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Willow-Parks Watershed Analysis

Shasta-McCloud Management Unit
Shasta-Trinity National Forest

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Introduction

About This Analysis

This watershed analysis is presented as part of the Aquatic Conservation Strategy (ACS) adopted for the President's Northwest Forest Plan (NWFP) Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl (NSO), including Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Related Species (NWFP, 1994).

The preparation of the Willow-Parks Watershed Analysis follows direction in the ACS that requires watershed analysis "for roadless areas in non-key watersheds, and Riparian Reserves prior to determining how land management activities meet Aquatic Conservation Strategy objectives" (NWFP, 1994).

This document is guided by:

1. Core topics – provide a broad, comprehensive understanding of the watershed. Core topics are provided in "Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis", Version 2.2 [Guide] (Guide, 1995) to address basic ecological conditions, processes, and interactions at work in the watershed.

2. Issues – focus the analysis on the main management questions to be addressed. Issues are those resource problems, concerns, or other factors upon which the analysis will be focused. Some of these issues prompted initiation of the analysis. Other issues were developed from public input on other projects in the area or were identified by the team during the analysis process. Issues are further described in Step 2.

   Key analysis questions are developed for each issue. These questions are organized by analysis steps to help focus the analysis and to provide organization to the document while addressing the issues.

The purpose of this analysis is to provide district resource managers with an understanding of the ecological processes and interactions occurring within the watershed area and how past and present activities and events interact with the physical, biological, and social environments. This information can then be used as a basis from which to make future decisions about the management of resources in the Willow-Parks watershed. While this document provides management recommendations, it is not a decision document. No direct changes in the management of resources in this watershed will occur without separate documentation, public involvement, and further environmental analysis.

Federal agencies will conduct multiple analysis iterations of watersheds as new information becomes available or as ecological conditions, management needs, or social issues change. Subsequent analysis iterations may be triggered when existing analyses do not adequately support informed decision-making for particular issues or projects. Future iterations also may be necessary to fill critical data gaps identified during earlier analyses.

The Analysis Process

This analysis used the six-step process as outlined in the Guide. The six-step process includes the following:

Step 1: Characterization- identifies the dominant physical, biological and human processes or features of the watershed that affect ecosystem function and conditions.

Step 2: Identification of Resource Issues and Key Questions – focuses the analysis on the key elements of the ecosystem that are most relevant to the management objectives, human values or resource conditions within the watershed.

Step 3: Description of Current Conditions – documents the current range, distribution and condition of the relevant ecosystem elements.

Step 4: Description of Reference Conditions – documents how ecological conditions have changed over time as a result of human influence and natural disturbances.

Step 5: Synthesis and Interpretation of Information – compares existing and reference conditions of specific ecosystem elements to explain significant differences, similarities or trends and their causes.

Step 6: Opportunities – brings the results of the previous steps to conclusion, focusing on management opportunities that are responsive to watershed processes identified in the analysis.

Watershed analysis is a continuous process. This report is a dynamic document and is intended to be revised and updated as new information becomes available.

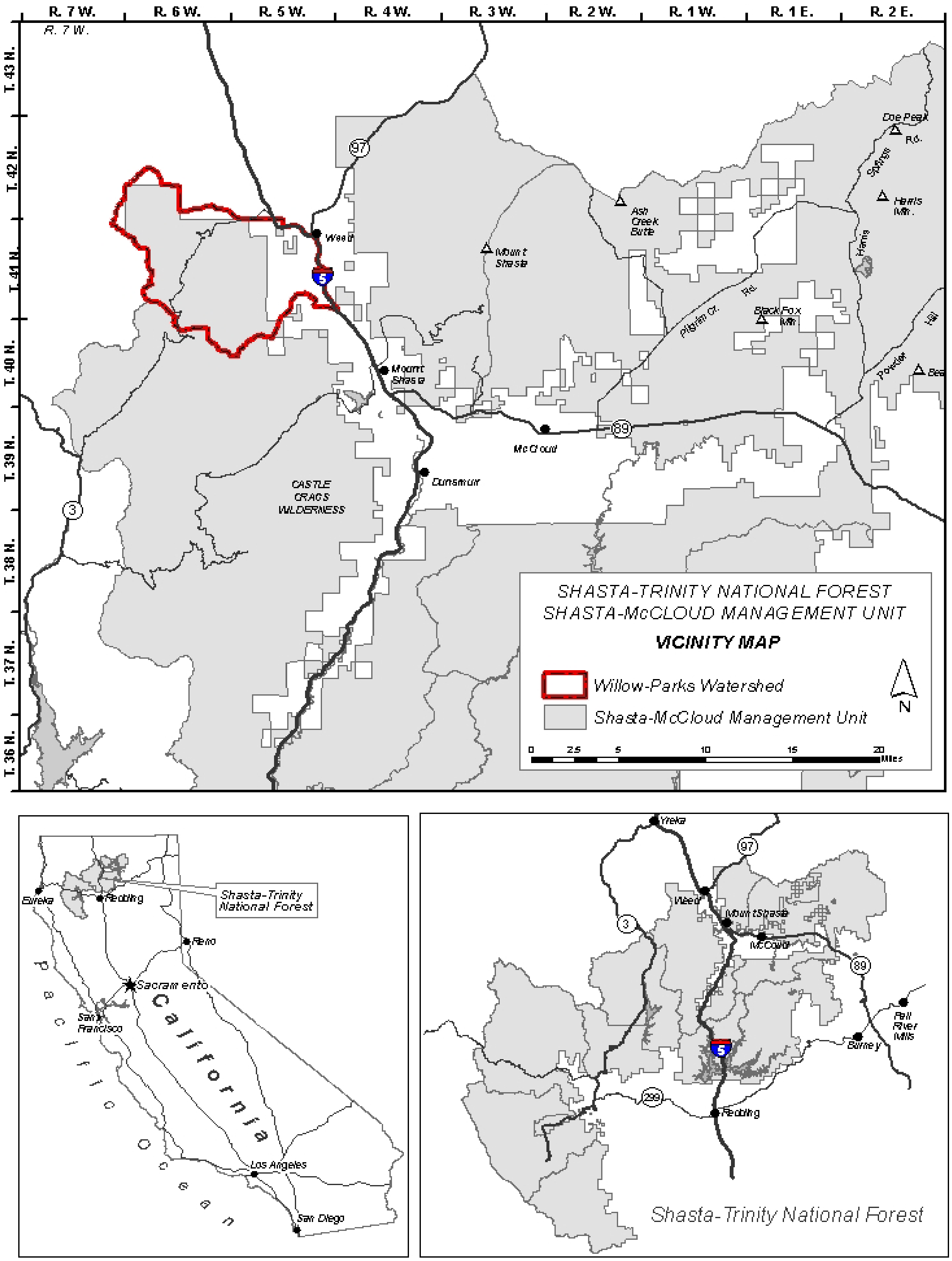
Chapter 1: Characterization of the Watershed

Location

The Willow-Parks Watershed is located in Northern California about 40 miles south of the Oregon border. This watershed is located almost entirely to the west of Interstate-5 and directly to the west of Weed, California.

Regional Setting

The Willow-Parks Watershed is located within the larger Shasta River Watershed. The Shasta River drains an area of 795 square miles. The Shasta River's main tributaries include Parks Creek, Eddy Creek, Beaughton Creek, Carrick Creek, Julian Creek, Jackson Creek, Big Springs Creek, Willow Creek, Yreka Creek, Guys Gulch, Oregon Slough, and the Little Shasta River (CDFG, 2009). The Shasta River is one of the main tributaries to the Klamath River. The Klamath River flows for a distance of 263 miles and drains an area of 15,600 square miles.



MAP 1-1: WILLOW-PARKS WATERSHED VICINITY MAP.

Climate

The Willow-Parks Watershed has a mediterranean climate characterized by warm, dry summers and cool, wet winters. Climate data from Mount Shasta, California indicate that the average annual maximum temperature is 62.4 degrees Fahrenheit (ºF) and the average annual minimum temperature is 36.2 ºF. Annual precipitation in the watershed varies with elevation and can range from anywhere between 10-55 inches with the majority of precipitation occurring between November and April. Annual precipitation amounts decrease sharply from south to north and with decreasing elevation due to a pronounced rain shadow effect over the Shasta Valley. The headwaters of Dale, Eddy and Parks Creeks receive over 50 inches of annual precipitation but this annual average drops to less than 10 inches on parts of the valley floor near Gazelle, California. The majority of the precipitation falls as rain below 4500 feet. Snow occasionally blankets the entire watershed but rarely accumulates below an elevation of 4000 feet. High-intensity, long-duration snow storms are common during the winter months, and the watershed is occassionally subject to intense thunderstorms in the summer months (USDA Forest Service, 2011).

Visual Resources / Scenery

The Willow-Parks Watershed Analysis (WA) area is characterized by very scenic natural features comprised of unusual serpentine rock formations with a large and unique diversity of trees, shrubs and forbs. The scenery of the area qualified the 42N17 (Parks Creek Road, also known as Hwy 17) as a scenic byway. The Watershed Analysis area is within the Klamath – Siskiyou landscape province character type. The National Forest Landscape Management (1976) characterizes the landscape type as a province that is typified by rugged topography and irregular drainage patterns; the ridge tops are often quite narrow and the canyons are deep and narrow in most places.

The current direction for scenery management within the WA area is directed by the Shasta-Trinity Land and Resource Management Plan (Forest Plan) which utilized the Visual Management System (VMS). VMS uses the distance of the landscape from the viewer, duration of the view, variety class and the sensitivity level of the view point to assess the visual quality. During the Forest Planning effort various Visual Quality Objectives (VQO's) were established for areas seen from highly used areas.

Per the VMS and the Scenery Management System (SMS), the more a trail or road is traveled the more sensitive it is from a scenery perspective; rivers, lakes and mountain tops where people may gather to view scenery are also seen as sensitive. The most sensitive area for scenery in the Willow-Parks Watershed area is Hwy 17, the Parks Creek Road, which is part of the 'Trinity Heritage Scenic Byway'. The Forest Service designated scenic byway begins at the juncture of Hwy 299 and Hwy 3 in Weaverville, California and travels north along Hwy 3 to County Road 204 (Rush Creek Road) to County Road 105 and back to Hwy 3 north to Hwy 17 (Parks Creek Road) then east over the Trinity divide and terminates at the junction with Interstate 5. The Parks Creek Road was not identified as sensitive for scenery at the time that the Forest Plan was developed, however the designation of the scenic byway and the amount of traffic that uses the road to the Parks Creek Trailhead may elevate the scenery resource from a social perspective.

Other viewing areas that would be considered sensitive for scenery include the Parks Creek Trailhead (summit of Hwy 17), Mount Eddy, the Caldwell lakes, the West Parks Lakes, Dobkins Lake, Durney Lake, and Little Crater Lake per the VMS and SMS, but not identified in the Forest Plan as sensitive for scenery.

Activities occurring in the watershed could affect the middle and background views as seen from Interstate 5; the Forest Plan identified this route as highly sensitive for the scenic resource.

Recreation

Since the turn of the 20th century, the Willow-Parks Watershed has provided ample opportunities for public recreation. The area hosts a multitude of outdoor activities that are enjoyed year round. Although no developed recreation facilities exist within the watershed (i.e., campgrounds, restrooms), thousands of Forest visitors enjoy the area's many dispersed recreation opportunities. Observed recreation includes hiking, backpacking, horseback riding, fishing, hunting, camping, bicycling (mountain and road), firewood gathering, mining, sightseeing, skiing, snowmobiling and Off Highway Vehicle (OHV) riding.

Vegetation

The landscape and the vegetation within the watershed are dominated by the topography. As elevation changes, so does the vegetation. When mapped, these changes in stand type vary by aspect, soil type and rainfall. While each layer is distinct, there is a mixing of types and species in each transition zone. A more complete discussion of each vegetation type can be found in Chapter 3. It should be noted that the data source for vegetation typing used in this watershed analysis is from Remote Sensing Application data and has limitations. All of the vegetation typing conducted for this analysis is intended to help characterize the landscape and should not be used as an absolute typing. Calveg vegetation descriptions specific to the Klamath Mountains Geological Province were also utilized. More detailed analysis should be done at the subsequent project level[s].

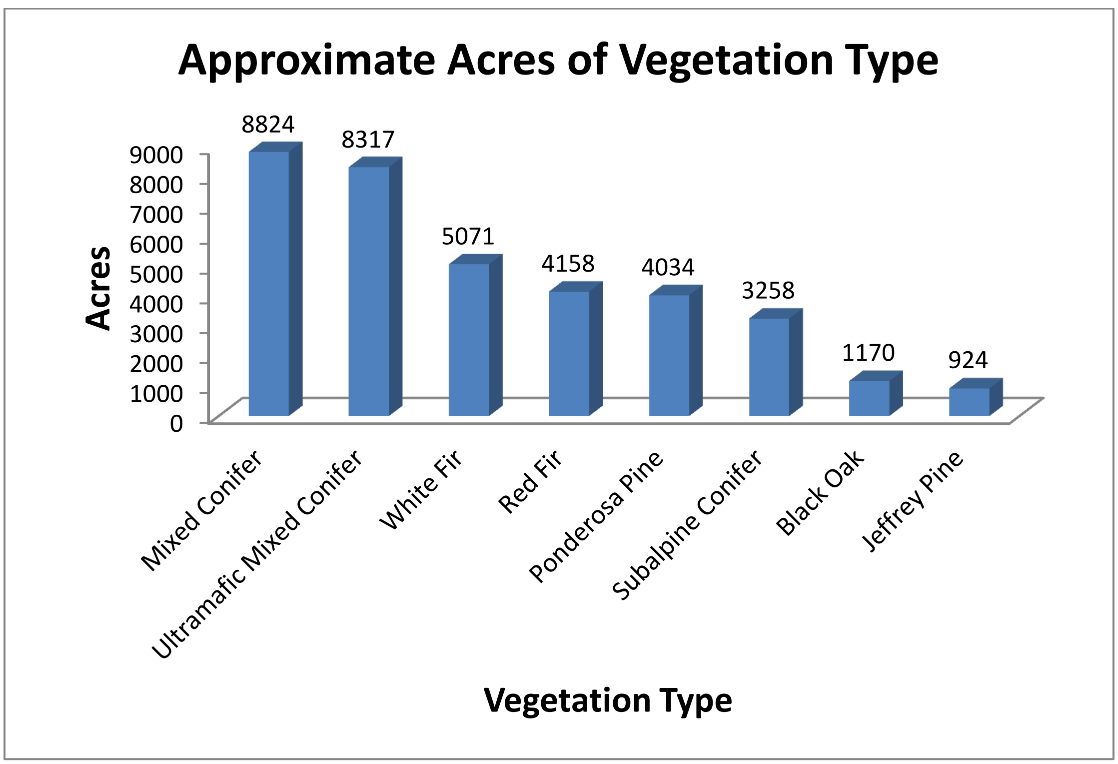


FIGURE 1-1: APPROXIMATE ACRES OF VEGETATION TYPE WITHIN THE WATERSHED.

Red Fir
Red fir is distributed in the highest elevational band from approximately 5500 to 8600 feet elevation. Red fir habitats are found in frigid soils over a wide range of topography exclusive of very wet sites. Mature red fir stands are normally monotypic, with very few other plant species in any layer. Heavy shade and a thick layer of duff act to inhibit understory vegetation especially in dense stands.

White Fir
White fir is distributed in an elevational band from approximately 4000 to 8000 feet elevation. In the Klamath Mountains, white fir habitat occurs between mixed conifer and red fir habitats. This habitat is characterized by a nearly monotypic even aged overstory. Overlapping crowns that cast deep shade are characteristic, although open stands are also common. The understory may consist of sparsely scattered grasses, forbs and shrubs or white fir seedling and saplings.

Subalpine Conifers
Some areas within the watershed have a mixture of subalpine conifers at higher elevations, commonly above 6500 ft. No single species is dominant.

Mixed Conifers/Ultramafic Mixed Conifer
The mixed conifer type covers the largest area in the watershed and is generally found below 5,000 feet ranging from 2,500 feet elevation and higher. It is considered a mixed series including incense cedar, sugar pine, white fir, Douglas fir along with a prominent ponderosa pine component. Ponderosa pine dominates at lower elevations and on south slopes. Jeffrey pine commonly replaces ponderosa pine at high elevations, on cold sites or on ultramafic (serpentine) soils.

Ponderosa Pine
In Northern California, ponderosa pine stands occur above oak woodland types and below the mixed conifer zone at elevations between 800 to 5000 feet. Montane hardwood stands may be below or interspersed with ponderosa pine. Tree spacing in ponderosa pine stands varies from open, patchy to dense clumps.

Black Oak
California Black Oak, widely distributed over most areas of California and elsewhere, occurs as a dominant species in its own alliance extensively in this zone. California Black Oak grows within a wide elevational range.

Plantations
Plantations in the Willow-Parks watershed were established 26 years ago and range from one acre to 68 acres, with the average plantation being 14 acres. These plantations are early seral age mixed conifer/pine/California Black Oak stands less than 20 feet tall and are currently at 2 – 6 inches in diameter at breast height (dbh). The seral stages are based on the Wildlife Habitat Relationship descriptions in the Forest Plan (USDA Forest Service, 1995, page 4-15) that were updated to Regional and National standards in September 2005 by the Remote Sensing Lab.

Unique Habitats
The many unique habitats occurring in this watershed are a product of diverse landscapes, geology and soils. The Klamath Range is noted as a species diversity hotspot especially for plants. These unique botanical communities are found in fens, Darlingtonia seeps, springs and meadows, ridge tops, subalpine and serpentine barrens. Many special status plants are associated with these unique habitats. Ethnobotanical species such as bear-grass (*Xerophyllum tenax*) are also found in this watershed. Some of these habitats have been impacted by poorly placed roads, trails and dispersed camping sites. Off-road vehicle use has also disturbed some habitats with the greatest impacts often occurring within riparian and wet meadow habitats.

Fire
Fire is an essential component of the ecosystem within the watershed analysis area. These ecosystems have developed in conjunction with fire. Long-term alterations of fire patterns have occurred as a result of changes in climate and human interactions. Fire is a process (Sugihara, et al., 2006) that impacts ecosystem composition, structure and function. There is a continuous feedback of fire, fuels and vegetation within the watershed analysis area. Fire interacts with and is affected by, species composition, vegetation structure, fuel moisture, air temperature, biomass, and many other ecosystem components are so interdependent that changes to one, including fire, often result in significant changes to others (Sugihara, et al., 2006).

Lightning is the primary fire ignition source within the watershed analysis area. Weather patterns can produce widespread thunderstorms that result in numerous fires. Hundreds of lightning fires can be ignited over short periods during these events, such as occurred in 2008.

Fire behavior in the watershed analysis area is driven primarily by topography, specifically aspect, slope position and elevation. Significant differences in fire return intervals occur within the same forest type on different slope aspects. Fire return intervals increase with elevation, resulting in upper slopes having shorter average fire return intervals than middle and lower slopes. Natural barriers such as lava flows, breaks in vegetation and riparian zones affect landscape patterns of fire spread (Skinner and Taylor, 2006).

The seasonality of fires within the watershed analysis area is mostly mid-summer through fall, which is typical of forests under the influence of long, dry summers of Mediterranean climates. Dead and live fuels reach their lowest moisture levels at that time and they ignite and burn easily. There is also a temporal and spatial variation in the seasonal timing of fires indicating the influence of slope aspect, elevation, climate variation and seasonal occurrence of fire. Fires occur earlier in the season on drier pine dominated sites (south and west facing aspects) at lower elevations. Higher elevation sites along with those that are wet (north and east facing aspects) have fires occurring later in the season.

Species and Habitats
Wildlife
There are many documented occurrences of a variety of terrestrial wildlife species within the watershed; however, specific population information is lacking. Wildlife species of special concern or interest in the Willow-Parks Watershed are divided into four main categories for the purpose of this

analysis. These include federally listed species, Forest Service sensitive species, game species of interest, and fish species of interest. Species with recorded observations within the watershed include the northern spotted owl (NSO), Pacific fisher, silver-haired bat, blue grouse, black bear, mountain lion, bobcat, and a variety of bird species (Natural Resource Information System-NRIS). Many other species of interest have suitable habitat and the potential for occupancy in the watershed (see discussion in Chapter 3).

Designated northern spotted owl critical habitat is located in portions of the watershed, primarily in areas to the west (USDI Fish and Wildlife Service, 2008). A new rule for designating northern spotted owl critical habitat was developed by the U.S. Fish and Wildlife Service (FWS) and was finalized in November 2012. Management within areas designated as northern spotted owl critical habitat are defined in the new rule.

Currently there are four known NSO activity centers along the western side of the watershed (Forest Records). NSO dispersal within the watershed is dependent on the suitability and capability of habitat. Non-capable habitat in the northeast portion of the watershed (the grasslands and brush fields along Interstate 5) and areas at the higher elevations (above 7,000 feet) are barriers to NSO movement. NSO can and do disperse through the majority of the other areas within the watershed. Breeding areas are based on the quantity, quality and location of nesting, roosting, foraging, and dispersal habitat (USDI Fish and Wildlife Service, 2011). Additionally, Interstate 5 and road 42N17 (Stewart Springs road) can be barriers to owl movement. Residential development and transmission lines within the watershed can also have significant impacts on NSO dispersal.

The Willow-Parks watershed supports both summer and winter range for Rocky Mountain mule deer, black-tailed deer, and elk (California Department of Fish and Game, 1985). Interstate 5 and Stewart Springs Road (42N17) provide barriers to deer and elk movement, as do residential development and transmission lines within the watershed.

Several *Anadromous salmonid* populations historically utilized the watershed, though construction of dams has limited connectivity and runs are significantly lower than historic levels. These populations include fall Chinook, coho salmon, and fall and winter steelhead, all of which were —at one point— prolific on the Shasta River, to which all four creeks in the Willow-Parks Watershed boundary drain. Connectivity still exists along Parks Creek, and juvenile steelhead have been observed within the drainage at the lower elevations.

Plants

There are 24 special status plants known to occur within the watershed boundary. They are associated with wet meadows, riparian edges, ridge tops, serpentine barrens and subalpine conifer/shrub habitats. Several historical populations would require survey to see if the populations are still extant. Other areas have had limited survey. The China Mountain/South China Mountain Special Interest Area (SIA) near the top of the watershed needs botanical surveys. Of the 24 special status plants known to occur in the watershed, 14 are associated with or generally found growing on serpentine soils. There are no federally listed Endangered or Threatened plants known to occur in the watershed. Whitebark pine (*Pinus* *albicaulus*) is a candidate for federal listing. Trinity buckwheat (*Eriogonum alpinum*) is listed as Endangered by the State of California.

Invasive species are not currently an issue, but could be in the future. There is a population of dyer's woad (*Isatis tinctoria*) known to occur on private land not far from the Parks Creek Trailhead just outside of the watershed boundary. A Scotch broom (*Cytisus scoparius*) population was located and pulled along Parks Creek Road in 2003. However, because seeds can remain viable for a very long time, the site should be monitored occasionally to ensure that the Scotch broom does not return.

Late Successional Reserves

Late-Successional Reserve (LSR) and Managed Late-Successional Areas (MLSA) are key components of the Forest Plan in providing for mature forest ecosystems including habitat for the northern spotted owl and connectivity for species health. It is important to understand the role of this watershed and the effect that management actions will have on the overall functioning of the LSRs. The forest wide LSR Assessment reveals there are critical issues that need attention within these areas including high fuel hazards and management practices on adjacent private land (USDA, 1999). There are two Late Successional Reserves on National Forest System (NFS) lands within the Willow-Parks Watershed Analysis Area (USDA 1999) (Map 3-7). This includes all or portions of the Scott Mountain LSR (RC-340) and the Eddy LSR (RC-341).

Geology

This watershed is different from other parts of the Klamath Mountains, in that one rock type (ultramafic rock) dominates this landscape, and most of the high elevation areas, particularly around Mount Eddy, exhibit classic glacial landforms. The ultramafic rock (peridotite and serpentenite) commonly forms bold red outcrops supporting only sparse vegetation due to plant-inhibiting soil properties which develop on these rock types (Photo 1-1). This rock contains chromite (an ore or chromium) which drew prospectors to the study area during World Wars 1 and 2. Ultramafic rock also contains one form of naturally occurring asbestos (chrysotile), which can become hazardous to humans when introduced into the air.

PHOTO 1-1: ULTRAMAFIC ROCK OUTCROPS (PERIDOTITE).

Hazards to human health from asbestos can occur when soils and rock are disturbed by motorized vehicles when the soil is dry. Coarse grained gabbro (pegmatite) with large crystals up to 4 inches in diameter is exposed in road cuts along the Parks Creek road immediately west of Stuart Springs. The cleavage faces of these crystals reflect sunlight and create a sparkling effect to morning travelers along the road. Gold deposits were formed in the South Fork of Willow Creek (Dewey Mine), where gabbro of the China Mountain Pluton intrudes peridotite of the Trinity Terrane. These deposits were mined for many years.

Glacial processes formed the long broad valleys occupied by the major streams in the study area, along with the steep headwaters of these streams (glacial cirques). The steep slopes of the cirques and valley walls are prone to rockfall, shallow landslides, and snow avalanches. Glacial moraines (rock and soil rubble eroded by glaciers) are common to this watershed, and many are exposed by cuts along the Parks Creek road (Photo 1-2). These bouldery deposits re-vegetate slowly, and ravel each winter, requiring regular maintenance. Some form irregular deposits on valley floors and walls, while others form long, narrow ridges.

PHOTO 1-2: GLACIAL MORAINE ALONG PARKS CREEK ROAD.

Many of the moraines have been cemented by mineral rich groundwater percolating through the deposits, making them quite hard and similar in appearance to concrete or cement (Lindsley-Griffin, 1982). This has resulted in local place names like “Cement Banks”, or “Cement Bluff”. The moraines on valley floors and on other gentle slopes are generally stable, but those plastered on steeper valley walls are subject to landslides. For example, one active landslide (a slump), over an acre in size was identified in glacial deposits on the west valley wall of Eddy Creek during field reconnaissance for the WA. This feature is on the west side of Eddy Creek at elevation approximately 6,400 feet, and the bench at the head of the slide (in the center of the field of view on Photo 1-3 is slowly moving downslope, and taking the large 3’ diameter conifers with it.

PHOTO 1-3: ACTIVE LANDSLIDE DEVELOPED IN GLACIAL MORAINE DEPOSITS.

Soils

The watershed is dominated by soils derived from ultramafic parent materials that are strongly influenced by topography. These ultramafic soils support unique botanical communities due to a shift in the ratio of calcium and magnesium. Smaller portions (about 25%) of the watershed's soils are volcanic in nature reflecting their position on the lower slopes of Mt. Shasta. These soils are largely on private land. Erosion potential for soils in the watershed is moderate to high, particularly in the frigid and mesic temperature regimes due to their position on steep mountain side slopes. Many of the drainages in the watershed have a network of wet meadows and fens where soils reflect an aquic moisture regime.

Hydrology, Stream Channels, Water Quality

The Willow-Parks Watershed is a sub-watershed of the larger Shasta River Watershed. The watershed consists of the Shasta River headwaters which includes the Shasta River, Parks, Eddy and Dale Creeks, and the South Fork of Willow Creek. The drainage area of the watershed analysis planning area is 72 square miles. The hydrology of the Willow-Parks Watershed is very complex, owing to the many water diversions and withdrawals that occur in the lower portions of the watershed as well as natural variability created by variations in precipitation and drainage characteristics. Hydrologic features and their associated aquatic and riparian habitats are managed according to direction for Riparian Reserves and the Aquatic Conservation Strategy as described in the Forest Plan.

Channels in the watershed can be partitioned into three distinct regions: 1) Headwater Channels, 2) Midslope Channels and 3) Valley Channels (see Chapter 3 for a complete description of channel types). Stream channels have evolved in response to large scale disturbances including past glaciations and debris flows from Mount Shasta. Timber harvest, road construction, grazing, recreation and channel restoration activities also have resulted in changes to channel condition.

The quality of water in the Shasta River and its tributaries is generally very good on NFS lands. Water quality problems are almost exclusively related to those arising from poorly drained and hydrologically connected roads. Downstream of the watershed analysis area water quality has been affected by dams, diversions, and agriculture uses.

Human Uses

The watershed is identified as part of the ancestral homeland of the Ahotire 'itsu Shasta Indians. Twenty-two prehistoric and historic cultural resource sites associated with pre-European settlement have been recorded on the flats along drainages and the areas around meadows and lakes. Many of these sites are home to lithic scatters and ground stone artifacts for plant material processing. Signs of other historic activity can be found in this watershed as well such as: gold, chromite and asbestos mining, logging. Chapter 3 and 4 goes into further detail about the prehistoric and historic uses of the watershed.

Chapter 2: Issues and Key Questions

The purpose of this chapter is to focus the analysis on the key elements of the ecosystem that are most relevant to the management questions and objectives, human values, or resource conditions in the watershed. Watershed concerns are identified and framed within the context of issues. The Willow-Parks Watershed Analysis Interdisciplinary Team formulated issues and key questions.

All information needed to address the issues and key questions is presented within the context of the core topics. The core topics, issues and key questions address the basic ecological conditions, processes, and interactions at work in the watershed. Core topics are presented in part 2.

Core topics that should be covered in all watershed analyses include:

1. Geology and Erosion Processes
2. Hydrology, Stream Channels Water Quality
3. Vegetation
4. Unique Habitats
5. Species and Habitats
6. Human Uses

Identification of issues and key questions serves to focus the analysis on those key elements that are relevant to management objectives, human values and resource conditions within the watershed.

The following issues were identified for the Willow-Parks Watershed Analysis:

Watershed Access (Roads and Trails) and Recreation

Access opportunities in the watershed for both public use and management purposes are dictated by the current condition of the transportation system. The transportation system was originally constructed to support mining operations and later timber harvest activities. As a result, the road density in the Eddy and Parks Creek Watersheds is relatively high, however many roads cannot be driven due to road washouts and lack of maintenance. Problems with roads include: undersized culverts, lack of adequate surface drainage resulting in rilling and erosion, and poorly located and designed roads. Many roads within the watershed are not passable for most 2-wheel drive vehicles and some pose a risk to water quality in the form of introduced sediment. About 1/3 of roads that were inventoried in 2012 are not accessible to vehicles. Impacts from roads can also affect other resources including heritage, botanical special interest areas, and sensitive habitats such as wet meadows. Opportunities exist to better manage public access, reduce impacts to forest resources, and reduce maintenance costs associated with the transportation system.

Public access is limited in the South Fork Willow and Dale Creek Watersheds due to ownership patterns and historic road agreements. There is no public road access to Dobkins, Durney and Little Crater Lakes.

Recreation use is dependent on roads for access to trails, hunting grounds, etc. The area receives abundant recreation use but has no developed recreation facilities. Lack of restrooms at the Parks Creek trailhead has raised concerns associated about sanitation and water quality. Additionally, a lack of trailhead parking, information signs, and maps can hinder public use of trails and recreational opportunities throughout the area. Unmanaged recreation has led to resource impacts specifically in sensitive areas (e.g. vehicles entering wet meadows and riparian areas).

Key Questions

- What is the desired future condition for the transportation system on public lands? What resource concerns should be considered when developing recommendations for the existing and future transportation system?
- What opportunities exist to improve access for public recreation opportunities (e.g. hunting, hiking, fishing, camping, OHV). What opportunities exist to improve public access to high alpine lakes (e.g. West Parks, Durney, Dobkins)?
- What other public uses (commercial, recreational, residential) occur within the watershed, and what are the access considerations for management of these uses?
- Where is recreation occurring in the watershed and at what levels (seasonal use patterns, numbers)?
- Where does concentrated public use occur and how does it interact/affect: unique habitats, cultural resources, local economy, adjacent private owners and property?
- What opportunities exist to improve management of developed recreation within the watershed?

- What are relevant internal/external legal designations that influence both opportunities and constraints (e.g. ownership patterns, Forest Plan, Traditional Cultural Properties, state water rights, Critical Habitat Units)?

Visual Resources / Scenery

Scenery is a human value which can be enhanced and/or protected by designing management activities that alleviate previous human-caused changes to the landscape and by creating opportunities to enjoy the scenic character of the area.

Key Questions

- How does dense vegetation influence visual access into the forest or distant views, thereby affecting scenery?
- Are there opportunities to:
    - Improve scenic views from Parks Creek Road to the valley below?
    - Thin vegetation to open views into the forest?
    - Create pull-outs on Parks Creek Road for people to view the valley?
    - Remediate past management activities that affect scenery?
- Has mining activities impacted scenery from sensitive viewing areas?

Vegetation and Fuels Management

Opportunities for mechanical management of vegetation in the watershed are generally very limited to the rugged and rocky nature of the soils. Despite active fire suppression over the past 100 years most natural stands are currently not in need of management. Future vegetation management activities are expected to be limited to plantation maintenance and wildland urban interface treatments. Vegetation management activities are constrained by uneconomical conditions and low site productivity.

While site productivity is low, fire suppression over the last 100 years has impacted ecological function in some habitats. There is a need to return fire as an ecological process back into the ecosystem. Opportunities exist to reduce fire risk in the wildland urban interface in the eastern third of the watershed.

Key Questions:

- What opportunities exist to improve vegetative condition in the watershed (e.g. plantations, meadows WUI, habitat improvements for game species)? *[Shrub areas associated with serpentine barrens, located on ridgetops (no need for treatment; cryic soils).]*
- How has habitat for game species changed over time?
- How has habitat for special status plants changed overtime?
- What is the current condition of vegetation in the wildand urban interface? What opportunities exist to reduce the risk of fire and improve vegetative condition in the WUI? What opportunities exist for joint benefits to wildlife and other resources from vegetation management activities in the WUI?
- How can natural ecosystem processes, including fire, mortality and disease, be safely returned to the entire watershed area to restore ecosystem structure and function?

- How has fire suppression impacted vegetation composition and structure over time and what is the current hazard to the watershed as a result of this change (e.g. disease)
- What public information opportunities exist to reduce the risk of human ignited fires and collaborate on treatments within the WUI?

Habitat Quality – Wildlife and Plants

Mid and late-seral mixed conifer and conifer/hardwood habitats have the potential to support a variety of species including the northern spotted owl (NSO) in the southern and eastern portion of the watershed. There is a need to manage and protect what currently exists and to recruit additional habitat of this type for the future. Areas in the Willow-Parks Watershed contain federally designated Critical Habitat for NSO, it is essential that the key elements that constitute suitable NSO habitat are considered when assessing the overall quality of the habitat within the watershed.

Early-seral shrub habitat has the potential to support early-seral species including deer, mountain quail and elk. Bitterbrush is minimal within the watershed and where it does occur it is mostly found on private land at lower elevations. Though bitterbrush might be lacking, there are 40 other different species of shrubs in the watershed. The abundance of open shrub, grass/forb habitat in the watershed may benefit from fire.

The lower reaches of Parks Creek are home to anadromous salmonid species habitat, but there is a need to maintain or improve habitat quality and connectivity to ensure the continued presence of these species in the watershed.

There are 24 special status plants known to occur within the watershed. They are found in many unique habitats such as meadows and riparian areas. They also occur along roads, ridge tops and in the subalpine conifer-shrub habitats. There is a need to try to relocate historic population sites to see if they are still there. There is also a need to protect many sites and their habitats from recreation activities and road and trail maintenance. Most meadows are in good condition but are experiencing small amounts of conifer encroachment and off-road vehicle disturbance. Invasive species are largely absent from the watershed, though opportunities do exist to further reduce the risk of invasive species introduction.

Key Questions:

- How has management influenced habitat for species of concern and species that depend upon a variety and diversity of habitats?
- What management actions can be undertaken to improve habitat conditions and quality (including reducing the potential for high-severity wildfire) for species of concern and species that depend on diverse habitat types.
- What opportunities exist to prevent the introduction and spread of invasive species in the watershed?
- Where and to what extent are wet meadow habitats being impacted? What opportunities exist to prevent impacts to wet meadows and other sensitive habitats?
- What opportunities exist to improve connectivity and quality of aquatic habitat within the watershed?

Human Uses

Past cultural resource surveys within the watershed have resulted in the recordation of seven (7) prehistoric Native American sites and 15 historic Euro-American sites. Historic land uses are more prominent and include mines, mine tailings, stamp mills, diversion dams, ditches, cyanide processing tanks, mining cabins and related domestic refuse, mine claim markers, roads, trails, bridges, logging skid trails, logging skid roads, logging chutes, log landings, stumps, discarded cull logs, remains of snow survey cabins, remains of two lookouts, remains of an historic lodge and the remains of range cabins, corrals, and fences. Other historic sites (trails, roads, prospects, mines, logging camps, etc.) are known to be located within the watershed, but have never been formally recorded.

Compared to other regions on the Shasta-Trinity National Forest, known evidence of ancestral *Ahotire 'itsu* uses within the watershed is sparse. The scarcity of evidence on NFS lands may be due to the lack of survey coverage for most of the watershed with the exception of lands within timber sale areas. Shasta sites include trails, small encampments, and resource procurement areas. The Forest Service is not privy to any surveys on private land in Shasta Valley, so information about cultural resources on private land is seldom available; but it is probable that the Shasta Valley was more populated than the uplands. Terrain, slope, aspect, and local weather conditions may have been an environmental factor that also influenced aboriginal land uses of the uplands within the watershed.

Historic mining impacts to the watershed are related to the removal of native vegetation and topsoil, shallow open pit mining, adits, shafts, prospects, road construction, building construction, and the introduction of natural and manufactured toxic substances into the watershed through leaching and direct dispersal within creeks, such as asbestos fibers, arsenic, cyanide, mercury, etc. (see Tetra Tech Em, Inc. 2007 for a comprehensive list associated with the Dewey Mine). Historic logging activities associated with Central Pacific Railroad and early mining activities within the watershed were probably done by horse and trailer and at least in one instance removal by log chute. There is ample evidence of modern (ca. 1950s and later) tractor logging as represented by un-patterned skid roads visible both on the ground and on air photos, pushed-over stumps, and bladed logging roads and re-routes. Historic air photos (1944-1975) and historic International Paper photos on file at the Mt. Shasta Ranger District office suggest that tractor logging occurred within riparian reserves.

Key Questions:

- What opportunities exist to work with local Tribes to improve access to Traditional Use Areas, Traditional Cultural Properties, and Sacred Areas (if present)?
- What opportunities exist to conduct new cultural resource inventories?
- How has past mining and logging activities affected the overall health of the watershed?
- What management actions can be undertaken to improve water quality and also protect historic and prehistoric cultural resources and other cultural values?
- What opportunities exist to work with local land owners to improve drainage on the Dewey Mine Road and protect historic cultural resources?
- Are there opportunities for interpreting cultural resources within the watershed?

Chapter 3: Current Conditions

The purpose of this chapter is to develop information relevant to the issues and key questions identified in Chapter 2. The current range, distribution, and condition of the relevant ecosystem elements are discussed.

Visual Resources / Scenery

Chapter 1 described the areas that have a high value for scenery within the analysis area. Other elements also affect how a person experiences the visual resource. Whether a scene is viewed from a motorized or non-motorized mode of travel, the speed at which the traveler is moving, the distance from the viewing area, air quality and topography all affect how a person views scenery. Also a persons' subjective experience influences their experience, i.e. eyesight, attention focus, and line of sight. The steep topography on the side of a mountain is visually more apparent than on flat topography due to the viewing angle; it is analogous to viewing a bill board on the side of the road. Usually only the foreground can be viewed on flat topography. Another element that influences the scenic experience is the time frame a person has to view the landscape. The longer a person has to view a scene, the more apparent landscape details would be noticed, i.e. if a person is stationary while sitting at a picnic table or walking along a trail they would notice the details of the landscape more than if they were traveling 55 miles per hour on a highway.

Parks Creek Road (also known as the 17 Road or 42N17) is very curvy through the mountainous terrain; therefore the attention and focus of the driver is primarily on the road and in the immediate foreground except when the motorist pulls over on the occasional turn out.

PHOTO 3-1: PARKS CREEK ROAD.

The scenery viewed from this road includes sparsely vegetated rocky outcroppings and mountain peaks at higher elevations to richly vegetated riparian areas where the road crosses smaller creeks. The rock and mountain formations offer visual interest. The attractive riparian areas host crystal clear streams, flowers, forbs, shrubs with deciduous and conifer trees. Views include Mt. Shasta and the valley below.

PHOTO 3-2, 3-3, 3-4: VIEWS FROM THE ROADS.

Current conditions include areas with densely stocked small conifers and understory which block views into the forest plus distant views. There are also large conifers which block views of the valley below.

PHOTOS 3-5, 3-6, 3-7: VIEWS FROM THE ROADS THAT ARE BLOCKED BY TREES.

The Forest Plan utilizes the Visual Management System (VMS) to identify Visual Quality Objectives (VQO's) to manage scenery from well-traveled routes. The VQO's indicate allowable changes to scenery as a result of management activities. The Visual Quality Map identifies that the VQO's for Parks Creek Road ranges from Modification (management activities may dominate the characteristic landscape, but must follow naturally established form, line, color, and texture characteristics), Partial Retention (management activities may be evident, but must remain subordinate to the characteristic landscape) and Retention (management activities are not evident to the casual forest visitor). The existing scenic condition as viewed from Parks Creek Road varies from Retention to Modification due to roads, prior management activities and a rock quarry at the summit.

The Forest Plan identifies a VQO of Retention for Interstate 5 in the foreground (1/2 mile). Views of the project area from the interstate would primarily see the middle to background (further than 1/2 mile from the interstate). The Forest Plan identifies the VQO's as seen from I-5 for the analysis area as Partial

Retention. The analysis area as seen from the interstate looks primarily natural therefore meets Partial Retention VQO.

The Parks Creek Trailhead and surrounding area is consistent with the Forest Plan VQO of Modification due to the parking area and rock quarry across Hwy 17.

Views from Dobkins Lake, Durney Lake, and Little Crater Lake meet the Forest Plan VQO of Retention due to the lack of developed access or facilities. While there is road access (with locked gate) across the adjacent private property, these small lakes can also be accessed on foot from the south or west across NFS lands. The Caldwell Lakes and West Parks Lakes also meet the VQO of Partial Retention due to the limited access by trail.


PHOTOS 3-8 AND 3-9: VIEWS FROM MOUNT EDDY AND REMAINS OF MOUNT EDDY LOOKOUT.

Views from Mt. Eddy encompass the surrounding valleys; the picture above includes Lake Shastina to the northeast. Mt. Eddy has a VQO of Retention map which it currently does not meet due to the remnants of a historic look-out tower which diminishes the scenic integrity.

Generally, the scenery within the analysis area is has a very high scenic integrity as seen from sensitive viewing areas.

Recreation

For decades Forest visitors have used the Parks, Willow, Dale and Eddy creek drainages to enjoy a diversity of outdoor activities including hiking, fishing, hunting, camping, bicycling, sightseeing, firewood gathering, mining skiing, snowmobiling, and OHV operations. Within the last decade, observed recreation use has been increasing. This trend has been especially noted at the Parks Creek Trailhead where estimated use has tripled in the last five years. No developed recreation facilities exist within the watershed (i.e., campgrounds, restrooms) and current opportunities are limited to a handful of trails and dispersed recreation.

The majority of recreation within the watershed is concentrated along Hwy 17. This road system serves as a main arterial into the Parks Creek drainage and during the dry season, provides access to a variety of recreational destinations, not only in the watershed but throughout the region. During the summer and fall months, the road is frequently used to access the Trinity Alps Wilderness, Trinity Lake, and the north coast of California. This through-traffic increases recreation use within the watershed.

Dispersed camping is concentrated around roads, streams and lakes. Sixteen dispersed campsites were inventoried along roads in June of 2012 and these sites varied in size and condition. Many of the campsites inventoried had not experienced use in several seasons while others appeared to be frequently used.

PHOTO 3-10: DISPERSED CAMP LOCATED AT LOWER WEST PARKS LAKE, JULY 2012.

With the start of deer hunting season in autumn, the area sees a surge of public use. During these months, dispersed camping is at its highest. Road and trail use increases dramatically and OHV use increases.

The Parks Creek Trailhead (picture 3-11) is possibly the most popular recreation area in the watershed. The site includes trailheads for the Pacific Crest Trail (PCT) and the popular trail to Deadfall Lakes, the Sisson Callahan Trail, and the summit of Mt. Eddy. The upper parking area typically hosts 20-60 vehicles per day with dozens of hikers frequenting the trail. Sanitation and impacts to water quality below the trailhead has been a concern due to the popularity of the trails.

PHOTO 3-11: PARKS CREEK TRAILHEAD, JULY 2012.

Mountain Lakes

There are several mountain lakes that exist within the watershed and receive significant use by recreationalists. These include:

Dobkins (6,788 ft.)/Durney (7, 045 ft.)/Little Crater (7,581 ft.)

These lakes are located in Section 6, T40N, R5W just north of the summit of Mt. Eddy. Historically, these lakes were frequented throughout the summer by Forest visitors, although in the 1990's, the private land owners closed and gated the private roads across their land reducing the use at the lakes. Two historic trails (5W02 and 5W03) lead to Little Crater Lake and Dobkins Lake, although the current condition of these trails is unknown. There is no known trail that leads to Durney Lake. Alternate hiking access is available from points south and west across NFS lands, although no trail development has occurred.

Caldwell Lakes (6,835 ft.)

These lakes are located in Section 29, T41N, R6W within the Parks Creek drainage just below the Trinity divide. Access to the lakes is off of forest road 41N74 from Hwy 17. Trail 6W01 accesses lower, middle and upper Caldwell lakes which receive moderate use. Several dispersed camps are located near the lakes and are frequented by users during the snow-free season. The trail is in good condition at the upper end and fair to poor condition at the lower elevation. The transition from the road to the trail is unmarked and there are drainage, engineering and accessibility problems along both the trail and access road. Dispersed camps are located at all three lakes and are in fair condition with the majority of them located near the water.

West Parks Lakes (7,435 ft)

These lakes are located in Section 21, T41N, R6W just before the Caldwell lakes turn on Hwy. 17. Access is off of road 41N73, although the last 1.5 miles of the road is not accessible by vehicle due to a washout. There is limited use by ATVs on the road past the washout. Forest visitors on ATVs have performed some maintenance along the upper section of road by trimming vegetation and maintaining the road prism. Trail 6W23 provided historic access to the middle and upper lakes; however a Forest Service inspection in July 2012, could not relocate the trail. There are several dispersed camps located around the lakes which appear in fair to good condition.


PHOTOS 3-12 AND 3-13: LOWER WEST PARKS LAKE, JULY 2012.

Winter Recreation

Visitors enjoy a variety of winter recreation opportunities in the area including snowmobiling, backcountry skiing, Christmas tree cutting and mountain climbing. Concentrated winter recreation occurs along Hwy. 17 with many snowmobilers and skiers seeking the slopes of Mt Eddy and the steep slopes into Eddy Creek. A smaller amount of winter time recreation is accessed through private lands.

Since 1936, the California Cooperative Snow Survey program has used the Parks Creek Drainage to measure snow and provide water data for the Shasta River watershed.

Transportation

The Willow-Parks watershed area has approximately 106 miles of Forest Transportation System (FTS) roads. This includes 9 miles of paved arterial routes, 7 miles of collector routes and 90 miles of native surfaced local roads. There are also an unknown number of un-inventoried unauthorized routes in the area.

In addition the FTS, there are also 12 miles of county road and an additional 5 to 10 miles of private timber land and residential roads. County roads include N. Old Stage Road, College Drive, Stewart Springs Road and a portion of Parks Creek Road. Interstate 5 forms the easterly boundary of the analysis area.

The majority of roads in the watershed are high clearance, four-wheel drive roads (maintenance level 2). These roads vary in condition from good to poor and interact with the watershed frequently through stream crossings, fords, drainage structures and erosion features. Some roads are poorly located and others have intercepted subsurface and surface water and have become diversion stream beds. Refer to the Hydrology section for more information on road and stream interaction.

PHOTO 3-14: A FORD WATER CROSSING (NORTH STATE RESOURCES 2010).

Peak traffic conditions occur during the summer and fall when commercial and recreational use is the highest, with the majority of use concentrated on the Parks Creek Road (42N17). Parks Creek Road provides access to a multitude of camping, hiking, swimming, fishing, hunting and other recreation opportunities as noted above. With the close proximity to the cities of Weed and Mount Shasta, users to the area can often be expected to make a same day return trip. Traffic during winter and spring is limited by road and snow conditions. Parks Creek Road is not plowed during the winter and on a typical year a snow drift at the top near the Parks Creek summit limits access west of the watershed until late June.

Right Of Way

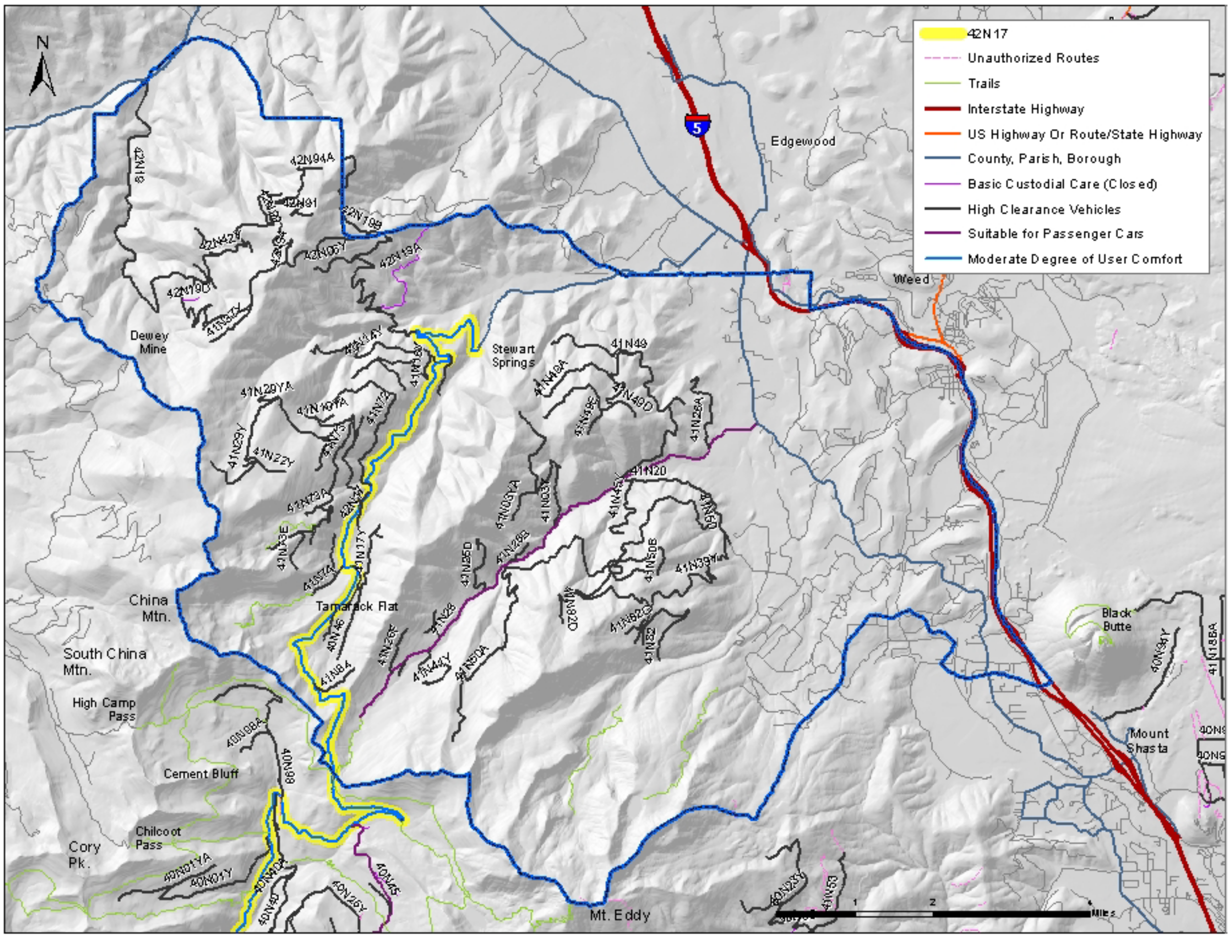
Right of way and public access is an issue for the Willow-Parks assessment area. The Willow Creek area is only accessible to the public via the Dewey Mine Road (42N19) from Hwy. 17 and portions of that alignment pass through wet meadow and eroded streambeds. There is no current public or administrative road access to NFS lands at the top of the Dale Creek Drainage. The lower reaches of the Eddy Creek Road (41N26) pass through approximately 1 mile of residential development.

Cost share roads are a moderate concern for actions involving the road system within the analysis area. While the lands are primarily National Forest System, cost share and road use agreements with private landowners are still in effect. This will require coordination with the private owners for timely closures and decommissioning.

Roads

42N17 Parks Creek Road

This is the primary access route to the Parks Creek watershed and upper Willow Creek watershed. The Parks Creek road (Hwy. 17) has a paved surface and is suitable for passenger cars. The road width varies and is narrow (single lane) in areas. Prominent slumping is occurring on the lower Parks Creek road and is illustrative of some of the geomorphic challenges faced when building roads in the watershed. Cemented glacial outwash gravel under the road fill material and subsurface water flow combine to remove material from beneath the road to create a slump, or depression in the road surface. These slumps may be difficult to see on the roadway since they can occur without visually disturbing the surface pavement. Road user safety is a concern with the slumping roadway and the hazards they present. Road user sight-distance is also a safety concern.



MAP 3-1: ROAD SYSTEM WITHIN THE WATERSHED (NOTE: CONTRARY TO WHAT IS SHOWN THE EDDY CREEK ROAD 41N26 IS NOT SUITABLE FOR PASSENGER CARS).

Parks Creek Road System

Roads that connect to 42N17 see regular use and are in varying conditions. The steep terrain limits the amount of unauthorized off road vehicle use and concentrates traffic on the existing road system. Skid-trails from past logging activities are evident outside the roadway but are impassible to most four-wheel drive vehicles (some have OHV and/or motorcycle use). Roads are either mostly open and drivable, or have been naturally closed due to deferred maintenance and vegetation ingrowth. Road maintenance has been limited and drainage facilities on local and collector roads are more likely to be impaired or under at-risk conditions.

41N26 Eddy Creek Road

This is the primary route to the Eddy Creek drainage area. The road begins with a paved surface through private property and changes to native surface road at the Forest boundary. At this point the road is passible only by high clearance four-wheel drive vehicles. Drainage facilities on this road are inadequate; surface and subsurface water flows are diverted by the road in several locations. Several segments of this road are in poor surface condition because fine materials in the roadway have been washed away and only the larger, rocky materials remain. This road ends near a meadow and turns into a non-motorized trail with evidence of motorized vehicle use.

Eddy Creek Road System

Spur roads that connect to 41N26 Eddy Creek Road vary in condition. Typically, the closer the road is to Eddy Creek the more susceptible it is to carry surface run off to the creek, resulting in a poorer condition. As roads climb up the slope from Eddy Creek, they are generally in better condition. There are several old drainage structures at stream crossings that are in disrepair and contribute increased sediment to streams. Roads that move south from 41N26 use fords to cross Eddy Creek. Use farther from the creek up into the higher slopes is also less apparent with roads segments naturally closing from deferred maintenance and impassible vehicle conditions.

42N19 Dewey Mine Road system

The 42N19 Road is accessible via 42N17 and provides access to the upper Willow creek drainage. The Dewey Mine is located in this vicinity on private property with private road access. Past efforts have been made to restrict road access to this area, but unauthorized use and vandalism have been a problem. The 42N19 road is only passable for high clearance four-wheel drive vehicles and limits management capabilities. A climbing segment of this road features steep switch backs that are subject to surface runoff and unstable road surface conditions.

Maintenance

Road maintenance for the FTS in the analysis area has predominantly been a result of vegetation management projects in the past. Road conditions have deteriorated due to reduced budgets and lack of recent maintenance. A sediment source inventory completed in 2010 identified road segments and road drainage features that were not functioning properly. A subsequent road condition inventory in 2012 confirmed the overall condition of the FTS in the analysis area and the need for immediate road maintenance.

The native surfaced roads, abundant surface water and the steep terrain of the area contribute to erosion and road maintenance problems throughout the watershed. Native surfaced roads without adequate, functioning drainage and runoff control lose their fine surface materials and the result is a rough and cobbled road surface. Roads lowest in the watershed, closest to the creeks and drainages see the most damage with concentrated runoff from higher elevations. Typically as roads climb away from the drainage they are in better condition as long as the road surface drains properly. Local roads in the watershed see less use, regulated by the condition of the road, individual vehicle capabilities and gated private roads.

PHOTO 3-15: A LACK OF MAINTENANCE AND EROSION CONTROL CREATES POOR ROAD CONDITIONS AND SAFETY CONCERNS (NORTH STATE RESOURCES 2010).

Road Closures

The lack of funding for general road maintenance in the area includes a lack of maintenance of closure structures. Roads that were closed through past management activities have been opened up through vandalism. Roads that were not actively closed have been closed by deterioration and natural events. Roads that were intended for seasonal closure have been left open year round. Typical closure methods include gates and earthen berms. Earthen berms appear to be more successful in closing roads as gates are more susceptible to vandalism. Road closures in the area are important to reduce road densities, but management access and fire access needs are a constant concern.

PHOTO 1-16: SLIDE MATERIAL AND VEGETATION HAVE CLOSED THIS ROAD (NORTH STATE RESOURCES 2010).

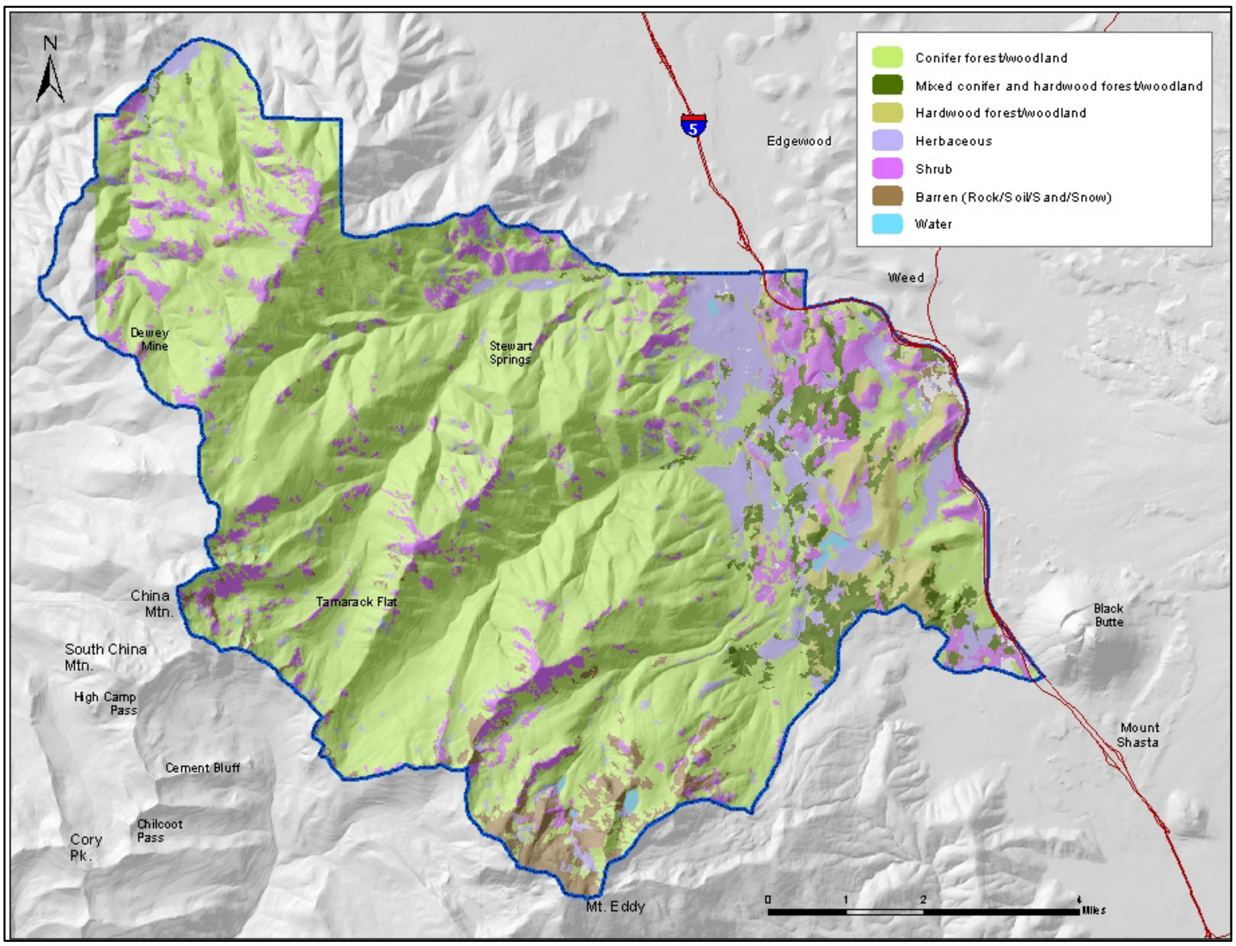
PHOTO 3-17: A FUNCTIONING ROAD CLOSURE BERM (NORTH STATE RESOURCES 2010).

Vegetation

The majority of this watershed is located within the Eastern Klamath Mountains Geological Province. The current condition and general health of the vegetation within the watershed was determined using various tools such as aerial photos and site visits. An additional resource that was used to help identify the potential problem spots, specifically in the forested stands, was the Forest Health Protection flight data (U.S. Forest Service, 2011a). This flight data identified mortality areas and the potential causes for that mortality. The data also determined the species of the trees being affected by the mortality, as well as an estimate of the area being affected. More information on Forest Health Protection is available here:

http://www.fs.fed.us/foresthealth/aviation/aerialsurvey.shtml

Vegetation within the watershed is dominated by the topography of Mt. Shasta which can be seen in Map 3-2: "Mt. Shasta Watershed Dominant Vegetation Types in the Willow-Parks Watershed" below. The vegetation typing in Map 3-2 was formed from Remote Sensing Application data and has some limitations. It should be noted that all the vegetation typing that was done for this analysis is intended to help characterize the landscape and should not be used as an absolute typing.



MAP 3-2: DOMINANT VEGETATION TYPES IN WILLOW-PARKS WATERSHED.

Map 3-3: "Vegetation Seral Stages in the Willow-Parks Watershed" shows the vegetation seral stages in the Mt. Shasta watershed and was also created using Remote Sensing Application data. The seral stage map depicts the overall size and canopy closure of the stands within the analysis area. The breakdowns of the sizes are depicted in the table below.

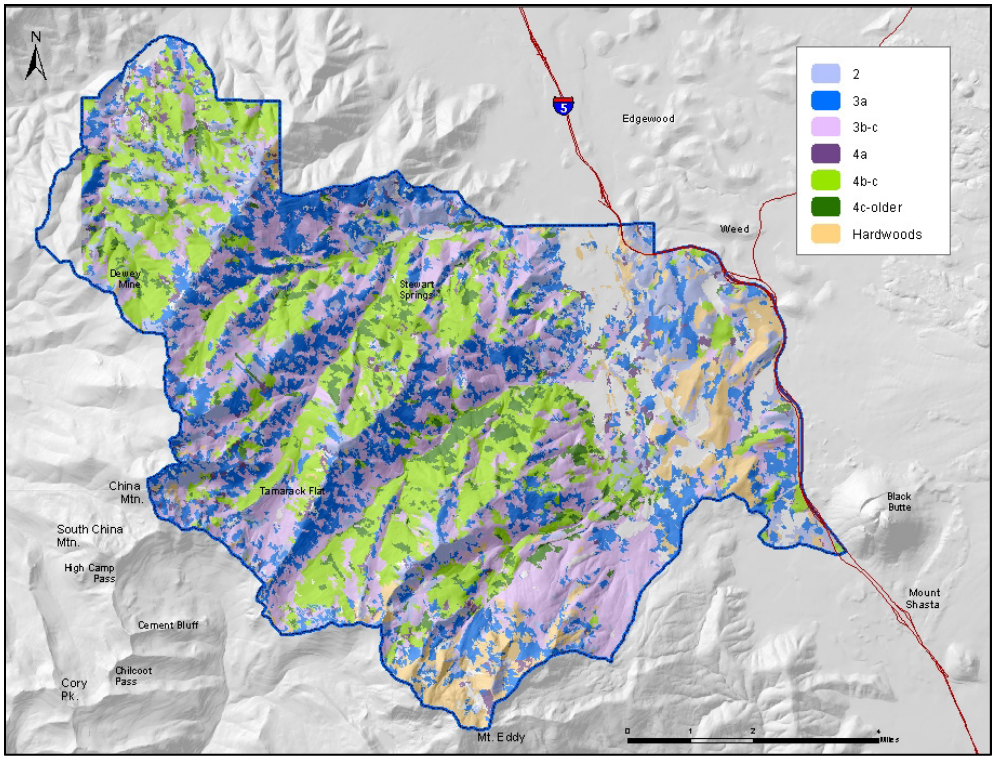
WHR Seral Stage	Size/Density Class	Crown Diameter (inches)
2	Brush, seedlings, 1N, P, S & G	6-12 feet, poles
3a	2S, 2P, 3S, 3P	13-24 feet, small to medium timber
3b-c	2N, 2G, 3N, 3G	13-24 feet, small to medium timber
4a	4S, 4P, 5S, 5P	25-40 feet, large sawtimber
4b-c	4N	25-40 feet, large sawtimber
4c-older	4G, 5N, 5G	25-40 feet, large sawtimber
Hardwoods		

TABLE 3-1: SERAL STAGES CROSSWALK WITH MAP 3-3.

Density Codes	Crown Cover
S	<20%
P	20-30%
N	40 -69%
G	≥70%

TABLE 3-2: VEGETATION DENSITY AS DEFINED IN LMP.

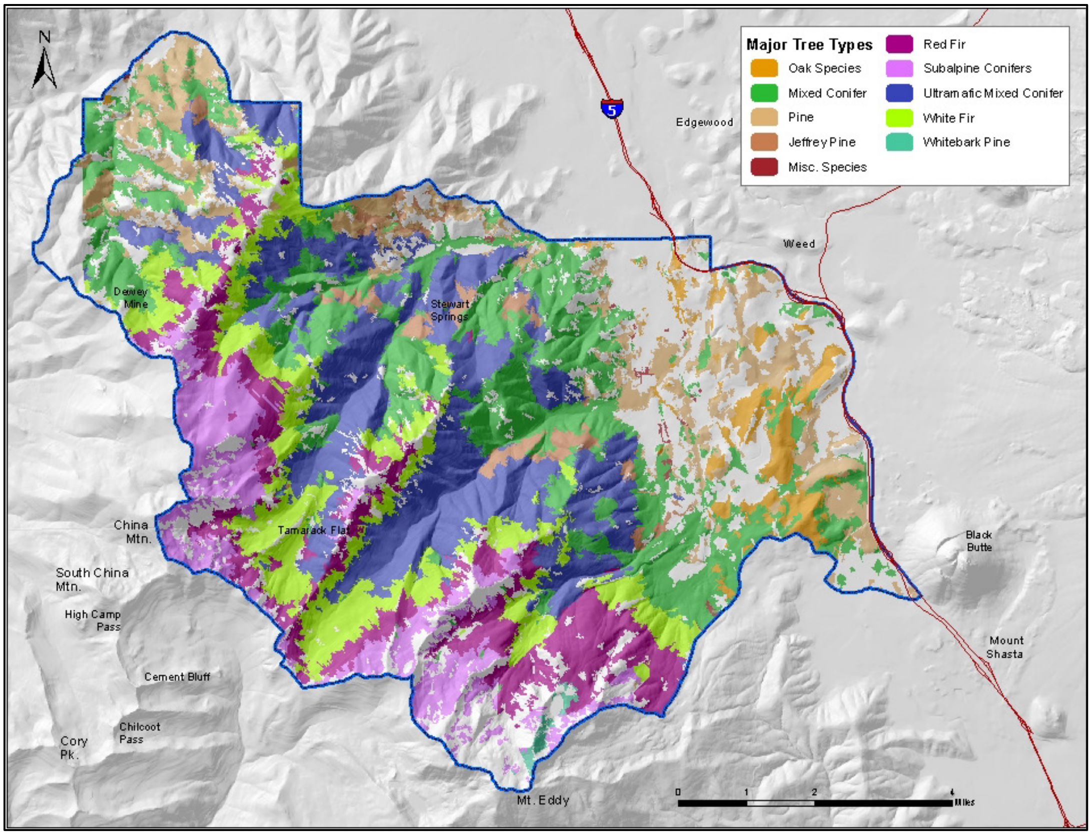
The percentage of canopy closure is determined by the percentage of ground that is covered by the overstory trees as seen from a bird's eye view. The knowledge of the seral stages in the watershed can help managers determine where actions may be needed to either accelerate conditions to meet large tree late seral conditions, or where actions may be needed to try and maintain this conditions.



MAP 3-3: VEGETATION SERAL STAGES IN THE WILLOW-PARKS WATERSHED.

Red Fir /White Fir Types

Red and Shasta Fir (*Abies magnifica var. magnifica* and *A.m. var. shastensis*) dominate high elevation stands from about 5500 - 8600 feet. Lodgepole Pine (*Pinus contorta ssp. murrayana*) is a common conifer associate at lower elevations, and subalpine conifers such as Mountain Hemlock (*Tsuga mertensiana*), Western White Pine (*P. monticola*), and Whitebark Pine (*P. albicaulis*) are found as inclusions on some ridge tops. Red fir habitats are found in frigid soils over a wide range of topography exclusive of very wet sites. Mature red fir stands normally are monotypic, with very few other plant species in any layer. Heavy shade and a thick layer of duff tend to inhibit understory vegetation especially in dense stands.



MAP 3-4: MAJOR TREE TYPES IN THE WILLOW-PARKS WATERSHED.

White Fir (*Abies concolor*) occurs at elevations usually below 7000 feet. Slopes may be gentle or steep, and the aspects are often northerly where this species forms almost pure stands. Overlapping crowns that cast deep shade are characteristic, although open stands are common. The understory may consist of sparsely scattered grasses, forbs and shrubs or white fir seedling and saplings. Harvesting of Ponderosa Pine and fire exclusion policies have contributed to the White Fir dominance on many of these sites. Many areas have some evidence of injury to White Fir where the fir engraver beetle is the primary agent. Other conifer species which may be present in minor amounts include Incense Cedar (*Calocedrus decurrens*), Ponderosa Pine (*Pinus ponderosa*), Lodgepole Pine (*P. contorta ssp. murrayana*) and Red Fir (*A. magnifica*).

Species specific strains of dwarf mistletoe *(Arceuthobium abietinum)* are common in true fir. Although mistletoe rarely kills trees directly, it can kill limbs and it can create large bole cankers that make the tree susceptible to breakage.

Many of the true fir stands are also susceptible to attack by the fir engraver beetle *(Scolytus ventralis)* when overstocked stands combine with drought conditions to increase tree stress. Overstocked stands reduce the amount of nutrients and moisture available in the soil making the fir trees weak and susceptible to fir engraver attacks. Affected trees can be identified by bore holes and boring dust, as well as prevalent pitch streams that come from the bore holes. The fir engraver can also have nonlethal attacks which result in top kill of the fir trees. Cytospera canker (*Cytospera abieties*) frequently attacks true fir stands that have been infected with dwarf mistletoe, resulting in extensive branch kill. Cytospera has been detected in the watershed in red fir as noted in the Forest Health Protection Flight.

Subalpine conifers

A mixture of conifers may be found at the higher elevations commonly above 6500 feet in which no single species is dominant. Various combinations of Red Fir (*Abies magnifica* var. *magnifica* and var.*shastensis*), Western White Pine (*Pinus monticola*), Lodgepole Pine (*P. contorta* ssp. *murrayana*), Mountain Hemlock (*Tsuga mertensiana*) and Whitebark Pine (*P. albicaulis*) may be present in this area. These stands are often interspersed with bare areas or alpine forb or shrub communities.

Mixed conifers/Ultramafic Mixed conifer

The mixed conifer type covers the largest area in the watershed and is generally found at elevations between 2,500 and 5,000. It is considered a mixed series including incense cedar, sugar pine, white fir, Douglas fir along with a prominent ponderosa pine component. Ponderosa pine dominates at lower elevations and on south slopes. Jeffrey pine commonly replaces ponderosa pine at high elevations, on cold sites or on ultramafic soils. At the higher end of this series, on more moist sites the ponderosa pine is replaced by white fir as the more prominent species of the series. Species specific dwarf mistletoe is frequently present in this mixed conifer type within the watershed and has been found on all tree species. Dwarf mistletoes are small parasitic plants in the genus *Arceuthobium*. They grow exclusively on conifer stems and branches and are almost completely dependent on their host trees for food and water. Dwarf mistletoes are species specific and are obligate parasites which mean that they require a living host to survive. Dwarf mistletoes weaken trees by slowly depriving them of both nutrients and water. Heavy infections (many dwarf mistletoe plants distributed throughout the crown of the tree) can lead to severe growth loss and decreased survival which is evident in numerous stands within this type in the watershed.

The growth reduction and mortality associated with dwarf mistletoe can lead to radically different forest structures, densities and productivity levels in infected stands compared to uninfected stands on similar sites. For example, a small tree that is severely infected with dwarf mistletoe is unlikely to survive and grow into a large tree; stands of small trees that are severely infected will not grow into large tree dominated forests. Both of these examples are frequently visible within the mixed conifer and ponderosa pine type in this watershed.

PHOTO 3-18: AN EXAMPLE OF A DWARF MISTLETOE INFECTION IN PONDEROSA PINE.

The picture in Photo 3-19 illustrates the negative effects of severe dwarf mistletoe infections on tree growth and vigor. The characteristic "witches brooms" often associated with dwarf mistletoe is also evident in this photo which is an abnormal proliferation of many small twigs and foliage on a branch that appear as a clustered mass.

PHOTO 3-19: THE NEGATIVE EFFECTS OF SEVERE DWARF MISTLETOE INFECTIONS ON TREE GROWTH AND VIGOR.

The effects of this parasitic plant are compounded in ultramafic soils which are found in 2/3 of the watershed.[1] Soils formed on serpentinite generally produce more exaggerated effects than other types of ultramafics. Soil profile development is generally slow and poor, with average pH between 6-7.5. Soil moisture holding capacity is generally low. Ultramafic soils are often lacking in nitrogen, phosphorous and sometimes molybdenum; they are moderate to high in Cobalt, chromium, iron and nickel. Because soil development is poor and slopes are steep, ultramafic soils are not stable. This affects the establishment of pioneering vegetation and as a consequence, further slows soil development. Timber productivity is highly variable, but mostly very poor on these soils. Timber can be harvested from sites that are not so severe that they exclude tree growth, but regeneration after harvest is often difficult and growth is poor. Ultramafic sites in forested regions are often classified as non-productive, especially as the amount of serpentine increases.[2] The negative effects of these ultramafic soils on site quality and subsequent timber growth and vigor are quite evident in numerous stands within this watershed. Despite the challenging growing conditions, many of the mixed conifer stands within the watershed have high stocking levels especially in the understory where competition for water and nutrients is high and vulnerability to insect and disease infestations is increased. Ponderosa pine within this mixed conifer type is susceptible to western pine beetle *(Dendroctonus brevicomis)* attacks and tree resilience is reduced when overstocking exists. Under normal conditions and stocking levels, the pine trees natural defense to exude pitch out of the insect holes is sufficient to limit infestation and mortality.

Ponderosa Pine

In Northern California, ponderosa pine stands occur above oak woodland types and below the mixed conifer zone at elevations between 800 to 5000 feet. Montane hardwood stands may be below or interspersed with ponderosa pine. Tree spacing in ponderosa pine stands varies from open, patchy to dense clumps. Black Oak (*Quercus kelloggii*) is the most prevalent hardwood associated with these stands but, Canyon Live Oak (*Q. chrysolepis*) and Oregon White Oak (*Q. garryana*) occur less commonly. The pine may become the dominant conifer on well- drained, often droughty, non-serpentinized soils such as coarse-textured alluvial sites and southwest-facing or steep slopes. The negative effects of ultramafic soils and dwarf mistletoe infections on growth and vigor are also present in this type. Ponderosa pine stands are also susceptible to insect attacks and subsequent mortality especially when the stands are overstocked.

Black Oak

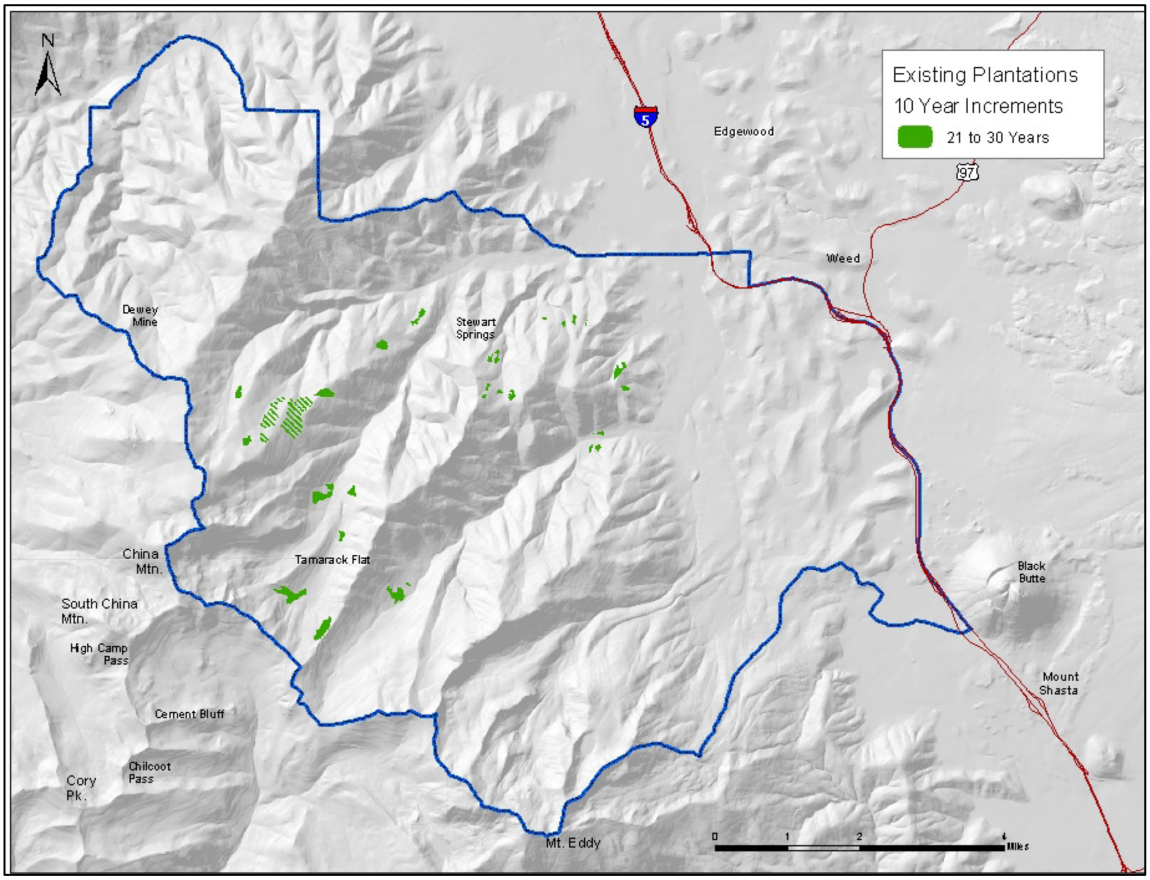
California Black Oak (*Quercus kelloggii*), widely distributed over most areas of California and elsewhere, occurs as a dominant species in its own alliance. California Black Oak grows within a wide elevational range. Black Oak can occur in pure stands in forest openings associated with a variety of edaphic conditions and with conifers such as Ponderosa Pine (*Pinus ponderosa*), White Fir (*Abies concolor*), Douglas-Fir (*Pseudotsuga menziesii*), and Western Juniper (*Juniperus occidentalis*). This forest type occurs solely on private land in the eastern portion of the watershed.

[1] Personal communication, Juan dela Fuente, Geologist

[2] SERPENTINE: EXPRESSIONS OF EARTH'S DEEP AND DARK INNER WORKINGS (MASON MCKINLEY, JUNE 2001)

Plantations

Plantations in the Willow-Parks watershed were established 26 years ago and range from one acre to 68 acres, with the average planation being 14 acres. As shown in Map 3-5 below, the plantations are primarily found in the central portion of the watershed in the Eddy Creek drainage and the Parks Creek drainage. These plantations are early seral age mixed conifer/pine/California Black Oak stands less than 20 feet tall and are currently at 2 – 6 inches in diameter at breast height (dbh). These plantations have a moderate to heavy shrub component (40-90 percent cover), made up mostly of manzanita spp. and rabbit brush that ranges in height from 2 - 4 feet.



MAP 3-5: PLANTATIONS WITHIN THE WILLOW-PARKS WATERSHED.

Unique Habitats

Many unique habitats are found throughout the watershed. Habitat types are dependent on elevation, topography, aspect, disturbance regime and soil type. Historically, fire played a role, to varying degrees, in maintaining habitats of all types by creating a mosaic of age classes and canopy cover. The Klamath Range is noted for its high species diversity. Soils derived from serpentine and peridotite (ultramafic) parent materials (about 75%) support unique botanical communities due to a shift in the ratio of calcium and magnesium (see soils section). These unique botanical communities are found in fens, Darlingtonia seeps, springs and meadows, ridge tops and serpentine barrens. There are unique shrub types such as the curly leaf mountain mahogany/western juniper type scattered throughout the watershed. This vegetation type is generally associated with the eastern Cascades and the Great Basin. It can be found on both volcanic and ultramafic soil types.

There are many streams in the watershed. Creeks such as the South Fork of Willow Creek and Eddy Creek have western birch (*Betula occidentalis)* and willow (*Salix*) as a primary shrub species while others fall into the mountain alder (*Alnus incana spp. tenuifolia*), willow and ninebark (*Physocarpus capitatus*) communities.

Of the 24 special status plants occurring in the watershed, fourteen are associated with or generally found growing on ultramafic soils. Most of these plants are at higher elevations and occur on ridge tops and mountain side slopes or they are found at mid to high elevations in wet meadows, springs and seeps and along streams. Three species are known to occur at mid to low elevations on the northern and eastern boundaries of the watershed. Nine species are endemic to California. Four of these endemics are listed as Sensitive by Region 5 and 1 species is also listed as Endangered by the State of California. In total, there are nine species listed as Sensitive by Region 5 occurring in the watershed. Other species are listed by the California Native Plant Society (CNPS) in their “Inventory of Rare Plants of California” at http://www.rareplants.cnps.org/. These are watch list or National Forest Management Act (NFMA) species. There are 10 watch list species occurring within the watershed. From sub-alpine to lower montane, there are at least 40 known species of shrubs occurring within the watershed. They occupy all habitats from mountain tops, ridge lines, mountain side slopes, stream sides, serpentine slopes and riparian habitats including meadows, fens, seeps, springs and streamsides. Just off of Parks Creek Road is the only population of Canadian buffalo-berry (*Shepherdia canadensis*) with a specimen filed in the Jepson Interchange of California Herbaria. The Jepson Manual (1993) didn’t list this species as occurring in California. According to the Fire Effects Information System (FEIS) database, this species is not known to occur in California. It is found from Nova Scotia, southwest across Maine to western New York and northern Ohio, west to the Black Hills of South Dakota and Alaska, avoiding most of the Gear Basin. From Alaska it follows the Rocky Mountains south to Arizona and New Mexico and extends east across northern Canada to Newfoundland (USDA NRCS, 2012). In the CNPS online Inventory, Canadian buffalo-berry is listed as “Plants Rare, Threatened, or Endangered in California, but more common elsewhere (2B) and identifies the plant as being seriously endangered in California (.1).”

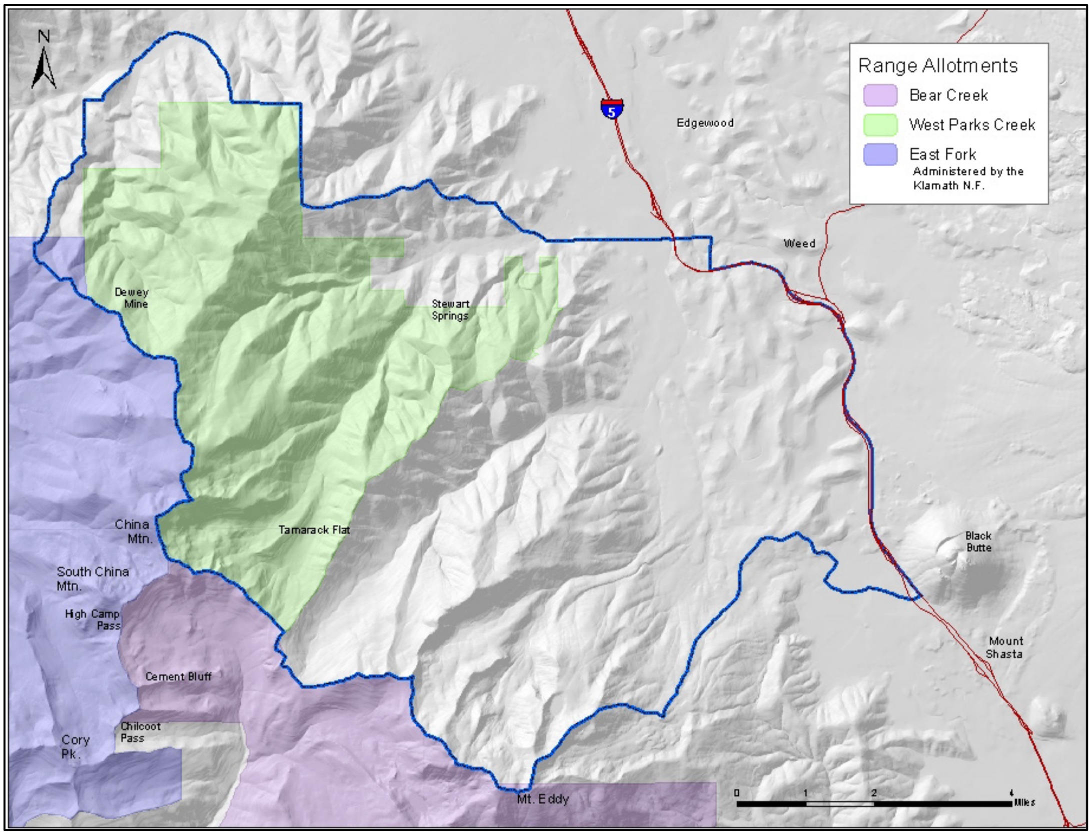
See the Species and Habitat Section – Botanical Species in Chapter 3 for more information on these species. Other species are listed by the California Native Plant Society in their “Inventory of Rare Plants of California” the online version.

Range Usage

The Willow-Parks watershed analysis area is contiguous with the currently vacant West Parks Creek and Eddy Creek grazing allotments. The West Parks Creek grazing allotment was last grazed in 1993 and the Eddy Creek grazing allotment was last grazed in 1997.

Range Conditions

The last rangeland condition sampling occurred in the 1990s. Evaluation of the vegetation composition data was based on the Parker 3-Step sampling protocol which was designed to measure forage quality. The conclusion reached was that rangeland condition was in fair to poor condition because the vegetation composition in meadows was predominately sedges and rushes rather than grasses. Current protocols used by the Forest Service analyze vegetation composition for ecological condition. Re-evaluation of the data from the early 1990s to assess ecological condition rather than rangeland condition suggests that the vegetation sampled at those points was in late-seral condition.



MAP 3-6: RANGE ALLOTMENTS.

Invasive Plants

There are limited, known populations of non-native invasive plants in the Willow-Parks watershed. This is likely due to a combination of unique soil characteristics that most non-native invasive plants are not adapted to, a limited road system and steep topography that limits the opportunity for introductions to occur. There is one inventoried occurrence on NFS lands of scotch broom (*Cytisus scoparius*) along the Parks Creek Road. There are also known occurrences on NFS lands of cheatgrass (*Bromus tectorum*), medusahead grass (*Taeniatherum caput-medusae*), and bull thistle (*Cirsium vulgare*). Given the characteristics of the landscape, only the occurrence of scotch broom is of great concern.

On private lands at lower elevations within the watershed, there are populations of dyer's woad (*Isatis tinctoria*), musk thistle (*Carduus nutans*), spotted knapweed (*Centaurea stoebe* ssp. *micranthos*), diffuse knapweed (*Centaurea diffusa*), and squarrose knapweed (*Centaurea squarrosa*). In some cases, these are large populations on private lands. They may not occur on the higher elevation NFS lands due to a lack of suitable habitat, a lack of appropriate vectors, or some combination of these two reasons.

Fire / Fuels

The watershed analysis area has experienced nearly 100 years of fire suppression. The result is a landscape greatly altered in structure and composition from historical conditions. The total area burned by fires has greatly reduced in the 20th century compared with pre-historic levels. The reduction in size and frequency of fires across the landscape has resulted in increased stand density, a shift from fire-tolerant to fire-intolerant species, and reduced structural diversity throughout the watershed analysis area. As a result, where surface fires were frequent and extensive and mostly low to moderate intensity, fires are currently either kept small or they escape initial attack and become large potentially high intensity fires. Severe wildfires have increased throughout the Klamath Range, especially in the low and mid elevation forests. As fire suppression continues, severe fires may escalate in less fire-prone, higher-elevation forests because of the increase in fuel loads and stand density (Taylor and Skinner, 1998)

Currently, all wildland fires within the watershed analysis area receive a full suppression response. Shasta-Trinity National Forest fire planning efforts are continuing to incorporate national fire management policies to manage fires under a full range of strategies.

Fuels

Table 3-3 displays the fuel models in terms of description, acres, and percentage of each category of fuels in the watershed analysis area. These fuels models are derived from the vegetation layer and can describe fire behavior based on weather, topography, and weather characteristics.

Fuel Model and Category	Description (Scott, Burgan 2005)	Percent within Analysis Area / Acres
Non-Burnable		
91 - NB1	Fuel model NB1 consists of land covered by urban and suburban development. These areas will not support wildland fire spread, but may experience structural fire losses during a wildland fire incident	0.5% / 256 acres
98 - NB 8	Land covered by open water such as rivers and lakes.	0.2% / 109 acres
99 - NB 9	Land devoid of enough fuel to support wildland fire spread. Such areas may include gravel pits, sand dunes, rock outcroppings, etc.	3.2% / 1512 acres
Grass		
101 – GR 1	The primary carrier of fire is sparse grass, though small amounts of fine dead fuel may be present. The grass is generally short, either naturally or by grazing, and may be sparse or discontinuous. The predicted spread rate and flame length are low.	0.2% / 79 acres

Fuel Model and Category	Description (Scott, Burgan 2005)	Percent within Analysis Area / Acres
102- GR 2	The primary carrier of fire in GR2 is grass, though small amounts of fine dead fuel may be present. Load is greater than GR1, and fuel bed may be more continuous. Shrubs, if present, do not affect fire behavior.	0.6% / 296 acres
107 – GR 7	The primary carrier of fire is continuous dry-climate grass. Grass is about 3 feet tall.	0.1% / 61 acres
Grass – Shrub		
121- GS 1	The primary carrier of fire is grass and shrubs combined. Shrubs are about 1 foot high, grass load is low. Spread rate is moderate; flame length low.	8.6% / 4030 acres
122 – GS 2	The primary carrier of fire is grass and shrubs combined. Shrubs are 1 to 3 feet high, grass load is moderate. Spread rate is high; flame length moderate.	8.2% / 3805 acres
Shrub		
141 – SH 1	The primary carrier of fire is woody shrubs and shrub litter. Low shrub fuel load, fuelbed depth about 1 foot; some grass may be present. Spread rate is very low; flame length very low.	5.4% / 2501 acres
142 – SH 2	The primary carrier of fire is woody shrubs and shrub litter. Moderate fuel load, depth about 1 foot, no grass fuel present. Spread rate is low; flame length low.	5.5% / 2586 acres
145 – SH 5	The primary carrier of fire is woody shrubs and shrub litter. Heavy shrub load, depth 4-6 feet. Spread rate very high; flame length very high.	4.3% / 1984 acres
147 – SH 7	The primary carrier of fire in SH7 is woody shrubs and shrub litter. Very heavy shrub load, depth 4 to 6 feet. Spread rate lower than SH7,but flame length similar. Spread rate is high; flame length very high.	1.5% / 679 acres
Timber Understory		
161 – TU 1	The primary carrier of fire is low load of grass and/or shrub with litter. Spread rate is low; flame length low.	8.2% / 3814 acres
165 – TU 5	The primary carrier of fire is heavy forest litter with a shrub or small tree understory. Spread rate is moderate; flame length moderate.	21.2%/ 9894 acres
Timber Litter		
182 – TL 2	The primary carrier of fire is broadleaf (hardwood) litter. Low load, compact broadleaf litter. Spread rate is very low; flame length very low.	4.4% / 2054 acres

Fuel Model and Category	Description (Scott, Burgan 2005)	Percent within Analysis Area / Acres
183 – TL 3	The primary carrier of fire is moderate load conifer litter, light load of coarse fuels. Spread rate is very low; flame length low.	2.5% / 1160 acres
184 – TL 4	The primary carrier of fire is moderate load of fine litter and coarse fuels. Includes small diameter downed logs. Spread rate is low; flame length low.	3.4% / 1600 acres
185 – TL 5	The primary carrier of fire is high load conifer litter; light slash or mortality fuel. Spread rate is low; flame length low.	2% / 910 acres
186 – TL 6	The primary carrier of fire is moderate load broadleaf litter, less compact than TL2. Spread rate is moderate; flame length low.	0.5% / 234 acres
188 – TL 8	The primary carrier of fire is moderate load long-needle pine litter, may include small amount of herbaceous load. Spread rate is moderate; flame length low.	12.3%/ 5715 acres
189 – TL 9	The primary carrier of fire is very high load, fluffy broadleaf litter. TL9 can also be used to represent heavy needle-drape. Spread rate is moderate; flame length moderate.	7.2% / 3334 acres

TABLE 3-3: FUEL MODELS FOUND WITHIN THE SHASTA RIVER WA AREA.

Fire Regime

Fire regime groups are utilized to describe historical frequency and severity under which fires burned. The classification is based on the role fire would play across a landscape in the absence of human intervention. The five class system was developed based on the average number of years between fires (fire frequency) in conjunction with severity (amount of replacement) of the fire on the dominant overstory vegetation (NWCG, n.d.). The five classes are as follows:

I – 0-35 year frequency and low (surface fires mostly) to mixed severity (less than 75% of the dominant vegetation replaced).

II – 0-35 year frequency and high (stand replacement) severity (greater than 75% of the dominant over-story vegetation replaced).

III – 35-100+ year frequency and mixed severity (less than 75% of the dominant over-story vegetation replaced).

IV – 35-100+ year frequency and high (stand replacement) severity (greater than 75% of the dominant over-story vegetation replaced).

V – 200+ year frequency and high (stand replacement) severity.

The fire regimes within the watershed analysis area, and the area that the regimes cover is represented in Table 3-4.

Fire Regime	Acres	Percent
Urban	5767	13
1	28,378	62
2	2015	4
3	5554	12
4	4398	9

TABLE 3-4. FIRE REGIMES WITHIN THE WILLOW-PARKS WA.

Fire Return Interval Departure (FRID)

Fire return interval departure is utilized to assess the amount of departure from the natural regime. This is calculated using the natural fire regime, and fire history records. Fire return interval departure is divided into three classes. The three classes are based on low (FRID 1), moderate (FRID 2), and high (FRID 3) departure from the natural (historic) fire regime (NWCG, n.d.).

Currently 65% of the watershed is classified as a high departure. These areas have missed several fire return intervals and the risk of losing key ecosystem components is high. Currently 11% of the watershed analysis area is at a moderate fire return interval departure. These areas have missed one or more return intervals and the risk of losing key ecosystem components is moderate while 10 % of the watershed analysis area displays a low fire return interval departure. These areas are within the natural range of fire occurrence and the risk of losing key ecosystem components is low. Within the watershed 1% of the area has seen fire return intervals more frequent than historical ranges and 13% of the watershed is urban.

Fire Hazard

For the watershed analysis, modeling results from 90th percentile weather conditions are reported. Fires under 90th percentile weather conditions have demonstrated significant fire behavior and large fire growth.

One of the primary measures utilized for assessing fire hazard or fire behavior is flame length. Flame length is an indicator of how hot or severe a fire can become. The hazard analysis provides an evaluation of where vegetation may be problematic in a wildfire situation. Flame lengths are categorized in the Fire Management Plan and Appendix B of the Fire Line Handbook as follows:

Low – Flame lengths 0 to 4 feet. Persons using hand tools can generally attack fires at the head or flanks of fires.

Moderate – Flame lengths 4 to 8 feet. Fires are too intense for direct attack on the head of the fire by persons using hand tools. Equipment such as dozers, engines and retardant aircraft can be effective.

High – Flame lengths greater than 8 feet. Fires may present serious control problems such as torching, crowning, and spotting. Control efforts at the head of the fire will probably be ineffective.

Flame Length	Acres	% total area
Low 0-4 feet	26,792	58
Moderate 4-8 feet	10,850	23
High >8 feet	8998	19
Total	**46640**	**100**

TABLE 3-5 FIRE BEHAVIOR POTENTIAL BASED ON FLAME LENGTHS UNDER 90TH PERCENTILE WEATHER WITHIN THE WILLOW-PARKS WA.

Fire Risk

Fire risk is defined in the Fire Management Plan as the probability of a fire start occurring over a 10-year period for a given 1000-acre area. Fire risk is based on the Shasta-Trinity National Forest GIS layers for fire occurrence records within the analysis area. The risk classification within the Fire Management Plan is as follows:

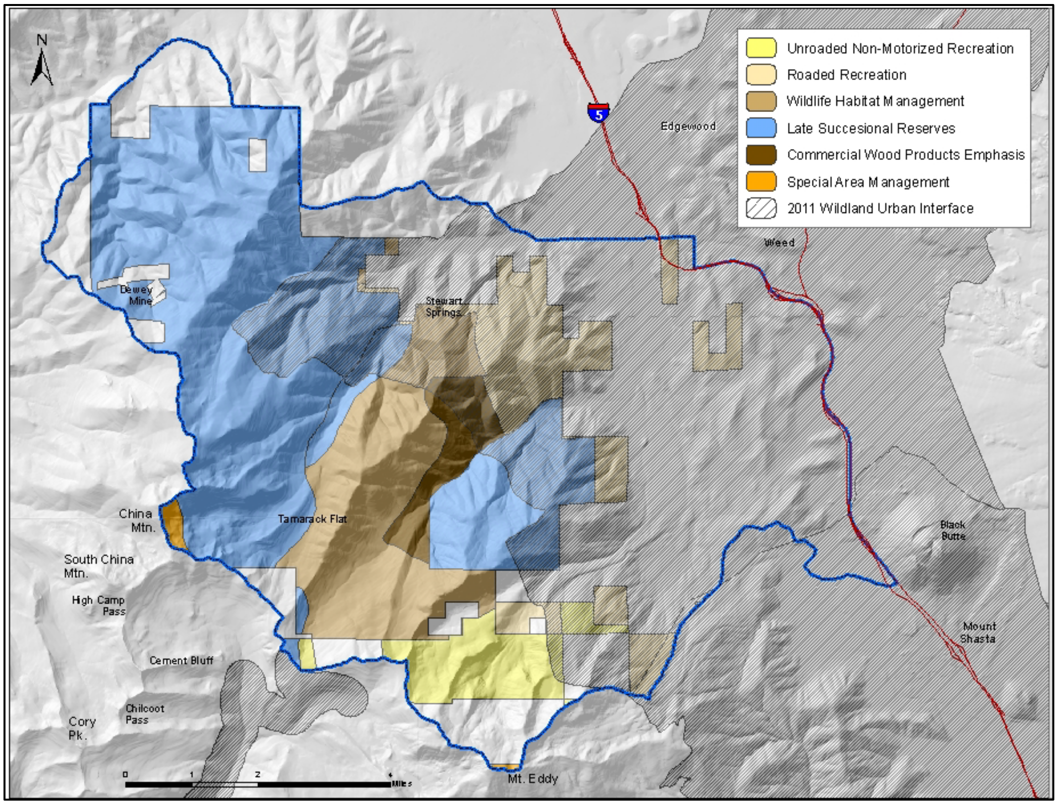
- Low Risk = Less than 0.5 fires expected to occur per decade for every 1000 acres being analyzed.
- Moderate Risk = Between 0.5 and 0.99 fires expected to occur per decade for every 1000 acres in the area being analyzed.
- High Risk = At least one fire expected to occur per decade for every 1000 acres in the area being analyzed.

The watershed analysis area currently has 97% of the area at low risk, 3% at moderate risk and none of the area is at a high risk rating.

Wildland Urban Interface (WUI)

Wildland urban interface (WUI) is an area where structures and other human development meet or intermingle with undeveloped wildland (National Fire Plan, 2000). Within the Willow-Parks Watershed Analysis area there are communities (Weed), powerlines, highways, communication towers, recreation facilities and other infrastructure. The WUI accounts for 22,840 acres or 49% of the NFS lands within the watershed analysis area.

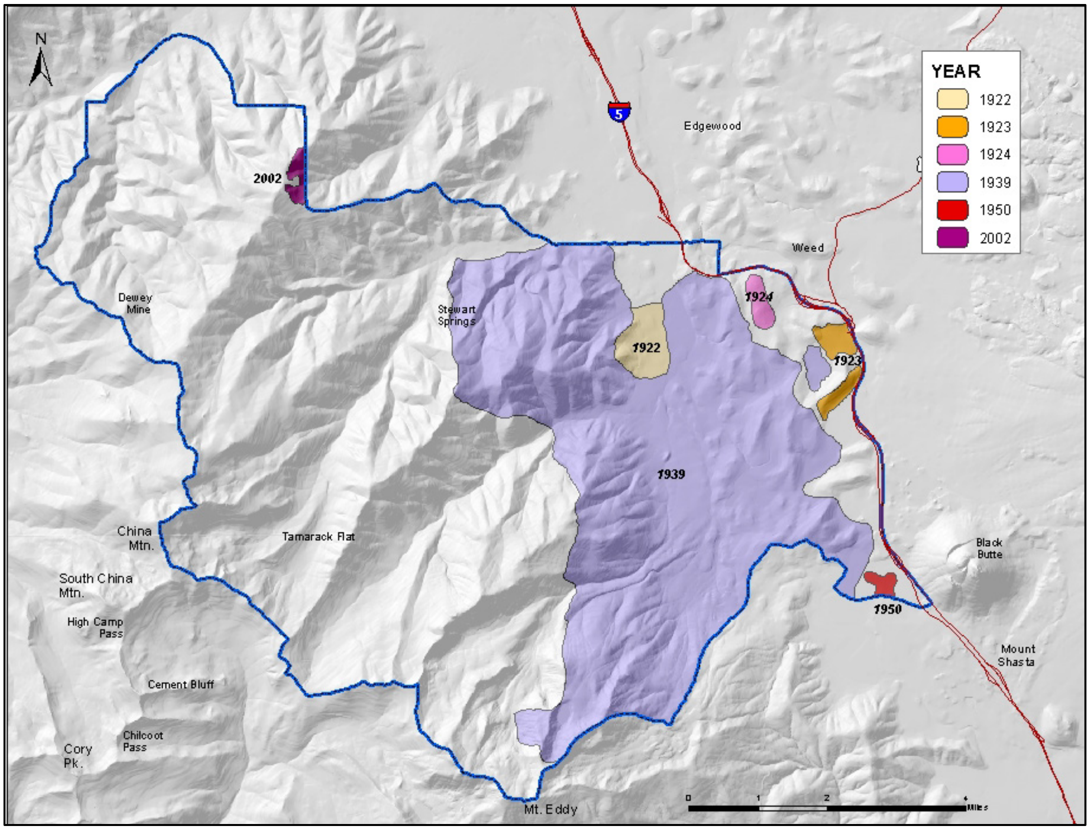
The Fire Management Plan outlines objectives for treatments within the WUI. The primary goal for these treatments is to establish an environment where firefighters can safely manage a wildfire while protecting infrastructure. See map 3-7 for the location of these areas within the analysis area.



MAP 3-7: WILLOW-PARKS WATERSHED MANAGEMENT PRESCRIPTIONS.

Wildfires

Since 1922, 30 fires have been recorded within the watershed analysis area. Additional fires may have occurred, as early fire tracking records are likely to be incomplete. The fires that we do have records for burned 19,434 acres within the watershed analysis area. The largest fire was a 14,625 acre lightning caused fire and occurred in 1939. Human starts account for 47% of the fires within the watershed analysis area, while lightning started 54% of the fires. The human starts are scattered throughout the watershed analysis area and are not concentrated near population centers as is the case in other watersheds.



MAP 3-8: WILLOW-PARKS WATERSHED LARGE FIRE HISTORY.

Multiple agencies respond to wildland fires within the analysis area. This includes staffed and volunteer fire departments as well as CalFire (California Department of Forestry and Fire Protection). CalFire has protection responsibility on national forest land for a portion of the analysis area. The Forest Service has direct suppression responsibility for a majority of the NFS Lands within the watershed and no responsibility for private property.

Species and Habitats

The Willow-Parks watershed contains habitat for one wildlife species listed as Federally Threatened, 12 Forest Service Sensitive Species, two game species of concern, and three fish species of interest (USDA Forest Service, 2007). These species and their status are listed in Table 3-6 and discussed in the following sections.

Wildlife Species of Concern	Status
Northern Spotted Owl	Federally Threatened
Northern Goshawk	Forest Service Sensitive
Willow Flycatcher	Forest Service Sensitive
Bald Eagle	Forest Service Sensitive
California Wolverine	Forest Service Sensitive
Pacific Fisher	Forest Service Sensitive
American Marten	Forest Service Sensitive

Wildlife Species of Concern	Status
Pallid Bat	Forest Service Sensitive
Townsend's Big Eared Bat	Forest Service Sensitive
Western Red Bat	Forest Service Sensitive
Northwestern Pond Turtle	Forest Service Sensitive
Cascades Frog	Forest Service Sensitive
Mule Deer	Game
Elk	Game
Fall Chinook	Fish Species of Interest
Coho Salmon	Fish Species of Interest
Fall and Winter Steelhead	Fish Species of Interest

TABLE 3-6: WILDLIFE SPECIES OF CONCERN WITHIN THE WILLOW-PARKS WATERSHED.

Federally Threatened Species

Northern Spotted Owl (NSO)

The northern spotted owl (*Strix occidentalis caurina*) is a medium-sized owl that inhabits conifer forests of the Pacific Northwest, including northwestern California (Forsman, 1984) and has been listed as a threatened species by the U.S. Fish and Wildlife Service (FWS).

Northern spotted owls are strongly associated with late-seral coniferous forests and suitable habitat for the species on the Shasta-Trinity is described as multi-layered, multi-species coniferous forest stands with >60 % total canopy cover for nesting/roosting, a minimum of 40 % canopy cover for foraging; large (>18"dbh) overstory trees, large amounts of down woody debris, and presence of trees with defects or other signs of decadence in the stand (USDI Fish and Wildlife Service, 2011).

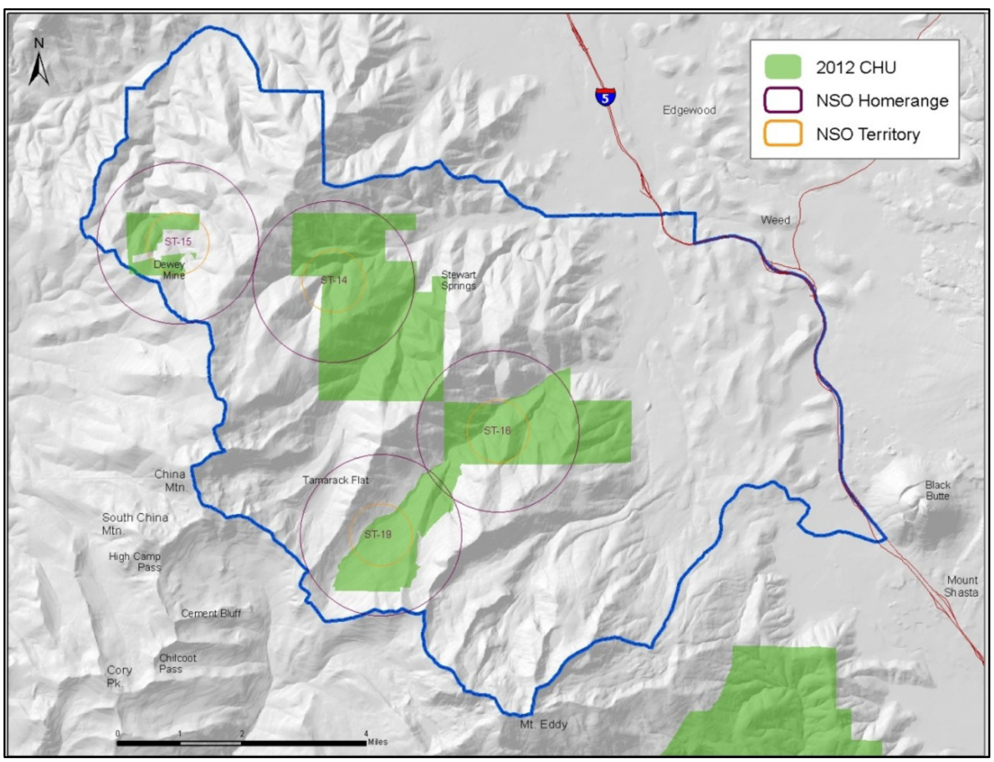
PHOTO 3-20: ADULT NORTHERN SPOTTED OWL FEEDING A JUVENILE SPOTTED OWL.

The Shasta-McCloud area is near the southern edge of the range for the NSO (*Strix occidentalis caurina*) and the northern boundary for the California spotted owl (*Strix occidentalis occidentalis*). This area was identified as an area of concern between the two species in the 1992 final rule for Critical Habitat (USDI Fish and Wildlife Service, 1992).

Suitable habitat is scattered throughout the watershed but does not exist in the grasslands and shrub lands in the northeastern portion of the watershed or in the high elevation white fir, red fir and alpine habitats. A majority of the habitat at lower elevations is not currently considered suitable NSO habitat due to the prevalence of homogeneous ponderosa pine stands that have limited species diversity, lack tree age classes which provide vertical structure, and tend to contain more open canopy within the stands. These areas may provide a dispersal function that links the two subspecies of owl. Currently there are four NSO activity centers in the western portion of the watershed (see Table 3-7 and Map 3-9 below).

NSO Activity Center ID	Year last visited	Last year owl was detected	Status in year last detected
ST – 014	2013	1990	Night Response
ST – 015	2013	1989	Nest, 1 Juvenile
ST – 016	2013	2013	Nesting pair, two fledglings
ST – 019	2013	2013	Single male

TABLE 3-7: NORTHERN SPOTTED OWL ACTIVITY CENTERS IN THE WILLOW-PARKS WATERSHED AS OF 2012.



MAP 3-9: NORTHERN SPOTTED OWL ACTIVITY CENTERS IN THE WILLOW-PARKS WATERSHED AS OF 2013.

Barred owls are recognized as a significant threat to the recovery of the NSO (USDI Fish and Wildlife Service, 2011). No barred owls have been detected within the watershed boundary (USDA Forest Service, 2012b).

Northern Spotted Owl Critical Habitat

Spotted owl habitat preference was identified in 1989 (USDI Fish and Wildlife Service, 1989) and critical habitat was originally proposed within the Federal Register on May 6, 1991 (56 FR 20816-21016) (USDI Fish and Wildlife Service, 1991). A Final Rule was published on January 15, 1992 (57 FR 1796-1838) (USDI Fish and Wildlife Service, 1992). This rule was superseded by a new rule published on August 13, 2008 which became effective on September 12, 2008 (USDI Fish and Wildlife Service, 2008). A portion of the watershed on NFS land occurs in NSO critical habitat unit 28 (Eastern Klamath Mountains) (USDI Fish and Wildlife Service, 2008). Following the 2008 rule, numerical subunits were designated to help locate areas on the ground. All of subunit 62 is within the Willow-Parks watershed area (USDI Fish and Wildlife Service, 2008). A new rule for NSO critical habitat was developed by the FWS and was final in November 2012.

The 2008 designation of critical habitat for the NSO (USDI Fish and Wildlife Service, 2008) addresses the primary constituent elements (PCEs) which are used to identify the known physical and biological features essential to the conservation of the NSO. The PCEs are summarized below.

1. “Forest types that support the northern spotted owl across its geographic range.” In the southern portion of its range, specifically in the watershed area, this includes mixed conifer and fir forests.

2. “Nesting, roosting, foraging habitat. Forest types described in the paragraph above that contain habitat types to meet the home range needs of territorial pairs of northern spotted owls throughout the year or that are habitat capable of developing one or more of these habitat types.”

> a. “Nesting habitat is essential to provide structural features for nesting, protection from adverse weather conditions, and cover to reduce predation risks. It includes moderate to high canopy closure (60-80%); a multilayered, multi species canopy with large (generally greater than 30 inches (in) (76 centimeter (cm) diameter at breast height (dbh) overstory trees; a high incidence of large trees with various deformities (e.g. large cavities, broken tops, mistletoe infections, and other platforms); large snags, large accumulations of fallen trees and other woody debris on the ground; and sufficient open space below the canopy for northern spotted owls to fly.”

> b. “Roosting habitat is essential to provide thermoregulation, shelter, and cover to reduce predation risk while resting or foraging. It differs from nesting habitat in that it need not contain those specific structural features used for nesting (such as cavities, broken tops, and mistletoe platforms), but does contain moderate to high canopy closure (60-80%); a multi-layered, multi-species canopy; large accumulations of fallen trees and other woody debris on the ground; and open space below the canopy for northern spotted owls to fly.” Nesting/roosting habitat within the watershed area is limited.

c. "Foraging habitat is essential to provide a food supply for survival and reproduction. It contains some roosting habitat attributes, but can consist of more open and fragmented forests or, especially in the southern portion of the range where some younger stands may have high prey abundance and structural attributes similar to those of older forests, such as moderate tree density, sub canopy perches at multiple levels, multilayered vegetation, or residential older trees." Much of the watershed that is in mixed conifer stands is described as foraging habitat.

d. Dispersal habitat is "essential to the dispersal of juvenile and non-territorial northern spotted owls." Furthermore, it is "essential to maintaining stable populations by filling territorial vacancies when resident spotted owls die or leave their territories; and to providing adequate gene flow across the range of the species." In the watershed area, dispersal habitat is typified as homogeneous ponderosa pine stands, young plantations, or forest stands of sparse canopy closure with little structure.

Northern spotted owl movement within the watershed is dependent on the suitability and capability of habitat. Non-capable habitat in the northeast portion of the watershed (the grasslands and brush fields along Interstate 5) and areas at the higher elevations (above 7,000 feet) are barriers to owl movement. Owls can and do disperse throughout the majority of the other areas within the watershed. Owl breeding areas are based on the quantity, quality and location of nesting, roosting, foraging, and dispersal habitat (USDI Fish and Wildlife Service, 2011).

Additionally, Interstate 5 and road 42N17 (Stewart Springs road) can be barriers to owl movement. Residential development and transmission lines within the watershed also can have significant impacts to owl movement.

Forest Service Sensitive Species

Northern Goshawk

The northern goshawk is a large forest raptor that occupies boreal and temperate forests throughout the Holarctic (Squires and Reynolds, 1997). Although goshawks nest in a variety of habitat types--from willow stands to massive old growth forests of the Pacific Northwest--they seem to prefer mature forests with large trees and open understories (Squires and Reynolds, 1997). Goshawks in northern California prefer mature and old-growth conifer forests that have relatively dense canopy closures, have usually little understory, and are in close proximity to riparian corridors (Zeiner et al., 1990). Openings may increase nest access, serve as travel corridors (Speiser and Bosakowski, 1987), support open country prey (Shuster, 1980) or reduce flight barriers to fledglings (Hall, 1993).

Random acoustic surveys using taped goshawk vocalizations in potentially suitable nesting habitat have not been conducted in the watershed but are recommended (USDA Forest Service, 2012a).

Willow Flycatcher

The willow flycatcher is a common migratory species that breeds in a variety of usually shrubby, often wet habitat from Maine to British Columbia and as far south as southern Arizona and California (Sedgwick, 2000). In general, the willow flycatcher prefers moist, shrubby areas, often with standing or running water; e.g., in California "strikingly restricted to thickets of willows, whether along streams in broad valleys, in canyon bottoms, around mountain side seepages, or at the margins of ponds and lakes" (Grinnell and Miller, 1944). Cottonwood clumps may also be important. Surveys for willow flycatchers have not been conducted in the watershed but are recommended.

Bald Eagle

The bald eagle is the only eagle unique to North America. On August 9, 2007 the U.S. Fish and Wildlife Service (FWS) removed the bald eagle from the threatened and endangered species list. The bald eagle is protected by the Migratory Bird Treaty Act and the Bald Eagle and Golden Eagle Protection Act (USDI Fish and Wildlife Service, 2010a). Bald eagles have been seen less than a mile south of the watershed, though formal surveys have not been conducted.

Pacific Fisher

The Pacific fisher is a forest carnivore that is the largest member of the genus *Martes.* Populations of fisher currently occur in the North Coast ranges of California and the Klamath-Siskiyou mountains of northern California (native fisher) and southern Oregon (reintroduced fisher). Additionally, surveys and sightings in California also place fisher throughout much of the Sierra Nevada range. The Klamath region population, which includes areas within the watershed, may be the largest population remaining in the western United States (Carroll, 1999). The Pacific fisher most often occurs between 2,000 - 5,000 feet in the Klamath Province.

Sightings of fisher have occurred in several areas of the watershed; however, additional surveys are recommended. A large portion of the watershed is within the altitudinal distribution of the Pacific fisher.

American Marten

There are two subspecies of American marten in California, *Martes americana humboldtensis* and *Martes americana sierrae* (Zielinski et al., 2001). Both subspecies are, for the most part, geographically distinct from one another. The exception is in Trinity and Siskiyou counties where their distributions potentially overlap (Zielinski et al., 2001). The American marten is associated with late-seral coniferous forest characterized by closed canopies, large trees, and abundant standing and downed woody material (Zielinski et al., 2001). Of particular importance is the quantity of downed debris on the forest floor as it provides protection from predators, access to the subnivean (under snow) environment for hunting and resting, and thermal protection from heat and cold (Ruggiero and Aubrey, 2004).

On the Shasta-Trinity National Forest, the American marten is associated with higher elevation (greater than 4,000 feet) late successional old growth true fir stands, and to a lesser extent, lower elevation coniferous forest similar to fisher habitat. Suitable habitat consists of various mixed conifer types with at least 40 percent crown canopy closure with large trees and snags. Small clearings, meadows, and riparian areas provide foraging habitat. Absence of roads is preferred. Suitable habitat is available within the watershed. The majority of the watershed at the higher elevations is within the altitudinal distribution of the American marten.

A large portion of the watershed exists within the altitudinal range of the marten. Surveys are recommended to determine presence, as there have been several reports of marten tracks within the watershed.

Wolverine

In California, wolverine once occurred throughout the Sierra Nevada, Cascades, Klamath, and northern Coast ranges in forests in alpine, boreal forest and mixed forest vegetation types (Schempf and White, 1977). Wolverines predominately use coniferous forest, but their significant use of non-forest alpine habitats distinguishes them from the fisher and marten (Banci, 1994). In north coastal areas, wolverines were observed in Douglas fir and mixed conifer habitats, and probably use red fir, lodgepole, wet meadow, and montane riparian habitats. Most sightings in this region range from 1600 to 4800 feet elevation, according to California Department of Fish and Game records from 2005.

Wolverines appear to select areas that are free from significant human disturbance, especially during the denning period from late winter through early spring. Deep snow is required for successful wolverine reproduction because female wolverines dig elaborate dens in the snow for their offspring (USDI Fish and Wildlife Service, 2010b). These den structures are thought to protect wolverine kits from predators as well as harsh alpine winters. Wolverines that occur in forested areas use dense forest cover for travel and resting, especially in the winter.

In California over the last 20 years, numerous surveys using remote cameras at several locations, including the Shasta-Trinity National Forest, have detected only one wolverine which was located on the Tahoe National Forest (Moriarty, 2008). There have been several wolverine sightings on the Shasta-Trinity National Forest but none have been confirmed.

Pallid Bat

There have not been any Forest Service bat surveys conducted within the Willow-Parks watershed. Pallid bat is a locally common, year-long resident of low elevations in California (Zeiner et al., 1990). It occurs throughout California except for the high elevation Sierra Nevada from Shasta to Kern counties, and the northwestern corner of the state from Del Norte and western Siskiyou counties to northern Mendocino County. It is most common in open, dry habitats with rocky areas for roosting, though a wide variety of habitats are used: grasslands, shrublands, woodlands, and forests.

PHOTO 3-21: PALLID BAT.

Townsend's Big-eared Bat

This species occurs in the western and southeastern United States and in southern British Columbia with isolated populations on the Southern Plains and southward to Mexico. It is found throughout California from low desert to mid elevation montane habitats (Zeiner et al., 1990). The roost sites for this species are cavernous sites associated with caves, mines, and buildings. It also roosts in hollow trees, bridges and in some instances bird boxes.

A Townsend's big-eared bat colony is known to exist in a cave located on the McCloud Ranger District east of the watershed.

Western Red Bat

Zeiner wrote that red bats are locally common in some areas of California; occurring from Shasta County to the Mexican border, west of the Sierra Nevada/Cascade crest and deserts (Zeiner et al., 1990). Red bat winter range includes western lowlands and coastal regions south of San Francisco Bay.

Northwestern Pond Turtle

The Northwestern pond turtle occurs in a variety of habitat types associated with permanent or nearly permanent water (Holland, 1991) and they are often concentrated in low flow regions of rivers and creeks, such as side channels and backwater areas. Habitat suitability is limited. Most of the watershed is above the elevation where pond turtles commonly occur. In addition, the general lack of aquatic habitats with permanent water within the watershed further limits the availability of pond turtle habitat. There have not been any Forest Service reptile surveys conducted in the watershed.

Cascades Frog

Cascades frogs inhabit high altitude ponds, lakes, and streams within open coniferous forest from Washington to northern California (Briggs, 1987). Suitable habitat occurs within the watershed, largely within high meadows; however no Forest Service amphibian surveys have been conducted within the Willow-Parks watershed. Incidental sightings have occurred in many of the high meadows within the watershed.

Fish Species of Interest

Anadromous Salmonids

Salmonids require clear, cold, flowing water with complex substrate on which they spawn. As anadromous fish, they also require an unobstructed path from the Pacific Ocean to return to the headwater streams that serve as nursery areas for juveniles. The Willow-Parks Watershed Analysis is within the range of three native salmonid populations: fall Chinook, coho salmon, and fall and winter steelhead trout. All three species inhabit the Shasta River and historically had the potential to utilize Parks, Eddy, Dale, and South Willow Creeks. Lower Parks Creek alone remains unobstructed to fish passage and juvenile steelhead have been known to rear there throughout the summer months (Chesney, 2005). Downstream efforts by the Nature Conservancy, CalTrout, and the California Department of Fish and Game seek to restore the upper Shasta River and its tributaries as spawning grounds for native salmonids.

Non-Migratory and Introduced Fish

The Shasta River hosts numerous populations of non-migratory native fishes, including a variety of sculpins and speckled dace. Introduced species include yellow perch, brown bullhead, bluegill, largemouth bass, mosquitofish, green sunfish, brook trout, and brown trout. No surveys for these species have been conducted in the Willow-Parks watershed, and habitat for most of these species is extremely limited or nonexistent. The high alpine lakes in the Willow-Parks Watershed were stocked with by California State Fish and Wildlife Department up until 1976. Currently there is no fish stocking inside the watershed boundary.

Game Species of Interest

Klamath Deer Herd

The Willow-Parks analysis area is within the Scott Valley sub-herd of the Klamath Deer Herd. It is also within the B-2 hunting zone. Deer movement within the watershed is dependent on terrain, location of water sources, and the quantity and quality of vegetation. High-elevation lakes and meadows are distributed throughout each drainage, but most of the watershed has limited availability of water and high-quality forage. Connectivity of these habitats and the ease of movement between them are limited by steep terrain.

Concern exists for resident and seasonal deer populations, including the loss of early-seral habitat, the loss of herbaceous and young shrub layer in the understory, and the loss of mast (e.g. acorns) producing hardwoods causing a reduction in an important food source for deer. The exclusion of fire has caused the habitat to shift from a mosaic of early-seral habitat, to mostly mid-seral habitat. This shift encroaches upon herbaceous openings as well as limits the amount of palatable browse. Fire exclusion has also allowed the understory of forested conifer and oak habitats in the eastern and southern portions of the watershed and shrubs in the northern portion of the watershed to mature, to be shaded out and to be replaced by shade tolerant species. Late summer forage important for resident deer is reduced with this change in vegetation. Surveys for deer are lacking within the watershed.

American Elk

Elk occur west of the Cascade crest, Sierra foothills, and coast range from Oregon to Baja California from sea level to approximately 7,000 feet, although they are rare over 4,800 feet. Elk concentrate in riparian timber edge habitats near meadows.

Similar to the deer herd, elk migrate from lower elevation areas near Shasta Lake into the watershed for summer range. Elk utilize areas within the watershed, though currently elk densities are relatively low. Elk herds in northern California have been increasing over the past few decades. Despite less than ideal habitat conditions, elk herds may continue to increase. Many of the factors limiting deer herds—primarily declining habitat quality due to exclusion of fire and vegetation management practices—are also limiting elk. Surveys for elk in the watershed are lacking.

Late Successional Reserve

There are two Late Successional Reserves (LSRs) on NFS lands within the Willow-Parks Watershed Analysis Area (USDA Forest Service, 1999) (See Map 3-7, Table 3-8 and 3-9). Please note that the acres, percentages and miles are for the entire LSRs and not broken down based on the watershed boundary.

Total Acres (Shasta-Trinity NF and Klamath NF)	25,638
Acres Capable of Supporting Late-successional Habitat	22,702
Acres Currently Supporting Late-successional Habitat	1,715
Acres of Early-Successional Habitat	1,243
Acres of Riparian Reserve	5,187
Suitable Owl Habitat as a Percent of Capable Owl Habitat	90%
Miles of Road	72.2
Road Density	2.1
Private Land	13,176

Table 3-8: Scott Mountain LSR (RC-340)

Total Acres (Shasta-Trinity NF)	2,723
Acres Capable of Supporting Late-successional Habitat	2,701
Acres Currently Supporting Late-successional Habitat	0
Acres of Early-Successional Habitat	184
Acres of Riparian Reserve	212
Suitable Owl Habitat as a Percent of Capable Owl Habitat	93%
Miles of Road	11.9
Road Density	2.8
Private Land	13

Table 3-9: Eddy LSR (RC-341)

Botanical species

There are no plants federally listed as Endangered or Threatened known to occur within the boundaries of the Shasta-Trinity National Forest. There are nine species listed as Sensitive by Region 5 known to occur inside and along boundaries of Willow-Parks Creek Watershed. Of the 23 special status plants occurring in the watershed, fourteen are associated with or generally found growing on serpentine soils. Most of these plants are at higher elevations and occur on ridge tops and mountain side slopes or they are found at mid to high elevations in wet meadows, springs and seeps and along streams. Three species are known to occur at mid to low elevations on the northern and eastern boundaries of the watershed. Nine species are endemic to Siskiyou and Trinity Counties. Endemic means they are not known to occur anywhere else. Five of these endemics are listed as Sensitive by Region 5 and 1 species is listed as Endangered by the State of California. Species listed by the California Native Plant Society in their "Inventory of Rare Plants of California" the online version (California Native Plant Society, 2012), but not listed by Region 5 as Sensitive or classified as an endemic, are considered watch list (NFMA) species. Information for the table below was also obtained from this site and the *Jepson Manual Vascular Plants of California, Second Edition* (2012). For management purposes, sensitive and endemic species are treated the same in that surveys are performed, populations are mapped and resource protection measures are put into place for known populations. Known watch list plants for a certain area are surveyed for and mapped. If a new watch list species is found during surveys, these are mapped and resource protection measures are put into place.

There is one known location for survey and manage fungi species *Nivatogastrium nubigenum* (NINU50). NINU50 is listed as Category B fungi by the *Settlement Agreement, Conservation Northwest v. Sherman, No. 08-1067-JCC* dated 07/-6/11. All known sites of Survey and Manage Category B species require protection from man-made disturbance. NINU50 is a false truffle that forms sequestrate sporocarps that develop and mature on the surface of rotten fir (*Abies)* logs. It is found in association with the roots of logs at high elevations (above 4,000 feet). This taxon is believed to be at high risk under the Northwest Forest Plan because of its rarity and dependent saprophytic association with old growth legacy, high elevation *Abies* species (Castellano and O'Dell, 1997). According to *Mushrooms Demystified, Second Edition* (Arora, 1986), *Nivatogastrium nubigenum* grows "solitary to gregarious or in small clusters on rotting conifers, often near melting snow or shortly after snow disappears; fairly common in the mountains of the west in the spring and early summer, especially on fir and lodgepole pine".

Botanical Species of Concern				
Name **Symbol** **State/Global Ranking**	**Listing** **R5 Sensitive (RS)** **CA Endangered (CE)** **Endemic (E)** **Watch List (WL)**	**Counties where endemic species occur**	**CNPS Rankings**	**Habitat**
Balsamorhiza lanata woolly balsamroot BALA8 S3/G3	E	Siskiyou (SIS) Trinity (TRI) Counties	1B.2	Rocky, volcanic. Cismontane woodland
Claytonia umbellata Great Basin claytonia CLUM S1.3/G5?	WL		2.3	Subalpine coniferous forest
Cypripedium montanum mountain lady's slipper CYMO2 S4.2/G4	RS		4.2	Habitat is variable
Darlingtonia californica California pitcherplant DACA5 S3.2/G3G4	WL		4.2	Mesic, generally serpentine seeps, bogs, fens and meadows
Draba aureola golden alpine draba DRAU2 S1.3/G4	WL		1B.2	Serpentine or volcanic. Alpine boulder and rock fields; subalpine coniferous forest.
Draba carnosula	RS	Del Norte	1B.3	Serpentinite, rocky. Subalpine

Botanical Species of Concern				
Name **Symbol** **State/Global Ranking**	**Listing** **R5 Sensitive (RS)** **CA Endangered (CE)** **Endemic (E)** **Watch List (WL)**	**Counties where endemic species occur**	**CNPS Rankings**	**Habitat**
Mt. Eddy draba DRCA6 S2.2/G2	E	(DNT) SIS, TRI		coniferous forest; upper montane coniferous forest.
Epilobium oreganum Oregon fireweed EPOR S2.2/G2	RS		1B.2	Mesic. Bogs and fens; lower montane coniferous forest; upper montane coniferous forest
Epilobium siskiyouense Siskiyou fireweed EPSI2 S2.2/G3	WL		1B.3	Rocky, serpentine. Alpine boulder and rock fields; Subalpine coniferous forest; upper montane coniferous forest,
Erigeron bloomeri var. nudatus Waldo daisy ERBLN S2?/G5T4	WL		2.3	Serpentine. Lower montane coniferous forest; upper montane coniferous forest.
Eriogonum alpinum Trinity buckwheat ERAL6 S3/G3	RS CE E	SIS, TRI	1B.2	Serpentine, rocky. Alpine boulder and rock fields; Subalpine coniferous forest; upper montane coniferous forest
Eriogonum siskiyouense Siskiyou buckwheat ERSI5 S3.3/G3	E	SIS, TRI	4.3	Serpentine, elevation between 5,200 and 9,184 feet.
Eriogonum umbellatum var. humistratum Mt. Eddy buckwheat ERUMH2 S3.3/G5T3	E	Shasta (SHA), SIS, TRI	4.3	Rocky, serpentine; alpine boulder and rock field, chaparral, meadows and seeps. Elevation 5,580 to 9,200 feet.
Galium serpenticum ssp. scotticum Scott mountain bedstraw GASES2 S2.2/G4G5T2	E	SIS, TRI	1B.2	Serpentine. Lower montane coniferous forest. Elevation 3,280 to 6,560 feet.
Hulsea nana little hulsea HUNA S2.3/G4	WL		2.3	Rocky or gravelly, volcanic. Alpine boulder and rock fields; Subalpine coniferous forest

Botanical Species of Concern				
Name **Symbol** **State/Global Ranking**	**Listing** **R5 Sensitive (RS)** **CA Endangered (CE)** **Endemic (E)** **Watch List (WL)**	**Counties where endemic species occur**	**CNPS Rankings**	**Habitat**
Hymenoxys lemmonii alkali hymenoxys HYLE S2/G3?	WL		2.2	Great Basin scrub, lower montane coniferous forest and meadow and seeps (subalkaline).
Ivesia pickeringii Pickering's ivesia IVPI S2.2/G2	RS E	SIS, TRI	1B.2	Mesic, clay, usually serpentine seeps. Lower montane coniferous forest and Meadows and seeps
Parnassia cirrata var. intermedia Cascade grass-of-Parnassus PAHII S2/G5T2T3	RS		2.2	Rocky, serpentinite. Bogs, fens, meadows and seeps.
Phacelia sericea var. ciliosa blue alpine phacelia PHSEC S1.3/G5T5	WL		2.3	Great Basin scrub. Upper montane coniferous forest (rocky)
Pinus albicaulus whitebark pine PIAL	RS Candidate for Federal listing			Upper red fir forest to timberline, especially subalpine. Alpine in shrub form (krumholtz)
*Polemonium chartaceum (eddyense)** POCH3? S1.3/G1?	RS		1B.3	Rocky, serpentinite, Alpine boulder and rock fields, subalpine coniferous forest
Potentilla cristae crested potentilla POCR6 S2.3/G2	E	SIS, TRI	1B.2	Seasonally mesic, often serpentinite seeps, gravelly rocky. Alpine boulder and rock field and subalpine coniferous forest
Raillardella pringlei showy raillardella RAPR S2.2/G2	RS E	SIS, TRI	1B.2	Mesic, serpentinite. Bogs, fens, meadows, seeps and upper montane coniferous forest
Sedum divergens Cascade stonecrop SEDI S1.3/G5?	WL		2.3	Alpine boulder and rock field

Botanical Species of Concern				
Name **Symbol** **State/Global Ranking**	**Listing** **R5 Sensitive (RS)** **CA Endangered (CE)** **Endemic (E)** **Watch List (WL)**	**Counties where endemic species occur**	**CNPS Rankings**	**Habitat**
Shepherdia canadensis Canadian buffalo-berry SHCA S1.2/G5	WL		2.1	Streamside, serpentine, rocky; Upper montane coniferous forest. Known to occur along Parks Creek Rd. (42N17) at approximately 5,600 feet.

TABLE 3-10: BOTANICAL SPECIES OF CONCERN WITHIN THE WILLOW-PARKS WATERSHED.

Studies have shown that populations of *Polemonium chartaceum* found on Mt. Eddy are different from plants found in the Sweetwater Mountains and White Mountain Peak (Inyo-White Mountains). It has been named *P. eddyense* (Stubbs and Patterson, 2013), but is waiting to be published so it can go through the peer review process.

Whitebark pine is being proposed as an addition to the Region 5 Sensitive Species List (2013).This species is also being proposed as a candidate for federal listing.

Definitions of Rare Plant Ranks (California Native Plant Society, 2012)

California Rare Plant Rank 1A: Plants Presumed Extinct in California
California Rare Plant Rank 1B: Plants Rare, Threatened or Endangered in California and Elsewhere
California Rare Plant Rank 2: Plants Rare, Threatened or Endangered in California, but More Common Elsewhere
California Rare Plant Rank 3: Plants About Which We Need More Information – A Review List
California Rare Plant Rank 4: Plants of Limited Distribution – A Watch List

Definitions of State Threat Ranks

- Seriously threatened in California (over 80% of occurrences threated/high degree and immediacy of threat)
- Fairly threatened in California (20-80% of occurrences threatened/ moderate degree and immediacy of threat)
- Not very threatened in California (<20% of occurrences threatened/ low degree and immediacy of threat or no current threats known)

Note: The above threat Rank guidelines only represent a starting point in the assessment of threat level. Other factors, such as habitat vulnerability and specificity, distribution and condition of occurrences are also considered in setting the Threat Rank.

Region 5 Sensitive Botanical Species

1. Mountain lady's slipper (*Cypripedium montanum*): there is one known population within the watershed boundary. It was discovered during a visit to the area on June 21, 2012. It was found growing on a road cut along the 42N42Y road near Dewey Mine. There are only three

populations known to occur on NFS lands within the boundary of the Shasta-McCloud Management Unit. The population is small; 2 adults and 7 young plants. The road cut didn't have much vascular vegetation, but a large portion of the soil was covered by foliose lichen (genus yet to be determined). The overstory was dominated by Douglas fir and ponderosa pine. Mountain lady's slipper is also a survey and manage species requiring pre-disturbance surveys. It was added to the Region 5 Sensitive List in 2006. This species is found in many different habitats including moist spots, dry slopes and mixed evergreen or conifer forest between 650 and 7,200 feet. It is threatened by logging, horticultural collecting and road maintenance. Since this population is found along a road, maintenance could be a major threat.

2. Mt. Eddy draba (*Draba carnosula*): Habitats include rocky serpentinite openings in subalpine and upper montane coniferous forest. Elevation ranges from 6,500 to 9,020 feet. There is one population within the watershed boundary and another just outside of the boundary (Mt. Eddy). The one within the watershed occurs near Little Crater Lake. It's not known what condition the population is in at this time. Since access to the population area is very limited, it is likely that the population is doing well.
3. Oregon fireweed (*Epilobium oreganum*): Habitats include bogs and fens, lower montane coniferous forest and upper montane coniferous forest. Elevation ranges from 1,800 to 5,900 feet. According to GIS layers showing Forest Service and California Natural Diversity Database (CNDDB) populations there are two (historical, 1914) populations of this species. One population is shown to occur in the southeast corner of the watershed on private land in the area of Kaiser Meadow. Voucher specimens from the Jepson Interchange put the population at Deetz Station near Black Butte. The other population is shown as occurring near the top of Mt. Eddy. These populations have not been confirmed in recent years. Kaiser Meadow has been used for livestock grazing since the area was settled. Grazing continues, but not on a yearly basis and the season is short (Cassidy, personal communication, 11-5-12).
4. Trinity Buckwheat (*Eriogonum alpinum*): This species is also listed as Endangered by the State of California. Habitats include rocky, serpentinite alpine boulder and rock fields, subalpine coniferous forest and upper montane coniferous forest. Elevation ranges from7,400 to 8,900 feet. There are four populations within the watershed boundary and three populations just outside of the boundary. There are populations known to occur near the Parks Creek Trailhead and the vicinity of the Mt. Eddy. Several are on private land and their condition is not known. It is known that recreation in the Mt. Eddy area is increasing. It is also known that off-road vehicles use the 6W02 trail creating damage to wetlands along upper Eddy Creek. Some hikers and vehicles may also be damaging habitat for Trinity Buckwheat which occurs just off of the Parks Creek Road slightly northeast of the Pacific Crest Trail and appears to be a barren rocky ridge top.
5. Pickering's ivesia (*Ivesia pickeringii*): According to the Jepson Exchange and database maps there are two populations within the watershed. One is approximately 1.0 air miles west of Stewart Springs and the other is up near the northwestern boundary of the watershed. It occupies mesic, clay meadows and seeps (usually serpentine) in lower montane coniferous. Elevation ranges from 2,600 to 4,900 feet. Any activity that changes the hydrology in meadows and seeps would cause damage to this species. User created trails may result in trampling by hikers as well as changes in hydrology. Dispersed camping could also damage plants and habitat. This population does not appear on the Forest Service or CNDDB mapping layers.
6. Cascade grass-of-Parnassus or fringed grass-of-Parnassus (*Parnassia cirrata* var. *intermedia*): There is one known population within the watershed in the vicinity of Caldwell Lakes. It was found in 2011. It occupies rocky, serpentine bogs, fens, meadows and seeps. Elevation ranges from 2,300 to 9,500 feet. This species was found growing in an area that was later classified as a

fen in 2011 by a fen mapping team from CNPS. Fens are threatened by any condition or activity that disturbs the hydrologic regime or soils temperature of a fen, causing drying or warming. Fens are rare in the watershed.

7. Whitebark pine (*Pinus albicaulus*): This species is found at upper red fir to timberline habitats, especially subalpine. It occurs in alpine habitats in a shrub form called "krumholtz". Elevation ranges from 6,560 to 12,130 feet. Threats to whitebark pine include logging and a warming climate. As temperatures increase insects and disease are moving up in elevation. This species is not listed by CNPS and does not occur in their online inventory of rare plants.
8. Mason's sky pilot (*Polemonium chartaceum*): This species is only known to occur on the upper slopes of Mt. Eddy. Habitat is alpine boulder and rock fields with serpentinite soils. Elevation ranges 8,520 to 9,025 feet. This species was renamed in 2013 to *P. eddyense* by Rebecca Stubbs as part of a study of Polemonium species for her master's thesis. Her work still needs to be peer reviewed so the name has not been formally changed as yet. When or if the name is changed*, P. eddyense* will only include those populations found in the Eddy Mountains. Threats to Mason's sky pilot are few. Some plants may be trampled by hikers going to the summit of Mt. Eddy and warmer temperatures may cause problems at some time in the future.
9. Showy raillardella (*Raillardella pringlei*): There are four know sites within the watershed. Three sites are on private lands just south of Tamarack Flat along the Parks Creek Road. The other site occurs on NFS land along the upper reaches of Eddy Creek and follows the stream for approximately 1.5 miles. Habitats include bogs, fens, wet meadows, stream banks and seeps on serpentine-derived soils, in conifer forest. Elevation ranges from 4,260 to 7,220. This population was not visited during the 2012 field season but was scheduled for a visit in 2013. Threats include changes to hydrologic functions from road building, creation of skid trails and off-road vehicle use. The 6W02 trail which was originally a road goes through the population as it follows the headwaters of Eddy Creek. Off-road use was noted on one field trip taken up the Eddy Creek Road. Where the road ends, there were vehicle tracks going through the meadow on the opposite side of the creek. When the tracks were followed, it was determined that someone had travelled from the upper reaches of the creek. See the Stream Channel Discussion in the Hydrology section for more information on this problem along with pictures. In the past, grazing was a big threat to raillardella populations. Greatly reducing or eliminating grazing has been shown to have a very positive effect on the number of plants and their vigor. Threats also come from trampling by hikers and dispersed camping.

Endemic Plant Species not listed as Sensitive by Region 5

1. Woolly balsamroot (*Balsamorhiza lanata*): There are four populations within the watershed boundary. Two occur on the eastern side of the watershed and two occur in the northwestern part of the watershed. Populations occur at lower elevations (2,260 to 3,440 feet). Soils are rocky and volcanic. Habitats are open woodlands and grassy slopes. Three populations occur on private lands. The one population on Forest Service land is in the upper northwestern corner of the watershed. All four populations are found growing along roads. Threats to these populations would come from road maintenance and building of new roads.
2. Siskiyou buckwheat (*Eriogonum siskiyouense*): There are two populations that are definitely within the watershed and several populations just outside the boundary in the Mount Eddy area. They occur in rocky areas at elevations between 5,248 and 9,184 feet. According to maps in the Jepson Exchange Consortium of California Herbaria, one population is just off of the Parks Creek Road and the other is on a rocky slope just east of Little Crater Lake. The population near the Parks Creek Road may be threatened by road maintenance. The Little Crater Lake population

has no real threats at the present time. However, surveys should be done in these habitats prior to road or trail construction.

3. Mt. Eddy buckwheat (*Eriogonum umbellatum var. humistratum*): There are three populations known to occur within the watershed and there are at least two just outside of the boundary in the Mount Eddy area. Habitats include rocky, serpentine sites that include alpine boulder and rock fields, chaparral and meadows and seeps at elevations between 5,580 to 9,200 feet. One occurrence is near the Parks Creek Trail Head and could be threatened by road and trail maintenance. Otherwise occurrences are in isolated areas where few people go. These isolated populations have few threats at the present time. However, surveys should be done in these habitats prior to road or trail construction.
4. Scott Mtn. bedstraw (*Galium serpenticum ssp. scotticum*): There is one known population of Scott Mountain bedstraw known to occur within the watershed boundary. It occurs along the northwestern boundary. Habitat for this species is steep slopes of open pine forests on serpentine soils between 3,280 and 6,560 feet. Since this population is associated with one or more roads, road maintenance may pose a threat to this species.
5. Crested potentilla (*Potentilla cristae*): There are two populations of crested potentilla in the watershed. One is in the vicinity of Dobkins Lake and the other is near the summit of Mount Eddy. This species is found in seasonally wet, serpentine and granitic seeps that are gravelly rocky, alpine boulder and rock fields and subalpine coniferous forest. Elevation ranges from 5,900 to 9,200 feet. The Mount Eddy population has no trails going into the area so human use is minimal. The Dobkins Lake population is on NFS lands. According to maps, it appears to be in the rocky slopes on the northwest side of the lake. This area is difficult to get to, but there is a small amount of public use. Since this plant grows in wet, rocky areas, the population is probably secure at this point.

Watch List Species

1. Great Basin claytonia (*Claytonia umbellata*): According to CNDDB, there is one population known to occur within the watershed. It is found on private land along the southwestern boundary approximately 1.0 miles east of the Parks Creek Trailhead. Habitat is talus slopes, stony flats and rock crevices at subalpine to alpine elevations (6,200 to 11,480 feet). There are no roads appearing on maps in the population area. Threats are probably limited to trampling from foot traffic. This area may see some use, but it would be light.
2. California pitcherplant (*Darlingtonia californica*): Wet to mesic, generally serpentine seeps, bogs, fens and meadows. This species is found in many of the wet areas within the watershed. Threats to these plants include any activities that alter the hydrologic function, trampling by people and livestock, off-road vehicle traffic and horticultural collecting.
3. *Draba aureola* (golden alpine draba): There are two populations of this species. Both are on the north slope of Mount Eddy. Habitat is alpine boulder and rock fields and subalpine coniferous forest. Soils can be serpentine or volcanic. Threats to this species are minimal.
4. Siskiyou fireweed (*Epilobium siskiyouense*): There are seven known populations within the watershed and two just outside the boundary on the south side of Mount Eddy. Habitat is scree slopes with moist edges and serpentine ridges at elevations between 5,600 and 8,200 feet. Plants are often found growing with other special status plants such as Trinity buckwheat, Mt. Eddy draba, golden alpine draba and Mt. Eddy buckwheat.
5. Waldo daisy (*Erigeron bloomeri var. nudatus*): There are two populations within the watershed and one just outside of the boundary. The two populations within the boundary are along the northern boundary and extend outside of the watershed. All populations are on private lands.

They are associated with soils derived from ultramafic parent material. Populations are associated with roads so threats to this species would come from road maintenance.

6. Little hulsea (*Hulsea nana*): There is one population at the summit of Mount Eddy. This is a high elevation plant that grows in talus. Generally it is found on volcanic talus and more common in the Cascades of California, Oregon and Washington. Elevation ranges from 7,900 to 9,800 feet. The summit of Mount Eddy is getting more and more visitors every year. Trampling and the creation of trails by hikers and others create the biggest threat to this species.
7. Alkali hymenoxys *(Hymenoxys lemmonii):* There is one population known to occur along the northern boundary of the watershed on private land. Habitats include roadsides, open areas, meadows, slopes, drainage areas and streambanks. More commonly associated with Great basin scrub with subalkaline soils. Elevations range from 2,600 to 10,500 feet. Populations generally occur in eastern California, Arizona, Idaho, Nevada, Oregon and Utah. This species is threatened by development and agriculture.
8. Blue alpine phacelia (*Phacelia sericea var. ciliosa*): There is one population known to occur on the ridge line of China Mountain (boundary between Klamath NF and Shasta-Trinity NF and the eastern boundary of the watershed). It is known from California only from the Warner Mountain and China Mountain. Usually associated with Great Basin scrub, ridges and talus slopes. Populations also occur in Arizona, Colorado, Idaho, Nevada, Oregon, Utah and Wyoming. Threats to the China Mountain population may come from trampling by hikers and backpackers hiking on trails from the Klamath National Forest.
9. Cascade stonecrop (*Sedum divergens*): There is one known population and it is just outside of the boundary on the Klamath National Forest in the vicinity of China Mountain and Crater Lake. Habitat includes gravelly, flat slopes between 5,200 and 6,600 feet. The only threats at this time come from trampling by hikers and backpackers.
10. Canadian or russet buffalo-berry (*Shepherdia canadensis*): According to the Consortium of Herbaria, there is only one population of this shrub in California. Of course there could be more they just haven’t been documented. This population occurs along Parks Creek Road at approximately 5,600 feet on NFS land within the watershed boundary. This plant is found from Newfoundland to Alaska, south to Maine, to western New York, Ohio and Northern Mexico. It occurs on dry to moist open woods and thickets, from lowlands to middle elevation forests. It prefers moist wet soil and is generally found on rocky, sandy or gravelly soils and is able to survive on nutrient poor soils because of its nitrogen fixing ability. This species prefers partial shade or partial sun to full sun (USDA NRCS, 2012). This population is not far from Parks Creek Road on the upslope side. Road maintenance or construction may be the biggest threat to this population.

Geomorphic Processes

Roads in the study watershed have interacted with geomorphic processes. Field reconnaissance for the Watershed Analysis revealed the following relationships:

1. Glacial Moraines- Glacial moraines exhibit a broad range of physical characteristics, depending primarily on their age. Some are deeply weathered into clayey soil, whereas others are only a few thousand years and are sandy, with little cohesion. Where road cuts expose the gravels, they are subject to wash and surface erosion, are very slow to re-vegetate, and shed rounded boulders down on to the road.

2. Road Fills Placed on Cemented Gravels- Slides have occurred in areas where fills have been placed on cemented glacial outwash or moraines, particularly along the lower part of the Parks Creek Road (42N17).

3. Road Fills Built of Sandy Soil Derived from Gabbro- Slides have occurred in areas underlain by pegmatitic gabbros (gabbro with large crystals). These soils are commonly coarse and sandy, and fills constructed from them are prone to sliding when they become saturated.

4. Dormant Landslide Deposits- One landslide examined in the field occurred in pre-existing dormant landslide deposits which had been mapped in the Forest Geomorphology layer. Many of these dormant slides developed in areas underlain by gabbro.

Detailed road inventories are available for the project area (USDA Forest Service, 2011). These inventories will provide the basic information needed for restoration planning. Four landslide sites were inspected by project geologists during field reconnaissance for the Watershed Analysis, and are described below. Repair designs and cost estimates for these sites should be developed jointly by engineering, geology, and hydrology personnel.

Slumping on Parks Creek Road (42N17)- There are a number of slumps developing in the fills along Road 42N17, particularly on the east facing slopes immediately north of Stewart Spring (Photos 3-22 and 3-23). These fills were placed on cemented glacial outwash gravel, and subsurface water is passing through the fills and saturating them. The problem can be effectively repaired with a good geotechnical design, such as a drained, mechanically stabilized, earthen structure.

PHOTO 3-22: PARKS CREEK ROAD 42N17- SETTLING OF FILL AND BUCKLING OF PAVEMENT NEAR STEWART SPRINGS.

PHOTO 3-23: PARKS CREEK ROAD 42N17- PERFORATED PIPE BELOW ROAD (EARLIER ATTEMPT AT DEALING WITH SUBSURFACE WATER) WHERE FILL IS SETTLING.

Landslide Below 41N16Y- There is a small fill failure on this road in NE ¼ Section 10 which is about 70 feet wide (Photo 3-24). The road was still drivable at this site in 2012, but the prism was only 12 feet wide. The slide looked about 20-years old based on vegetation, or around 1992.

PHOTO 3-24: FILL FAILURE ABOUT 20 YEARS OLD ALONG ROAD 41N16Y.

Landslide Above Road 41N16Y- A slide dumped debris on road 41N16Y forming a deposit 5-8 feet thick and about 100 feet wide. It is more than 7-years old based on vegetation and is in the NE ¼ Section 10. People have driven over the debris this year (2012), but it would be difficult to cross when wet. The actual landslide, a debris slide, is located between 41N16Y, and the "A" spur (41N16YA), and is about 30 feet wide, more than 150 feet long and on average about 7 feet deep (photos 3-25, 3-26, and 3-27).

PHOTO 3-25: LANDSLIDE RUBBLE ON ROAD 41N16Y.

PHOTO 3-26: LANDSLIDE ABOVE ROAD 41N16Y- VIEW UPHILL.

PHOTO 3-27: LANDSLIDE ABOVE ROAD 41N16Y- VIEW DOWNHILL, DEBRIS COVERS THE ROAD AT THE BOTTOM OF PHOTO.

Road 42N19- In the West Fork of Parks Creek, Road 42N19 traverses a long narrow earthflow with several switchbacks, making it very difficult to control surface runoff (Photo 3-29). The earthflow has many springs and wetlands (Photo 3-28), and some local active areas where the freshness of landforms indicates that earthflow movement may have occurred in the past 50-100 years. Air photo review indicates that the headwaters draining to this feature may have contained ice or glaciers as indicated by the presence of incipient cirques. The chronic gully issues on the road will be very difficult to fix, and there is a longer term risk of eventually having the concentrated water trigger a larger slide on the old dormant feature. Pursuing alternative access via alternate routes on private land may be the best option for addressing problems with Road 42N19. If segments of Road 42N19 are decommissioned, extreme care will have to be taken in restoring the original drainage, since the road was built as a through-cut in many segments, and currently functions as a canal during snowmelt.

PHOTO 3-28: SMALL WETLAND ON EARTHFLOW BELOW ROAD 42N19.

PHOTO 3-29: ROAD 42N19- MANY SWITCHBACKS MAKE IT DIFFICULT TO CONTROL ROAD RUNOFF.

Geologic Hazards at Developed Recreation Sites- In 2011, the Forest service conducted a reconnaissance level assessment of geologic hazards at developed recreations sites (USDA Forest

Service, 2011). Unfortunately, none of the sites in the project area met the criteria for developed sites, and consequently, none were evaluated at that time. Hazards which could affect recreationists and other visitors to in the study watershed include the following.

Landslides and Rock Fall- Landslides and rock fall could pose a hazard to roads and road users.

Naturally Occurring Asbestos- Vehicle traffic on unsurfaced roads in ultramafic rock under dry conditions can generate dust. This dust could contain naturally occurring asbestos, and as such would pose a hazard to humans. Potential for this hazard also exists in areas underlain by glacial moraines developed from ultramafic rock.

Snow Avalanche- Snow avalanche tracks have been identified on air photos in parts of the project area, and could pose a hazard to snow recreationists.

Soils

The watershed is dominated by soils derived from ultramafic parent materials which are strongly influenced by topography. Soils derived from serpentine and peridotite (ultramafic) parent materials support unique botanical communities due to a shift in the ratio of calcium and magnesium. A smaller portion of the watershed's (about 25%) soils are volcanic in nature and reflect their position on the lower slopes of Mt. Shasta. These soils occur mostly on private land. Erosion potential for soils in the watershed is moderate to high, particularly in the frigid and mesic temperature regimes due to their position on steep mountain sideslopes.

Soils in the highest elevations of the watershed are weakly developed (Entisols and Inceptisols) and in the cryic temperature regime. Due to the harsh temperatures, these soils develop slowly and exhibit poor site conditions with a high component of semi-barren land and rock outcrop. Forested sites are dominated by subalpine conifer species.

Soils in the frigid temperature regime (5000' to 7000' elevation) are generally more developed and have a subsurface accumulation of clay (Alfisols). These ultramafic soils support stands of white fir and ultramafic mixed conifer but productivity is still low and re-establishment of vegetation after disturbance is slow. Skid trails are readily visible decades after logging.

The lowest elevations in the watershed (below 5000') that are on federal land are dominated by soils with dark surface horizons (Mollisols) and are in the mesic temperature regime. They are more developed than soils at higher elevations, and have subsurface clay accumulation and support stands of ponderosa pine and mixed conifer. However, site class for these soils remains low and re-vegetation is slow.

Many of the drainages in the watershed have a network of wet meadows and fens. These are often mapped as Aquolls indicating their aquic moisture regime (saturated conditions for at least a few days). These soils also support a unique botanical community and are highly susceptible to damage from vehicular traffic. Several meadows visited within the watershed show evidence of recent OHV traffic and occasional passenger vehicle traffic. It's not known how widespread the problem is.

Hydrology

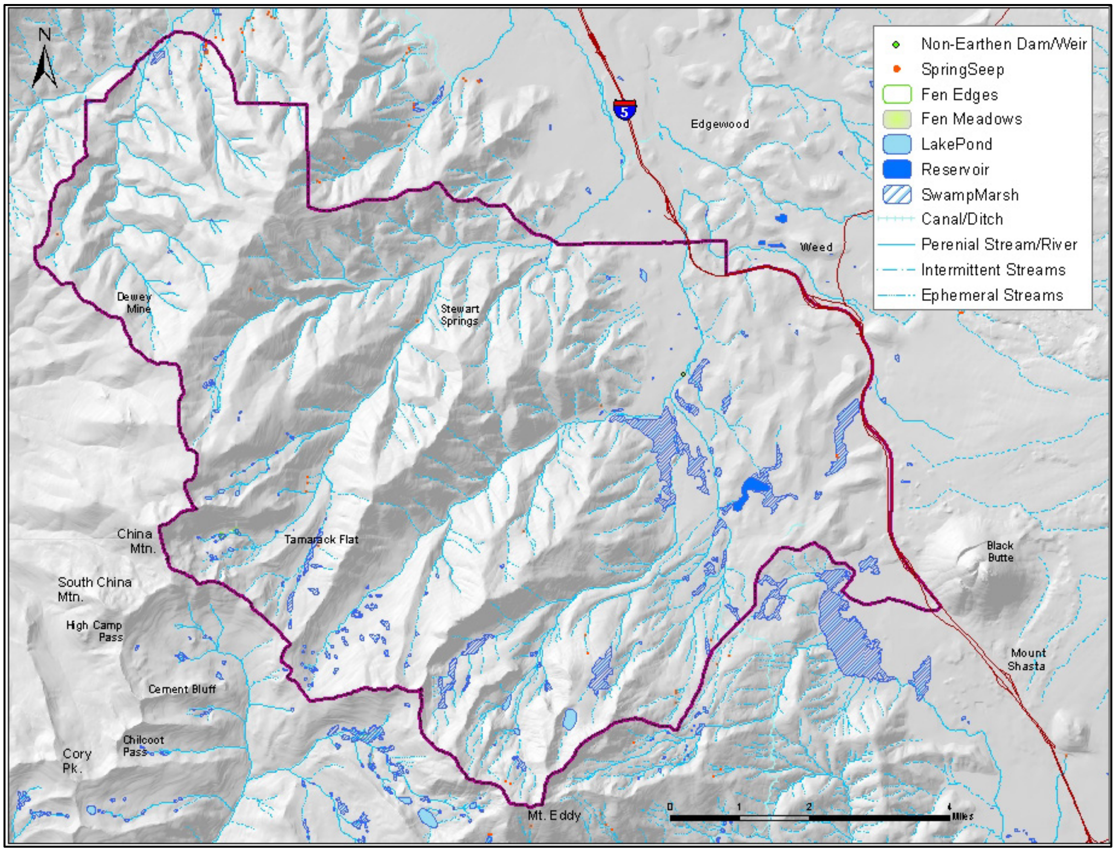
The Willow-Parks watershed comprises the headwaters of the Shasta River which includes the Shasta River, Parks, Eddy and Dale Creeks, and the South Fork of Willow Creek. The Shasta River drains an area of 795 square miles and is one of the larger tributaries to the Klamath River. The river is about 58 miles long. The Willow-Parks Watershed does not include the portion of the Shasta River headwater area that drains Mount Shasta in the eastern Cascade geologic province. The latter area was analyzed in the Mount Shasta Watershed Analysis and is hydrologically different from the Willow-Parks Watershed in that it is mostly devoid of stream channels.

The Willow-Parks watershed analysis area is not a true watershed with respect to analysis area boundaries. The lower portion of the watershed on the Shasta Valley floor takes in the extent of public lands but does not extend into areas of the Shasta Valley that are composed exclusively of private lands. The drainage area of the watershed analysis planning area is 72 square miles.

The headwaters of the Shasta River originate in the southeastern portion of the watershed below Mount Eddy. The primary tributary drainages include the South Fork of Willow Creek, Parks Creek, Eddy Creek, Dale Creek and the upper Shasta River. The tributaries to the Shasta River drain mountainous terrane that is primarily vegetated by mixed-conifer forests. Elevations in the watershed range from a high of 9,025 feet above sea level on the summit of Mount Eddy to just over 3,000 feet on the valley floor. Other high points in the watershed include China Mountain (8,551 feet), and Park Mountain (6,887 feet). Table 3-11 displays physical characteristics for each tributary drainage.

The Shasta River flows northward for a distance of approximately 12 miles before entering Lake Shastina (Dwinnell Reservoir). Dwinnel Reservoir was constructed to provide water for agricultural interests but also has played a role in reducing flood in the lower Shasta River Valley. Upon exiting Dwinnell Reservoir the Shasta River flows to the northwest past Montague and Yreka before entering a canyon and flowing into the Klamath River. Annual flood peaks in the Shasta River have rarely exceeded 4,000 cfs since 1934 when data collection began below the reservoir.

The Shasta River and its tributaries exhibit a dendritic drainage pattern typical of most watersheds in the Klamath Mountains. The drainage density of the watershed analysis area is approximately 3.1 miles of stream channel per square mile. Drainage densities increase in a southward orientation due to increased annual precipitation (Map 3-10: Hydrolic Features). The watershed contains approximately 86 miles of perennial streams and 110 miles of intermittent and ephemeral streams. Ephemeral streams differ from intermittent streams in that they flow only in response to high intensity precipitation events or rapid snowmelt. The watershed also contains approximately 1,066 acres of lakes, swamp/marsh, fens and reservoirs (Map 3-11: Riparian Reserves).



MAP 3-10: HYDROLOGIC FEATURES IN THE WILLOW-PARKS WATERSHED.

Drainage	Drainage Area (mi^2)	Drainage Density (mi/mi^2)	Main Tributary Length (miles)	Description
South Fork Willow Creek	7.5	2.73	4.6	Tributary to Willow Creek. No public access.
Upper Parks Creek	23.9	2.77	9.5	Includes Upper, West Fork and Middle Parks Creek above Dwinnell Reservoir diversion. Tributary to Shasta River below Dwinnell Reservoir.
Eddy Creek	11.8	2.69	7.3	Tributary to Shasta River.
Dale Creek	8.6	3.91	6.6	Includes Durney, Dobkins and Little Crater Lakes. Tributary to Shasta River.
Shasta River Headwaters	6.9	4.44	5.1	Headwaters of the Shasta River extending down to Dale Creek confluence. Receives water diverted from North Fork of Sacramento River (Hammond Ditch)

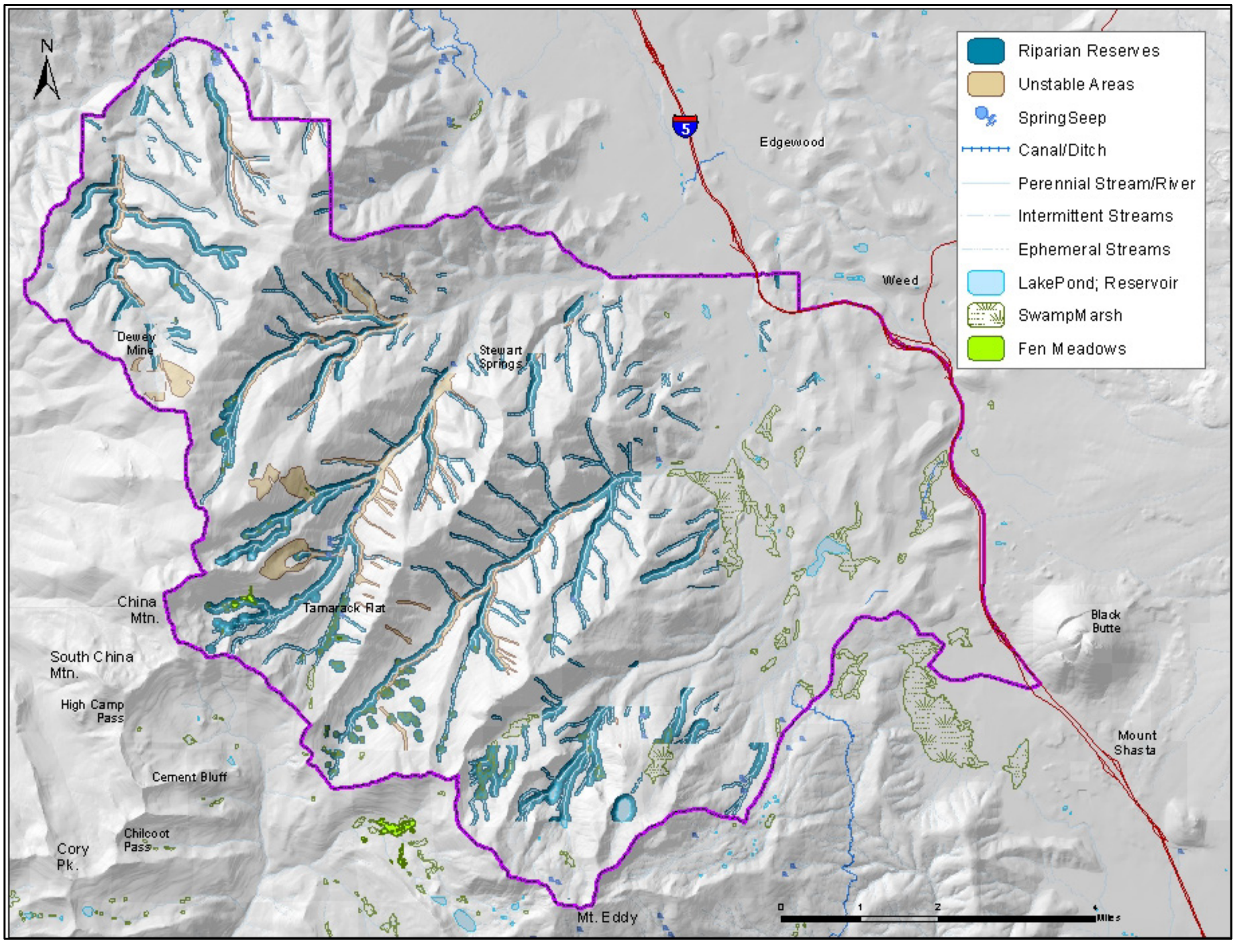
TABLE 3-11: DRAINAGE CHARACTERISTICS FOR PRINCIPLE TRIBUTARIES TO SHASTA RIVER IN THE WILLOW-PARKS WATERSHED.

The Shasta River and its tributaries originate in the vicinity of Mount Eddy in the Klamath Mountains. These streams are primarily fed by winter rainfall and spring snowmelt. Low baseflows are sustained by springs and seeps in most of the tributary drainages during the summer and fall. Streamflow in the headwater reaches of the watershed is mostly unimpacted by reservoirs or diversions but this is not the case on the valley floor where the hydrologic routing of flow becomes more complex. Numerous diversions occur on all tributaries on the valley and streamflow diminishes rapidly in all tributaries during the summer months. In addition to these diversions, streamflow from the North Fork of the Sacramento River is diverted into the Willow-Parks Watershed via the Hammond Ditch. Runoff from the Shasta River, Dale and Eddy Creeks flows into Dwinnell Reservoir. From October through mid-June up to 14,000 acre-feet of water from Parks Creek is diverted into the Shasta River above Dwinnell Reservoir under a water right owned by the Montague Water Conservation District. The Parks Creek channel continues below this diversion for a distance of about 12.5 miles below flowing into the Shasta River below Dwinnell Reservoir. The South Fork of Willow Creek is a perennial fish-bearing stream however once it reaches the valley floor the streamflow is rapidly depleted and the channel is usually dry by early summer.

Riparian Reserves

Hydrologic features and their associated aquatic and riparian habitats are managed according to direction for Riparian Reserves and the Aquatic Conservation Strategy as described in the Shasta-Trinity Forest Plan. Riparian Reserves are applied along all perennial and intermittent streams and along all ephemeral channels that exhibit annual scour. Mapped hydrologic features such as reservoirs, springs, seeps and wetlands are also within Riparian Reserves. Unstable or potentially unstable areas are also included within Riparian Reserves (USDA Forest Service, 1995). Riparian Reserves are intended to provide special protection to areas, where changes likely to occur in the absence of that protection would significantly affect on-site or downstream aquatic and riparian values (ROD, 1994).

Riparian Reserves in the Willow-Watershed account for approximately 22 percent of public lands (Map 3-11: Riparian Reserves). The majority of the Riparian Reserve acreage is composed of stream channels. Riparian Reserves associated with stream channels, springs, lakes and wet meadows account for 73 percent of the Riparian Reserve acreage and Riparian Reserves associated with unstable or potentially unstable areas account for approximately 27 percent of Riparian Reserve acreage.



MAP 3-11: RIPARIAN RESERVES IN THE WILLOW-PARKS WATERSHED.

Base and Peak Flows

The hydrology of the Willow-Parks Watershed is very complex owing to the many water diversions and withdrawals that occur in the lower portions of the watershed as well as natural variability created by variations in precipitation and drainage characteristics. Annual precipitation in the watershed varies with elevation and can range from anywhere between 10 to 55 inches with the majority of precipitation occurring between November and April. The headwaters of Dale, Eddy and Parks Creeks receive over 50 inches of annual precipitation but this annual average drops to less than 10 inches on parts of the valley floor near Gazelle, California. High intensity, long duration storms are common during the winter months and the watershed is occassionally subjet to intense thunderstorms in the summer months (USDA Forest Service, 2011).

Runoff from the Willow-Parks Watershed is predominantly surface flow, whereas streams that drain the eastern headwaters of the Shasta River off Mount Shasta are predominantly spring fed. Runoff in streams draining the Willow-Parks Watershed is flashier and seasonally driven as opposed to runoff from springfed streams (e.g. Boles, Beaughton and Carrick Creeks) which tends to be less variable and can provide stable baseflows to the Shasta River even during dry years (CDFG, 2009).

The Shasta River itself is regulated and the current flow regime is very different from the historic, unimpaired flow regime; the primary difference being that less water is available to the river in the summer months below Dwinnel Reservoir. Table 3-12 shows the mean flows for the Shasta River near Yreka for the entire period of record (all regulated).

Station Name	Station Number	Area (sq. miles)	Period of Record
Shasta River near Yreka, CA	11517500	793	1933-41 and 1944-2011

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
151	194	278	336	334	311	202	141	102	45	39	73

Table 3-12: Mean Discharge - Impaired (cfs) for Shasta River near Yreka, CA.

Very little streamflow data are available for tributaries to the Shasta River in Willow-Parks Watershed. Summer baseflows are generally very low (e.g. less than 15 cfs) while winter base flows can be flashy and considerably higher.

Estimates of instantaneous peak streamflows for 2, 5, 10, 25, 50 and 100 year recurrence intervals were calculated for selected tributaries in the Willow-Parks Watershed and the Shasta River according to Waananen and Crippen, 1977 (Table 3-13). Because precipitation amounts vary spatially within drainages runoff estimates are approximate, however the estimates do provide some context for peak flow potential for tributaries in the watershed.

Drainage	Area (mi^2)	Recurrence Intervals (in years)					
		Q2	Q5	Q10	Q25	Q50	Q100
South Fork Willow Creek at conlfuence with Willow Creek.	7.5	309	557	815	1,181	1,628	2,046
Upper Parks Creek near Dwinnell Diversion	23.9	789	1,419	2,063	2,978	4,134	5,229
Eddy Creek at Shasta River Confluence	11.8	455	830	1,223	1,788	2,497	3,172
Dale Creek at Shasta River Confluence	8.6	313	576	855	1,260	1,766	2,253
Shasta River at Dale Creek Confluence	6.9	232	425	629	926	1,293	1,645
Shasta River upstream from confluence of Parks Creek Diversion*	**	-	-	3,700	-	8,000	9,700

Table 3-13: Predicted peak flows for selected streams in Willow-Parks Watershed and vicinity (cubic feet per second)(Based on Waananen and Crippen, 1977). *Data from FEMA Flood Insurance Study, 2011. **Drainage area not calculated but assumed to include Shasta River, Dale and Eddy Creek contributions.

Stream Channels

The current morphologies of stream channels in the Willow-Parks Watershed are a consequence of hillslope erosion and fluvial processes which have been shaping and maintaining channel form for thousands of years. Stream channels, lakes and meadows have evolved within a landscape formed by mulitple glacial periods. Hillslope processes including landslides and debris flows often serve as catalysts for changes in channel morphologies while more frequent bankfull flow events are responsible for maintaining existing channel morphologies.

Channels in the watershed can be partitioned into three distinct regions: 1) Headwater Channels, 2) Midslope Channels and 3) Valley Channels. Above the valley floor the Shasta River and its principle tributaries exhibit similar physical characteristics due to similarities in climatic conditions and the geologic parent materials in which they formed. Headwater reaches of all tributaries were glaciated and exhibit remnant glacial features from the last glaciation as well as lakes and wet meadows.

Headwater Channels: This channel type is commonly associated with terrain created during the last glacial period about 10-12,000 years ago. Headwater channels can include both low gradient response reaches and steep transport reaches. Transport reaches include most of the small headwater channels at the higher elevations in the watershed. Headwater channels are either tributary to larger transport channels or small response reaches. Response reaches are characterized by having low gradients and are commonly associated with wet meadows, fens and springs, although wet areas can also occur on hillslopes. Examples of headwater response reaches includes the Tamarack Flat creek (tributary to Parks Creek) and meadow systems associated with low gradient reaches of upper Eddy and Dale Creeks. Many smaller wet meadows, fens and springs also contain response reaches although at a smaller scale than the aforementioned creeks.

Midslope Channels: At the mid-elevations in the watershed channel gradients steepen and watershed contributing area increases. Most streams in this zone are characterized as high gradient, transport reaches, with step-pool or cascade channel types. Transport reaches comprise the dominant channel type found on public lands within the watershed. They include steep headwater reaches as well as the steeper reaches of Parks, Eddy, Dale, and the South Fork of Willow Creeks. Channel gradients decrease dramatically once the channels enter the upper Shasta River Valley.

PHOTO 3-30: LOW GRADIENT, RESPONSE HEADWATER CHANNEL (TAMARACK FLAT), 2008.

PHOTO 3-31: WEST FORK PARKS CREEK - MIDSLOPE TRANSPORT CHANNEL, 2012.

Valley Channels: Channel morphologies on the valley floor have evolved following an enormous debris avalanche on Mount Shasta that occurred about 300-380,000 years ago and buried much of the ancestral Shasta River Valley. The avalanche deposit covers an area of 260 square miles and has served as the primary control of drainage network development on the valley floor (CDFG, 2009). Stream channels in the lower 1/3 of the analysis area have been significantly altered by historic and current land-use practices. Land-use activities that have affected channel conditions include development (roads and other infrastructure, beaver trapping, mining, water diversions, dams and impoundments, grazing, agriculture and restoration activities.

Water Quality

Water quality in the Willow-Parks Watershed is regulated by the Clean Water Act. The quality of water in the Shasta River and it's tributaries is generally very good on public lands in the upper elevations of the watershed. Most of the streamflow generated in the analysis area results from spring snowmelt. Summer base flows provide cool water to support aquatic and riparian habitats. The quality of water generally declines once the runoff reaches the valley floor. Downstream of the watershed analysis area cold water beneficial uses have been affected by dams, diversions, agriculture uses.
Shasta River was added to California's 303(d) impaired waters list in 1992 because of water quality issues associated with organic enrichment and low dissolved oxygen. In 1994 the river was also listed for elevated temperature. Elevated temperature and low dissolved oxygen levels have impaired beneficial uses of water and resulted in non-attainment of water quality objectives. The primary affected beneficial use is the cold water salmonid fishery. Low dissolved oxygen levels and high water temperatures have also been identified as factors that are contributing to the decline of the coho salmon population and other salmonids in the river (CRWQCB, 2006).

Some Total Maximum Daily Load (TMDL) implementation actions for addressing dissolved oxygen and water temperature impairment have implications for Forest Service management activities in the Willow-Parks Watershed. Implementation actions applicable to the Forest Service include the following.

- **Range and Riparian Land Management:** Landowners should employ land stewardship practices and actvivities that minimize, control, and preferably prevent discharges of fine sediment, nutrients and other oxygen consuming materials from affecting waters of the Shasta River and tributaries. Landowners should also employ land stewarship practices and activities that minimize, control, and preferably prevent elevated solar radiation loads from affecting waters of the Shasta River and its Class I and II tributaries.
- **Lake Shastina:** The Forest Service was named as one of the responsible parties for improving water quality in Lake Shastina. The responsible parties shall complete a study of water quality conditions and factors affecting water quality conditions in Lake Shastina and develop a plan for addressing factors affecting water quality conditions to bring Lake Shastina into compliance with water quality standards, the TMDLs, and NPS (Nonpoint Source) Policy. The plan should be implemented within 5 years of EPA approval.
- **Activities on NFS Lands:** The USFS should consistently implement the best management practices for timber harvest activities, grazing and other activities included in the Shasta-Trinity Forest Plan (USFS, 1995) and Water Quality Management for Forest System Lands in California, Best Management Practices (USFS, 2000).

The Shasta River TMDL information represents a partial summary of TMDL implementation actions. Refer to Resolution No. R1-2006-0052 for more information on the TMDL and a complete description of TMDL implementation actions (CRWQCB, 2006).

Land-Use Activity Effects to Hydrology, Stream Channels and Waters Quality

Past and present land use activities have influenced hydrology, stream channels and water quality in the watershed. In general most of the impacts are legacy in nature and overall land-use appears to have declined in recent decades.

Surface and groundwater hydrology within the watershed has been altered by roads, diversions and impoundments. Roads have the greatest influence on surface and groundwater flow in the upper elevations of the watershed while impoundments and diversions play a larger role in altering surface flow in the lower watershed. Refer to the roads and channel effects discussion for more information on how roads impacts surface and subsurface flows.

The Willow-Parks Watershed receives a small amount of imported water (about 2,000 acre-feet per year) from the North Fork Sacramento River through a canal called the North Fork Ditch (also Hammond Ditch). The North Fork Ditch begins at a diversion upstream from Lake Siskiyou on the North Fork of the Sacramento River and ends at Dwight Hammond Reservoir about 2.5 miles southwest of Weed. The water is used for irrigation purposes (DWR, 2009). While most impoundments are located in the lower watershed some lakes in the upper watershed have also been augmented by small impoundments (Photo 3-32 and 3-33).


PHOTO 3-32 AND 3-33: UPPER CALDWELL LAKE AND CONSTRUCTED ROCK DAM (2012).

Stream channels and other aquatic and riparian habitats in the Willow-Parks Watershed have been affected to various degrees by land-use activities. Timber harvest, road construction, grazing, recreation and channel restoration activities all have resulted in changes to channel condition. The scope and extent of past land-use activities are described in more detail under reference conditions for water resources in Chapter 4.

The current conditions of stream channels on public lands is influenced by roads and legacy timber harvest activities. Although timber harvest activities on public lands have not occurred in 25 years impacts to channels continue to occur largely due to the transportation system that was developed to facilitate vegetation management. Nearly every road that was built on NFS lands was done so for the purpose of harvesting timber. As timber harvest declined so did road maintenance activities resulting in impacts to stream channels and sensitive habitats.

Sediment source inventories (SSI) completed in the watershed in 2010 and more recent road condition surveys completed in 2012 provide insights as to the current condition of roads in the watershed (USDA Forest Service 2011 and 2012 – forms only). Problems with the road system that affect channel morphology include plugged and undersized culverts, interception of sub-surface flows (from roadcuts), rilling, gullying, and undercutting of unstable areas due to poor road location. While some of these problems are caused by poor design, the majority of problems with stream crossings can be attributed to lack of maintenance.

PHOTO 3-34 AND 3-35: DRAINAGE ISSUES ON ROADS 42N19 (LEFT) AND 41N74 (CALDWELL LAKES ACCESS).

Data from the 2002 and 2010 SSI's indicated that about 39 miles of road within the watershed were hydrologically connected to the stream network. Most of the connected road segments occurred in the Parks Creek and Eddy Creek drainages with a lesser amount (4 miles) within the South Fork Willow Creek drainage. The SSI data also indicated that fluvial erosion, in the form of gullies, was the dominant erosion mechanism delivering sediment to the stream network. Gullies are initiated primarily by snowmelt runoff and occassional rainfall runoff (USDA Forest Service, 2011).

Gullying from hydrologically connected roads conributes sediment to streams, but other erosion sources are less apparent. Soils within the watershed were found to be relatively unsusceptible to erosion. Most of the soils in the watershed exhibit coarse soil textures and fine textured soils are relatively uncommon. The location of the watershed in a snow dominated zone also reduces the likelihood of soil erosion due to limited rainfall (USDA Forest Service, 2011).

Data from the sediment source inventories also indicate that many stream crossings have contributed sediment to aquatic habitats in the past. Many crossings have failed and have stabilized and are no longer sources of sediment to aquatic habitats. The SSI also determined that low water fords were more common in the Willow-Parks Watershed when compared to other watersheds on the Shasta-side of the Forest.

In addition to stream channels the transportation system has also affected hydrologic conditions in meadow, wetland and stream habitats. These habitats are relatively common, particularly at higher elevations and often are traversed by roads. The road system tends to intercept sub-surface flow in areas where road cuts pass through wet areas. Oftentimes intercepted runoff is diverted down the roads which degrades the road surface and drains aquatic habitats located downslope of the diversion points (Photos 3-34 and 3-35).

PHOTO 3-36: OFF-ROAD VEHICLE USE AND RUTS CREATED IN WET MEADOWS IN EDDY CREEK DRAINAGE.

Wetlands and meadows have also been affected by off-road vehicle use. Evidence of OHV use occurring in wet meadow habitats was observed during field reconaissance of the watershed in 2012. OHV use in wet meadows is unauthorized and can have negative impacts to meadow hydrology, soils and vegetation (Photo 3-36). Meadows and wetlands experiencing OHV use are located in the upper reaches of the Dale, Eddy and Parks Creek drainages.

Past restoration activities in the watershed suggest that historic timber harvest and grazing activities affected channel stability. Timber harvest occurring in the 1960's was linked to loss of channel stability in Tamarack Meadow. Impacts to the unnamed creek in Tamarack Meadows included channel widening and bank erosion caused by increased runoff from roads and associated skid trails and landings (USDA Forest Service, 1993). In 1992 the Forest Service implemented restoration work designed to narrow and deepen the channel and restore aquatic and riparian habitats. The project was intensively monitored in 1993 and the restoration work was found to be successful (USDA Forest Service, 1993). The area was revisited in 2003 after a large summer storm which produced unusually high runoff in Parks Creek. Post-storm surveys revealed that the channel did not become unstable as a result of the event and that the restoration project was providing long-term benefits to the channel.

Other meadow restoration activities attempted by the Forest Service, sometimes met with mixed results. Around 1990, the Forest Service girdled lodgepole pine trees in Tamarack Meadows in an attempt to control conifer encroachment. The pines were killed but the dead trees attracted woodcutters and vehicles which damaged wet meadow habitats (USDA Forest Service, 1993). Field reviews of Tamarack Meadows occurring in 2012 indicate that the meadows have recovered from OHV impacts, but that meadow conifer encroachment is still active.

Water quality problems in the upper elevations of the watershed are almost exclusively related to those arising from poorly drained and hydrologically connected roads. These roads have and in some cases continued to serve as a sediment source to streams and other aquatic habitats. Fine sediment inputs can impact habitat (e.g. spawning gravels) and elevate turbidity levels during periods of high runoff. Excessively high inputs of fine sediments can also impact water quality by reducing the amount of dissolved oxygen in streams and lakes. Dissolved oxygen levels are of particular concern in the watershed due to the Shasta River TMDL which lists the Shasta River as impaired for both dissolved oxygen and temperature (CRWQCB, 2006).

The South Fork of Willow Creek drains a headwater area composed of ore bodies containing granodiorite, with quartz veins and abundant sulfides. Beginning in 2006 the Forest Service has been assessing the risk to water quality from historic mining activities associated with the Dewey Mine. The Dewey Mine was established in 1880 in the headwaters of the South Fork of Willow Creek. Operations at the mine ended in about 1940. Preliminary findings indicate that past mining activities have affected water quality. Almost all of the sites that were tested for sediment contaminants had elevated levels of arsenic and minor presence of other metals associated with sulfide ore. While concentrations of arsenic are high for sediment and pose a moderate risk to humans, the overall risk to exposure is considered to be very low. Surface water samples slightly exceeded human health or ecological screening benchmarks for arsenic. This is primarily due to the fact that there is no public access into the mine area and there is no recreation (e.g. camping) associated with the affected area. There is also very little evidence of human visitation to the area (USDA Forest Service, 2007). The Forest Service is working to pursue options to reduce impacts to water quality and restore areas impacted by historic mining activities.

The main stem of the South Fork of Willow Creek still contains two log dams that were built by the miners to trap sediments introduced by mining activities. The lower dam is on public lands and has completely aggraded with sediment. The aggraded area is covered with wetland vegetation. The lower dam is still intact and is not showing signs of deterioration (Photo 3-37). The Forest Service is evaluating restoration actions for the dam site associated with other potential reclamation activities.

PHOTO 3-37: OLD LOG DAM ON SOUTH FORK WILLOW CREEK ASSOCIATED WITH HISTORIC MINING OPERATIONS, 2001.

Human Uses

Twenty-two prehistoric and historic cultural resource sites associated with past human uses have been recorded within the WA. Seven of these are prehistoric sites associated with the Ahotire 'itsu Shasta and consist of lithic scatters of mostly (traded) obsidian debitage and tools. Ground stone artifacts for plant material processing are present at some of these sites. These sites are mostly found on flats along drainages or in the vicinity of meadows or lakes. The prehistoric sites were found during surveys for timber sales in the 1970s and 1980s and most have not been revisited since. All of the site records for these sites reveal past impacts from roads or logging activities from timber sales that took place before the National Historic Preservation Act was signed into law in 1966. Some of the prehistoric sites have also experienced some minor erosion from run-off.

Ethnobotanical plants used by Native Americans such as bear grass, yew, willow, Oregon grape, mahogany and others are present within the WA (see Table 4-2 for complete list). As of this writing, it is unknown if the Ahotire 'itsu Shasta still use this land to gather plant materials or hunt or fish. It is possible that access to these ethnobotanical and wildlife areas may be of some importance to the Tribe. Direct contact with members of the Tribe may result in the identification of areas accessed for Traditional Uses. Some areas such as beargrass locations could benefit from the re-introduction of fire to flourish. Roads needed to access these areas may need to be improved or in some instances, roads may need to be closed/decommissioned.

Fifteen (15) historic sites have been recorded on NFS lands in the WA. More historic sites have been reported by Shasta-Trinity employees, many historic trails, snow cabins, and possibly guard stations are identified on historic maps but because there have been no ground-disturbing activities proposed in the WA for some time, none have been field-verified or recorded.

No specific geographic areas on NFS lands were favored historically, as there were a variety of uses of the landscape, based either from resource extraction (mining, timber), resource use (cattle and sheep grazing), resource protection (firefighting/detection), or recreation (dammed lakes for planted fish, trails, snow cabins, lodge), or habitation (homesteads). Historic sites known to exist within the WA include homesteads, gold, chromite, and asbestos mines, mine tailings, prospects, shafts, adits, stamp mills, diversion dams, ditches, cyanide processing tanks, mining cabins and related domestic refuse, mine claim markers; roads, trails, bridges, logging skid trails, logging skid roads, logging chutes, log landings, stumps, discarded cull logs, remains of snow cabins, remains of an historic lodge and the remains of range cabins, corrals (stone and barbwire), and fences.

Gold, chromite, and asbestos mines are located in association with the parent rocks, although some exploratory prospects and road systems to such prospects may also be located in areas where these resources did not exist. The Dewey Mine is probably a historically significant site, but it has not been evaluated to the National Register of Historic Places. When the Dewey Mine (gold mine) was reopened in the 1930s, access was via truck and ore was extracted using a chemical process. A cyanide processing plant was constructed on the west bank of South Fork of Willow Creek and a large "sand pile" of chemically-treated crushed rock was deposited on a hillslope downstream from the main workings of the mine and directly upslope from the creek. Two rolling dips drain the Dewey Mine Road and have the potential to direct water over the site of the cyanide processing plant. Refer to the water quality section for more information on ongoing efforts to address potential water quality concerns associated with historic mining activities.

PHOTO 3-38: LARGE "SAND PILE" DOWN SLOPE FROM THE MAIN WORKINGS AT DEWEY MINE, ON NFS LAND. THE SAND PILE IS UPSLOPE FROM SOUTH FORK OF WILLOW CREEK, ON THE EASTERN SIDE. DEWEY MINE ROAD IS LOCATED BETWEEN THE SAND PILE AND THE CREEK (CREEK AND ROAD WOULD BE DOWNSLOPE TO THE RIGHT BY LESS THAN ONE HUNDRED FEET).

PHOTO 3-39: RUNOFF AREA AND CYANIDE PROCESSING PLANT AT DEWEY MINE. PHOTO IS TAKEN FROM DEWEY MINE ROAD.

PHOTO 3-40: ROLLING DIP ON DEWEY MINE ROAD, UPSTREAM FROM THE MAIN CYANIDE PROCESSING PLANT.

Evidence of Chromite mining is believed to be somewhat similar but less ubiquitous than gold mining within the WA; however, only one mine, the "Sheep Camp Cabin and Mine" has been formally recorded. This site was determined eligible for inclusion in the National Register of Historic Places in 1989

(California Office of Historic Preservation, 1989). The mine has three tunnels with tailings, a prospect, two cabins, a structure platform, remains of a rock crusher, shoot bin, rolling mill and table, the remains of a tram, and a small artifact dump. The site was visited in 2010 and roads, structural deterioration, evidence of use by campers and hikers, and erosion were observed (McMaster, Woods and Putty 2010).

Only two asbestos mines have been formally recorded within the watershed; they have not been evaluated for inclusion in the National Register. These mine sites contain evidence of tractor mining activity, mine prospects, roads and log cabins/line shacks/explosive sheds. They have not been revisited since they were recorded in 1986. Other evidence of asbestos "prospecting" is present in the form of linear and circular pits/depressions found in serpentine. Some of these "prospects" may also be associated with gold mining.

Other land uses, such as ranching, fire detection use, and recreation varied over time and has had various impacts to cultural resources. Prior to the Forest Reserves, cattle, goat and sheep grazing within the watershed was not regulated. Horses and mules were probably grazed in meadows along drainages such as Eddy Creek. No historic documentation about the number of animals allowed to graze within the watershed prior to it being part of the Forest Reserve system was found. It is, however, probable that the numbers were reduced in size once the land became part of the Forest Reserves. Cattle, goat and sheep impacts to cultural resources probably decreased over time, with the most likely evidence of use being trails, trampling, bedding down areas, wallows, fence lines, and excrement.

Recreation uses over time have increased with increased access. Most impacts to cultural resources observed within the watershed including driving over sites, parking/camping on sites; driving OHVs off road within site boundaries, fire rings in site boundaries, and firewood cutting within site boundaries. The latter can result in possible looting if the site is not well-concealed.

Chapter 4: Reference Conditions

The purpose of this chapter is to explain how ecological conditions have changed over time due to human influence and natural disturbances. A reference is developed for later comparison with the current conditions over the period that the system evolved and with key management objectives.

This chapter summarizes how physical and biological elements and processes and human uses were affected over time as the result of changes in land-use patterns in the watershed. Discussions of physical features, biological features and human uses can generally be segregated into two distinct periods, as follows:

- Pre-European Settlement: During this period, significant human influences were absent. Although native peoples used the area, the ecosystem was functioning under essentially natural conditions during this time.
- Post-European Settlement: During this period, human influences began to affect natural processes in the watershed. The area began to experience increased effects from settlement, mining, wildfire suppression, timber harvest, and road construction activities.

The chapter begins with an overview of prehistoric and historic activities and uses that occurred in the watershed.

Visual Resource / Scenery

It is speculative what the scenery looked like historically. Changes to the landscape from past human activities would have altered the scenic character. The visual resource is and was determined by natural rock formations, the type and quantity of vegetation and how much of the natural environment has been disturbed. Historically the landscape would have looked markedly different during the Pre-European settlement, the European settlement and after the invention and wide use of the automobile and other mechanized equipment. Human activities within each time frame would have influenced the vegetation and natural rock formations, in turn influencing the scenic resource.

Pre-European Settlement Period

During the Pre-European settlement period there may have been more natural fires due to the lack of fire suppression and probably some human caused fires. Native American tribes reportedly used fire as a tool to manage the landscape, (please see the fuels and archaeology reports). Fire usually burns the understory, thereby opening up the forest for herbs and forbs to sprout creating a more open looking forest stand. There would have been burnt brown-black vegetation and areas void of vegetation from the forest fires. Smoke may have obscured views. Smoke and burnt vegetation may have impacted scenery negatively, but in the long term the fires would have contributed to open forested environments which provide visual access and are usually seen as attractive (Ryan, 2005).

Fires would have been the major human activity to change the scenic resource during the Pre-European Settlement Period; there would not have been any roads or mining activities that detracted from scenic resources.

European Settlement Period

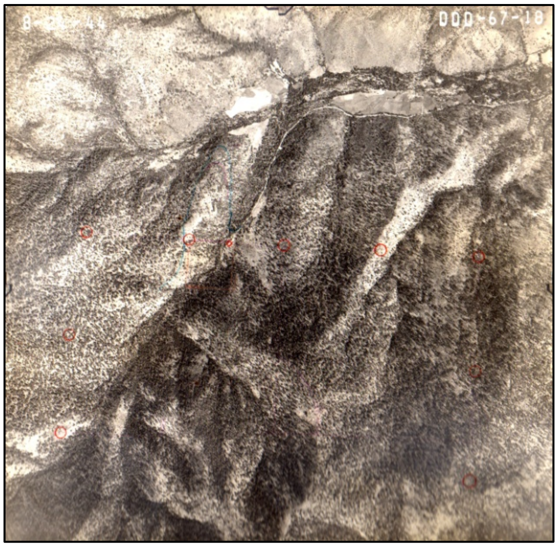
The European Settlement Period would have had the same influences on scenery from fires; however the landscape also would have been impacted from mining, railroads and logging. The mining activities would have altered the streams, hill slopes, rock formations and vegetation causing a scar on the landscape. Logging activities would have removed older legacy trees leaving smaller conifers which would have been viewed as less scenic. The European Settlement Period would have impacted scenery more than the Pre-European Settlement Period based on the impacts from human activities.

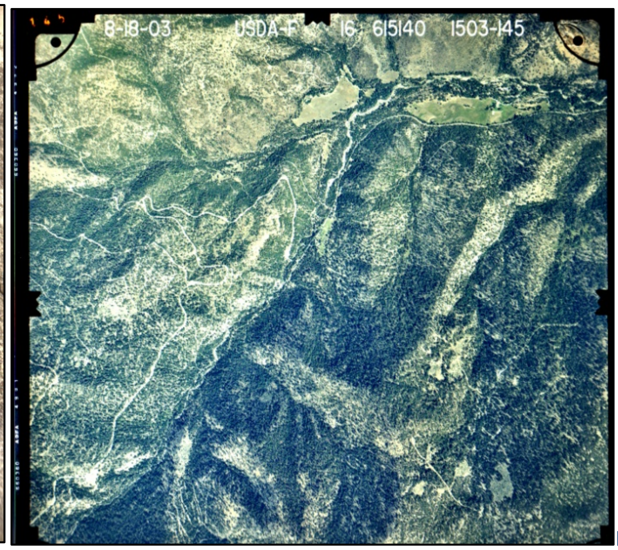
Post Automobile and Mechanized Equipment Period

The development of the automobile, other mechanized equipment and the transportation system brought unique challenges and benefits to the scenic resource. Roads created impacts to scenery by creating cut and fill linear features on the landscape and removing vegetation. However, roads also made it easier to access the landscape to fight forest fires, access recreation opportunities and they made it easier for people to see the beauty of the area more readily.

Aerial photographs from 1944 were compared to 2003 aerial photographs to ascertain the changes to the landscape due to the automobile and mechanized equipment. One of the major changes was the number of roads which had greatly increased in the 2003 photos. Parks Creek Road didn't exist in 1944;

in fact it wasn't constructed until after 1960. The access has allowed more human activities, including logging. The 1944 aerial photos showed two distinct clear cuts, but none in the 2003 photos. It appears that there may have been a general slight decline in the amount of vegetation between the two eras. It is unknown if the change in vegetation was due to logging or natural influences.





PHOTOS 4-1 AND 4-2: ARIAL PHOTOGRAPHS FROM 1944 AND 2003 OF THE WATERSHED

Scenery on and from Mount Eddy would have looked more natural prior to automobiles. The mountain top has excellent views of the valley and large ground disturbing events can be seen from this vantage point. Access also supported the construction of the Mt. Eddy Look Outs (two) and currently remnants are strewn about degrading the view.

In conclusion, the Pre-European Settlement Period would have looked the most natural and probably would have been considered the most scenic for those who could traverse the steep mountainous terrain.

Grazing

Peak grazing since the Forest Service began managing the area occurred during World War I. Limited permitted horse and mule grazing occurred before 1930 but, otherwise, all permitted grazing in this watershed that has occurred since 1907 has been by cattle.

From about 1980 to 1993, about 100 cow-calf pair grazed the watershed per year with a season of use from about mid-June to mid-October. From 1994 to 1997, grazing continued on the West Parks Creek grazing allotment with an average of 35 cow-calf pair per year from mid-June to mid-October. Because the watershed is characterized by steep valleys with large, but discrete wet meadows surrounded by low-productivity uplands (due to low productivity soils), it was possible and common for livestock to be managed in this watershed on a rotational basis, utilizing each wet meadow as a "paddock" for a prescribed period of time and then moving the herd to another meadow once management thresholds were reached.

Figure 4-1 displays livestock use in the Willow-Parks watershed by year and livestock type. Use was primarily by cattle until grazing ended in 1997 with a few years of some permitted grazing by horses before 1930. The peak year of grazing was 1914 with 6,103 AUMs of livestock use.

FIGURE 4-1: LIVESTOCK USE IN THE WILLOW-PARKS WATERSHED

Vegetation

Pre-European Settlement Conditions

The disturbance factors that shaped the forest under pre-European settlement conditions were mainly fire and drought. Fire disturbance was wide-spread and relatively frequent. Drought was periodic and infrequent.

The general pattern of forest types probably existed then, as they do today, and under the specific characteristics of each of these types, the stocking levels differed and were not necessarily static. A general model of the disturbance regimes affecting stocking levels is that the ponderosa pine stands at lower elevations had a short interval fire regime and open stands. The fir stands at higher elevations had lengthened fire intervals and demonstrated a disturbance cycle with low to high stocking levels.

Wildfires were generally low intensity surface fires in the watershed. Ecosystems maintained by surface fires such as ponderosa pine and drier mixed conifer types are a result of fire tolerant successional species that are generally shade intolerant. These regimes contain persistent successional species that generally are shade intolerant and have developed adaptations to survive fire and maintain a constant or fluctuating population in response to disturbance. In the absence of fire beyond the normal return interval, these fire adapted species are replaced by late-successional species that are predominantly shade tolerant thus producing the development of fuel ladders that alter fire behavior and effects.

There have been many drought and wet cycles over the past 7500 years. 7,500 to 5,000 years BP (before present), was considered a very dry period. During the period of 5,000 to 4,000 BP, precipitation and temperatures were up, and 4,000 to 3,000 BP was wet and cool. From 2,500 to 1,500 BP the area was experiencing severe drought and increases in fire. 1,200 years BP there was an increase in summer precipitation, and between 900 to 700 BP was a drying period. The period of 700 to 150 BP was been called “The Little Ice Age”, and was the coolest and wettest period during the last half of the Holocene. Since the end of the Little Ice Age around 1850, annual temperatures have been slowly but steadily rising (Miller R. et al., 2005). Such droughts probably created the same opportunity for insect infestations and disease causing a similar pattern of tree mortality as is seen today.

Post European Settlement Conditions

Under historic conditions, disturbance regimes have been altered. Human influences affected natural disturbance regimes and began to shape the forest.

Alteration of the natural fire regimes has had several direct effects on vegetation within the watershed:

- It has permitted stands to attain higher understory stocking level than before the human created fire suppression, than would be found under natural conditions. Wildland fire risk has increased in the watershed during the recent past due to fire suppression activities that have resulted in a buildup of understory fuels. These understory fuels were historically reduced by low-intensity fires that occurred every 12 to 19 years (Taylor and Skinner 1998).
- It has reduced seral diversity among stands. Openings and early seral stages are reduced from pre-suppression conditions.

Timber was originally needed for settlement and early mining operations in the Shasta Valley near Yreka beginning in the 1850s (gold was discovered in Yreka in 1851). Commercial timber harvest began in earnest after World War II and was accompanied by the widespread construction of logging roads and skid trails on public and private lands.

Timber harvest as a disturbance factor also has direct effects on vegetation:

- It has changed stocking levels. Widespread timber harvest opened mixed conifer stands and shifted the distribution of seral stages from a primarily old-growth composition with fewer stems per acre to a far greater proportion of early to mid-mature stages with greater stand densities.

- Timber harvest has affected species composition through a prolonged practice of selecting the most valuable species for harvest. Sugar pine, ponderosa pine, and Douglas-fir were selected over incense cedar and white fir. Logging also maintained openings that permitted shade-intolerant species such as black oak to persist even in the absence of fire.

Botanical Species and Habitats

Pre-European Settlement

Habitats for the 24 special status plants and one survey and manage fungi known to occur within the Willow-Parks Watershed would have been maintained by natural disturbances such as fire, drought, floods and movement of rock and soil (gravity). Soils and climate were also important. Prior to European settlement, livestock grazing, mining and road building would not have disturbed populations or destroyed habitats associated with special status plants. Many of the rare plant populations are found along roads and trails so it is expected that there were more of these plants prior to these activities. Plants known to occur in riparian areas and meadows would not have been affected by road and trail building, water diversions and impoundments and excessive livestock grazing. Some plants found presently growing only at higher elevations may have been found in the same habitats at lower elevations due to "The Little Ice Age", 700-150 years BP that ended in the 1850s. Since the end of "The Little Ice Age", temperatures have been slowly but steadily rising (Miller at el, 2005). There may have been other plants growing here that we don't know about because they were extirpated early on in the European settlement experience. The lower elevation areas of the Shasta Valley within the watershed were rich with spring feed meadows and vernal pools. Sensitive plants such as Pickering's ivesia are known to occupy habitats associated with springs and ultramafic soils.

Post European Settlement

As settlers began to move into the Shasta Valley and Mt. Shasta areas, they built homesteads, roads and trails, and raise livestock and food crops. They needed lumber for constructing homes, businesses, barns, fences, mines etc. They needed water for drinking, livestock, irrigation and mining so they set about building dams and water diversions. They dug out ponds and tapped into springs and diverted water from streams. Meadows were used to grow hay for livestock and then grazed. Livestock was moved up into the forest during the summer months were they were moved from meadow to meadow on a first come first served basis. Prior to the establishment of the Shasta National Forest, sheep and cattle were grazed in these meadows. It's not known how many animals spent their summers in the mountains, but during the early days of the Forest Service range records showed the largest number of permitted animals (cattle) was in 1914 (6,103 AUMs). Meadows were used as paddocks and animals were rotated from one meadow to another. With over 100 years of grazing some plant species may have been extirpated from these meadows. Exotic species such as dandelions and cheatgrass are associated with grazing. Other exotic species may have been brought in with seeds for crops or were crops or ornamentals that escaped cultivation such as dyer's woad and Scotch broom. Exotic species were then spread by the building of roads and trails allowing for vehicle traffic. Most roads were built for logging from the 1960s through the 1980s. Between the 1850s and 1980s, many meadows and grasslands were plowed and planted or grazed. Several historical (late 1800s to early 1900s) rare plant populations have not been relocated mostly due to settlement activities. Ponds were dug out in areas where plants, now rare, would have grown.

Fire

There are generally two time periods of fire history within the watershed with distinctly different fire regimes, as outlined in *Fire in California Ecosystems*. The first was before 1905, a Native American period, when fires were generally frequent. This time period includes the European-settlement as well as pre-historic periods. The Native American period was followed by the fire-suppression period which began with the creation of the national forest reserves in 1905. This time period is characterized by a significant decrease in fire occurrence.

Pre-1905

The Mediterranean climate of the watershed promoted frequent lightning ignitions. The result was frequent surface fires of mostly low to moderate intensity.

C. Hart Merriam, Chief of the Division of Biological Survey in 1898, wrote "of the hundreds of persons who visit the Pacific slope in California every summer to see the mountains, few see more than the immediate foreground and a haze of smoke which even the strongest glass is unable to penetrate". Few forested regions have experienced fires as frequently and with such high variability in fire severity as those in the Klamath Mountains (Taylor and Skinner, 1998).

Forest conditions were likely open from frequent fires. Research shows that lower elevation mixed conifer forests of the Klamath Mountains historically burned every 12 to 19 years. These frequent, mixed-severity fires killed some overstory trees, initiated recruitment, and thinned or killed understory stems. The resulting forest structure consisted of multi-aged stands where tree establishment was associated with more severe fires where a portion of the canopy was killed (Taylor and Skinner 1998). Tree-ring fire-scar studies indicate that fires burned mostly in mid-summer through fall. (Skinner and Taylor, 2006)

"In … the southern portions of… the Cascades … where the forests are largely or mainly of yellow pine in open growth, with very little litter or underbrush, destructive fires have been few and small, although throughout these regions there are few trees which are not marked by fire, without, however, doing them any serious damage." – Henry Gannett, 1902 (Skinner and Taylor, 2006)

Post - 1905

The decrease in fire occurrence began with settlement. The decrease was first evident near meadows as a result of heavy grazing. Other areas began to experience pronounced decreases in fire occurrence with the beginnings of fire suppression. Fire suppression efforts were instituted after the establishment of the National Forest system. Since the onset of fire suppression in the early 1900s, and with the increased effectiveness of mechanized suppression techniques (fire engines, dozers, aircraft, etc.) in recent years, total area burned by fires has been greatly reduced compared to historic levels (Skinner and Taylor, 2006). Average fire return intervals in the Klamath Mountains have increased to over 20 years (Taylor and Skinner 1998).

With successful fire suppression, fuels and vegetation density have increased and fires have the potential to become more intense and difficult to control. Suppression concerns have primarily been focused around homes and improvements (i.e. wildland urban interface). Under the current fire suppression strategy, fire as an ecosystem process has been dramatically reduced. This has resulted in the development of a more homogeneous landscape pattern in terms of age and size class as well as vegetative structure. Concerns over fire effects to resources (e.g. wildlife habitat, soils, human uses, hydrology, air quality, etc.) have increased through time.

Species and Habitats

Wildlife

Early survey results recorded 68 mammals and 136 birds occurring on Mt. Shasta and in the surrounding vicinity (Merriam, 1899). The survey noted mountain sheep, and grizzly bear, although these have since been exterminated or driven away. Deer and elk were noted as common in the Sierra-Cascade system while antelope were common in the Shasta Valley but are now rarely seen.

The Shasta River was once one of most productive streams of its size for anadromous fish in California (National Research Council, 2003), with four of its tributaries are located within the WA boundary. The Shasta River Fish Counting Facility is managed by the California Department of Fish and Game and has been in operation since 1930. In that time, it has seen drastic declines in returning populations of anadromous salmonids. Though this facility's primary function is to monitor Chinook runs, it counts all salmonids as they pass through. Chinook runs in the Shasta River were once as high as 100,000 fish in the spring and 80,000 fish in the fall but have fallen as low as 5,000 fish and 750 fish, respectively, following the population boom of the early-to-mid 20th century (Moyle, 2002; CDFG, 1997). Similarly, fall and winter steelhead runs have ranged from 8,513 fish to under 250 fish (Klamath River Information System, 2006). Less is known about coho runs, but the counting facility has noted a high of approximately 900 and lows under 100 individuals (Klamath River Information System, 2006). It is suspected that anadromous coho are present within the watershed. While these numbers do not represent total population in the Shasta River, they serve to illustrate likely changes in population size over time. With tributaries located within the Willow-Parks WA boundary, it is likely that salmonid populations have varied proportionally with the main stem of the Shasta River. Stocking has occurred in lakes within the watershed since at least 1946, but these lakes are not currently stocked. The last stocking occurred in 1976.

Unique Habitats

Pre-European Settlement

Unique habitats include streambanks, wet and seasonally wet meadows, fens, seeps, bogs and springs, serpentine barrens, high elevation ridge tops, rock outcrops and talus slopes and unique vegetation types such as the curly-leaf mountain mahogany/western juniper/rabbitbrush/ Bluebunch wheatgrass association and the Canadian buffalo-berry/western azalea association. The curly-leaf mountain mahogany association is found more commonly in the eastern Cascades and Great Basin and can be found on volcanic and ultramafic soils. There is one population of Canadian buffalo-berry found growing with western azalea in a very wet area just off of the Parks Creek Road. This is the only recorded population in California.

Streambanks may have had more riparian habitat prior to European settlement and fire suppression. Other riparian habitats such as meadows, fens and seeps and springs were maintained by fire and amount of water present. For some meadow types, generally those that are seasonally wet, fire was important for maintaining their habitat by keeping trees and shrubs from invading the meadows. Tamarack Flat is one example of this type of meadow. The meadows in the vicinity of Caldwell Lakes are very wet and include fens, seeps and springs. Conifer and shrub encroachment in these meadows would have been possible only during long dry periods. Once the dry period was over, the meadow would become very wet again and conifers and shrubs would die. Fire was less important in maintaining these habitats over time. Fire may have been important as a rejuvenation tool for the different plant associations growing in these wet meadows by providing some nutrients. Fire may have been important in maintaining openings along ridge tops. Although due to shallow, rocky soils, many ridge tops may have been sparsely populated anyway. Serpentine (ultramafic) barrens are maintained as openings by the soils themselves as they tend to be shallow and rocky. Ultramafic soils are high in magnesium and low in calcium making them poor for growing many plants. Although many interesting plants can be found in these openings, they are usually scattered and don't provide enough fuels to carry fire. Rock outcrops and talus slopes probably looked pretty much the same then as they do now. Habitat for the curly-leaf mountain mahogany vegetation type would have been maintained by fire. Fire would have kept juniper trees to rock outcrops and ridge tops (Miller et al., 2005).

Post European Settlement

Ranching (1850s) on low elevation private lands brought with it livestock grazing, tilling soil for crops, water developments including wells, impoundments and diversions, road and trail building and the cutting of trees for lumber and firewood. Mining changed the hydrology in streams like the South Fork of Willow Creek by building dams and other water diversions. Miners also cut trees for lumber and dam building. Roads built largely to support logging activities, changed hydrology patterns along streams and many wetlands and weren't designed to maintain hydrology processes.

The early days of livestock grazing heavily impacted meadow systems within the watershed. It's not known how many head were grazed in the years before the Forest Service started keeping records. Forest Service range records showed the largest number of permitted animals (mostly cattle) was in 1914 where almost 600 head of cattle and horses were permitted to graze mostly from March to November, with a few being grazed year round, in allotments within the watershed.[3] They were moved from meadow to meadow on a rotational basis. It is also known that after 1907, cattle were the primary grazing animal with permits for a small number of horses. Numbers started to drop after 1914. For more information on range, see the range discussion in Chapter 3. These meadows and their plant communities were not adapted to being grazed by large numbers of domestic livestock. Meadow soils and plants were trampled and plants were selectively grazed. This may have reduced the number of species or changed the species composition occurring within these meadows. Down cutting of some streams within meadows began to occur within meadows as plant species growing next to the streams helping to slow the flow of water were trampled and eaten. Carpets of moss along streams, springs and

[3] Personal communication with Philip Brownsey, Range Conservationist, on 12/5/12.

seeps were trampled and destroyed. These moss carpets were important in holding soil in place and retaining water. Fire suppression led to conifer encroachment in drier meadows such as Tamarack Flat.

Geology

Reference conditions for geology can be described with a brief geologic history, which follows.

1. **Geologic Terrane Assembly**- Rocks exposed within and adjacent to the study watershed are some of the oldest in Northern California. Over the past 567 million years, this part of the Klamath Mountains was assembled through plate motions and accretionary processes. The Trinity Geologic terrane occupies most of watershed, and consists dominantly of ultramafic rock (peridotite, serpentinite, etc.), though large intrusions of gabbro are also present. These rocks are Ordovician in age (radiometric dates of 472-480 million years). Gabbros of the Rail Creek terrane, which lie immediately west of the study watershed, are even older, being assigned to the Neoproterozoic Era with radiometric dates of 560-567 million years. As such, rocks of the Rail Creek Terrane are the oldest convergent rocks in western North America, and were attached to the Trinity terrane between 480-560 million years ago (Elder et al., 2012).
2. **Multiple Stages of Uplift**- At least three episodes of uplift have been reported for the Klamath Mountains. There was uplift in the Cretaceous Period about 130 million years ago, about 4 million years ago in the Pliocene Epoch, and continued uplift after that time (Elder et al., 2012).
3. **Glaciation**- Over the past 2 1/2 million years, glacial ice covered the upper parts of the project area, and spectacular U-shaped valleys and cirques, along with long, linear glacial moraines were created, such as along the main road up Parks Creek. Glacial outwash deposits from some of the earliest and most extensive glaciation are preserved lower in the valleys. Some of these gravels are cemented and well exposed in road cuts along Parks Creek road 42N17.
4. **Volcanic Activity**- Periodic volcanic activity from Mt Shasta affected the area over the past 600,000 years, depositing ash and debris in certain areas. The Shasta Valley Debris Avalanche occurred about 350,000 years ago, and was caused by the catastrophic collapse of the entire volcano. The debris avalanche filled the lower reaches of the main streams (Willow, Parks, Eddy, Dale Creeks), and this had a dramatic effect on drainage patterns and stream flow characteristics. Thin layers of volcanic ash were also deposited much more recently in the study watershed. A sediment core taken from Mumbo Lake about 8 miles south of Mt. Eddy revealed the presence of volcanic ash from an eruption at Little Glass Mountain in the Medicine Lake highlands about 1,000 years ago (Daniels et al., 2005).
5. **Post-Glacial Landslide and Fluvial Processes**- With retreat of the glaciers, forest cover became established in all but the highest elevations during the Holocene Epoch. With the forest cover, came the effects of fire. Deep-seated landsliding occurred in parts of the study watershed where weak rock was undercut by streams or earlier glacial erosion. Some areas underlain by gabbro contain abundant dormant landslides. Snow avalanche tracks are evident in some areas, such as on the east side of Parks Creek, north of Tamarack Flat.
6. **Historic Floods**- Floods in 1955, 1964, 1974, 1997, and 2006 initiated landsliding and debris flows. Based on a reconnaissance level examination of historical air photos conducted for this Watershed Analysis, it appears that 1997 had greatest effects on the channel system.

Pre-European Settlement

Glaciation played a critical role in shaping the current landscape in the study watershed, and as a result, this process is described in more detail below. Glacial and interglacial periods are currently described by oxygen isotope stages. These stages are defined by oxygen isotope ratios (O^{18}/O^{16}) derived from shells of foraminfera recovered from deep sea cores. During glacial periods, O^{18}/O^{16} ratios are higher as lighter

O^{16}-rich water molecules are preferentially evaporated and locked in glacial ice, thus enriching oceans in O^{18} water molecules. By convention, glacial periods are given even Stage numbers, and interglacial periods are assigned odd Stage numbers. Glacial deposits in the study watershed are limited to Stages 2 and 6, and though other Stages may have been deposited there, none are known to have been preserved. Stage 6 glaciation occurred from about 194 to 133 thousand years ago. Stage 2 occurred from 32 to 13 thousand years, reaching a maximum from 23.5 – 17.0 thousand years in the Sierra Nevada. Stage 2 (Late Wisconsin) is commonly subdivided into two or three advances or substages. Remnants of Stage 4 glaciation (or Tenaya-aged tills of the Sierra Nevada) are now believed to have been obliterated in this area by Stage 2 glaciation, which was more extensive, with ice advancing further down valleys (Elder et al., 2012). Many of the present-day glacial lakes (tarns) are dammed by moraines of the Holocene Neoglaciation that occurred from about 3,200 years ago to the end of the Little Ice Age around 1850 AD. However, many of the lakes have existed and received sediment for 15,000 years or longer.

Numerous lake core studies have been conducted to the west study watershed with the goal of recreating post-glacial climate and wildfire patterns. These studies paint a fairly clear picture of the climate and fire history at higher elevations since the retreat of the glaciers, and allow some comment on the likely effects these changes had on geomorphic processes. The results of three of these recent studies are briefly summarized below. It should be noted that fire frequencies interpreted from lake cores should not be compared directly to those from fire scar studies or historical inventories without fully considering the differences between these methods.

Bluff and Crater Lakes- Post glacial fire and vegetational history at Bluff Lake (Trinity River Basin, 4 miles NW of Mt Eddy) and Crater Lake (Klamath River basin, 7 miles NW of Mt Eddy) were compared (Mohr et al., 2000). Histories for these lakes were found to be very similar, despite differences in geomorphic setting. Of the two lakes, Crater Lake is more similar to the lakes in the project area than Bluff Lake, due to its northerly aspect and location within the Klamath River basin. From 15,500 - 13,100 years ago, both sites were occupied by subalpine parkland, with scattered pine (*Pinus*) and fir (*Abies*). After 13,100, a closed forest of Western White Pine (*Pinus monticola*), Lodgepole Pine (*Pinus contorta*) and Abies became established, and fire frequency was low. This suggests that the climate at that time was cooler and wetter than present. In the early Holocene (about 11,500 years ago) conditions were warm and dry, and Pinus and huckleberry oak (*Quercus vaccinifolia*) dominated both sites. Later in the Holocene, the climate became wetter and cooler, and Abies became more dominant at both sites, and mountain Hemlock (*Tsuga mertensiana*) increased at Crater Lake. These species displaced Pinus and Quercus at both sites. Similar fire trends were observed at both lakes, with high fire event frequencies at 8,400, 4,000 and 1,000 years ago, and low values at 4,800 years ago. The actual event frequencies 8,400 years ago were 10 fire events per 1,000 years at Bluff Lake and 16 fire events at Crater Lake. By comparison the low event frequencies 4,800 years ago were 5 events per 1,000 years at Bluff Lake and 9 per 1000 years at Crater Lake.

Mumbo Lake (8 miles SSW of Mount Eddy)**-**

Toward the end of the Pleistocene (15,200 to 12,200 years ago), the climate was cooler and drier than at present, and subalpine parkland occupied the site, with juniper, lodgepole pine and sagebrush represented. Fire frequency was low (3.3 events per 1000 years). From 12,100 to 9,800 years ago, increasing moisture and soil development occurred, with several new pine species represented (Jeffrey, foxtail, and western white). Fire frequencies remained low (3.3 events per 1000 years). From 9800 – 7200 years ago, climate warmed and dried, with an expansion of oak and other chaparral species. Fire frequency increased slightly to 3.9 events per 1000 years, but low charcoal accumulation suggests low fire intensity. From 7200- 3800 years ago, the climate was cooler and moister with many new conifers showing up for first time. At this time, most the species found in the modern watershed were already present, and chaparral species remained important. There was a dramatic increase in charcoal accumulation rates and fire frequency increased to 5.1 events per 1000 years. From 3,800 years ago to present, there were more conifer species (white bark pine and mountain hemlock show up) and chaparral species decreased to their present levels. Fire frequency remained at 5 events per 1000 years, and there was a sharp increase in frequency 1,000 years ago, around the Mediaeval Warm Period, a peak also identified at Bluff and Crater Lakes. In summary, the fire history observed at Mumbo Lake was similar to that identified by adjacent studies. This suggests that climate dictates regional fire patterns

Comparison of Lake Cores from Northern California and Southern Oregon- A study by Briles, et al (2011) looked at post glacial vegetation changes at some of the same lakes described above (Crater, Bluff, Mumbo) as well as at Cedar Lake (7 miles south of Mt Eddy), and others considerably further to the NW (Taylor, Campbell, Sanger, and Bolan Lakes). The focus of this study was on the effects of rock type (ultramafic rock in particular) on vegetation and fire history. This study found that Ultramafic substrates show very different post glacial vegetation history than other substrates. In non-ultramafic settings, dominant trees and shrubs shifted in elevation in response to Holocene climate variation, and vegetation experienced compositional and structural changes. In contrast, vegetation in ultramafic settings experienced structural changes only, that is relative abundance of species changed, but distribution did not. Fire patterns were similar thru the Holocene across the lakes studied, except for declines in fire frequency over the past 4,000 years on ultramafic substrates. This observation is attributed by the authors to a reduction in understory fuel in ultramafic areas, and to the cooler, wetter conditions over the past 4,000 years compared to the middle Holocene.

Post-European Settlement

Land-use

Air Photo Investigation

Historical air photos were examined in order to gain insight into reference conditions relative to erosional processes, with the emphasis on landsliding. Due to limited time available, a sample of photo years was selected to straddle some of the largest floods which are known to have occurred in the recent past (1964 and 1997). This was accomplished with air photos from 1944, 1980, and 1998. Methods included examining air photos stereoscopically and identifying active landslides and channels which appeared in the photos to have been recently altered by scour or deposition (usually indicated by lighter color and lack of riparian vegetation).

Assumptions made:

1. Harvest units are located within the analysis area. These were identified by photo observation and approximate Forest land boundaries.
2. Landslides that were observed on the 1980 air photos and not on 1944 may have occurred during the 1964 flood event. Landslides that were observed on the 1998 air photos and not on the 1980 air photos may have occurred during the 1997 flood event.
3. A landslide that intersects or is immediately adjacent to a man-made feature, e.g. road and/or harvest unit, may have a cause/effect relationship with that man-made feature.

Summary of Air Photo Investigation

The air photo investigation revealed that most of the debris slides and channel alterations occurred between 1980 and 1998. About half of the events were in or adjacent to roads or harvest areas. The other half were natural, or removed from roads or harvest units. Although some debris slides and channel alteration did occur during the 1964 flood event, it was much less pervasive than in 1997. This difference in response between the floods of 1964 and 1997 may have been linked to the increase in harvest and clear-cuts after 1980 but prior to the 1997 flood event. Regeneration harvest reduces root support and evapotranspiration, and can lead to accelerated landslide rates. A brief summary of observations from each photo year is located below.

1944: Black and white air photos were examined for 1944, and little to no harvest activity was evident. Ground disturbance associated with Dewey Mine is clearly visible on the air photos. There are few obvious landslides within the area. Valley inner gorges are evident along Willow Creek, Parks Creek, Eddy Creek, and Dale Creek. An unnamed tributary to Eddy Creek has observable scour for approximately 1 mile (line 34, photo 67-16). Several other creeks outside of the analysis area appear to have also been scoured. These include an unnamed tributary to High Camp Creek, approximately 2 miles, an unnamed tributary to the North Fork Sacramento, approximately 2 miles, and an unnamed tributary to Middle Fork Sacramento, approximately 4 miles. Glacial features, such as cirques, tarns and u-shaped valleys are evident in the middle to southern portion of the analysis area. The most recent and well-formed features occur around Mount Eddy and expand out radially.

1980: Both color and color infrared air photos were examined for 1980. There is a slight increase in harvest activity from 1944, including clear-cuts and thinned stands, along with associated roads and landings located in the northern section of the analysis area, north and northeast of Parks Creek. There is observable scour in Parks Creek, approximately 1 mile in length, which is possibly related to a road failure on private land in the Stewart Springs area (line 39, photo 2180-75). There is also scour in an unnamed tributary to the Shasta River, approximately 0.5 miles in length, east of the Forest Service boundary.

1998: Color air photos were examined for 1998. Harvest activities have increased relative to the 1980 air photos, timber harvest is predominantly stand thinning with a few clear-cuts. Associated roads and landings have increased within these areas, especially in the northern part of the analysis area, north of Parks Creek. Parks Creek has observable scour from the headwaters to the West Fork Parks Creek confluence. There is also observable scour along an unnamed tributary to Eddy Creek, approximately 2 miles, and approximately 1 mile of scour along Dale Creek. Approximately 0.5 miles of Wagon Creek also has observable scour, located just east of the analysis area.

Hydrology, Stream Channels and Water Quality

Pre-European Settlement

There is little information available concerning prehistoric conditions for water resources in the Willow-Parks Watershed. Prehistoric conditions for hydrologic resources and processes in the watershed are different from those found today due to land-use practices. In addition to anthropogenic impacts the watershed has been subject to some very large scale disturbances in the distant past which would have undoubtedly impacted water resources. These large-scale disturbances included volcanic activity, glacial periods and floods/debris flows.

The Mount Shasta debris avalanche that occurred about 350,000 years ago undoubtedly had an enormous impact to the lower elevation areas of the watershed in the upper Shasta Valley and resulted in large scale alterations to drainage patterns and runoff processes. The impacts of the debris avalanche were greatest in the northern portion of the Shasta Valley but the avalanche influenced channel evolution and development on the southern third of the watershed. The Shasta River and valley reaches of Parks Creek have evolved as low gradient channels due to the presence of erosion resistant bedrock in the lower Shasta Valley. This bedrock contained the debris avalanche deposit and now serves as the control of base levels for valley streams such as the Shasta River, Eddy and Parks Creek (CDFG, 2009).

Past glacial activity also has played a significant role in shaping the channels and drainage basins in the watershed. The most recent glaciation occurred about 10-12,000 years ago during which time much of the southern third of the watershed was glaciated. Channel morphologies in this landscape evolved in response to peak flows and hillslope erosion processes including mass wasting. Most of the lakes and meadows at higher elevations (e.g. Durney, Dobkins, Caldwell, Little Crater) were formed by glacial processes.

The amount and distribution of surface and groundwater flow in the watershed was influenced by past glacial activity and other variations in climate. Base and peak flows in the watershed were likely influenced by variations in climate and to a lesser extent by wildfires. Variations in annual precipitation and periodic droughts would have affected both surface and groundwater flows. Vegetation composition and wildfire activity would have also been affected by variations in climate.

Post-European Settlement

Land-use activities beginning in the early 1800's influenced runoff patterns, stream channels and water quality in the Willow-Parks Watershed. The effects following European settlement in the watershed and vicinity have had lasting impacts on hydrology and geomorphic processes (CDFG, 2009). The first changes to channel morphology were likely the result of beaver trapping which began as early as 1820 and was likely concentrated in the Shasta Valley and the low elevation valley bottoms in the Willow-Parks Watershed. Logging, mining, grazing, road construction, and stream alteration projects commenced immediately following European settlement in the mid-1800s. By the beginning of the 19th century mining activities were in decline and agriculture had become the dominant land-use activity in the Shasta Valley. Numerous irrigation districts formed in the Shasta Valley in the early 1900s for the purpose of managing water resources. Shortly after the formation of the irrigation districts the increased demand for water resulted in the formal adjudication of water rights in the Shasta River Watershed (CDFG, 2009). Intensive timber harvest management and road construction on National Forest lands began in about 1950 following World War II and continued through the 1980s. All of the aforementioned land use activities interacted with hydrologic and geomorphic processes, and affected water quality, stream channel morphology and the timing and amounts of runoff. In recent decades stream restoration projects on both public and private lands have been implemented in order to restore habitat that was degraded as a result of the previously noted land-use practices. A general summary of how land-use activities impacted hydrology, stream channels and water quality is presented in Table 4-1.

Land-Use	Hydrologic Processes	Stream Channels	Water Quality
Beaver Removal	Changes in water storage and delivery rates. The full extent of beaver activity in the watershed is not known but it is possible that beavers may have influenced the development and hydrology of high elevation meadows (e.g. Tamarack) as well as drainage patterns on the valley floor.	Substantial alterations to channels from beaver removal. Loss of channel complexity, loss of channel sinuosity and vegetation, increased flow velocities, loss of slow water habitats.	Increased erosion resulting from conversion of wetlands and slow water channels to fast water reaches following beaver and dam removal.
Reservoirs and Diversions	The watershed contains both water diversions and impoundments. Diversions have impacted in-stream flows, with the greatest impacts occurring in the lower third of the Willow-Parks Watershed and on downstream reaches of the Shasta River and Parks Creek. Diversion ditches also intercept seep and spring flows. Flow reductions in the Shasta River and in Parks Creek have resulted in changes to habitat and channel morphology as well as sediment transport processes. While outside the watershed, Dwinnel Dam is the largest impoundment in the larger Shasta River Basin. The dam was completed in 1928 and is managed by the Montague Water Conservation District.	Changes in channel morphology in response to diversions both from loss of flow and from construction of ditches. Loss of some habitats (stream channels, wetlands) due to impoundments and drainage. Impacts greatest on lower third of the watershed. Small dams constructed to increase the size of lakes have resulted in partial conversion of meadows and wetlands to lake habitats (e.g. Caldwell Lakes).	Impacts to water quality from diversions are mostly associated with increased sediment following construction of ditches and impoundments and from diversion maintenance activities.
Timber Harvest Activities	Changes in runoff patterns resulting from poorly drained skid trails, landings and roads. Altered infiltration rates in intensively managed areas. Increased peak	Increased bank erosion and sediment delivery to channels. Impacts to streams from skid trails and road construction at crossing locations. Changes in stream	Increases in turbidity associated with ground disturbance, primarily from roads and skid trails. Increases in stream temperature in channels with extensive canopy removal.

Land-Use	Hydrologic Processes	Stream Channels	Water Quality
	flows, shifts in timing of peak flows.	habitat characteristics resulting from increased sediment loads. Removal of vegetation, changes in woody debris recruitment and canopy cover.	
Road and Trails	Similar impacts as timber harvest activities but longer lasting. The majority of roads in the watershed were built to facilitate harvest activities. Many trails were originally constructed for logging purposes and later became hiking or OHV trails. Lack of road and trail maintenance and chronic drainage issues inhibit recovery of hydrologic processes and aquatic and riparian habitats. In some areas roads have intercepted groundwater and surface runoff and dried out wet meadows and small riparian areas.	Similar impacts as timber harvest activities but more chronic in nature. Most roads constructed on public lands were constructed for timber harvest activities and have not been maintained regularly. Common road impacts to stream channels include increased sediment transport and fine sediments to channels, channel aggradation above plugged or partially plugged culverts, channel degradation below stream crossings, and gullying along poorly drained road systems.	Similar impacts as timber harvest activities. In many cases increased turbidity and sediment inputs from poorly maintained road systems have stabilized over time due to the complete loss of fines from the eroded areas. Poorly maintained roads located in wet meadows are chronic contributors of fine sediment to downstream areas (e.g. response reaches, low gradient reaches of Parks Creek and Shasta River.
Fire Suppression	Successful suppression of fire has affected runoff and water yield due to increased vegetative cover and increased evapotranspiration of water by vegetation.	Decreased wildfire disturbance has likely offset some of the sediment increases brought about by timber harvest activities and roads. In unmanaged areas fire suppression has promoted development of abundant vegetation in and adjacent to stream channels.	Reduced fine sediment inputs to streams through reduced loss of vegetation. Reduced hillslope erosion.
Grazing	As of 2012 there are no grazing allotments in the watershed. Indirect influence on hydrology (grazing was one of the drivers responsible for water diversions in the lower third of watershed). Potential influence on runoff processes due to compaction and bank erosion.	Trampling and loss of riparian vegetation, increased compaction, bank erosion, loss of shade, reduction in woody debris, loss of pool habitat. Loss of channel complexity and cover. Impacts from historic grazing on public lands were likely concentrated in meadows and other areas where abundant forage existed.	Degradation of water quality. Localized, short term increases in turbidity, introduction of fine sediment to streams through bank erosion processes. Increased water temperatures in areas that were intensively grazed.
Agriculture	Agricultural impacts are largely tied to the effects of impoundments and water diversions. Decreased surface flows in Shasta Valley.	Reduced in-stream habitat (due to less water).	Locally increased water temperatures. Decline in productivity of fisheries.
Mining	Impacted stream flow through	Direct impacts to stream channels	Impacts to water quality from

Land-Use	Hydrologic Processes	Stream Channels	Water Quality
	hydraulic mining practices and associated diversions. Many diversion ditches constructed for mining now supply water for irrigation.	from placer mining activities, diversions and on-channel impoundments (e.g. Dewey Mine dams on South Fork Willow Creek). Changes in sediment transport (both bedload and suspended sediments).	increased sediment yield and delivery, contaminants (e.g. arsenic, mercury and other metals).
Recreation	No known impacts from to hydrologic processes from recreation activities.	No early impacts to stream channels from recreation. Impacts to meadows and sensitive areas from OHV use over past 30 years.	OHV impacts including damage to wet meadows and other sensitive habitats. Increased sedimentation to stream below disturbed areas.
Stream and Riparian Corridor Restoration	Restoration of surface and groundwater flows in localized areas.	Restoration of aquatic and riparian habitats. Improvement of fish habitat, including canopy cover. Improved channel stability.	Improved water quality (e.g. cooler temperatures, reduced sediment, turbidity and nutrients).

TABLE 4-1: GENERAL OVERVIEW OF HISTORIC LAND USE EFFECTS TO HYDROLOGY, STREAM CHANNELS AND WATER QUALITY IN THE WILLOW-PARKS WATERSHED (EMPHASIS ON PUBLIC LANDS).

Human Uses

Minimal cultural resource inventories have been conducted within the watershed analysis (WA) area on National Forest System lands. Private land located within the watershed analysis area has not been assessed. As a result, there is limited knowledge about the prehistoric and historic uses of the entire landscape within the watershed.

Pre-European Settlement: Native American Uses

The watershed is located within the ancestral lands of the *Ahotire 'itsu* (Okwanuchu, or Shasta Valley) Shasta and was occupied for over 5000 years (Dixon, 1907; Sundahl and Krieger, 1986). The presence of glaciers during the Late Pleistocene precludes any knowledge about earlier uses. Seasonal camps were established in the uplands, but main camps or villages were concentrated in the lowlands and foothills, closer to the Shasta River and other water courses (Silver, 1978; Betts, 1985). A Shasta village site is reportedly located off Parks Creek (Harmon n.d.). Its exact location is unknown. The artifact assemblages found at these sites suggest that their main function was for resource procurement and possibly as temporary hunting and food (vegetal and animal) gathering/processing camps or small tool workshops. Most of the stone tool material found was obsidian obtained through trade, from sources near McCloud and Medicine Lake. Like many areas with steep topographical relief, it is probable that ridgetops and watercourses were the main travel routes for trade and resource procurement within and outside the watershed. Some of the natural resources the tribes used were: deer, antelope, bear, small animals and insects such as grasshoppers and crickets, fish (salmon, trout, suckers, eel, crawfish, turtles), shellfish (mussels), bear grass, yew, acorns, pine nuts, juniper berries, etc., and for trading with neighboring tribes.

Plant Name	Usage
Angelica	Medicinal
Beargrass	Basketry
Bitter cherry	Food
Bracken fern	Food
Buckwheat (at least two species)	Food
Bush chinquapin	Adornment
Carex (several species)	Basketry
Ceanothus at least two species	Hair soap, other possible uses
Clematis (virgins bower)	Women's reproductive
Coffeeberry (at least two species)	Unknown
Coyote mint	Medicinal
Dandelion	Roots medicinal; leaves edible
Elderberry	Food, medicinal, music instruments
False Solomon's seal	Medicinal
Galium (bedstraw)	Medicinal
Gooseberries/currents (at least three species)	Food
Huckleberry	Food
Juncus (several species)	Basketry?
Juniper(Western)	Food, medicine, adornment
Labrador tea	Medicinal
Leopard lily	Food (bulbs)
Mahogany	Arrows
Manzanita	Food, medicinal
Oak, black	Food
Oak, white	Food
Oregon grape	Medicinal
Pacific yew	Bows
Prince's pine	Medicinal mostly
Red-stemmed dogwood	Food, medicinal
Rose	Food, tea
Russet buffalo-berry	Food
Shooting stars	Medicinal
Snowberry	Medicinal
Strawberries	Food
Yarrow	Medicinal

*Source: Rhonda Posey, Mt. Shasta Ranger District Botanist; Esther Morgan, McCloud District Archaeologist.

TABLE 4-2: SOME ETHNOBOTANICAL PLANTS LOCATED WITHIN THE WATERSHED THAT MAY HAVE BEEN USED BY THE SHASTA.

Ethnographers reported that the Shasta living in Shasta Valley used fire in isolated areas to improve wild seed production, enhance tobacco production, and to smoke out bears and rodents. Wild seed was also scattered by hand to increase production (Silver, 1978), but it is unknown if this method had any association with fire. Like their Scott Valley neighbors, *Ahotire 'itsu* Shasta may have used fire to enhance beargrass production and may have burned around oaks to enhance acorn production/harvest and to prevent the spread of understory plants and disease. Usage of fire was not something ethnographers typically documented in-depth. As a result, it is unknown how extensively ancestral Shasta used fire within the watershed.

In 1856, after helping the Oregon Shasta during the Rogue River wars, the California and Oregon survivors were removed to Grande Ronde first, then Siletz (Silver, 1978). The overall population of the Shasta in California declined from an estimated 2,000 in 1770 to 100 in 1910 (Kroeber, 1953).

Post-European Settlement: Historic-Period Uses

Historic-period uses by trappers and emigrants (Americans, Canadians, western Europeans and Chinese – all lumped in as "Euro-American" for this document) in the watershed included fur trapping, logging, mining (gold, chromite and asbestos), cattle ranching, sheep ranching and goat ranching (Sundahl, 1986). Even though the watershed was Mexican territory during the early historic period, there did not seem to be any particular interest in exploiting the natural resources in this region by the Mexican government (Martin et. al., 1981).

It is believed that the watershed was first visited by persons of European descent in the 1820s. An expedition from the Hudson Bay Company is said to have set up a trading post on Willow Creek near Gazelle (Wales, 1947), possibly as early as 1821 (Schrader n.d.) and again in 1825 by Finan McDonald and Thomas McKay (Martin, Hodder and Whitaker, 1980). Peter Skeen Ogden visited the area in 1827 and is credited for naming the Shasta River and Mt. Shasta after its local indigenous residents. By the 1830s-1840s, fur-bearing animal populations dwindled and local trappers started raising cattle. In 1832, aboriginal populations in the area were also decimated by malaria, which was probably spread by the trappers (Martin et. al., 1980). By 1850, gold was discovered near Yreka, which lead to a mining boom throughout Siskiyou County. By the 1860s, farming and ranching again became a main industry. By 1887, the California-Oregon/Central Pacific Railroad through the Shasta Valley was constructed, and logging and agriculture flourished (anonymous 1970; Apperson and Apperson 1981).

According to Sundahl (1986), Mt. Eddy and possibly Eddy Creek were named for Nelson Harvey Eddy, who settled the area with his wife in 1854 and later purchased a ranch near Edgewood in 1867.

Local lore suggests than members of Captain Jack's family lived in the vicinity of South Fork of Willow Creek after the Modoc War. Structures associated with this settlement may be present on one of the private parcels located within the watershed (Hill, personal communication, 10/4/2012).

Early Logging and Lumber Mills

Evidence of historic and recent logging is ubiquitous on NFS and private lands within the watershed boundary. Evidence of logging activities include stumps of various ages, a wooden chute, roads, skid roads, skid trails, cables, cable yarding trails, and possibly remains of camps and temporary log structures. It is probable that the earliest logging that occurred within the watershed was for use at the mines located within it. Wood was also harvested for the railroad. As the California and Oregon Railroad (owned by Central Pacific Railroad) wound its way north from Sacramento to the Oregon border in 1886-87, the railroad company, through the California-Oregon Land Grant (Railroad Grant Act of 1866), obtained “open” checkerboard land from the government as incentive to construct the railroad. The July 16, 1887 edition of the *North Star* states that the railroad opened the area for development and encouraged logging, mining, ranching, and farming. The surrounding timbered land within the watershed was logged for railroad construction and to supply wood for the early locomotives. An October 11, 1887 article in the *Mt. Shasta Herald* states that 30 cords of wood was cut per day to power the locomotives. The railroad played a major role in the development of the watershed and northern California/Southern Oregon in general.

Logging operations may have also supplied lumber to local communities like Gazelle, Weed, and elsewhere. The earliest known sawmill in Siskiyou County is located just outside the watershed in Edgewood (Martin, Hodder and Whitaker 1980). “Durney’s Mill” was located off Dale Creek, on private land. It was originally operated by Abner Weed between 1894 and 1897 and then by J. N. Durney between 1897 and 1903. Dobkins had a mill on the Shasta River in 1879 (Anonymous n.d.). Maxwell’s mill was located on Eddy Creek in 1893 (Ibid). Between 1900 and 1922, a logging camp was established on Eddy Creek (Krieger, 1985). The Davis Mill, which is located on private land, was in operation until 1913 (Esping, 1979a). An historic log chute leading from NFS land to the mill was recorded in 1985.

Early logging activities associated with mining, the California and Oregon/Central Pacific Railroad and the settlement of the Shasta Valley were probably done by people and beasts of burden. Transport was via animal or by 1913, the Davis Logging Chute. Much of the mechanical logging on privately-owned checkerboard lands that later became Federal lands occurred in the 1920s through 1960s. During this period, there were no laws passed to protect cultural and natural resources and logging operations occurred on all types of landscapes within the watershed, including within and along stream courses. Tractor logging during this period resulted in the construction of unplanned, overlapping roads on slopes and in drainages. Erosion in the form of local landslides and drainage destabilization occurred as a result.

PHOTO 4-3: THE ORIGINAL CAPTION OF THIS PHOTOGRAPH READS, "SLOPPY LOGGING ON PARKS CREEK ROAD IN PARKS CREEK DRAINAGE, MAY 10, 1963". NOTE LANDSLIDE IN PHOTO. PHOTO FROM MT. SHASTA RANGER DISTRICT ARCHIVES.

PHOTO 4-4: INTERNATIONAL PAPER CREW MEMBER DIGGING UP A CULVERT AT WEST PARKS CREEK IN 1963 (CREEK IS TOWARD THE TOP OF PHOTO). PHOTO FROM MT. SHASTA RANGER DISTRICT ARCHIVES.

The floods of 1964 and 1997 probably resulted in the destabilization of some roads and drainages. According to Larry Stevenson (personal communication, 2012), the 1997 flood took out many of the roads within the watershed. Logging and road construction/reconstruction operations completed prior to the National Historic Preservation Act being signed into law probably unearthed portions of all of the known prehistoric sites in the watershed.

Practically every other 1-mile section within the watershed was originally Central Pacific land until the 1950s, when it was consolidated with Southern Pacific. Much of this land was transferred to the Forest Service through land exchanges, such as the Pondosa Exchange (Jerry Harmon, Personal Communication, January 8, 2013). Figure 4-2 shows the extent of cutover land within the watershed in 1943.

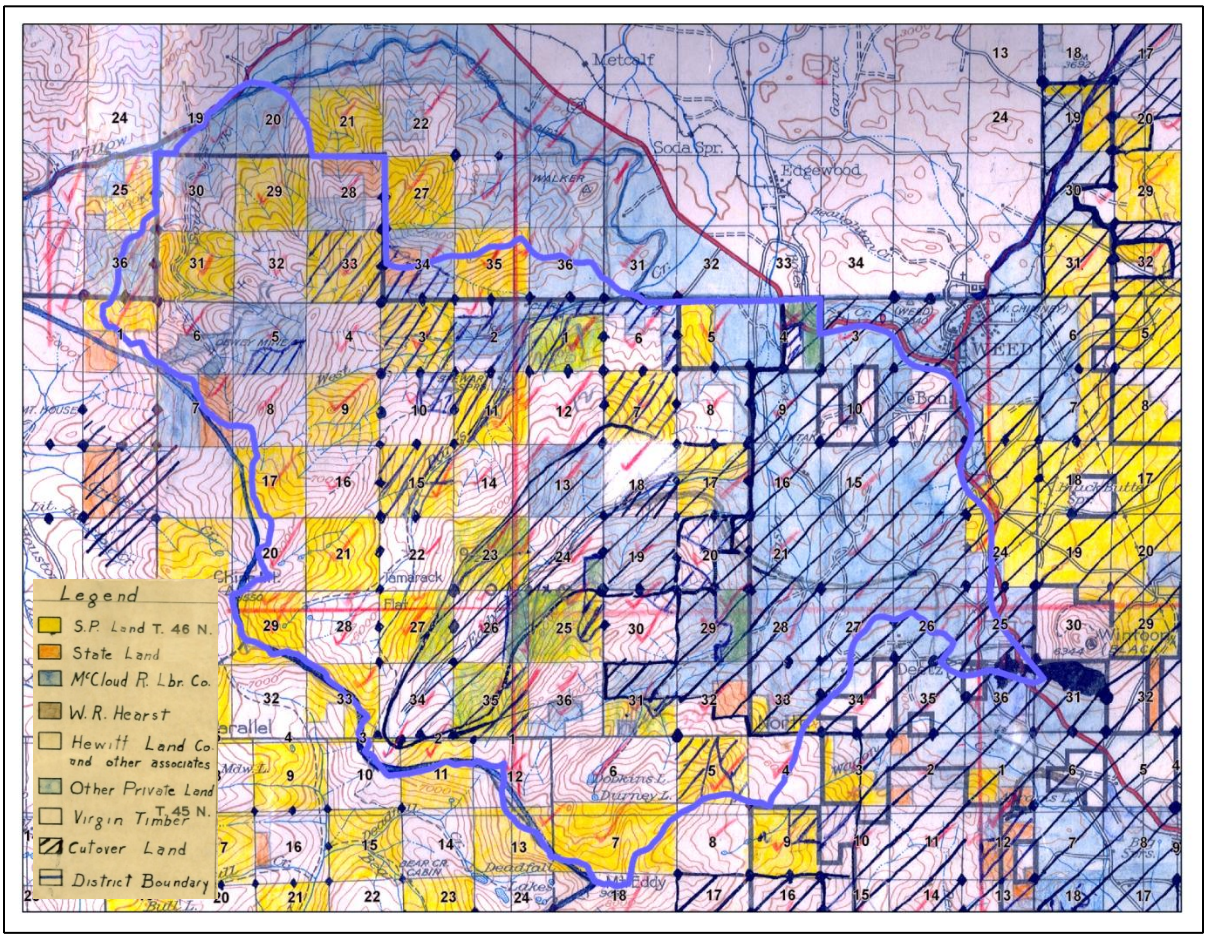


FIGURE 4-2: 1943 TIMBER RESOURCE MAP OF THE WILLOW-PARKS WATERSHED ASSESSMENT AREA (SACRAMENTO DISTRICT OF THE SHASTA NATIONAL FOREST) SHOWING LANDS OWNED BY SOUTHERN (CENTRAL) PACIFIC, THE STATE OF CALIFORNIA, HEWITT LAND CO., W. R. HEARST (NONE WITHIN THE WATERSHED), OTHER PRIVATE LAND OWNERS, AND THE SHASTA NATIONAL FOREST. THE PURPLE BOUNDARY ON THE MAP REPRESENTS THE WATERSHED BOUNDARY. HATCH MARKS SIGNIFY LANDS CUT OVER BY DECEMBER 30, 1943.

Within the watershed, there have been several timber sales and salvage sales on NFS lands that took place in the 1970s and 1980s. These include the Eddy Creek Timber Sale which was 2,865 acres (McDonald, 1978), West Parks Timber Sale that was a 3,000 acre clear-cut (Esping, 1979a), Caldwell Salvage Sale, where 200 acres were cut (Vaughn, 1985), the Eddy Timber Sale a 2,020 acre clear-cut (Sundahl, 1986), and the 154 acre South Willow Timber Sale (Hoertling and Sundahl, 1987). Some of the timber units were located in what was considered old-growth stands that had limited historic harvesting for mine use (Hoertling and Sundahl, 1987). Approximately 8,239 acres of NFS land were logged for these timber sales.

Early Mining

Euro-American interest in the watershed did not pique again until the discovery of gold in 1850, which was the earliest mineral mined in the watershed. Gold was discovered in the vicinity of Yreka, California, located approximately 30 miles north of the watershed. Between 1853 and 1856, local miners constructed a large canal to divert water from several drainages in the watershed to supply water to Yreka and Hawkinsville placer fields. This drainage canal took water from both Parks and Eddy Creeks and is probably the first feature constructed that had some effect to the watershed. Gold was discovered up Eddy Creek in the early 1880s. This mine, known today as Dewey Mine, probably had the most human influence on the watershed during the late 19th and early 20th centuries. The Dewey Mine operated within the watershed from 1898 until 1907 (Averill, 1935; Brown, 1915; Esping, 1979a) and was part of the Gazelle Mining District. A stamp mill was operated there until the early 1900s. A power line from Gazelle provided electricity to the mill. As a result of this mine, the watershed was logged for timber for the stamp mill and local communities of Gazelle and Edgewood. Camps were established in the uplands, and roads and pack trails were constructed to access the mine and areas to log. A saw mill was constructed at Stewart Springs to mill the lumber that came from the watershed. In addition, the historically swampy areas at the foothills of the Eddy Mountains were used for grazing cattle and sheep as well as for hay and grain to supply the miners and settlers in the region. The presence of sheep pens and small range camps within the watershed provide evidence that both sheep and cattle grazed in the uplands.

Early mining operations such as the first phase of operations at Dewey Mine were done by horse, people power, and dynamite. The mines from the 1800s to early 1900s were accessed by narrow, winding roads, many of which were probably constructed on trails created by the Shasta Indians. Early transportation to and from the watershed area was by pack train, and later by wagon. Effects to the historic watershed included the construction of roads up South Fork of Willow Creek to the mine, three log dams the creek, ditches, flumes, shafts, adits, drifts and raises.

PHOTO 4-5: TYPICAL PACK TRAIN AND TRAIL DURING THE EARLY MINING ERA. PHOTO FROM MT. SHASTA RANGER DISTRICT ARCHIVES.

Widening to allow access by horse and wagon/cart occurred later, as a need to transport ore from the mines to the train station in Gazelle and supplies from Gazelle to the mines became important. No placer or hydraulic mines are known to occur during this period, so it is likely that other ground disturbances were in the form of adits, shafts, buildings/building flats and ditches constructed by hand and draught animal. Later times, especially towards the turn of the 20th Century and in the mid-20th Century when chromite and asbestos mining became the main focus, machinery was used to extract the resources. Mechanical equipment was used to construct/reconstruct roads and extract minerals, potentially increasing the amount of surface area that saw disturbance, and depending on location, could have resulted in increased effects on the watershed. In addition, as technology evolved, so did new methods of mineral extraction.

Dewey mine, located on South Fork of Willow Creek is an example of a mine where extraction techniques changed over time. When this gold mine was originally opened up in the 1800s, extraction was done by dynamite and human labor. The parent rock was crushed at the stamp mill onsite and transported to Gazelle via pack train. When the mine was reopened in the 1930s, access was via truck and ore was extracted via a chemical process. A cyanide processing plant was constructed on the west bank of South Fork of Willow Creek and a large “sand pile” of chemically-treated crushed rock was deposited on a hill slope downstream from the main workings of the mine and directly upslope from the creek. The mine shut down in 1907, but was re-opened in the mid-1930s (Averill, 1935). Most of Dewey Mine was patented through the 1872 Mining Act on July 26, 1905 (Mineral Survey, 3953, Shasta-Trinity National Forest). Only one other mine, the Prather lode mine (Dividend, Capitola, and Connectivity Line claims) was patented within the watershed. It was patented on August 9, 1916 (Mineral Survey 4485, Shasta-Trinity National Forest, n.d.).

Prior to the Dewey Mine, ground-altering activities within the watershed that may have had some impact to the watershed included the construction of the “Big Ditch”. This 96-mile-long ditch was constructed to divert water from Shasta River, Parks and Willow Creeks (plus other tributaries along the way) to send it north to the gold placer mines in Greenhorn, Yreka and then to Hawkinsville (Herzog, 1957; Foulke et al. 1960). Construction, which was all volunteer work by Euro-Americans, began in 1853 and was completed in 1856 (Rosborough, 1947). Chinese emigrants were used to maintain and reconstruct the ditch over the years, but did not take part in the construction of the ditch (Foulke et al. 1960). Flumes along the ditch were constructed of white pine, ponderosa pine, and sugar pine, presumably from local sources on the east slopes of the Eddys near the head of the ditch (Foulke et al. 1960). Once productivity of the mines waned, the function of the ditch changed to supplying local farmers in Shasta Valley with water. Much of the ditch was abandoned in 1887 (*Ibid*: 3) leaving only two stretches from Shasta River and Parks Creek (totaling about a 19-miles long) in use (Foulke et al. 1960). By 1960, these segments of ditch were still in use.

Chromite Mining

During World War I (ca. 1916-1919), chromite was mined from ultramafic deposits (peridotite and serpentine derived from peridotite) in the Willow Creek Drainage (Elliott, 1991). Four chromite mines are known to be located within or adjacent to the watershed, in Sections 4, 32 and 33 of T. 42 N., R. 6W (Wells and Cates, 1950) and Section 36 of T. 42 N., R. 7W. During World War I, 110 long tons from a chromite lump ore was packed and shipped out from the Chastain and Bower mine, presumably by rail, prior to a substantial price drop in 1918 (*Ibid.*: 110). Between 1917 and 1918, 207 long tons were removed from the Leviathian Mine (*Ibid.* 83). Chromite was again mined during World War II (Elliott, 1991). During World War II, owners of the Constable and Foster Claims built a mile of road to haul chromite to the Yreka stockpile (Stevenson, Personal Communication 2012). By December 31, 1944 more than 90 chromite deposits were mined in Siskiyou County, placing it 5th in the state (Wells and Cates, 1950).

Chromite was used for strategic purposes for the war efforts. It is the only source of chromium, which is used for the manufacture of several different varieties of hardened steel, including stainless steel. Chromite is also used for chrome-plating auto bumpers and other fittings, leather tanning and producing some pigments (California Division of Mines, 1955). During the Cold War, there were concerns about the availability of chromite in the U.S. Other countries where chromium was obtained include: Turkey, South Africa, and the Philippines (California Division of Mines, 1955). Lump ore was commonly mined by open cut or underground methods, with the ore hand-sorted and shipped out (*Ibid:* 1). Disseminated ore is mined by open cut methods, and the ore body crushed a couple of times, then milled and sorted using gravity tables (*Ibid*: 2). Depending on extent, this form of mining and ore processing often involves more ground disturbance.

The majority of the chromite ore in California was mined during the wars. According to the California State Division of Mines (1955), about 2/3 of the chromite in California was mined during this time, “when domestic mining was stimulated by high prices and lowered grade requirements.” Most of the remaining 1/3 was mined between 1869 and 1895. Ore was directly sold to the War Production Board in the 1940s and the Emergency Procurement Service of General Services Administration for the war efforts and stockpiled up until 1957. Metal Reserve Co. stockpiled chrome in Yreka in 1942 (Krieger, 1989). These efforts were authorized under the Strategic Minerals Act (SMA) of 1939 (PL 117). Under Section 7 of the SMA, mineral geologists through the WPA were sent out to different parts of the Americas to locate minerals of strategic value (US Geological Survey, n.d.). Also in the 1950s, there was a redevelopment in chromite deposits in California (*Ibid.*3). It is unknown if any re-development occurred within the watershed.

Asbestos Mining

Asbestos mining within the serpentine belt in the watershed occurred in the 1930s and 1940s (McDonald, 1978), possibly also in the 1950s. A lack of readily accessible historical data and no formal site recordings within the watershed suggests that these mining operations were pretty small-scale compared to other asbestos mines in the country. Some possible asbestos mines/prospects noted during cultural resource surveys consisted of linear prospect pits, remnants of access roads; board scatters/collapsed structures of unknown function, corrugated metal, explosives boxes, dispersed artifact scatters, and possible loading ramps (Hoertling and Sundahl, 1987).

Early Forest Service

Shasta National Forest was created from Federally-reserved lands in 1905. The ancestral Shasta lands in the watershed not owned by Central Pacific Railroad, mining operations, ranchers, or farmers were eventually included in the National Forest Reserve system, and became part of the Sacramento District. Within the watershed, early management of the landscape was for resource protection, including putting out wildfires. Some of the uses included the management of range allotments, construction (or reconstruction) of trails up drainages, snow cabins, and lookouts for fire detection. Within the watershed one of the earliest fire lookouts, Mt. Eddy Lookout, was constructed by Anderson and Meehan in 1913 (Mt. Shasta Herald, 1913).

PHOTO 4-6: THE FIRST MT. EDDY LOOKOUT. THE CUPOLA COULD BE RAISED AND LOWERED. PHOTO TAKEN BY W.S. CLINE IN 1914. PHOTO FROM MT. SHASTA RANGER DISTRICT ARCHIVES.

A second lookout was constructed in 1920 and was in use until 1933 (Harmon n.d.). In a somewhat unusual management action, the early lookout was left standing, rather than torn down as is the usual practice.

PHOTO 4-7: 1920 MT. EDDY LOOKOUT (FOREGROUND) WITH THE 1913 LOOKOUT IN THE BACKGROUND. PHOTO FROM MT. SHASTA RANGER DISTRICT ARCHIVES.

The later lookout and a 1921 subterranean lightning shelter were thought eligible for inclusion in the National Register of Historic Places in 1987, based on their rarity, association with early Forest Service fire detection, and age. The site was also selected as a "Prescription XI" site in 1985 and listed in the Forest Land Resource Management Plan (USDA Forest Service, 1995). Prescription XI sites are those sites the Shasta-Trinity deemed especially unique and require additional management such as restoration, stabilization, interpretation, monitoring, or preservation. The lookout site was formally recorded in 1994 (Cassidy and Coombs, 1994). In 2003, as part of a Region-wide historic lookout study, the lookout was determined ineligible for inclusion in the National Register of Historic Places (California Office of Historic Preservation, 2003). It has since collapsed and many boards from the lookout have been removed (Johnson and Putty, 2010).

In conjunction with lookout construction, trails and telephone lines connecting district offices to the lookouts were constructed during the turn of the 20^{th} century. Numerous trails are evident on historic Shasta National Forest maps dating from 1916 to 1940. Trails were constructed to access remote areas for land management, including firefighting and snow surveys. During this era, local residents, such as local ranchers were also recruited to fight fires (Mt. Shasta Herald, July 31, 1913). Early Forest Service communications systems were often constructed so that ranchers and others could call in fires.

Early Fish Rearing and Fish Planting in the watershed

Manipulation of fish-bearing streams started out relatively early in the watershed. In 1888, the Sisson Fish Hatchery was established by the California Fish and Game Commission. The hatchery's original purpose was to propagate salmon. Salmon eggs were removed from the Baird hatchery on the McCloud River and hatched in Sisson, where the fry were fed. Once large enough, the fry were released at the headwaters of the Sacramento River. This process was not very successful, as only a few thousand fry were released annually (Bliss and Bliss, 1981).

In 1895 fry feeding was discontinued and the fish were directly planted in streams as soon as they were ready to feed. This process resulted in millions of salmon being hatched at the Sisson Hatchery and released in the Sacramento River and its tributaries (Bliss and Bliss, 1981). The old process of raising salmon fry was re-established in 1911-13 when new holding ponds were built (*Ibid:* 147). Trout were later propagated, when ponds were constructed at the hatchery to hold brood fish (Bliss and Bliss, 1981).

Early trout rearing operations consisted of raising trout at the Sisson Hatchery and then between July 1 and November 15, transporting them to be released throughout the state by way of transporting them in cans (up to 12, as space allowed) in railroad baggage cars. The fish in cans were aerated by an attendant using a hand dipper until they reached their destination. Distribution was limited. This method of transport continued until 1910, when a 60-ft. baggage car was purchased from Southern Pacific and converted into a fish distributing car-complete with a coal-fired boiler, sleeping quarters, office space kitchen, extra water for the fish. A second fish-distributing car was purchased in 1915 (Bliss and Bliss, 1981) and used gasoline to power it.

In the spring of 1907, the California Fish Commission and the Federal Bureau of Fisheries collected salmon eggs from the Shasta River four miles from Yreka, below the dam at Siskiyou Electric Power Company. These eggs were hatched at the Sisson Hatchery (Bliss and Bliss, 1981).

With the prospects of the use of a fish distributing railroad car, during the spring of 1908, rainbow trout eggs hatched a small, previously-defunct hatchery at Shovel Creek Station. In 1910, racks and a trap were installed at Bogus Creek in order to collect rainbow trout eggs. Eggs were carried from the trap in the canyon to the railroad track, loaded on hand cars to Thrall and then transferred to the Southern Pacific Railroad and taken to Sisson (Bliss and Bliss, 1981).

With the use of the two fish cars, fish were hauled throughout California and a few were sent to Mexico City. The use of this transportation system resulted in the stocking of "many barren lakes". Eastern Brook Trout and Brown trout were also raised and sent out from the Sisson Hatchery (Bliss and Bliss, 1981). Many of these lakes were modified with the installation of dams to support the propagation of fish.

PHOTO 4-8: SISSON FISH HATCHERY REARING POND, WITH MT. SHASTA IN THE BACKGROUND. 1914 PHOTO BY WS CLINE. PHOTO FROM MT. SHASTA RANGER DISTRICT ARCHIVES.

Wagons and mule trains were used to access remote areas such as Parks or Eddy Creeks (Bliss and Bliss, 1981). In 1914, lock leven, eastern brook, rainbow, black-spotted mackinaw trout, and steelhead were reared and distributed by train. In 1917, automobiles (trucks) were used the first time to distribute fish from the hatchery to the railroad stations. Automobiles were used more often as roads were expanded and improved. By 1937, automobiles replaced rail transportation, but mule and horse pack trains were still used to transport fish to high mountain lakes, that would otherwise be inaccessible. Transport by pack train continued until 1946, when airplanes were used to drop fish into the lakes from the air (*Ibid:* 147-8). Early distribution of fry and fingerlings by truck was similar to distribution by train: fish were transported in cans in the back of a truck with an attendant aerating the cans with a hand dipper and adding ice to keep the water cold (*Ibid*: 150).

Fueled by pressure from anglers and the fact that fingerlings could not survive to catchable size (7-10 inches) in southern California streams that dried up in late summer, the practice of planting fry and fingerlings changed to the planting of catchable-sized trout throughout California in 1930. By the 1950s the Sisson Hatchery produced approximately 100,000 pounds of trout and salmon per year, which amounted to approximately 500,000 7-10 inch rainbow trout and 3-4 million 2-3 inch fingerling trout. Only rainbows were planted as catchable fish; other fish reared as fingerlings before planting were brown, cutthroat, eastern brook and kamloop trout, and three species of salmon. Fingerlings were planted in remote areas and were "used primarily in lake management" (*Ibid:* 148-149).

PHOTO 4-9: FRANK HOHENECKER PLANTING FISH IN THE HEADWATERS OF EDDY CREEK, JULY 1940. NOTE THE CANS USED TO PLANT FISH. PHOTO FROM MT. SHASTA RANGER DISTRICT ARCHIVES.

Since 1938, rainbow trout was selectively bred for rapid growth, disease resistance, beauty, and longer spawning periods (for spring and fall spawning), but breeding programs for fall spawning began as early as 1883. Spring eggs were taken from the McCloud River and shipped to Neosho, Missouri. Some fish were selected at Neosho and sent to Springville, Utah, where additional selective breeding for fall spawning took place. California hatcheries obtained these fish in 1933, "forming the nucleus of California's present fall spawning stock" (*Ibid:* 149).

In 1979, the Sisson Hatchery stopped raising salmon and catchable trout. Instead, the hatchery focused on maintaining rainbow and brown trout brood stock and shipped eggs and fingerlings to other hatcheries. Catchable trout was raised at the Darrah Springs Hatchery near Red Bluff, where the warmer water produced catchable trout faster. Salmon were hatched and raised at the Iron Gate Hatchery rather than Sisson.

Forest Fire History

Forest fire history in the watershed is sparse. However, two 1920 Sisson Headlight articles indicate that lightning and severe wind storms were common on Mt. Eddy (Sisson Headlight, August 19, 1920 and October 14, 1920). In early August, 1920, fire lookout McClemmens was injured by lightning at Mt. Eddy and was forced to resign from the Forest Service (Sisson Headlight, August 19, 1920).

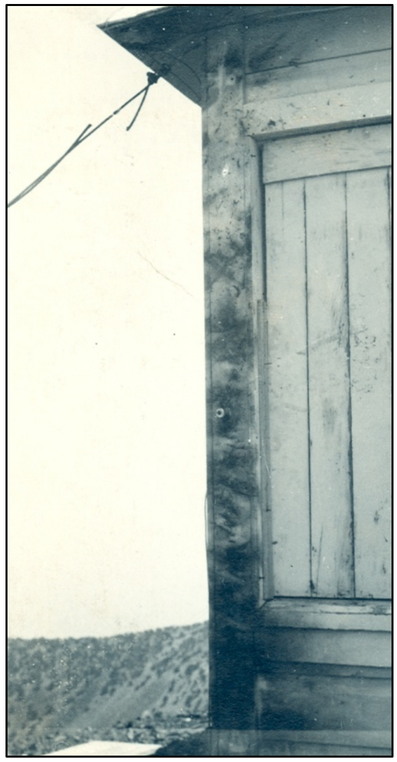


PHOTO 4-10: CHARRED CORNER BOARD OF MT. EDDY LOOKOUT AT THE TIME MCCLEMMENS WAS STRUCK BY LIGHTNING IN AUGUST, 1920. PHOTO FROM MT. SHASTA RANGER DISTRICT ARCHIVES.

See Fire History Map for additional information about historic to more recent fires.

Recent Uses

See the recreation section for detailed information about recent recreational uses. Archaeological survey reports have documented the use of the watershed for camping in the 1950s, based on the presence of fire pits with associated artifacts from that era (Esping, 1979). Mountain lakes have been planted with trout since the historic period and were (and still are) probably popular fishing areas for backcountry horsemen and hikers. Opportunities for sightseeing grew once roads were constructed and improved for cars during the post-World War II era. The Trinity Heritage Scenic Byway (FH 17 within the WA boundary) was designated by the Shasta-Trinity National Forest as a National Forest Scenic Byway on April 3, 1990 (http://www.byways.org).

As mentioned above, much of the land within the watershed historically consisted of checkerboard ownership patterns and was composed mainly of privately-owned railroad land and federal reserve (NFS) land, with two privately-owned patented mining claims (Dewey and Prather mines). The Land Status Maps for the Shasta National Forest indicate that private ownership (other than railroad lands) within the watershed was mainly through the 1862 Homestead Act and the Timber and Stone Act of 1878. A few parcels of land belonged to the State of California as part of the 1853 State Grant. Some of these parcels were granted to Southern and Union Pacific Railroads through the 1853 State Grant. The Railroad Grant Act of July 25, 1866 granted every other section of federal land within 15 miles of a proposed railroad line to railroad companies. Within the watershed, these lands were granted to California-Oregon/Central Pacific Railroad between 1895 and 1896. The distance varied from 10 to 30 miles on either side of the tracks depending on the location and year. On the Shasta-Trinity, the land has traded hands through land exchanges, most of which were under the authority of the General Exchange Act of 1922. Many of these parcels were logged over and exchanged for NFS land with virgin timber (Harmon, personal communication 2013). One of the earliest exchanges on record is the Paul M. Wherrit et. ux Land Exchange that occurred in 1976. The land in Section 31 of T.41N., R.6W., was exchanged to the Forest Service in 1984 (Anonymous n.d.a.). Other sections of land (for example, Sections 15, 17, 21, 25, 26, 27, 29, 33 and 35) may have been exchanged at this time as well.

Chapter 5: Interpretations

The purpose of this chapter is to compare existing and reference conditions for specific resources within the context of the issues previously identified in Chapter 2. The present conditions for resources affected by each issue are identified and the causal mechanisms responsible for the current condition of each resource are identified. Trends for resource condition are described and resource interactions with physical, biological, and social processes are listed. The capability of the system to achieve key management plan objectives is evaluated and conclusions are presented for each resource issue.

This chapter focuses on issues that affect public lands managed by the Shasta-Trinity National Forest.

Additional issues and topics are also addressed here if they are deemed important for guiding future management direction for the watershed, or will result in a management opportunity.

Issues addressed in this chapter include:

- Watershed Access (Roads and Trails) and Recreation
- Visual Resources/Scenery
- Vegetation and Fuels Management
- Unique Habitats
- Habitat Quality
- Other Resource Topics

Watershed Access (Roads and Trails) and Recreation

Topic 1: Access (Roads and Trails)

Present Condition

- Watershed access is hindered by lack of maintenance and lack of active management and some of the roads in the watershed can no longer be driven. In addition to restricting access lack of road maintenance has resulted in road prism and crossing failures which have impacted water quality and riparian and aquatic habitats in some areas.
- Road 42N17 (Parks Creek Road) is a Scenic Byway. The road receives a notable amount of summer and fall season use by recreationists (including a recreation bike event) and coastal commuters. The condition of Road 42N17 is slowly deteriorating which may eventually lead to less use by the public.
- Road 41N26 (Eddy Creek Road) is the primary access to the Eddy Creek drainage. The road is in poor condition and can only be used by high clearance vehicles.

- The Willow Creek area is only accessible to the public via 42N19 road from the Parks Creek road.
- Roads provide limited access but are important for fire management and plantation maintenance.
- Limited access to Dobkins, Durney and Little Crater lakes is a public concern. There is no public or administrative access to the upper Dale Creek Drainage. Sanitation issues associated with littering and overflowing campfire rings have been observed at Dobkins Lake.
- The current condition of the trail systems that use to access Durney, Dobkins, Little Crater and West Park lakes is unknown. These trails may have become grown over with vegetation and may be difficult to locate. Even if the Durney, Dobkins and Little Crater Lake Trails are located they would not be accessible to the public from east side of the watershed.
- Road 41N74 (accesses Caldwell Lakes trail) has erosion damage and is accessible by high clearance vehicles only. The Caldwell Lakes Trail has drainage problems and is impacting sensitive habitats (i.e. wet meadows). The lower end of the trail is located on an old road prism. The trail is steep and needs realignment to mitigate erosion problems and impacts to sensitive habitats.
- Several trails leading to high mountain lakes are in disrepair. Some mapped trails can no longer be located.
- Little information currently exists as to tribal access needs in the watershed.

Causal Mechanism(s)

- The watershed is located in close proximity to Mount Shasta City, Weed and other outlying communities in southern Siskiyou County. The proximity of the watershed to these communities raises concerns associated with poor access and deteriorating road conditions.
- Roads that are open to the public and readily accessible provide quality access for users seeking recreation pursuits and forest products.
- The watershed has the potential to provide high quality recreation. Recreation values include outstanding hikes, scenery and views, as well as fishing, hunting and other outdoor opportunities. These values create a desire for available access.
- Roads and trails have not been maintained regularly over the past 25 years due to lack of active management. Watershed access had been reduced as roads close themselves due to lack of maintenance.

Trends

- Recreation use on 42N17 road has been increasing with respect to accessing the Parks Creek Trailhead on the Pacific Crest Trail.

Influences and Relationships

- Some cultural resource sites have been impacted by roads. The extent and distribution of impacts is not known.
- The condition of roads in the watershed is often influenced by underlying stability issues (e.g. portions of Road 41N26 (Eddy Creek Road) traverse a debris flow deposit).

- Poor road access may be influencing OHV access in the watershed which in turn can have negative impacts to aquatic and riparian habitats.

Conclusions

- Consider options for public or administrative road access to NFS lands in upper Dale Creek if the opportunity arises.
- Investigate opportunities to improve trail access to Dobkins, Durney, and Little Crater lakes.
- The condition and location of historic trail system that accessed areas like West Park Lakes is not known.
- Road 42N17 is in need of maintenance and should continue to be managed as a Scenic Byway.
- Opportunities exist to improve, redesign or develop a better road and trail access to Caldwell Lakes. Additional infrastructure improvements such as a trail head and parking area should be incorporated into designs.
- There is a need to compile visitor use data by implementing recreation use surveys and installing road counters on selected roads accessing recreation sites.

Topic 2: Developed and Dispersed Recreation Access and Facilities

Present Condition

- High amounts of dispersed recreation occur within the watershed. Observed recreation includes hiking, fishing, hunting, camping, sightseeing, skiing, snowmobiling and OHV operations.
- The watershed contains no developed recreation facilities for the public (e.g. campgrounds, restrooms).
- The Parks Creek trailhead has been receiving increasing numbers of visitors. Human sanitation is a concern. The parking area is consistently filled with litter and improperly disposed human waste. Signage and interpretive information are substandard or non-existent.
- Tamarack Flat has multiple dispersed camps that are located too close to the creek. The close proximity of these camps may have effects on soil, vegetation and water quality. Vehicle intrusions into the stream have been observed.

Causal Mechanism(s)

- Lack of management, limited funding for recreation.
- Unmanaged dispersed recreation.
- Limited FS staff to patrol and provide public education.
- Lack of funding and personnel to maintain trail systems.
- Limited public access.

Trends

- Recreation use data is limited, however an increase of visitors at the Parks Creek trailhead has been observed. This use trend has also been observed at Deadfall Lakes and surrounding areas.
- In recent years, metropolitan newspapers and internet sites have featured the Parks Creek TH and the Deadfall lakes area. This publicity may have an effect on use trends.

Influences and Relationships

- Lack of interpretive signs (educating the public on resource issues), and a management presence have resulted in unmanaged recreation and resource damage in some areas of the watershed.
- Increased visitor use has a direct effect on human sanitation, crowding, user conflicts and natural resource in areas where recreation use is concentrated (e.g. Parks Creek Trailhead).

Conclusions

- There is a need to improve the Parks Creek Trailhead by increasing parking, providing adequate signage and providing sanitation facilities. Improvements that should be considered include an improved parking area, construction of rest rooms and installation of interpretive and information signs that conform to Accessibility Standards and Forest Service policy.
- There is a need for restoration of the road access and lower reaches of the trail system that accesses Caldwell Lakes.
- There is a need to increase Forest Service management presence in the watershed to better manage dispersed recreation and protect resources.
- There is a need to assess the amount and distribution of dispersed recreation use occurring in the watershed.

Visual Resources / Scenery

Present Condition

- The general scenic condition of the Willow-Parks Watershed Area has a very high scenic integrity, as seen from Parks Creek Road 42N17.
- There are some areas adjacent to Road 42N17 where scenery could be improved through vegetation management.
- There are not very many areas along Road 42N17 to view scenery.
- Human caused debris has been left at sensitive scenery areas including Road 42N17 trailheads, lakes and on the summit of Mount Eddy.

Causal Mechanism(s)

- Past fire suppression activities may have contributed to forest stands with over stocked understory vegetation which prevents views into the forest as well as distant views.
- Lack of road maintenance and improvements contribute to the lack of scenery viewing areas on Road 42N17.
- Lack of maintenance causes debris to be left in scenic areas.

Trends

- The trend is for increased use on Scenic Byways as the largest demographic in the United States, the baby boomers, who will have more free time to travel and recreate.

Influences and Relationships

- Vegetation management can increase scenic opportunities.
- Lack of maintenance and improvements on Road 42N17 inhibit motorists' abilities to view scenery.

- Human caused debris degrades the visual resource.

Conclusions

- Scenic quality and views could be improved by thinning the overstocked understory stands adjacent to Road 42N17 in select areas and by cutting some trees that block views to the valley in some locations.
- Safety and opportunities for viewing scenery could be improved by creating more pull outs on Road 42N17.
- Remove the debris from the summit of Mt. Eddy and fill in the holes that remain from the look outs.
- Continue efforts to acquire privately owned lands to protect the visual resource for future generations as directed by Forest Land and Resource Management Plan.

Vegetation and Fuels Management

Topic 1: Vegetation Management

Present Condition

- There is little opportunity for commercial harvest in the watershed. Constraints on opportunities include uneconomical conditions due to past over story removal harvesting and low timber site productivity (soils).
- Site productivity in the watershed is low resulting in slow growth rates for conifers.
- In some areas of the watershed understory tree densities are creating ladder fuel conditions that can increase the risk of uncharacteristic wildfire.
- Dwarf mistletoe infections are above endemic levels in both ponderosa pine and mixed conifer stands and are leading to increases in mortality and reductions in tree growth and vigor.
- Conifer encroachment in areas of black oak is reducing the long term viability of hardwoods in some stands.
- Many of the plantations lack heterogeneity and are in need of continued maintenance to remain healthy and viable.

Causal Mechanisms

- Past and present management practices including historic mining and timber harvest are responsible for the current condition of many stands.
- Approximately 100 years of fire suppression have led to increased understory growth resulting in ladder fuels that if ignited can result in uncharacteristic wildfire.

Trends

- Ladder fuels are expected to increase resulting in higher wildfire risk.
- The extent of dwarf mistletoe disease is expected to increase.
- The hardwood component will decline in certain areas where conifers continue to encroach within black oak stands.

Influences and Relationships

- Vegetation type, structure and condition influences both fire susceptibility and wildlife habitat quality.
- Past vegetation management and fire exclusion have affected habitat conditions for wildlife.
- Recreation uses such as hunting can be affected by stand and habitat conditions.
- Scenic quality can be affected by stand conditions.

Conclusions

- There is a need to maintain stand densities at levels that promote health and help prevent the chance of uncharacteristic wildfires in all stands.
- There is a need to incorporate diversity into the stands whenever necessary to prevent continued outbreaks of disease and insect attacks.
- There is a need to identify natural hardwood stands in the watershed. Where hardwood species naturally occur and are being outcompeted by the conifers, manage the conifers to promote the hardwood species.
- Past management practices have favored conifer establishment over hardwoods and other vegetation types with a resulting decrease of habitat for hardwood dependent species.
- There is a need to prioritize vegetation treatments in the watershed in order to make the best use of limited funding and resources available for such treatments.

Topic 2: Fire Exclusion

Present Condition

- Ecosystem composition, structure and function vary greatly from historic conditions due to fire suppression over the last century.
- A large portion of the landscape has missed several fire return intervals and the risk of losing key ecosystem components is high. Approximately 65% of the watershed analysis area has a high departure from historic fire return intervals. There is a potential for larger fire size, greater fire intensity and fire severity. The Wildland Urban Interface comprises 49% of this watershed. Firefighter and public safety is a priority.
- There are areas of dense vegetation and high fuel loading above what is characteristic of historic conditions.
- Humans account for 47% of fire starts in the watershed.
- Approximately 42% of the watershed is likely to have a fire that fire fighters will not be able to direct attack using hand tools. Equipment may be necessary to suppress fire in these areas.
- Air quality is at risk with the high fire behavior potential under extreme weather conditions.

Causal Mechanism(s)

- Fire exclusion has led to an increase in fuel loadings beyond historic levels.
- Fire exclusion has led to increased stand densities and reduced forest health. This results in increased populations of insects and diseases.
- Past vegetation management practices have encouraged denser stand conditions by not emphasizing thinning treatments.

- Increased public use in the analysis area has led to more human ignitions than occurred historically.

Trends

- Through time, vegetation density and fuel loading has increased and will continue to do so without interruption by disturbance or management action.
- Human uses have increased through time.
- Forest vegetation has changed from a heterogeneous pattern of mostly fire tolerant species to a more homogeneous pattern of denser vegetation with increased fire intolerant species.

Influences and Relationships

- Fire severity patterns on the landscape influence physical and biological resources (e.g. wildlife, water quality, human uses and natural resources).
- Vegetation type, disturbance history, soil type, fuels, topography and weather play a vital role in fire severity patterns on the landscape.
- Fire frequency influences vegetation, soil nutrient availability, insect populations and susceptibility to disease.

Conclusions

There is a need to:

- Manage fire within the analysis area to restore fire adapted ecosystems.
- Manage fire within the analysis area to protect property and improvements.
- Manage vegetation within the analysis area to restore ecosystem health.
- Protect the Wildland Urban Interface from uncharacteristic wildfire.
- Communicate with the public and other agencies regarding our activities.
- Coordinate our management activities with other agencies and organizations.

Unique Habitats

Topic 1: Present Condition for Streams and Other Wetland Habitats

The seasonally wet and wet meadows in the watershed appear to be in a continuing state of improvement after 100 years of grazing, poor road design and management, historical and current water diversions, spring development, pond creation, impoundments and OHV disturbance. Seasonally wet meadows and some wet meadows are seeing some conifer encroachment. Poorly placed trails and dispersed campsites are causing some trampling of plants, compaction of soils and damage to stream banks.

Causal Mechanism(s)

- Historical activities going back to homesteading, the gold rush, mining, timber harvesting private and public and excessive grazing created hydrologic problems for streams and other wetlands.
- Poorly placed trails and dispersed campsites are causing some trampling of plants, compaction of soils and damage to stream banks.
- Some meadows and stream banks are seeing an increase in conifer encroachment due to fire suppression.

- Off-road vehicle use is creating disturbance in some wetlands.

Trends

- Because access is limited into the Durney/Dobkins/Crater Lakes area of NFS, the Forest Service has not patrolled the area. It isn't known if resource damage to wetland habitats is occurring in the Dobkins/Durney/Crater Lake area, but it is assumed that it is, although limited.
- More people are accessing the Pacific Crest Trail from the Parks Creek Trailhead. The Pacific Crest Trail goes through many wetland habitats. It also provides connection to other trails such as the trail that goes up into the lower parts of the China Mountain/South China Mountain Botanical Special Interest Area. Increased use means more trampling of plants from hikers and campers. Possibly an increase in user created trail and campsite creation.
- There seems to be an increase in off-road vehicle use including 4-wheel drive vehicles and all-terrain vehicles such as quads and off-road motorcycles. There is evidence of these vehicles damaging meadows, riparian areas and serpentine barrens.

Influences and Relationships

- There is no public or administrative road access to NFS lands around Dobkins, Durney and Little Crater lakes. Existing roads cross private land and are gated which may have reduced visitor impacts to unique habitats in the area.
- Poor road access may be influencing unauthorized OHV access in the watershed which in turn can have negative impacts to unique habitats. Some unauthorized use is occurring where road access is available. There is recent evidence of vehicles crossing through meadows along the Eddy Creek Road coming in from the lower end. This may be happening in other places.
- Poor placement of roads, trails and camping areas are adding to negative impacts to unique habitats such as changes in hydrology and trampling.

Conclusions

- Road maintenance along Road 42N17 has the potential to damage unique habitats such as Canadian buffalo-berry habitat and other wetlands that occur along the road.
- Improvements such as redesigning or developing new roads, trails or infrastructure needs to be done in such a way as to do no harm to unique habitats or to create opportunities for unauthorized OHV use. Trails should be designed to go along edges of wetlands and not through them.

Topic 2: Other Unique Habitats; serpentine barrens, ridge tops and alpine/subalpine talus slopes

Serpentine barren and ridge top habitats have been fragmented in many areas by past road and trail construction. Alpine/subalpine talus slopes are relatively undisturbed except where trails have been built. Trails have created soil compaction especially in areas that tend to be wet and destroyed plants. Illegal OHV use has created further disturbance in some open areas.

Causal Mechanism(s)

- Historical creation of roads and trails through open areas such as ridge tops and barrens fragmented many of these open habitats many of which provide habitat for sensitive, endemic and watch list plant species.
- Illegal OHV use has created some unofficial roads and trails which have also fragmented open habitats, destroying habitat for sensitive and watch list plant species as well as other open habitat species.
- An increase in visitor use has led to an increase in the creation of trails, roads and dispersed camping sites across all unique habitats including barrens, ridge tops and subalpine talus slopes.
- Creation of trails such as the Pacific Crest Trail has made it easier for more visitors to reach interesting botanical sites in the alpine/subalpine zone.

Trends

As visitor use increases, so does the creation of trails, roads, dispersed camping sites and other infrastructure across all unique habitats including barrens, ridge tops and alpine/subalpine talus slopes.

- Road maintenance will continue and possibly increase the fragmentation of open habitats such as barrens and ridge tops.
- Off-road vehicle disturbances will continue and may increase.
- An increase in user created trails and camp sites is expected as more people use the area for backpacking, hiking, and camping.
- An increase in visitors interested in the diversity of plants and habitats is expected.
- More people in the area hiking and camping will trample more vegetation including sensitive, endemic and watch list species.

Influences and Relationships

- Lack of access to many areas has kept disturbance to many open habitats to a minimum.
- Lack of access may be encouraging some visitors to create their own roads and trails creating more disturbance and fragmentation to these habitats.

Conclusions

- Improvements such as redesigning or developing new roads, trails or infrastructure needs to be done in such a way as to do no harm to unique habitats or to create opportunities for unauthorized OHV use.
- As far as ridge tops and barrens are concerned, most of the fragmentation occurred years ago, but may increase in the future due to road maintenance and new construction of roads and other infrastructure.
- There is a need for well-designed trails, roads and campgrounds so people don’t have to create their own.
- Serpentine barrens, ridge tops and alpine/subalpine talus slopes are currently being maintained in many areas of the watershed due to limited access.

Habitat Quality

Topic 1: Wildlife Species and Habitat

Present Condition

- Current habitat quality and species distribution has changed from historic conditions due to past logging and a lack of low to moderate-intensity fire. Past management practices and fire suppression within the mixed conifer type have created a dense mid-story canopy or a more tightly closed over-story canopy as well as accumulations of large amounts of dead and down woody debris. In the eastern portion of the watershed fire suppression has resulted in decadent brush fields that are lacking in nutritious vegetative growth.
- Habitat for late-seral species such as the northern spotted owl, goshawk, marten and fisher currently exists in the watershed and is of variable quality. There are both known locations and unconfirmed sightings for federally listed and candidate species within the watershed; four northern spotted owl activity centers and several confirmed and unconfirmed fisher sightings.
- Habitat for early-seral species such as deer currently exists in the watershed and is of low quality.
- Surveys for federally listed, FS Sensitive species or species of concern have not been conducted within the majority of the watershed, with the exception of specific areas for northern spotted owls and northern goshawks.
- There are no known caves within the watershed. This may suggest a lack of habitat for several bat species. There are adits in the area that are likely providing habitat for bats.

Causal Mechanism(s)

- Lack of low to moderate intensity fire has resulted in loss of early seral habitat and openings.
- Past and current vegetation management has altered habitats. Late-seral habitats have been replaced by early seral habitats (i.e. plantations). Past over story removal has resulted in a loss of late-successional characteristics in some stands.
- Habitats have been fragmented by the transportation system, irrigation developments and historic mining operations.
- Lake habitats have been enhanced by small dams. The enhancements have likely resulted in the replacement of some wetland or meadow habitats by lake habitat.

Trends

- Mid and late-seral stands will continue to mature, and large snags and downed logs will accumulate, causing an increase in habitat for species associated with large woody debris, such as forest carnivores (fisher, marten, etc.) and prey species (wood rats, rodents species, etc.).
- Subsequently, fuels will continue to accumulate over time, increasing the vulnerability of the habitat to high intensity, stand replacing fire and the potential loss of large blocks of mid and late-seral habitat.
- Stands containing early-seral brush/browse species will continue to become decadent, decreasing the palatability of forage and increasing the risk of high-intensity fire in areas

containing dense woody debris and extensive brush skeletons, leading to a subsequent loss of important forage habitat (for species such as deer, elk, and prey species).

Influences and Relationships

- Past timber harvest has influenced the relationships of species and their habitats in the watershed on both private and public lands within the watershed.
- Fire suppression has influenced the quality of habitat for both early and late-seral species.
- NSO critical habitat is a vital area for providing linkage and connectivity, and an opportunity for genetic interchange between the northern and California subspecies.

Conclusions

- Management should focus on activities that are compatible with the objectives of enhancement, protection, and promotion of high value habitat within the watershed.
- A lack of comprehensive surveys in the watershed prevents managers from providing site-specific recommendations geared toward the enhancement or protection of a specific species and its associated habitats.

Topic 2: Aquatic and Riparian Habitats

Present Condition

- Aquatic and riparian habitats are generally functional and in good condition; however some habitats have been impacted by roads, trails and legacy logging and mining activities.
- Aquatic habitats have been extensively influenced on the valley floor by reservoirs, diversions, grazing and historic mining activities.
- Most roads and trails in the watershed are not regularly maintained and as a result can impact hydrologic processes and water quality. Impacts from roads and trails can include stream crossing failures, interception and diversion of runoff on road and trail prisms, hill-slope gullying, and sedimentation.
- The overall condition of wet meadow habitats can be characterized as good and properly functioning. Many meadow habitats appear relatively undisturbed although it is likely that they experienced active grazing in the past.
- Some meadows have been impacted by OHV use. Problems with OHV use including rutting and compactions and are most severe in wet areas.
- Conifer encroachment is occurring in meadows but encroachment is hindered by slow rates of growth and spread.
- Drainage in some meadows, wetlands and seeps/springs has been affected by road cuts resulting in drying of some wetland areas and hill-slope erosion.

Causal Mechanism(s)

- Very little management has occurred in the watershed over the past 25 years resulting in a commensurate lack of road maintenance and a lack of Forest Service presence.
- Historic and current land-use practices including grazing, agriculture and mining are largely responsible for current water infrastructure (e.g. reservoirs, diversions) in watershed.

- No grazing or timber harvest activities have occurred on public lands in the watershed in the past 25 years which has likely resulted in improved meadow conditions (e.g. Tamarack Flat) and improvement of some riparian/aquatic habitats.
- Fire suppression has resulted in some conifer encroachment but the effects are relatively limited in scope.
- OHV off designated roads and trails has impacted some wet meadow habitats (e.g. Eddy Creek meadows).
- Recreation use is limited to relatively small user groups and tends to restrict recreation impacts to isolated areas.

Trends

- Road related erosion impacts to meadows and aquatic/riparian habitats have stabilized in most areas. Most meadows exhibit chronic signs of degradation from roads (e.g. gullies, deposition, incision, dewatering and associated off-road OHV use).
- Lack of maintenance and management has prevented any change in trends for road related impacts to aquatic and riparian habitats.
- Gradual improvement in meadow conditions in areas that were actively historically grazed.
- Wetlands and other riparian habitats that have been impacted by OHV use are likely experiencing similar impacts as past decades with no observable trend in condition (i.e. impacts are believed to be occurring at similar intensities as previous decades).
- Conifer encroachment continues to occur at a very slow rate. Conifer encroachment will continue to occur in the absence of fire or other restorative actions.

Influences and Relationships

- The transportation system in the watershed was constructed almost solely for the purpose of facilitating timber harvest activities. The decline of active management, particularly timber harvest, road construction, and grazing have allowed for the recovery of some areas that were degraded as a result of past activities.
- Lack of road maintenance has affected road condition as well as aquatic and riparian habitats. Lack of maintenance can exacerbate drainage and erosion issues. Poorly located roads contribute to drainage and erosion issues.
- Fire suppression may be affecting vegetation composition in meadows in addition to encouraging conifer encroachment.
- OHV related impacts to wet meadows are often associated with the existing road and trail network.
- Recreation activities (e.g. OHV use, dispersed camping) often occur in association with aquatic and riparian habitats particularly along streams, lakes and wet meadows.
- Lack of adequate facilities and poor sanitation practices may be impacting water quality in areas where recreation use is concentrated.

Conclusions

- Meadows, wetlands, seeps and springs on public lands in the Willow-Parks Watershed are generally functional and in good condition.
- Many riparian and aquatic habitats that are in a degraded condition have stabilized and are no longer actively eroding; however opportunities exist to restore degraded riparian and aquatic habitats, particularly those associated with roads and trails.
- There is a need to control unauthorized OHV access to aquatic and riparian habitats and to implement restoration actions in wet meadows, seeps and springs impacted by vehicles.
- There is a need to evaluate the ecological and vegetative condition of wet meadow habitats and implement actions that control conifer encroachment and restore the natural processes and functions associated with wet meadows.

Topic 3: Wetland/Riparian Habitats for Special Status Plants

Present Condition

- See Aquatic and Riparian Habitats for Wildlife above.
- Plant populations that have been visited recently appear to be doing well. Several populations have not been visited in many years and are in areas with little or no access.

Causal Mechanism(s)

- See Aquatic and Riparian Habitats for Wildlife above.

Trends

- See Aquatic and Riparian Habitats for Wildlife above.

Influences and Relationships

- See Aquatic and Riparian Habitats for Wildlife above.

Conclusions

- See Aquatic and Riparian Habitats for Wildlife above.
- Known sites for historical special status plants known to occur in the watershed need to be revisited to determine the condition of these populations.

Topic 4: Alpine/subalpine

Present Condition

- These habitats are generally in good condition except where they are dissected by trails and roads or have dispersed camping sites.
- Condition is not known in areas with no or limited access. Since most of the species are associated with rocky areas, hopefully conditions are good.
- Subalpine habitats have had more disturbance than alpine habitats; both are seeing an increase in recreation activity.

- Exclusion of fire has had little to no effect on these habitats because they rarely burned historically.

Causal Mechanism(s)

- Special status habitat generally occurs in rocky habitats.
- The increase in visitors has put more stress on these habitats by creating trails and campsites.
- The area is notable for its diversity of plant species and habitats. It has become a favorite place for people looking for wildflowers combined with beautiful scenery.

Trends

- Visitor use is increasing in these areas especially along the Pacific Crest Trail
- As visitor use increases so does the possibility of plant populations being trampled, or destroyed.

Conclusions

- Historical sites need to be revisited to determine their condition.

Topic 5: Ridge tops and Serpentine barrens and openings

Present Condition

- Many populations associated with these habitats may have been effected by road and trail creation.
- Many plant populations were found because they were growing along roads
- Exclusion of fire has had little to no effect on these habitats at higher elevations, but may have decreased the amount of habitat at lower elevations.
- Habitat for plants occurring along roads and trails, especially in the northern part of the watershed such as woolly balsamroot, are being maintained by road and trail maintenance instead of natural disturbances such as fire. There has been very little road or trail maintenance in the past 25 years.
- Many populations in the northern part of the watershed are on private land.
- Most populations occur along the southern and western boundaries of the watershed.

Causal Mechanism(s)

- Ridge tops and serpentine openings were considered excellent places to put roads and trails.
- Many populations were found because they grow along roads (easy and accidental botany).
- Ridge tops and serpentine barrens/openings especially at mid to alpine elevations tend to have shallow soils that don't support dense vegetation. These habitats do not carry fire well. Lower elevation populations may require more disturbances such as fire to maintain their open habitats.

Trends

- Most populations are probably in fairly good condition although many have not been revisited in 20 to 30 years.
- Use of roads and trails is increasing so the effects to these populations may also increase.

- Serpentine barrens/openings occurring along roads are frequently used for parking or for pulling off of the road. This activity may affect plants growing there.
- Road maintenance, especially along the Parks Creek Road, has the potential to destroy plants if surveys are not done prior to the work being started.

Conclusions

- More information is needed to know the condition of these plant populations. This will require surveys of known populations that occur along roads and trails and in serpentine barrens/openings.

Other Resource Topics

Topic 1: Legacy mining impacts – South Fork Willow Creek Drainage

Present Condition

- Legacy mining impacts in the South Fork of Willow Creek originating from past operations of the Dewey Mine have stabilized, however they may warrant further restoration or rehabilitation activities in order to prevent impacts to water quality and stream habitat that could occur in response to log dam failure or erosion of other disturbed sites located in close proximity to the South Fork of Willow Creek.

Causal Mechanism(s)

- Historic mining activities in South Fork Willow Creek drainage.

Trends

- The trend for the condition of aquatic and riparian habitats is static. Failure of the log dam on NFS land could impact channel conditions, fish habitat and water quality in the future.
- There is no past information on water quality trends for the South Fork of Willow Creek. Because disturbance has been non-existent in past decades, the trend for water quality is believed to be static over past 50 years.

Influences and Relationships

- Roads also have the potential to impact water quality in the South Fork of Willow Creek due to multiple low water crossings.
- Public access in the South Fork of Willow Creek drainage is very limited.

Conclusions

There is a need to continue on-going efforts to assess the potential for restoration legacy mines and mitigate future risks to stream channels and water quality.

Topic 2: Cultural Resources

Present Condition

- The presence/absence of Traditional Cultural Properties, Traditional Use Areas, or Sacred Areas is currently unknown, but ethnobotanical plants, wildlife, and fish historically obtained by the Shasta and other Tribes are present within the watershed.
- Historic maps, information from former Shasta-Trinity employees and limited survey of the watershed suggest that there are numerous cultural resources yet to be found.
- The current condition of most of the sites inside the watershed is not known because they have not been visited or assessed for impacts since their original documentation.
- Some of the recently-visited sites within the watershed have been susceptible to damage from human uses (logging, road construction and maintenance) and other ecosystem processes (erosion, natural deterioration, and collapse) inside the watershed. These activities in turn may have also affected water quality or will affect water quality if left unabated.
- Road maintenance activities on the privately owned and maintained segments of the Dewey Mine road, directly north of Dewey Mine, may have resulted in some disturbance to the historic Dewey Mine and may have also contributed to polluted runoff flowing into the South Fork of Willow Creek during storm events.
- There are many potential opportunities to interpret historic uses that occurred within the watershed, such as Native American use and occupation, early non-native settlers and miners, the history of Eddy Mountain Lookout, or information about the Trinity Heritage Scenic Byway.

Causal Mechanism(s)

- Currently, because of the paucity of recent projects being proposed for NFS lands in the watershed, tribal consultation about access or other concerns within the watershed has not occurred. It is unknown if local members of the Ahotire 'itsu Shasta or other Tribes use the watershed to obtain natural resources for food, ceremony, or utilitarian purposes.
- Surveys for cultural resources inside the watershed analysis area have previously been limited to timber sales, causing large areas within the analysis boundary to remain unsurveyed.
- Most of the sites have not been formally visited or monitored since their original documentation.
- Site records indicate that sites/features located on or near roads and trails have been more susceptible to damage from users of those routes, including road maintenance, vandalism from looting and impacts from modern camping.
- Erosion, deferred road maintenance and use causing damage to some sites.

Trends

- Knowledge about presence/absence of Traditional Cultural Properties, Traditional Use Areas, or Sacred Areas will continue to be unknown without open communications with the Tribes. These communications do not have to be via formal consultation for projects.
- New/additional inventory will not occur without new projects being proposed within the watershed.

- The condition of most of the sites within the watershed will continue to be unknown unless they are revisited for projects or for Prescription XI site monitoring.
- Natural erosion, weathering, fire activity, casual recreation, looting, road construction, and road reconstruction/maintenance will continue to impact sites over time.
- Drainage problems on the Dewey Mine Road through Dewey Mine will continue to have impacts to the historic site and the water quality of the Creek unless abated.
- Opportunities for interpretation will continue to slip away.

Influences and Relationships

- The amount of Tribal consultation, site visits, and survey coverage is project driven.
- Continued or improved recreational access to the watershed will increase negative impacts to cultural resources.
- Management activities such as prescribed fire, logging and road construction/maintenance have the potential to disturb or destroy known and unknown cultural resources.
- Continued neglect of the Dewey Mine Road will increase negative impacts to the historic mine and South Fork of Willow Creek.

Conclusions

- Identify Traditional Cultural Properties, and Sacred Areas, if present in the watershed.
- Partnerships/Agreements developed with interested Tribes could have beneficial effects to ethnobotanical and other natural resources within the watershed that may have been managed by Tribes in the past.
- There is a need for adequate survey for cultural resources within the entire watershed boundary to ensure an accurate inventory and to document previously unknown sites.
- Partnerships/Agreements with local land owners who maintain private roads through NFS lands such as the Dewey Mine Road could have beneficial effects to both the cultural resources and streams impacted by maintenance/runoff.
- There is a need to visit previously-recorded sites to update the site records and document impacts that may have occurred since the sites were originally recorded.

Chapter 6: Opportunities

This step discusses management opportunities within the context of each issue, key question and the conclusions generated in Step 5. Although presented within the context of the primary issue, many opportunities respond to multiple resource concerns.

Watershed Access (Roads and Trails) and Recreation

Topic 1: Access (Roads and Trails)

Conclusions from Chapter 5:

- There is a need to investigate and develop opportunities to facilitate public access to NFS lands around Dobkins, Durney and Little Crater Lakes that are compatible with private landowners.

- Investigate opportunities to improve portions of existing trails and/or develop a new trail system that provide access to NFS lands Dobkins, Durney, and Little Crater lakes.
- The condition and location of historic trail system that accessed areas like West Park Lakes is not known.
- Road 42N17 is in need of maintenance and should continue to be managed as a Scenic Byway.
- Opportunities exist to improve, redesign or develop a better road and trail access to Caldwell Lakes. Additional infrastructure improvements such as a trail head and parking area should be incorporated into designs.
- There is a need to compile visitor use data by implementing recreation use surveys and installing road counters on selected roads accessing recreation sites.

Opportunities:

- Develop Parks Creek trailhead to reduce crowding impacts and improve sanitation.
- Identify other viable access routes to NFS lands around Durney, Dobkins and Little Crater Lakes area in the headwaters of Dale Creek.
- Survey for recreation use and road use.
- Re-establish and maintain existing trails (e.g. West Park Lakes).
- Improve the 42N17 Road (resurfacing and maintenance).
- Implement TAP Recommendations.
- Storm proof drainage system on roads (e.g. upsizing culverts, armoring).
- Build turnouts on 42N17 Road.
- Research road Right of Way easements.
- Implementation to control OHV laws for illegal off road use in wet meadows, fens, etc.
- Identify opportunities to relocate or realign roads, trails and trailheads outside of active areas such as debris flow channels, landslides, and rock slides, and to avoid cultural resources.
- Identify cultural resources where roads or trails have impacted them in the past and identify opportunities to reduce future impacts such as placing sterile fill over roads or trails that go through sites, closing roads or trails, or rerouting roads or trails.
- Work with Tribes to identify roads and trails that they may use to access the Watershed, develop agreements or partnerships with them to keep the roads maintained.

Topic 2: Developed and Dispersed Recreation Access and Facilities

Conclusions from Chapter 5:

- There is a need to improve the Parks Creek Trailhead by increasing parking, providing adequate signage and providing sanitation facilities. Improvements that should be considered include an improved parking area, construction of rest rooms and installation of interpretive and information signs that conform to Accessibility Standards and Forest Service policy.
- There is a need for restoration of the road access and lower reaches of the trail system that accesses Caldwell Lakes.

- There is a need to increase Forest Service management presence in the watershed to better manage dispersed recreation and protect resources.
- There is a need to assess the amount and distribution of dispersed recreation use occurring in the watershed.

Opportunities:

- Implement measures to reduce impacts at dispersed campsites located adjacent to creek in Tamarack Flat.
- Develop a trailhead at Caldwell lakes with parking area, signs and interpretive information.
- Increase Forest Service presence with patrols in areas where most human use is occurring.
- Develop and implement inventory and use survey of dispersed recreation sites.

Visual Resources / Scenery

Conclusions from Chapter 5:

- Scenic quality and views could be improved by thinning the overstocked understory stands adjacent to Road 42N17 in select areas and by cutting some trees that block views to the valley in some locations.
- Safety and opportunities for viewing scenery could be improved by creating more pull outs on Road 42N17.
- Continue efforts to acquire privately owned lands to protect the visual resource for future generations as directed by Forest Plan.

Opportunities:

- Open views into the forest as well as distant views by thinning understory in overstocked stands along Road 42N17.
- Remove trees that block views to the valley from Road 42N17 in specific locations.
- Construct more traffic pull-outs on Road 42N17 not only to view scenery, but to increase safety.
- Acquire Sections 33 and 11 on Road 42N17 and Sections 7, 9 and 5 on Mt. Eddy to help protect scenery for future generations.

Vegetation and Fuels Management

Topic 1: Vegetation Management

Conclusions from Chapter 5:

- There is a need to maintain stand densities at levels that promote health and help prevent the chance of uncharacteristic wildfires in all stands.
- There is a need to incorporate diversity into the stands whenever necessary to prevent continued outbreaks of disease and insect attacks.
- There is a need to identify natural hardwood stands in the watershed. Where hardwood species naturally occur and are being outcompeted by the conifers, manage the conifers to promote the hardwood species.

- Past management practices have favored conifer establishment over hardwoods and other vegetation types with a resulting decrease of habitat for hardwood dependent species.
- There is a need to prioritize vegetation treatments in the watershed in order to make the best use of limited funding and resources available for such treatments.

Opportunities:

- Pre-commercial thin existing plantations and reduce hazardous fuel loading through brush treatment.
- Reduce understory fuel ladders within WUIs to increase stand resilience to wildlife events.
- Explore alternative funding sources for proposed vegetation treatments.
- Recommend continuing early detection and rapid response for treating new weed introductions in the watersheds. Continue efforts to contain invasive located on private off National Forests.
- Thinning treatments within plantations and natural stands should emphasize the retention of hardwoods and healthy conifers free of dwarf mistletoe infections.

Topic 2: Fire Exclusion

Conclusions from Chapter 5:

There is a need to:

- Manage fire within the analysis area to restore fire adapted ecosystems.
- Manage fire within the analysis area to protect property and improvements.
- Manage vegetation within the analysis area to restore ecosystem health.
- Protect the Wildland Urban Interface from uncharacteristic wildfire.
- Communicate with the public and other agencies regarding our activities.
- Coordinate our management activities with other agencies and organizations.

Opportunities:

- Fuel reduction should focus on the Wildland Urban Interface, then areas where high resource values are subject to high hazard and high risk, followed by those areas with the greatest fire return interval departure. Incorporate fuel reduction zone objectives, as outlined in the Fire Management Plan, in all vegetation and administrative planning efforts.
- Return fire to the ecosystem through the use of managed fire (both natural-ignition wildfires and prescribed fires) throughout the watershed analysis area to reduce fuels, improve forest health, and move the ecosystem toward historical conditions. Utilize fire to restore and maintain meadows and riparian areas. Historical fire return intervals may be maintained through planned or unplanned ignitions.
- Utilize a collaborative landscape approach with adjacent landowners, Tribes, and agencies to reduce the risk of uncharacteristic wildfire in the watershed Continue to work with the Fire Safe Council’s to coordinate projects across jurisdictional boundaries. Look for new opportunities to collaborate with additional land management organizations.
- Insure access during fire season and during periods of project implementation.

- Plan projects to allow prescribed fire at the landscape level. This may include burn-only treatments where mechanical treatments are not required or not feasible given other restraints with vegetation removal. Include multiple fire entries in the project decision document.
- Keep the public informed on Forest Service projects and management actions. This will be especially important as we modify fire management techniques to conform with new policy direction.
- Coordinate with Cal Fire regarding cross training, fire response, and current fire management policies on National Forest System lands, and fire management messages given to the public.

Habitat Quality

Topic 1: Wildlife Species and Habitat

Conclusions from Chapter 5:

- Management should focus on activities that are compatible with the objectives of enhancement, protection, and promotion of high value habitat within the watershed.
- A lack of comprehensive surveys in the watershed prevents managers from providing site-specific recommendations geared toward the enhancement or protection of a specific species and its associated habitats.

Opportunities:

- Partner with the California Department of Fish and Game, California Deer Association, Mule Deer Foundation, Rocky Mountain Elk Foundation and others to develop habitat enhancement projects for deer, elk and other early-seral wildlife species.
- Work with the U.S. Fish and Wildlife Service to implement the recovery action objectives as outlined in the Northern Spotted Owl Recovery Plan and critical habitat plans. Implement the recommendations in the Forest Wide LSR Assessment within the two LSRs located in the watershed. Update critical habitat maps in 2012 when USFWS issues new ruling.
- Partner with the California Department of Fish and Game, CalTrout, The Nature Conservancy, and others to develop habitat enhancement projects for anadromous fish within Parks Creek.
- Perform site-specific and species-specific surveys for federally listed or candidate species and Forest Service Sensitive or species of special concern and their potential habitats within the watershed in order to assess priorities for management actions or protections.

    - Examples of such surveys are:
        - Breeding bird surveys as no current presence/absence or abundance and distribution information is available.
        - Amphibian surveys within Parks Creek and Eddy Creek.
        - Goshawk and forest carnivores surveys in suitable mid and late-seral habitat.
        - Re-establish and expand past NSO surveys in an effort to determine to what extent the barred owl has impacted the area and whether known NSO activity centers have been affected.
        - Conduct aquatic mollusk surveys, particularly near springs and seeps that may be impacted by erosion or management actions.

- Evaluate current condition and capability of LSRs located in urban interface areas and develop management strategies to improve management of LSRs for multiple resource objectives (e.g. fire and fuels, recreation, habitat).

Topic 2: Aquatic and Riparian Habitats

Conclusions from Chapter 5:

- Meadows, wetlands, seeps and springs on NFS lands in the Willow-Parks Watershed are generally functional and in good condition.
- Many riparian and aquatic habitats that are in a degraded condition have stabilized and are no longer actively eroding; however opportunities exist to restore degraded riparian and aquatic habitats, particularly those associated with roads and trails.
- There is a need to control unauthorized OHV access to aquatic and riparian habitats and to implement restoration actions in wet meadows, seeps and springs impacted by vehicles.
- There is a need to evaluate the ecological and vegetative condition of wet meadow habitats and implement actions that control conifer encroachment and restore the natural processes and functions associated with wet meadows.

Opportunities:

- Impacts to wet meadows, fens, and channels are often associated with drainage problems on both roads and trails. Consider restoration needs for these habitats when planning and implementing road and trail restoration, closure, decommissioning or drainage improvement projects.
- Unauthorized vehicle use has impacted some wet meadows and riparian/aquatic habitats in the Eddy, Parks and Dale Creek drainages. Plan and implement actions to prevent unauthorized vehicle use and to restore meadow, and riparian/aquatic habitats that have been degraded by off-road vehicle use.
- Preserve meadow habitats by controlling conifer encroachment in Tamarack Flat and other meadows (e.g. meadows adjacent to Eddy Creek).
- Continue efforts to mitigate legacy mining impacts in Willow Creek drainage. Work with landowners to ensure access to South Fork Willow drainage for addressing legacy mining impacts.
- Evaluate opportunities to decommission roads and trails impacting sensitive habitats.

Habitat Quality – Special Status Plants

Topic 1: Meadow and Riparian Habitats

Conclusions from Chapter 5:

- See Aquatic and Riparian Habitats for wildlife above.
- More information is needed regarding the locations and viability of known sites for historical special status plants known to occur in the watershed.

Opportunities:

- See Aquatic and Riparian Habitats for wildlife above.
- There are many wetlands in the watershed that have not been surveyed for special status plants or classified. These areas should be surveyed and for special status plants and classified as to what type of wetland they are.

Topic 2: Alpine/subalpine Habitats

Conclusions from Chapter 5:

- Historical sites need to be revisited to determine their condition.

Opportunities:

- There is an opportunity to do surveys of these populations to determine their locations, size and condition.

Topic 3: Serpentine Barrens, ridge tops and other openings

Conclusions from Chapter 5

- Historical sites need to be revisited to determine their condition.

Opportunities:

- There is an opportunity to do surveys of these populations to determine their locations, size and condition.

Other Resource Topics

Topic 1: Legacy mining impacts – South Fork Willow Creek Drainage

Conclusions from Chapter 5:

- There is a need to continue on-going efforts to assess the potential for restoration legacy mines and mitigate future risks to stream channels and water quality.

Opportunities:

- Continue efforts to mitigate past environmental impacts from historic mining operations associated with the Dewey Mine.

Topic 2: Cultural Resources

Conclusions from Chapter 5:

- There is a need for timely (formal or informal) consultation with local Tribes about access concerns and uses and to ensure that Tribes have needed access to Traditional Use Areas, Traditional Cultural Properties, and Sacred Areas, if present in the watershed.
- Partnerships/Agreements developed with interested Tribes could have beneficial effects to ethnobotanical and other natural resources within the watershed that may have been managed by Tribes in the past.
- There is a need for adequate survey for cultural resources within the entire watershed boundary to ensure an accurate inventory and to document previously unknown sites.

- Partnerships/Agreements with local land owners who maintain private roads through NFS lands such as the Dewey Mine Road could have beneficial effects to both the cultural resources and streams impacted by maintenance/runoff.
- There is a need to visit previously-recorded sites to update the site records and document impacts that may have occurred since the sites were originally recorded.

Opportunities:

- Continue to Consult with Tribes to identify Traditional Use Areas, Traditional Cultural Properties, or Sacred Areas, within the watershed.
- Work with Tribes to enhance any identified Traditional Cultural Properties, Traditional Use Areas, or Sacred Areas.
- Conduct survey within the watershed boundary to inventory and document all cultural resources possible, update INFRA and GIS databases.
- Monitor documented sites to assess the current conditions and update the site records. Stabilize creek banks and roads associated with the erosion of cultural resources.
- Protect cultural resources against negative effects by limiting public use through the installation of barriers and by posting "No Camping" signs at sites that are attractive to campers.
- Install interpretive signs about prior human uses (such as the history of Native American uses, firefighting in the watershed or Mt. Eddy Lookouts) for public education at Parks Creek trailhead.
- Develop an interpretive brochure, CD or DVD for the Trinity Scenic Heritage Byway.

Bibliography

Anonymous. n.d. Mills of Southeastern Siskiyou and Northern Shasta Counties. MS on file, Mt. Shasta Ranger District Office, Mt. Shasta, CA.

Anonymous. n.d.a. Undated notes about a land exchange is Section 31 of T. 42 N., Range 6W. MS on file, Mt. Shasta Ranger District Office.

Anonymous. 1970. Gold Districts of California. California Division of Mines and Geology, Bulletin 193.

Arora, D. 1986. Mushrooms Demystified (2nd Ed.). Berkley, CA: Ten Speed Press.

Averill, Charles B. 1935 . Mines and Mineral Resources in Siskiyou County. IN Thirty-first Report of the State Mineralogist, California Division of Mines, Pp. 255-338.

Baldwin, B. G., Goldman, D. H., Keil, D. J., Patterson, R., Rosatti, T. J., and Wilden, D. H. (eds.). 2012. The Jepson Manual Vascular Plants of California (Second Edition). Berkley and Los Angeles, CA: University of California Press.

Banci, V. 1994. Wolverine. In: Ruggiero, L.F.; Aubry, K.B.; Buskirk, S.W.; Lyon, L.J.; Zielinski, W.J., tech. eds. The scientific basis of conserving forest carnivores, American marten, fisher, lynx, and wolverine in the Western United States. Gen. Tech. Rep. RM-254. Ft. Collins, CO: U.S.Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experimental Station, 99-123.

Betts, D. 1985. Archeological Digs on Proposed Ager Road Site. IN Siskiyou Pioneer, 5(8): P. 64.

Bliss, Richard and Hellen Bliss. 1981. The Sisson Fish Hatchery. IN Siskiyou Pioneer, 5(4): Pp 142-150.

Briggs, J.L., Sr. 1987. Breeding Biology of the Cascade Frog, Rana cascadae, with Comparisons to R. aurora and R. pretiosa. Copeia 1987 (1):241-245.

Brown, GC. 1915. California State Mining Bureau, 14th Report of the State Mineralogist. P. 87.

Byways.org website. n.d.

California Department of Fish and Game. 1985. McCloud Flats Deer Plan. Planning Cooperators include the U.S. Forest Service, U.S. Bureau of Land Management and U.S. Park Service. 70 pp.

California Department of Fish and Game (CDFG). 1997. A biological needs assessment for anadromous fish in the Shasta River, Siskiyou County, California. California Department of Fish and Game, Northern California-North Coast Region. Redding, CA. 29 pp.

California Department of Fish and Game, 2009. Shasta River Watershed-Wide Permitting Program, Final Environmental Impact Report, FEIR Volume 1: Revisions to the Draft EIR Text, Chapter 3.2: Geomorphology, Hydrology and Water Quality.

California Department of Fish and Wildlife. 2013. California Department of Fish and Wildlife BIOS California Natural Diversity Database (CNDDB) accessed on 12/10/2013

California Division of Mines. 1955. Chromite in California IN Mineral Information Service Volume 8 (10). State of California, Department of Natural Resources, Division of Mines.

California Native Plant Society (CNPS). 2012, Inventory of Rare and Endangered Plants (online edition, v8-01a). California Native Plant Society. Sacramento, CA. Accessed between October 1 and October 24, 2012; http://www.cnps.org/cnps/rareplants/

California Office of Historic Preservation, Department of Parks and Recreation. 1989. Letter regarding the National Register eligibility of Sheep Camp Cabin and Mine (FS site no. 05-14-59-299). Reference number USFS890818B. On file, Mt. Shasta Ranger District Office.

California Office of Historic Preservation, Department of Parks and Recreation. 2003. Letter to John Shilling, Director of Public Use and Facilities, USDA Forest Service, Pacific Southwest Region, R5, regarding Section 106 Consultation on the non-eligible fire lookouts in Region 5, Pacific Southwest Region. Reference number USFS891005B. On file, Mt. Shasta Ranger District Office.

California Regional Water Quality Control Board, North Coast Region, 2006. Resolution No. R1-2006-0052. Amending the Water Quality Control Plan for the North Coast Region to Include the Action Plan for The Shasta River Watershed, a Major Tributary to the Klamath River, Temperature and Dissolved Oxygen, Total Maximum Daily Loads. 31 p.

Carroll, C., W.J. Zielinski, and R.F. Ross. 1999. Using Presence-absence Data to Build and Test Spatial Habitat Models for the Fisher in the Klamath Region, U.S.A. Conservation Biology 13 (6):1344-1359.

Cassidy, Julie and Brad Coombs. 1994. Site record for Mt. Eddy Lookout. MS on file, Mt. Shasta Ranger District.

Cassidy, Julie. Personal Communication, November 5, 2012.

Castellano, M. A. and O'Dell, T. 1997. Management Recommendations for Survey and Manage Fungi (version 2). US Department of Agriculture and US Department of the Interior.

Chesney, W.R. 2005. Personal communication with Bill Chesney of the California Department of Fish and Game via email with Katherine Carter (Regional Water Board Staff) on December 19, 2005 for Shasta River TMDL report.

Chinn. 1969. The Chinese in California. San Francisco: Chinese Historical Society of America. Pp. 31-32.

Daniels, Mark L., Anderson, R. Scott, and Whitlock, Cathy. 2004. Vegetation and fire history since the Late Pliestocene from the Trinity Mountains, northwestern California, USA. In: The Holocene 15,7 (2005) pp. 1062-1071.

Dixon, Roland B. 1907. The Shasta. Bulletin of the American Museum of Natural History. 17(5): 381-498.

DWR, 2009. California Water Plan Update 2009. North Coast, Integrated Water Management, Volume 3. Bulletin 160-09.

Elder, Don, de la Fuente, Juan, Bell, Angie, Mikulovsky, Ryan, Stevens, Melanie, Levitan, Fred. 2012. An Introduction to the Geology of the Klamath, Mendocino, Shasta Trinity, and Six Rivers National Forests in Northwestern California Draft March 22, 2012.

Elliott, Daniel. 1991. Site record for FS site 05-14-59-358. MS on file, Mt. Shasta Ranger District Office, Mt. Shasta.

Esping, Amy. 1979. Site record for 05-59-142. MS on file, Mt. Shasta Ranger District Office, Mt. Shasta.

Esping, Amy. 1979a. West Parks Creek Timber Sale. ARR 05-14-371. MS on file, Mt. Shasta Ranger District Office, Mt. Shasta.

FEMA, 2011. Flood Insurance Study, Siskiyou County, California and Incorporated Areas, Flood Insurance Study Number 06093CV000A, p. 20.

Forsman, E.D., E. C. Meslow, and H.M. Wight. 1984. Distribution and Biology of the Spotted Owl in Oregon. Wildlife Monographs. 87:3-64.

Foulke, Lewis M., James Farraher, and Edson L. Foulke, jr. 1960. The Big Ditch: A History of the Old Big Ditch to Yreka, Now Known As the Edson-Foulke Yreka Ditch Company Ditch. IN: Siskiyou Pioneer, 3(3): Pp. 47-50.

Frederickson, D. 1974. Cultural Diversity in Early Central California. UC Berkeley. Pp. 41-53.

Gray, Bob and Herman Barr. 1981. U.S. Forest Service. IN: The Siskiyou Pioneer 5 (4), pp. 135-138.

Grinnell, J. & Miller. A. H. 1944. The distribution of the birds of California. Cooper Ornithological Club. Berkeley, CA.

Hall, P. A. 1993. A comparison of nest sites of the northern goshawk in Arizona and California [Abstract only]. J. Raptor Res. 27: 72. Holland, D.C. 1991. A synopsis of the ecology and status of the western pond turtle (Clemmysmarmorata) in 1991. Unpublished report prepared for the U.S. Fish and Wildlife Service.141 pp.

Harmon, Jerry. Personal Communication, January 8, 2013.

Harmon, Jerry. n.d. Historical Locations on the Mt. Shasta Ranger District. MS on file, Mt. Shasta Ranger District Office, Mt. Shasta, CA.

Heizer, Robert. 1978. (ed) Handbook of North American Indians, Volume 8. Washington DC: Smithsonian Institution, pp. 37-57, 324-340, 211-224.

Heizer, Robert and Hester. 1970. Shasta Villages and Territory. University of California Archaeological Research Facility. Pp. 133-144.

Herzog, Frank. 1957. The Big Ditch. IN Siskiyou Pioneer, 2(10): Pp. 68-69.

Hill, Dustin. Personal Communication, October 4, 2012.

Hoertling, Gerald and Elaine Sundahl. 1987. South Willow Timber Sale, ARR 05-14-821. MS on file, Mt. Shasta Ranger District Office, Mt. Shasta.

Holland, D.C. 1991. A Synopsis of the Ecology and Status of the Western Pond Turtle (Clemmys marmorata) in 1991. Report to National Ecology Research Center, USFWS, San Simeon, CA.

Holt, Catherine. 1942. Shasta Ethnography. IN Anthropological Records Vol. 13 (4), Berkeley, CA. Pp 32-33.

Johnson, Leslie, and Darren Putty. 2010. Monitoring Form for Mt. Eddy Lookout. On file, Mt. Shasta Ranger District Office, Mt. Shasta, CA.

Klamath River Information System (KRIS). 2006. KRIS Klamath Chart Table Page, Shasta Racks data 1930-2002. Available at http://www.krisweb.com.

Krieger, Julie. 1985. Archaeological Reconnaissance of the Eddy Meadows Resort, Siskiyou County, California. MS on file, Mt. Shasta Ranger District Office, Mt. Shasta.

Krieger, Julie. 1989. Written notes about chromite mining. MS on file, Mt. Shasta RD office.

Kroeber, A. L. 1953. Handbook of the Indians of California. Berkeley: California Book Company.

Lindsley-Griffin 1982. Structure, Stratigraphy, Petrology, and Regional Relationships of the Trinity Ophiolite, University of California, Davis; Phd Dissertation.

Martin, Ilse B., David T. Hodder and Clark Whitaker. 1980. Overview of the Cultural Historical Resources of Euroamerican and Other Immigrant Groups in the Shasta-Trinity National Forest. Report prepared for the Shasta-Trinity National Forest by Geo-Scientific Systems and Consulting, Plaza del Rey, CA.

McDonald, Clarence. 1978. Eddy Creek Timber Sale. ARR-05-14-43. MS on file, Mt. Shasta Ranger District Office, Mt. Shasta.

McMaster, Georganne, Matthew Woods, and Darren Putty. 2010. Site Monitoring Form for Sheep Camp Cabin and Mine, FS site number 05-14-59-299. MS on file, Mt. Shasta Ranger District Office, Mt. Shasta.

Meighan, Clement W. 1955. Archaeology of the North Coast Ranges of California. University of California Archaeological Survey, Berkeley, CA. Pp. 32-33.

Merriam, C. Hart, USDA Division of Biological Survey. 1899. North American Fauna No. 16. Results of a Biological Survey of Mt. Shasta. Washington Government Printing Office.

Miller, R., Bates, J. D., Svejcar, T. J., Pierson, F. B., Eddleman, L. E. 2005. Biology, Ecology, and Management of Western Juniper. Technical Bulletin 152. Oregon State University, Agricultural Experiment Station.

Mineral Survey, 3953, Shasta-Trinity National Forest. On file in Mount Shasta District Office.

Mineral Survey 4485, Shasta-Trinity National Forest, n.d. On file in Mount Shasta District Office.

Mohr, Jerry Ann, 1997. Postglacial Vegetation and Fire History Near Bluff Lake, Klamath Mountains, California. A Thesis Presented to the Department of Geography and the Graduate School of the University of Oregon in partial fulfillment of the requirements for the Degree Masters of Science December, 1997.

Moriarty, Katie. 2008. Oregon State University Graduate Project photo station. Truckee, Ca.

Moyle, P.B. 2002. Inland Fishes of California, 2nd Edition. Berkeley and Las Angeles, CA. University of California Press

Mt. Shasta Herald. October 11, 1887.

Mt. Shasta Herald. July 31, 1913

National Fire Plan. 2000. Accessed from http://www.forestsandrangelands.gov/resources/overview/

National Forest Landscape Management. June 1976. The Visual Management System, California Region Landscape Character Types and Variety Class Criteria, 2 (1): 19.

National Research Council (NRC). 2003. Endangered and Threatened Fishes in the Klamath River Basin: Causes of Decline and Strategies for Recovery. The National Academies Press. Washington, D.C. 378 pp.

National Wildfire Coordinating Group (NWCG). Glossary. Accessed from http://www.nwcg.gov/var/glossary

Price, L. Dean. 1991. Dewey Mine Access Road. MS on file, Mt. Shasta Ranger District Office, Mt. Shasta.

Prather, Rita Boyle. 1957. John F. Boyle and His Mines. IN Siskiyou Pioneer, 2(10): Pp. 75-78. Yreka: Siskiyou County Historical Society.

Rosborough, Alex J. 1947. The Big Ditch. IN: Siskiyou Pioneer, 1(2): Pp. 1-3.

Ruggiero, L. F., K.B. Aubrey et al. 2004. The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx, and Wolverine in the Western United States. Fort Collin, Colorado, USDA Forest and Range Experimental Station.

Ryan, Robert L. 2005. Social Science to Improve Fuels Management: A Synthesis of Research on Aesthetics and Fuels Management. General Technical Report NC-261. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 58 p.

Schempf, P. F., and M. White. 1977. Status of six furbearer populations in the mountains of northern California. USDA Forest Service. Region 5. CC. 51pp.

Scott, J.H., Burgan, R.E. 2005. Standard fire behavior fuel models: A comprehensive set for use with Rothermel's surface fire spread model. General Technical Report RMRS-GTR-153. USDA Forest Service. Rocky Mountain Research Station, Ft. Collins, CO.

Sedgwick, James A. 2000. Willow flycatcher (Empidonax traillii), Birds of North America Online (A. Poole, Ed.), Ithaca: Cornell Lab of Ornithology. Retrieved from the Birds of North America Online. http://bna.birds.cornell.edu/bna/species/533

Shasta-Trinity National Forest. n.d. Land Status Maps for the Shasta National Forest. On File, Mt. Shasta Ranger District Office, Mt. Shasta, CA.

Shraeder, George. n.d. Earliest Hudson Bay Trappers' Trail Through Shasta County. Pp. 607-609. MS on File, Mt. Shasta Ranger District Office, Mt. Shasta, CA.

Shuster, W. C. 1980. Northern goshawk nest site requirements in the Colorado Rockies. West. Birds11: 89-96.

Silver, Shirley. 1978. Shastan Peoples. In Handbook of North American Indians, California, Volume 8: 211-224. Robert F. Heizer, editor. Washington DC: Smithsonian Institution.

Sisson Headlight. August 19, 1920. F.A. Nixon takes lookout post on Mt. Eddy.

Sisson Headlight. October 14, 1920. Storm plays havoc with Eddy Station

Skinner, C.N., and Taylor, A.H. 2006. Southern Cascades Bioregion. Sugihara, N. G., Van Wagtendonk, Jan W., Shaffer, K. E., Fites-Kaufman, J., and Thode, A. E. (Eds.), *Fire in California's Ecosystems* (195-224). University of California Press, Berkeley.

Speiser, R. and T. Bosakowski. 1987. Nest trees selected by northern goshawks along the New York-New Jersey border. Kingbird 39: 132-141.

Stevenson, Larry. Personal Communication, November 14, 2012.

Strand, Rudolph G. 1963. Geologic Map of California – Weed Sheet. California Division of Mines and Geology, San Francisco.

Stubbs, R. L. and Patterson, R. 2013. Revisions in *Polemonium* (Polenmoniaceae): A New Species and a New Variety from California. Madrono, 60 (3): 243-248.

Squires, John R. and Richard Reynolds. 1997. Northern Goshawk (Accipter gentilis) Birds of North America Online (A. Poole, Ed.), Ithaca: Cornell Lab of Ornithology. Retrieved from the Birds of North America Online. http://bna.birds.cornell.edu/bna/species/298.

Sugihara, N. G., Van Wagtendonk, Jan W., Shaffer, K. E., Fites-Kaufman, J., and Thode, A. E. (Eds.). 2006. "Fire in California's Ecosystems". University of California Press.

Sundahl, Elaine. 1986. Eddy Timber Sale. Archaeological Reconnaissance Report No. 05-14-793. MS on file, Mt. Shasta Ranger District Office, Mt. Shasta.

Sundahl, Elaine and Julie Krieger. 1986. Site record for 05-14-59-318. MS on file, Mt. Shasta Ranger District Office, Mt. Shasta.

Taylor, A.H., Skinner, C.N. 1998. Fire history and landscape dynamics in a late-successional reserve, Klamath Mountains, California, USA. Forest Ecology and Management. 111. pp.285-301.

Tetra Tech EM Inc. 2007. Final Combined Preliminary Assessment/Focused Site Inspection Report, Dewey Mine, Siskiyou County, California.

The North Star. July 16, 1887.

USDA Forest Service, 1993. Parks Creek Monitoring, Preliminary Report, unpublished, 4 p.

USDA Forest Service. 1994. Northwest Forest Plan Record of Decision.

USDA Forest Service. 1995. Shasta-Trinity National Forests Environmental Impact Statement Land and Resource Management Plan (LRMP). Redding, CA

USDA Forest Service. 1995. Shasta-Trinity National Forest Land and Resource Management Plan. Redding, CA.

USDA Forest Service. 1999. Shasta-Trinity NF Forest Wide LSR Assessment. Redding, CA pp. 2-85 and 2-88.

USDA Forest Service. 2000. Water Quality Management for Forest System Lands in California Best Management Practices. Pacific Southwest Region. pp1-138.

USDA Forest Service, Pacific Southwest Region. 2007. Sensitive Animal Species by Forest. Updated as of June 1998, Appended 6 March 2001, 7 May 2003, April 2004, 3 March 2005 and 15 October 2007.

USDA Forest Service. 2011. Forest Health Protection Flight Data. Conducted by B. Oblinger, R. Noyes & Z. Heath on August 23-24 and September 20-21, 2011.

USDA Forest Service. 2011. Sediment Source Inventory and Roads Analysis Process Report, Shasta-Trinity National Forest, Shasta River Headwaters. Prepared by North State Resources. 28 p. and appendices.

USDA Forest Service. 2012. Roads Condition Assessment - Forms.

USDA Forest Service. 2012a. Shasta-Trinity NF. Goshawk Wildlife files (1989-2011). Mt. Shasta, CA.

USDA Forest Service. 2012b. Shasta-McCloud Management Unit Northern Spotted Owl Survey Records (1989-2011). Mt. Shasta, CA.

USDA Forest Service. 2013. R5 Sensitive Species List 2013.

USDA NRCS. 2012. Buffaloberry *Shepherdia canadensis*. Accessed on October 18, 2012 from http://www.fs.fed.us/database/feis/plants/shrub/shecan/all.html

USDI Fish and Wildlife Service. 1989. Federal Register. Endangered and Threatened Wildlife and Plants; Proposed Threatened Status for the Northern Spotted Owl; Proposed Rule. Vol. 54; No. 120 pp. 26666-26677. June 23, 1989.

USDI Fish and Wildlife Service. 1991. Federal Register. Endangered and Threatened Wildlife and plants; Proposed Determination of Critical Habitat for the Northern Spotted Owl; Proposed Rule. Vol. 56; No. 87 pp. 20816-20862 May 6, 1991.

USDI Fish and Wildlife Service. 1992. Federal Register. Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for the Northern Spotted Owl; Final Rule. Vol. 57. No. 10 pp. 1796-1838. January 15th, 1992.

USDI Fish and Wildlife Service, 2008. Federal Register. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the Northern Spotted Owl, Final Rule. Vol. 73; No. 157 Pp. 47326-47522.

USDI Fish and Wildlife Service. 2010a. Bald Eagle Conservation. http://www.fws.gov/midwest/eagle/

USDI Fish and Wildlife Service. 2010b. Wolverine to be Designated a Candidate for Endangered Species Protection. News release email from Jane Chorazy@fws-gov dated December 13, 2010.

USDI Fish and Wildlife Service. 2011. Recovery Plan for the Northern Spotted Owl (Strix occidentalis caurina) Region 1 Portland, Oregon. 258 pp.

USGS, Waananen, A.O., and Crippen, J.R., 1977. Magnitude and Frequency of Flood in California, Water-Resources Investigation 77-21, 96 p.

US Geological Survey. n.d. Website, http://minerals.usgs.gov/plan/2006-2010/background.html

Vaughn, Trudy. 1985. Caldwell Salvage Sale. MS on file, Mt. Shasta Ranger District Office, Mt. Shasta.

Wales, Joseph H. 1947. Field Research Committee Report. IN: Siskiyou Pioneer, 1(2): 40

Wells, Harry L. 1981. History of Siskiyou County, California. Oakland: D.J. Stewart and Co.

Wells and Cates. 1950. Chromite Deposits of Siskiyou County, CA. [[NEED TO GET BETTER BIBLIO INFO]]

Williamson, M.D. 1943. Timber Resource Map, Sacramento District. Map on file, Shasta-Trinity Ranger District Office.

Winthrop, Kathryn and Robert Winthrop. 1983. Archaeological Site Survey Report for Section 17, T. 41N., R. 5W.

Winthrop, Robert. 1986. Survival and Adaptation Among the Shasta Indians. Report prepared for the Klamath National Forest, Yreka.

Zeiner, D.C, W.F. Laudenslayer Jr., K.E. Mayer and M. White. 1990. California Statewide Wildlife Habitat Relationships System. California's Wildlife; 3 vol. California Dept. of Fish and Game, Sacramento, CA.

Zielinski, William J, Keith M. Slauson, Carlos R. Carroll, Christopher J. Kent, and Donald Kudrna. 2001. Status of American martens in coastal forest of the pacific states. Journal of Mammalogy 82(2):478-490.

Acronyms

CNDDB-California Natural Diversity Database

CNPS-California Native Plant Society

FEIS-Fire Effects Information System

FH – Forest Highway

FRID-Fire Return Interval Departure

FSR – Forest System Road

FTS-Forest Transportation System

FWS – Fish and Wildlife Service

LRMP – Land Resource Management Plan

LSR – Late-Successional Reserve

MLSA – Managed Late-Successional Areas

NFMA-National Forest Management Act

NFS – National Forest System

NPS-Nonpoint Source

NRIS – Natural Resource Information System

NSO – Northern Spotted Owl

NWCG-National Wildlife Coordinating Group

OHV – Off Highway Vehicle

SMA – Strategic Minerals Act

SMS – Scenery Management Systems

SIA – Special Interest Area

SSI-Sediment Source Inventories

TMDL- Total Maximum Daily Load

VMS – Visual Management System

VQO – Visual Quality Objectives

WA – Watershed Analysis

WPA – Works Progress Administration