Chapter 5 – Interpretation

This chapter compares current conditions (also referred to as the existing situation) with historical conditions of specific landscape elements or features and explains significant similarities or differences and their causes. Causes can be either natural or human-caused or a combination of both. Future trends projected five to ten years out are also discussed. Issue-specific desired conditions based on *Forest Plan* guidance and landscape characteristics are discussed. These provide a basis for the recommendations of **Chapter 6**.

Chapter 5 begins with a brief outline of planning direction as it applies to the Horse Creek Analysis Area. A brief overview of management areas and their corresponding goals and objectives is included with the planning direction. Answers to the key questions for this chapter follow.

Planning Direction

The planning direction for determining desired conditions is derived from all appropriate laws and administrative direction, including the *Record of Decision for Amendments to the Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* and attached *Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl* (USDA, 1994a), which established a system of Late-Successional Reserves (LSRs) to provide habitat and connectivity for late-seral dependent wildlife species and the Aquatic Conservation Strategy (ACS) to restore and maintain the ecological health of watersheds and aquatic ecosystems. The ACS includes establishment and management of Riparian Reserves and Key Watersheds, completion of watershed analyses, and watershed restoration.

The Klamath National Forest Land and Resource Management Plan (*Forest Plan*; USDA, 1995) incorporated all current management direction. The *Forest Plan* allocates lands for specific management objectives as provided by law, policy, and direction; identifies desired conditions; and provides standards and guidelines for the management of National Forest System lands. This ecosystem analysis incorporates and relies on the *Forest Plan*. A brief summary of *Forest Plan* Management Areas found within the Horse Creek Analysis Area follows. The allocation of land into Management Areas provides a basis for the desired conditions presented by issue later in this chapter. See the *Forest Plan* for a more detailed description of the Standards and Guidelines applicable within individual Management Areas.

The seven *Forest Plan* Management Areas found on the National Forest System lands within the analysis area are: Special Habitat - Late-Successional Reserves (LSRs), Special Interest Areas (SIAs), Riparian Reserve, Retention Visual Quality Objective (VQO), Recreational River, Partial Retention VQO, and General Forest. See **Figure 1-2** *Forest Plan Management Areas*, contained in the Map Packet at the end of this document, for their locations. **Table 5-1** *Forest Plan Management Area Acreage*, displays the acreage of each Management Area and the percentage of National Forest System lands.

Table 5-1. *Forest Plan* Management Area Acreage.

Management Area	Acreage 1/	% NF Lands
LSRs	20,776	55
Special Interest Areas	109	<1
Riparian Reserve	4,565	12
Retention VQO	1,107	3
Recreational River	189	<1
Partial Retention VQO	6,899	18
General Forest	4,171	11
TOTAL	**37,816**	100

1/ *Forest Plan* estimates updated with revised Riparian Reserve acreages. Private lands (32,120 acres) are not included.

Late-Successional Reserves (LSRs)

LSRs occupy more land than any other Management Area within the analysis area (55% of National Forest System lands). The goal of LSR areas is to provide habitat over the long-term for late-seral dependent wildlife and other terrestrial species listed as Threatened or Endangered under the Endangered Species Act. Portions of the Johnny O'Neil (LSR 354) and Collins Baldy (LSR 355) LSRs are within the analysis area and six 100-acre LSRs are located in the area between the two large LSRs. Lands included lands are located along the western and northwestern boundary of the analysis area: along Johnny O'Neil Ridge from Hamburg Gulch north to the Siskiyou Crest, over to Reeves Ranch, and down to Rainy Saddle. Also included are the checkerboard lands south of the Klamath River, including Lime Gulch, Collins and Kinsman Creeks.

Riparian Reserves

Riparian Reserves are for the protection of aquatic dependent species and to provide late-seral connectivity between LSRs. Riparian Reserves generally include an aquatic ecosystem and adjacent

upland areas that may directly affect it. They can also include unstable and potentially unstable areas that are not associated with a riparian area. Riparian Reserve acreage is approximated for this analysis as described in Chapter 3 and Chapter 5 *Riparian Reserves*. Riparian Reserve acreage within LSRs is not included in **Table 5-1**. Riparian Reserve boundaries on the ground are to be determined during project development, analysis, or implementation, and may further refine the mapping done for this analysis. Riparian Reserve Standards and Guidelines do not apply to private lands.

Recreational River

The Klamath River is a designated component of the National Wild and Scenic River system. The boundaries of the Wild and Scenic River corridor were established in the *Forest Plan*. Their boundary they typically runs ¼ mile on each side of the river (see Appendix J of the *Forest Plan* for legal descriptions). In the Recreational River management area, the river area may be developed for the full range of agricultural or forestry practices, show evidence of past and ongoing timber harvest or include some residential, commercial, or similar development.

Retention VQO

The Retention VQO Management Area provides attractive scenery by maintaining natural or natural appearing conditions. The Retention VQO areas are found along Highway 96 and the Siskiyou Crest. The Retention VQO has timber harvest expectations and scheduled yields. Timber output is expected to be low because of the visual considerations. It is modeled in the *Forest Plan* at five percent of standing volume per decade.

Partial Retention VQO

The Partial Retention VQO Management Area is intended to provide an attractive landscape where management activities remain visually subordinate to the natural character of the landscape. Partial Retention has timber harvest expectations and scheduled yields. Timber outputs are considered moderate for the Partial Retention areas and is modeled in the Forest Plan at approximately 16% of the standing timber volume harvested per decade.

General Forest

The General Forest Management Areas are areas where timber outputs are a high priority. General Forest lands are found scattered in the eastern half of the analysis area north of the Klamath River. Timber outputs are considered moderate for the General Forest areas, and is modeled in the Forest Plan at approximately 16% of the standing timber volume harvested per decade. General Forest areas have the less restrictive VQOs of either Modification or Maximum Modification.

Special Interest Areas (SIAs)

The analysis area contains three SIAs. SIA's are sites designated for recreation experiences where education and interpretation of unique or special natural resource values are emphasized. The Horse Creek SIA was established to highlight the botanical values of old growth riparian vegetation. The White Mountain SIA was established to highlight the only population of American sawwort (*Sausseria americana*) in California. The Condrey Mountain Blueschist SIA was established to highlight an example of rock formed at very high temperature and pressure in the Klamath Mountains. Both the Horse Creek and White Mountain SIAs do not show on **Figure 1-2** because they are masked by the LSR (refer to **Figure 6-5** for SIA locations).

TABLE 5-2. Special Interest Area (SIA) Acreage and Feature

SIA	Area Acres	Feature/Significance
Horse Creek Botanical Area	200	Old growth riparian vegetation
White Mountain Botanical Area	100	Only population of *Sausseria americana* known in California
Condrey Mtn Blueschist Geologic Area	500	Example of rock formed at very high temperature and pressure

Additional Management Direction

There are two more areas of special management consideration in the analysis area in addition to the Management Areas allocated by the Forest Plan: *Critical Habitat Units* (CHUs) for the northern spotted owl, and a *Released Roadless Area.* These areas occur within the Management Areas allocated by the Forest Plan. Specific Management direction for these areas must be considered in addition to the standards and guidelines that apply to the overlaying Management Areas.

Critical Habitat Units (CHUs)

The Fish and Wildlife Service established Critical Habitat Units for long-term protection of habitat for the northern spotted owl prior to the establishment of LSRs. Most of the CHU areas have been incorporated into LSRs, but small portions extend outside of LSRs into other Management Areas where

the objectives may appear to conflict. Management implications of CHUs will be discussed in more detail under the Terrestrial Wildlife issue.

Released Roadless Area

A portion of the Condrey Mountain Released Roadless Area lies within the Horse Creek Analysis Area. It comprises 2,930 acres and lies entirely within the Johnny O'Neil LSR. With the passage of the Released Roadless Area rule (January, 2001) road construction and timber harvest are limited in inventoried roadless areas. This policy was recently upheld by the Bush Administration.

Hillslope Processes

Key Question#1 - What changes are there between current and reference/historical runoff and erosion rates and what is the cause of these changes?

Changes between reference/historic and current watershed conditions are best described in general, qualitative terms, as little quantitative data exists before fifty years ago. It is assumed that watershed impacts were, and are, proportional to amounts of ground-disturbing activities. Beginning in the late 1800s and through the 1900s humans modified the Horse project area landscape with mining, roads, timber harvest units, and recreation facilities. The ecological regime was also modified by fire suppression, which changed the character of the vegetation.

The only way to estimate watershed conditions in the past is through older aerial photographs and geologic investigations. Pre-historically, natural landslides and floods occurred primarily in response to severe rainstorms. It is assumed then, based on hill slope conditions that the pre-historic rate of sediment production was much less than the modern rate. This interpretation is based on several assumptions:

Table 5-3. Road Miles

Watersheds	Acres	System	FS Unclass	Private	County	State	Road Density*
Upper Horse	11383	48.92	3.7	3.11	0	0	3.13
Lower Horse	10375	52.59	6.57	6.76	2.05	0	4.07
Middle Creek	8030	38.18	4.22	27.88	0.19	0	5.60
Buckhorn	9153	41.1	5.82	15.77	0.2	0	4.38
Kohl/Dona	8452	20.72	0.25	12.68	0	3.55	2.55
Doggett	7727	26.65	0.76	41.09	0	0.07	5.67
Blue Heron	6372	13.13	0.53	8.32	0	4.35	2.21
Collins/Lime	7191	28.21	0.6	9.05	2.48	3.34	3.37
Quigley	6236	9.8	0	3.11	0.05	5.56	1.32
Total	74919	279.3	22.45	127.77	4.97	16.87	3.67

*Miles of road per Mile^2 of Sub-watershed Area.
Road density does not include State or County roads.

The first assumption: Prior to the construction of Forest Service and County roads, sediment was not generated from road surface erosion, fill-failures, and road stream crossings to the same magnitude as the present day. See **Table 5-3** for the miles of roads in each sub-watershed.

The second assumption: Prior to suppression of wildfire, fires burned with less intensity, resulting in fewer post-fire landslides and erosion problems. The primary reason for increased erosion after wildfire is the loss of ground cover in severely burned areas. To a certain extent, this can be mitigated, naturally by needle cast, or by Burn Area Emergency Rehabilitation (BAER) measures designed to restore groundcover. See **Table 5-4** for the percent of each sub-watershed with moderate and high timber mortality.

Table 5-4. Fire Starts

Watersheds	Acres	Fire Starts	Timber Mortality (% Of Watershed)	
			Mod	High
Upper Horse	11383	54	5%	10 - 12%
Lower Horse	10375	50	40 – 50%	20%
Middle Creek	8030	50	10%	25-35%
Buckhorn	9153	50	10 – 15%	10 – 12%
Kohl/Dona	8452	35	1 – 2%	25%
Doggett	7727	44	5 – 10%	10 – 12%
Collins/Lime	7191	48	5 – 10%	40 – 45%

The third assumption is that prior to timber harvest, sediment was not generated from surface erosion or landslides in harvest units. See **Table 5-5** for the timber acreage harvested within each sub-watershed.

Table 5-5. Acres Timber Harvest on Public Land		
Watersheds	**Acres**	**Harvest**
Upper Horse	11383	1456
Lower Horse	10375	2104
Middle Creek	8030	1082
Buckhorn	9153	1471
Kohl/Dona	8452	543
Doggett	7727	740
Blue Heron	6372	464
Collins/Lime	7191	474

Early mining had an occasional intense effect on channel and hill slope conditions. Intense mining activity occurred in virtually every sub-watershed in the project area from the 1850s to the early 1900s. Both lode and placer claims were worked including hydraulic operations and extensive dredging. The portion of Horse Creek, from the confluence with the Klamath River up to almost Fish Gulch was dredged, most recently in 1938. In addition, several large rainstorms occurred in the late 1800s. These storms were probably equivalent to, or slightly larger than the December 1964 flood.

The effect on hill slope condition was probably less severe than it was on channel condition. The slopes that were timber harvested have largely regenerated; however, most hydraulic pits remain devoid of vegetation today.

Extensive development of Forestlands for timber harvest did not occur until the early 1960s. New roads were constructed into previously undeveloped areas and the first timber sales with large clear cuts were harvested. Shortly afterwards, the flood of December 1964 occurred. Many of the roads were built to a highway standard that did not allow water to disperse off the road surface, and many large clear cut areas had just recently been harvested or burned. The 1964 storms had a severe damaging effect on these roads and harvest units.

Key Question #2 - What are the hydrologic/erosional concerns in the analysis area and in each sub watershed?

There are two important modes of sediment production: 1) chronic sediment production, the fine sediment produced from exposed soil surfaces during runoff-producing rainfall. Exposed surfaces can be natural, road surfaces, or the result of timber harvest or fire; and 2) episodic sediment production, the sediment produced under intense rainfall resulting from natural and management-related landslides.

Chronic sediment production occurs every year, when and where runoff occurs on recently disturbed soil. Runoff occurs when and where the precipitation rate (or melt rate in the case of snow) exceeds the infiltration rate of the soil. Soil particles detached by abrasion of dry soil, disturbance of saturated soil, and ripping are carried by overland flow. Some overland flow arrives at stream courses or drainage ditches leading to stream courses. Burned surfaces produce ash, fine organic material, and soil particles. Local areas may experience runoff-producing precipitation during summer thunderstorms, but most fine sediment is produced by runoff of wet-season storms. Once loose particles have been removed by early runoff, the rate of fine sediment production declines. Without continuous disturbance of soil surfaces, fine sediment production carried by runoff would decline noticeably.

Chronic fine sediment production is a concern where sediment charged stream waters infiltrate gravels in stream channels, depositing sediment in spawning gravels in slower flow areas. This process interferes with respiration of salmonid eggs in the streambed as well as other biological processes in other aquatic species

Road surfaces are the major controllable source of chronic sediment production. The primary management-related component of chronic sediment originates from erosion of abraded, dry road surfaces; ditch erosion and wet weather use and disturbance of roads. Chronic fine sediment production from roads is controllable by surfacing roads with aggregate and control of road use during the times that the road surface is susceptible to abrasion and wet-weather disturbance. See **Table 5-6** for the Universal Soil Loss Equation (USLE) values for each sub-watershed.

Table 5-6. Universal Soil Loss Equation (USLE) Index Scores				
Watersheds	**Acres**	**Back-ground Sedi-ment**	**Roads Sed.**	**Roads % of Back-ground**
Upper Horse	11383	210.63	1304.39	619
Lower Horse	10375	118.16	983.83	833
Middle	8030	89.09	936.24	1051
Buckhorn	9153	95.98	761.28	793
Kohl/Dona	8452	71.01	613.35	864
Doggett	7727	67.63	594.25	879
Blue Heron	6372	68.7	315.69	460
Collins/Lime	7191	53.48	397.27	743
Quigley	6236	31.25	151.2	484

Episodic sediment production occurs less frequently, about 5% probability in a year (a twenty year event), with more intense rainfall (10 or more inches of rain

in 10 or less days for mid-winter). Episodic sediment production may also occur under intense precipitation of summer thunderstorms. Natural and road-related landslides, road-associated fill and cut failures, and road/stream crossing failures are the common sources of episodic sediment production.

Natural landslides that contribute to episodic sediment production include large, active earth flow landslides of the dormant landslide and residual soil terrane and debris slides of shallow soil mantle that occur in all of the geomorphic terranes.

The primary management-related component of episodic sediment originates from road-associated landslides, road-associated fill and cut failures, and road/stream crossing failures. According to "The Flood of 1997: Klamath National Forest" (de la Fuente et al. 1998), 83% of flood damage sites resulting from the January, 1997 flood were the result of these three sources of episodic sediment. See **Table 5-7** for the mass wasting indices for each sub-watershed.

Table 5 -7. Mass Wasting Index Scores

Watersheds	Acres	Bkgrnd Yds^3/Ac	Current Yds^3/Ac	Rds % Bckgrnd
Upper Horse	11383	3.202	7.476	132
Lower Horse	10375	3.18	7.498	122
Middle	8030	3.283	9.816	200
Buckhorn	9153	4.568	10.293	118
Kohl/Dona	8452	3.365	9.051	165
Doggett	7727	4.035	10.27	149
Blue Heron	6372	2.472	5.32	112
Collins/Lime	7191	2.138	5.224	144
Quigley	6236	4.035	5.046	115

Road-related landslides account for about 18% of road damage sites from the 1997 flood. Roads through, or immediately adjacent to, active landslides pose the greatest risk to large volumes of episodic sediment delivery. Areas of toe zone, inner gorge, and dissected granitics have high potential of producing road-related earthflows. Some landslides can be small in size and easily handled by routine road maintenance. However, most are significantly large failures that are difficult or financially unfeasible to repair. In some cases the failure is slow and not readily or immediately apparent.

Road fill failures account for about 14% of the road damage sites as reported in the flood damage study. Numerous failures of the road cut face and natural foundation of the fill are observed in unconsolidated inner gorges and toe zones. Many fill failures are called wash outs or blowouts due to the erosive action of flowing water on poorly compacted fills. Fill failures can also result in mudflow landslides, which are often very destructive for a long distance down stream.

Most significantly, road/stream crossing failures account for about 51% of the road damage sites. In this count are all damage sites at stream crossings, regardless of cause, including culvert failures, landslides, and soil saturation. Many culverts were unable to pass the high volume of water and debris during the flood. Portions of roads and adjacent hill slopes were severely eroded, as culverts plugged or were overtopped. Streams were routed across or down roads and down slopes not capable of handling the large amount of flow. See **Table 5-8** for the number of streams with four or more stream crossings for each sub-watershed.

Table 5 -8. Channels with Multiple Crossings

Watersheds	Acres	Streams with 4+ Crossings	Concern Level
Upper Horse	11383	11	Mod/High
Lower Horse	10375	3	Low
Middle	8030	19	High
Buckhorn	9153	14	High
Kohl/Dona	8452	10	Mod/High
Doggett	7727	17	High
Collins/Lime	7191	0	Low

Episodic sediment production of rare, intense storms produces large amounts of sediment to streams, resulting in significant changes in channel form, channel location, and disturbance of floodplain vegetation. Transport of such large influxes of sediment continues at an elevated rate for ten years after the original flood. During this time, the channel bed remains relatively unstable. Channel wandering and channel bank erosion occurs as flows find a way around deposits of coarse sediment. Movement of the unstable substrate can result in loss of developing fish eggs and sub gravel embryos.

Episodic sediment production is most effectively controlled by avoidance of construction in unstable terrane, site-specific mechanical stabilization measures, and control of drainage. There are only a few feasible opportunities to stabilize natural earth flow landslides, as most are too large and complex for reasonable fixes. There are, however, many opportunities to reduce the destabilizing effects of roads on earth flow landslides, toe zones, and stream crossings.

Key Question #2a - What management strategies should be used to minimize impacts from human activities?

One of the best approaches to managing unstable ground, which are areas where large road-related earthflows are most likely to occur, is avoidance. High maintenance road segments in toe zone, unconsolidated inner gorge, and dissected granitics are good candidates for road decommissioning. Earthflows may continue to move, but suspending activities that keep the road open will often result in significant abatement of landslide processes. If a road on unstable terrane must be kept open, then road-aggravated damage by active earthflows can be reduced by minimizing the size of cuts and fills and avoiding disturbance of both surface and subsurface natural drainage patterns.

There are several techniques effective in preventing fill failure. Many local roads were constructed without controlled compaction. Achieving maximum compaction in construction of fills and repair of fill failures is key to preventing a subsequent failure at the same site. Soil moisture in the fill must be within a narrow range to achieve optimum compaction. Well-compacted soil has fewer and smaller voids, so it absorbs less water and remains stronger when inundated. By controlling soil compaction and soil moisture the possibility of fill failure can be minimized. Increased soil density can significantly improve the stability of road fills. Mechanical reinforcement of fill (such as layered geo-textile) and surface and subsurface drainage also serve to improve the strength of fills. This is an effective technique in situations where location of the road or soil properties makes good compaction difficult. Improvement in soil strength from good compaction, mechanical reinforcement, and drainage can prevent and/or reduce, damage by flowing water, such as by culvert failure.

In some cases structural repairs of fill failures, especially on unstable ground, toe zone, unconsolidated inner gorge, and dissected granitics, can be effective when a competent local foundation can be achieved. Over-excavating the foundation to competent material may stabilize foundation failures. Without achieving a competent foundation, repairs often won't survive subsequent flood events, failing in much the same way as before. Cut failures on unstable ground can often be stabilized with a drained reinforced earth buttress behind the cut. An inventory to identify low-density fills, fills constructed of non-cohesive soil (decomposed granite) or other unsuitable material, and sites where surface or subsurface drainage threatens stability is needed to develop an effective watershed restoration program that reduces episodic sediment delivery.

There are also some techniques effective in reducing the risk of road/stream crossing failure. The standard design practice when most Forest roads were built included specifications for stream crossings to withstand 20-year floods. These crossings are at risk to fail during larger storm events. Construction and reconstruction now require stream crossings designed to withstand 100-year floods. To minimize impacts, road/stream crossings should be upgraded to pass water and debris during a 100-year or larger flood. Upsizing the culvert is one way to achieve this. Another is to design crossings so, if culvert capacity is exceeded, water over-topping the road will cause minimal damage, erosion, and sediment delivery. An effective design may incorporate a culvert with rock-fill and a rolling dip to allow passage of water and debris over the road if necessary, while keeping the natural drainage channel in its original location. The site-specific road/stream crossing inventory should be utilized to determine sites most in need of upgrading. Drainage design is of key importance in reducing episodic sediment production at stream crossings.

Key Question #3 – Which subwatersheds have continued watershed concerns, when will they be considered recovered, and how can recovery be promoted?

The Cumulative Watershed Effects (CWE) models (see **Step 3***, Hillslope Processes, Key Question 4*, and **Appendix B**) provide an index of existing conditions relative to disturbance and land sensitivity. These models along with riparian condition, stream condition, land allocations, and professional interpretation, were used to evaluate sub-watersheds to determine areas that have continued watershed concerns or "impaired" watersheds.

Impaired sub-watersheds are places where levels of natural and human-caused disturbances may have exceeded the ability of the area absorb and/or be resilient to additional disturbances. They are places where adverse Cumulative Watershed Effects may be more likely to occur. Impaired sub-watersheds express diminished beneficial uses (i.e. fish habitat, drinking water). Generally, impaired watersheds are measured using the Cumulative Effects Assessment; by the degree cumulative conditions exceed thresholds of concern. They are areas with high concentrations of roads, burned areas, and timber harvest units. Impairment is characterized by reduced resiliency to moderate-sized (10-year) disturbances.

Four watersheds have been identified as impaired: Lower Horse Creek, Middle Creek, Buckhorn Creek, and Doggett Creek. The primary contributors are high road density, high percentage of channels with four or more road crossings, timber harvest, scoured channels, and fire. Impaired sub-watersheds are displayed in **Figure 5-1** and **Table 5-9** below.

Table 5-9. Impaired Watersheds

Watershed	ERA/ TOC	Combined Index	Non-system Roads (miles)	Streams with 4+ Crossings	Road Density (rd. miles/ sq mile)
Lower Horse	0.61	0.73	3.7	11	4.07
Middle Creek	0.76	0.97	6.57	3	5.60
Buckhorn	0.79	0.74	4.22	19	4.38
Doggett	0.94	0.72	0.25	10	5.67

Detailed information for each sub-watershed, including recommendations for future restoration activities, is contained in the following paragraphs. Impaired sub-watersheds are considered recovered when adverse cumulative watershed effects are no longer a concern.

Lower Horse Sub-watershed from the mouth of Middle Creek to Seiad Low Gap

There were 18 ERFO sites from the flood of 1997 in the Lower Horse sub-watershed. The risk ratio of 0.61 was raised slightly to 0.73 due to soil loss. There are 3.7 miles of non-system or unclassified roads in the sub-watershed; its road density is moderately high for the analysis area. There are 11 stream channels with 4 or more road crossings.

Middle Creek Sub-watershed

Although, with a risk ratio (ERA/TOC) of 0.76, the sub-watershed is well below the Threshold of Concern at 1.0, the road density, and the associated soil loss from roads have raised the combined index to 0.97. There were 5 storm damage (ERFO) sites in the watershed area. Middle Creek hosts both resident and Steelhead fisheries values. There are 3 registered water rights on Middle Creek

The Middle Creek sub-watershed is dominated by dormant landslide deposit and toe zone terranes, typified by the Middle Creek earthflow. It has 4.22 miles of unclassified roads. Decommissioning of these roads, and adding an out slope configuration to the road prism would serve to lessen the soil loss while reducing the sub-watershed ERA's. Concentrating on stream crossing protection is also warranted.

Buckhorn Creek Sub-watershed

This sub-watershed was heavily burned and salvaged in the late 1970's. It has a bit higher risk ratio, but is lower in the combined index, reflecting the lower road density than Middle Creek. There were 3 ERFO sites associated with the flood of 1997. Buckhorn Creek hosts both resident and steelhead fisheries values. There is one registered water right in Buckhorn Creek.

Like Middle Creek the sub-watershed is dominated by dormant landslide terrane, but has over twice the toe zone terrane. There are 4.22 miles of unclassified road in the sub-watershed and 19 channels with 4 or more road crossings. Decommissioning of these roads, and adding an out slope configuration to the road prism would serve to lessen the soil loss while reducing the sub-watershed ERA's. Concentrating on stream crossing protection is also very much warranted.

Doggett Creek Sub-watershed

The Lower Horse sub-watershed has high anadromous fisheries values, hosting Coho and Chinook salmon, as well as high resident fisheries values. There are 3 registered water rights in Horse Creek.

The Doggett sub-watershed underwent pockets of high intensity fire on the west flank of the watershed in mid-2001 that left virtually no ground cover in areas of the burned area. Doggett Creek is nearly at its Threshold with a risk ratio of 0.94. Some decommissioning and post-fire BAER work has served to lower the combined index to 0.72. This sub-watershed is also dominated by dormant landslide deposit and toe zone terranes.

There is only 0.25 mi. of unclassified roads in this sub-watershed, and 10 stream channels with 4 or more road crossings, but it has the highest road density in the watershed analysis area. There were 3 ERFO sites from the flood of 1997. Doggett Creek is host to resident and steelhead populations. There are 4 registered water rights in the sub-watershed.

Key Question #4a - What watershed processes are of concern with the current road system?

Key Question #4b - What are the criteria used to assess roads for the Roads Analysis included in Appendix E of this document?

The following factors were determined to be of concern in relation to watershed processes and the current road system: reducing accelerated sediment delivery from both mass wasting and surface erosion, reducing the alteration of hydrologic integrity, reducing road-related impacts to riparian reserve integrity, and giving special consideration to areas with high Cumulative Watershed Effects (see **Appendix B** for a detailed discussion of the process). These items were intended to focus the Roads Analysis on the most relevant processes affecting roads and the aquatic environment. They were based on findings and discussions contained within the Horse Creek Ecosystem Analysis. They were not intended to cover **all** potential impacts roads may have on aquatic systems.

Mass wasting is indicated by potential landslide sediment delivery to stream channels. This is determined based on the stability of the geomorphic terrane typed each road segment passes through. For example, a road segment that passes through an active landslide, toe zone, inner gorge, or dissected granitic land has a high sediment delivery potential.

Surface erosion is indicated by potential surface sediment delivery to stream channels using a combination of three indicators: sediment yield, human use level, and road surface type. All three indicators received equal weighting. Soil type was identified using the erosion hazard rating (EHR) based on soil type and slope.

Alteration of hydrologic integrity is indicated by a road's potential to: alter physical stream channel dynamics, divert a stream, or extend a stream network. This was measured by the number of road and stream intersections on a given road segment.

Road-related impacts to Riparian Reserve integrity are indicated by an overall loss of riparian habitat. This was measured by length of road segments within Riparian Reserves. Since the focus here is on riparian habitat, the unstable lands components of Riparian Reserves (dissected granitic lands and toe zones of slumps and earthflows) are not included. These components are included in the mass-wasting indicator.

Special consideration is given to areas with high CWEs based on the CWE assessment from this analysis. The combined index values of 7th-field watersheds are used to determine a road's rating.

The aquatic processes, indicators, and rating criteria used to assess roads for **Appendix E** *Roads Analysis Process* are shown in Table 5-10.

Table 5-10. Definitions of Aquatic Rating Criteria for Roads Analysis				
PROCESS	**INDICATOR**	**HIGH**	**MODERATE**	**LOW**
Reduce Accelerated Sediment Delivery: **Mass-Wasting.**	**Sediment delivery potential based on geologic type.**	3 = top 1/3	2 = mid 1/3	1 = =low 1/3
Reduce Accelerated Sediment Delivery: **Surface-Erosion.**	**Surface sediment delivery potential based on a combination of three indicators a) sediment yield b) use level, c) road surface type.**	a) 3 = top 1/3 b) b) 3 = hi c) 3 = native	a) 2 = mid 1/3 b) 2 = moderate c) 2 - aggregate	a) 1 = low 1/3 b) 1 = low c) 1 = asphalt/ chip seal
Reduce Alteration of Hydrologic Integrity.	**Potential to: alter physical channel dynamics, divert stream, extend stream network, based on six indicators: a) stream proximity, b) low slope position, c) steepness; d) channel crossings, e) hydrologic connectivity, and f) diversion potential.**	a) 4 = top 1/4 b) 4 = top ¼ c) 4 = top ¼ d) 4 = top ¼ e) 4 = top ¼ f) 4 = top 1/4	a) 3, 2 = mid ½ b) 3, 2 = mid 1/2 c) 3, 2 = mid 1/2 d) 3, 2 = mid 1/2 e) 3, 2 = mid 1/2 3, 2 = mid 1/2	a) 1 = low ¼ b) 1 = low ¼ c) 1 = top ¼ d) 1 = top ¼ e) 1 = top ¼ f) 1 = top ¼
Reduce Road-Related Impacts to Riparian Reserve Integrity. **(RR includes stream buffers, active slides and inner gorge.)**	**Overall loss of riparian habitat (shade, wood recruitment, species travel corridors) based on miles of road in RR.**	8 = ≥ .75 mile	5 = .25 to .74 miles	2 = <.25 miles
Give Special Consideration to Areas With High Cumulative Watershed Effects (CWE).	**CWE Assessment from this analysis based on 7th field watersheds.**	10 = ≥ .67	6 = .37 to .66	3 = ≤ .36
Summary – road inventory	**Overall rating based on two indicators: a) summation or overall rating, b) highly rated sites**	a) 3 = top 1/3 a) 3 = top 1/3	a) 2 = mid 1/3 ▫ 2 = mid 1/3	▫ 1 = low 1/3 ▫ 1 = low 1/3

Key Question #5 – What are the trends for hill slope processes in the analysis area?

Unstable areas will continue to unravel as natural processes and management activities occur in the analysis area. Landslides and surface erosion will continue, especially when the area is subject to heavy, sustained rainfall or flooding. Accelerated erosion rates resulting from past fires and the 1997 flood will continue to recover. The probability of future severe fire adversely affecting hill slope processes will increase as fuel levels continue to increase. Sediments from the 1997 flood are expected to be re-worked, moved throughout stream channels, and out of the Horse Creek analysis area channel system over the next ten years. Sediment produced from similar future flood events are expected to be relatively unstable for a decade after the event. Direct management impacts from timber harvest will decline overall compared to the past several decades, primarily due to the designation of many areas as administratively withdrawn from programmed timber harvest. The extent of the road system is likely to decrease. Unless opportunities in the Roads Analysis Process are implemented, long-term lack of road maintenance will increase sediment delivery to stream channels from surface erosion, mass wasting and culvert failure. Roads will continue to suffer damage during floods due to inadequate road/stream crossings, inadequate surfacing, landslides, and other road stability problems.

Desired Conditions

- Watersheds are resilient to natural disturbance and management activities. Management activities lead to recovery of impaired watersheds. Future management activities in non-impaired sub-watersheds do not lead to impaired condition so over the long-term, none of the watersheds are impaired or nearing impairment threshold.

- Management of the road system is adequate to manage the land while minimizing impacts to aquatic resources. The Access and Travel Analysis is utilized to identify road repair, storage, and decommissioning projects.

- Fuels conditions are such that the risk of severe fire effects is small throughout the watershed.

Riparian and Stream Areas

Key Question#1 – How have Riparian Reserve acreages evolved from the *Forest Plan* through this analysis?

The Riparian Reserve acreage estimates described in **Chapter 3** *Riparian and Stream Areas* and shown in **Table 3- 13** *Riparian Reserves (RR) With ROD Buffers*, are derived from updated geomorphic and stream buffers mapping (update version for each, September 1997). The Riparian Reserves include the unstable lands geomorphic types; active landslides, toe zones of dormant landslides, and all types of inner gorge. The stream buffer mapping includes 340-foot buffers (approximately two site potential tree heights for the area) on fish-bearing streams and lakes, and 170 foot (one site potential tree) on non-fish bearing perennial and intermittent streams, marshes, and springs. The streams, marshes, and springs mapping is based on USGS 1:24,000 quad maps supplemented with additional streams based on a 20-acre accumulation model. The 20-acre accumulation model predicts the beginning of a stream, assuming 20 acres of land draining to a single point will initiate an "annual scour" stream; "Annual scour" is used as described in the *ROD* and the *Forest Plan*. The model has been spot tested in Elk Creek, Beaver Creek, Callahan, and the Lower South Fork of the Salmon River watershed analysis areas, and has shown to give a good estimate of stream extent in those areas. The 20-acre accumulation model streams have been incorporated into Forest wide streams and stream buffers coverages.

In addition, project level delineation of Riparian Reserves will result in changes to the unstable lands geologic data layer. This will be due to both under-mapping or over mapping of unstable geomorphic terrains (active landslide, toe zone, inner gorge, dissected granitic lands) at the Horse Creek ecosystem analysis level.

Based on project level mapping samples done on the Salmon River District, the following changes to Riparian Reserve acreage may occur at the project level in the Horse Creek area. Mapped active landslide acreage will likely increase (primarily slumps and earth flows not visible on air photos). This proportion increase would be very small since active slides usually occupy less that one percent of the land base. Mapped toe zone acreages will likely increase. Mapped inner gorge acreages will likely decrease on smaller streams (first to third order), and on floodplains. However, much of the over-mapped portion in these areas may still be in Riparian

Reserves due to proximity to streams. Dissected granitic lands can increase or decrease. There is not a good sample of project level mapping of these areas to draw conclusions from.

Key Question #2 - What are the natural and human causes of change between historical/reference and current riparian area conditions, including the impacts of roads and other disturbances?

The wildfires of 1987, and the 1997 flood were natural events that impacted many acres of riparian area by changing vegetation seral stage and increasing erosion potential. Fire suppression activities result in a build-up of available fuel and can put upslope riparian areas at risk to high fire severity. Portions of upslope riparian reserves burned at high intensities during the 1987 wildfires, consuming vegetation, which provided hillslope stability, large wood recruitment, and shade.

Mining was the probably the earliest Euro-American activity to impact riparian areas in the analysis area. Placer mining along Horse Creek and several tributaries disrupted stream channels and riparian vegetation, primarily in the 1890 to 1920 time period. Most of these old placer workings have become revegetated although evidence of past workings can still be seen. Mining that occurred in ore deposits generally had little effect on riparian areas. Currently, the mining that occurs in the analysis area is primarily suction dredging in the Klamath River.

During this period of placer mining, streams in the analysis area were channelized, decreasing summertime stream flows. The current condition of well-confined streams is much different than the marshy, wooded lowlands that likely existed prior to Euro-American settlement. These conditions have contributed to lowered flows and raised summer water temperatures in the lower sections of the analysis area. Roads and timber harvest are additional human-caused disturbances affecting the riparian areas today. Roads are a high impact due to the long-term loss of growing site for vegetation and potential sources of eroded sediment. Roads constructed adjacent to streams generally result in a loss of riparian vegetation to improve driver visibility, and reduce hazard trees falling on roadways. As a result there is reduced stream shading, causing increased stream temperatures, reduced large wood recruitment, and overall loss of habitat for aquatic and riparian species (USFS 1999). Timber harvest is a temporary change in erosion potential and vegetation seral stage, also affecting sediment inputs to streams, stream shading, and large wood recruitment.

Key Question #3 - How do the current riparian habitats compare to optimum habitats, and how can riparian areas be protected and/or restored? What poses problems to stream channel stability and resilience?

Information from stream habitat surveys can be used as a descriptive tool for assessing aquatic habitat conditions. Various problems arise, however, when attempting to set standard thresholds for stream habitat parameters. One set of criteria cannot fit all streams. Scaling stream habitat parameters to the size of a stream and geologic morphology of its watershed can be difficult. Pools in smaller streams tend to be shallower than pools in larger streams. Streams in a watershed having large areas of decomposed granitic terrain generally have a higher percentage of fines in the substrate than streams within watersheds where most of the terrain is composed of competent bedrock. Other problems arise because there is very little information on reference stream habitat conditions and ranges in reference data vary widely.

Because optimum habitat conditions for Horse Creek analysis area streams are largely unknown, reference habitat parameters from three sources are used in this analysis. Reference conditions for instream habitat components have been identified in measurable elements in the *Forest Plan.* National Marine Fisheries Service (NMFS) has established measurable indicator criteria to determine if stream ecosystems are at a properly functioning condition. Habitat parameters from unmanaged streams within the Scott River Ranger District are also used as reference conditions. **Table 5-11** *Reference Habitat Components*, summarizes the three sets of reference habitat values (only water temperature and fish habitat parameters presented in Step 3 are displayed).

Table 5-11. Reference Habitat Components

Parameter	*Forest Plan*	NMFS Matrix	Scott River District Reference
Water Temperature	Below 70°F	Below 69°F	**N/A**
Pool Frequency	One Pool Every Three to Seven Bankfull Widths	One Pool Every Three to Seven Bankfull Widths.	**One Pool Every Four Bankfull Widths**
Maximum Pool Depth	At Least 3 Feet	At Least 3 Feet	**Not Applicable**
Canopy Cover	80% Surface Shading	Not Applicable	**76% Surface Shading**
Coarse	20 Pieces Per	>20	**See Table 5-**

Woody Material	1,000 Lineal Feet (24" Diameter x 50' Length)	Pieces/Mile (>24" Diameter x >50' Length)	**10, below**
Substrate	Not Applicable	Not Applicable	**Gravel, Cobble Dominate**
Fine Sediment	<15% in Spawning Gravel	<15% in Spawning Gravel	**8% Overall, 2% in Pool Tailouts**

Determination of habitat criteria from the *Forest Plan* is based on the "Draft Proposal For managing and Monitoring Streams For Fish Production" (Sedell 1988), local data and current literature. Sedell's proposal was intended to provide direction for Forest Plan application in Oregon and Washington Forests in the Columbia River Basin. These may be adjusted to the Klamath National Forest as additional information is obtained.

The National Marine Fisheries Service (MNFS) Matrix of Factors and Indicators is used to document baseline stream and watershed conditions. Current aquatic conditions for each surveyed stream in the assessment area are compared to NMFS indicator criteria to determine "Functioning", "At-Risk", or "Not Properly Functioning" habitat components. The indicator criteria used for this assessment are shown in **Table 5-10** *Matrix of Factors and Indicators*. **Appendix C** - *Aquatic Habitat*, contains completed comparison tables titled "Justification of Matrix of Factors and Indicators" for each surveyed stream. These tables display determinations of "Properly Functioning", "At- Risk", and "Not Properly Functioning" habitat components and the justification behind the determinations. The NMFS matrix criteria must be used for each Klamath National Forest proposed project to meet obligations of compliance under the Federal Endangered Species Act.

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Table 5-12. Matrix of Factors and Indictors

FACTORS	INDICATORS	PROPERLY FUNCTIONING	AT-RISK	NOT PROPERLY FUNCTIONING
WATER QUALITY	Temperature	69 °F or less	69 to 70.5 °F	>70.5 °F
	Turbidity	Turbidity Low	Turbidity Moderate	Turbidity High
	Chemical/Nutrient Contamination	Low levels of contamination from agriculture, industrial, and other sources: No excess nutrients	Moderate levels of contamination from agriculture, industrial, and other sources: some excess nutrients	High levels of contamination from agriculture, industrial, and other sources: high levels of nutrients
HABITAT ACCESS	Physical Barriers	Man-made barriers allow upstream and downstream passage at all flows	Man-made barriers do not allow upstream and/or downstream passage at base/low flows	Man-made barriers do not allow upstream and/or downstream passage at a range of flows
HABITAT ELEMENTS	Substrate	Less than 15% fines in spawning habitat and cobble embeddedness less than 20%	15 to 20% fines in spawning habitat and/or cobble embeddedness is 20 to 25%	Greater than 20% fines in spawning habitats and cobble embeddedness greater than 25%
	Large Woody Material	More than 20 pieces of large wood per mile and current riparian vegetation condition near site potential for recruitment of large wood	20 pieces or less of large wood per mile or current riparian vegetation condition below site potential for recruitment of large wood	Less than 20 pieces of large wood per mile and current riparian vegetation condition well below site potential for recruitment of large wood
	Pool Frequency	One pool every 3-7 bankfull widths. Pools should occupy 50% of the low flow channel width and all have a max depth of at least 36 inches	One pool every 3-7 bankfull widths. Pools should occupy 50% of the low flow channel width and half have a max depth of at least 36 inches	Less than 1 pool every 7 bankfull channel widths and/or less than half of the pools have a max depth of at least 36 inches
	Off-Channel Habitat	Backwaters with cover and low energy off-channel areas	Some backwaters and high energy side channels	Few or no backwaters or off-channel ponds
	Refugia	Refugia exist and are adequately buffered, sufficient in size, number and connectivity	Refugia exist but are not adequately buffered, are insufficient in size, number and connectivity	Adequate refugia do not exist
CHANNEL CONDITIONS AND DYNAMICS	Width/Depth Ratio	W/D ratio <12 on all A, G, and E channel types. W/D ratio >12 on all B, F, and C channel types	More than 10% of the reaches are outside of the W/D ranges given for properly functioning	More than 25% of the reaches are outside of the W/D ranges given for properly functioning
	Streambank Condition	>90% stable i.e.. on average <10% of banks are eroding	80-90% stable	<80% stable
	Floodplain Connectivity	Off-channel areas are frequently linked to main channel. Overbank flows occur and maintain wetland functions, riparian vegetation and succession	Reduced linkage of wetland floodplain and riparian areas to main channel. Overbank flow reduced as evidenced by moderate degradation of wetland function, riparian vegetation, and succession	Severe reduction in connectivity between off-channel wetland, floodplain, and riparian areas. Wetland are drastically reduced and riparian vegetation and succession altered significantly
FLOW HYDROLOGY	Changes in Peak/Base Flows	The Risk Ratio in the ERA model is less than 0.5	The ERA Risk Ratio is between 0.5 and 1.0	The ERA Risk Ratio is greater than 1.0
	Increase in Drainage Network	The density of road/stream crossings is less than 3 per square mile	The density of road/stream crossings is between 3 and 6 per square mile	The density of road/stream crossings is greater than 6 per square mile
WATERSHED CONDITIONS	Road Density	Less than 2 miles per square mile	Between 2 and 4 miles per square mile	Greater than 4 miles per square mile
	Disturbance History (landslide model)	Current condition in the landsliding model is less than 100 percent over background	Current condition in the landsliding model is between 100 and 200 percent over background	Current condition in the landsliding model is greater than 200 percent over background
	Disturbance History (surface erosion model)	Current condition in the surface erosion model is less than 400 percent over background	Current condition in the surface erosion model is between 400 and 800 percent over background	Current condition in the surface erosion model is greater than 800 percent over background
	Riparian Reserves	Less than one percent of Riparian Reserve is roaded and less than 10 percent is <40 year old plantation or stand replacing fire	Between one and two percent of Riparian Reserve is roaded or between 10 and 20 percent is <40 year old plantation or stand replacing fire	Greater than two percent of Riparian Reserve is roaded or greater than 20 percent is <40 year old plantation or stand replacing fire

Reference streams used for the Scott River Ranger District are either wilderness stream reaches or stream reaches that are primarily un-roaded and un-managed. They are considered to have pristine conditions for the Scott River Basin area. **Table 5-13** displays reference habitat parameters for Scott River District streams. **Table 5-14**, *Reference Coarse Woody Material*, summarizes instream wood values for Scott River District un-managed streams. Values for Scott River District reference streams are averaged across all channel types, watershed areas, and elevations.

Table 5-13. Scott River District Reference Habitat Parameters

Stream	WA Area	Reach Length	Width/ Depth	% Substrate composition 1/					Pool Tailouts	Channel Widths/ Pool 2/		# of Pools/Mile		% Shade 3/
	(ac)	(m)		Fines	Gravel	Cobble	Boulder	Bedrock	% Fines	SCI	Primary	SCI	Primary	
W Boulder	1,500	449	26	29	17	33	21	0	6	3	0	140	0	69
Up Sugar 1	2,500	474	18	9	22	3	12	53	<1	2	12	160	31	62
Up Sugar 2	2,500	386	18	11	27	21	22	18	<1	3	29	134	13	90
Up Sugar 3	2,500	904	18	4	36	16	39	5	<1	2	25	157	14	75
L Etna Mill 1	6,700	328	40	12	39	10	12	31	<1	2	7	88	25	84
L Etna Mill 2	6,700	379	40	15	44	10	31	35	<1	1	14	157	13	78
U Etna Mill 1	6,700	730	31	-	32	34	33	4	<1	2	0	90	0	83
U Etna Mill 2	6,700	527	31	1	15	12	26	45	<1	1	21	168	9	65
Wooley 1	9,500	871	23	3	13	38	35	11	<1	6	17	26	9	79
Wooley 2	6,000	620	-	1	28	35	18	19	N/A	N/A	N/A	N/A	N/A	-
Wooley 3	15,700	862	31	2	30	39	25	46	4	9	10	11	9	-

1/ Substrate particle size breakdown; fines = <4mm, gravel 4-64mm, cobble 64-256mm, boulder >256mm
2/ Bankfull channel width divided by number of pools in each category. SCI pools are of a depth at least two-time that of the pool tail crest. Primary pools are greater than
Three feet in depth.
3/ Average percent shade includes both canopy cover and topographic shade; not just vegetation.
SCI Protocol version 3.4 (6/27/96)

Table 5-14, Reference Coarse Woody Material 1/

Diameter Class 2/	# Pieces	Volume (cub.met)	Length class (m) 2/	# Pieces	Volume (cubmet)
<.4	10.8	6.3	2-8	10.1	10.8
.4-.8	12.3	47.7	8-16	9.5	31.6
.8	2.3	43.6	16+	5.9	55.2
TOTAL	**25.4 3/**	**97.6**	**TOTAL**	**25.5 3/**	**97.6**

1/ All values are per 1,000 lineal feet of stream.
2/ Minimum diameter = .4m, while minimum length varied and usually was 3+ meters.
Meters.
3/ Approximately sixteen pieces of wood (>.4 m in diameter & >2+ m in length)
Were found on avg/1,000' of channel length. Of this, 4.8pieces/1,000' were > .4m
(About 16") in diameter and 7.9 pieces were > 8m (26.2') in length. Volume (cubic meters)
averaged 24.8/1,000' of channel.

Many of the values for fisheries habitat criteria in the *Forest Plan* and environmental indicators in the NMFS matrix may be inappropriate, especially when applied to moderate to small streams in the Horse Creek assessment area. In some cases this may have resulted in a determination of Not Properly Functioning or At-Risk when the negative connotation of these labels may not always be warranted. Thresholds for habitat parameters in the *Forest Plan* and NMFS matrix may need refinement. More thorough analysis of existing data and further surveys of undisturbed streams could help refine appropriate ranges of conditions for comparing current to reference aquatic habitat quality.

Successful recovery efforts will conserve and restore the long-term dynamics of watersheds, rather than just habitat attributes. Meeting any given management-imposed habitat standard may or may not reflect the health of a stream. Maintenance of critical stream processes, such as the regimes of water; sediment and woody material delivery are more likely to result in the successful conservation of aquatic dependent species.

Overall, most of the stream habitat condition values are in line with properly functioning habitat conditions from both the *Forest Plan* and the NMFS Matrix of Factors and Indicators. Most exceptions are low pool frequencies, high amounts of fine sediments, and low numbers of key large woody material.

Cool, deep pools are critical for summer holding and rearing habitat. Spawning takes place in the deposited gravel in pool tailouts. Several amphibian species require cool, deep pools high in dissolved oxygen for successful breeding. Pools can also be highly sensitive indicators of changes in watershed conditions (EPA 1991). Pools are categorized into two classes: primary pools with a depth of at least one meter, and SCI pools with a depth greater than two times the pool tail crest.

Two of the ten reference reaches displayed in **Table 5-13** and one of the eight managed reaches for Horse Creek displayed in **Table 3-18** have no primary pools. However, frequencies of primary pools, for reaches of Horse Creek that have them, are below those displayed for reference streams. The eight managed reaches of Horse Creek do not meet the NMFS pool frequency criteria for properly functioning because of the depth requirement. A 36-inch depth may be an unrealistic standard for smaller sized, high gradient streams in the Horse Creek assessment area.

Reference reaches exhibited a much higher frequency of SCI pools than was found in Horse Creek: an average of one pool every 2.9 bankfull units for reference streams, versus an average of one pool every 20 bankfull units for manage streams.

Stream temperatures are related to water temperatures in headwater streams, solar radiation, air temperature, stream gradient, and flow. The amount of solar radiation hitting the stream is influenced by the amount of vegetative and topographic shade. During the summer months, temperatures greater than the optimum required for salmonid growth can occur in the mainstem Klamath River. Overall, the managed streams have a slightly higher amount of shading than the non-managed reaches. Only reach 2 of Horse Creek (80% canopy closure) meets *Forest Plan* canopy closure criteria.

Large wood provides a source of cover and habitat diversity for fish through a range of flows and seasonal conditions. It is important for diversifying the habitat of amphibians and other riparian dependent species. Wood serves an important role in maintaining healthy stream channels. None of the reaches of Horse Creek met the NMFS properly functioning value of 20 pieces/mile. If the NMFS size classes for "East Side" wood frequencies are used (a less stringent criteria of greater than 12 inches in diameter and greater than 27 feet in length), then the upper five reaches exceed the criteria. Development of size criteria in-between these two may be more appropriate to Scott River tributaries. None of the reaches of Horse Creek met or exceeded the *Forest Plan* value of 105 pieces/mile.

The composition of streambed material influences the flow resistance in the channel, stability of the bed, and quantity as well as quality of aquatic habitat available to developing eggs, small fish, and invertebrates (Olson and Dix 1993). Streambed quality for aquatic organisms is highly dependent on amounts of surface fines and substrate embeddedness; a measure of the extent that large streambed particles are surrounded or buried by fine sediment. Excessive fines and embeddedness decreases embryo and fry survival and emergence, decreases or alters invertebrate populations that serve as a food base, decreases rearing habitat available for juvenile salmonids, and decreases pool frequencies.

Reference streams were primarily bedrock or boulder dominated with lesser amounts of cobble and gravel. The lower five reaches of Horse Creek were largely composed of cobble with lesser components of gravel and boulders. The upper three reaches are also largely composed of cobble but contain higher percentages of boulders and less gravel than the lower five reaches. All reaches of Horse Creek had 18% or greater fines in pool tailouts except for reach 6, which had 10% fines. Overall Horse Creek has higher fine sediment levels than the reference streams, especially in spawning gravels, and is not meeting both NMFS and *Forest Plan* criteria.

Key Question #4 - What are the trends for riparian areas in the watershed?

Riparian areas and channels affected by the 1987 wildfires will continue to recover, as trees become established and grow. Lands affected by the 1997 flood will also continue recovering for the next decade throughout the assessment area, barring any additional disturbance; riparian vegetation will slowly increase and shade will improve. In stream channels not severely affected by the flood or fires,

the proportion of dense, late-seral vegetation in riparian areas will increase, as trees grow larger and older. Some dense, early-seral stands may stagnate as tree densities approach site capacity. Poor site quality areas will probably change little over time. Overall instream aquatic habitat should slowly improve over time as the impacts of the fire and flood continue to diminish. However, some upslope riparian areas will remain at risk to high severity fire until adjacent high fuel loadings can be reduced. Pool habitat will increase in heavily scoured streams over the next decade. Riparian area conditions will continue to fluctuate with future intense storm events and wildfires.

Streams within subwatersheds with high road densities, poor road conditions, and high disturbance histories will continue to experience chronic sediment inputs. Repair of known road-related erosion problems, decommissioning of unneeded roads, and appropriate logging practices in matrix will decrease sediment impacts in the long-term. Provided future flood events, wildfires, road building, and timber harvesting activities do not severely impact large areas, watershed processes should continue toward reference conditions.

DESIRED CONDITIONS

--Mid to late-seral stands in Riparian Reserves are maintained over the long-term at a percentage consistent with reference conditions. Riparian Reserves, especially in headwater areas are resilient to fire. Connectivity for late-seral wildlife is also maintained.

--High quality aquatic habitat exists in all streams with adequate amounts of pools and LWM in streams as site capacity allows.

--Habitat is sufficient for sustainable populations of indigenous aquatic species including flow and temperature conditions, especially in mainstem Klamath River and Horse Creek. Fine sediment input, accumulation, and transportation in streams are reduced to levels consistent with good quality aquatic habitat.

--Roads, dispersed recreation sites, and other human developments in riparian areas are maintained to achieve attainment of *Aquatic Conservation Strategy* objectives and there is reduced habitat disturbance from management activities.

--Riparian features are well identified on maps and on the ground.

Aquatic Dependant Species

Key Question #1 - What are the natural and human causes of change between historical/reference and current species distribution and populations sizes?

As stated in Step 4, Aquatic Dependent Species, it is assumed that there is a substantial decline from historical levels in the abundance of all anadromous species and in their diversity of life history patterns within the Klamath River basin. Weakened anadromous populations within the basin have been impacted by aquatic habitat loss, often seasonal in nature, habitat degradation and simplification, and loss of habitat connectivity. As aquatic habitat becomes degraded or unavailable in the Klamath River system, anadromous fish production throughout the basin, including the analysis area, is weakened. The introduction of non-native fish species in mountain lakes may also be negatively affecting native populations.

Due to the geographical location of the Horse Creek Analysis basin, low annual precipitation amounts, high evapo-transpiration rates, and the deep alluvial nature of Scott Valley proper, stream flow in some of the major valley tributaries may have historically gone subsurface during low rainfall years. Even some valley portions of mainstem Scott River appear capable of going dry a few times a century. Historically, many beaver dams were present and probably provided high quality habitat for salmonids even in areas where flow went subsurface during dry summer months. These beaver dams may have been located at places where water tables were higher and provided secure refuge in dry areas until stream flow was re-established. Low numbers of beavers are still present in Scott Valley but beaver dams, especially on the low gradient portion of the valley and its tributaries, are virtually gone.

Increased water usage in recent decades (hydropower operations, agriculture water diversions) in the portions of the Klamath River upstream from the analysis area and groundwater pumping in the Shasta River Valley upstream from the analysis area, has probably increased the frequency, duration, and the extent of reduced flow in the main river. This impact results in a direct loss of habitat. This process can occur abruptly with the onset of the growing season, sometimes as early as April or May, and extend until significant fall rains re-establish flow, October to November.

The valley portion of the Shasta River is very low gradient and historically supported a very productive fishery. However, unrestricted grazing in riparian areas has contributed to a loss of riparian vegetation and streambank support. Both processes have resulted in increased width to depth ratios, increased down cutting, and a loss of undercut banks and side channels.

The increased width to depth ratios of the river and declines in riparian vegetation, have combined with decreased summer flows to increase water temperatures, especially during the summer months. All of the preceding processes have contributed to degraded aquatic habitat, negatively influencing carrying capacity and the over-summering and over-wintering capabilities of the area.

Water temperatures in the Klamath River within and downstream of the analysis area may approach or even exceed 80 degrees Fahrenheit. In drought years juvenile salmonids are assumed to flee to the cooler tributary streams to rear. This effect is diminished in years with cool summers, good snow packs, and longer periods of spring runoff.

Effects of diminished flows and elevated stream temperatures continue downstream past the analysis area. Both the amount and quality of available habitat is reduced, although flows and water temperatures are slightly improved by the contribution of several perennial, coldwater tributaries, i.e. Thompson, Indian, Grider and Elk Creeks. In general, present-day summer low flows and the associated warm stream temperatures in the mainstem Klamath are thought to especially impact those salmonid species, such as coho and steelhead, which generally spend one or more years in freshwater before emigrating to the ocean. Fish health problems also begin to arise as poor water quality and high stream temperatures are encountered.

In addition to creating a loss of habitat, and degraded habitat condition, low flows and warm stream temperatures also cause a break in habitat connectivity, especially for anadromous populations, between upriver and downriver areas. A well-connected river/tributary system facilitates a diversity of life history patterns and habitat utilization, which strengthens the persistence of anadromous populations.

As a result of habitat connectivity loss, smolt out migration may be unduly hastened, resulting in small smolt size and reduced ocean survival. Out migration can even be terminated by the presence of thermal barriers or dry sections of stream channels. As the historically most productive, low gradient, areas in the Horse Creek Watershed become either impaired or unavailable during much of the summer period, fish that would normally rear in the watershed may be forced to rear in the canyon area of the Klamath. Klamath rearing may also become restricted, especially as summer stream temperatures begin to rise and flows begin to drop, and fish may be forced to rear in greater numbers in less productive tributaries.

At times these conditions also exist in nearby Shasta River, and in mainstem Klamath River coming out of Irongate reservoir. The net impact of the preceding conditions has probably also contributed to the loss of early run fish, such as summer steelhead and spring Chinook, and a general reduction in fall/winter run steelhead and coho salmon in the mid Klamath region.

Diversion ditches, many of which have been in use since the 1800's, can also disrupt habitat connectivity. A loss of out migrating juvenile salmonids can occur as they became entrained in the water flowing into ditches. The result is often young fish stranded on an agricultural field. Many diversion ditches have been screened to avoid this loss but significant unscreened diversions still exist.

Upper sub-basin anadromous stocks require the analysis area to complete portions of their life history (rearing, out migration, etc.). It is also expected that fish from the analysis area may require use of the upper sub-basin for prime over wintering habitat, and crucial feeding and rearing ventures, for example, steelhead half-pounder runs that follow Chinook salmon upstream during spawning to feed on salmon eggs.

The impacts of high mountain lake fish stocking on other native aquatic populations within the analysis area are unassessed. There are no high mountain lakes within the analysis area. The introduction of fish into previously barren mountain lakes can result in a decline of native invertebrate and amphibian populations. At the same time, a popular sport fishery is established within the lake and usually in previously barren stream reaches below the lakes. The stocked trout may also move downstream into anadromous reaches where they compete with native fish for habitat. It may be possible that some interbreeding may occur between introduced and native fish of the same species. The outcome of this occurring, or the potential of negative genetic impacts, is also unassessed.

Key Question #2 - What are the risks/trends to areas critical for maintenance, protection and recovery of aquatic dependent species and how can they be mitigated?

The analysis area will continue to be impacted by low summer flows and poor water quality conditions, especially water temperature, generated upstream. These conditions will likely persist until water use and land use practices in the Klamath River Basin are modified. Significant strides in riparian protection on private land are occurring but the collective restoration of the valley channel structure and desired summer flows, have not yet been initiated.

The continued participation of the Klamath National Forest with Federal Energy Regulatory Commission is important in working towards both favorable flow levels and water quality within the Horse Creek Analysis Area.

Key Question #3 - What are the population trends and desired conditions for aquatic dependent species in the watershed?

The anadromous fish populations within the analysis area will continue to be influenced by upriver sub basin conditions, mainstem Klamath River conditions, ocean conditions and harvest levels. Long-term solutions for this area will require continued improvement of habitat factors, including obtaining a suitable flow, water temperature and sediment regime, especially in the mainstem Klamath River and in several main tributaries.

Salmonids:

Fall Chinook*:* Large, recent runs (estimated 12,000+ fish) have occurred in 1996 and 1997, and were thought to result from severe ocean harvesting restrictions in place at the time. Smaller runs (estimated 2500-3500 fish) have occurred in 1998 and 1999. The smaller run in 1999 is assumed to be linked with the January 1997 flood. Chinook eggs and fry were still in the gravels when severe scouring flows occurred. Chinook populations within the analysis area and the sub basin appear moderately stable and even able to expand when unfavorable habitat conditions are removed. The species appears to sustain itself moderately well in the Klamath because juveniles can largely avoid summer low flows and the associated poor water quality conditions. Even greater Chinook production could be expected if the flow, water quality and sediment issues are improved.

Early-Run Fish (Spring Chinook, Summer Steelhead): These stocks within the analysis area and the Upper Klamath are not expected to recover in the near future because of a very weakened metapopulation in the mid-Klamath area. Projected poor summer holding conditions, such as low flows and high stream temperatures in the Scott River system also deter their recovery. Similar low flows and poor water quality conditions exist in the mainstem Klamath and Shasta Rivers. Significant improvement in these watercourses, along with the Scott, is necessary to re-establish these early-run salmonids within the mid-Klamath region. Adult strays of these fish will likely continue to explore the Horse Creek watershed in very low numbers unless metapopulation numbers are decreased even further.

Coho salmon, Steelhead: Both species are largely unassessed in the Horse Creek watershed. Local knowledge of these species may increase soon due to proposed smolt out migration studies recently initiated by the USFS, USFWS, and CDFG in connection with the Klamath River Instream Flow

TRENDS

Study and CDFG steelhead monitoring activities. Because of their listing as a threatened species, wild stocks of coho salmon and steelhead in the Southern Oregon Northern California Ecological Significant Unit are protected by harvest and/or sport fishing regulations. These factors should allow a small increase in the numbers of adults returning each year, but whether the gain is significant remains to be shown. The apparent cessation of the drought from the 1980's and mid 1990's may also be contributing positively to steelhead populations. Significant increases of coho salmon and steelhead trout within the mid-Klamath region, Scott sub basin, and the analysis area are not expected to occur until stream flow and water quality issues stream temperatures are resolved.

Non-game Resident Fish:

Dace, suckers, Sculpins: Population numbers for these fish over time are unknown, however, populations appear numerous and robust under current water quality and flow conditions. Populations of these fish are expected to continue as at present without any change in water quality or

flow conditions. Current spawning substrates for suckers may not be as negatively impacted as those for salmonids within the sub basin.

Lamprey: Populations are largely unmonitored, however, it is assumed that adult populations returning to the analysis area streams to spawn, are much reduced from historical levels. However, during electro fishing and out migration operations, lamprey juveniles (ammocoetes) appear numerous in some areas of the basin. This species needs to be monitored more closely to assess population trends.

Hatchery Fish (Salmonids): High mountain lake stocking programs are expected to continue at present levels within the basin. Some lakes within the basin may be self-sustaining in regards to fish populations, but these conditions are currently unassessed. Lakes are expected to continue to supply stocked fish to downstream habitats, including anadromous reaches.

Other aquatic species:

Tailed Frogs, Pacific Giant Salamanders: These species primarily reside in coldwater tributaries within the analysis area and are largely unaffected by water conditions within the mainstem Klamath. Population numbers for these species over time are unknown, however, populations appear numerous and robust where encountered during electro fishing projects. Populations are expected to continue at present numbers.

Freshwater mussels: This species resides in the mainstem Klamath River within the analysis area. Little is known about current or historical populations numbers or conditions. Elsewhere, mussel populations are known to be negatively affected by excessive sediment levels. Monitoring of mussel populations over time would need to occur to determine existing conditions and possible trends.

DESIRED CONDITIONS

--Management activities maintain or improve the high quality, cool water contribution of analysis area tributaries to Horse Creek and the Klamath River.

--Aquatic populations especially threatened and endangered species, within the analysis area increase toward habitat carrying capacity. Current fish range resembles historic range. Genetic and life history knowledge of anadromous fish, especially coho salmon and steelhead stocks, is improved. Public knowledge of anadromous processes and needs is strengthened.

--Summer flow levels are increased and summer water temperatures are decreased in the Klamath River as it enters the analysis area, thereby improving connectivity and habitat volume throughout the sub basin.

--Important low gradient, alluvial valley habitat is restored, providing necessary features for fulfillment of life history requirements for sub-basin stocks.

--Cool water flowing from Horse Creek to the Klamath River is increased during the summer months. The entire mid-Klamath metapopulation of coho salmon, Chinook salmon, and steelhead trout is strengthened by improved water quality and summer flows in the Scott River, Shasta River and upper Klamath River. The survival and timely growth of Horse Creek and other upper/mid-Klamath out migrating smolts is promoted.

Forest Health and Fire Disturbance Risk and Hazard

Key Question 1 - How have the vegetation communities changed over time and what have been the agents of change?

Much of the analysis area has been logged at varying intensities. Extensive partial cutting has been done throughout the area, clear cutting has been done on at least 9,000 acres. Timber harvest activities for the most part removed larger trees and high value conifer species (ponderosa pine, sugar pine and Douglas-fir). Younger stands of dense conifers are currently more prevalent in the watershed than during reference conditions. Historically, open stands of large trees were the most prevalent characteristic through the mid to high elevation mixed conifer areas.

With the combined effects of timber harvest (clear cuts and extensive partial cutting), timber stand improvement projects, road construction, impacts from large fires, fire suppression (reducing low intensity fire disturbance), and natural processes that have continued to generate large amounts of vegetative biomass on very good site, vegetative conditions have developed that are susceptible to disturbances such as insects and disease outbreaks

and stand-replacing fires. More detail follows in discussions by vegetation community.

Vegetation communities in the analysis area developed, adapted, and were maintained by variations in soils, aspect, precipitation, microclimate, and disturbance. Changing the role of fire from a frequent low to moderate severity disturbance to less frequent moderate to high severity disturbance has been the most dramatic change to vegetation communities. In attempting to protect them from fire, communities that were resilient and adapted to frequent fire have developed conditions that make them more vulnerable to being lost to fire. Some communities (fire intolerant species) are more extensive due to their ability to establish and persist in undisturbed areas. With continued protection from fire, some species dependent on fire disturbance to persist may cease to be found in the analysis area. Fire disturbance is necessary in order to maintain a wide variety of vegetative communities, remove decadence, increase species, and seral stage diversity.

Mixed Chaparral

The historic frequent fire regime that for this community averaged 8 years maintained more of a grass/forb and young shrub condition in much of the area occupied by mixed chaparral. Spatially there has been very little change in this community. It is typically found on poor sites that will not support conifer stands. Mixed chaparral found in the analysis area consists mostly of species mixes dominated by *Ceanothus cuneatus* (wedgeleaf ceanothus) with inclusions of *Arctostaphylos patula* (greenleaf manzanita) and *Cercocarpus betuloides* (mountain mahogany). These species are all adapted to fire disturbance. Wedgeleaf ceanothus generates in large numbers after fire. It is typically described as a nonsprouter, but seedbanks in the soil under mature shrubs geminate in large numbers after fire. Exposure to heat stimulates seed germination. Greenleaf manzanita seeds have an extremely thick endocarp and will not germinate unless scarified. Seed coat scarification usually occurs naturally by the high temperatures associated with fire. Greenleaf manzanita also reestablishes after fire by sprouting from dormant buds in the root burl. Birchleaf mountain-mahogany is a strong resprouter after fire and survival is usually high, although seeds are not heat-resistant and are easily destroyed by fire. These adaptations have ensured that once these species are established on a site they will persist. Within the analysis area this community is found mostly on dry southern aspects below 3,500 feet. Historically, frequent fire occurrence maintained this community in more open condition with natural grasses and forbs found in the open areas between patches of shrubs that had much less decadence than is found currently. Studies indicate that fire return intervals less than 20 years will significantly reduce the amount of *ceanothus*. These sites historically burned on average every 8 years, which would not have allowed for the development of decadent shrub conditions which are currently prevalent.

Montane Hardwood

This community is found in close proximity to the mixed chaparral community. *Quercus garryana* (Oregon white oak) is the most abundant hardwood species found in this community. *Quercus chrysolepis* (canyon live oak) is also found on harsher sites. These species found without much intermix of conifers define the community. Due to soils and moisture regimes (harsh site conditions), the area occupied by this community has not changed significantly from historic to current conditions, although some conifer encroachment has occurred with the removal of fire as a frequent disturbance. Frequent fire disturbance maintained open conditions with an abundance of natural grasses and forbs throughout the community. Both of these oak species are prolific sprouters following fire. Older trees produce less sprouts than younger trees. Although a lack of disturbance is probably least beneficial, this community will persist, despite an increase in the fire return interval.

Montane Hardwood/Conifer

These hardwood dominated areas tend to be found at lower elevations within the analysis area, mostly on the lower one-third of south aspects. This community is often a transition zone between hardwood and mixed conifer communities. The community often occurs in a mosaic-like pattern with small, pure stands of conifers interspersed with small stands of hardwoods. Typically where the species are found together, conifers form the upper canopy and hardwoods comprise the lower canopy. Little understory occurs under the dense, multi-layered canopy; however, considerable ground and shrub vegetation can occur in ecotones or following disturbance such as fire or logging. Steeper slopes normally have a light covering of litter; gentler slopes often have considerable accumulations of litter and downed woody material.

Oregon white oak, California black oak and Pacific madrone are the most common hardwoods in this community, with big leaf maple and red alder found

in riparian areas. Ponderosa pine is the most abundant conifer, with Douglas-fir, incense-cedar, and sugar pine also associated with the community. With removal of frequent fire disturbance, more conifers have been able to establish in this community. This encroachment into poorer quality sites has increased competition for moisture and nutrients, thus has increased mortality in this community.

Ponderosa Pine/Mixed Conifer

This is the most abundant community in the analysis area. The ponderosa pine mixed conifer was naturally maintained in what has been described as an open pine savannah. Much of this community could be described as grass-covered slopes with scattered pines on drier sites and open mixed conifer conditions on more mesic slopes. This community is found throughout the low to mid elevations of the analysis area. It is more prevalent on south aspects and the very frequent fire returns on these slopes maintained the naturally occurring grasses, scattered oak, and ponderosa pine.

This community provided the commercially valuable conifers that drew loggers to the area; sugar and ponderosa pine being the most sought-after species in the early years of logging. After the harvestable pine species were depleted, Douglas-fir and true fir were harvested.

Two regimes of partial cutting contributed significantly to changes in species mix and stand structure. Unit area control in the 1950s through early '60s and Klamath partial cuts of the '70's altered the species composition, overall stand structure, health, and vigor. Similar to railroad logging, generally the largest trees were removed; however, all species were cut as opposed to primarily pine species. Some cut areas were planted, but the majority was left to naturally reseed. These areas are currently stocked with trees that seeded in from the suppressed and intermediate size-classes. Overall stand vigor is deteriorating, due in part to logging damage of the residual trees, and that much of the in-growth is mistletoe infected. In general, most logging slash was left untreated.

The fire suppression era, beginning about the same time as the first commercial harvest activities, allowed dense conifer stands to develop. The lack of fire favored regeneration of Douglas-fir and white fir over pine species. The introduction of white pine blister rust has hampered the reestablishment of sugar pine. Currently dense stands of Douglas-fir and white fir are found in areas that were historically open, pine dominated stands. With eighty years of fire suppression, stands are denser, and litter and downed woody material accumulations are greater than that maintained under the historic fire regime. Increasing mortality, untreated fuels from past partial cutting and timber stand improvement projects exacerbate the fire hazard.

Douglas-fir/Mixed Conifer

The Douglas fir mixed conifer community was naturally maintained with frequent fire in a much more open condition than is found today. This community, often referred to as the Klamath mixed conifer community makes up the majority of vegetation from the mid-high elevations of the analysis area. Timber harvest history for this community is much the same as the Ponderosa Pine Mixed Conifer. This area is typically very good site conditions, which ensures good seedling survival, growth and thus competition for moisture and nutrients once trees reach larger size classes. Areas with this competition have increased mortality.

True fir

This high elevation conifer community is dominated by red fir. In this analysis area, this community is found on good site conditions. In 1971 the Red Fir Fire had within its perimeter what was at that time the largest Red Fir tree ever recorded. Historically a fire regime that on average would burn through this community every 25 years removed decadence in these stands. With the removal of fire disturbance these stands have become extremely decadent. Comparing the latest aerial photos to earlier photos this decadence stands out as these stands have turned from green to brown. Other changes associated with this decadence has been the removal of shrub and grass/forb understories by the accumulation of litter and blowdown that has covered the forest floor. Currently this community has fewer openings and a more closed forest condition than was historically maintained, but it is set-up for the establishment of large open conditions.

Sub alpine

In the higher elevation sub-alpine areas, lightning fires were common, but moist conditions, lack of fuel continuity, and barren areas limited the spread and intensity of fires. This community is found in a condition very similar to what was maintained historically, although the loss of frequent small-scale low intensity fires has promoted a build-up of dead and down material and decadence in flowerpot

areas where dense stands of mostly red fir and mountain hemlock are found.

Montane Meadow

Comparing 1944 aerial photos with photos taken in 1999, it is very apparent that this community has been severely impacted by encroachment of conifers. The shapes of the meadows have stayed about the same but encroachment is occurring on all sides. Taking measurements on these photos indicates a 25% loss of meadows in areas not impacted by timber harvest. Areas where roads and recent timber harvest have occurred, it is difficult to conclude from the photos a significant difference in meadow sizes, although encroachment by conifers and shrubs is evident. Reducing fire disturbance has allowed encroachment by conifers and shrubs have reduced the size of these meadows in this complex.

Montane Riparian

This community is found along the Klamath River, major tributaries, including Horse, Buckhorn, and Middle Creek drainages, wet seeps and slumps, and high elevation wet meadow complexes. Much of what was this community along the Klamath River is now dredger tailings or has been converted to agricultural lands. What remains recovers well from disturbance, which happens mostly from flood events.

Comparing the current conditions of the vegetation communities with what was found within the analysis area at settlement (around 1850), in general, the most obvious change has been in the amount of vegetative biomass that was here historically and the increased amounts that are here now. With much less natural disturbance (fire), the vegetation communities have been allowed to increase vegetative biomass over the years. Small amounts of vegetative biomass have accumulated each year. As time has gone by the sum of these small annual increases is a dramatic increase in vegetative biomass from what was maintained historically to what is currently found in the vegetation communities.

As discussed in **Chapter 4**, research done on fire-scarred trees by Taylor and Skinner (1996) on Thompson Ridge (15 miles west of the analysis area) indicates that the fire return interval on south aspects averaged 8 years, and on the east aspects the fire return interval averaged 16 years for the pre-settlement time period (prior to 1850). Another study looked at changes in openings over a period of 41 years during the suppression era (Skinner 1995). This study indicates a decrease in the size of openings by over 10% occurred during the 41 year study period.

Based on these studies and the effects of the frequent natural fire return interval, early-seral vegetation and openings were more prevalent prior to the fire suppression era. The vegetation communities that exist currently were present historically, although changes have occurred in seral-stage, density and the area occupied by fire tolerant and intolerant species. The natural fire regime favored fire tolerant species and communities. Much of the increase in vegetative biomass and stand densities has come from the spread and development of fire intolerant species, especially within the understories of the mixed conifer communities.

Key Question #2 - Where are large areas at risk from catastrophic fire disturbance and what areas are important to treat and/or protect?

Fire behavior modeling has identified 66% of the analysis area as having high to moderate fire behavior potential. See **Figure 3-8** *Fire Behavior Potential*, contained in the Map Packet located at the end of this document. Fires occurring in these areas have the potential of becoming large, high intensity burns. These fires have the potential of reducing the amounts of pole, early/mature, mid/mature, late/mature, and old-growth seral stages, while increasing the amounts shrub/forb seral stages.

Plantations on good sites are valuable investments. Protecting these sites is important for wildlife values, visual quality enhancement, and future harvest opportunities. These stands should be evaluated for treatment needs.

Wildfires respond to breaks in topography and vegetation (natural and/or constructed fuelbreaks). Some natural fuelbreaks exist in the analysis area, as well as some fuelbreaks, which are remnants from wildfire suppression and fuels treatment activities. These fuelbreaks can possibly be utilized with little investment, in the future for fuels treatment or fire suppression activities that will protect and promote desired vegetative conditions.

It is extremely important to protect people living in the analysis area and their residences from fire. All residents in the watershed should be concerned and take precautions to protect themselves and their homes from wildfire. Wildfires will continue to

threaten residences in the analysis area. Area residents should be encouraged to clear fuels and use defensible space precautions around their homes. Cooperative efforts can be taken to reduce fuels on Public lands adjacent to private property.

Streams providing high quality water also have adjacent vegetative conditions that are prone to high severity wildfire. The complete removal of vegetation, as in a stand-replacing fire, can increase sedimentation, change the flow regimes, and increase stream temperatures, thus degrading aquatic species habitats. This makes it critical to protect these areas from catastrophic fire, which can be made possible by making the upslope areas more resilient to the effects of fire.

An average of 8 fires occur within the analysis area every year. Based on the size of the analysis area and the number of starts that have occurred since 1922, a risk rating of **high** has been calculated. The natural disturbance regime for the analysis area was dominated by large low to moderate severity fires. Fire suppression efforts over the last approximately 80 years have been, for the most part, very successful in limiting fire spread and effects in the analysis area. This has allowed for increased vegetative biomass (fuels), high decadence, standing dead, and down available fuels.

The current fire suppression organization has been very successful (since 1922, 92% of all fires have been caught at <10 acres), but multiple start events can be quickly stretch this organization to its limits. A trend has developed that shows fires that escape initial attack are getting larger and more damaging. With the high fuel accumulations creating higher fire intensities and making it more difficult to build fire line, fire suppression forces will have less success in the future. In addition, a damaged and poorly maintained transportation system hinders or can make initial attack with engines impossible in some areas. With the continuation of a successful fire prevention program, lightning storms igniting multiple fires will continue to be the source of most fire starts. Based on continuing increases in fuels, these fires will more often overwhelm fire suppression forces, escape initial attack, burn more area, and burn with higher intensities.

With frequent fire disturbance, mixed conifer communities were maintained with light fuel loadings (Fuel Models 8 and 9). With fire exclusion, these communities have been allowed to accumulate high fuel loadings (Fuel Model 10). These communities were historically maintained with frequent low to moderate intensity fires. To continue to maintain these communities, it is important that they be treated i.e., underburned. Areas modeled as Fuel Model 10 tend to correspond with areas of late-successional habitat. Many areas of late-successional habitat have accumulated high fuel loadings and are modeled as having high fire behavior potential. These factors impact the health of stands by increasing stand densities, inner tree competition, and reducing the ability for early and mid-seral trees to grow larger, and the ability of larger trees to survive large-scale fire disturbance.

Wildlife habitats susceptible to high fire severity are found in the analysis area, along with private residences and other Forest investments. In order to enhance and protect these important features, the development of a coordinated system of natural and managed shaded fuelbreaks was identified in the Klamath National Forest *Forest-Wide LSR Assessment* (USDA, 1999) as a first step.

As part of the development of the Road Analysis Process portion of this analysis (**Appendix E**), some roads that could be utilized for developing these shaded fuelbreaks have been identified, as well as other roads and ridges that are important for fuels treatment and fire suppression efforts. Once developed, this system can be used for fire suppression and for implementing fuels treatment activities that use prescribed fire, along with other types of fuels removal, to protect important features now found in the area and to develop desired conditions. See **Figures 6-2** and **6-3** for fire and fuels treatment opportunities, contained in the Map Packet located at the end of this document.

Key Question #3 - What is the desired role of fire in the analysis area and how can fire be incorporated as an ecological process and meet standards for smoke management?

One of the highlights from the *Forest Plan* is "an aggressive Fuel Management Program treating about 27,000 acres per year will reduce fuels with the intent that future fires will be less intense and less destructive. A primary objective of the Fuel Management Program is to allow fire to play its regulating role in the ecosystem. Prescribed fire and prescribed natural fire will be emphasized. Prescribed natural fire will be used in Wilderness, the larger LSRs, and in Backcountry." (*Forest Plan* Pages 3-18, 3-19) Through this analysis, we have defined the desired role of fire as a natural ecological process that has the ability to: control vegetation density and fuel loadings; maintain vegetation communities in conditions that are more

resistant and resilient to the effects of high intensity disturbances; reduce the probability of a large catastrophic fire occurrence; promote vegetation species diversity; enhance and maintain disturbance-adapted plant species; enhance and maintain important wildlife habitats; and protect private residences and important investments. In response to *Forest Plan* goals and objectives, the Forest can implement fuels treatment projects within the analysis area. The 27,000-acre Forest-Wide target equates to approximately 1,100 acres of prescribed fire per year in this analysis area. In addition to this, there is also an opportunity to allow natural ignitions to burn in the LSR.

This analysis has identified fire as a tool which if utilized can develop and maintain desired conditions. High and moderate severity wildfire is a threat to current and desired conditions. Managed fire in this analysis area by itself and/or in conjunction with other vegetation management can be used to develop and maintain desired conditions. Large-scale catastrophic wildfire, on the other hand, will setback the development of these same desired conditions.

Managed fire will cause some small-scale detrimental effects, but these effects will be short lived and the long-term benefits far outweigh these short-term small-scale effects.

Following is a quote from the Thompson Ridge Fire History Study (Taylor and Skinner 1996) regarding late-successional habitat: "The cumulative effect of fire severity variation across slopes suggests that forests with late-successional characteristics (e.g., multi-layered canopy, high density of large diameter trees, snags, coarse woody debris) were more commonly found at lower slope positions as well as on north and east facing slopes. Upper slope positions as well as intermediate positions on south and west facing slopes were more likely to display a pattern of scattered, remnant, older trees and patches, exhibiting some late-successional characteristics within a coarser-grained pattern largely of younger stands. Managers designing activities to reduce the likelihood of large, severe fires (e.g., prescribed fires, thinning, fuelbreaks) while still providing for long-term, late-successional conditions in the LSRs may find it advantageous to pattern the severity and extent of treatments after these historical patterns of severity." Based on the results of the Taylor and Skinner study a map of fire return intervals has been developed. See **Figure 6-<>** *Fire Return Intervals*.

Survey and Manage requirements are currently increasing costs and causing severe delays in implementing projects, and also with the discovery of any species, reducing the size of project areas. The Forest needs to challenge the scientific community that single species management approaches are not appropriate outside of laboratory settings. The Forest is managing one of the most diverse areas for flora and fauna in the world. This diversity developed with the influence of frequent fire disturbance. To attempt to remove this disturbance threatens the existence of these disturbance-dependant species.

To meet air quality objectives, prescriptions for fuels treatment (underburning) include weather parameters that are favorable for smoke to quickly disperse from residential areas and view sheds in and near the analysis area. This is one advantage of using prescribed fire over wildfire to meet desired conditions. Managers should try to avoid burning under a stable air mass (inversion). Temperature inversions are common in the analysis area during late evening and morning hours. Burns should be timed so that the majority of smoke generated is transported out of the area during afternoon hours. Prescriptions can be developed that will avoid extended periods of smoldering. Large-scale wildfire events will not meet air quality guidelines. Temperature inversions and long-term smoldering will work together under a stable air mass to hold smoke and particulates within the analysis area for long periods. Depending on size and timing of the fire event, this could last from several days to months.

Key Question #4 - What type(s) of fuels treatments have been done in the analysis area and how successful have these projects been in meeting objectives?

Within the analysis many acres have been harvested and had activity fuels treated. For the clear-cut units the fuels treatment objectives were for site preparation (providing open ground for planting) and for hazard reduction. The fuels treatment objectives for clearcut units were most often met using broadcast burning and were very successful in removing fuels and creating open areas for planting. Partial cutting has been done throughout the analysis area without the benefit of fuels treatment.

Timber stand improvement projects that thin plantations have been done extensively on both public and private lands. Most of these units have not had any follow-up fuels treatment. An exception

is some units that had whole tree yarding done after the thinning. This removed the fuels and promoted the growth of grass understory that is being utilized by elk in the analysis area.

Key Question #5 - What is the desired relationship with private landowners in regards to fuels treatment?

It is important that the Forest Service maintains good relationships with private landowners (residents and industrial landowners) within the analysis area. Fuels treatment has been controversial within the area, due to smoke impacts, concerns for possible escapes, and damage to water sources or improvements. The Forest Service needs to work with private residents especially to help educate and resolve their concerns about burning. It is for benefit of residents as well as forest health, wildlife, fisheries, and recreation, that the underburn program continues to expand.

The largest industrial landowners Fruit Growers Supply Company has expressed that they would be willing to work with the Forest Service to utilize natural breaks for underburning. For burning next to boundaries with Timber Products, the next largest land owner, it may be possible to utilize fuel breaks that are already in place

Desired Condition

- The use of fire will likely be an integral component of management plans that successfully provide long-term, late-successional conditions in the newly established LSRs of the Klamath Mountains (Taylor and Skinner 1996).
- Stand conditions that don't promote high severity fires.
- Disturbance-adapted mixed conifer communities are maintained/increased.
- Fire-adapted plant species are maintained in the analysis area.
- Area is more resilient to catastrophic fire and drought disturbances.
- Fire plays a natural role allowing for development and maintenance of late-mature/old-growth stands.
- Management activities consider and are consistent with overall fire management strategies.
- A diversity of seral stages similar to pre-settlement conditions are maintained across the analysis area. This mosaic of moderate and small patches will provide habitats for the variety of wildlife that use the analysis area.
- Poor sites, which are mostly hot and dry and for the long-term can only support shrubs, are managed for wildlife values. These areas are important deer and elk winter and spring range.
- In LSRs and RRs where vegetation communities are mixed conifer and/or true fir, are managed for the maintenance of 50-75% of these stands with large tree character (mid/mature, old-growth). This is in line with natural conditions of the vegetation types in the analysis area.
- Conifer plantations growing on good sites in this watershed are protected from catastrophic fires. These same plantations are managed to promote tree growth and make them more resilient to fire. This will provide future mid/late-seral habitat and also commercial timber.
- A viable system of shaded fuel breaks (including ridge-top roads) is established and maintained throughout the analysis area. This system can be utilized for both fire suppression and fuels treatment activities.
- Reduce the severity/change the fuels profile to be conducive with historic vegetative patterns. Increase stability and diversity.
- Loss of mature forest cover to wildfire would be unusual.

- Plantations are put into a fire-stable condition.
- Human residents, their homes, and property are safe from the effects of wildfire.

Key Question #6 - What is the desired road system for fire suppression and fuels treatment activities?

The extensive road system in this analysis area has been a key component to the success of the fire suppression organization in keeping most fires small. The desire is for a road system that provides access for fire suppression and prescribed fire. These roads are utilized as control features for prescribed fire. During this analysis the terrestrial subgroup identified roads that were important for fire suppression and fuels treatment access and those that could be utilized as fuel breaks. **Table 5-15** *Fire/Fuels Road Rating Criteria*, describes the criteria used by this subgroup for rating roads within the analysis area.

Key Question 6 - What are forest health trends for the watershed?

This analysis area has more mortality identified than any analysis previously done on this Forest, 67% of the analysis area has some level of mortality identified.

Fire behavior potential modeling has identified 6,926 acres as having high, 39,049 acres as having moderate, 22,886 as having low fire behavior potential, and 975 acres are identified as being non-flammable. Areas identified as having high to moderate fire behavior potential account for 66% of the analysis area. The current conditions will burn with more intensity and higher severity than any vegetative condition that has existed in this area in documented history.

Investments made for future forested conditions, i.e., plantations are very susceptible to high severity fire. This susceptibility has been exacerbated by timber stand improvement projects that have recently thinned plantations and left these thinnings in the plantations. This analysis area has a higher fire risk than any other analysis area on the Forest. Even with active fire suppression efforts, there is a high likelihood that much of the analysis area will be involved in large-scale wildfire events in the near future. The following photos display plantation conditions found in the analysis area.

Table 5-15 Fire/Fuels Road Rating Criteria

Access Needs	Rating Criteria*		
	H	**M**	**L**
Fire Suppression Access	All roads under private, state or county jurisdiction and all ML 3, 4 and 5 roads and ML 2 roads on ridges or with main access	ML 1 and 2 roads that provide primary access or better access than alternate routes.	ML 1 and 2 roads that are not needed for primary access.
Prescribed Fire Access	All Forest Service ML 3, 4 and 5 roads and ML 2 roads on ridges or with main access	ML 1 and 2 roads that provide access for prescribed fire mgmt. and/or are strategically located for potential fuel-breaks.	ML 1 and 2 roads that are not needed for prescribed fire access or use.

H = High need for open and maintained road,
M = Moderate need for open and maintained road,
L = Low need for open and maintained road
ML=road maintenance level.

15 year old plantation, recently thinned, (fuel model 11 conditions).

23 year old plantation, recently thinned, (fuel model 12 conditions).

21 year old plantation thinned and slash removed (fuel model 9 conditions).

Of the three conditions displayed, the last one (fuel model 9) has the best chance of surviving a wildfire. These fuel model 9 plantations also represent the least amount of plantation conditions. The majority of plantations within the analysis area can be found in fuel model 11 condition and a large area within the Buckhorn burn (1977) area is found in fuel model 12 conditions.

With dense multistoried stands, an unstable vegetative condition has been created in an area where fire is the dominant disturbance agent. Opportunities to reduce fuels making mixed conifer communities more resilient to the effects of fire currently exist, but can be lost in an instant.
With high stand densities, competition for solar space and moisture increases mortality and susceptibility to attacks from insects and disease. Without some sort of stocking control, natural thinning by fire or forest management, dense stand conditions develop. These dense stand conditions reduce the ability of trees to grow large and promote increases in stand mortality and attacks by insects and disease. Reduced stand vigor and slow growth or even negative net growth is also expected in many densely stocked stands. These stands will also be less resilient to changing conditions such as short duration drought, less resilient to fires and will be more susceptible to stand replacement fires.

The formula for determining fire risk is outlined in the Forest Plan and in **Appendix D** *Fire and Fuels*. The fire risk analysis uses the Forest's fire history database to determine the number of fires that have occurred in the analysis area from 1922 to the present. Basically the formula is this, the number of fires recorded in this period is divided by the total number of years and then divided by the acres within the analysis area, and this output determines the fire risk. Using this formula, the number of fires that have been recorded in the analysis area over the last 79 years shows this area as a **high risk** for fire. These fire start locations have been fairly evenly distributed over the area. Lightning fires, which are 70% of the total number of fires, are mostly ignited along ridges, but also have been ignited mid and low on slopes and in drainage bottoms. The Klamath River corridor shows the highest number of human caused fires, and as seen last year, fires that start low in the canyon can become large and severe in a hurry, even when we haven't yet reached 90th percentile weather. As discussed in Step 4, large fire events are common in the analysis area. This is a list of the years that we have records of large fires (any fire >40 acres) occurring in the analysis area; 2000, 1994, 1987, 1983, 1977, 1971, 1968, 1963, 1962, 1956, 1954, 1949, 1947, 1945, 1944, 1943, 1939, 1938, 1935, 1932, 1930, 1929, 1928, 1927, 1926, 1925, 1924, 1923.

The perimeters of large fires that have occurred within the analysis area show many similarities to fire perimeters throughout the Klamath National Forest. The majority of the area burned is found on south aspects and the most severe intensities recorded are on the south aspect between 2,000 and 4,000 feet elevation. Large fires that occurred in 1987, 1994 and 2000 were all mapped by burn intensity level. High intensity indicates that 70 to 100% of the vegetation was killed. Moderate intensity is for areas that had between 30 and 70% of the vegetation killed. Low intensity identifies areas that had less than 30% of the vegetation killed by the fire. **Tables 5-16** and **5-17** *Burn Intensity By Elevational Range (Percent Of Total Area Burned)* and *Burn Intensity By Aspect (Percent Of Total Area Burned),* display data collected by the mapping of

burn intensities on fires that occurred within the analysis area in 1987, 1994 and 2000.

Table 5-16 Burn Intensity By Elevational Range (Percent Of Total Area Burned)			
Elevational Range	**<2000'**	**2000'-4000'**	**>4000'**
High Burn Intensity	0%	10%	7%
Moderate Burn Intensity	1%	35%	7%
Low Burn Intensity	0%	26%	13%
Total % Area Burned	**1%**	**71%**	**27%**

Table 5-17 Burn Intensity By Aspect (Percent Of Total Area Burned)				
Aspects	**North**	**East**	**South**	**West**
High Intensity	1%	6%	8%	3%
Moderate Intensity	2%	10%	25%	6%
Low Intensity	6%	7%	17%	10%
Total % Area Burned	**9%**	**23%**	**50%**	**19%**

Based on this analysis, approximately ½ of the analysis area should be considered at extremely high risk to disturbance by fire. Included in areas that are important to treat and/or protect could be these mid-elevation south aspects. It needs to be noted that protection of these areas will not always be successful. There appears to be many other benefits that could be realized by treating fuels in these mid-elevation areas, of note is the improvement of winter and transitory habitat for elk.

Late Successional Habitat

Key Question 1- How has the amount, distribution and condition of late-successional habitat within LSRs changed across the analysis area?

Key Question 1a- What have been the agents of change?

Late-successional forest habitats are naturally diverse within the project area. Historically, the distribution and condition of forest habitats were shaped by disturbance processes, such as weather events and/or fire. The natural fire regime had direct and indirect effects on species composition and species abundance. Prior to the influence of European settlers, it is expected that the landscape was patchy, containing a variety of different age and size classes in the forested communities. Large-scale fires were infrequent, while frequent low-to-moderate fires broke up the larger patches of forest and maintained fuels at a sustainable level. Dense, late-successional forest habitats were found along drainage bottoms, on the lower portions of north and east aspects, and in higher elevation true fir types (refer to Fire discussion). More open stands of late-successional forest (consisting of pine or pine/mixed conifer) occurred on south and west aspects. Scattered conifers and hardwoods with chaparral, grasses, and forbs in the understory covered south and west aspects at lower elevations.

Historically, frequent burning had a profound effect on the local fire regime by maintaining early successional vegetation in openings, maintaining open understories, excluding fire-intolerant species (such as white fir), and maintaining lower levels of ground fuels. Fire exclusion became policy for National Forests shortly after the turn of the century, but didn't have much effect until the 1940s when suppression efforts were mechanized after the World War II. Effective fire suppression since that time has changed the distribution and structure of late-successional forest by allowing stand densities to increase, allowing the understory to fill in with shade tolerant conifer and hardwood reproduction, increasing the buildup of fuels, promoting development of ladder fuels, and promoting development of closed canopies that can sustain crown fire. With this change in stand structure, fire suppression has also allowed for the development of more dense forested stands on south and west aspects, and higher on slopes, where historically stands were much more open.

Changes to forested stands over the last century have lead to large landscape-level fires burning with varying degrees of intensity across the Forest. These wildfires have reduced and fragmented late-successional forest in the landscape. Large fires occurred adjacent to the analysis area in 1955 and, more recently, within the analysis area in 1977, 1987, and 2000; large fires in the area have burned over 13,000 acres since 1935.

Forest management activities have also influenced late-successional forest habitats in the analysis area. Timber harvest and road building have accounted for most of the management that has impacted vegetation and influenced the amount of late-successional habitat currently found today. Roughly 17% of land in the analysis area has been cleared through timber harvest since the 1930s. In addition, there are approximately 459 miles of roads within the analysis area. Clearing through timber

harvest and road building has reduced the amount of late-successional habitat and fragmented larger blocks of habitat (refer to Step 3).

Areas that have been harvested in the matrix will be managed for forest health, maximum tree growth and yield, and future commodity outputs. Within LSRs, areas that have been harvested will be managed for development of late-successional forest habitat that will persist over time. It is not expected that LSRs will consist of homogeneous stands of late-successional forest, rather it is expected that the landscape will contain a mosaic of seral stages and structural components as described below under Key Question #2 *Desired Conditions*.

Many of the features that make late-successional habitat suitable for late-successional forest-related species also make it susceptible to catastrophic loss from wildfire or pest epidemic. Large downed wood, dense canopies, and understory vegetation all contribute to habitat suitability and to high fire behavior. The higher stand densities on south and west slopes, resulting from fire suppression, leave them susceptible to mortality from inter-tree competition, insect epidemic, and loss to fire. Treatments to reduce fire risk, such as reducing continuity of canopies, removing ladder fuels, and reducing ground fuels, may reduce the quality of habitat for late-successional forest-related species. Therefore, within LSRs it is important to seek balance in an approach that reduces risk of fire while at the same time protects large areas of fire-prone late-successional forest.

Currently, there are 12,329 acres of late-successional forest habitat within the analysis area (23% of the capable land). It is estimated that dense late-successional forest occupied roughly 25,000 acres of the area in the early part of this century, based on historic logging and road building (roughly 50% of capable land), with the remainder of the capable land in a variety of seral stages or open conifer stands influenced by natural processes. Using these acreage figures, late-successional forest habitat has been reduced by roughly 50%, on both public and private lands, since the 1930s. The overall distribution of late-successional forest is similar to historic patterns; however, larger stands of forest have been fragmented by wildfire, timber harvest, fire salvage, and roads. Average patch size has decreased, and there has been a loss of large diameter trees, especially in the pine/mixed conifer zone.

Key Question 2- What is the desired condition of late-successional habitat within LSRs and across the analysis area?

The desired condition for late-successional forest habitat focuses on reserves (LSRs) that have been set aside for the purpose of maintaining and enhancing late-successional forest habitat and other land allocations that are expected to provide dispersal for late-successional forest related species across the landscape (100-acre LSRs, RRs, and special habitat areas). The desired conditions described here have been adapted from the Forestwide LSR Assessment (USDA 1999).

The desired condition within reserves and special habitat areas is to provide late-successional forest in which structure and composition is consistent with site conditions and ecological processes. Important structural attributes include live old-growth trees, standing dead trees, fallen trees or logs on the forest floor, and logs in streams. Additional important elements typically include multiple canopy layers, smaller understory trees, canopy gaps, and patchy understory. These conditions typically begin to appear when forest stands are between 80 and 140 years in age, depending on site conditions, species composition, and site history.

A generalized desire for LSRs is to promote and maintain late successional conditions in the maximum amounts sustainable through time. Processes that historically have created late-successional ecosystems include: tree growth and maturation; death and decay of large trees; low to moderate intensity disturbances (such as fire, wind, insects and disease) that create canopy openings and gaps in the vegetation; establishment of trees beneath the maturing overstory trees either in gaps or under the canopy; and closing of canopy gaps by lateral growth or growth of understory trees. These processes result in forests moving through different stages of succession that may span several hundred years.

It is desirable to have variability in late-successional vegetative characteristics across the analysis area. Multistoried conditions will be scattered throughout the landscape, but will be more prevalent on the lower half of the more mesic north and east aspects, and in riparian areas. South and west facing slopes will have fewer multi-layered conditions and potentially different species composition. Canopy closure will vary across the landscape, ranging from less than 50% on south and west slopes to greater than 80% on north and east slopes and riparian

areas. Upper portions of all aspects, except in the true fir type, will generally have lower densities as compared to lower on the slopes. Snag and down log accumulations will be higher on the lower portions of slopes and decrease as one moves up slope.

It is anticipated that plantations are capable of supporting mature and late-successional forest, and therefore, the desired condition is to manage them over the long term to produce late-successional forest. Residual snags, hardwoods, and down logs from the previous stand will be desired components to maintain within these plantations. Hardwoods should be carried through the life of the stand. In the interim, the stands should be healthy and fast growing with stocking levels and fuel accumulations that reduce the likelihood of loss to catastrophic fire.

The introduction of prescribed fire into late-successional forest stands will help encourage the processes and attributes that define late-successional ecosystems. It is expected and even desirable to have low to moderate intensity fires burn in LSRs and Riparian Researves. Low intensity fires will reduce fine fuels and ladder fuels, create a seedbed for a diversity of herbaceous plants, and create a patchy understory. Moderate intensity fires are desirable if they create small openings in the canopy of one to five acres in size. This allows for regeneration of forest stands and creates snag patches and concentrations of down woody debris, which are important habitats for some late-successional forest-related species. Burn openings are most desirable if they occupy only a small percentage (5-10%) of the stands providing habitat. In addition, the introduction of a fire cycle more similar to that which occurred in pre-suppression times will reduce the risk of catastrophic fires. Large, stand-replacing, high intensity fires are not desirable within reserves or special habitat areas. Throughout the area, fuel conditions should generally range from low to moderate fire behavior. Variability of fuel conditions across the landscape is desired, with some high concentrations of fuel (coarse woody debris) intermixed with areas of low fuel accumulations. It is reasonable to expect that heavier scattered pockets of fuels (coarse woody debris) will occur on relatively cool, moist sites, such as those found on north and east aspects, or low on the slope adjacent to perennial riparian areas. South and west aspects and upper slope positions, which are typically drier and harsher, will generally contain lighter fuel loadings with fewer scattered pockets of heavy fuel. Site capability will also influence the amount of fuel or coarse woody debris.

It is desirable to continue to have insect and disease populations at endemic levels within late-successional forest habitats. Insects and diseases create gaps and are important for creating many of the decadence attributes desired in old-growth stands. It is important that they don't reach levels that will create situations that will prevent the long-term sustainability of late-successional habitats.

Key Question 3- How will connectivity of late-successional habitat be maintained within and between LSRs?

Connectivity between LSRs in the analysis area is considered good for two reasons. First, the distance between LSRs is less than 6 miles, giving it a "very strong" rating in the Forestwide LSR Assessment. Second (USDA 1999), the Horse Creek Analysis Area has more than 50% of capable ground in dispersal habitat (average diameter at breast height of 11 inches and average crown closure greater than 40%), putting it below the threshold for formal consultation on projects that will remove or degrade habitat for northern spotted owls (USDA 1999) (refer to **Table 3-28** *Dispersal Habitat Between LSRs and Wilderness Within The Horse Creek Analysis Area*). Although the criteria show that there is good connectivity in the area, the majority of dispersal habitat in the Matrix is in a mid-successional stage and is at the low end of the 11 inch diameter at breast height (DBH) criteria as described in **Chapter 3**. The quality of connectivity habitat in the Matrix portion of the Horse Creek Analysis Area is limited due to fragmentation of the landscape and a preponderance of early and mid-successional forest conditions.

Maintenance and/or improvement of existing connectivity between large reserves will be achieved through project planning that protects remaining old-growth patches, maintains more than 50% dispersal habitat in the watershed, through road decommissioning in areas with high road density, through maintenance of Riparian Reserves and 100-acre LSRs, and through management of plantations and burned areas to promote growth of mature trees.

Connectivity of late-successional forest within the Horse Creek portion of the Johnny-O'Neil LSR is lacking. The wildfires of 1987 and subsequent salvage logging reduced late-successional habitat on over 1,330 acres in the Horse Creek drainage. In addition, much of the LSR in the adjacent watershed was also burned. The desired condition for this LSR

is to promote the growth and development of late-successional habitat over time. Management of forested stands in this area should focus on treatments that will accelerate growth, reduce fuels, reduce competition, and protect the stands so that they can develop into late-successional habitat.

Overall distribution of late-successional habitat in the Collins-Baldy LSR is weak. Dense, mid-successional and pole stands dominate the LSR. These mid-successional and pole stands may provide some connectivity, however, dense stand conditions, high fuel levels, and conditions on adjacent private land reduce the effectiveness of the habitat for late-successional forest related species. Management of habitat in the Collins-Baldy LSR should focus on stocking control and fuels reduction. Protection and management of these stands is critical to the development of late-successional forest in this LSR. Connectivity of late-successional habitat across the LSR will continue to be limited due to the checkerboard ownership pattern. Management should focus on a mosaic of late-successional forest that includes larger patches on public lands (square mile sections) and expect smaller patches and clumps of residual trees on private land (spotted owl protection zones, riparian buffers, and other special management areas).

In order to maintain connectivity within and between large reserves, it is important to consider the potential for catastrophic loss of habitat through fire or disease. High stand densities and large amounts of ground and ladder fuels indicative of fire exclusion increase the risk of wildfire and insect epidemic. Thinning of dense stands and utilizing prescribed fire to reduce fuels will aid in maintaining existing habitat connections across the landscape.

Key Question 4 - How will the effects of high road density on late-successional habitats be minimized?

Key Question 4a - What are the criteria used to assess roads for the Roads Analysis Process included in Appendix E of this document?

Road construction in the Horse Creek Analysis Area was generally done to access timber harvest areas or mining claims. Road building opened up areas to higher levels of human use through recreation, hunting, or collection of forest products. Human access has effects on wildlife by providing a source of disturbance, which can reduce the effectiveness of the habitat. It also provides access to once remote areas, which can cause an increase in the illegal harvest of wildlife. Roads also permanently alter habitat within the roadway itself, they divide larger blocks of forest into smaller fragments, which impacts species of low mobility by splitting habitat and making portions of the habitat inaccessible.

Impacts to late-successional habitat and disturbance to wildlife populations can be minimized by closing roads, thereby eliminating disturbance from motorized vehicles and reducing access, or by closing/decommissioning roads and allowing the roadbed to be recolonized by the local vegetation or replanted.

Land allocations, such as LSRs and Riparian Reserves, have management goals/ objectives where commodities and logging are not the primary land use. The reserves are established to protect, enhance and restore habitats and ecosystems. Portions of the current road system are not consistent with these land allocations and have been reviewed as part of this ecosystem analysis. Refer to **Appendix E** *Roads Analysis Process*, which provides a starting point for developing road improvement, maintenance, and decommissioning opportunities.

The road network within the analysis area was assessed for effects on late-successional forest habitat and deer/elk range using road density criteria as displayed in **Table 5-18** *Terrestrial Wildlife Road Rating Criteria for the Horse Creek Analysis Area*.. These criteria were used to rate each road within the analysis area, combined with criteria from other resources including human use, as described in **Appendix E** *Road Analysis Process*. Areas rated as "high resource impacts associated with roads" (see below) were highest priority for road closure or decommissioning in order to reduce disturbance and/or reduce habitat fragmentation in those areas most heavily impacted.

Table 5-18, Terrestrial Wildlife Road Rating Criteria For The Horse Creek Analysis Area.

	Rating Criteria		
Resource Impacts	(**H**) high resource impacts associated with roads*	(**M**) moderate resource impacts associated with roads*	(**L**) low or negligible resource impacts from roads*
Reduce road density in LSRs	Areas within LSRs with >4 miles per sq. mile of roads	Areas within LSRs with 1-4 miles per sq. mile of roads	Areas within LSRs with < 1 mile per sq. mile of roads
Reduce road	Areas within deer/elk	Areas within deer/elk	Areas within deer/elk

Table 5-18, Terrestrial Wildlife Road Rating Criteria For The Horse Creek Analysis Area.			
Rating Criteria			
Resource Impacts	(**H**) high resource impacts associated with roads*	(**M**) moderate resource impacts associated with roads*	(**L**) low or negligible resource impacts from roads*
density in deer/elk range (winter, summer, transitory)	range with >4 miles per sq. mile of roads	range with 1-4 miles per sq. mile of roads	range with < 1 mile per sq. mile of roads
Site Specific Criteria: 1)Roads that access plantations, that have been identified for closure within LSRs, should be considered for gating to allow access for thinning of plantations, decommissioning should be planned for the future. Roads that intersect blocks of late-successional habitat within LSRs should be considered for decommissioning in order to reduce fragmentation of late-successional forest habitats. 3) Maintenance level 1 and 2 roads within 1/2 mile of bald eagle or peregrine nests should be considered for closure.			
*Road density ratings are based on total road density for system roads, including roads with seasonal or year-round closures. Therefore, open-road related disturbance is less than is implied by the above density ratings.			

Desired Condition

- Road densities are reduced to an average of less than two miles per square mile within LSRs.
- Road densities in the matrix are reduced to less than four miles per square mile where possible.
- Roads in the vicinity of known nest sites or important habitat areas are closed.
- Fragmentation of late-successional habitat is reduced by decommissioning of roads in areas that exceed four miles per square mile.

Key Question 5 - What are the implications of private land management adjacent to LSRs as it relates to managing for late-successional forest related species across the landscape?

Land management emphasis on privately owned land is long-term management of timber lands, using even and uneven-age management, for maximum production of high quality forest products while maintaining and enhancing other forest resources such as water quality and wildlife habitats (C. Brown and S. Farber, pers. comm. 1999). The goal of this management process is to maintain functional spotted owl habitat while growing and harvesting a sustainable yield of forest products. The strategy of maintaining structural features, such as snags, green cull, downed logs, and clumps of residual trees, is expected to provide for the long-term stability required for the conservation of the northern spotted owl.

Currently, there are roughly 32,120 acres of private land; 15% of that is in a late-successional forest stage, 34% is in a mid-successional stage, and 26% is in an early successional stage. Timber harvest on private land is expected to reduce late-successional habitats and promote early and mid-successional stages of forest habitat. Habitats on private land will consist of a mosaic of younger, harvested stands with clumps of large trees and patches of older forest in known spotted owl activity centers, in riparian buffers, and in other special habitat areas. It is expected that dense late-successional habitat will be reduced over time on private lands except in known spotted owl activity centers. Private lands will provide foraging and dispersal habitat for late-successional forest related species, but those species will rely on public lands for larger patches of mature forest for nesting and denning.

Terrestrial Wildlife and Plants

Key Questions for wildlife have been combined and will be answered together for each species.

Key Question #1 - For the identified habitats and associated wildlife/plant species, what has changed from historic to present and what have been the agents of change?
Key Question #2 - What are the desired conditions for habitat types in the analysis area?
Key Question #3 - What are the effects of exotic species on the ecosystems within the analysis area?
Key Question #4 – What are the effects of high road density on wildlife and plant species and their habitats?

Subalpine Conifer, Red Fir and White Fir

The distribution and composition of the subalpine conifer and true fir forest in the analysis area has been most influenced by wildfire, fire suppression, timber harvest, and road construction. Timber harvest, road construction, and wildfire (in 1971) have affected roughly 800 acres (15%) of mature green or burned forest, these acres have been set back to early seral stages through timber harvest or salvage on National Forest land in the last two decades. Harvest and road building have lead to

fragmentation and decreased patch size in older subalpine and fir forest in the vicinity of upper West Fork Middle Creek, upper Buckhorn Creek, and on the east side of Dry Lake Mountain.

The change in frequency and severity of fires through effective fire suppression over the past several decades has had an effect on the structure of subalpine conifer and true fir habitats. Forests in these types have become decadent, with high levels of downed wood, snags, and ladder fuels. Stands have become over-dense; crowding and competition have created conditions conducive to attacks by insects and disease. Although outbreaks of insects and disease are a natural occurrence in forested habitats, the lack of fire has lead to higher levels of mortality, which is exacerbating fuels conditions and increasing the risk of stand replacing wildfire. The fire interval is longer for true fir and subalpine conifer forest types than for mixed conifer types. Due to the longer fire interval in these forest types, they have not been as heavily impacted by fire suppression as have other habitat types, and are only now approaching twice the average fire-return interval found in several studies (Agee, 1993). Because of these minor alterations to the natural fire regime, we still have the ability to perpetuate the mosaic of age classes through the use of fire and other management techniques.

Trends

A change in the distribution of seral stages toward younger stands is expected in the true fir habitat type based on the moderate and high levels of mortality currently found in those types (refer to *Forest Health and Fire Disturbance Risk and Hazard* section). A decrease in patch size of older forest and the number of larger patches is expected, and an increase in the density of snags and logs is expected on National Forest lands. Overall, fire suppression activities will lead to continued fuel build-up, increased stand density, and increased risk from wildfire in this habitat type (refer to *Forest Health and Fire Disturbance Risk and Hazard*).

Desired Condition

- The amount of older subalpine conifer and true fir forest in the analysis area is maintained on at least 50% of the capable ground within the analysis area (50% of the subalpine conifer and true fir vegetation types).
- Mature subalpine conifer and true fir forest occurs adjacent to montane meadows, grasslands, red fir barrens and in Riparian Reserves.
- Fuels are reduced to a more natural level (refer to Forest Health and Fire discussion) and stand densities are reduced or maintained at sustainable levels.

Great Gray Owl

Incidental sightings of great gray owls have occurred within and adjacent to the analysis area. It is expected that true fir forests in the area provide suitable nesting and foraging habitat for this species.

Trends

- Few surveys have been conducted for great gray owls in the analysis area, it is expected that additional surveys will reveal owl nest sites in the area.
- Discovery of nest sites will allow for protection of those sites.
- The amount of suitable habitat will fluctuate as cut-over areas within the forest mature and additional areas are harvested. Current methods of timber harvest are not expected to remove large blocks of suitable habitat (clear cuts), partial harvest and patch cuts may continue to provide suitable habitat.
- Successful fire suppression has created conditions within suitable habitat that have increased the potential for large-scale disturbance events, such as wildfire or disease epidemics; large-scale disturbance would increase the fragmentation of suitable habitat.

Desired Condition

- Great gray owl populations are at or near full potential in the analysis area.
- The amount of suitable habitat within LSRs is at the maximum amount sustainable through time.
- Mature forest condition is provided at 50% of capable ground in the area outside of LSRs; mature forest habitat is provided adjacent to montane meadows, grasslands, streams and red fir barrens.

American Marten and Wolverine

American marten and wolverine have not been documented in the analysis area and it is expected they either do not occur or they are quite rare in the area. Due to the lack of historical data on populations within this analysis area, it is difficult to assess population changes from the historical to the current time period. Information in the literature on changes in populations focus on declines that occurred due to over trapping and logging in the United States and Canada. The literature suggests that California fur resources were so low by the late 1800s, that populations have not yet recovered (CDFG 1992).

There is little information on how trapping and habitat loss have affected populations locally. Logging, road building, and fire suppression have changed the structure of the forest, but suitable habitat is still abundant in the area. Recreational activities may impact marten and wolverine in the area through disturbance and displacement of individuals to avoid people. The description of habitat changes over time from Late-Successional Habitat Key Question #1 and the great gray owl discussion (above) also apply to marten and wolverine.

Trends

Management for late-successional forest within LSRs, with emphasis on large coarse woody material and snags, will provide habitat for the long-term. Trends for forest conditions are described above.

Desired Condition

- Marten and wolverine populations are at or near full potential in the planning area.
- Late-successional habitat (denning, resting, and foraging habitat) within LSRs is at the maximum amount sustainable through time.
- Foraging and dispersal habitat is provided in the matrix at 50% of capable ground in the area; mature forest habitat is provided adjacent to montane meadows, grasslands, streams and red fir barrens.

Klamath Mixed Conifer, Douglas-fir, Ponderosa Pine

The distribution and composition of the mixed conifer forest type has been most influenced by fire, timber harvest, road building, and fire suppression. The amount of late-successional forest has decreased in the analysis area on both public and private lands (refer to Chapter 3) through timber harvest, fire salvage, and road building. Harvested stands have been replanted, or have seeded in naturally, and are currently in early and mid-seral stages. Timber harvest and road building have lead to fragmentation, decreased patch size, and fewer large patches of older forest. Timber harvest and roading have lead to an increase in mid-seral, early seral and edge habitat.

The change in frequency and severity of fires through effective fire suppression over the past several decades has had an effect on the structure of mixed conifer habitat. Mixed conifer forest has become denser with multi-layered stands, larger numbers of shade-tolerant species and accumulations of ground fuels. Understory trees and shrubs have encroached into normally more open stands (e.g. ponderosa pine type) due to the lack of ground fires. This change to forest structure is creating a condition that will most likely lead to large stand-replacing fires similar to those already experienced during 1977, 1987 and 2000. The continuous accumulation of small surface fuels, vertical fuels, and large woody material have created a situation in which crown fires will occur with greater frequency and fires will be larger and far more destructive of habitat. In order to reverse the trend, fire would have to be reintroduced into the landscape. Fuels reduction efforts would have to be focused on areas where fuels were naturally lower, such as south and west aspects and higher on slopes.

Management direction in the *Forest Plan* emphasizes development, protection and enhancement of late-successional and old-growth forest in LSRs, 100-acre LSRs in the Matrix, and Riparian Reserves. In the analysis area, achieving *Forest Plan* objectives can be done by developing and enhancing previously burned and harvested stands, by reducing the current build-up of fuels and by reducing stand density in mid- and late seral stage stands. Outside of LSRs and Riparian Reserves, connectivity of older forest should be maintained by retaining 15% old-growth forest in fifth field watersheds and by maintaining and enhancing patches of mid- and late seral forest (size class 3 and above) over 50% of the watershed. Early seral habitat (size class 3 and below) should account for 50% of the land base in the Matrix within the fifth field watershed.

Trends

A change in the distribution of seral stages in the mixed conifer habitat type is expected based on natural succession: the amount of early seral mixed conifer forest will decrease and the amount of mid- and late-seral forest will increase as stands that were harvested in the past continue to mature. Stand replacing fires and timber harvest would alter this predicted change and private landowners are expected to continue to harvest their land using short rotations. An increase in patch size, the number of larger patches, and the density of snags and logs is also expected *Forest Health and Fire Disturbance Risk and Hazard* d on National Forest lands.

In ponderosa pine dominated mixed conifer stands, it is expected that continued fire suppression will promote encroachment of Douglas-fir and white fir and a reduction in pines. Overall, fire suppression

will lead to continued fuel build-up, increased stand density, and increased risk from wildfire in this habitat type (refer to *Forest Health and Fire Disturbance Risk and Hazard* section).

Desired condition

- The amount of older mixed conifer forest within LSRs is at the maximum amount sustainable through time.
- Connectivity of mid- and late seral mixed-conifer forest is provided at 50% of capable ground in the analysis area in Matrix.
- Early seral mixed conifer forest is provided on approximately 50% of the analysis area in the Matrix, and is provided in areas where natural disturbance has occurred within LSRs.
- Fuels are reduced to a more natural level (refer to Forest Health and Fire Disturbance Risk and Hazard discussion) and stand densities are reduced or maintained at sustainable levels.

Northern Spotted Owl

The change in frequency and severity of fires through effective fire suppression over the past several decades has had an effect on the structure of suitable spotted owl habitat. Mixed conifer forest in the analysis area has become denser with multi-layered stands, larger numbers of shade-tolerant species and accumulations of ground fuels. Understory trees and shrubs have encroached into normally more open stands (e.g. ponderosa pine type) due to the lack of ground fires. This change to forest structure is creating a condition that will most likely lead to large stand-replacing fires similar to those already experienced during 1977, 1987, and 2000, as described above.

It appears that the amount and distribution of conifer vegetation has changed in this analysis area as fire exclusion has allowed conifer growth or encroachment into other plant communities. It also appears that the amount of suitable spotted owl habitat (dense late-successional forest) has decreased overall as a result of timber harvest, fire salvage, and road building. Currently, within the analysis area, there are approximately 29,175 acres of suitable nesting, roosting, and foraging spotted owln ; this is roughly a 28% reduction in habitat since the 1930s based on historic logging. Of the habitat that has been affected by timber harvest and road building in the analysis area, roughly 30% is located within large LSRs. Current management direction in LSRs calls for the protection and enhancement of late-successional forest within LSRs. Given this direction, the long-term objective in this analysis area is to develop previously logged and roaded areas within LSRs into late-successional habitat suitable for northern spotted owls. There are approximately 3900 acres of previously harvested land that can be developed into suitable habitat over the long-term. In addition, as a result of fire suppression, there are large areas of dense, early and mid-successional habitat that are at risk of loss to wildfire, insects or disease. Thinning and fuels reduction in dense stands will increase growth and development of late-successional forest characteristics while protecting stands from loss to wildfire or insect epidemic.

There are currently 24 spotted owl activity centers tracked in the Forest Geographic Information System (GIS) in the analysis area; “activity center” status is based on the available survey data. It is expected that this number of identified activity centers over estimates the current population (due to nesting not having been confirmed at all sites, amount of available habitat, and close proximity of some activity centers), but that it is representative of the population potential for the analysis area. It is estimated that when previously burned and harvested forest stands recover, there is the potential for two or three more activity centers in Salt Gulch, Middle Creek, or Buckhorn Creek (refer to **Figure 3-11** *Wildlife Features***, and Figure 4-3** *Timber Harvest By Decade.*

Critical Habitat: Spotted owl Critical Habitat overlaps the two LSRs within the analysis area by 100% (both Johnny-O’Neil LSR and Collins-Baldy LSR). Critical Habitat (CH) will be managed as LSR (refer to *Forest Plan* and USDA 1999) and constituent elements of CH (physical and biological features that support nesting, roosting, foraging, and dispersal) will be maintained over the long term. In order to maintain constituent elements of CH, which are generally associated with mature and old-growth forests, techniques will need to be employed to reduce fuels, stand densities, and overall fire hazard and return stands to a condition that is sustainable over time under the inherent disturbance regime of the landscape (Everett, et. al. 2000).

Spotted Owl Baseline Analysis: LSRs categorized as insufficiently providing for owls (such as Collins-Baldy and, potentially, Johnny-O’Neil), require support from owl territories in the surrounding Matirx to maintain their populations as LSR habitat recovers (e.g. from wildfire, road building or timber harvest). To ensure support from owl territories in surrounding Matrix, the Baseline Analysis recommends that occupied owl home ranges within a 7-mile buffer surrounding

these LSRs are maintained at their current level of suitable habitat. Within these buffers, the United States Fish and Wildlife Service (USFWS) recommends minimization of incidental take to maintain owl populations during the LSR recovery period. Removal of nesting/roosting habitat within occupied owl home ranges (determined through protocol surveys) is not recommended. Without current protocol surveys, removal of unsurveyed nesting/roosting habitat is also not recommended. Seasonal restrictions are recommended for all projects involving habitat modification (February 1 through September 15) or noise disturbance (February 1 through July 31) within ¼ mile of suitable habitat or known spotted owl sites.

Trends

- The number of spotted owl activity centers will remain fairly constant for the near future (30 to 50 years) on National Forest lands, but may increase by 2 or 3 as habitat develops in previously burned and harvested areas (Salt Gulch, Middle Creek and Buckhorn Creek).
- The amount of suitable spotted owl habitat in LSRs will increase over time, provided there are no large-scale wildfires, as harvested areas, and areas affected by fire, recover within the LSRs.
- The amount of suitable habitat in the Matrix will fluctuate as cut-over areas within the forest mature and additional areas are harvested. Current methods of timber harvest are not expected to remove large blocks of suitable habitat (clear cuts), partial harvest and patch cuts may continue to provide suitable habitat.
- Dispersal and foraging habitat will increase as cut-over areas within the forest Matrix and in Riparian Reserves mature.
- Dispersal and foraging habitat (including harvested openings) will occur on adjacent private lands; nesting and roosting habitat will be more limited on private lands.
- Successful fire suppression has created conditions within suitable habitat that have increased the potential for large-scale disturbance events, such as wildfire or disease epidemics; large-scale disturbance would increase the fragmentation of suitable habitat.

Desired condition

- Northern spotted owl populations are at or near full potential in the planning area.
- Recovery of spotted owls is promoted or achieved through development and protection of suitable habitats.
- The amount of suitable habitat within LSRs is at the maximum amount sustainable through time.
- Dispersal habitat for owls is provided at 50% of capable ground in the fifth field watershed (McKinney-Horse); dispersal habitat is provided within 100-acre LSRs and within Riparian Reserves.

Northern Goshawk

There are seven known goshawk areas tracked (through GIS) in the analysis area; six of the sites were identified by multiple incidental sightings by Forest personnel and one is based on a confirmed nest site. None of the sites have been surveyed to protocol. The confirmed nest site (OK17) will be managed according to the *Forest Plan*, including designation of primary nest zones and foraging habitat zones. The remaining six sites should be surveyed to protocol (2 years) and, if occupied, managed according to the *Forest Plan*, or, if not occupied, removed from the network. In addition, for project work in which suitable habitat will be removed (e.g. timber harvest), surveys should be conducted to identify other goshawk nest sites in the vicinity and all nest sites should be afforded protection as outlined in the *Forest Plan*.

Goshawks utilize habitat that is similar to the northern spotted owl, including a variety of mature forest types. High canopy closure is desired. They commonly have more than one nest within their territories and use them on a rotating basis. Goshawks forage below the canopy on a variety of mammals and bird species. Within the analysis area, habitat for goshawks is described as similar to that of northern spotted owls; therefore, the discussion of habitat changes over time for spotted owls (above) applies for goshawks. Goshawks, however, are known to use stands that are much more open than those used by spotted owls (e.g., ponderosa pine stands); therefore, changes in stand structure as a result of fire suppression may have more impact on the ability of goshawks to forage under the canopy. This change to forest structure has also created a condition that will most likely lead to large stand-replacing fires and subsequent large-scale habitat loss.

Trends

- The amount of late-successional habitat will increase over time as harvested areas and areas affected by fire recover within the LSRs; however, dense stand conditions as a result of fire suppression may preclude the ability of goshawks to forage in dense stands.
- Habitat in the Matrix will fluctuate as cut-over areas within the forest mature and additional areas are harvested. Current methods of timber harvest

are not expected to remove large blocks of suitable habitat (clear cuts), partial harvest and patch cuts may increase goshawk foraging opportunities.
- Successful fire suppression had created conditions within suitable habitat that have increased the potential for large-scale disturbance events, such as wildfire or disease epidemics; large-scale disturbance would increase the fragmentation of suitable habitat.

Desired condition
- Goshawk populations are at or near full potential in the planning area.
- The amount of late-successional habitat within LSRs is at the maximum amount sustainable through time, more open stands are maintained on south and west aspects through the use of prescribed fire.
- Late-successional and mid-successional forest habitats are provided at 50% of capable ground in the fifth field watershed; suitable habitat is maintained within designated Goshawk Management Areas, 100-acre LSRs, and within Riparian Reserves.

Pacific Fisher

Incidental sightings of fisher in the analysis area, and survey data from the Collins-Baldy LSR and the adjacent watershed, indicate that fisher populations are well distributed in the area. Due to the lack of historical data regarding populations within this analysis area, it is difficult to assess population changes from the historical to the current time period. Information in the literature on changes in fisher populations focuses on declines that occurred due to over trapping and logging in the United States and Canada.

There is little information on how trapping and habitat loss have affected populations locally. Logging, road building, and fire suppression have changed the structure of the forest, but suitable habitat is still abundant in the area. The description of habitat changes over time from Late-Successional Habitat Key Question #1 and the northern spotted owl discussion (above) also apply to fisher.

Trends
- Management for late-successional forest within LSRs, with emphasis on large coarse woody material and snags, will provide for fisher for the long-term.

Desired Condition
- Fisher populations are at or near full potential in the planning area.
- Late-successional habitat (denning, resting, and foraging habitat) within LSRs is at the maximum amount sustainable through time.
- Foraging and dispersal habitat is provided in the matrix at 50% of capable ground in the fifth field watershed; foraging and dispersal habitat is provided within 100-acre LSRs, Riparian Reserves, and other special habitat areas.

Red Tree Vole

Very little is known about red tree voles in the analysis area. Recent surveys have found red tree voles on the Forest over 30 miles west of Horse Creek. Surveys in Oregon have found voles in the Applegate drainage north of the analysis area. These species will be better understood and protected as more information about populations, habitat occurrence, and distributions are found through surveys and research.

Trends
- It is unknown if red tree voles (*A. longicaudus*) occur within the analysis area, therefore trends for this species cannot be predicted. If red tree voles occur in this landscape, it is expected that habitat in LSRs will increase over time as harvested areas and areas affected by fire recover.
- Habitat in the Matrix will fluctuate as cut-over areas within the forest mature and additional areas are harvested. Current methods of timber harvest are not expected to remove large blocks of suitable habitat (clear cuts), partial harvest and patch cuts may continue to provide suitable habitat.

Desired condition within the range of the species
- The range of red tree voles in California is clearly defined through surveys and research, definition of the range will determine whether red tree voles occur in the watershed.
- Viable populations of red tree voles occur in suitable habitat with adequate corridors of habitat in the Matrix for dispersal between LSRs.

Mollusks

Very little is known about mollusks in the analysis area. These species will be better understood and protected as more information about populations, habitat occurrence, and distribution within the Lower Scott Analysis Area are found through surveys and research.

Trends

- Populations of mollusks will be located in the analysis area through implementation of available survey protocols.
- Management and protection of known sites will assist in maintaining the viability of known and newly discovered populations.
- Trends for mixed conifer habitats are described above.

Desired Condition
- Populations of mollusks within the analysis area contribute to the viability of the species over their ranges.
- Forest management practices are conducted congruent with maintaining viable populations of mollusks.

Montane Hardwood-Conifer, Montane Hardwood

The amount and distribution of the montane hardwood-conifer and montane hardwood habitat types has been influenced by fire exclusion, homesteading, mining, road building and wildfire. Homesteading, mining, and road building have resulted in conversion or loss of some hardwood habitat type, but there has not been significant loss in the analysis area. Fire exclusion (suppression) in the area has had a more profound effect on these vegetation types from a habitat perspective. These types were adapted to frequent fires and were more open and vigorous than what is found today, hardwood types have been encroached by conifers, and hardwoods have become decadent with little resprouting or regeneration.

Management direction in the Forest Plan emphasizes the maintenance of a significant hardwood component in the montane hardwood-conifer type, and emphasizes the maintenance or improvement of montane hardwood habitat, especially Oregon white oak. Use of frequent prescribed fire is a recommended tool for maintaining or improving stands.

Trends
- With continued fire suppression montane hardwood-conifer and montane hardwood habitat types will persist as a climax species on xeric sites unfavorable to conifers, stands will remain decadent with reduced vigor, resprouting and regeneration.
- With continued fire suppression, where conditions are favorable to conifers, hardwoods will be overtopped and sites will be converted to conifer type, reducing the amount of the hardwood habitat type in the analysis area over time.

Desired Condition
- Montane hardwood stands are maintained by frequent fire as open and vigorous stands with little woody fuel and an abundance of grass and forbs. Montane hardwood stands occupy approximately 3% to 5% of the analysis area.
- Montane hardwood-conifer stands are maintained by low intensity fires as relatively open stands with accumulations of litter and downed wood commensurate with a frequent fire regime. Montane hardwood-conifer vegetation occupies approximately 9% to 11% of the analysis area.

Turkey

Turkeys have been introduced on the Forest. Sightings of turkeys in the analysis area have been on the increase and they are expected to be abundant. Habitat for turkeys in the analysis area includes riparian areas, chaparral, oak woodlands, and agricultural or pasture lands along the Klamath River. Hardwood sprouting and mast production may be increased by the use of prescribed fire.

Trends
- Turkeys are a fairly recent arrival in the analysis area. It is expected that populations will increase until available habitats are occupied.
- As turkey numbers increase it is expected that turkey hunting will increase in the area.
- Hardwood and hardwood-conifer habitats suitable for turkeys are declining due to lack of fire disturbance.

Desired Condition
- Habitat for turkeys is maintained within the analysis area.
- Turkey populations are healthy, sustainable and huntable.

Montane Chaparral, Mixed Chaparral

The distribution and condition of chaparral habitat types in the analysis area has been most influenced by fire exclusion. The historic frequent fire return interval in the chaparral habitat types (approximately every eight years) promoted a mosaic of age classes from patches of older, senescent stands, to young, vigorous stands with inclusions of grasses and forbs in the understory. Changes in chaparral habitats in the analysis area over time include encroachment by conifers (reduction in the amount of chaparral), expansion of chaparral types into meadows or grasslands (increase in chaparral), and an overall increase in decadence. All of these changes are related to the lack of fire on the landscape. Although the amount of chaparral habitat has not changed

significantly from historic times, the quality and palatability of forage available for wildlife species has declined.

Trends
- With continued fire suppression chaparral habitats will remain as dense, decadent thickets with few grasses and forbs. The quality and palatability of these vegetation types for wildlife will decrease.
- With continued fire suppression, where conditions are favorable to conifers, chaparral will be overtopped and sites will be converted to conifer type, reducing the amount of the chaparral habitat type in the analysis area over time. On dry sites chaparral will persist as a subordinate species to conifers and chaparral will dominate on harsh sites.
- Timber harvest in the Matrix and on private land may create conditions favorable to colonization by chaparral as an early seral vegetation type, over time these stands will convert back to conifers.

Desired Condition
- Chaparral habitat types are maintained by frequent fire as vigorous stands with sprouting and regeneration. Plants are maintained in shrub form within moderately dense stands.
- Chaparral vegetation occupies approximately 3% to 5% of the analysis area.

Montane Riparian and Riverine

The distribution and condition of montane riparian and riverine habitats has been most influenced by mining, grazing, timber harvest, homesteading, road construction, fire suppression and flood events. Flood events are a primary disturbance process in riparian habitats and occur in conjunction with other disturbance processes. Over time there has been a change in the anthropomorphic disturbance agents influencing riparian vegetation from natural fire and Indian burning, to homesteading and extensive grazing by livestock, to a combination of timber harvest, roading, and grazing.

More recently, the effects of fire suppression on riparian habitats have become evident. In montane riparian habitats, vegetation (grasses, sedges, forbs, young willows and alders) adjacent to streams was probably more abundant and vigorous historically due to the renewing effects of fire, flooding, grazing and activities of beavers. Over the past several decades, there has been an increase of alder habitat that is older, larger, and more decadent, probably due to the effects of fire exclusion and the reduction in grazing. There has also been an increase in encroachment of conifers in riparian areas. Overgrazing in the 1800 and 1900s may have successfully limited the encroachment of alders into streamside habitats, but eventually resulted in degradation of riparian habitats, including changes in species composition. Mining, road construction and timber harvest have also had negative effects on the extent and condition of montane riparian habitats.

The majority of riverine habitat along the Klamath River is in private ownership (>80%). Riverine habitat has been affected by factors mentioned above and by Highway 96 which runs parallel to the river within the analysis area. Ranching, homesteading, mining, and occasionally logging on private will continue within the riverine habitat in the planning area. Implementation of RR and Recreational River guidelines will protect riverine habitat on National Forest Lands to the extent possible.

Trends
- Montane riparian habitats are in varying degrees of succession depending on the effects of recent flood events (e.g. 1997). Habitats that were affected by recent flooding will be in a early seral condition and will proceed to later seral communities. Grasses, forbs, willows and alders colonizing recently flooded areas will be vigorous and healthy.
- Riparian areas that were not affected by flooding will persist in their current condition (e.g. riparian shrub communities or conifer stands with riparian species as subordinates). These stands may be set back by future flood events.
- In riparian habitats where logging has occurred, Riparian Reserves protection will allow stands to mature and provide cover.
- Refer to the Aquatics Section for information on hydrologic trends in riparian areas.

Desired Condition
- Montane riparian habitats dominated by trees or shrubs are in a healthy vigorous condition and provide cover for wildlife and streams.
- Riparian dependent grass, forb and shrub types are frequently set back by natural flood events and recover quickly.
- ACS objectives are met and the Klamath River system is in an improving trend.
- The large tree component along the Klamath River, on National System Forest lands, is maintained for wildlife (osprey and bald eagles).

Willow Flycatcher

Habitat for willow flycatchers in the Horse Creek Analysis Area consists of riparian strips with willow or alder thickets, small patches of willows or alders in higher elevation montane meadows, and lower gradient reaches of Horse Creek, Middle Creek, and the Klamath River. Willow flycatchers have been documented along the Klamath River and in Horse Creek. Habitats in the analysis area have been impacted by mining, grazing, homesteading, and to some extent by road building. Hydrologic events, such as floods, remove willow habitat for short periods of time, but willows quickly re-colonize suitable disturbed sites. The effects of cattle grazing on willow flycatcher habitat in the analysis area are more thoroughly discussed in the Horse Creek/Dry Lake Allotments, Horse Creek/Beaver creek/Haystack Watershed Analysis (Klamath NF, 1996).

Although livestock grazing in the watershed is considerably less than it was at the turn of the century, riparian shrub habitats may continue to be impacted by cattle grazing in allotments and on private lands where shrub utilization is high. A major flood event in 1997 may have reduced patches of riparian shrub habitat with plants large enough for nesting in drainages within the analysis area.

Emphasis for willow flycatcher management should focus on protecting and enhancing existing meadows and willow habitat. Use of Riparian Reserve guidelines will protect willow stands within riparian buffers. Use management techniques to reduce encroachment of conifers in existing meadows to maintain desired opening sizes, and maintain or improve saturated, standing or flowing water near potential nesting areas. If it is determined through surveys that nesting is occurring in the analysis area, conduct monitoring of management activities, such as grazing, to determine potential negative effects.

Trends

- Management and protection of Riparian Reserves and implementation of the ACS objectives will improve willow and alder habitat conditions on National Forest System lands along the Klamath River and its tributaries. The amount and distribution of willow habitat will remain dynamic as influenced by hydrologic events (e.g. floods).
- With continued fire suppression, alder and willow patches will continue to expand in upper elevation meadows, and may provide nesting habitat.
- Protection of riparian habitats may lead to an increase in willow thickets and an increase in willow flycatcher nesting habitat. As a result, numbers of nesting birds may increase in the area.

Desired Condition

- Riparian reserves provide nesting habitat and dispersal corridors across the landscape.
- Breeding and dispersing willow flycatchers are at or near full population potential in the analysis area.
- Bird watching opportunities in the analysis area are identified and promoted.
- Important migratory and dispersal routes along the Klamath River and larger tributaries (e.g. Horse Creek) are developed and maintained through cooperative management efforts with private landowners.
- Livestock utilization or riparian shrubs is monitored; mitigations, such as fencing or deferred rotation grazing, are used to reduce impacts to habitat.

Western Pond Turtle, Yellow-legged Frog and Cascades Frog:

Incidental sightings of western pond turtles in the Klamath River drainage suggest that this species is fairly common and well distributed, although local abundance has not been determined. Western pond turtles are associated with aquatic habitats and may use upland habitats within 1/4 mile of water for nesting. The most significant declines in western pond turtle populations in California have occurred in the interior valleys such as the Sacramento Valley and the San Joaquin valley. Declines have been associated with livestock grazing, widespread conversion of aquatic habitats to farmland, reclamation of swamp and overflow land, and dam construction.

Distribution and abundance of yellow-legged and Cascades frogs are not known in the area. Both species of frogs have been documented elsewhere on the District and it is expected that they occur in the Horse Creek Analysis Area.

Locally, threats to western pond turtles and native frogs include the following: introduced predators such as bullfrogs; cattle grazing which may result in trampling of emergent vegetation and streambanks; mining which results in siltation and localized flooding; road building near riparian areas; and removal of logs, snags, brush or aquatic vegetation in riparian areas and streams. Survey information is needed in the Klamath River drainage and in the Horse Creek area to determine population levels and to better understand the extent of local threats.

Trends

- Management and protection of Riparian Reserves and implementation of the ACS objectives will improve habitat conditions along the Klamath River and its tributaries.
- Populations may increase with improved conditions in streams and riparian areas.
- Increasing bullfrog populations may impact turtle and native frog abundance or distribution.

Desired Condition
- Riparian Reserves guidelines protect aquatic habitats and provide nesting habitat in the adjacent upland.
- Western pond turtle and native frog populations are at or near full population potential in the analysis area.

Bald Eagle

Suitable habitat along the Klamath River and its tributaries has remained fairly constant over the last few decades, with a reduction in nesting and roosting habitat along the river (mining, road building, and logging) since historic times. Foraging opportunities along the River and the larger creeks have decreased with lower numbers of salmon. Without specific data on historic numbers of bald eagles, it is assumed that there were more nesting bald eagles in the area prior to European settlement than there are now due to higher abundance of prey, less disturbance, and potentially more large pines for nesting. Currently, bald eagle populations are on the increase from lowest population levels in the 1970s due to their protection under the Endangered Species Act and the restrictions on use of pesticides such as DDT (Dichloro-diphenyl-trichlorethane). The carrying capacity of the habitat within the analysis area is unknown. It is expected that the area cannot support more than one, or possibly two, nesting territories due to limited low gradient reaches of the Klamath River characteristic of nesting/foraging areas.

Trends
- It is expected that there will be a healthier and larger bald eagle population on the Forest, but with only one or two nest territories within the analysis area.
- Winter use of habitats along the Klamath River will remain the same or will increase with recovery of salmon populations.
- Protection of late-successional forest within Riparian Reserves, LSRs, Recreational River and Scenic River designations will ensure adequate nest and roost sites.
- Recovery efforts for anadromous fish are expected to increase foraging opportunities along the Klamath River.

Desired Condition
- There are late-successional forest conditions, with large trees/snags for nesting and roosting, along the Klamath River and within RRs with emphasis on large pines and low to moderate fuel loading.
- Future nest sites have limited or no road access with minimal disturbance from humans.
- There are only low levels of disturbance from recreationists around future nest sites.

Montane Meadow

The distribution and condition of montane meadow habitat in the analysis area has been most influenced by grazing, fire exclusion, road construction and recreation. Species composition and the condition of meadow habitat has been altered by historic extensive grazing as described in the Horse Creek and Dry Lake Allotments Watershed Analysis (Klamath NF 1996).

As described in the *Forest Health and Fires Disturbance Risk and Hazard* section of this document, the distribution (size or amount) of meadow habitat has been reduced through fire suppression and subsequent encroachment of conifers and brush species. This is supported by a study conducted in the Dillon, Clear, and Swillup Creek watersheds near Happy Camp (Skinner, 1995). Skinner found significant changes in the spatial characteristics of the openings in the landscape studied between 1944 and 1985. The primary differences between the characteristics were that the sizes of openings have decreased as distances between them have increased. Before the initiation of fire suppression activities, frequent fires were characteristic of landscapes in the vicinity of the study area. This is also true in the Horse Creek Analysis Area, where not only were lightning fires allowed to burn but fires were started by local residents to improve grazing conditions. The changes observed are consistent with changes that would be expected when fire is removed from a landscape where frequent, low-moderate severity fire was a common ecological process. With continued fire exclusion, and in the absence of a large stand-replacing fire, it is expected that this trend will continue. An ambitious prescribed fire program, which includes burning through high elevation meadows, would reduce encroachment on natural meadows and maintain available forage for wildlife in the analysis area.

Road building in the analysis area has opened much of the area to recreationists and hunting. In many locations, roads or spur roads access meadow habitat, increasing the potential for disturbance to wildlife and reducing the quality of the habitat. Meadows are often used as camping areas in the summer and during hunting season.

Trends:
- With continued fire suppression brush and conifer species will continue to encroach into montane meadow habitats.
- Recreation, especially hunting, will continue or increase in the area. Damage to meadow habitats from vehicles and camps may increase. Disturbance and displacement of wildlife in meadows may increase.

Desired Condition
- Montane meadow habitat types are maintained by frequent fire.
- Road density in the analysis area is reduced from the current condition and roads accessing meadows are closed or decommissioned.
- Montane meadow habitat occupies approximately 2% to 3% of the analysis area.

Caves, Cliffs and Talus

There has been little change in these unique habitat features over time. The spatial configuration for cave and cliff habitat is similar to what it was historically, although there have been changes to adjacent vegetative communities and potentially to the microclimates surrounding these sites. Talus habitat is scattered throughout the analysis area and has been most influenced by timber harvest, mining, rock quarry development and road construction. Mining, rock quarry development and road construction directly affect habitat and reduce the amount of talus. Timber harvest alters the microclimate surrounding talus habitats. Areas containing talus habitat are often small and location is unpredictable, therefore this type of habitat has not been specifically inventoried. Surveys for species that occupy talus habitat (e.g. salamanders) for projects that may alter habitat, will continue and habitat will be identified.

Trends
- Talus habitats will be identified and mapped through project surveys.

Desired Condition
- Cliff, cave and talus habitats are protected for their unique values.

Peregrine Falcon

Peregrine falcons are limited by suitable cliffs for nesting and snags and large trees available nearby for perches. There have been no nest sites or typical nesting habitat identified in the analysis area and the nearest known sites are over 10 miles away. Peregrine numbers have increased across their range due to protection under the Endangered Species Act and restrictions on pesticide use. The analysis area may provide foraging habitat for peregrines, foraging opportunities are abundant in the area, with open areas around Klamath River, riparian areas, meadows and other openings expected to be the preferred foraging areas. It is unknown what effect changes in forest structure, such as logging, burned areas, fire salvage, and road building, have had on peregrines in the analysis area. However, since peregrines are not adapted to close pursuit of prey among trees in closed canopy forests (Asay and Davis, 1984), it can be assumed that openings created by fire, timber harvest and road construction may have increased the foraging opportunities for peregrines.

Bats

Very little is known about bats in the analysis area, local distribution and abundance has not been determined. Potential roost and foraging sites, such as caves, buildings, late-successional forest and mine shafts, occur within the analysis area. Caves, abandoned buildings, and abandoned mine shafts will be surveyed or protected as outlined in the *Forest Plan*. These species will be better understood and protected as more information about populations; habitat occurrence and distribution within the Horse Creek Analysis Area are found through surveys and research.

Trends
- Decadence within late-successional forest habitats will increase with continued fire suppression; snags, dying trees and hollow logs will provide additional habitat for roosting.
- The amount of late-successional forest will increase as plantations and burned areas develop.
- Caves and abandoned mine shafts will remain constant; bat habitat will be protected as per *Forest Plan* Standards and Guidelines.
- Foraging habitat provided by riparian areas may improve as Riparian Reserve guidelines and ACS objectives are implemented. Habitat in riparian areas is dynamic and driven by hydrologic events.

Desired Condition

- Undisturbed roost sites, such as caves, abandoned mine shafts, and abandoned buildings, occur within the landscape.
- Forest structure in the vicinity of roost sites is maintained to provide foraging habitat and to limit the temperature fluctuations and intensity of sunlight penetrating caves and mines.
- Caves and abandoned mines known to be occupied by bats (through surveys), but that pose a hazard to the public, are closed using devices which do not preclude use by bat species (e.g., bat gates).
- Late-successional forest habitat is abundant and sustainable in the analysis area. Forested habitats provide adequate numbers of snags, dying trees, and hollow logs for roosting of bat species.

Del Norte and Siskiyou Mountains Salamanders

Recent surveys for Del Norte and Siskiyou Mountains salamanders have more clearly defined the range of both species on the Forest. Surveys have also indicated that these salamanders occupy a wider variety of habitats than previously suspected. Within this Analysis Area, it is known that Siskiyou Mountain salamanders occupy habitats in Horse Creek and east of the Scott River and near the mouth. It is expected that Del Norte salamanders do not occur as far east as the Horse Creek Analysis Area (S. Cuenca, pers. comm.)

Siskiyou Mountain salamanders are associated with deep, talus or rocky substrates; they are dependent on cool, moist environments. The presence of dense canopy closure may help to maintain optimum surface conditions. During periods of inhospitable environmental conditions, the salamanders retreat below the forest surface, utilizing interstitial spaces provided by deep layers of rock and talus. Management activities in the analysis area that may have affected suitable habitats for salamanders include mining, road building, rock quarry development, and timber harvest. These types of activities have affected habitats by directly disturbing rock talus or by altering the microclimate surrounding the talus substrate.

The effects of fire on plethodon salamanders are not well understood. It is expected that these salamanders are adapted to the historical fire regime of frequent low-intensity fires. Fires of this nature usually occurred during late summer and fall when it is expected that salamanders were below the surface. Fire suppression over the past several decades has probably had both positive and negative effects; accumulations of fuels, downed logs and dense canopies have increased habitat over the landscape; however, large catastrophic fires have removed habitat elements over large areas and may have eliminated isolated populations of salamanders.

Trends
- Populations of Siskiyou Mountain salamanders will continue to be identified in the analysis area through implementation of available survey protocols.
- Management and protection of known sites will assist in maintaining the viability of known and newly discovered populations.
- Knowledge of these species gained through survey and research will aid in developing management recommendations consistent with Forest management.
- Fire suppression, development of plantations, and development of previously burned areas will result in an increase of vegetation over existing rock talus, thereby creating a favorable microclimate for salamanders. Populations may increase as habitats become favorable.
- Catastrophic fire could radically change the microclimate in localized areas, causing short-term losses of isolated populations.

Desired Condition
- Populations within the landscape contribute to the viability of the species.
- Talus habitats are protected within the landscape, especially the older, more stable talus slopes where large, deep cobble and rock provide the best habitat.
- Forest structure associated with talus habitat is maintained to provide food sources and protection of sites from high temperatures and low humidities associated with increased exposure.
- Rock and gravel quarries for road building are developed to minimize negative effects to isolated populations of plethodon salamanders; this is done by locating quarries in areas with the least desirable characteristics (e.g., unstable areas in sedimentary rock with large amounts of fine material that may not provide habitat).

Wide-Ranging Species in the Analysis Area

Deer

Black-tailed deer are a Forest Emphasis Species and a species of local concern within the analysis area. Their needs are governed by the ability to find sufficient forage to meet their energy requirements, and cover to regulate body temperature and escape predation or harassment. Deer are a popular

species in this area to view and hunt. They are habitat generalists and as such use a variety of habitats within the analysis area for various aspects of their life histories. The analysis area contains winter range, transitory range, and summer range. While specific population estimates and habitat suitability are not available for the area, a California Department of Fish and Game (CDFG) draft habitat model was used to predict where high quality habitat may occur and how much of it is in the area.

Although no specific data exists, visual and photographic comparisons, field review, and anecdotal information, indicate that forage quality and availability are declining in the watershed. Declines are related to lack of fire, increasing decadence of brush stands, maturation of cut over and burned areas, and conifer encroachment in high elevation meadows. According to the draft habitat model, high quality foraging habitat occupies only 18% of the analysis area in scattered areas. Much of the area identified as "high forage value" is located within previously harvested or burned areas. Areas burned in 1977 and 1987 are becoming unusable for foraging due to age and size of plants. Areas identified by the model as "high cover value" are good quality cover close to high value forage; therefore, with limited forage, high value cover is also limited (39% of the analysis area). Forage quality and abundance can be improved by introducing an underburning regime in suitable forage areas relatively close to cover.

Competition for forage or cover between deer and cattle has not been documented within the watershed. Competition may occur in some areas, but the potential effects have been minimized through compliance with utilization standards and guidelines in the Forest Plan. Trends in rangelands are improving since the 1950's, when transects and plots were first installed in key grazing areas. Improvements in rangeland condition are associated with improved rangeland management by Forest personnel and allotment permittees, a gradual decrease in number of head on allotments, and with shortened grazing seasons since the early part of the century.

Road construction in the analysis area was generally done to access timber harvest units or mining claims. In addition, roads opened up areas to higher levels of human use through recreation, hunting, or collection of forest products. Human access has effects on wildlife by providing a source of disturbance, which can reduce the effectiveness of the habitat. It also provides access to once remote areas, which can cause an increase in the illegal harvest of wildlife. Use of roads and motorized trails can cause animals to move away from certain areas of heavy use. Thomas (1979) shows that both deer and elk respond negatively to increasing road density. Refer to **Table 5-18** for road rating criteria, and **Appendix E** *Road Analysis Process*, for recommendations for reducing road density.

Trends

- Deer habitat within the LSRs is expected to decrease due to management of habitat for late-successional forest-related species. In the present situation, continued fire exclusion will reduce the amount of early-successional habitat created by low or moderate burning and timber harvest. Early seral habitat will be reduced unless a stand-replacing fire occurs.
- It has been suggested that local herds are stable or declining (K. Nickell, pers. com., information from recent CDFG studies in California, M. Crew, pers. com.).
- In Matrix lands, large areas that were previously harvested or burned will be managed for later seral stages and this will reduce available forage in the analysis area. Under a continued policy of fire exclusion, early seral habitat would decrease except in areas of recent timber harvest or in the event of a stand-replacing wildfire.
- Under management direction in the *Forest Plan* and opportunities identified in the Forestwide LSR Assessment and in this analysis, an ambitious prescribed fire program is proposed. In the event that this program is adequately funded and implemented, development of early seral habitat, maintenance of shrub communities and natural meadows, and maintenance of more open stands on south and west aspects would provide a vehicle for maintaining a larger forage base for deer herds in the area.

Desired Condition

- Adequate cover in maintained through management of late-successional forest.
- High quality forage is maintained in the analysis area through underburning.
- Matrix lands consist of 50% of capable area in mid and late-successional condition (dense or open), the other 50% is early-successional, pole, and sapling, which will provide forage for deer.
- Natural meadows and brush fields are sustained by frequent, low intensity fire.
- Transitory range and winter range on south and west aspects have open, fire-adapted conifer stands with forage below, and are maintained by frequent low intensity fire.
- Road density and associated disturbance is reduced in the analysis area.

- Roads are below an average of two mi/mi² (total road density) in LSRs. Areas in Matrix with current densities of four mi/mi² have reduced densities (Refer to **Appendix E** *Road Analysis Process*, which provides a starting point for developing road improvement, maintenance, and decommissioning opportunities).

Elk

Elk are also a Forest Emphasis Species and a species of local concern within the analysis area. Their needs are governed by the ability to find sufficient forage to meet their energy requirements and cover to regulate body temperature and escape predation or harassment. The analysis area contains winter range, transitory range, and summer range. Elk are a popular species in this area to view and hunt. They are habitat generalists and use a variety of habitats for various aspects of their life histories. Elk were hunted out of California early in this century and are now re-populating from animals released on the Happy Camp Ranger District and from herds in Hilt and Applegate Valley. Most of the elk use in this area is in Horse Creek, Middle Creek, Dry Lake and Johnny-O'Neil Ridge. Currently, elk are not hunted to any great extent in the analysis area. When elk are hunted, they become very sensitive to open roads, and high open road density can greatly reduce habitat utilization by elk.

Potential elk habitat has been identified using the draft elk habitat model. Potential habitat was located throughout the analysis area with the largest patches identified along the north side of the Klamath River, along Middle Creek Ridge, in the vicinity of Dry Lake, in plantations, and in areas burned in 1977 and 1987. Cover habitat within the analysis area appears to be increasing as plantations and burned over areas develop into mature stands. On the other hand, forage habitat appears to be decreasing as plantations and burned areas progress to later seral stages. Fire suppression has resulted in forested stands that have become denser with multi-layered stands, larger numbers of shade-tolerant species, and accumulations of ground fuels. Understory trees and shrubs have encroached into normally more open stands (e.g., south and west aspects) due to the lack of ground fires. Natural meadows are being reduced in size by encroachment of conifers, due to lack of fire.

Road density in the analysis area is high, with over 79% of the area exceeding 2.5 mi/mi^2. Road construction in the analysis area was generally done to access timber harvest units or mining claims. In addition, as mentioned above for deer, roads opened up areas to higher levels of human use, human access has effects on wildlife by providing a source of disturbance, which can reduce the effectiveness of the habitat.

Trends
- It is expected that elk numbers will continue to increase.
- Elk foraging habitat will decrease as plantations mature, woodland and chaparral habitats become less vigorous and palatable, and meadows shrink by encroachment.
- Elk transitory range (forage) (i.e., south and west aspects) will become less suitable as conifers and brush continue to encroach with fire exclusion.
- In the event of catastrophic fire events, burned areas would provide new forage areas.

Desired Condition
- High quality forage and cover are provided in the analysis area.
- LSRs include late-successional habitat in draws, north and east aspects and Riparian Reserves; south and west aspects are more open (<50% crown) with forage below.
- Matrix lands consist of 50% of capable area in mid and late-successional condition (dense or open), the other 50% is early-successional, pole, and sapling, which will provide forage for elk.
- Natural meadows and brush fields are sustained by frequent, low intensity fire.
- Transitory range and winter range on south and west aspects has open, fire-adapted conifer stands with forage below, and are maintained by frequent low intensity fire.
- Roads are below an average of two mi/mi² (total road density) in LSRs. Areas in Matrix with current densities of four mi/mi² have reduced densities (refer to **Appendix E** *Road Analysis Process*, which provides a starting point for developing road improvement, maintenance, and decommissioning opportunities).

Special Emphasis Plant Species

The Horse Creek Analysis Area contains known populations and habitat for six plant species of concern: Pacific fuzzwort, American sawwort, Howell's lousewort, clustered lady's slipper orchid, mountain lady's slipper orchid and Henderson's horkelia.

Trends:
- Known populations, American sawwort, Howell's lousewort, and Henderson's horkelia, are

expected to persist through time in their present abundance and distribution.
- Populations of clustered lady's slipper orchids, mountain lady's slipper orchids and Pacific fuzzworts may increase as mature forest increases and as plantations convert to later seral stages.
- Uncontrolled noxious weed spread and suppression of natural wildfires may contribute to declining habitat conditions for these species.
- With the exception of weed and wildfire influences, existing habitat conditions will remain unaltered to provide necessary habitat elements for known population sites.
- Additional suitable habitat will remain unaltered and available in its current condition to provide dispersal habitat for juvenile recruitment.

Desired condition:
- Sensitive plant populations are stable and increasing in size and distribution.
- Suitable habitats are intact and are managed to provide recruitment opportunities.
- Botanical diversity is enhanced.
- Late-successional forest associated plant populations are healthy and viable, and are not declining.

Botanical Special Interest Area

There are two Botanical Special Interest Areas (SIAs) within the analysis area: the White Mountain Botanical SIA and Horse Creek Botanical SIA.

Trends:
- The unique features of White Mountain Botanical SIA are related to soil and geology and those features will remain the same. It will remain the site of the southern-most population of *Saussurea americana.*
- The Horse Creek Botanical SIA is a late seral stage riparian forest, it is unknown how long this late forest stage can persist, flood or fire could set the area back to early seral condition.

Desired Condition:
- Natural vegetation features are maintained to protect the unique plant communities of interest.
- Monitoring programs document changes in vegetative structure and composition over time.
- Human uses (grazing, recreation) are managed to minimize impacts to SIAs.

Exotic Species

Several species occur in analysis area that were introduced or that have expanded their range, such as bullfrogs and opossums. Introduced (range expanding) species compete with, or prey upon, native species. They are typically able to occupy a broader range of habitat conditions and they will continue to out-compete native species.

Trends:
- Population densities for exotic/expanding species are unknown within the analysis area. Species associated with human activities will most likely remain constant, as human populations are expected to remain about the same.
- More recently introduced species, such as opossums, may increase in numbers.
- Following current trends, bullfrogs will continue to expand their range.

Desired Condition:
- Exotic species populations are controlled and do not present a threat to native species diversity.

Noxious Weeds

Within the Horse Creek Analysis Area, five noxious weeds are known to occur: Dyer's woad (Marlahan mustard), Scotch broom, Scotch thistle, squarrose knapweed, and yellow starthistle. Squarrose knapweed and Scotch thistle have a pest rating of "A" and the other three have a pest rating of "C" by the State of California.

No formal weed control strategy has been developed on the Forest. Weed treatment has been accomplished by Siskiyou County in the past. With the issuance of the recent Invasive Species Executive Order on March 2, 1999, Federal agencies are directed to address noxious weeds in all environmental documents, and to fund and implement noxious weed control strategies. The Forest is currently in the process of preparing a noxious weed strategy (A. Yost, pers. com.).

Within the Horse Creek Analysis Area, the opportunity exists to plan control or eradication of several of the existing noxious weeds. Prevention of spread of these species should also be addressed in environmental documents produced within the watersheds.

Trends:
- Noxious weeds will continue to spread in the analysis area unless control measures are utilized.

Desired Condition:

- Noxious weed populations are controlled and do not present a threat to native plant diversity.

Roads

Key Question #1 - How have road uses changed from the past and why?

The types of road uses have changed considerably from the past. Historically, road use centered around resource use and extraction such as mining and timber harvest. Early road construction followed old trail alignments and was constructed to provide access for fire suppression and mining activities. Early timber harvest in the 1930-40s utilized existing roads, but as the Forest Service offered increasing numbers of timber sales in the late 1950s, new road construction was required to provide access for equipment and log transport. Road construction increased dramatically in the late 1960s through the late 1980s to provide access for the salvage logging following several large-scale fires in the analysis area. Logging continued until the early 1990s, at which time the road use related to the timber resource declined significantly in response to reduced timber harvest levels from Threatened and Endangered species issues.

There has been a slow but steady increase in recreational use of the road system, with current recreational use probably exceeding all other uses. A variety of recreational uses such as river rafting, fishing, hunting, sightseeing, etc. occur in multiple settings and are dispersed throughout the analysis area. Uses such as firewood, and basketry materials collection, have created public expectations for relatively easy access to sites.

In the past, timber sales were used as a means to accomplish more road maintenance and upgrade maintenance levels, supplementing road maintenance dollars. This allowed the Forest's road maintenance dollars to go further, creating a higher level of roads than the Forest could maintain.

Historically some of this Forest's road construction and/or maintenance were tied to timber sales. As a result, an extensive road system was developed to access timber resources. Timber sales prior to the 1990s maintained a good percentage of the Forest's mainline roads, thus forest maintenance funds could be spent on many of the other mainline roads, secondary and lower standard roads. Since the significant decline in timber harvest volumes in the 1990s, the Forest had to concentrate more on the mainline roads, thus secondary and low standard roads get very little maintenance.

Although the overall road budget has remained about the same since 1987 (prior to fire salvage from the 1987 fires), accounting for annual inflation, using Gross Domestic Product Price Deflators, annual road maintenance dollars have declined by as much as 31% since 1987. In 2000 the roads budget rebounded but was still 8% short of the budget needed to obtain 1987 maintenance levels, see **Table 5-19** *Road Maintenance Budget Levels 1987-2000.*

Table 5-19. Road Maintenance Budget Levels 1987-2000

Fiscal Year	Forest Maint. Budget	Road Miles Maint.	Ave. Cost/ Mile	Miles Maint. with Timber Sales	Timber Volume Hauled (mbf)	Budget Needed to Remain Level w/ 1987
1987	$1,200,000	1156	$1,038	785	238,000	-------
1995	$949,000	1165	$815	200	26,000	$1,520,100.
1997	$1,110,000	1061	$1,046	184	55,600	$1,612,700.
1999	$1,140,000	1132	$1,007	76	33,200	$1,710,900.
2000	$1,608,000	1759	$914	30	33,881	$1,762,800.

Several administrative road uses have probably stayed about the same, including fire suppression and law enforcement, while other uses such as silvicultural work have probably declined. Seasonal road closures have increased in the last ten years due to providing increased resource protection such as minimizing erosion in winter months, and reducing wildlife poaching and harassment.

Key Question #2 - What resource and social concerns exist with the current road system?

Resource and social concerns include more immediate needs and longer-term concerns. The January 1997 flooding and the heavy rainfall during the winter 1998 impacted the existing road system. Flood damage to the road system occurred across the analysis area. For further analysis discussion on hydrologic factors and roads, see *Hillslope Processes* in **Chapter 5**.

The Forest Service has repaired all but one site in the analysis area. Rather than repair this site on the Riley Road (47N05Y), the Forest Service is pursuing an easement from Fruit Growers Supply Company over an existing road for alternate access into the same area of National Forest System lands.

Long-term resource concerns (not flood related) generally involve stream sedimentation from small fill slope failures, cut bank raveling, and road surface erosion. Another resource concern involves road densities and their effect on wildlife habitat fragmentation. Stream crossings have the potential to fail, thus delivering sediment to aquatic habitats. Refer to the *Hillslope Processes* and *Terrestrial Wildlife and Plant Habitats* sections for additional discussion on road related concerns.

Social concerns about roads have been expressed at both the local and National levels. At a recent public meeting for the ecosystem analysis, the main concern expressed by local residents was the issue of road access and road closure. Present road closures and seasons of use will remain the same. Any changes in access will be analyzed and address at the project level, not in this document.

Other issues were the importance of keeping emergency access open into and out of the area by alternative routes from Seiad to Horse Creek via White Cloud and then Rainey Saddle. This access was opened during the 1997 floods and will be open in the future should it need be in an emergency situation. Another concern the public expressed was the repair work needed on the Seiad Low Gap Road (46N50). At this time the section of road that needs repair is under county jurisdiction, the county is responsible for repair and maintenance.

Vegetation encroachment along the roadway on cut banks and ditches is a continuing safety concern. This vegetation restricts safe sight distances at road intersections or along road curves and requires periodic trimming.

Other social concerns include providing long-term access for recreational activities, mining, special forest product collection (e.g., mushrooms, basketry), firewood, fire suppression, administrative use, and maintaining a transportation system to support timber harvest activities.

In January 2001 President Clinton signed the roads policy into law. This law requires the Forest Service complete a Transportation Analysis prior to construction or reconstruction of Forest Service roads. This law is effective on July 12, 2001.

President Bush placed a 60 day moratorium on the Roadless Policy. After expiring, Congress placed a 60 day moratorium on the Roadless Policy. It is still in effect as of this writing.

The majority of the existing road system was primarily constructed to provide access for logging operations. The change in *Forest Plan* land allocations has created management goals/ objectives where logging is either not allowed or is not the primary land use. Portions of the current road system (maintenance levels, density, miles, etc.) are not consistent with these land allocations and have been reviewed in this process. Refer to **Appendix E** *Road Analysis Process*, which documents the process used to develop road improvement, maintenance, and decommissioning opportunities. These opportunities are preliminary and will require further site specific environmental analysis before a decision is made.

Key Question #3 - What are future trends in road uses, needs, and management?

Trends

- A variety of recreational activities (hunting, sight-seeing, etc.) will slowly increase in use, thereby placing greater demands on the road system.
- Timber harvest will continue on Matrix lands in the analysis area, placing higher and limited demands on the existing road system during harvest activity.
- There will probably be a limited amount of new road construction of National Forest system roads, primarily to support timber harvest.
- Local opposition to road closure will continue and perhaps even intensify.
- There will be an ongoing need to retain emergency alternative access routes in and out of the analysis area.
- There is increased National emphasis on improving water quality and watershed restoration through road management and stabilization.
- Without routine road maintenance, roads will continue to deteriorate.

Desired Condition

- A road system that meets rural access, community/public needs, resource protection, and administrative needs**.**
- Roads are designed, constructed, or improved to minimize resource effects and meet Aquatic Conservation Strategy Objectives.
- Use Roads Analysis Process and more site-specific information to manage the road system.

Key Question #4 - What is the recommended travel and access network?

As part of this ecosystem analysis, an *Roads Analysis Process* (RAP) has been developed to make preliminary recommendations for road maintenance, improvement, and decommissioning. These recommendations are preliminary in nature, and will not be finalized until site-specific environmental analysis, conforming to the implementing regulations for the National Environmental Policy Act (NEPA), has been completed. The RAP considers potential resource costs and the need for access for each road in the analysis area. Both of these factors are considered, and then a recommendation is made based on the type and severity of the resource impact or access need or use. Recommendations include (but are not limited to): mitigate resource concerns, improve the level of maintenance, vary the season of use, or close the road.

One of the two primary considerations of the roads assessment is to determine the human access needs of the road system. A myriad of uses of the road system occurs: recreational activities - hunting, fishing, rafting, sight-seeing, wildlife viewing; private land access; administrative access; fire suppression; timber harvest; silvicultural access for stand treatment; firewood cutting; Christmas tree/bough collection; post/poles cutting; mushroom collection; mining and other uses.

To determine the human need for access in the roads assessment, all of the uses were "boiled down" into five categories: 1) Recreation, 2) Timber/Silviculture, 3) Public Access, and 4) Fire Access (discussed in the Terrestrial section). Definitions of the access need as high, medium, or low were then developed and are listed below in **Table 5-20** *Human Access Need - Definitions For Rating Roads In Road Analysis Process*. The definitions were then applied to each road segment, and are displayed in **Appendix E** *Road Analysis Process*.

Table 5-20. Human Access Need - Definitions For Rating Roads In Road Analysis Process

Recreation	
High	primary access to recreational facilities/sites identified on the 1997 Forest Visitors map. It includes campgrounds, trailheads, etc.,; or high use (i.e. hunting) general forest areas.
Medium	primary access to known dispersed camping sites, mountain bike routes, woodcutting areas, or trailheads not listed on the Forest Visitors Map
Low	any open or closed road not included above
Timber/Silviculture	
High	primary access to Matrix lands and/or multiple plantations, or areas with potential future expansion for timber sales
Medium	secondary access to Matrix lands and/or multiple plantations, or providing access to a small area of matrix
Low	all other roads not included above
Other Public Access includes mining, firewood cutting, access to private land and/or uses (e.g. water sources)	
High	known location with high use
Medium	secondary access, limited quantity or quality
Low	little or no use, no known resource value present, or a Level 1 road

Human Uses

Key Question #1 - How have recreation uses changed from the past and what are their trends?

Over the last five to ten years, general recreational use has remained about the same. There have been no significant changes to the road and trail system nor have there been any changes or improvements to the recreational facilities. Boating in the Klamath River, that is rafting, driftboating and kayaking has remained about the same due to dam controlled water flows, although fishing related activities fluctuate with salmon and steelhead runs. The major change is the introduction of elk has resulted in elk hunting and viewing as an important activity within this area.

TRENDS

--Recreational fishing will likely decline with increased regulations and listing of fish. This will have a negative effect on the local economy.

--Use patterns have changed somewhat from an exclusively locally dominated use to now include a Regional and National market. This is based on life-

styles oriented to the outdoors, ability to travel further, and National designations such as Pacific Crest Trail, and Wild & Scenic Rivers, which draw visitors from out of the area.

--Driving for pleasure, hiking, and camping have increased from past levels as a result of corresponding population increases. Their use is expected to increase.

--River rafting and kayaking use has stayed about the same.

--Hunting has always been a very popular use in the analysis area. Hunting use is expected to maintain at current levels or fluctuate slightly based on hunting regulations, herd size, and habitat conditions.

--The overall visual condition has and will continue to improve as vegetation recovers. Any decline in the visual condition will occur at a reduced rate than in the recent past because current management activities are smaller in scope and number than in past decades.

Key Question # 1a - What are the desired conditions for the recreation program?

Developed Recreation - Maintain the existing developed sites to meet the expectations of the current recreationists.

Reconstruct or improve these sites where needed to better meet safety, sanitation and setting requirements.

Remove barriers to reasonably allow access by the general public. Utilize the Forest Accessibility Action Plan (copy available in Supervisors Office).

Dispersed Recreation -

RIVER - Manage the Wild And Scenic river corridor to maintain its scenic quality. Provide reasonable public access to the different river segments to accommodate the current recreational uses. Maintain the existing river accesses to meet health and safety requirements and the needs of the current users.

GENERAL - Maintain reasonable road and trail access to accommodate current recreational uses outside the wilderness. Manage the scenery respective of the amount and kind of recreationist viewing.

Increase recreation opportunities, such as hiking, fishing, driving for pleasure, etc., to meet public need/demand while providing an economic benefit to the local communities.

Where possible, provide recreationists with a semi-primitive, non-motorized recreation opportunity. Maintain existing trailheads and trails to meet the needs of the current users. In some cases where the trail is substandard, it may need to be reconstructed.

Visual Quality Objectives (VQO) from the *Forest Plan* provides desired visual conditions for the watershed as well as potential rehabilitation opportunities. During project development, proposed management activities are assessed as to whether or not they meet the objective identified for the area in which the project is located. See **Table 5-21** *Visual Quality Objectives for the Analysis Area*, which lists the VQOs found within the watershed; also see **Figure 5-2** *Visual Quality Objectives*, contained in the Map Packet located at the end of this document.

Table 5-21 Visual Quality Objectives (VQO) for the Analysis Area

VQO	Acreage	Percent
Preservation	0	0
Retention	5,600	15
Partial Retention	26,600	70
Modification	3,800	10
Maximum Modification	1,800	5
TOTAL	**37,800 1/**	**100**

1/ Includes VQO acres for NF lands only.

Past management activities have created visual impacts (Existing Visual Conditions), which sometime currently exceed the desired visual conditions (Visual Quality Objectives) identified in the *Forest Plan*. An overlay of EVC and VQOs readily identifies discrepancies and will be used in Chapter 6 to identify visual improvement opportunities. These opportunities are general in nature and need additional site specific review. They should be looked at on case-by-case basis when feasible to implement concurrently with other opportunities.

Key Question #2 - How does private land affect National Forest management?

The checkerboard layout or arrangement of private land in the watershed can affect National Forest management. The straight property lines, which do not typically follow topographic features, create unnatural boundaries for fuels treatment and other projects.

Private land uses can affect National Forest management in various ways. Increased logging slash on private lands may increase the government's cost to treat logging slash or implement prescribed underburns on National Forest lands. Access to National Forest lands may be restricted or even denied if the only access is directly through private lands. Cooperator (COOP) roads, private easements and rights-of-way may be necessary to allow the public access.

Private land harvesting has affected the Forest Service's ability to harvest on Public lands. Watershed modeling has exceeded threshold limits, thereby restricting harvest on National Forest lands.

Key Question #3 - How has community interest/involvement changed from the past and what is likely to change in the future?

The local community (Horse Creek) has always had an interest in Forest management activities. This interest has increased since the late 1980s to early 1990s. National concerns over the environment have brought about changes in the use patterns of the landbase in the form of constraints and additional restrictions on its use. This has served to heighten awareness and increase sensitivity to the issues affecting the landbase that surrounds them. Local communities want to be more involved in land management decisions.

The area's primary economic dependence on Forest lands and waters from mining, logging activities, and the steelhead fishing industry has shifted to other tourist related activities (rafting, hiking, hunting) with the decline in timber harvest levels and fish populations. This shift has reduced economic opportunities for local communities.

TRENDS

--The desire by the community to be involved in land management decisions will continue to rise.

--There will be an increased community interest in water quality and domestic uses.

--The general population and amount of private land in the analysis area is expected to remain the same.

DESIRED CONDITIONS

--Diversify economic opportunities to compliment natural resource objectives.

--Maintain high quality water for domestic use.

--Develop firewood opportunities.

--Forest Service works closely with local communities through partnerships, collaboration, cooperative efforts, etc.

OPPORTUNITIES

Members of the Public identified opportunities at a public meeting held on February 27, 2001. Their comments have been summarized in **Table 5-22** below.

Table 5- 22. Summary of Road Opportunities Identified - Horse Creek Watershed Analysis Public Meeting 2/27/01.

Opportunities Identified:	Number of similar comments:
Grazing to reduce brush (fuels?)	1
Utilize fire crews w/ FS chipper to reduce slash on pvt lands	1
Timber harvest	2
Improve road signing	1
Road restoration/improvement	8
Fuels reduction projects	7
Fire line construction	1
Close little used spur roads	2
Sanitation/salvage projects	4
Pond development/habitat and meadow enhancement	4
Watershed restoration	2
Firewood/hardwood cutting areas	3
Improved dust abatement	1
Open gates during hunting season	2
Repair road at mile post 6 on 46N50	2
Coop Effort (FS, CDF & G, landowners) on stream diversion	1
Do not allow motorized vehicles on blocked off, closed by gates, or decommissioned roads	1
Remove mt lions	1

Collins Creek – County road culverts may be fish passage problem	1

Key Question #4 - How have commodity uses changed from the past and what are their trends?

The exploration and mining for gold had a significant influence on this area. The primary areas impacted were the mainstem Klamath and its major tributaries, such as Horse Creek, where large-scale operations were in production from the late 1800's to the mid 1900's.

These operations brought settlement and development to the area. Today, mining operations have greatly reduced in scope and scale on the National Forest Lands, primarily because smaller ore bodies, the cost of extraction has increased, the relative price has decreased and changes in state and federal laws and regulations have increased in complexity.

Commodity uses in the past were heavy to timber harvest and mineral extraction and the use of forage for beef production. Timber harvest has reduced in intensity on public lands as land management plans have de-emphasized timber harvest as a primary commodity output. A trend in timber production will be the continued low output of timber from National Forest lands, focusing on forest health.

Grazing: Livestock grazing was much more extensive within the watershed in the past than it is today. Domestic livestock were brought to California over 150 years ago. Miners and homesteaders raised livestock to supply food for local residents. As the Klamath River area was settled and ranches were established, cattle and sheep as well as horses, mules, goats, and swine were moved into the adjacent mountains to forage. It is estimated that almost several thousand animals were allowed to graze unregulated within the watershed and along the Sisikyou Crest compared to approximately 300 cows and calves currently permitted. Establishment of Forest Reserves and the creation of the National Forest in 1905 brought about the first regulated use of these lands.

Livestock management objectives have shifted from an emphasis nationally on red meat production to utilizing grazing animals as a tool to meet desired ecological conditions on rangelands. Numbers and season of use have been reduced significantly since the turn of the century when livestock grazing was largely unregulated. Animals were released from ranches in Horse Creek and along the Klamath River and they worked their way from the spring foothill range and into the high meadows following the snow melt and coming back to lower elevations after the first storms of the season in the late fall. Assigned areas (grazing allotments) were established and numbers and season of use controlled when the Forest Service began to manage the Forest Reserves in the early 1900's. Numbers were further reduced in the 1940's and 1950's when vegetation and soil condition studies showed evidence of over-use and resource degradation. Ecological trends have shown steady improvement with improved livestock management practices over the last 30 years. Current studies indicate that ecological condition and trend in forage areas meet desired conditions and current numbers and season of use are appropriate (refer to Horse Creek/Dry Lake Watershed Analyses, 1996 for issuance of livestock grazing permits on these allotments for more detailed information).

Timber: At the Forest scale, attaining the timber program outputs has become increasingly difficult since 1997. Numerous changes in management direction and fiscal allocation to the Forest have cumulatively contributed to this difficulty. A number of factors have been introduced or gained clarity in the seven years of implementation since the Forest Plan was adopted in 1995. Those factors include:

- Areas With Watershed Concerns (Impaired Watersheds)
- Other Discretionary Areas
- 100-Acre Late-Successional Reserves

During this analysis, the current Matrix landbase was analyzed to identify lands that could realistically provide timber outputs in the next ten years. **Table 5-23** provides a summary of the landbase realistically available for timber outputs. A significant reduction of *Forest Plan* identified Matrix lands from 13,630 acres to 3,215 acres is expected to be available in the short-term. It should be pointed out that 13,630 are still designated in the *Forest Plan* until such time as a planning amendment formally changes the lands available. The 3,215 acres identified in the analysis are only to be used for timber planning purposes for the next decade.

Table 5-23 *Forest Plan* and Ecosystem Analysis Comparison of Lands Available for Scheduled Timber Harvest (Matrix)		
Land Allocation or Consideration	**Updated Acreage for Short-Term Timber Program**	***Forest Plan* Acreage**
Initial Land Base (NF lands only - excludes private lands)	+37,810	+37,810
Administratively-Withdrawn (Special Management, LSRs - except 100 acre LSRs & Riparian Reserves)	-20,270	-20,270
100 Acre Late-Successional Reserves (LSRs)	-600	n/a
Riparian Reserves (mapped)	-4,570	-3,890
Lands Available for Timber Harvest **1/**	**12,370**	**13,630**
Impaired Watersheds**2/**	-7,820	-11,510
Non-Commercial Species Lands **3/**	1,335	0
TOTAL	**3,215**	**2,120**

1/ Lands available for timber harvest include Retention, Partial Retention, Recreational River, and General Forest land allocations, collectively referred to as Matrix lands.
2/ Also called Areas With Watershed Concerns, acres listed for Matrix lands only.
3/ These acres are lands (outside of impaired watershed and include areas mapped as water, barrens, meadows, and hardwood-dominated stands.

As shown in **Table 5-23**, several factors were highlighted during this analysis that reduced the Matrix land capability to produce timber outputs during the ten-year period. These acres are still considered Matrix land allocation, but current issues and constraints make it difficult to predict timber availability with any certainty. Listed below are the constraining factors and a discussion of how the *Forest Plan* considered them and how they were applied in this analysis for a short-term timber program (next ten years).

100-Acre Late-Successional Reserves (LSRs)
These were not identified in the *1995 Forest Plan*. Since that time, six spotted owl activity centers totaling approximately 600 acres were identified in the watershed, on Matrix Lands. Each has been designated 100-acre late-successional reserve, and as such they are permanently unavailable for scheduled timber harvest.

Riparian Reserves
These reserves have been refined since the *Forest Plan* acres that were originally mapped. The revised reserve acres increased by 680 acres (from 3,890 to 4,570 acres), which are unavailable for scheduled timber harvest, were removed from previously identified matrix lands. For a more detailed description of the Riparian Reserve revisions made during the ecosystem analysis process, refer to the "*Riparian and Stream Areas*" section **Chapter 5**. Further refinement of riparian reserves will continue to occur at the project scale as projects are proposed.

Impaired Watersheds
The *Forest Plan* identified 11,510 acres of Areas With Watershed Concerns in Matrix lands. Management activities in impaired watersheds must be neutral or contribute to recovery. This ecosystem analysis reassessed these areas and determined that 7,820 acres (in Matrix) are considered "Impaired Watersheds" (formerly called Areas with Watershed Concerns). (See "*Hillslope Processes*" - **Chapter 5**.) Therefore these acres were considered to be limiting in the near future, unless specific management actions are neutral or contribute to watershed recovery. Future analysis determines when a watershed is no longer impaired.

Non-Commercial Species Lands
These areas include lands identified as grass, brush, non-commercial species in the vegetation data layer. Occupying 1,335 acres of matrix lands, these acres were considered to be limiting in the future.

See **Figure 5-3,** which displays *Short-Term Timber Program Analysis*, contained in the Map Packet located at the end of this document for locations of matrix lands, where timber outputs may be considered.

15% Old Growth Retention: The *Forest Plan* requires that a minimum of 15% old-growth be retained in all 5th field watersheds (includes **all** land allocations). The Horse Creek analysis area makes up portions of two 5th field watersheds – McKinney/Horse and Humbug/Lumgrey. The Horse Creek 5th field watershed makes up 31,270 acres (National Forest lands only) of the analysis area; also includes a portion of the Haystack 5th field watershed (Doggett & Kohl Creeks). See **Table 5-24** below.

Table 5-24 Percent Old Growth in Fifth Field Watersheds			
Watershed	**Total Capable* Acres**	**Late Successional Acres**	**% Late Successional**
McKinney/ Horse	41,810	10,890	26%
Humbug/ Lumgrey	20,150	1,470	7.3%
*** =** Lands capable of growing 20 cubic feet of commercial wood products per acre per year Source: Rick Svilich, personal communication, 5/30/2001.			

There are 10,890 acres or 26% old-growth in the McKinney/Horse watershed, thus exceeding the **minimum** retention of 15% old-growth in a 5th field watershed standard (per *Forest Plan*).

On the other hand, the Humbug/Lumgrey watershed is deficit with 7% old-growth. Within these areas, all remaining late-successional stands should be protected. Protection of these stands could be modified in the future, when other portions of the watershed have recovered to the point where they could replace the ecological roles of these stands.

TRENDS

The high public sensitivity to timber harvest in released roadless areas will probably continue making these lands in essence unavailable for harvest.

--The threat to plantations from large, stand-replacing wildfires is great.

--Survey and Manage species, cultural concerns, wildlife issues, released roadless, and unstable lands will continue to strongly influence timber project scheduling, location, and design.

--Mining activities will continue to fluctuate with market conditions and mining regulations.

--Demand for other wood products (boughs, posts, poles, etc.) will fluctuate with market and local economic conditions and may increase slightly.

--Commercial popularity of mushroom picking will fluctuate with market conditions.

Key Questions #4a - What are the desired conditions for commodities?

--Meet public demands for commodities commensurate with resource objectives.

--Provide an even flow of timber products consistent with the Land Management Plan to help support local communities and meet National needs.

--Wildfire threats are minimized to commodity resources.

--The analysis area should be managed toward the desired mix of seral stages. **Table 5-25** *Existing and Desired Seral Stage* lists the existing and desired mix of seral stages for the Matrix land allocations (i.e. Retention, Recreational River, Partial Retention, and General Forest).

Table 5-25 Existing and Desired Seral Stage Percentages for Available Lands for Horse Creek Watershed		
Size Class	**Existing Seral Stages (%) 1/**	**Desired Seral Stages (%) 2/**
Shrub/Forb	360	5-25
Pole	2,890	10-15
Early/ Mid-Mature	4,280	35-60
Late-Mature/Old-Growth	1,090	15-45
1/ Source – *Forest Plan* layer data sort **2/** Rick Svilich, personal communication, 2001.		

OPPORTUNITIES

Using the 3,215 acres identified earlier (see **Table 3-24)**, the analysis area is estimated to produce 3,357 millon board feet/decade on 519 acres/decade in the short term. See **Appendix F** for the calculations used to estimate these timber outputs.

There are approximately 360 acres of plantations between less than 30 years of age that should be assessed for possible precommercial thinning with appropriated dollars. Plantations should be considered for thinning if they can be accomplished for no more than $275/ac.

Regeneration harvesting should occur in older decadent late-seral stands, stands that are currently

under stocked, and mid successional stands that have culminated. Late seral stands are currently lacking in this analysis area. Size class 4 stands should not be regenerated unless they are completely falling apart. Explore M3G stands for potential regeneration harvest, especially the stands over 130 years of age. If regeneration is not an option due to the good health of the stands, additional commercial thinning should be done in the watershed in order to develop additional late-seral stands. Treatment of younger plantations should be emphasized in order to reduce the percent of acreage in the shrub/pole size class. The Blue Heron, Collins/Lime, Kohl/Dona, and Quigleys 7th field watersheds should be prioritized for harvesting. Field verification will be necessary to determine stand conditions and actual seral conditions remaining in available ground.

In general, stocking control is needed in most of the watershed at the lower to mid elevations. Much of the true fir stands, in addition to be heavily overstocked, have had decades of mistletoe infection and cytospora abietas. Many of these stands are now literally falling apart with dead and broken tops, very poor live crown ratios and over 50% mortality in pockets throughout the zone. Most of the dead trees have fallen or blown over. The Collins Creek drainage on the south side of the river experienced high mortality in the mid 1990's with no salvage harvesting taking place. Much of this dead conifer component is now beginning to fall, significantly increasing ground fuels throughout the drainage.

Key Question #5 - What are the contemporary American Indian uses and trends and how have they changed?

Contemporary American Indian uses of the analysis area are not well known. However use is generally associated with road access, and include hunting, fishing, and woodcutting, collection of special forest products (i.e. ichnish).

Specific conflicts with proposed land management activities will need to be addressed on a case-by-case basis, thru the environmental analysis process. Close coordination with American Indians of proposed management activities on National Forest lands has increased over past levels.

TRENDS

--Interaction will continue between the Forest Service and the Quartz Valley Reservation, the Shasta Nation, the Karuk Tribe, and the Yurok Tribe.

--Traditional uses may conflict with other forest uses as more demands are placed on Federal lands.

Key Question #5a - What are the desired conditions for the cultural resources program?

--Cultural and natural resources are identified and managed to benefit American Indian members where possible.

--To maintain a dialog with the Quartz Valley Reservation, the Shasta Nation, the Karuk Tribe of California, and the Yurok Tribe.

--To strive towards agreements and partnerships on issues such as water quality and fisheries.

Key Question #6 - What the expected special uses in the watershed?

The current Special Use Permits will probably be renewed for the foreseeable future. The number of new permits is difficult to estimate because they are issued based on approval of applications submitted by the public and these are received on an occasional basis.