erosion

Upland areas in the LSR have produced some increased sediment yields to the Pit River, mainly from roads, from old timber harvest units, and from undercutting of steep sideslopes and slides by tributary streams. The following erosion sources exist in the Chalk Mountain LSR, including the Rock Creek watershed:

Human caused or created erosion sources[2]

- System roads and associated drainage facilities, including stream crossings;
- Non-system roads and crossings, which have mostly stabilized now, including active, "informal" spur roads to dispersed camping sites along the Pit River and on the middle reach of Rock Creek;
- Livestock grazing and dispersed camping along upper Peavine Creek (tributary to Rock Creek);
- Sediment produced from overland flows on old timber harvest units on National Forest and acquired (formerly private) lands, now mostly abated;
- Informal trailheads and angler trails, from the 50 road (paved Pit River road), down to the river (The Delucci Ridge area is particularly popular for fishing.);

2. The Shasta-Trinity NF side of the LSR has not been thoroughly inspected for recreation impacts.

- System hiking trails, including the Pacific Crest Trail;
- Potential diatomite mining on steeper slopes or near riparian reserves (Not presently a problem in the LSR).

Natural erosion sources

- Larger "dormant" landslide areas slowly moving downhill toward streams;
- Inner gorge areas where deep soils are undercut by incising stream channels;
- Bank erosion by streams at flood stage;
- Effects of wildfire on steep areas, particularly when dormant or slowly creeping landslides are activated after loss of stabilizing vegetation; and
- Surface erosion and rilling on small areas of soil with high erosion hazard, including some steeper diatomite areas.

Sediment movement in the Pit River itself has been affected by the Pit 3, 4, and 5 dams and by their partial regulation of flows in the Pit River. In the Pit River channel, terrace and gravel bar building regimes have probably been reduced since the 1925 construction of the Pit 3 dam and the later construction of the Pit 4 and 5 dams. Pool scouring has probably been reduced, except during exceptionally wet winters. Sediment is certainly collecting behind the major dams in the LSR, but its rate of accumulation has not been determined. Since 1987, summer flows have been increased to 150 cfs, which has both expanded aquatic habitat and improved riparian zone irrigation. There has likely been a minor increase in erosion of bars and banks because of heightened summer flows, without compensating increases in bar or terrace building during most winter floods. It is unknown whether the pools in the Pit 3, 4, and 5 reaches are growing, shrinking, or staying the same in overall extent and depth. Angler trails, use of road shoulder areas for trailhead parking, and some dispersed camping on accessible terrace areas have removed ground cover and possible created minor local sediment sources, but the impacts on soil and water quality do not require urgent remedial action. As a minimum, continued monitoring of those impacts should be included in the long term LSR monitoring plan. (No adverse effects have been identified, for angler impacts on bald eagle foraging or nesting or on other wildlife.)

Riparian reserves in the middle and upper reaches of the tributaries have been variously affected by timber harvesting and road building, mostly since 1960. Heaviest harvesting effects on National Forest land were in the headwaters of East Fork Nelson Creek, Deep Creek, Screwdriver Creek, Poison Creek, and Canyon Creek. Many forested stands in the Rock Creek watershed were partly logged (including the now-acquired lands in Section 21), with attendant development of spur roads and landings.

Livestock grazing occurs on NFS land in the headwaters of Peavine Creek in the Rock Creek watershed and on nearby private lands to the north and northeast. Persistent grazing has reduced ground cover and somewhat reduced the extent of alders and aspen in that area. {*Insert range management material on Cayton Allotment here*?}

Reference Conditions

Steep, tributary streams in the LSR were locally important sources of boulders and sediment to the Pit River, since most larger size materials from upstream sources would have been dropped into floor alluvium in Fall River valley, although a portion would continue moving downstream, as bedload from eroded banks and bars during flood events. However, the amount of sediment from the LSR's tributaries was much less than in the 1960–1980 period, when road systems and timber harvesting in headwaters areas undoubtedly created sediment surges and some local stream channel incision. Landslides were a natural debris source that probably generated episodic pulses of sediment, gravel and boulders to the tributaries and thence to the Pit River. The primary activators of those slides would have been infrequent, intense wildfires and extreme climatic events, such as localized maximum probable precipitation events or 100 year (plus) floods, including mid-elevation rain-on-snow floods.

The role of ground water is important in stream systems based on Cascade volcanics. Tributary perennial streams in the LSR were cold water sources to the Pit River during late summer base flow periods, and the Pit River system base flow was sustained by a significant ground water component, indirectly from such streams as Hat Creek, Fall River, Rising River, Rock Creek, and directly from other ground water supplied streams and springs along the main channel. The complete extent of tributary ground water sources and routes is unknown, but a considerable share of high ground snowmelt moves toward the Pit River via subsurface routes, before emerging as springs in the Hat Creek area and in other drainages that affect the LSR.

Because of the relatively high proportion of groundwater in the Pit System in at least this reach of the Pit River (and for the area 20 miles upstream), the river (and the lowest reaches of its perennial tributaries) would have been less sensitive to short term and multi-year drought effects than most other Northern California streams. Its base flows would likely have diminished more slowly than most stream systems to longer term droughts accompanying regional climatic change. This "constant" portion of the Pit River's flow may have made it an important sustaining component for the upper Sacramento River anadromous fishery, prior to construction of numerous dams, starting in the 1920's.

Riparian reserves in the lower reaches of the Pit River tributaries have probably not changed much, and many of their lower reaches remain inaccessible and mostly undisturbed. Rock Creek has substantially recovered from the impacts of P.G. & E's. dewatering of its lowest 0.93 miles of channel, from approximately 1925 to 1987. Instream flows in the tributaries are unchanged from reference conditions, except for minor impacts from sporadic water drafting at streamcrossings on the existing road system. Riparian reserves in the tributaries' middle and upper reaches were intact and exerted a stabilizing effect on dormant landslide areas, by some water pumping, but mostly by the effects of their root systems and litter on soil cover, shear strength, and cohesion. Perennial tributary reaches supported multi-layered stands that included obligate riparian trees, shrubs, and herbaceous vegetation.

Along the Pit River, terraces and gravel bars were built, eroded, and shifted in a dynamic equilibrium, as did major pools along the river. The relatively narrow canyon bottom, combined with reaches of basalt bedrock bottom and natural channel elevation controls confined flood flows and kept them relatively narrow and rapid, assuring regular scouring of pools along the river. Some pools were persistent long term features, because of local bedrock formations, and others were linked with shifting meander bends. Occasional major flood events created erosion and deposition on the terraces and bars that provided bare ground for establishment of new generations of cottonwoods, willows, and other riparian hardwoods.

Synthesis and Interpretation

In the Rock Creek area (where landform effects were integrated into delineation of ecological mapping units by the ecological unit inventory [Alexander 1996]) and in the rest of the LSR, there are four general landforms that act as arenas for erosion, namely

(1) Upland slopes, ridges and plateaus, including low slope riparian areas at the headwaters of Peavine Creek and the "frog pond" wetlands in section 20 (T. 37 N., R. 2 E., MDM);
(2) Inner valley gorges along tributaries to the Pit River, especially in their middle and lower reaches;
(3) Pit River canyon sides; and
(4) Pit River bottom areas.

In the first landform category, erosion is mainly due to human causes, including existing system and non-system roads, old landings, stream crossings, harvest units, livestock grazing, and recreational use. Future diatomite mining is most likely to occur in this landform, because is represents the most accessible terrain for economical extraction of diatomaceous earth.

The second and third landform classes are dominated by natural erosion processes, relating to dormant landslides, steep inner valley gorges along streams, and to natural channel incision processes. Some road system and streamcrossing impacts have occurred in these areas, particularly along Screwdriver, Poison Creek, and Underground Creek. Old logging roads in the channel bottom areas were once notable sediment sources, but they have mostly regrown with thick vegetative cover in the last two decades. Some P.G.& E. roads and facilities are located on these lands, and their use on National Forest land should also be subject to implementing approved BMP's to minimize adverse water quality impacts. One identified problem site is the P.G. & E. access road to the Rock Creek crossing site for the Pit 3 aqueduct to the Pit 3 powerhouse. A 200 foot section of the road needs to either be abandoned or strengthened with a retaining wall, to prevent fill sloughing into Rock Creek.

The Pit River bottom area is dominated by the mostly regulated flow regime in the Pit River. There are secondary, minor effects from the existing, paved river road and from sidecasting off its fill slopes. There are also some uses of river terraces for dispersed camping that have reduced ground cover and compacted terrace areas.

Water quality and temperature

Based on P.G. & E. monitoring reports, on Forest Service stream surveys, and personal observation of some of the tributaries in the LSR, water quality is compatible with the Aquatic Conservation Strategy, except for some erosion-created sediment. While old timber sales may have destabilized some landslides or created non-point sediment sources from heavily logged areas, most of the old harvest areas are well vegetated and more than 90% recovered now. Some of the formerly forested areas have become brush fields, but any new site preparation activities on a large scale would be incompatible with LSR objectives in most cases. Some additional sediment reductions can be achieved implementing recommended watershed restoration measures [Keller 1995], including decommissioning old spur roads that are not needed for long term management of the LSR. Where stream crossings cannot be maintained or reconstructed to pass 100 year flows, they should be removed. If crossings have to be reused, temporary culverts, bridges, or other structures may be needed.

Because of relatively abundant precipitation and deep soils in most of the LSR riparian reserves, the riparian areas and deeper-soiled areas of the LSR have rapidly reestablished shading vegetation and ground cover (particularly the heavily-logged, acquired land in the Rock Creek watershed). Natural regrowth of vegetation in riparian reserves will move tributary stream temperatures toward reference conditions. One enhancement project would be to restore complete overhead vegetative cover along perennial reaches of upper Peavine Creek. That would require modification of livestock grazing and some dispersed camping practices in that area.

The large volume of cool discharges from Lake Britton (described in the P.G. & E. monitoring reports) has changed the summer temperature relationship between the Pit River and its tributaries, compared to the reference condition. Before the dam releases were increased, tributaries in the LSR provided relatively cool summer inflows to the Pit River, and species favoring cool water environments probably used the lower reaches of the perennial streams as refuge areas. Rock Creek's mean summer temperatures are now slightly warmer than the Pit River. While these differences are not great, they indicate that the amount of habitat for cool water species has been greatly expanded, and that warm water summer habitat in the Pit River has at least proportionately diminished. At the increased release rate, it is possible that the higher stage of flow provides some solar-heated, warmer water habitat in shallow fringe areas along the main channel.

Riparian reserves

Considering the LSR's geomorphology, topography, and soils, guidelines for riparian reserves detailed in the ROD will provide adequate protection of riparian reserves, as at least interim amendments to the Lassen National Forest and Shasta-Trinity National Forests land and resource management plans. At this time, those guidelines appear sufficient to assure implementation of the Aquatic Conservation Strategy in the LSR. For the Lassen NF portion of the LSR, the recommended riparian reserve widths are somewhat wider than those described in the original LRMP, but that expansion of riparian reserve widths will have minimal management effects, particularly since land management options are substantially constrained everywhere in the LSR.

Riparian reserve widths must be widened considerably in inner valley gorge situations, which occur along most of the tributaries to the Pit River in the LSR. Riparian reserve widths would also be extended to include the heads of all identified slides that occur in the inner valley gorges. Along some reaches of Deep Creek, Canyon Creek, Underground Creek, Poison Creek, East Fork Nelson Creek, and Screwdriver Creek, that would require a considerable widening of riparian reserves beyond the initial 100–300 foot requirement along streams [ROD 1994], to favor maximum stability of dormant slides and to protect highly erodible inner gorge areas.

Vegetation in riparian reserves is improving or in good condition, except for the area in the headwaters of Peavine Creek where grazing has thinned riparian hardwoods, reduced ground cover, and flattened some channel segments. Grazing has altered the vegetative mosaic in the "frog pond" area, by browsing alleys and openings in the shrub component. Grazing on those soft pond bottom areas has created some hoof holes and churned areas that have probably further altered local vegetation and possibly affected young frogs and tadpoles. Many old skid trails in riparian reserve areas initially revegetated with mountain maple that are now being shaded by young conifers. Except for eliminating or modifying grazing impacts, the best actions for riparian reserve vegetation is to leave the reserves alone, except where some manipulation is needed to accommodate recreation or other compatible human uses—or to reestablish or invigorate riparian hardwoods.

Pit River flows

Present flow regimes in the Pit River are different from reference conditions. While infrequent, wet year flooding may be comparable to reference conditions when all of P.G. & E.'s spillways are overflowing, most of the sediments that formerly moved downstream from the Fall River valley, Hat Creek, Cayton Creek and Burney Creek are now trapped in Lake Britton. That sediment loss was more than made up by sediment contributions from Rock Creek, Screwdriver Creek, and Underground Creek created by logging and roading in the 1960–1980 period. However, that surge in sediment delivery from tributaries is much reduced now. While sediment from those drainages will likely never be fully reduced to reference levels because of the persistent, minor effects of the long term road system, proposed watershed restoration activities would further reduce existing sediment loads to levels compatible with the Aquatic Conservation Strategy.

Mining

Potential mining in the LSR consists mainly of surface and near surface removal of diatomaceous earth and of surface removal of such common variety materials as rock, gravel, and sand. Most common variety use would be better accommodated outside the LSR, considering the necessary expense of monitoring to assure that ongoing extraction and hauling operations conform to permit requirements designed to minimize adverse effects to the LSR and any involved riparian reserves. The Forest Service has considerable control concerning siting and procedures used at common variety mineral sites, and applications can be denied to protect resource values. Under some circumstances, operators can file locatable mining claims for diatomite. The Forest Service has less capability to actively control the impacts created on locatable mining claims, although some mitigative measures can be required in plans of operations and in special use permits issued for access roads and other support facilities. There are diatomite bodies in the LSR, and some of them are on the edge of unstable areas or on benches bordering steep lands along tributary streams or along the Pit River.

Mining of these types of material can create short term impacts as noise, hydrocarbon emissions and fugitive dust. Longer term effects include removal of groundcover and vegetation from pit areas and access roads; grading and material removals that may change local drainage patterns; removal or displacement of topsoil "overburden," with long term loss of growing site potential.

Potential effects on the landform class 1 areas (i.e. flatter upland ground) can usually be mitigated or limited. Potential impacts on the category 2 and 3 landforms (inner gorge areas and steep slopes, including slide areas) would be much harder to control, and sedimentation effects would be much more likely from mining on these areas. Mining in the Pit River bottom area would almost certainly create both short and long term adverse effects on riparian reserve vegetation and to channel features. Some sediment and rock removals may be necessary for maintenance of existing reservoirs, but that would be administratively different than new mining operations aimed at exporting materials from the LSR. The most economical management solution and the best guarantor against future disturbance in the LSR would be to obtain Federal legislation that would formally withdraw the entire LSR from mineral entry. At present, there are numerous, alternative sites on private lands to the east, so such a withdrawal would not create economic hardships on parties currently mining in the area.

Management actions in the matrix

As previously mentioned in the geology and soils sections, much of the LSR is unstable, too steep for conventional ground skidding, or involves riparian reserve areas. Operations on the remaining areas are subject to guidelines detailed in the ROD [ROD 1994], in the Forests' land and resource management plans, and in implementing approved BMP's for water quality protection. However, many previously entered areas is the western portion of the LSR (north of the Pit River) will require continued stand tending activities, including thinnings, to move plantations toward old growth condition. Some site preparation and planting of diverse tree species may be needed in some areas where old harvest units have not reforested or where fire has created brush fields that could become old growth stands. Fuel reduction activities are appropriate for some areas, where they will reduce the risk of losing existing late seral stands. In areas unsuited to ground harvesting or bunching systems, helicopters or some manual treatments could be done with minimal risk for erosion and sedimentation. The final administrative road network for the LSR will have some road sections that traverse steep slopes or cross streams. Those facilities will be hardened where necessary to meet LSR and riparian reserve objectives. Where those objectives are jeopardized, relocation or decommissioning of some roads may be necessary.

Recommendations

- Manage the LSR to improve water quality in tributaries to the Pit River, especially where lower reaches of perennial streams support native aquatic species. Maintain stream "refugia" where present conditions approach or are the same as reference conditions and improve streams where current conditions are worse than reference conditions.

- Complete transportation planning for the LSR and move ahead to complete watershed restoration activities on the road system in the Rock Creek watershed. Inventory and prioritize needed road restoration and decommissioning projects in the Shasta-Trinity NF portion of the LSR. The final transportation system must be engineered to create minimal adverse impacts to water quality and soil productivity. Stream crossings that are retained in the permanent road system will be designed to accommodate 100 year flood events [ROD 1994]. Monitor ongoing, residual road system sediment sources, especially after wetter than normal winters. Implement further hardening measures where needed or abandon and rehabilitate chronic source sites that produce more than minimal amounts of sediment.

- Emphasize BMP implementation to minimize sediment production resulting from timber harvesting, fuel reduction, and road maintenance activities. Use the onsite and administrative evaluations in BMP Evaluation Procedure (BMPEP) protocols to monitor all management activities in the LSR, including wildfire suppression [BMPEP 1992].

- Modify or terminate livestock grazing on the LSR portion of the Cayton allotment, to restore riparian reserves in the upper Peavine Creek and "frog pond" areas.

- Propose withdrawing the LSR from future mineral entry for locatable minerals (i.e. prevent future disturbance of diatomite areas in the LSR). Until the area can be excluded from mining claim filings, apply all feasible mitigative measures to minimize potential adverse effects from diatomite mining. Issue common variety minerals permits only when environmental analysis determines that there are no reasonably accessible sources at nearby sites outside the LSR and that will be no adverse effects to old growth vegetation or riparian reserves in the LSR.

- Monitor impacts of informal trailheads, parking areas, and angler trails along the Pit River and Rock Creek. Take administrative action to prevent adverse effects on water quality or riparian vegetation, while still allowing for compatible human uses of the area. Review human uses of the terrace and bar areas along the Pit River for loss of vegetation and soil compaction. Where riparian vegetation could be enhanced in conformance with the Aquatic Conservation Strategy, redirect or limit vehicle access to reduce erosion and to improve riparian vegetation and soil conditions.

- Work with P.G. & E., FERC, and other interested parties, to adjust flow release schedules and regimes and manage recreational and industrial uses to maintain and restore the integrity of the aquatic and riparian zones along the Pit River.

- While this watershed analysis attempted to consider all available information, some more intensive background work would help to better access the dynamics of the LSR's stream systems. For example, more accurate flood frequency estimates can be developed, based on hypsometric curves that plot drainage area vs. elevation for all the local catchments. Ongoing development of Forest Service geographic information systems can make such detailed analyses far more feasible than methods requiring manual measurement and calculations from topographic maps.

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Appendix 4 - Keller Report

United States Department of Agriculture | Forest Service | Plumas National Forest | 159 Lawrence Street P.O. Box 11500 Quincy, CA 95971-6025

Reply to: 1920 Date: January 10, 1995

Subject: Rock Creek Area FEMAT Study of Roads Impacts and Restoration Needs

To: District Ranger, Hat Creek Ranger District

INTRODUCTION

The following report is written to document the watershed analysis work done regarding the impacts and watershed restoration needs identified on approximately 70 miles of roads in the Rock Creek area of the Hat Creek Ranger District, Lassen National Forest. The area encompasses approximately 22 square miles of National Forest land, including some private land, north of the Pit River and west of Lake Britton (see Area Map, Exhibit I). The watershed is primarily that of Rock Creek, but the study area also includes most of the Screwdriver Creek drainage.

The field work was conducted during the summer and fall, 1994 and included an on-the-ground review of virtually all of the existing road system in the area, as well as some closed roads, and a review of air photos of the area. Also specific drainage crossings were examined and area materials sources were evaluated for potential use. The project was reviewed and discussed with Chuck Rowe, Resource Officer on the District and with Steve Young, Hydrologist, and Rick Kennedy, Assistant Forest Engineer in the Supervisor's Office. Also the area transportation system was reviewed with Ken McCullough, Forest Transportation Planner.

The Rock Creek watershed and study area are formally designated as non-Key Watersheds, but appear to clearly have the attributes of a Tier 2 Key Watershed. Factors of Rock Creek consistent with Key Watersheds include its "wild trout" fisheries in the lower portion of the drainage and its overall valuable contribution to fisheries in the Pit River system; it is an important source of high quality water, with potential for additional improvements; it is the most "pristine" watershed within the Pit River system; and the unique beauty and diversity of this watershed with mixed conifer forest with some old growth timber on the edge of the Southern Cascade mountain province. Much of the area was heavily logged in the past but has had 15 to 25 years since logging and associated road construction activity to recover. Significant additional improvements can be made with appropriate watershed restoration work.

OBJECTIVES

The basic objective of this watershed analysis is <u>to minimize the impacts of roads</u> in the area. This can be accomplished by the identification and prioritization of roads impacts and subsequently the implementation of watershed restoration projects to correct the problems or eliminate the impacts. The work has been identified following the guidelines established in the Forest Ecosystem Management Assessment Team (FEMAT) Report, Appendix H for Restoration of Watersheds and Riparian Ecosystems, the Record of Decision and Standards and Guidelines for Management of Habitat for Old Growth Forest Related Species Within the Range of the Northern Spotted Owl, and in A Federal Agency Guide for Watershed Analysis. Also considerable personal judgment and local experience is incorporated into the process and restoration work defined herein.

Identified "impacts" within the study area include riparian area degradation and sedimentation and subsequent degradation of water quality in area streams from roadway surface runoff and inadequate roadway drainage; from disturbed cut, fill and materials borrow areas; from poorly constructed and/or inadequate capacity drainage crossings; from local instability areas; etc. Other impacts and associated problems include degradation to riparian areas and fish habitat, as well as cumulative watershed impact from the area road system.

PRIORITIZATION OF IDENTIFIED WORK

Most work identified for watershed improvement consists of upgrading, repairing, and maintaining the roadway prism and surface, roadway drainage, and stream crossings on the existing transportation system, particularly on the 29 miles of main or collector road system in the area. Some realignment work is also recommended. An additional 37 miles of interior local and spur roads, generally away from the Rock Creek drainage, were examined for needed work. Work involves road decommissioning (closure or obliteration) on roads or portions of roads which appear unnecessary to the area transportation system and which have adverse impacts, as well as considerable needed maintenance and surface drainage work.

The identified work has been prioritized for restoration treatment into three groups, in descending order of stream and riparian area impact. Priority I and Priority II work items have immediate, direct, or potentially severe impacts on live streams and riparian areas. Priority III work involves "hillslope" restoration on roads relatively high in the watershed or some distance from a live drainage. Priority groups are defined below.

-Priority I work involves items which present a "substantial risk" to water quality degradation such as undersized culverts (for a 100 year storm event), poorly constructed drainage crossings or crossings without overflow protection, areas where roadway fill or slide material enters directly into Rock Creek, or areas or fills where a significant amount of material (over 50 cubic yards) may directly enter into a tributary of Rock Creek.

-Priority II work involves roadway surface drainage and erosion control measures on roads adjacent to or near Rock Creek and its tributaries which are a steady source of minor stream sediment, but sites are not directly at crossings. Items of work include additional waterbars or dips, added crossdrains, additional aggregate surfacing and erosion control measures on disturbed areas, some road closure and relocation, and maintenance of ditches and crossdrain pipes. Also it includes needed drainage work and removal of some existing culverts in other watersheds such as Screwdriver creek which are not "wild trout" fisheries.

-Priority III items involves roadway segments and disturbed area work in areas which are not near Rock Creek or which do not significantly impact its tributaries. Priority III work includes upland roadway maintenance, ditch and culvert cleaning, additional water bars and cross drains, additional armored dips, spot rocking, and most of the road decommissioning identified in this report.

NEEDED RESTORATION WORK

Listed below are the specific areas and items of work within the study area, prioritized by groups, and also listed in descending order of priority within the groups. Note that the prioritization of these projects is based upon qualitative judgment of impacts to the stream and riparian ecosystem, and may be subject to differences of opinion. Some quantitative analysis of impacts may be desirable on large cost items of work. Specific work is summarized and outlined below.

PRIORITY I PROJECTS

PG&E PENSTOCK ACCESS ROAD ALONG LOWER ROCK CREEK (WILD TROUT PORTION)

-Add/improve 13 water bars on the 0.4 mile long road.

-Close the upper portion of road by the debris slide area directly into Rock Creek as an alternative to construction of a 100' X 8' high retaining wall (Est cost $24,000) across the slide area. Add some vegetative stabilization to the berm and do not allow sidecasting!

37N02 CROSSING OF ROCK CREEK (12' CMP CULVERT)

-Add 250 CY of riprap armor to the culvert fill face.

-Survey the site, construct an armored dip across the road to keep high water from running down the road.

-Add berms along the road edge and downdrains.

-Close or waterbar the spur road to the creekside campsite. Seed and scarify about 1 acre of the intersection area.

Note that fish passage is not an issue with this pipe since the waterfalls just downstream of this crossing preclude fish passage.

37N30 CROSSING, NORTH FORK OF ROCK CREEK

-Construct an estimated 25 foot span bottomless arch or timber bridge. Exact size depends on hydrologic and hydraulic analysis. Alternatively, if road use is very low, an armored, vented ford (low water crossing) could be considered.

37N30 B-SPUR, MP 1.6 (IN SECTION 8)

-Remove the remaining road fill and armor the crossing in this debris torrent channel.

37N30 A-SPUR, MP 0.1 (NEAR UPPER ROCK CK)

-Remove the poorly located 18" CMP. Replace with an armored dip and 10 CY of riprap for slope protection.

ROAD 37N30 ALONG ROCK CREEK IN SECTION 22, DECOMMISSIONING AND ALTERNATE UPSLOPE REALIGNMENT

-Close, scarify, seed and waterbar 1.7 miles of existing road neer Rock Creek. Eliminate this section with debris slides directly into the creek.

-Improve upper road, add 20 rolling dips plus a 36" CMP.

-Add a new construction tie road about 1/4 mile long.

-Spot rock one mile of the road in deep rutted areas.

PRIORITY II PROJECTS

ROAD 37N30 ALONG ROCK CREEK, 37N02 TO 37N75 (1.9 MI)

-Add 8 additional rolling dips to the road for improved drainage.
-Close the roads or add dips/water bars on two spur roads which access camping sites along the creek and drain directly into the creek.

ROAD 37N30 ALONG ROCK CREEK, 37N75 (ABOVE REALIGNMENT) TO NORTH FORK ROCK CREEK CROSSING (1.3 MI)

-Add 12 rolling dips into the road to improve surface drainage.
-Add spot rock (aggregate) to one half of this 1.3 mile segment.

ROAD 37N30 ALONG ROCK CREEK, NORTH FORK ROCK CREEK CROSSING TO 38N10 (PEAVINE CREEK CROSSING) (2.8 MI)

-Add an overflow armored dip and some riprap at the Rock Creek crossing.
-Seed and mulch about 1/2 acre of barren disturbed ground near the creek.
-Add 21 rolling dips along this segment.
-Spot rock about 0.9 miles in a couple soft, rutting areas near the creek, using local pit run aggregate.
-Do 2.8 miles of roadside maintenance, including cleaning the ditches and culvert inlets/outlets.

UPPER SCREWDRIVER CREEK CROSSINGS (ON CLOSED ROADS 37N05C & 37N06)

-Remove the 48", 48", and 54" CMPS and two old log culverts on this closed road system before they overtop and wash out.
-Add 8 large berms or waterbars to the presently closed roads.
-Scarify, seed and mulch about 2 acres of old quarry and landing area which are still barren and are sources of erosion very near Screwdriver Creek.

SCREWDRIVER CREEK BRIDGE (PG&E?) ON FH 50

-Upsize the present box culvert which is undersized and has periodically been overtopped, eroding local stream banks. Increase size to about a 25 foot span bridge or arch culvert.

PRIORITY III PROJECTS

UPLAND ROADS 37N74, 37N56, 37N86 (BIRD FLAT AREA)

-Decommission--Close, scarify, seed and waterbar one mile of existing road.
-Add 8 additional rolling dips to the existing roads.
-Do roadway maintenance on 3.5 miles of system roads, including ditch and culvert inlet/outlet cleaning.
-Outslope and reshape/add waterbars to 0.95 miles of poorly draining road.

UPLAND ROADS 37N30 SPURS A, B, C (NORTH OF ROCK CREEK)

-Decommission--Close, scarify, seed and waterbar 2.6 miles of existing roads.
-Add 3 additional armored rolling dips in areas of these roads.
-Add about 20 driveable dips or water bars to these low standard roads.
-Do ditch and pipe cleaning maintenance on 2.5 miles of these spur roads.

INTERIOR UPLAND ROADS 37N08, 37N52Y, 37N05 AND SPURS

- -Add spot rock (aggregate) on 0.85 miles of these roads in rutted areas near stream crossings.
- -Decommission--Close, scarify, seed and waterbar 1.3 miles of existing roads.
- -Add 31 additional rolling dips to improve surface drainage on the main system roads.
- -Add 43 driveable dips or water bars for drainage control on low standard spur roads, some of which are now nearly closed.
- -Do roadway maintenance on 14.3 miles of main roads, including ditch and culvert inlet/outlet cleaning.

UPLAND ROADS-JAKE SPRING LOOP & DELUCCI RIDGE AREA

- -Add spot rock on 0.55 miles of roads in badly rutted areas.
- -Decommission--Close, scarify, seed and waterbar 2.0 miles of existing roads or old roads which are only partially closed.
- -Add 10 additional rolling dips on system roads.
- -Add 15 driveable dips or water bars on lowest standard open roads.
- -Do roadway maintenance on 3.1 miles of main roads.

ROAD 38N10 (OLD OIL SURFACE), 37N30 TO 37N02
MP 4.1 TO MP 9.1 (5.0 MI)

- -Add 13 additional armored rolling dips for improved drainage on this main system road.
- -Add spot rock to 0.6 miles of road in soft, rutting areas along creeks.
- -Do roadway maintenance on 5.0 miles of main roads.

FH 37 (37N02) (OLD CHIP SEAL ROAD), 38N10 TO PAVEMENT
AT MINESITE (6.2 MI)

- -Do roadway maintenance on about half of this 6.2 mile segment of main chip seal road including ditch and culvert inlet/outlet cleaning.
- -Install 7 additional 24" CMP culvert cross drains across this main system road. Depending on traffic volume, armored dips could replace these pipes.
- -Add a trash rack to the 72" culvert crossing at Screwdriver Creek. Some debris exists in the drainage. Plugging is unlikely, but the high fill would cause significant watershed damage if it ever failed.

COSTS

The total estimated cost of the Priority I work is $139,890, the Priority II cost is estimated at $116,005, and the Priority III work is $212,670. The total cost of the above outlined work is $468,565. The costs are based upon unit costs from the regional cost guide and local experience for the specified restoration work. Costs include Mobilization, 25% Profit and Overhead (for Public Works Contracting), 15% Project Engineering and Construction Engineering (PE/CE) costs, and a 15% surcharge for Forest General Administration (GA) cost. Costs may vary somewhat depending on funding mechanism and method of restoration or reconstruction work used, and how much work is accomplished under any one project or contract.

Note that the cost of items of work such as spot rocking assumes that local area materials sources will be used. One existing quarry site is located along Road 37N05 in the middle of Section 27, T37N, R2E. This site requires a crushing operation but can produce near-standard base or surface course aggregate. The blocky to platey volcanic rock is only slightly softer and less durable than normally specified. This source can also be used to produce 6 to 9 inch size light riprap.

A pit run materials source also exists on the north side of the study area near Rock Creek along Road 37N30 in the NE quarter of Section 17, T37N, R2E. This source has been used for local road surface stabilization in the past. The very fractured cobbly to sandy volcanic rock can be used as is or preferably would be screened or primary jaw crushed. The material is relatively soft and has variable quality, but is suitable for erosion control and surface stabilization on low traffic volume roads. Similar material exists in some other road cuts near this site, but volume is small. Pit development and restoration plans need to be developed for any sites used in this watershed to minimize additional environmental impacts.

Enclosure II shows a summary of work by site or road segment, with the projected cost of that work. Also the cumulative cost of the identified work is shown, as summarized above. Enclosure III presents the individual area or road work lists by milepost, with the specific work identified for that road or area. Finally Enclosure IV is a detailed map of the study area showing the proposed transportation system, roads suggested for decommissioning, potential materials sources, and some of the specific items of work.

SUMMARY

The Rock Creek watershed area have been surveyed for watershed impacts relating to the road system. As a result of this inventory, numerous improvements and watershed restoration projects have been identified. This work has been prioritized by relative impact on local water quality and riparian areas. Also the cost of the restoration work has been estimated and presented by priority group. The identified work is practical, effective, and is needed to protect and improve the watershed condition. The total estimated restoration cost is $468,500, with about one third of that cost being on the highest priority items.

The Rock Creek watershed has the attributes of a Key Watershed because of its old growth forest, its wild trout habitat, potential high water quality, and the opportunity through restoration work to be a pristine watershed within the Pit River system. The identified restoration work will be highly beneficial in making this area unique and will significantly aid in the recovery of area fish habitat, riparian habitat, and water quality.

Please call me at (916) 283-2050 if you need any further information at this time or if you have questions concerning the items of work or the costs of identified restoration and repair work.

Respectfully,

GORDON R. KELLER, PE
Geotechnical Engineer

EXHIBIT II

FEMAT ROAD RESTORATION COSTS
HAT CREEK RANGER DISTRICT
LASSEN NATIONAL FOREST

COST SUMMARY

PRIORITY I PROJECTS	COST	CUMULATIVE COST
PG&E PENSTOCK ACCESS ROAD ALONG LOWER ROCK CK		
ADD 11 WATER BARS + 2 ARMORED DIPS @ $400/DIP	$1,515	
CLOSE UPPER PORTION OF ROAD AS ALTERNATIVE TO 100' X 8' RETAINING WALL ACROSS SLIDE, PLUS SOME VEGETATIVE STABILIZATION	$ 500	
	$2,015	$2,015
37N02 CROSSING OF ROCK CREEK (12' CMP CULVERT)		
250CY RIPRAP @ $40/CY + SEED/SCARIFY 1 ACRE	$12,000	
SURVEY, ARMORED DIP, BERMS, WATERBARS	$ 4,000	
	$16,000	$18,015
37N30 CROSSING, NORTH FORK OF ROCK CREEK		
25 FOOT SPAN BOTTOMLESS ARCH OR TIMBER BRIDGE	$55,000	$73,015
37N30 B-SPUR, MP 1.6 (IN SECTION 8)		
REMOVE ROAD FILL AND ARMOR CROSSING IN DEBRIS TORRENT CHANNEL (10 CY RIPRAP)	$ 1,500	$74,515
37N30 A-SPUR, MP 0.1 (NEAR UPPER ROCK CK)		
REMOVE 18" CMP IN POOR LOCATION, REPLACE WITH ARMORED DIP & 10 CY RIPRAP	$ 2,000	$76,515
ROAD 37N30 ALONG ROCK CREEK IN SECTION 22, DECOMMISSIONING AND ALTERNATE UPSLOPE REALIGNMENT		
SCARIFY, SEED AND WATERBAR 1.7 MILES @ $5750/MILE	$ 9,775	
UPPER ROAD, ADD 20 ROLLING DIPS @ $400/DIP	$ 8,000	
NEW CONSTRUCTION TIE- 1/4 MILE @ $40,000/MILE	$10,000	
SPOT ROCK 1.0 MILES OF ROAD @ $29,000/MILE	$29,000	
ADD 36" CMP	$ 6,600	
	$63,375	$139,890

PRIORITY II PROJECTS

ROAD 37N30 ALONG ROCK CREEK, 37N02 TO 37N75 (1.9 MI)		
ADD 8 ROLLING DIPS @ $400/DIP	$3,200	
CLOSE OR ADD DIPS ON 2 SPUR ROADS TO CREEK	$2,050	

	$5,250	$145,140
ROAD 37N30 ALONG ROCK CREEK, 37N75 (ABOVE REALIGNMENT) TO NORTH FORK ROCK CREEK CROSSING (1.3 MI)		
ADD 12 ROLLING DIPS @ $400/DIP	$ 4,800	
SPOT ROCK 1/2X 1.3 MI @ $29,000/MILE	$18,850	

	$23,650	$168,790
ROAD 37N30 ALONG ROCK CREEK, NORTH FORK ROCK CREEK CROSSING TO 38N10 (PEAVINE CK CROSSING) (2.8 MI)		
ARMORED DIP AND RIPRAP AT ROCK CK XNG (5 CY)	$ 725	
SEED AND MULCH 1/2 ACRE @ $2,000/AC	$ 1,000	
ADD 21 ROLLING DIPS @ $400/DIP	$ 8,400	
SPOT ROCK 1/2+OF MP2.0-3.4(0.9 MI) @ $20,000/MILE	$18,000	
2.8 MILES OF MAINTENANCE (DITCH AND PIPE INLET CLEANING) @ $1,350/MILE	$ 3,780	

	$31,905	$200,695
UPPER SCREWDRIVER CREEK CROSSINGS (ON CLOSED ROADS 37N05C & 37N06)		
REMOVE 48", 48", 54" CMPS AND 2 OLD LOG CULVERTS	$ 3,000	
ADD 8 LARGE WATERBARS/BERMS @ $400 EA	$ 3,200	
SCARIFY, SEED & MULCH 2 ACRES @ $2000/AC	$ 4,000	

	$10,200	$210,895
SCREWDRIVER CK BRIDGE (PG&E?) ON FH 50		
UPGRADE BOX CULVERT TO 25' SPAN BRIDGE/ARCH PIPE	$45,000	$255,895

PRIORITY III PROJECTS

UPLAND ROADS 37N74, 37N56, 37N86 (BIRD FLAT AREA)		
CLOSE/SEED & SCARIFY/WATERBAR 1.0 MILES @ $5750/MI	$ 5,750	
8 ADDITIONAL ROLLING DIPS @ $400/DIP	$ 3,200	
DITCH/PIPE MAINTENANCE ON 3.5 MILES @ $1350/MILE	$ 4,725	
OUTSLOPE AND/OR WATERBAR 0.95 MILES @ $2000/MI	$ 1,900	

	$15,575	271,470
UPLAND ROADS 37N30 SPURS A, B, C (NORTH OF ROCK CK)		
CLOSE/SEED & SCARIFY/WATERBAR 2.6 MILES @ $5750/MI	$14,950	
3 ADDITIONAL ROLLING DIPS (ARMORED) @ $525/DIP	$ 1,575	
ADD APPROX 20 DRIVEABLE DIPS/WATER BARS @ $65 EA	$ 1,300	
DITCH/PIPE MAINTENANCE ON 2.5 MILES @ $1350/MILE	$ 3,375	
	$21,200	$292,670

INTERIOR UPLAND ROADS 37N08, 37N52Y, 37N05 AND SPURS		
SPOT ROCK 0.85 MILES @ $29,000/MILE	$24,650	
CLOSE/SEED & SCARIFY/WATERBAR 1.3 MILES @ $5750/MI	$ 7,475	
31 ADDITIONAL ROLLING DIPS @ $400/DIP	$12,400	
ADD 43 DRIVEABLE DIPS/WATER BARS @ $65 EA	$ 2,795	
DITCH/PIPE MAINTENANCE ON 14.3 MILES @ $1350/MILE	$19,305	
	$66,625	359,295
UPLAND ROADS-JAKE SPRING LOOP & DELUCCI RIDGE AREA		
SPOT ROCK 0.55 MILES @ $29,000/MILE	$15,950	
CLOSE/SEED & SCARIFY/WATERBAR 2.0 MILES @ $5750/MI	$11,500	
10 ADDITIONAL ROLLING DIPS @ $400/DIP	$ 4,000	
ADD 15 DRIVEABLE DIPS/WATER BARS @ $65 EA	$ 975	
DITCH/PIPE MAINTENANCE OF 3.1 MILES @ $1350/MILE	$ 4,185	
	$36,610	$395,905
ROAD 38N10 (OLD OIL SURFACE), 37N30 TO 37N02 MP 4.1 TO MP 9.1 (5.0 MI)		
ADD 13 ROLLING DIPS (ARMORED) @ $525/DIP	$ 6,825	
SPOT ROCK 0.6 MILES @ $29,000/MILE	$17,400	
5.0 MILES OF DITCH/PIPE MAINTENANCE @ $1350/MILE	$ 6,750	
	$30,975	$426,880
FH 37 (37N02) (OLD CHIP SEAL ROAD), 38N10 TO PAVEMENT AT MINESITE (6.2 MI)		
3.1 MILES OF DITCH/PIPE MAINTENANCE @ $1,350/MILE	$ 4,185	
INSTALL 7 ADDITIONAL 24" CMP CROSS DRAINS @ $5000	$35,000	
ADD TRASH RACK TO SCREWDRIVER CK 72" CMP @ $2500	$ 2,500	
	$41,685	$468,565
TOTAL ESTIMATED COST	**$468,565**	

UNIT COSTS

The following unit costs have been used in the development of the costs for the above specified restoration work. Please note that the unit costs shown in parenthesis include Mobilization, and 25% Profit and Overhead, assuming that the work would be done with a Public Works Contract. These costs are consistent with the Regional Road Construction Cost Estimating Guide.
Also an additional 15% Project Engineering/Construction Engineering (PE/CE) cost is applied for the cost of design, contract preparation and administration. Finally a 15% surcharge is applied to cover the General Administration (GA) cost used by the Forest. Depending on funding mechanism, the actual unit costs used may be reduced somewhat.

-Road closure/scarify, seed, mulch, waterbar	(\$4,350) \$5,750 per mile
-Roadside ditch maintenance and culvert inlet/outlet cleaning	(\$1,000) \$1,350 per mile
-Outslope/minor reshaping, some water bars	(\$1,500) \$2,000 per mile
-New construction, 14' wide road, Level II	(\$30,000) \$40,000 per mile
-Spot rock/6" of local aggregate	(\$22,000) \$29,000 per mile
-Scarify, seed, and mulch areas	(\$1500) \$2,000 per acre
-Armored driveable dips	(\$400) \$525 each
-Driveable rolling dips	(\$300) \$400 each
-Water bars @ 200' spacing (\$65 ea)	(\$1,500) \$2,000 per mile
-Installation of 24" to 36" CMP (35')	(\$5,000) \$6,600 each
-Removal of culverts 18" to 48" CMP	(\$750) \$1,000 each
-Retaining structures	(\$30) \$40 per FT^2 of face
-Riprap	(\$30) \$40 per YD^3

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Appendix 6 - Late Successional Species

Birds

Wood Duck	*Aix sponsa*
Bufflehead	*Bucephala albeola*
Common Merganser	*Mergus merganser*
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Northern Goshawk	*Accipiter gentillis*
Red-tailed Hawk	*Buteo jamaicensis*
Golden Eagle	*Aquila chrysaetos*
American Kestrel	*Falco sparverius*
Peregrine Falcon	*Falco peregrinus*
Blue Grouse	*Dendragapus obscurus*
Band-tailed Pigeon	*Columba fasciata*
Flammulated Owl	*Otus flammeolus*
Western Screech-Owl	*Otus kennicottii*
Great Horned Owl	*Bubo virginianus*
Northern Pygmy-Owl	*Glaucidium gnoma*
Spotted Owl	*Strix occidentalis*
Northern Saw-whet Owl	*Aegolius acadicus*
Vaux's Swift	*Chaetura vauxi*
Anna's Hummingbird	*Calypte anna*
Calliope Hummingbird	*Stellula calliope*
Belted Kingfisher	*Ceryle alcyon*
Red-breasted sapsucker	*Sphyrapicus ruber*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
White-headed woodpecker	*Picoides albolarvatus*
Black-backed Woodpecker	*Picoides arcticus*
Pileated Woodpecker	*Dryocopus pileatus*
Olive-sided Flycatcher	*Contopus borealis*
Hammond's Flycatcher	*Empidonax hammondii*
Tree swallow	*Tachycineta bicolor*
Violet green Swallow	*Tachycineta thalassina*
Mountain Chickadee	*Parus gambelli*
Chestnut-backed Chickadee	*Parus rufescens*
Red-breasted Nuthatch	*Sitta canadensis*
White-breasted nuthatch	*Sitta carolinenesis*
Pygmy Nuthatch	*Sitta pygmaea*
Brown Creeper	*Certhia americana*
Winter Wren	*Troglodytes troglodytes*
Golden-crowned Kinglet	*Regulus satrapa*
Ruby-crowned Kinglet	*Regulus calendula*
Hermit Thrush	*Catharus guttatus*
Warbling vireo	*Vireo gilvus*
Orange-crowned warbler	*Vermivora celata*
Yellow-rumped warbler	*Dendroica coronata*
Black-throated Gray Warbler	*Dendroica nigrescens*
Hermit Warbler	*Dendroica occidentalis*
MacGillivray's Warbler	*Oporomis tolmiei*
Western Tanager	*Piranga ludoviciana*
White-crowned sparrow	*Zonotrichia leucophrys*
Dark-eyed Junco	*Junco hyemalis*
Brewer's Blackbird	*Euphagus cyancephalus*
Cassin's Finch	*Carpodacus cassinii*

Red Crossbill	*Loxia curvirostra*
Pine Siskin	*Carduelis pinus*
Evening Grosbeak	*Coccothraustes vespertinus*

Mammals

Water Shrew	*Sorex palustris*
Trowbridge's Shrew	*Sorex trowbridgii*
Yuma Myotis	*Myotis yumanensis*
Long-eared Myotis	*Myotis evotis*
Long-legged Myotis	*Myotis volans*
California Myotis	*Myotis californicus*
Silver-haired Bat	*Lasionycteris noctivagans*
Big Brown Bat	*Eptesicus fuscus*
Hoary Bat	*Lasiurus cinereus*
Western Gray Squirrel	*Sciurus griseus*
Douglas Squirrel	*Tamiasciurus douglasii*
northern Flying Squirrel	*Glaucomys sabrinus*
Bushy-tailed Woodrat	*Neotoma cinerea*
Western Red-backed Vole	*Clethrionomys californicus*
Western Jumping Mouse	*Zapus princeps*
Gray fox	*Urocyon cinereoargenteus*
Black Bear	*Ursus americanus*
Ringtail	*Bassariscus astutus*
Marten	*Martes americana*
Fisher	*Martes pennanti*
Ermine	*Mustela erminea*
Long-tailed weasel	*Mustela frenata*
Mink	*Mustela vison*
Wolverine	*Gulo gulo*
River Otter	*Lutra canadensis*
Mountain Lion	*Felis concolor*
Bobcat	*Felis rufus*
Elk	*Cervus elaphus*

Amphibians

Long-toed Salamander	*Ambystoma macrodactylum*
Cascades Frog	*Rana cascadae*
Rubber Boa	*Charina bottae*

Appendix 7 - Team Members

Team Member	Area of Expertise	Role	Agency/Unit
Boyd Turner	Wildlife	Team Leader	Lassen NF, Hat Creek RD
Debbie Mayers	Fuels Management	Core Team Member	Lassen NF, Hat Creek RD
Beth Corbin	Botany	Core Team Member	Lassen NF, Supervisor's Office
Steve Young	Hydrology	Core Team Member	Lassen NF, Supervisor's Office
Teresa Pustejovsky	Fisheries	Core Team Member	Lassen NF, Eagle Lake RD
Bob Wise	Archeology	Core Team Member	Lassen NF, Hat Creek RD
Scott Stawiarski	Forestry	Core Team Member	Lassen NF, Hat Creek RD
Ken Dominguez	Silvicultural Treatments	Core Team Member	Shasta Trinity NF, Shasta Lake RD
Michael Bornstein	Wildlife	Core Team Member Liason w/ USFWS	US Fish and Wildlife Service, N. Central Valley Field Office
Tim McCammon	Fire Suppression	Core Team Member Liason w/ CDFFP	Calif. Dept. of Forestry and Fire Protection
Rich Coakley	Silviculture	Contributor	Lassen NF, Hat Creek RD
Joyce Wood	Range	Contributor	Lassen NF, Hat Creek RD
Kathy Turner	Recreation/Lands	Contributor	Lassen NF, Hat Creek RD
Terry Healey	Fisheries	Contributor	Calif. Dept. of Fish and Game
Nancy Hutchins	Wildlife	Contributor	Shasta Trinity NF, Shasta Lake RD
Deborah Romberger	Administration	Line Officer	Lassen NF, Hat Creek RD
Robert Hammond	Administration	Line Officer	Shasta Trinity NF, Shasta McCloud RD

Appendix 8 - Fuel loading acceptability table

Fuel loading acceptability table.

	Fuel Break		Habitat Areas	
Photo Series Page	Acceptable	Unacceptable	Acceptable	Unacceptable
1-MP-4	✓		✓	
2-MP-4	✓		✓	
3-MP-4	✓		✓	
4-MP-4		✓	✓	
5-MP-4		✓		✓
1-MF-4	✓		✓	
2-MF-4	✓		✓	
3-MF-4		✓	✓	
4-MF-4		✓	✓ only for fuels >9"	✓- for fine fuels
5-MF-4		✓		✓
1-PP-2		✓	✓	
2-PP-2		✓	✓-for ground fuels	✓-not for ladder fuels
3-PP-2		✓		✓
4-PP-2		✓		✓
1-PP-3	✓		✓	
2-PP-3	✓		✓	
3-PP-3	✓		✓	
4-PP-3	✓		✓	
1-PP-4	✓		✓	
2-PP-4	✓		✓	
3-PP-4	✓		✓	
1-WF-2		✓	✓	
2-WF-2		✓		✓ ladder fuels too heavy
3-WF-2		✓	✓	
4-WF-2		✓		✓
1-WF-3		✓	✓	
2-WF-3		✓	✓	
3-WF-3		✓	✓	
4-WF-3		✓		✓
5-WF-3		✓		✓
1-WF-4	✓		✓	
2-WF-4	✓		✓	
3-WF-4		✓-too many 1-3 in materials	✓	
4-WF-4		✓	✓	
5-WF-4		✓	✓	
1-RF-3	✓		✓	
2-RF-3		✓- too many fines	✓	
3-RF-3		✓	✓	
4-RF-3		✓	✓	
5-RF-3		✓		✓
1-RF-4	✓		✓	
2- RF-4		✓	✓	
3- RF-4		✓	✓	
4- RF-4		✓	✓	
5- RF-4		✓		✓ on steep slopes

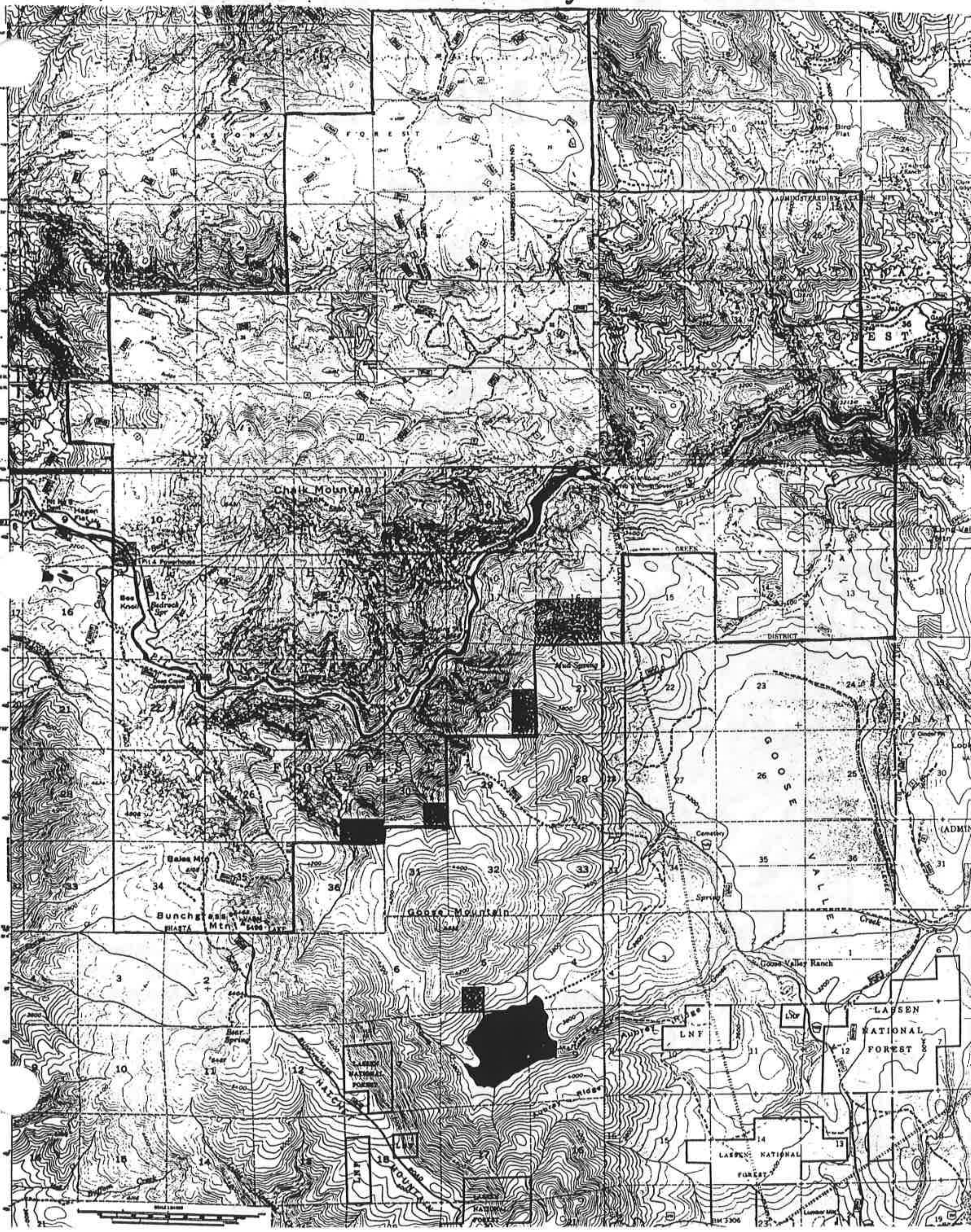
Appendix 9 - Description of Mature and Late Successional Conditions

Description of Mature and Late Successional Conditions

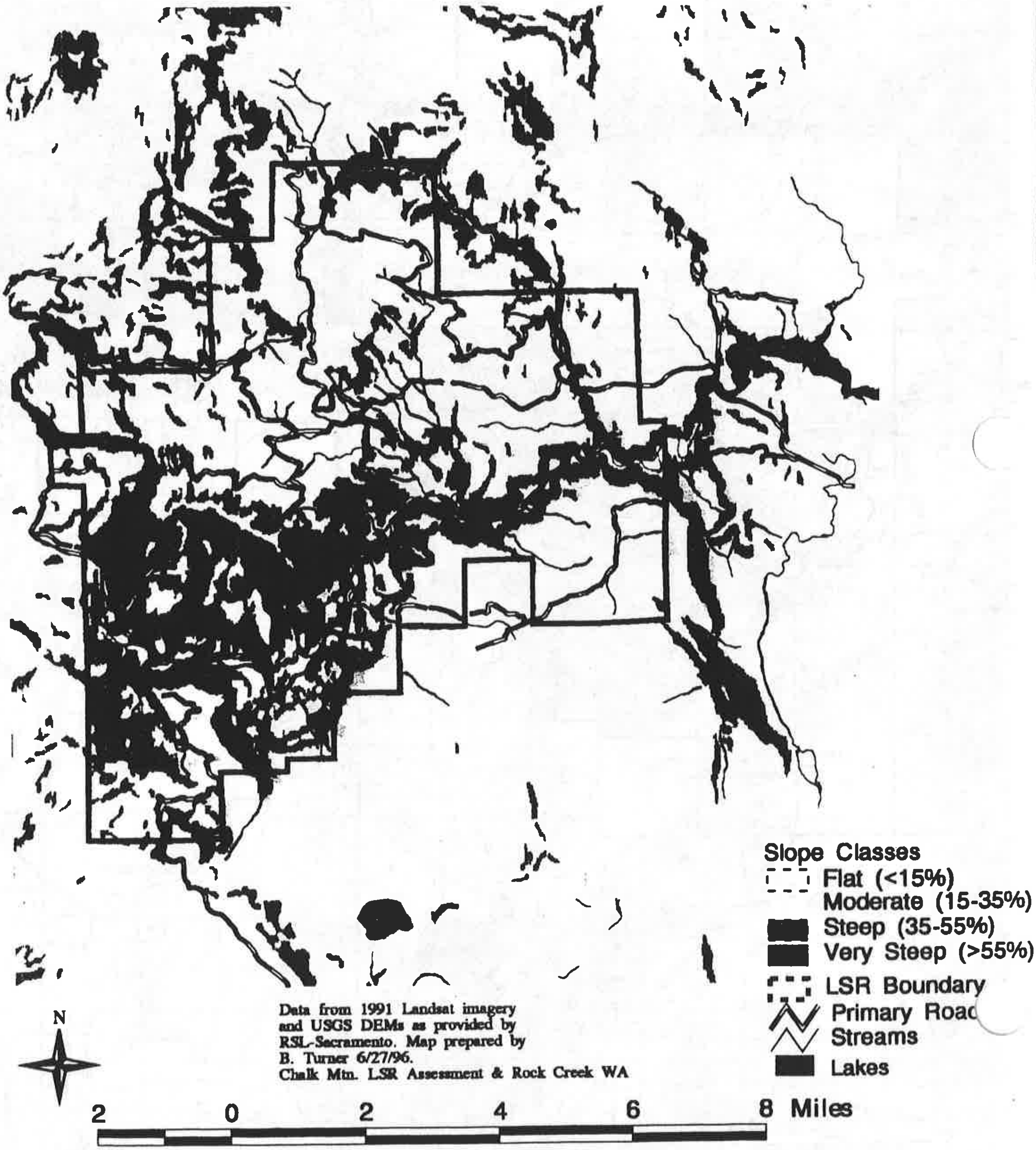
Vegetation Type	Overstory Tree Size	Overstory Species Mix[1]	Canopy Closure	Basal Area	# of Layers	Snag Levels	Logs[2]
Within FMZs							
Mixed Conifer - Fir	>24"	WF,PP, DF, IC, BO[3]	65-80%	50-70% of normal or sufficient to maintain 65% canopy closure	1	2-4/ac >24" DBH	<10 tons/acre or<480 lineal feet
Mixed Conifer - Pine	>24"	PP, JP, IC, DF, SP, WF, BO	65-80%	50-70% of normal or sufficient to maintain 65% canopy closure	1	2-4/ac >24" DBH	<10 tons/acre or<480 lineal feet
Mixed Conifer - Douglas Fir[4]	>24"	DF, WF, IC, BO, MA	65-80%	50-70% of normal or sufficient to maintain 65% canopy closure	1	2-4/ac >24" DBH	<10 tons/acre or<480 lineal feet
Ponderosa Pine	>24"		65-80%	50-70% of normal or sufficient to maintain 65% canopy closure	1	2-4/ac >24" DBH	<10 tons/acre or<480 lineal feet
Lodgepole Pine	>16"		65-80%	50-70% of normal or sufficient to maintain 65% canopy closure	1	2-4/ac >18" DBH	<10 tons/acre or<480 lineal feet
Gray Pine[5]							
Outside FMZs							
Mixed Conifer - Fir	>24"	WF,PP, DF, IC, DF, BO	70-100%	90-120% of normal	2-3	4-8/ac >24" DBH	
Mixed Conifer - Douglas Fir	>24"	DF, WF, SP, IC, PP, BO, MA	70-100%	90-120% of normal	1-3	4-8/ac >24" DBH	5-25 tons/acre or 240-1200 lineal feet
Mixed Conifer - Pine	>24"	PP, JP, IC, DF, WF, BO	70-100%	90-120% of normal	1-2	3-6/ac >24" DBH	5-25 tons/acre or 240-1200 lineal feet
Ponderosa Pine	>24"	PP, JP, BO	65-90%	90-120% of normal	1	2-5/ac >24" DBH	5-15 tons/acre or 240-720 lineal feet
Lodgepole Pine	>16"		70-100%	Dependent on stem size and maintenance of canopy closure	1	2-4/ac >16" DBH	5-15 tons/acre or 240-720 lineal feet
Gray Pine	>16"	GP, JU, JP, PP			n/a		2-5 tons/acre or 96-240 lineal feet

1 Species listed in declining order of occurrence.
2 Logs are a minimum of 18" diameter.
3 Species codes: BO = black oak, DF = Douglas-fir; GP = gray pine; IC = incense cedar; JP = Jeffrey pine; JU = juniper; MA = maple (includes big-leaf and vine); PP = ponderosa pine; SP = sugar pine; WF = white fir;
4 White Fir photo series utilized as a substitue for this vegetation type. This is not a recognized CalVeg type but is descriptive of an elevational band of vegetation within the LSR.
5 The Gray Pine vegetation type is not found in the proposed fuel breaks.

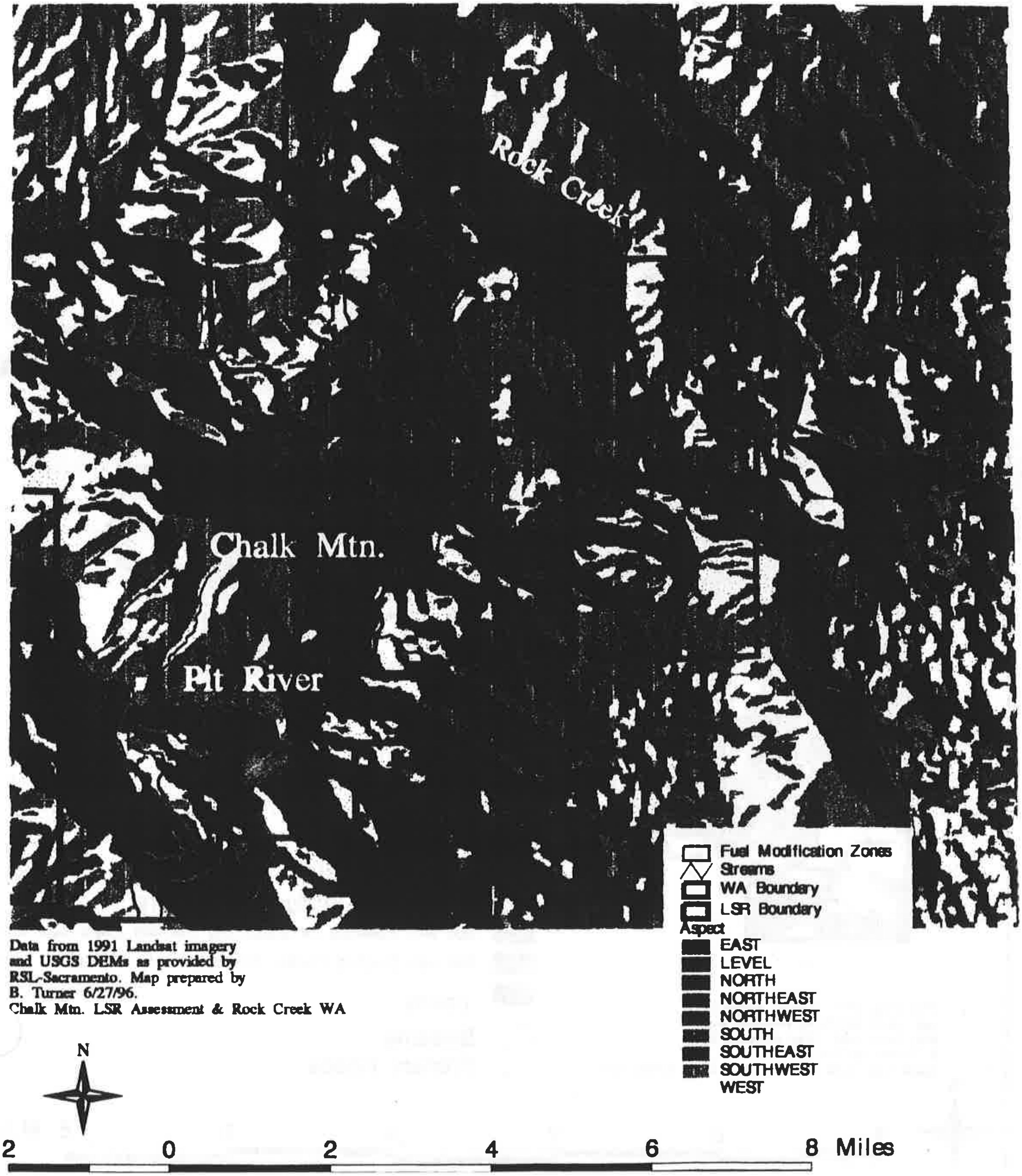
Map 1 - Topographic and Public Land Survey Features



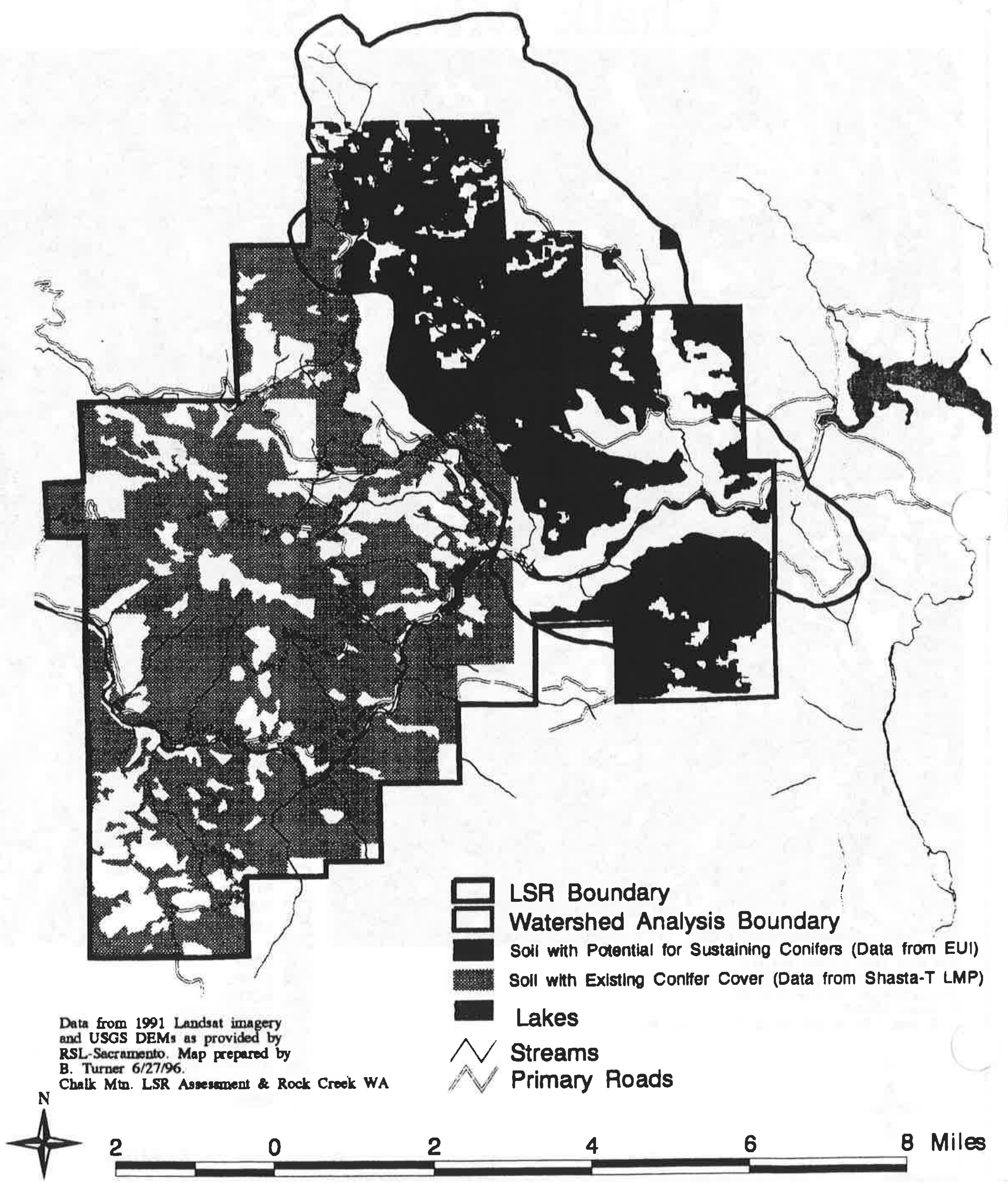
Map 2 - Slope in and adjacent to the Chalk Mtn. LSR



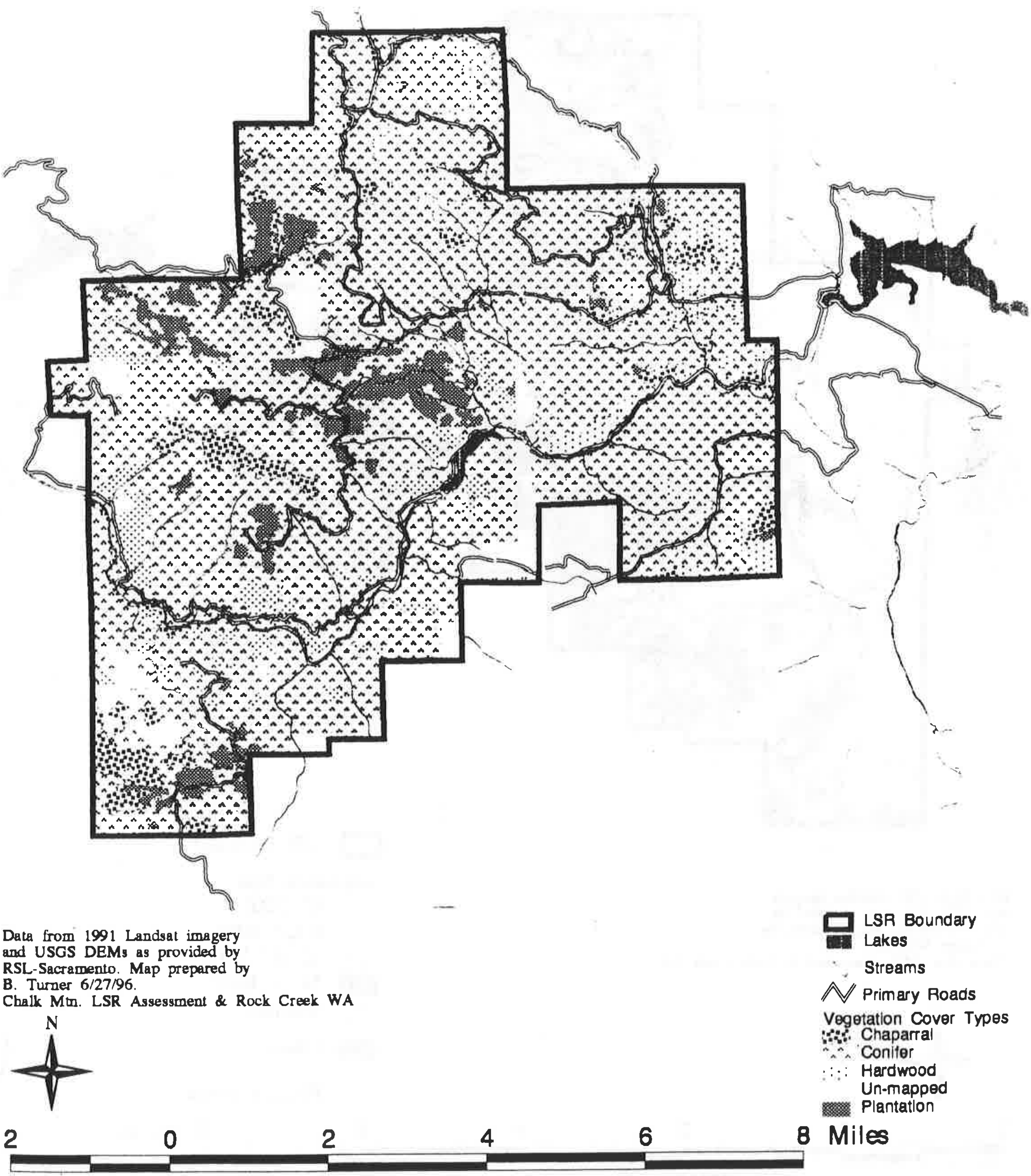
Map 3 - Aspect in and adjacent to the Chalk Mtn. LSR



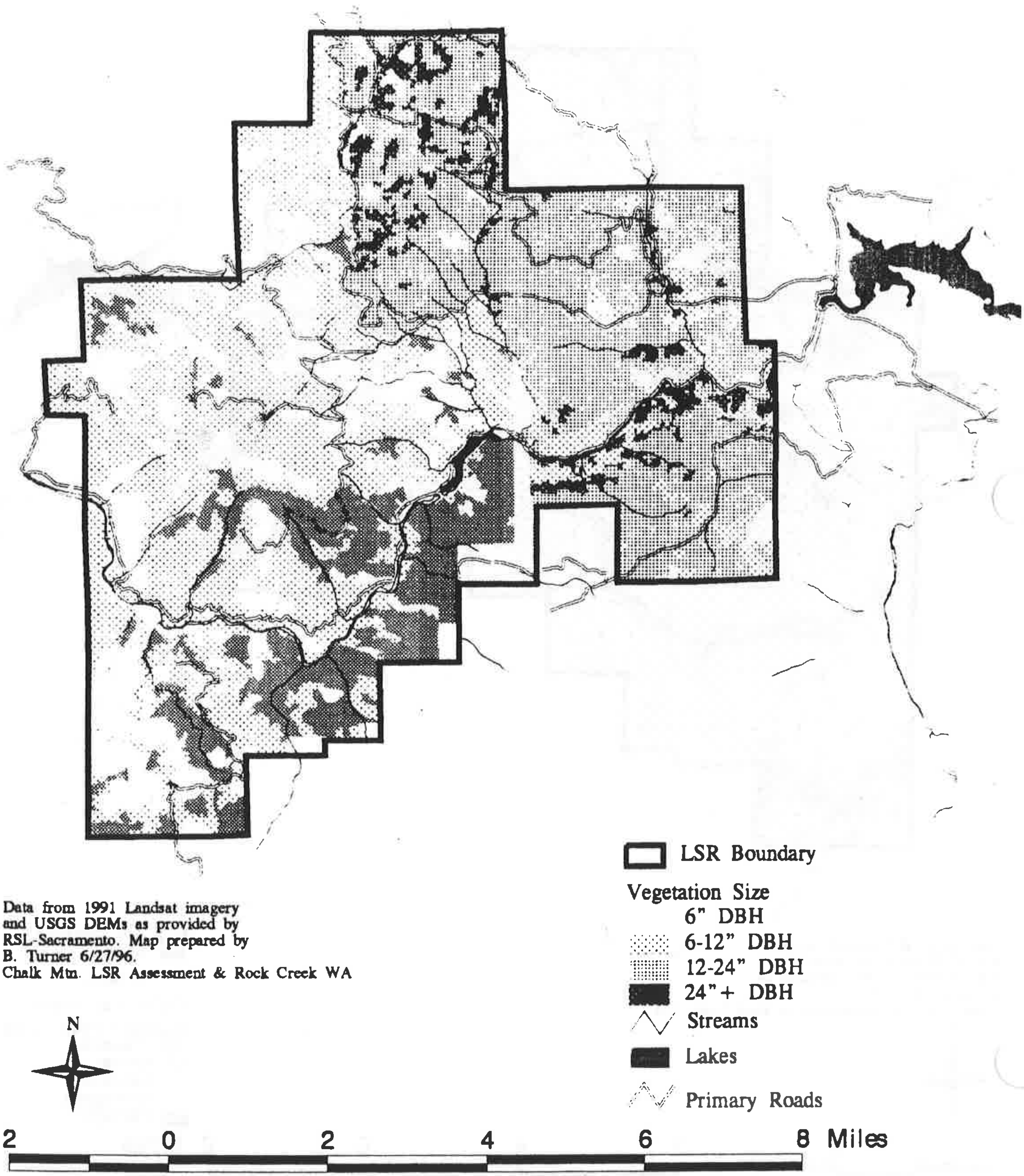
Map 4 - Soils potentially suitable for sustaining conifers



Map 5 - Cover Type

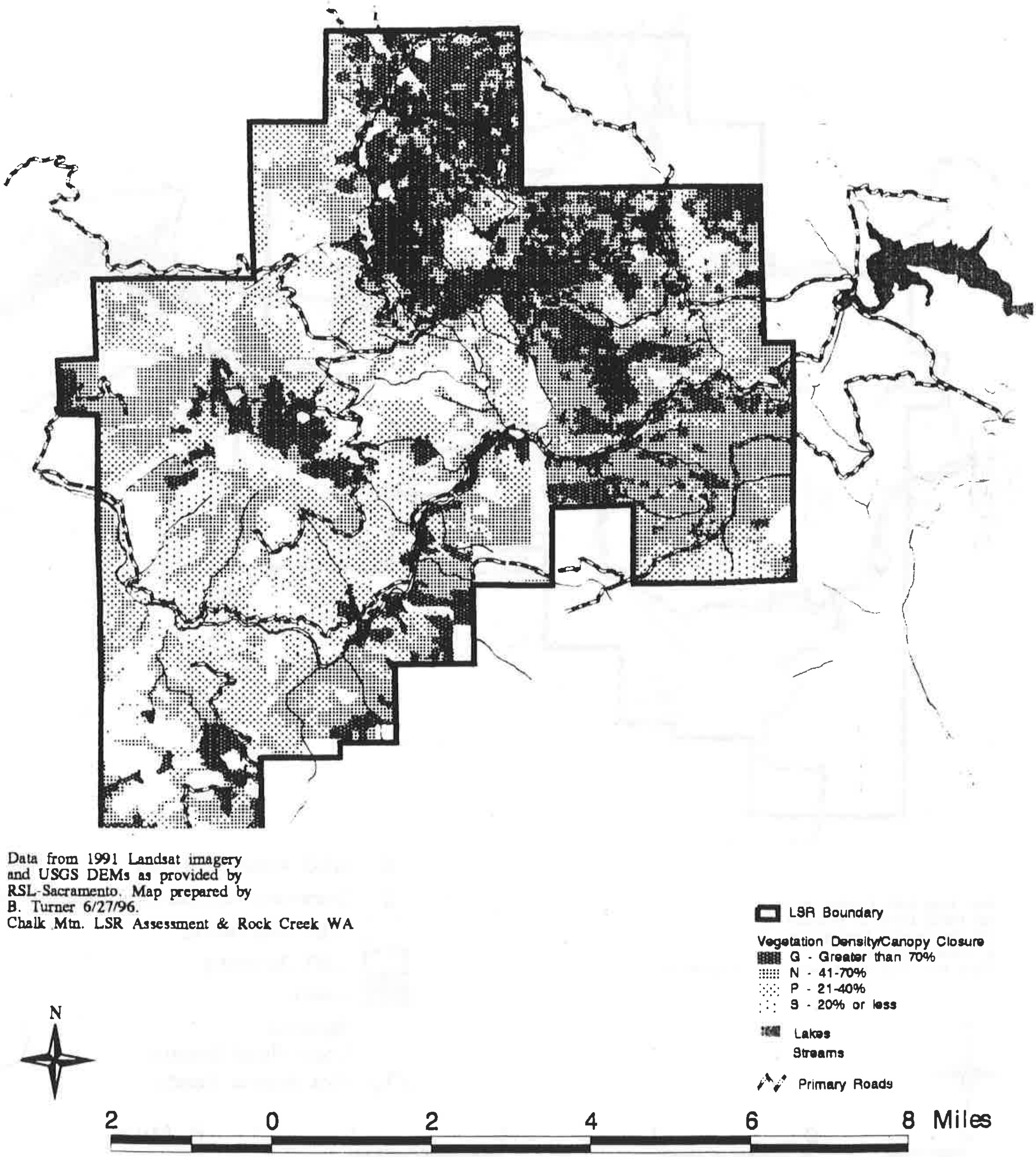


Map 6 - Tree Size



Data from 1991 Landsat imagery and USGS DEMs as provided by RSL-Sacramento. Map prepared by B. Turner 6/27/96.
Chalk Mtn. LSR Assessment & Rock Creek WA

Map 7 - Stand Density



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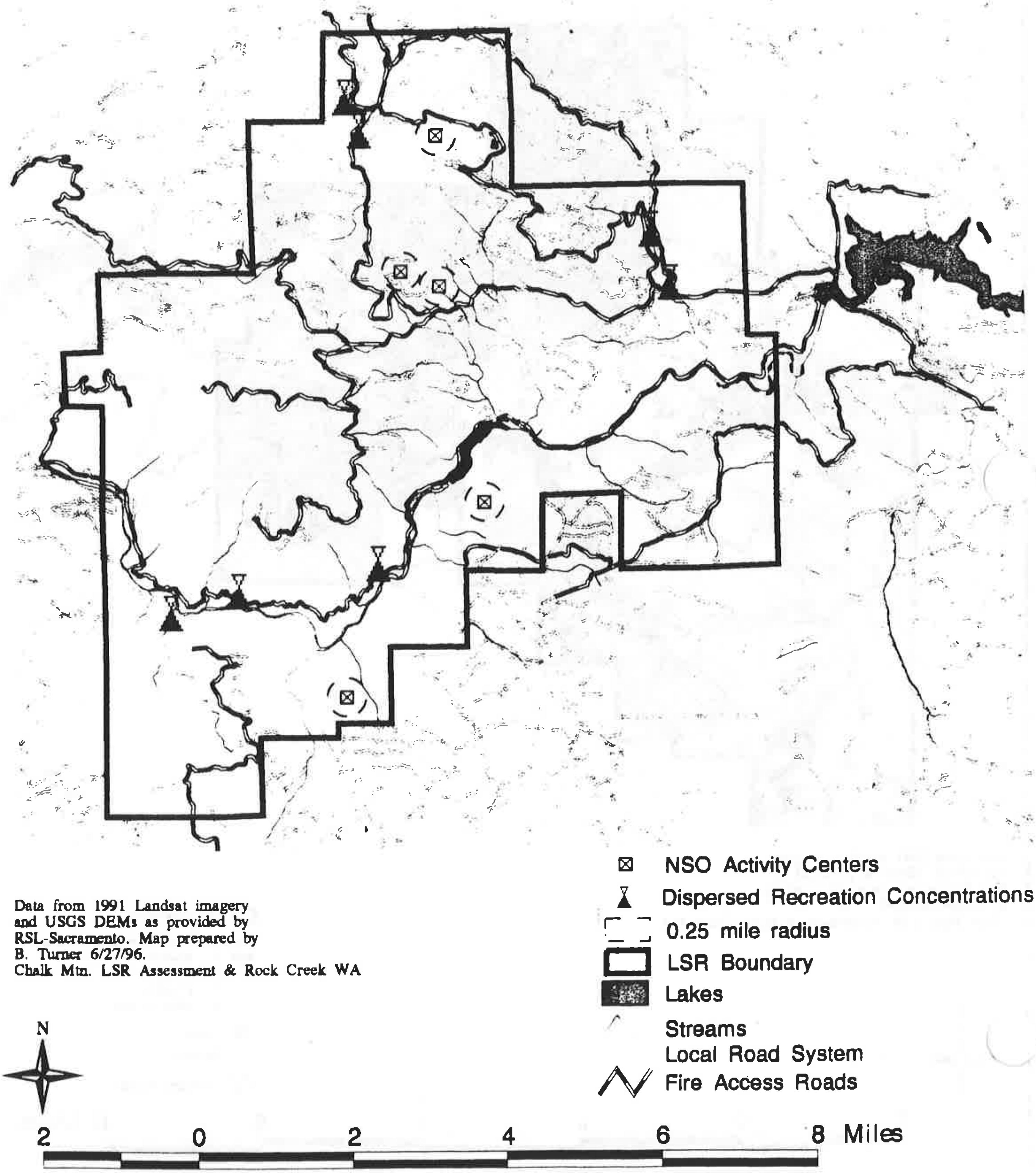
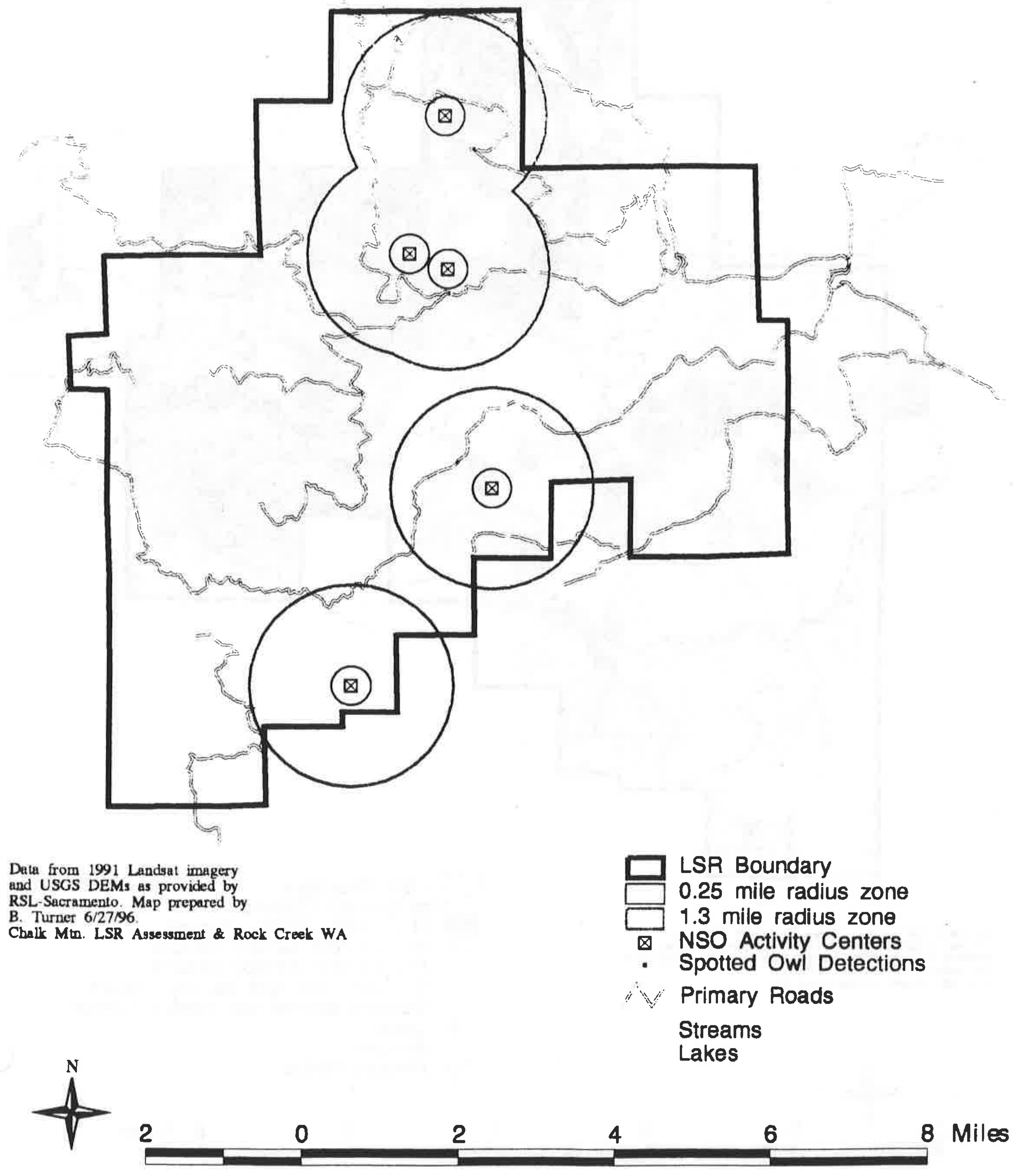
Chalk Mtn. LSR Assessment & Rock Creek WA

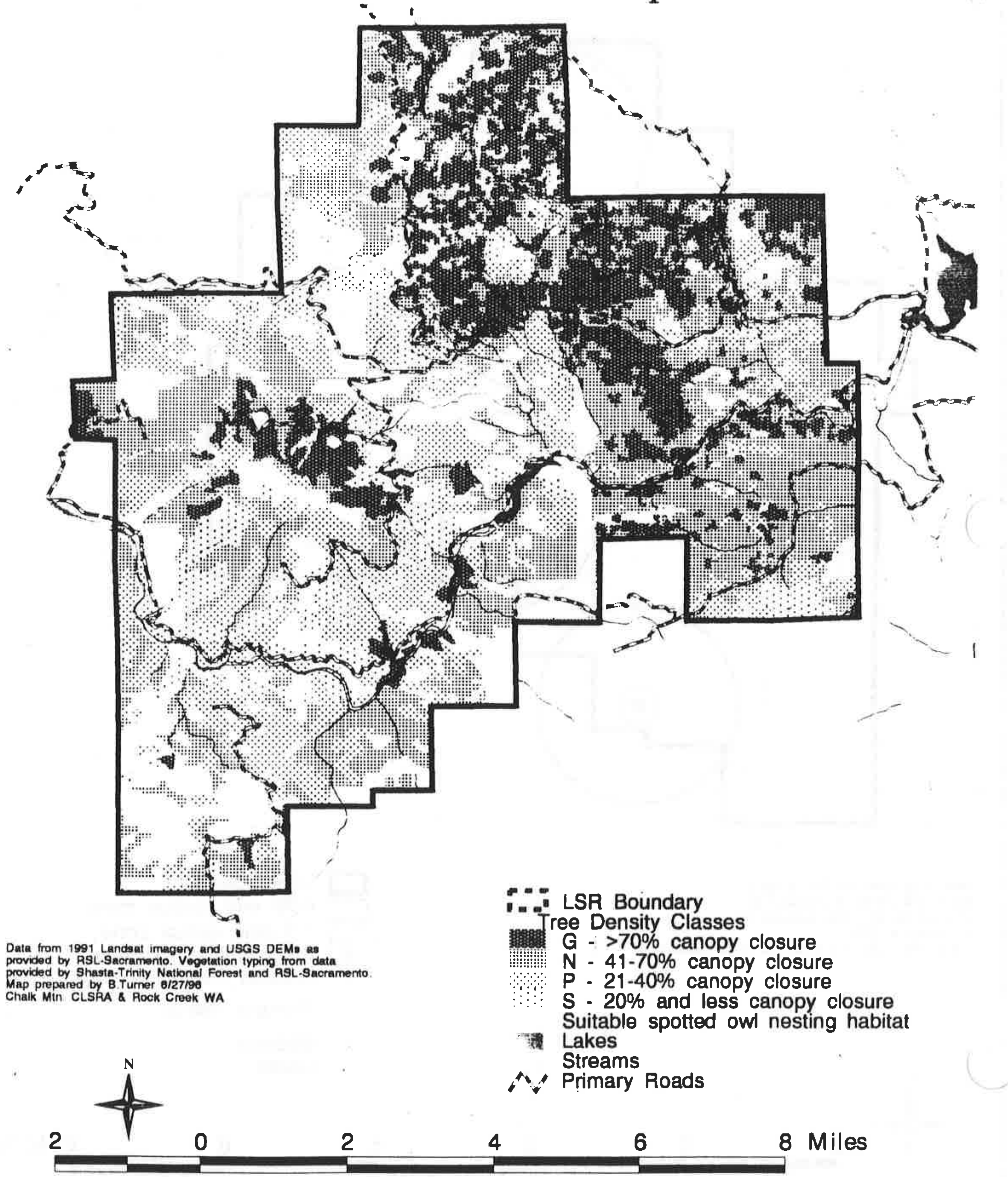
Map 8 - Dispersed Recreation Concentrations



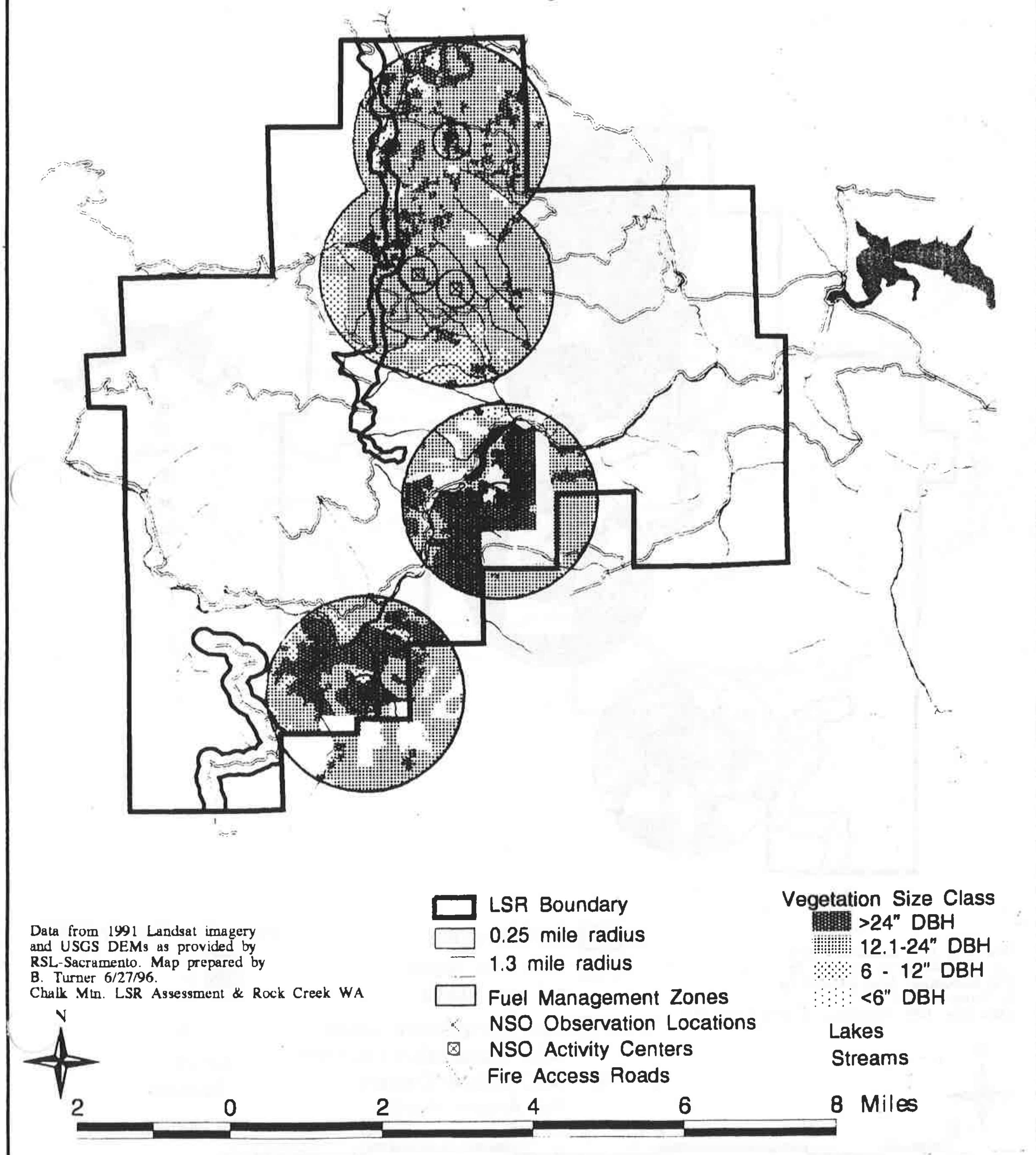
Map 9 - Spotted Owl Observations Within the LSR



Map 10 - Distribution of Suitable Nesting and Roosting Habitat for Northern Spotted Owls

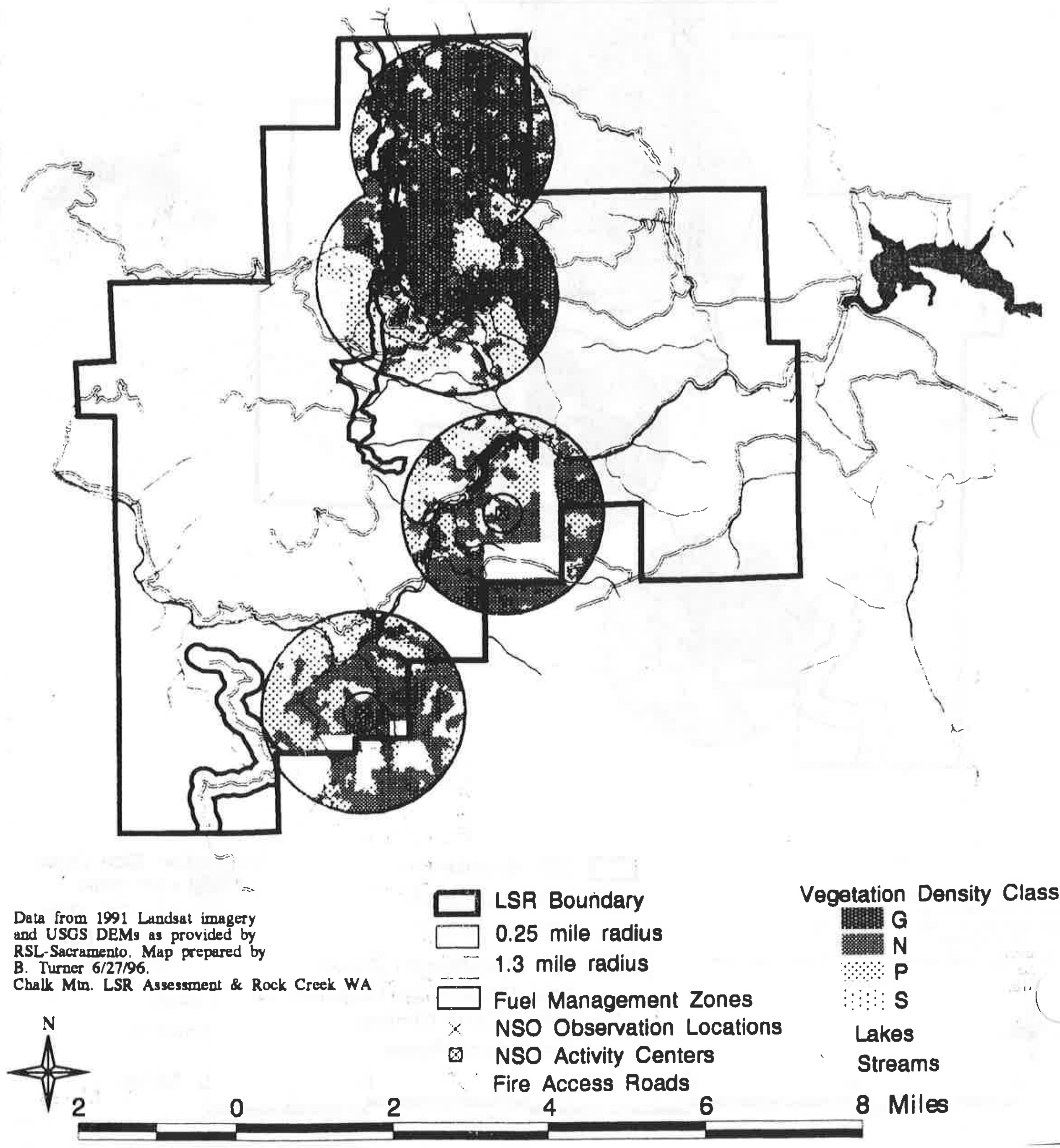


Map 11 - Tree Size within 1.3 miles of Spotted Owl Activity Centers

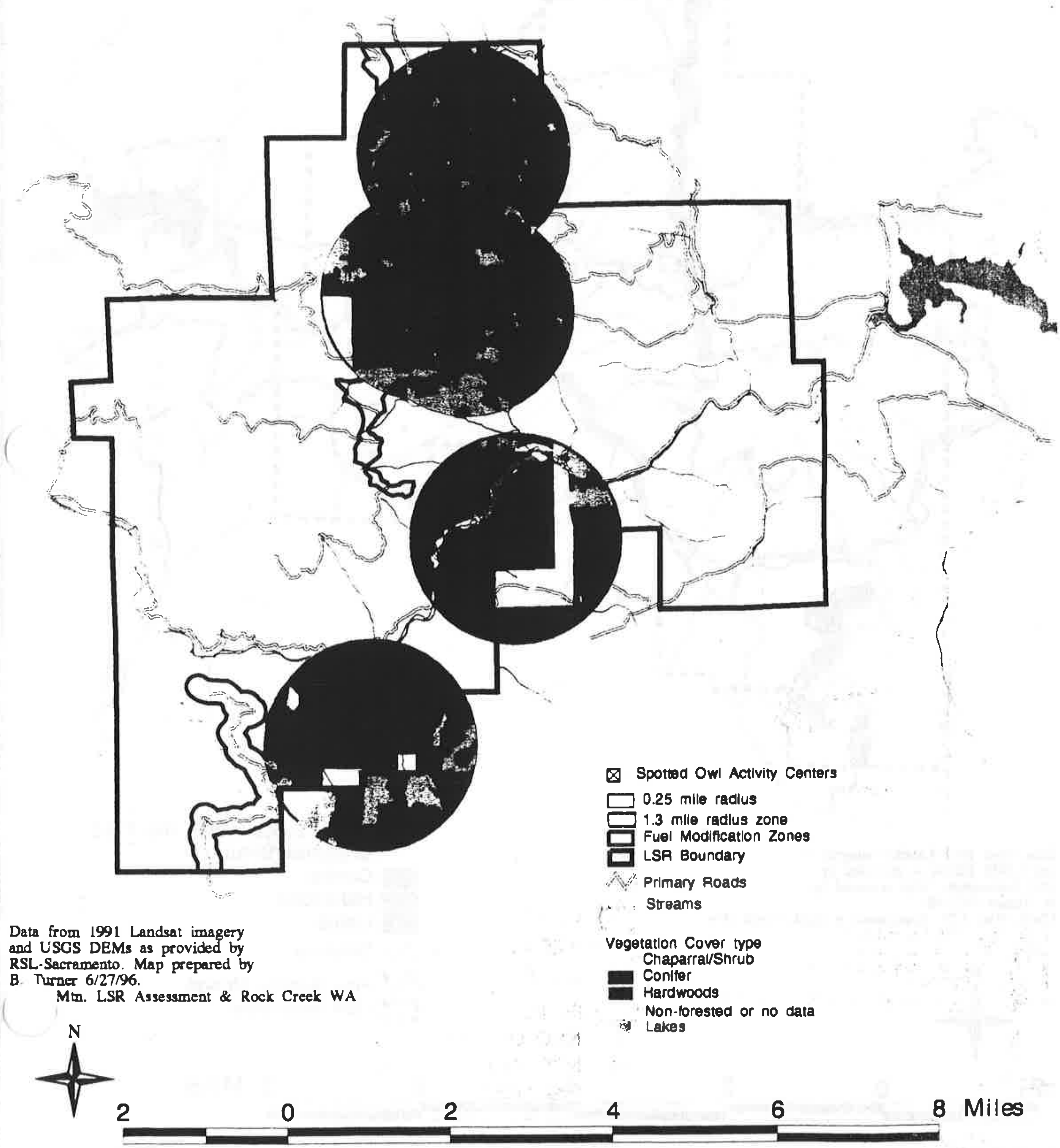


Data from 1991 Landsat imagery and USGS DEMs as provided by RSL-Sacramento. Map prepared by B. Turner 6/27/96.
Chalk Mtn. LSR Assessment & Rock Creek WA

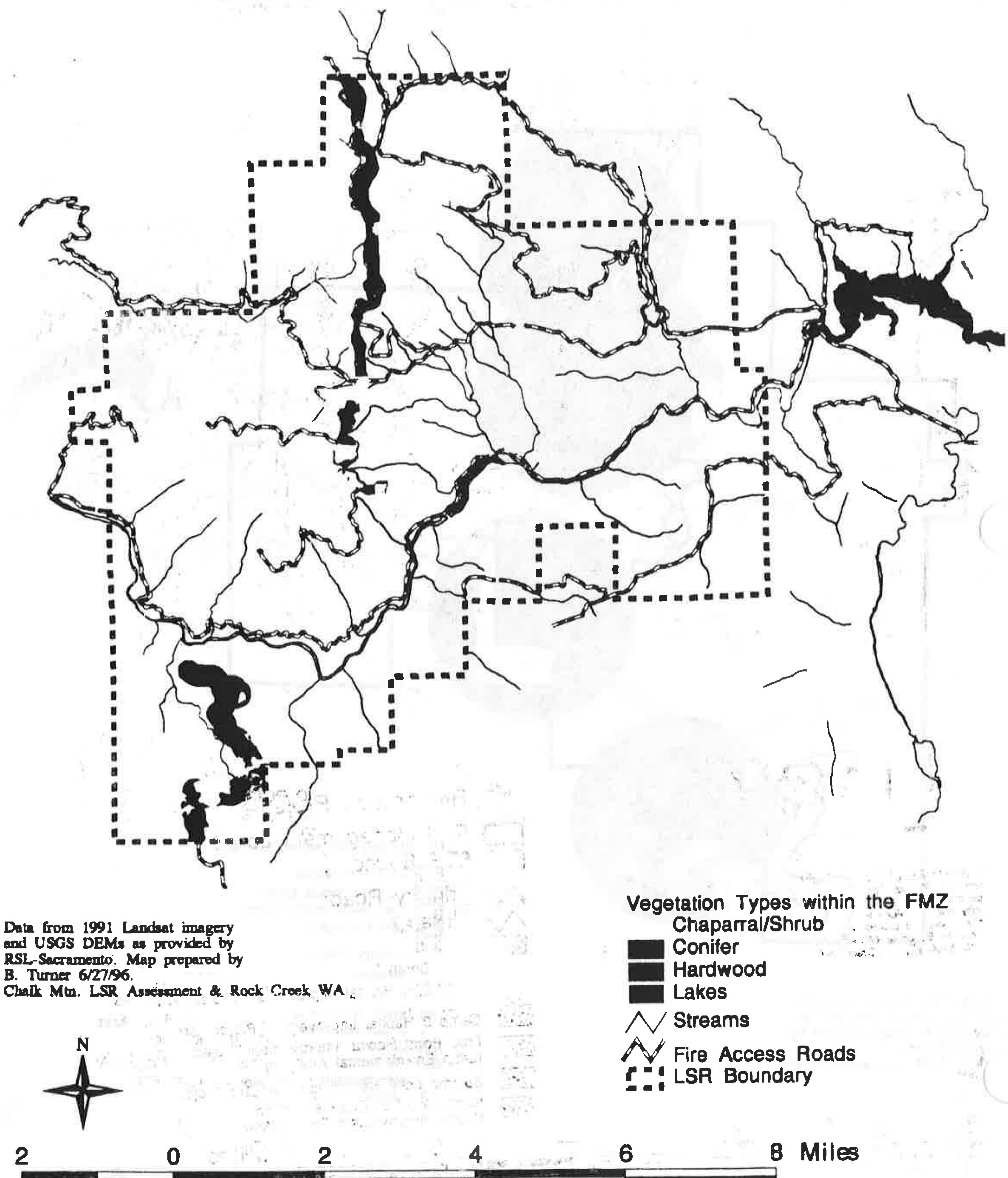
Map 12 - Stand Density within 1.3 miles of Spotted Owl Activity Centers



Map 13 - Vegetation Adjacent to Owl Activity Centers



Map 14 - Cover Types within the FMZ model area.



Map 16 - Potential Project Areas within the Chalk Mtn. LSR