HORSE CREEK WATERSHED ANALYSIS

CHAPTER 3

HISTORIC, CURRENT, AND FUTURE TRENDS

OVERVIEW OF GEOLOGIC RESOURCES

Introduction

The Horse Creek Watershed is a complex and highly diverse assemblage of biotic and abiotic components (Map 3-1). These components influence the type and abundance of ecosystems present and how they respond temporally and spatially to disturbance events. Understanding these ecosystem resources requires an interpretation of the natural disturbance regimes that have resulted in the current topography and geomorphic landforms.

Valley Stress Relief

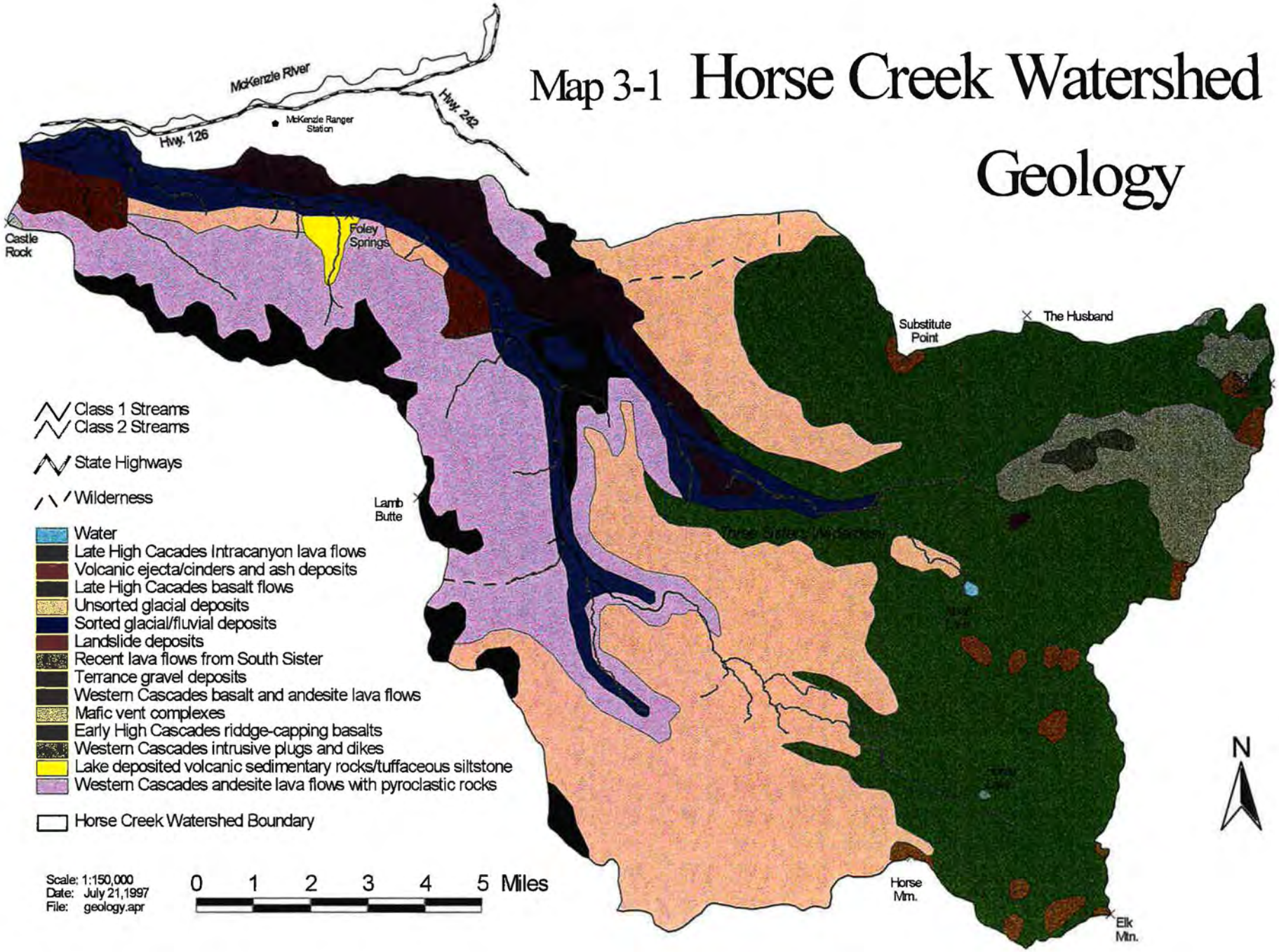
The collapse of valley sideslopes and the resulting talus and deep colluvial toe slopes is the result of valley stress relief and elastic rebound. These conditions, which are conducive to mass wasting, are prevalent in Separation Creek. Differential weathering occurs in rock masses that are layered with alternating rock of different strength, such as sandstone and shale sequences; basalt flows over glacial till; ridge-capping basalts overlying pyroclastic rocks (such as in Lower Horse Creek); or the inter-canyon lava flows of Foley Ridge. In these situations, the lower-strength, underlying material weathers at a faster rate than the overlying material, resulting in an overhang. The imbalance eventually results in failure of the overhang, which can cause mass failure of the slope.

Alpine Glacial Processes

During the Pleistocene (1.6 my bp to 12,000 yrs. bp) at least three major changes of climate (perhaps more than a dozen) produced a High Cascade ice field that completely covered all but the highest of the Cascade volcanoes (Birchfield et. al 1981). The ice sheet eventually moved down the valleys on both sides of the Cascades and into Separation and Horse Creek, causing scour and valley side slope stress. These advances were followed by retreats of the ice, which resulted in landslides from stress relief and outwash flooding.

During glacial retreat, deposition also occurs along valley sidewalls. This deposited material fell on top of the ice mass at the lateral margins then became stranded on the

Map 3-1 Horse Creek Watershed Geology



valley side slopes after the ice melted. It may remain in a marginal state of slope equilibrium, and may be susceptible to failure with very little geometric modification, such as road construction or stream scour. Geomorphic features produced by glacial scour and morainal blockage of streams in the higher elevations include most of the high elevation basins of this watershed. Other features produced include cirques (depressions left by ice), cols (saddles between ridges formed by coalescing glaciers), and tarns (peaked spires).

Fire Processes

Fires of low, moderate, and high intensities have historically occurred throughout this watershed. Low and moderately intense fires leave the majority of the surface litter and vegetation, and generally do not produce hydrophobic conditions or barren soil over large, continuous areas. In comparison, high intensity fires kill the majority of the live vegetation, combust much of the surface litter, seed stores, and fine roots, and can create hydrophobic conditions over relatively large, continuous areas. Swanson (1979) cites that "almost 70 percent of long-term sediment yield ...occurs in the first year after fire...." Amaranthus and Trappe (1993) found that 2 to 4 cm. (0.5 to 1.0 inches) of soil loss can occur during a single sustained rainfall event following stand replacement fires. Selective erosion removes trace nutrients, seed stores, and mineral clay particles which limits the establishment and survival of the conifer seedlings. Prior to fire suppression in this watershed, moderate and high intensity fires probably resulted in high sediment loads, due to the presence of soils sensitive to surface erosion.

Fire, especially of high intensities where tree mortality is greater than 70%, has four direct impacts on slope stability:

1) root strength is removed from the soil as root systems are burned underground and/or from root decay following mortality of the stand;
2) macropores are opened in stump holes leaving large cavities for water infiltration;
3) evapotranspiration becomes negligible;
4) tree surcharge, which adds a stability component to the slope, is removed.

OVERVIEW OF SOIL RESOURCES

Approximately 86% (87,588 acres) of the soils within this watershed are suitable for timber production (Map 3-2). This includes approximately 22,438 acres of Site Class II-III and 65,151 acres of Site Class IV-V soils. Cold, high elevation soils (SRI 73, 91, 910, and 920), those relatively low in productivity, and those which are potentially unstable, are also considered suitable for timber production. The Matrix allocation is almost entirely occupied by suitable soils. The LSR is dominated by suitable soils, but nearly

20% of the area in unsuitable SRI 3, 6, 21OU, and 61OU soil types. The wilderness is occupied by cold high elevation soils. Although unsuited soils support forest ecosystems, they pose unique challenges for managed forest regeneration and road construction.

There are 1318 acres of SRI units 310U and 610U in this watershed, which all fall within wilderness or late successional reserve allocations which prohibit or severely limit timber harvest. These soils are considered unsuitable for timber production due to difficulty of successful regeneration under a clear cut harvest regime. Several harvest units on these soils on south facing slopes have been successfully re-generated, however, not without multiple planting efforts.

There are approximately 5164 acres of slopes greater than 70%, which would be difficult to harvest without increasing the likelihood of slope failure. In the Lower Horse Creek area, steep slopes form the canyon walls along Separation Creek and southwest portions of Horse Creek (Map 3-3). These areas fall within the wilderness and late successional reserves where timber harvest is prohibited or very restricted. Silvicultural prescriptions (uneven-aged prescription, high green tree retention), road design (full bench/end haul) or road alignments (shallower slopes) can be crafted to limit or mitigate the potential of slope failures in these steep areas. Landform types and soils with greater than Slope Stability Class III on slopes steeper than 70% have the greatest potential of failure that could result in debris torrents (Map 3-3). In general, shallow mantled soils on slopes greater than 70% pose the greatest potential of failure. Fine textured soils (SRI 235 and 25) are uncommon and are associated with earthflow terrain. These soils are generally very productive, however, harvest can initiate slow moving rotational earthflows. These soils are also susceptible to compaction where slopes are shallow enough for ground based yarding systems. Map 3-4 displays the locations of previously documented landslides.

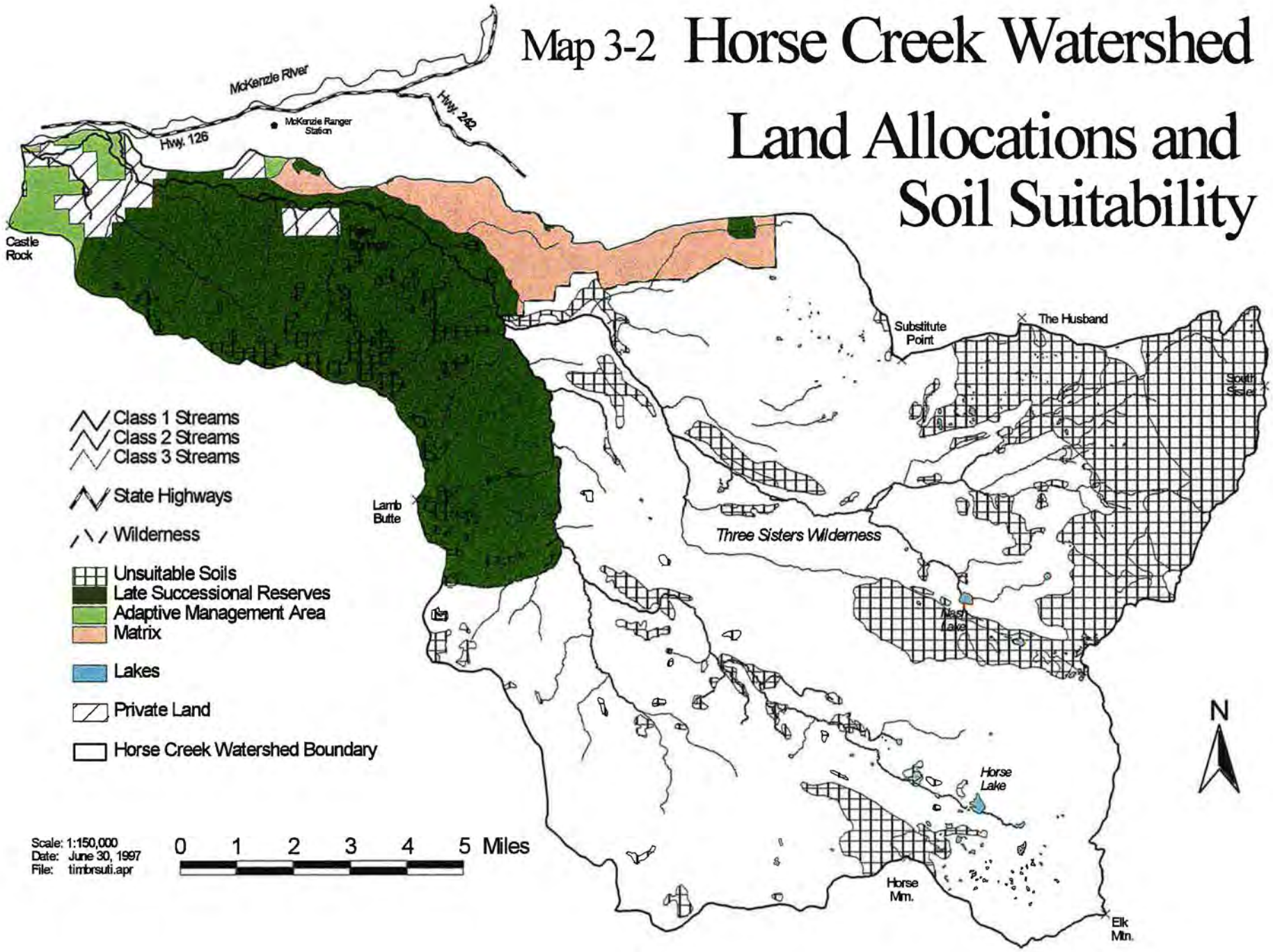
Although areas of steep slopes are often where unsuitable soils occur, they are not synonymous. Within the LSR, there is a relatively high correlation between 3, 6, and 61OU soils with steep slopes, where as in the wilderness, unsuitable soils are associated with wetlands, very cold, low productivity soils, and in recent volcanic ejecta.

Slope Stability and Historic Disturbance

In general, the highest incidents of mass wasting have occurred in the lower Horse Creek drainage. This is because the landform is located in the glacially-scoured valleys of Western Cascade and Early High Cascade ridge-capping volcanics. These areas consist of hydrothermally altered basalts and pyroclastic rocks that are more susceptible to weathering and decomposition. Recent failures in the wilderness of this watershed have generally been due to high intensity storms or rain-on-snow events

Map 3-2 Horse Creek Watershed

Land Allocations and Soil Suitability



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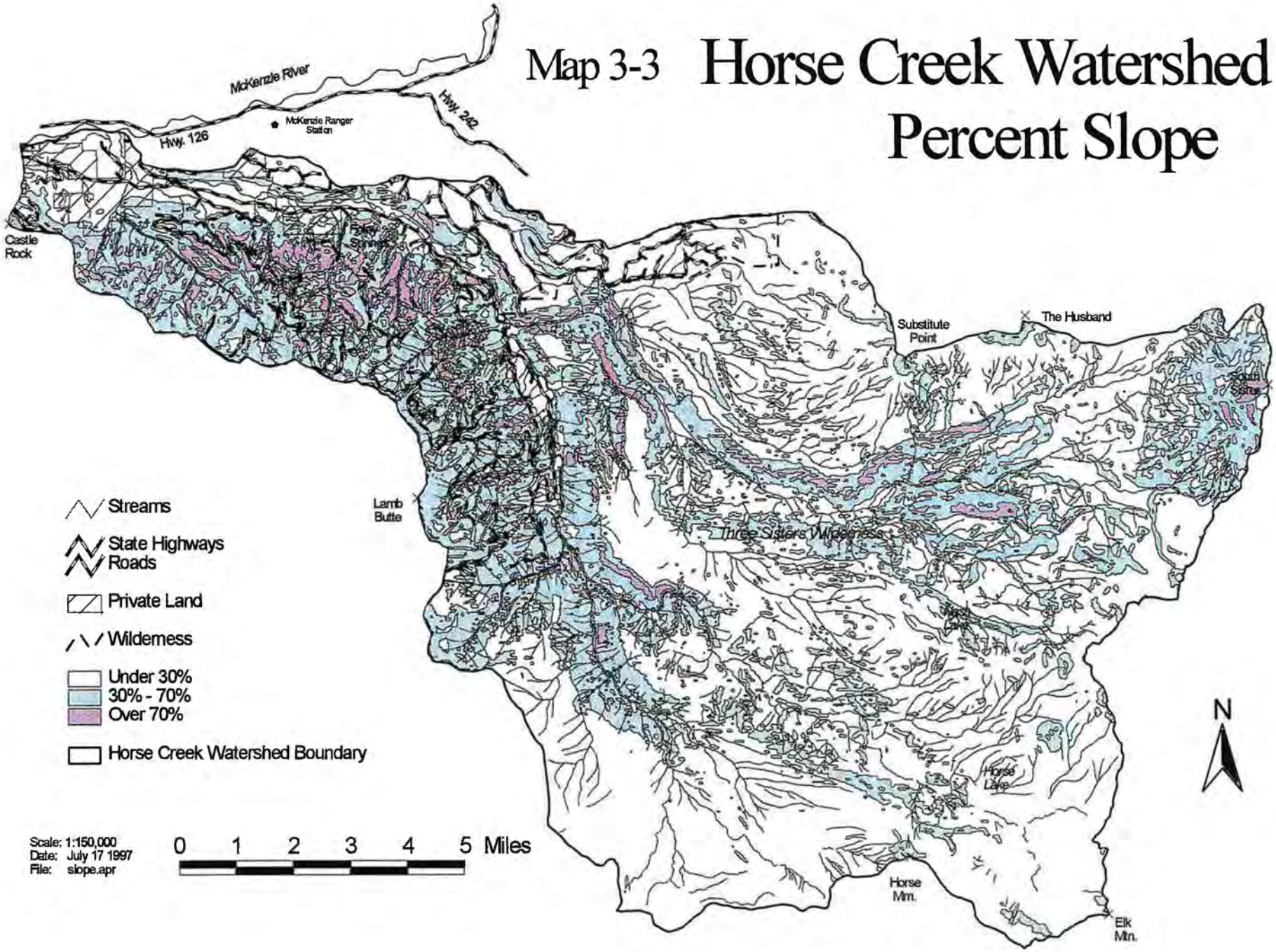
Map 3-3 Horse Creek Watershed Percent Slope



that initiated debris avalanche or debris flow. An anecdotal account of the 1933 failure of the Skinner glacier terminal moraine on South Sister was reported in the Eugene Register Guard (Tims 1958). An unusually warm summer accelerated the melting rate of the glacier, causing the melt water to overtop the debris dam at its front. The resulting failure sent "millions of cubic feet of water" down Separation and Horse Creeks to the McKenzie, scouring out the channel and substrate to bedrock.

S.R.I. Land Type and Stability Classification Conditions

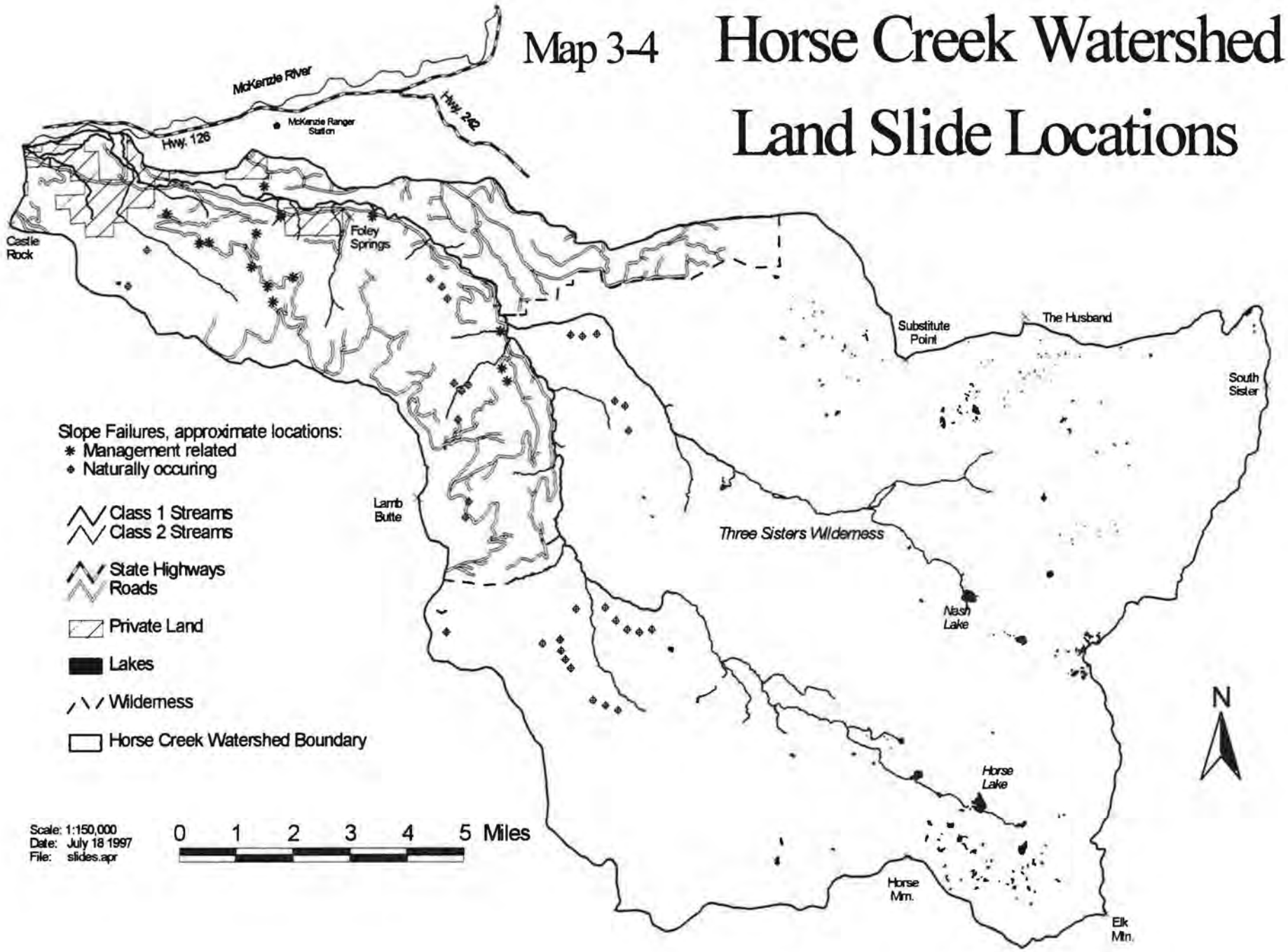
The following groupings of SRI soil complexes were used to delineate mass wasting potential.

I. **Unstable**: areas which are prone to mass failure under natural conditions (un-roaded, unharvested), and where human activities such as road construction and timber harvest are likely to increase landslide distribution in time and space to the point where this change is likely to modify natural geomorphic and hydrologic processes. Classified by the Forest S.R.I. as moderately unstable (several failures observed within a polygon) to very unstable (entire polygon shows evidence of recent and past failures).

SRI Type w/in Horse Creek Watershed	*Description*	*Acres*	*Location*
25	Cohesive residual and colluvial soil, sandy silt with some clay and rock fragments overlying pyroclastic rock on 20 to 40% slopes.	59	Lower Horse Creek

II. **Potentially Unstable**: Areas which contain conditions of steep geometry, high ground water potential, and soil with low shear strength characteristics that considers the probability of landslide-triggering storms within the period of minimum root strength and elevated ground water (as well as slope adjustment to piping changes), and the probability of channel adjustments that trigger streambank and toeslope failures. These conditions include areas following high intensity fire and clear-cut harvesting. Classified by the Forest S.R.I. as stable or moderately stable to locally unstable.

Map 3-4 Horse Creek Watershed Land Slide Locations



II. Potentially Unstable:

SRI Type w/in Horse Creek Watershed	*Description*	*Acres*	*Location*
3	Rock outcrops of basalt, andesite, and pyroclastic material which are prone to differential weathering and stress relief from glacial unloading which produce talus slopes and debris avalanches.	5400	Throughout the watershed
235	Granular glacial/fluvial deposits on mid-slope and toeslopes.	803	Western Portion of watershed

III. Potentially Unstable on slopes >70 %: Shallow soils in steep sideslope or valley headwall areas that have a potential for debris avalanche or shallow translational landslide failure. Classified by the Forest S.R.I. as stable.

SRI Type w/in Horse Creek Watershed	*Description*	*Acres*	*Location*
16	Toe slopes glacial/fluvial deposits	4300	Eastern portion
61, 64, 610, 610U, 614	Glacial till overlying basalt and andesite soil depth 3-6 feet	8300	Western portion
71	Ridges and cirque headwalls w/less than 3 feet of granular soil.	445	Eastern portion of watershed
21, 203, 210U, 310U	Sandy silt to clayey silt overlying tuffs and breccias with less than 3 feet of lightly plastic soil.	4149	Western portion of watershed

SOILS AND SLOPE STABILITY

Mass Wasting

This watershed has a diversity of landforms and geologic materials that are prone to instability. However, the watershed is not dominated by these features. Naturally unstable slopes are largely associated with slopes greater than 70%, earth flows, and intra-canyon lava flows or differentially weathered rock types. Although naturally

unstable landforms exist, slope failures are largely restricted to steep and volcanic ejecta within the Wilderness and along the steep canyon walls of lower Horse Creek and Separation Creek. Management related slope instability is restricted to a relatively small portion of the watershed within the LSR in the western third of the watershed.

Mass wasting and landslide processes in the Lower Horse Creek Watershed, and glacial scour and bank erosion along high gradient drainages on the South Sister, remain the largest sources of sediment and geologic materials entering this watershed's stream system. Slope failures generally occur episodically during higher than normal years of precipitation, during intense rain storms and/or rain on snow events, or following seismic activity. The storms during February, November and December of 1996, and the storm of 1964 introduced considerable amounts of sediment, geologic materials, and large woody debris into the drainage system via landslides and stream bank erosion.

Although a comprehensive assessment of the entire watershed has not been performed by aerial photograph interpretation or through extensive ground reconnaissance since the storms of 1996, it is likely that road alignments and even-aged timber management on slopes greater than 70% have increased the frequency of slope failures. It is known that slope failures did occur along present road alignments and from within some harvested stands (Map 3-4). No slides from the 1996 storms have been observed in fully forested areas within the watershed. Observing debris avalanches and torrents in fully forested areas is difficult due to the heavy canopy and the characteristically narrow paths of torrents. The sub-drainages of Separation Creek, Pasture Creek, Castle Creek, Eugene Creek, Wildcat Creek, and an un-named face drainage north of Pasture Creek show a history of debris torrents, scree slopes, and rock fall. However, identifying recent disturbance in an established active debris path may not appear significantly different in aerial photography following a flood producing storm event. These scree slopes are unstable and are subject to constant rock fall, which keeps the debris torrent path void of overstory vegetation and dominated by rock fall material.

Six known slope failures in the form of debris avalanches originated within harvested areas on SRI soil type 16, 168, 203 and 616 in the 1996 storms. Three resulted in debris torrents that directly affected surface water quality and channel morphology of the drainage it originated in, and indirectly impacted Horse Creek. Aerial photography and data on possible slope failures outside roaded areas and in the wilderness are lacking; therefore, there is insufficient data to evaluate the response of the watershed as a whole and how fully forested stands responded to the recent storm events. In many respects, the storms of 1996 provided a threshold event for managed and unmanaged normally unstable slopes. There are no indications of movement in deep seated earth flows that could have been initiated by the higher than normal precipitation of 1996.

Forest Road 1993 (Wapiti Road) and associated spurs are constructed on SRI land types that are largely stable and moderately stable. However, where alignments occur on slopes greater than 70% using side cast construction, the potential for road related slope failure increases. The Wapiti Road has a history of fill slope and cut bank instability. Road related slope failures are likely to initiate debris avalanches and debris torrents due to the topographic relief (steep slopes) and the high drainage density. During the storms of 1996, eight road-related slope failures on this road were identified. Most of the road-related failures occurred along FR1993. Three failures that occurred above FR 2639 did result in debris torrents that impacted the road. However, they did not reach Horse Creek. Failures off FR 1993 have not been fully investigated to determine the existence or extent of a torrent.

Pasture Creek experienced debris torrents during the floods of 1964 and 1996. These torrents were naturally occurring and were not initiated from roads or managed areas.

Soil Erosion Potential

The 1990 SRI, as mapped, indicates the majority of the soils within the Horse Creek Watershed have a moderate-severe to very severe erosion hazard rating. Based on knowledge of the slope and soil texture characteristics, and monitoring of past land management activities in the watershed; the SRI inaccurately portrays the abilities of these soil to produce sediment and their sensitivity to erosion. Moderately severe to severely erosive soils are limited to the very steep slopes along lower Horse Creek and Separation Creek, and on the cinder cones and tallus slopes of the Three Sisters in the Wilderness.

Erosion potentials are based on the rate of soil erosion that would occur if all the surface vegetation and litter were removed. These conditions are similar to what would be expected following a stand replacement fire. Severely erosive soils are those low in clays (sandy and loamy textures), low in surface and internal rock fragments, steep, and/or have long slope length. Although slope plays a role in the erosive energy of surface flows, it is the texture and lack of surface rock fragments along with slope that strongly influence erodability.

Surface Erosion

Surface erosion is rare throughout the watershed and is limited to the very steep poorly vegetated slopes in the Wilderness. Past regeneration harvest followed by hot prescribed fires in the Wapiti area has resulted in temporary increases in soil loss rates. These effects are limited to two or three years due to the rapid recovery of vegetation which provides effective ground cover. In the remainder of the watershed, outside the Wilderness surface erosion is rare due to the high infiltration and percolation rates of

the soils, the low intensity rainfall patterns, and high levels of effective ground cover. Surface erosion from harvested stands (except where noted above) remains rare and cumulatively well below the amount of sedimentation from road surfaces and slope failures.

Management-related surface erosion and sediment transport remain largely a function of roads within the watershed. The watershed is largely lacking in roads, with the majority occurring in the south west. The roads produce sediment on a relatively continuous basis, which is quickly and efficiently incorporated into the drainages of the watershed. A site-specific assessment of sediment production from roads and transport mechanisms into the drainage network has not been performed. Specific road alignments that indirectly contribute sediment into Horse Creek have not been determined.

Surface erosion in forested areas is absent or non-existent. The soils are largely very well drained with high infiltration rates which are rarely exceeded by normal precipitation or rain on snow events. Soils associated with wetlands and upland grassland communities are stable and show little evidence of surface erosion. Some upland grassland and wetland communities continue to experience erosion patterns established during historic grazing practices or by recent use by permitted outfitter-guides, hunters with pack livestock, and/or by human impact (foot traffic). These areas of accelerated erosion are limited to rather rare grassland and wetland communities in the wilderness which are heavily used by recreationists. The impacts are minimal with respect to spatial extent, threats to site productivity, and water quality.

Fire and Erosion

It is unlikely, given the limited affects of low and moderate intensity fires, that fire altered the soil erosion pattern or rate, or the frequency of mass wasting events. Planned ignitions of low and moderately intense fire would produce the same magnitude of effect.

High intensity fires would have caused high levels of mortality in the overstory, and consumption of surface litter, down woody debris, and soil organic matter. This could have resulted in a significant increase of surface erosion and mass wasting. Historically, high intensity wildfires did occur in parts of this watershed. Since this

watershed is dominated (60% or 60368 acres) by soils with a moderate-severe and severe-very sever erosion potential, it is highly likely that fire occurred on these soil types. The post-fire condition could have produced soil loss rates greater than 35 tons per acre per year, and possibly higher on very steep slopes. These conditions would exist for years, maybe decades, before effective ground cover would be provided by early seral plant species. High intensity fires on less erosive soils would have produced soil loss rates much greater than fully forest conditions, but the loss rates and could have affected site productivity.

Rural Residential

Riparian area soils and ecosystems in the lower Horse Creek that are in private land holdings have been impacted by urban development, road construction, and conversion to orchards and grazing pasture. Housing and paved road construction permanently removes the land from productive condition. These constructs are also impermeable to infiltration, which influences the routing of precipitation and may increase the transport of non-point sediment and other pollutants into surface waters. The use of household herbicides and pesticides, the use of chemicals in commercial orchards, and silvicultural operations near Horse Creek and its tributaries may introduce material into the drainage network. Livestock pastures often have reduced infiltration rates due to compaction of the soils which may increase surface erosion and the transport of sediment and other non-point pollutants.

Road and residential construction along with active filling or blocking of secondary and tertiary channels reduces the effective capacity of the river channel. The results are often felt during flood events, as in 1996, when the active channel is exceeded and the secondary channels are unavailable to accept the flood discharge. Housing, roads, and land developments can be threatened under flood conditions due to the positioning of many of these improvements within the active 100 year flood plain.

Riparian Reserves and Aquatic Conservation Strategy Objectives

Consideration in managing riparian areas in the Class I and II portions of this watershed's streams should incorporate the entire flood plain, terraced glacial terrace deposits (SRI 16), or toe slopes in many areas along Horse Creek to meet the intent of the ACSO's. Protecting the immediate area near the stream and not considering potentially unstable slopes/landforms adjacent to the riparian area or on the upslope is unlikely to adequately protect surface water quality and fish habitat. Understanding the inter-relationship between hill slope processes and channel dynamics, and incorporation those concepts into project planning and implementation on a site specific basis, is more likely to meet riparian and water quality objectives.

The inter-relationship between the present channel morphology/dynamics and SRI

15and 16 soils warrants consideration. The soils and landforms associated with SRI 16 are perched above the present flood plain (Map 3-5). The slope and soils of SRI 16 are relatively susceptible to slope failures. Slope failures did occur in 1996 within harvested SRI 16 soils immediately above the present flood plain. These slope failures impacted the riparian areas by the physical disturbance of the slide, and the deposition of large woody debris and geologic materials. These areas will remain as sources for sediment that is incorporated into the drainage system until vegetation provides effective ground cover and slope stability.

OVERVIEW OF HUMAN USE

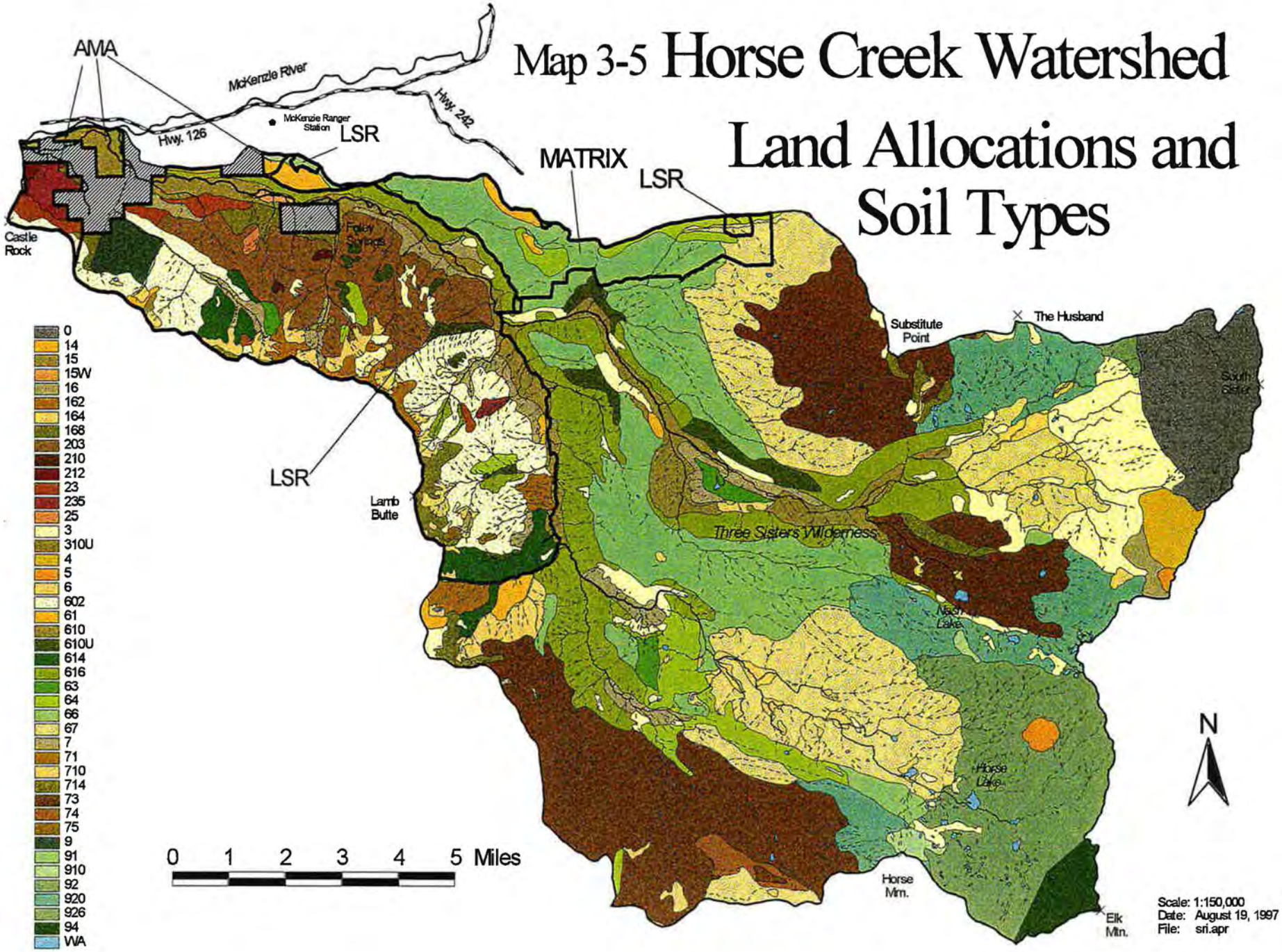
Prehistoric Resources

Prehistoric heritage resources in the Horse Creek watershed are not well-understood at this time in terms of the activities of native peoples which lead to the deposited artifacts. Most artifact patterning observed today leads to generalized interpretations. For example, we assume that hunting-related activities and plant resource processing must have taken place at many locations. Yet the obsidian spearpoints and scraping and cutting tools left at those sites have seldom been subjected to detailed study which could yield specific information about which plants or which animals were involved. Most documentation is in the form of USFS Region Six Site Forms. Earlier years of recording (1979-86) are rather sketchy, though improvements in data have occurred in recent years. In addition, several archeological evaluations have resulted in some increased understanding.

Clusters of prehistoric archeological sites have been recorded in the northwest and southeast portions of the watershed. The meaning of that clustering is unclear, since archeological survey has been project-specific rather than research design-based. Environmental data (topography and freshwater availability) suggest that those in the northwest portion may have been temporary camps along travel routes into the high country obsidian sources north of the watershed.

Prehistoric resources include chipped obsidian lithic scatters and obsidian lithic isolates, representing tool use, modification or manufacture related to "broad spectrum" hunting and gathering. Ongoing stone tool analysis, both by USFS archeologists and contractors, suggests that this portion of the Cascades was occupied primarily by people indigenous to the Cascades. Those people were probably ancestral to the Molalla and possibly Kalapuya people involved in early treaties of the 1850's, some of whose descendants are members of the Siletz and Grande Ronde confederated tribes. However, it is also highly likely that people living east of the Cascade crest (prehistoric ancestors of the Tenino and Paiute people currently enrolled at Warm Springs), also made seasonal (summertime) trips to the upper reaches of the Horse Creek watershed.

Map 3-5 Horse Creek Watershed Land Allocations and Soil Types



There appears to be a long period, the Middle Archaic (about 8,000-2,000 years ago) where there was marked stability in adaptation, at least insofar as it relates to stone tool use. Many of the sites from that period probably represent warm season occupation of the high elevation reaches of an ethnic group's territory, or they may be in areas of probable travel routes (such as the Foley Ridge area). The large number and high density of prehistoric sites near high elevation lakes in the southeast portion of the watershed are likely to be temporally - overlapping summertime encampments.

Historic Resources - Native American

Two unique resources dating to the Native American historic period are found in the western half of Horse Creek watershed. They are peeled cedar tree sites, the living remnants of 19th and early 20th century Warm Springs container-making activities.

The mid-19th century was a time of sweeping cultural, geographic, and technological change for Indians in Oregon. The most significant land use or geographic change involved the resettlement of Native American tribes and bands onto reservations. Although Horse Creek watershed clearly had seen prehistoric land use, there were no Indian villages whose residents were displaced by white settlers, unlike so many locations in the Willamette Valley.

What the early explorers, settlers, and then merchants of the upper McKenzie area saw when they saw Indians were Warm Springs reservation people, who had been moved to their central Oregon reservation near Madras in the 1850's through the 1870's. Those Indians were primarily from Tenino, Wasco, and Warm Springs culture areas along the Columbia and lower reaches of the Deschutes Rivers. After the Paiute wars ended, Northern Paiutes from the desert Great Basin also were resettled at the Warm Springs Reservation.

A major technological change (only one or two generations old by the 1850's) was the use of the horse by the Indians. Horses had become major status markers for Indians, and the number of horses one owned that could be exchanged for a bride or given to one's relatives was a direct measure of social status. Horses certainly enabled long distance travel for trade and subsistence purposes, but they also required adequate forage and safeguarding. Thus, the rich huckleberry fields on burned over Cascade Mountain ridgetops became natural resource draws, because the horse made them accessible and enabled transport of large quantities of dried berries (Bergland 1992). There was abundant forage (although not without some competition from sheep herders), water and relative safety from Northern Paiute people, who apparently were raiding horses from the Warm Springs reservation until the 1870's.

Warm Springs Indians on summer/fall seasonal trips into and through the Horse Creekwatershed were observed by early USFS Rangers, sheep herders, and residents from the 1860's until as recently as the 1920's and 1930's. One particularly important archeological site from that period is found near Lamb Butte along the western edge of the watershed. There we have documented historic camp remains and peeled Alaska yellow cedar trees. The presence of other rare botanical species in the Lamb Butte area suggests the possibility that Native Americans also may have used the area for the gathering of special medicinal plants. Chinook jargon place names also suggest the importance of the area to Indians. For example, Olallie Ridge and Olallie Mountain both probably were named for the abundant huckleberries nearby. Horsepasture Mountain reportedly was the scene of summertime Indian horse racing (Williams 1988:109), and it is also near the western edge of the Horse Creek Watershed.

Historic Resources - Euroamerican (Early Settlement)

Historic period Euroamerican settlement is not yet manifested in documented archeological sites within the Horse Creek watershed. Williams recounts a number of instances and situations which may some day be verified, either through historic documents or historic archeology.

Horse Creek itself is perhaps named after an incident in the 1840's or 1850's, in which one or two immigrant wagons made it over the crest of the Cascades and down Horse Creek, where they lost their horses (Williams 1988:106). Various confirmations of this event have been postulated, including the purported discovery of wagon remains along Horse Creek, and the purported discovery of wagon parts on Olallie Ridge in the early 1900's, but neither discovery can be objectively confirmed at this time. Another somewhat better-documented immigrant tale is from 1853, when a party on horseback (who had separated from a wagon train in central Oregon) supposedly came through the Separation Creek and Horse Creek areas, were lost, and were subsequently rescued by a settler from the Springfield area (Williams 1988:150).

According to an elderly informant, Mrs. Elizabeth King homesteaded the area along King Road in the 1860's (Williams 1988:122). Williams goes on to note, however, that Mrs. King officially filed on a claim under the 1906 Forest Homestead Act in 1910. It may be that the 1860's date is wrong, or that Mrs. King had a "squatter claim," a not uncommon practice at the time. At any rate, if correct, the 1860's date would make it one of the earliest homestead dates in the area, on a par with the John T. Craig homestead near McKenzie Bridge, established ca. 1869.

Historic Resources - Euroamerican (Sheep herding)

Sheep herding was a significant early economic use of the Cascades. According to Williams, the area along both the east and west sides of the watershed bears place names which relate to sheep herders: McClennan Mt. (herded by Ewan McClennan from 1907-1918); O'Leary Mt. (herded by Johnny O'Leary at turn of the century); and

Hinton Creek (grazed 1912-1948 by Jim Hinton, and we have 1982 photographs from the Separation Meadow area of a carved tree marked with the name Hinton and a 1907 date). Mike Reider was another sheep herder who used the Olallie Mountain area with up to 3,000 sheep from 1872-1909. In 1872 he supposedly drove off a band of Warm Springs Indians who arrived on Olallie Meadows with about 250 horses, and who had come to fatten the horses and pick huckleberries. Sheep herding persisted on Olallie Mountain until the mid-1930's, and there may be archeological evidence there for sheep camps (Williams:177). Indeed, the historic materials found near Lamb Butte area may be from sheep herders or Native Americans, since both were using much of the same gear at the time.

Historic Resources - Euroamerican (Recreation)

The most significant historic recreational development within the Horse Creek watershed was Foley Hot Springs, a major public attraction from the 1870's through probably 1950. The development of Foley in many ways paralleled that of Belknap Hot Springs, and thus constitutes the first purely recreational commercial development in the area.

Other recreational developments which are discernible in their physical traces are the Forest Service hiking and pack trails dating from the turn of the century through the WWII era. Many such traces are to be found in the Three Sisters Wilderness portion of the Horse Creek watershed, and perhaps the most significant are those traces of the Oregon Skyline Trail.

Yet another remnant of historic recreation development may be found in the Eastern Brook trout - Williams notes that a local fishing and hunting guide, Harry Hayes (who also owned the McKenzie Bridge general store), stocked Separation Lake with brook trout, and essentially used the lake as a destination for his guided trips (Williams 1988:213)

Historic Resources - Euroamerican (Forest Service)

Forest Service-related heritage resources overlap with some of the above categories; historic trails, for example. There were two fire lookouts within the watershed, but those have been demolished (Castle Rock and Horsepasture Mountain), and only archeological traces remain. Likewise, the Horse Lake Ranger Station, first built in 1909, then rebuilt in 1934, was demolished in 1972, at which time the Horse Lake Shelter (built in the mid-1930's) was also torn down.

The reference trees carved by the Forest Reserve rangers are rare, early Forest Service heritage resources. Two such examples are known within the watershed, and there may be more. They were carved by Ranger Cy Bingham in 1907, and appear to have marked designated sheep herder camps (one of the early ranger duties was to administer grazing permits). See the above discussion of sheep herding.

OVERVIEW OF RECREATION

Recreational activities within the analysis area vary by setting where the recreation occurs, seasonal distribution of use, and levels of use. Use data within the watershed is not detailed.

SETTINGS

Private Ownership
Recreational activities occur on about 1725 acres of private lands within the watershed. Residences, resorts and individual cabin rentals dominate these lands. Considerable angling occurs along portions of the various forks of Horse Creek in the Delta area.

National Forest
Recreational settings on National Forest Lands are described by the Recreation Opportunity Spectrum (ROS). Some specific settings are prescribed by Land Management allocations contained in the Forest Land and Resource Management Plan.

Land Management allocations (MAs) within the watershed which specifically describe a range of appropriate recreational activities include Wilderness (MA-1A), recreation sites (MA-12a), and special use sites (MA-12b).

SEASON OF USE

The majority of recreation use within the watershed occurs between mid-April and late November. The traditional opening of fishing season marks the beginning of the "recreation season" and concludes with the closing of elk season. Between those times most activities follow a seasonal pattern. That pattern generally progresses from fishing, wildflower viewing, berry picking, through the various big game hunting seasons, and fall foliage viewing.

Other activities occur more-or-less uniformly throughout this period. Camping, picnicking, viewing scenery, driving for pleasure, mountain biking, and hiking are typical of those pursuits.

Winter recreation use is low. Contributing to low use levels is the pattern of access and snowfall patterns. Winter access is generally along Forest Road 2638. The road is frequently covered with snow of poor quality. This generally makes the higher elevation, and higher quality snows inaccessible. During periods of high quality snow

at lower elevations snowmobiling and nordic skiing occur on a sporadic basis. Very low levels of winter "adventure recreation" occur at the highest elevations with the Wilderness.

There also exists an elevational component to seasonal use patterns that is dictated by the rate and pattern of snowmelt. Consequently, much of the recreational use within the Wilderness is concentrated during the relatively brief period of early July to late October. Heavy concentrations of insects (mosquitoes and flies) early in the season further concentrates use at higher elevations.

Probably the most consistent year-round recreational activity is the use of the recreation residences within the Delta A and Delta B recreation residence tracts. These recreation residences are operated under the Forest Service Special Uses Program.

LEVELS OF USE

The 1996 Recreation Resource Inventory System (RRIS) tracks different recreational activities on the McKenzie Ranger District. Over 1,542,468 separate activity-days (occasions) were tabulated. This equals 405,430 Recreation Visitor Days or RVDs. An RVD is equivalent to one person recreating for 12 hours. This may be one person counted several times as they hiked, rode, or camped overnight during their stay within the watershed. The Horse Creek watershed accounted for approximately 15% of total occasions on the District.

While recreation use across the watershed can generally be characterized as low to moderate, there are sites of concentrated use or popularity.

Non-Wilderness

- Forest Road 1993 (Wapiti Road): This road links the Horse Creek drainage with Forest Road 19 at Cougar Dam. Within the watershed, the route is generally steep with extremely steep sideslopes. Because of the landforms it traverses and its position on the highest prominent ridge to the west of the Three sisters Wilderness, the panoramic views of the Three Sisters make it extremely popular for viewing scenery and photography. For those not deterred by driving challenges, it is perhaps the premier scenic route on the McKenzie Ranger District. Views from along this route are to be found in 'Coffee Table' books, posters, and postcards.

- Horse Pasture Mountain: Located along the western watershed boundary, this spot is frequently visited by those seeking a scenic vista, a photographic opportunity, and in the early summer viewing wildflowers.

- Recreation residences in Delta A and Delta B tracts along the McKenzie River and the west fork of Horse Creek: These areas are extremely popular recreational retreats for Special Use Permit Holders.

- Horse Creek group site campground: While occupancy rates at this facility are not heavy (35% of capacity), it serves as the only group reservation site on the McKenzie Ranger District. Operated on a reservation system, it serves as base for many other recreational activities in the McKenzie Bridge area.

- Mosquito Falls viewpoint: This undeveloped viewpoint, accessed by a short cross country hike from Forest Road 2638, receives moderate levels of use. It is a popular site for "rural" weddings.

Three Sisters Wilderness

Records show that 50,886 people visited the entire Three sisters Wilderness in 1996. Of those about 24% stayed overnight, with an average length of stay of 2.5 days, and as part of a group of 2.8 people. Ninety percent traveled by foot, and 10% traveled with stock. Use within the analysis area accounted for approximately 6.5% of the total Wilderness use. (See Map 3-6 for high use areas and the trail system in the Horse Creek watershed).

- James Creek, Hinton Creek, Mesa Creek and Separation Creek: Use in the meadow areas, at these sites is generally moderate with about 1,500 visitors annually. Major travel routes into the area include the Foley Ridge, Louise Creek and Pacific Crest National Scenic Trail (PCNST). Stock use is more common during hunting season, (September - November) around meadows due to the presence of good feed, water, and camp locations. A small three sided, Adirondack style shelter constructed by the CCC's is located near James Creek.

- Honey Lakes complex: The Honey Lakes area is comprised of several medium sized lakes including Honey, Kidney, and Square Lakes, along with Buck Meadows. Use is low to moderate with about 1,000 visits annually. The lake areas draw the most use and have the highest concentration of camp sites within the complex. The Buck Meadows shelter, also a small three sided Adirondack style built by the CCC's, draws numerous campers. The primary recreational pursuit within the complex is fishing.

- Sister Mirror Lake complex.: The Sisters Mirror complex is comprised of numerous small lakes located between Burnt Top peak to the west, Koosah Mountain to the south, and House Rock to the north.

- Horse Lake: Once the site of Horse Lake Guard Station Administrative Site, this lake remains popular with anglers. Sites are accessible by early summer in all but the most severe snow years. A number of the most severely impacted campsites within the Three Sisters Wilderness are found along the northern and eastern shores of the lake.

There are a total of 282 inventoried campsites located within the Wilderness portion of the analysis area. The majority of those located in the areas of concentrated use described above. A review of inventory data collected since 1985 reveals the presence of water is the geographical feature which overwhelmingly attracts people to a particular camping location. Data indicates that 257 of the 282 inventoried sites lie within the riparian zone as defined in the rest of this document. The influence of this preference raises important issues related to water quality and riparian function.

Neither of these parameters have been extensively measured and represent future data needs within the watershed. Some hydrologic and fisheries inventory work has been accomplished but are insufficient to draw any conclusions as to the impact of this pattern of recreation use.

However a comparative look at total riparian acres and acres of direct campsite disturbance within the riparian zone gives one a sense of the magnitude of the possible impacts. The area of disturbance associated with these campsites was derived from "Campsite Monitoring Impacts Worksheet" data forms collected by Wilderness management personnel. The sites were inventoried between 1985 and 1988. Approximately 60% of all sites have been re-inventoried at least once since initial measurement. Some 26 parameters are measured; of those three were used to construct the tables that follow. Those parameters were "distance to water," "camp area," and "barren core area."

"Distance to water" is a direct measurement of the distance the "camp area" is from the nearest water. "Camp area" is the size of area used for camping. This is determined by changes in ground cover ratios between the campsite and of adjacent undisturbed areas. It is recorded in square feet. The "Barren core area" is that area of nearly every campsite that is devoid of ground cover and forest litter. Most commonly it is associated with the area of the site that serves the "kitchen area" function and the immediate area around the campfire (if present); it also is recorded in square feet. The results are summarized in the tables below.

Table 3-1a: Wilderness campsites within the Horse Creek Watershed.

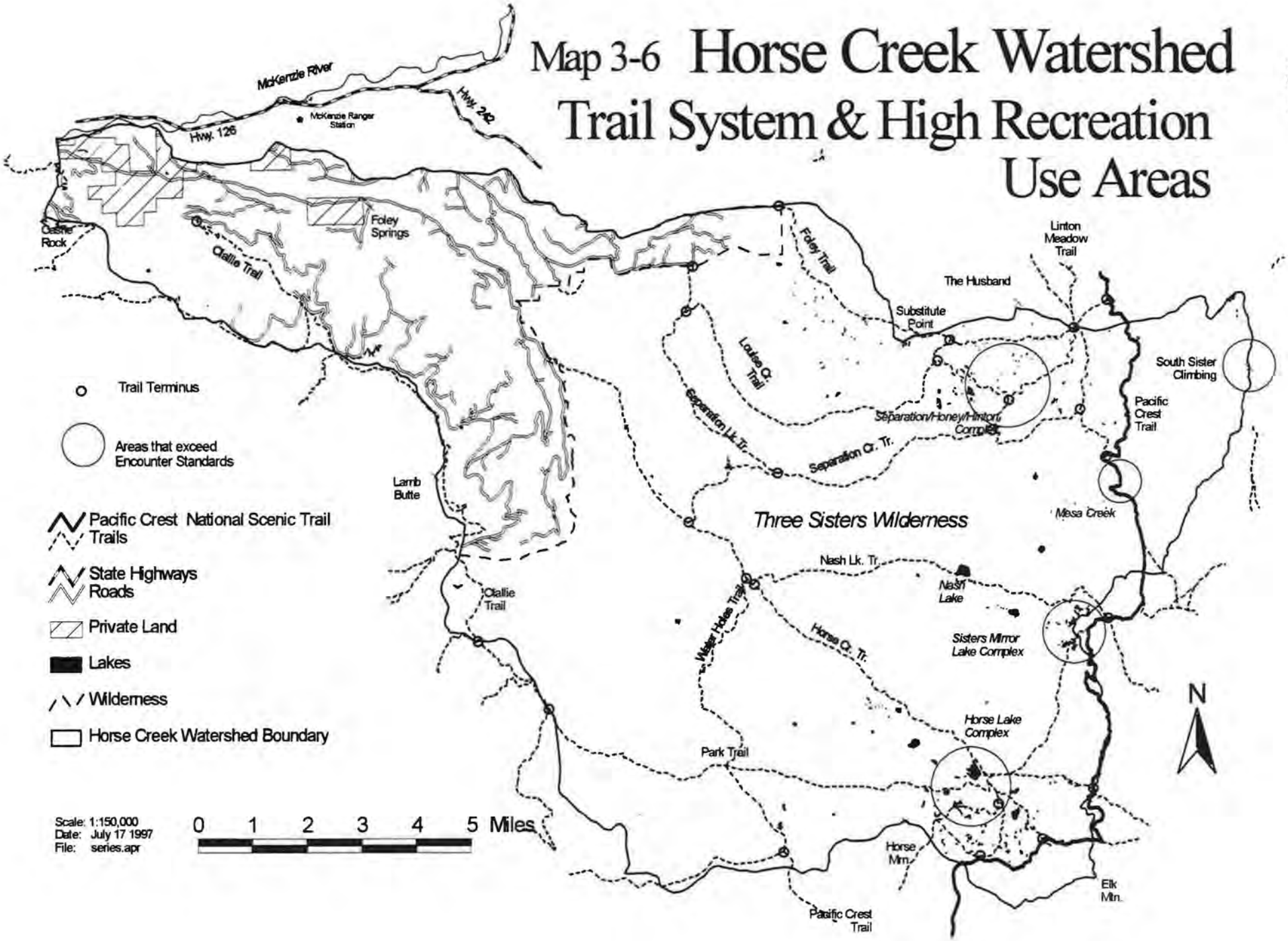
			CAMPSITE AREA WITHIN RIPARIAN [1]				
				STREAMS [2]			
Travel Zone	Total Sites	Sites w/in Riparian	Lakes [2]	Class I	Class II	Class III	Class IV
030	5	5	1846 (210)	-	-	-	-
032	25	23	24400 (7410)	-	-	15600 (4500)	-
033	94	85	9575 (3600)	-	-	141904 (41607)	5995 (1104)
034	0	0	-	-	-	-	-
035	17	13	12650 (4900)	-	5800 (1514)	-	-
040	5	1	2762 (2762)	-	-	-	-
041	19	16	36975 (8400)	-	-	-	-
042	37	37	30350 (10825)	-	-	7170 (3150)	-
043	61	60	75325 (29630)	-	-	-	-
050	19	17	26125 (135630)	-	-	-	-
TOTAL	282	257	220008 (81300)	-	5800 (1514)	164679 (49257)	5995 (1104)
			ACRE CONVERSION				
			5.05 (1.87)	-	0.13 (0.03)	3.78 (1.13)	0.14 (0.03)

[1] Two figures given. The parenthetical number is the "barren core" area of the campsite. The 'barren core" is the area of exposed mineral soil within a campsite. The non-parenthetical number is the total area of a campsite. This is defined by changes in vegetative cover (includes the 'barren area').
[2] Area given in square feet.

Table 3-1b: Summary of wilderness campsites within riparian areas.

RIPARIAN TYPE		RIPARIAN AREA (ACRES)	CAMPSITE AREA (ACRES)	% TOTAL RIPARIAN
Lake		5350	5.05	0.094
Streams				
	Class I	935	0	0.0
	Class II	2262	0.13	0.01
	Class III	2213	3.78	0.17
	Class IV	10774	0.14	0.001
TOTAL		21534	9.10	0.04

Map 3-6 Horse Creek Watershed Trail System & High Recreation Use Areas



While the total area of riparian occupied by campsites is quite small it is impossible, with available data, to determine to what level riparian functions may be being affected.

It is interesting to note that in all the sites inventoried no "barren core areas" are located immediately on water, i.e. "distance to water" equals zero. And that the majority of campsites are more than 45 feet from the water's edge.

When looking at re-inventory data there is no clear trend whether sites are growing or diminishing in size. Where there have been active management efforts sites seem to be remaining the same or diminishing slightly. A few sites where no management activities other than litter clean-up and fire ring reduction show evidence of growth. In the light of a growing use trend in the Three Sisters (about 5% per-annum) impacts from campsites seems to be relatively stable.

TRAIL USE

There are a total 117.6 miles of system trails within the analysis area.: 12.8 in non-wilderness areas and 104.8 miles in wilderness. Trails are rated according to type of travel, difficulty level, and maintenance level. Tables 3-1c and 3-1d describe the extent of the trail system and recent use.

Table 3-1c: Trail system within the Horse Creek Watershed.

Trail Name	Trail No.	Total Miles	WA Miles	Trail Class	Primary Use	Wilderness
King Castle	4326	3.6	1.7	M	Hiker/Bike	No
Olallie	3529	11.1	11.1	M	Hiker/Bike	No
Olallie	3529	3.0	2.2	M	Horse/Hiker	Yes
Horsepasture	3529.5	1.3	1.3	M	Hiker/Bike	No
Park	3530	11.3	11.3	M	Horse/Hiker	Yes
Horse Creek	3514	14.9	14.9	M	Horse/Hiker	Yes
Separation Lk	3536	8.1	8.1	M	Horse/Hiker	Yes
Separation CK	3524	7.2	7.2	S	Hiker	Yes
Louise Creek	3520	9.2	9.2	M	Horse/Hiker	Yes
Foley	3511	8.7	7.7	M	Horse/Hiker	Yes
Indian Holes	3524	2.5	2.5	S	Hiker	Yes
Separation Mdw	4331	2.0	2.0	S	Hiker	Yes

Trail Name	Trail No.	Total Miles	WA Miles	Trail Class	Primary Use	Wilderness
Linton Mdw	3547	5.6	3.1	M	Horse/Hiker	Yes
Nash Lake	3527	8.5	8.0	M	Horse/Hiker	Yes
Water Holes	3538	10.8	7.8	S	Horse	Yes
Pacific Crest	2000	38.6	18.0	M	Horse/Hiker	Yes
McBee	3523	0.0	1.5	M	Horse/Hiker	Yes
Island	3515	1.5	1.5	S	Horse/Hiker	Yes
Rainbow Falls	3543	0.7	0.7	S	Hiker	Yes

M= Mainline trail
S= Secondary trail

Table 3-1d: Trailhead use in the Horse Creek Watershed, 1991-1994.

Trailhead Name	No.	Use (Total Visits)			
		1994	1993	1992	1991
Foley Ridge	26	567	537	580	488
Separation Lake	25	258	306	181	238
Horse Creek	24	195	147	128	55
Pat Saddle	23	369	328	384	376
Olallie	(No data available)				

Data from Wilderness Permit information

Trail use has not increased in this watershed to the extent it has in other areas of the Three Sisters. Use level generated trail problems are generally minimal within the watershed. Trails with heavy stock use, particularly those used early and late in the season when wet conditions predominate, show the greatest levels of impact. Other than very localized situations these impacts do not seem to be affecting other resources.

The largest cause of trail related impacts is due to a large backlog of heavy maintenance items. The cause is directly related to declining levels of trails funding over the last decade. Those items include trail drainage problems, relocation needs, trail alignment problems, and deteriorating trail structures (water crossings, turnpikes, and puncheon).

POTENTIAL WILD AND SCENIC RIVER ELIGIBILITY

Background

The Willamette National Forest has identified the Watershed Analysis process as the vehicle to identify rivers and streams that may meet eligibility criteria for Wild and Scenic River status. The criteria are the river/stream be: 1) free-flowing and 2) have at least one "outstandingly remarkable value" (ORV). This screening process will result in a preliminary list of rivers/streams which appear to meet eligibility criteria that would be validated in the public scoping part of a Forest suitability study EIS. Eligible rivers will be protected according to Forest Plan direction until a suitability study is completed and Congress determines which - if any - rivers/streams are to be designated.

To qualify as an "Outstandingly Remarkable Value," a river-related value must be a unique, rare, or exemplary feature significant at a regional or national level. For regional comparison, the geographic regions defined in the 1989 Statewide Comprehensive Outdoor Recreation Plan (SCORP) for Oregon are used. SCORP Region 8 is used for rivers/streams on the Willamette National Forest.

Rivers/streams are evaluated using nine criteria. Each of these are made up of various components. The ten values examined during the resource assessment are: scenic values, recreation, geology, water quality/hydrology, vegetation/ecology, prehistoric, historic, fish - anadromous and resident, and wildlife. Evaluation criteria details can be found in the Recreation Appendix.

Two streams, Horse and Separation Creeks, were examined for their eligibility potential. Based upon physical attributes Horse Creek was analyzed in three segments; Separation Creek as a single segment.

Horse Creek was segmented as follows:

- Segment 1 (Delta): Confluence of Horse Creek with the McKenzie River (RM 0.0) to Horse Creek bridge on Forest Rd 2638 (T.16S., R.6E., Sec 24)(RM 3.0).
- Segment 2 (Middle Horse): Horse Creek bridge (RM 3.0) to the confluence of Mosquito Creek (T.17S., R.6 1/2E., NE 1/2Sec.28)(RM 15.5).
- Segment 3 (Upper Horse): Confluence of Mosquito Creek (RM 15.5) to Sunset Lake (T.18S., R.7E., NE1/2Sec.26)(RM 28.0).
-

The termini used for Separation Creek were from the confluence with Horse Creek (RM 0.0) (Horse Creek RM 10.8) to the west end of Separation Meadows (T.17S., R7E., NW1/4Sec.13) (RM 13.0).

Findings
The resource assessment found Outstandingly Remarkable Values for Separation Creek and all segments of Horse Creek. Findings are summarized in the following table. Detailed analysis results are found in Recreation Appendix, however, Table 3-1e displays a summary of the Outstanding Remarkable Values.

Both streams are wholly or partially within the Three Sisters Wilderness. Separation Creek lies entirely within the Three Sisters. The Wilderness boundary description establishes the boundary as the "thread" of Horse Creek. The easterly half of Horse Creek stream channel from Horse Creek's confluence with Separation Creek to the Mosquito Creek confluence lies within the wilderness. Upstream of Mosquito Creek Horse Creek lies entirely within the Wilderness.

Table 3-1e: Summary of Outstanding Remarkable Values for Horse Creek and Separation Creek.

	Outstanding Remarkable Values[1] (ORV)								
	1	2	3	4	5	6	7	8	9
Horse Creek									
Segment 1	N[2]	N	N	N	N	N	N	Y	N
Segment 2	N	N	N	N	N	N	N	Y	Y
Segment 3	N	N	N	N	N	N	N	Y	N
Separation Creek	N	N	N	N	N	N	N	Y	Y

[1] 1 = Scenic, 2 = Recreation, 3 = Geology, 4 = Water Quality/Hydrology, 5 = Vegetation/Ecology, 6 = Prehistoric, 7 = Historic, 8 = Fish(anadromous and resident), 9 = Wildlife

[2] N= Not found to be an ORV
Y= ORV

OVERVIEW OF UPLAND VEGETATION

The forested vegetation of the Horse Creek Watershed is characteristic of vegetation west of the Cascade crest. Plant series classification is a convenient and often used way of defining and stratifying these plant communities. The forested plant series typically found in the Western Cascades include Douglas-fir (PSME), Grand fir (ABGR), Western hemlock (TSHE), Pacific silver fir (ABAM), and Mountain Hemlock (TSME = lower subzone; TSME SUBALPINE = upper subzone).