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Lower Lewis River Watershed Analysis

Gifford Pinchot National Forest

Lower Lewis River Watershed Analysis

Mount St. Helens National Volcanic Monument
Gifford Pinchot National Forest
Pacific Northwest Region
USDA, Forest Service

July, 1996

EXECUTIVE SUMMARY

The 166,145-acre Lower Lewis River Watershed is comprised of National Forest (87,557 acres) and State and private (78,588 acres) ownership. The area has been divided into 37 sub-basins for analysis by an interdisciplinary team.

In this first iteration of analysis, the following ten issues are analyzed: Mass Wasting; Surface Erosion from Roads; Fire History; Vegetation; Riparian Reserve Habitats and Fragmentation; TES Plants and C-3 Species; Habitat Condition for TES Animal Species; Hydrologic Changes; Water Quality and Key Habitat Attributes for Salmonids; and Demand for Recreational Opportunities.

Characterization

The Lewis River is dammed at three successive locations forming the impoundments known as Lake Merwin, Yale Lake, and Swift Reservoir; part of Yale and all of Swift are within the watershed that was analyzed.

The Lower Lewis is two distinctly different areas geologically. The area north of Swift Reservoir and Yale Lake is composed of intermixed volcanic flows less than 40,000 years of age and is highly susceptible to surface erosion. South of the reservoirs, one finds much older, weathered volcaniclastic materials with very steep slopes, which are prone to deep-seated landslides and debris flow features. Elevations range from 483 feet at Yale Lake to 8,298 feet at the summit of Mount St. Helens. Drained by the main stem of the Lewis River, Siouxon Creek, Canyon Creek, and their tributaries, the watershed is vegetated by coniferous forest plant associations which provide habitat for 253 wildlife species.

A pattern of large, although low-frequency, high-intensity, stand-replacement fires have occurred through time. Since 1930, very little of the watershed has burned from wildfire.

Current Conditions

Unstable and potentially unstable lands are mapped both north and south of the Lewis River. Surface erosion from sensitive tephra deposits have contributed large amounts of sediment to streams particularly north of the Lewis River. Erosion rates have been especially high since the 1980 eruption of Mount St. Helens, with road construction playing a significant role as well.

During February, 1996 much of the Pacific Northwest experienced an unusually heavy storm in which relatively large amounts of warm rain fell on a significant snowpack. The resulting runoff caused severe damage at various elevations ranging from flooding in lowlands to landslides, road washouts, debris torrents, and stream channel scouring and widening in the uplands. Mass wasting and erosion moved large amounts of sediment in short periods of time. While this storm event is recognized, mapping of the affected areas in the Lower Lewis River Watershed has not skiing, and motorized use activities in the same areas.

Reference Conditions

Reference conditions explain how the existing conditions have changed over time as a result of human influence and natural disturbances. They describe the known or inferred history of the landscape. From this, we may understand what was sustainable in the past and what changes have occurred to affect sustainability.

Volcanic processes and glaciers have created a landscape naturally prone to movement through mass wasting and surface erosion. Soil movement has been accelerated by roading and to a lesser degree by timber harvest.

Past vegetation patterns were shaped predominately by volcanic eruption and large, stand-replacement fires, changing thousands of acres at a time. Over the past 50 years timber harvest and related activities have altered stand structure, composition and distribution across the landscape by creating numerous small openings containing little if any standing multi-layered old trees and down woody material. Accordingly, plant and animal habitats have changed.

The distribution of fish within the watershed has been sharply altered by construction of roads and the three dams on the main stem of the Lewis River.

The extent and magnitude of human uses in the watershed has grown exponentially from the mid-1800's until present time, intensified by population growth and technological advancements accompanying the industrial era.

Interpretation

Eight dominant processes affecting the watershed's ecosystem are identified: volcanic and seismic activity, erosion, fire, damming, roading, flooding, timber management, and recreation activities.

For each of the ten issues, current and reference conditions are compared by explaining significant differences, similarities, or trends and their causes. The comparisons, explanations, and discussions are presented in a similar series of tables and paragraphs that enable the reader to follow the logic of the analysis.

Information from earlier stages of the analysis is synthesized in order to further understand and discover interrelationships between elements of the ecosystem. The synthesis was conducted in three dimensions of the ecosystem: aquatic, terrestrial, and social/economic. Each is presented in an explanation, a table and a map.

Finally a table was compiled showing the different factors of ecological concern(columns) for each sub-basin (rows) in comparative format.

TABLE OF CONTENTS

LIST OF FIGURES

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INTRODUCTION

Management direction for the National Forest lands comprising the Lower Lewis River watershed (Figure 1, Vicinity Map) is set forth in the Gifford Pinchot National Forest Land and Resource Management Plan, 1990 as amended (through amendment 11 Update No. 2, June 26, 1995), hereafter referred to as the 1990 GPNF Forest Plan (Figure 2, Land Allocations). On April 13, 1994, the 1990 GPNF Forest Plan was amended by the Secretary of Agriculture as documented in the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl, hereafter referred to as the ROD. This Record of Decision is the culmination of a public land management effort initiated by President Clinton in April, 1993, and along with the accompanying Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl is frequently called the Northwest Forest Plan. The Northwest Forest Plan (NFP) provides extensive management direction, including land allocations, see Figure 3 Northwest Forest Plan Allocations, that comprise a comprehensive ecosystem management strategy. A major part of this strategy is the Aquatic Conservation Strategy (NFP, page B-9) which has four components (NFP, Page B-12)

- Riparian Reserves
- Key Watersheds
- Watershed Analysis, and
- Watershed Restoration

The Lower Lewis River Watershed was selected for analysis at this time because:

1. most of the area is a Key Watershed (ROD, page B-18).
2. it is known to contain high priority watershed restoration needs.
3. a watershed-scale analysis is needed to support proposed timber sales, timber stand improvement, and recreation-related development work.

During February, 1996 much of the Pacific Northwest experienced an unusually heavy storm in which relatively large amounts of warm rain fell on a significant snowpack. The resulting runoff caused severe damage at various elevations ranging from flooding in lowlands to landslides, road washouts, debris torrents, and stream channel scouring and widening in the uplands. Mass wasting and erosion moved large amounts of sediment in short periods of time. While this storm event is recognized, mapping of the affected areas in the Lower Lewis River Watershed has not yet been accomplished. Therefore, the ID team was not able to account for most of these newly-damaged areas in this analysis.

The **purpose** of this watershed analysis is to: 1) develop and document an understanding of the ecological structures, functions, processes and interactions occurring within the Lower Lewis

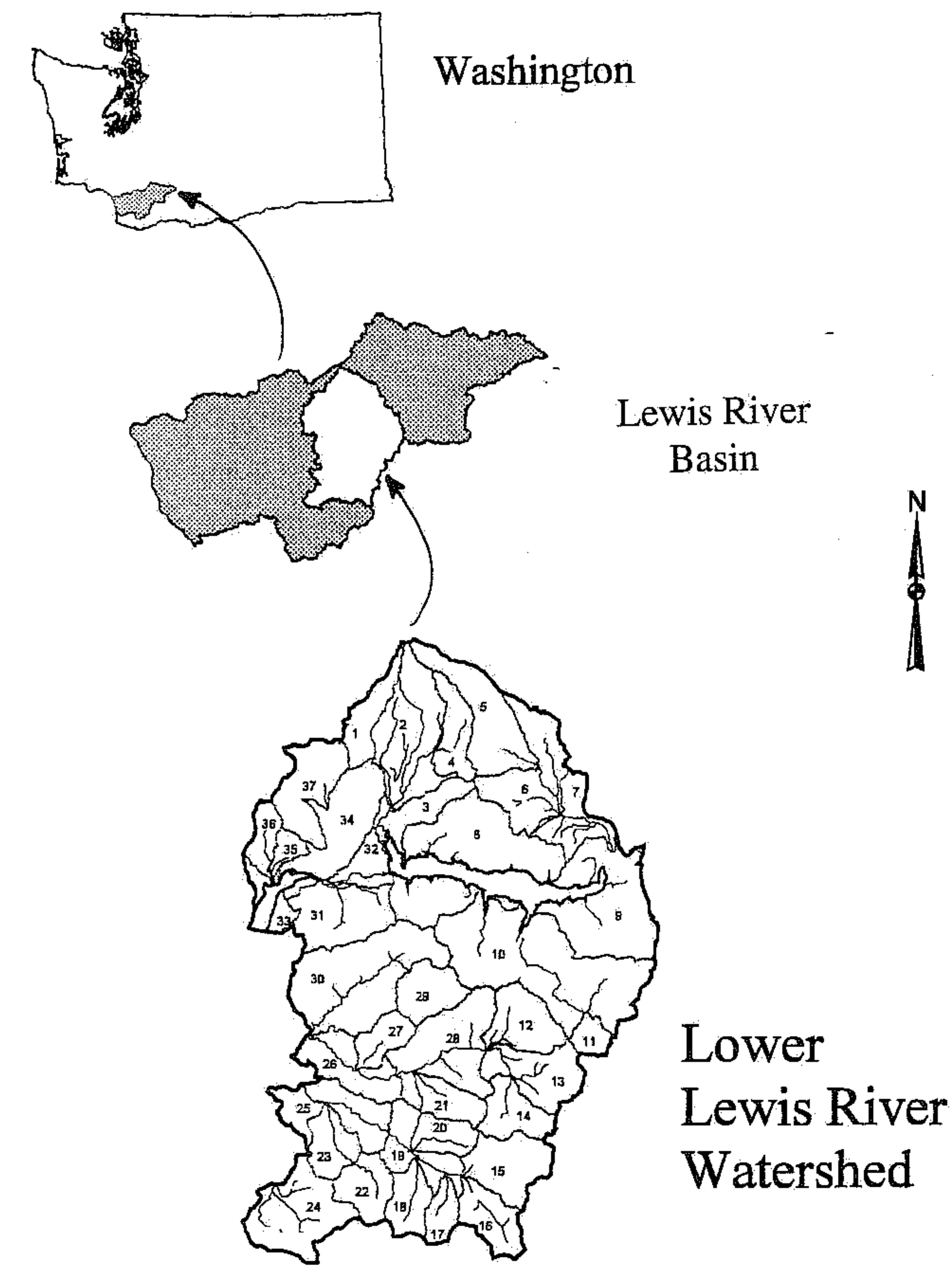


Figure 1. Vicinity Map. The Lower Lewis River Watershed is a part of the larger Lewis River Basin which is located in the southwest corner of Washington state.

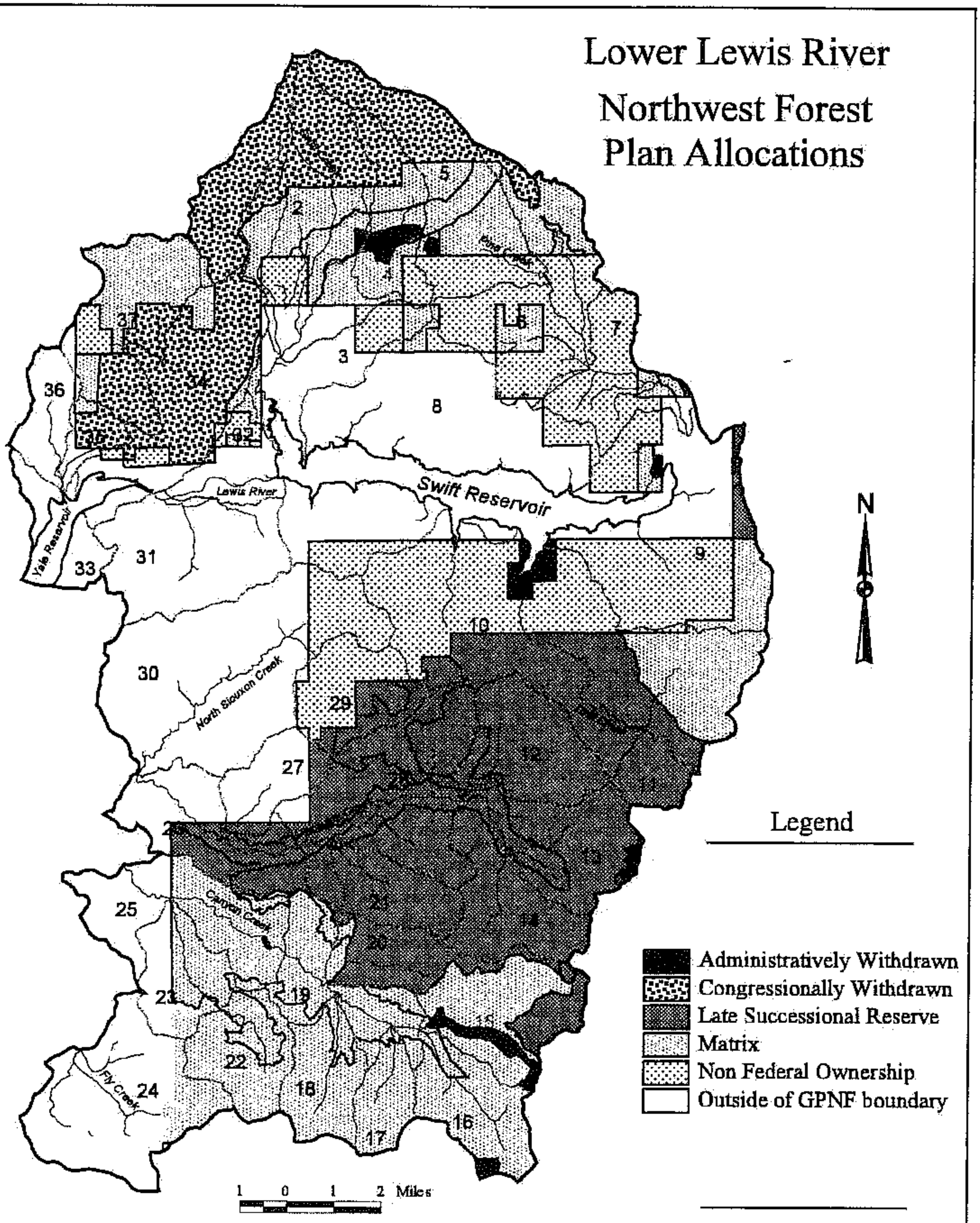


Figure 3. Under the Northwest Forest plan, all federally administered lands within the range of the northern spotted owl are assigned to specific land allocations.

Chapter V - **Interpretation** - compares the existing historical, and reference conditions of specific ecosystem elements by explaining significant differences, similarities, or trends and their causes. The capability of the system to achieve key management objectives is also explored.

Chapter VI - **Recommendations** - identifies those management activities that could move the system toward reference conditions or management objectives, as appropriate.

Material is presented in the same general order in each chapter to follow a logical and parallel pattern as follows:

1. Geology and physical processes,
2. Fire History
3. Vegetation
4. Riparian Reserve Habitats
5. TES Plants and C-3 species
6. Habitats for TES animal species
7. Hydrology
8. Water quality and key habitat attributes for salmonids
9. Demand for Recreational Opportunities

CHAPTER I CHARACTERIZATION

A large portion of the Pacific Northwest lies within the Columbia River basin, which can in turn be divided along watershed boundaries into smaller component river basins such as the Lewis River basin. The Lower Lewis River is a relatively small watershed that occupies a portion of the Lewis River basin. See Figure 1, Vicinity Map in the Introduction.

The Lower Lewis River Watershed Analysis Area (hereafter referred to as the Lower Lewis) encompasses an area of National Forest and other ownership lands within the Lewis River watershed and some of its tributaries. The Lower Lewis includes lands drained by Panamaker Creek, Cougar Creek, Swift Creek, Marble Creek, Pine Creek, Drift Creek, North Siouxon Creek, Siouxon Creek, Canyon Creek, and several other smaller, named and unnamed, interspersed drainages.

The analysis area is divided into 37 sub-basins (Figure 4, Sub-Basins Map).

The Lower Lewis covers 166,145 acres (87,557 of National Forest and 78,588 of State of Washington and private ownership), and ranges in elevation from 483 feet at Yale Lake to 8,298 feet at the summit of Mount St. Helens. All of the land, water, plants, animals, and people within this area make up the Lower Lewis ecosystem.

Geology, Soils, Erosion Processes

The Lower Lewis is best characterized geologically into two distinctly different areas, (1) a north area lying north of the Lewis River (Yale Lake and Swift Reservoir), and a south area comprising the land south of the Lewis River.

The north area is composed of volcanic flows originating from Mount St. Helens, basaltic/andesitic flows and lahars (mudflows) intermixed with pyroclastic flows, all less than 40,000 years of age. The south area is comprised of much older volcaniclastic material.

The north region is more susceptible to surface erosional processes with soils composed mostly of ash and pumice. The southern area, on the other hand, is more susceptible to mass wasting processes, with deep-seated landslide and debris flow features, due to steeper ground and older weathered pyroclastic materials.

The 1980 Mount St. Helens eruption clearly demonstrated volcanism is the dominant landscape forming process in the Lower Lewis, particularly in the north area . Glacial activity has played an important but secondary role in shaping the countryside. Ongoing erosion processes from water and wind continue to erode the landscape, causing major impacts since the 1980 eruption removed or killed vegetation allowing these erosional processes to accelerate.

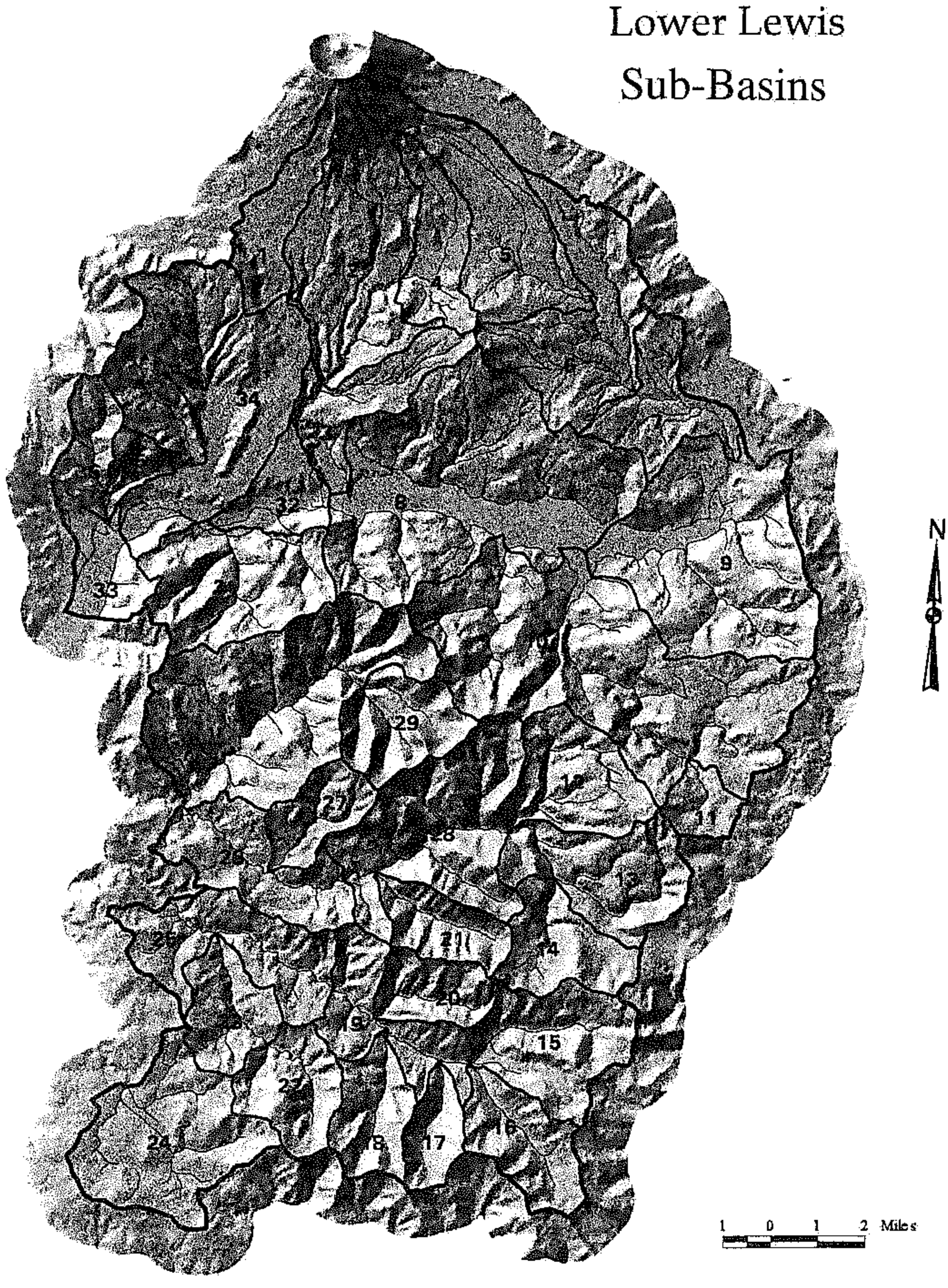


Figure 4. Sub-Basins . For this analysis, the 166,145-acre Lower Lewis River Watershed is divided into 37 sub-basins.

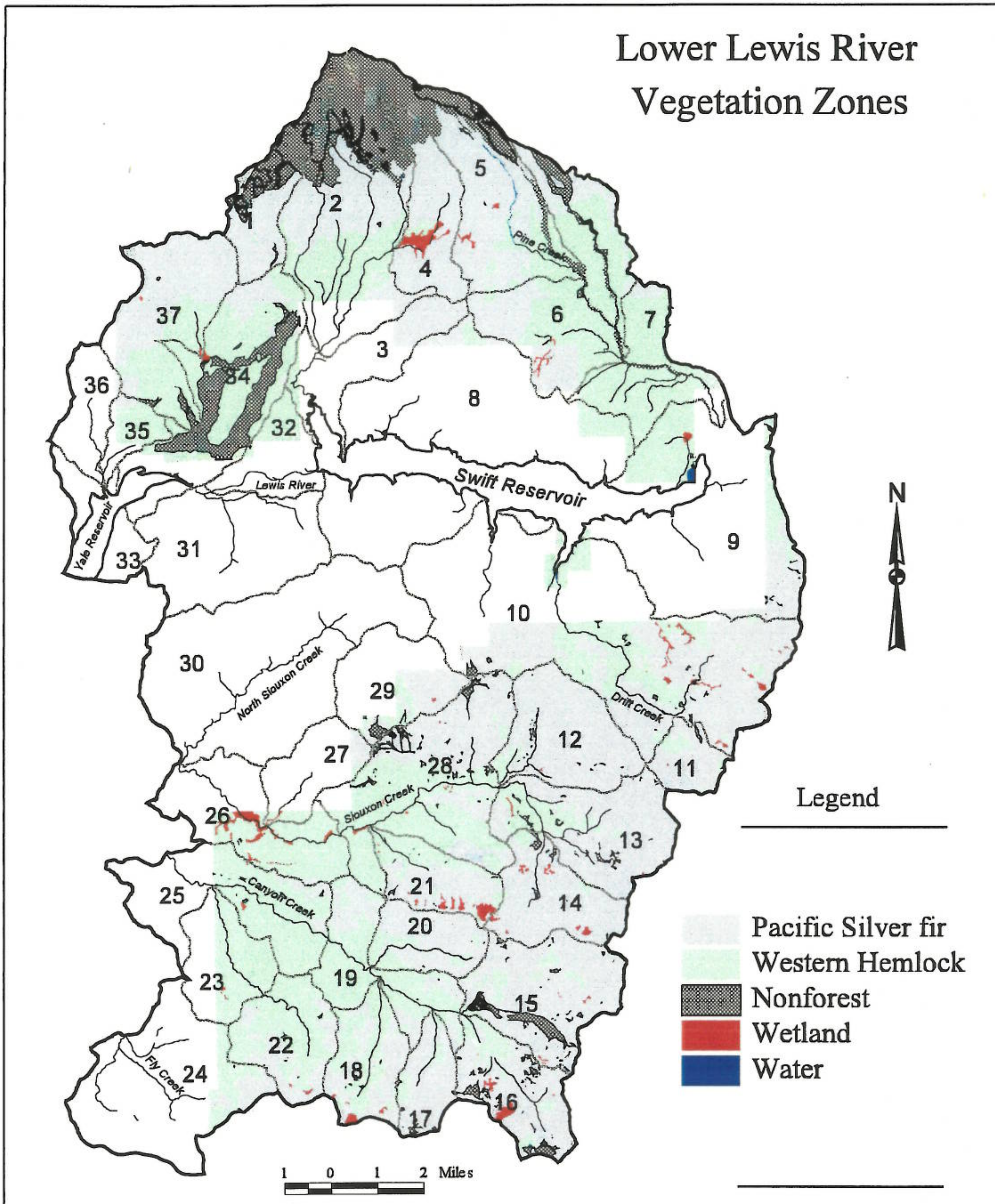


Figure 5. Vegetation Zones (Ecoclasses) of the Lower Lewis River Watershed. Non-National Forest lands (in white) are not categorized into vegetation zones.

Since 1930, very little of the watershed has burned from wildfire. Siouxon Creek, Canyon Creek, and Timbered Peak show signs of large historical fire. Many other areas within the watershed show the characteristics of catastrophic fire, but this appearance can be attributed to large areas that have been harvested by clearcutting which would create openings similar to those created by large fires.

Fire suppression and prevention policies instituted by the Forest Service in the 1910's, as well as increased logging road access, have reduced the number and size of catastrophic fires. Large documented fires located within the watershed or which burned through or near the watershed include:

1902	Siouxon	24,320 acres
1919	Brewer	3,500 acres
1927	Siouxon	1,000 acres
1979	Ruth	3,200 acres
1985	West Point	285 acres

See Figure 7 on page I-7.

Approximately 30 percent of fire starts between 1970 and 1994 were caused by lightning with the remaining 70 percent due to industrial use and visitors. Catastrophic fires can be minimized or postponed, but inevitably, some large, severe fires will continue to occur in the future.

Water Features and Hydrologic Processes

General Physical Characteristics. The Lewis River is dammed at three successive locations forming the impoundments known as Lake Merwin, Yale Lake, and Swift Reservoir. Lake Merwin and most of Yale Lake lie just to the west of the watershed analysis area, while the remainder of Yale Lake and Swift Reservoir are included. Siouxon Creek is a Tier 2 (water quality) key watershed. Two hydrologically unique areas, one at Cougar Creek in the northwest part and one in Hackmore Creek in the southeast part, are located within the watershed. A series of streams enter recent lava flows, flow sub-surface for a distance and then emerge as springs downstream. A major mudflow from the 1980 Mount St. Helens eruption traveled down Pine Creek.

In the Lower Lewis, the average annual precipitation ranges from 80 to 120 inches per year. The maximum yearly flow of record ranges from 2,490 cubic feet per second (cfs) in 1977 to 27,000 cfs in 1934 and 1974, measured above Swift Reservoir.

Initial channel segment mapping identified sensitive response type segments concentrated in the Pine Creek drainage.

Riparian Reserves. As a key element of the Aquatic Conservation Strategy (ROD, B-9), the Riparian Reserves provide an area along all streams, wetlands, ponds, lakes and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Riparian Reserves are important to the terrestrial ecosystem as well, serving, for example, as dispersal habitat for certain terrestrial species. Figure 6 shows the riparian reserves in the Lower Lewis Watershed in two categories , those associated with streams and those associated with unstable ground.

Water Quality. No 303 (d) water quality impaired stream segments are presently identified on the Washington State 303 (d) list; however, this is expected to change when the list is revised. Over the years they have been monitored, the following streams have exceeded the State water quality standards for stream temperature: Lewis River exceeded 18 times; Canyon Creek exceeded 57 times; Siouxon Creek exceeded 69 times; Puny Creek exceeded 6 times; Sorehead Creek exceeded 15 times and Pine Creek two times.

Water quality is being affected in areas having relatively high road densities: in Canyon Creek (3.9 miles per square mile) and in Pine Creek (3.1 miles per square mile). High road densities located on sideslopes exceeding 55 percent also occur in Canyon Creek, some of the highest on the Gifford Pinchot National Forest.

The Pine Creek aquatic system is highly fragmented having one of the highest number of road/stream crossings per square mile of land area on the Forest. In a 1994 evaluation of watershed conditions, Pine Creek and Canyon Creek were rated among the basins in the poorest condition on the Forest.

The February 1996 flooding caused significant damage to the drainages lying north of Swift Reservoir. Stream channels were simplified and large amounts of sediment were introduced into Swift Reservoir by debris torrents.

Water Quantity. The majority of the Lower Lewis is in the transient snow zone and subject to rain-on-snow storm events.

The likelihood of peak-flow increases caused by natural or human activity is of high concern in Canyon Creek and Pine Creek. Canyon Creek has peak flow increases from 5 to 12 percent and a road density of 3.9 miles per square mile causing concern about possible impacts from timber harvest and road construction. Pine Creek, with peak flow increases ranging from 7 to 12 percent and a road density of 3.1 is of concern due to timber harvest, road construction, and volcanic eruption.

Aquatic Animals and Habitat

The Lower Lewis River Watershed has approximately 1,433 miles of stream; 47 miles are Class I, 91 miles are Class II, 231 miles are Class III and approximately 1,964 are Class IV (Figure 8). Rainbow trout (*Oncorynchus mykiss*), cutthroat trout (*O. Clarki*), and sculpin (*Cottidae* sp.) are the most common fishes found in the streams. Bull trout (*Salvelinus fontinalus*) are found only in a few of the streams draining into Swift Reservoir and Yale Lake.

There are two large reservoirs created by dams on the Lewis River that are very popular recreation areas. These are Yale Lake and Swift Reservoir, which are approximately 3,800 and 4,580 acres respectively. No anadromous fish currently access this portion of the Lewis River Basin because upstream fish passage is blocked by the dams at both Yale Lake and Swift Reservoir. Both reservoirs contain rainbow trout, cutthroat trout, bull trout, whitefish (*Prosopium williamsoni*), and suckers (*Catostomus* sp.). A stocked population of kokanee (*O.nerka*) are also present in Yale Lake and provide a popular fishery.

The bull trout population in Swift Reservoir spawn in several Middle Lewis River tributaries (see Middle Lewis River Watershed Analysis for additional information) and in Pine Creek which is located within the Lower Lewis Watershed. The bull trout that exist in Yale Lake spawn in Cougar Creek. Bull trout have been proposed to be listed under the Endangered Species Act, however the listing has been precluded due to other higher risk species.

Two natural lakes are located in this area: June Lake and Zig Zag Lake. They are on opposite ends of the watershed, but each receives a relatively high recreation use. Zig Zag Lake supports a self-sustaining population of brook trout. June Lake contains no fish.

Siouxon Creek is a major tributary to this section of the Lewis River. The upper-most sub-watersheds have been impacted by past harvest activities, but the middle section is "essentially roadless". The entire area was burned around the turn of the century (1900-1920) and is now in the process of recovery from that event. The population of rainbow trout that are present in the stream are of interest to many local angling groups. Genetic studies suggest that wild rainbows in Siouxon Creek are significantly different than hatchery stocks (Conklin 1992).

Canyon Creek is a second major tributary to this section of the Lewis River. It is has been impacted by intensive harvest operations, including road building. Genetic studies suggest that wild rainbows in Canyon Creek are significantly different than hatchery stocks (Conklin 1992). The WDFW currently manages Canyon Creek for harvest of catchable (stocked) rainbow trout.

Pine Creek, a third major tributary in this area, was severely impacted by past harvest, and mudflows that occurred due to the eruption of Mount St. Helens in 1980.

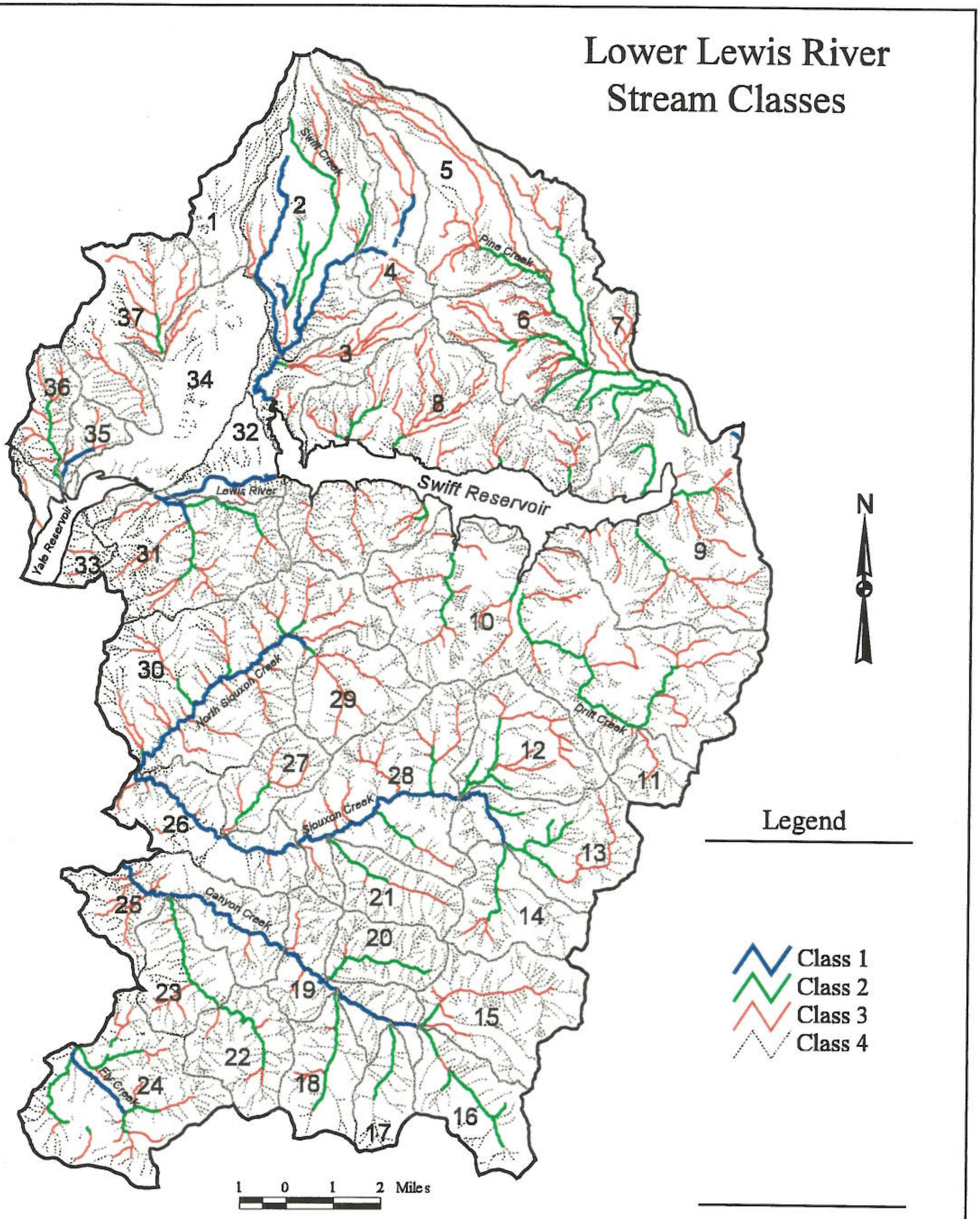


Figure 8. Stream segments have been grouped according to their size and presence of beneficial uses. These groups, referred to as stream classes, range from Class 1, which is a large perennial stream, to Class 4 which is a small, intermittent stream.

Terrestrial Animals and Habitats, TES Animal Species

The watershed contains habitat that supports 253 wildlife species, including 47 species that are dependent on snags and 64 species that are dependent on down logs for a part of their life cycles. High interest species known to exist in the watershed include spotted owl, bald eagle, black-tailed deer, elk, and Townsend's big-eared bat.

Old growth and large tree conifer habitat occurs in fragmented blocks that generally have a high ratio of edge to interior habitat. The Lower Lewis contains about 27,025 acres of suitable spotted owl habitat on National Forest, which is 31 percent of the National Forest land.

Bald eagles are known to nest and forage at Swift Reservoir.

The watershed contains 13,800 acres of elk and deer winter range on National Forest land which is 16 percent of the National Forest portion of the watershed.

Lava tubes that are suitable roost, maternity, and hibernacula sites for bats, including Townsend's big-eared bat, are found in the Lower Lewis River watershed. Other special habitats include talus, lava flows, lakes, and meadows.

The watershed contains a portion of Late Successional Reserve (LSR) #152. This LSR extends southeast from this watershed to the Columbia River.

The Human Dimension

The Lower Lewis has been occupied by, and it's environment modified by humans, for at least the past six thousand years. Native Americans established seasonal villages along the Lewis River where they fished for salmon, collected edible plants, and hunted game in the surrounding hills. Fires were often set in the fall to clear undergrowth, rejuvenate berry fields, make travel easier, and to enhance hunting. When European immigrants began homesteading in the early 1800's they encountered an altered landscape.

CHAPTER II ISSUES AND KEY QUESTIONS

Having characterized the watershed, the ID team assembled the issues to be studied. For this watershed analysis, "Issues" are topics of concern about key elements of the ecosystem that are related to:

management goals and objectives,

human values, or

resource conditions within the Lower Lewis River Watershed.

Each issue generates Key Questions to be investigated. These questions

1. address the issues by focusing on the elements that influence and are influenced by humans, and which can be measured at the watershed scale, and

2. are expected to be answered by the analysis.

A general letter announcing the beginning of the watershed analysis and soliciting ideas about topics that should be investigated was mailed to 84 addresses which included private landowners living within the watershed analysis area, individuals interested in watershed analysis in general, and other agencies. Some of the "other agency" representatives who have provided input in recent watershed analysis efforts include:

Neal Darby and Tod Williams, US Fish and Wildlife Service
Matt Longenbaugh, National Marine Fisheries Service
Ron Lee, Environmental Protection Agency
Nora Jewett, Washington Department of Ecology,
Rollie Geppert, Washington Department of Fish and Wildlife.
John Barnett, Cowlitz Tribe, and
Lee Carlson, Yakama Indian Nation

From the characterization (Chapter I of this report) and from verbal and written input, a list of Issues and Key Questions was compiled. See Appendix C, List of Issues and Key Questions.

In order to proceed, the total list was narrowed to concentrate the team specialists' limited time and resources on those issues of greatest importance.

Being prepared to answer watershed-scale questions about anticipated future land management ecosystems to provide effective habitat for riparian dependent plant and animal species, and other species that may use Riparian Reserves as habitat connections between larger habitat blocks.

- **<u>TES Plants and C-3 Species:</u>** The Endangered Species Act and the Northwest Forest Plan mandate that we monitor for threatened, endangered, and sensitive (TES), and late-successional-dependent (C-3) species respectively. Less than five percent of the watershed has been surveyed for TES species, and none of the watershed has been surveyed for C-3 species.

- **<u>Habitat Condition for TES Animal Species:</u>** The watershed contains suitable, or potentially suitable habitat for TES species including spotted owl, peregrine falcon, gray wolf, bald eagle, Townsend's big-eared bat, and Larch Mountain salamander.

- **<u>Hydrologic Changes:</u>** Past disturbances may have influenced basin hydrology by increasing peak flows during fall and winter storms and decreasing summer low flows. Human activities have occurred throughout the watershed and may influence the timing and quantity of runoff as well. Due to time limitations the analysis will focus on peak flows only.

- **<u>Water Quality and Key Habitat Attributes for Salmonids:</u>** Current aquatic habitat conditions are a result of past natural and human induced processes that have occurred in the watershed. Road building, dams, and fire regimes, combined with timber harvest and increased human populations in the watershed have through time altered stream habitats and aquatic communities. Degraded water quality from sediment and high water temperatures may be affecting habitats for bull trout, kokanee, and cutthroat trout. State water quality regulations are in place to protect existing and designated uses of water (i.e., beneficial uses). Due to time and analysis information limitations the focus will be on fish spawning and rearing.

- **<u>Demand for Recreational Opportunities:</u>** The demand for snow-play and parking far exceed the capacity of existing facilities. Note: The watershed receives heavy recreation use such as dispersed camping, fishing, and hunting which is unrelated to sno-play and parking facilities; issues associated with these other issues will not be addressed in this analysis.

CHAPTER III CURRENT CONDITIONS

Chapter III consists of brief presentations (illustrated by maps, tables, and charts) which describe current conditions and trends of relevant ecosystem elements and processes within the watershed.

Geology, Physical Processes

Mass Wasting

Unstable and potentially unstable land in the Lower Lewis Watershed is shown on Figure 9. These areas have been placed in riparian reserves in accordance with the Northwest Forest Plan. Current conditions in the watershed have been mapped from existing data available on the forest and the use of aerial photos. Mapping of newly damaged areas from the 1996 storm events has not yet been accomplished. Some of these areas will be identified as unstable and potentially unstable land, and this will increase the area of riparian reserves in the watershed. Table 1 shows the percentage of unstable and potentially unstable ground by sub-basin. Unstable and potentially unstable ground outside the National Forest is not identified, so reviewers should be aware that only National Forest acres appear in the table.

The 1996 storm events resulted in mass wasting and erosion moving large amounts of sediment in short periods of time. These types of events tend to scour channels and drastically alter the hydrologic regime of an area for many years. The scoured channel of Marble Creek is a good example. This massive slide appears to have started as a fill failure on an existing road on the hillside above and proceeded through a clear cut before it reached Marble Creek. From there the mass apparently liquefied and followed the Marble Creek channel, scouring the wall up to 40 feet in height above the above the creek bed, taking out Road 9015 prism on its way down slope. When the mass reached Road 90 fill, it appears the fill initially held backing up the water and debris until it overtopped the road. From this point it must have eroded the fill at a slower rate down to stream bed level. There does not appear to be the scour below the Road 90 like that seen above.

Erosional processes

Surface erosion is a concern primarily in the northern half of the watershed due to the sensitive tephra deposits from past eruptions of Mount St. Helens. The ash and pumice soils from these eruptions are highly erodible and easily transported. With the 1980 eruption of Mount St. Helens and the resulting loss of vegetation, erosion has proceeded at higher levels than seen prior to the eruption. Road construction has also influenced sediment production and transport. Sub-basins with relatively high road densities, steeper slopes, and highly erodible soils show the most concern. This is displayed in Figure 10. This map shows (by sub-basin) where erosion rates from

Sub-Basin	Acres in Sub-Basin	Acres Unstable	Acres Potentially Unstable	Percent of Sub-Basin
17	1561.69			
18	2457.11			
19	3172.85	16.97		0.53%
20	2048.84			
21	2204.09		16.80	0.76%
22	2849.1	1.78	301.02	10.63%
23	2553.52		351.67	13.77%
24	6373.53			
25	4558.91	38.48	221.30	5.70%
26	3941.87	730.42	327.76	26.84%
27	1993.43	0.02	20.70	1.04%
28	6888.58	536.69	68.49	8.79%
29	3022.50		237.69	7.86%
30	10336.05		0.91	0.00%
31	5340.21			
32	1981.16		3.75	0.19%
33	2081.70			
34	6207.41		1541.61	24.83%
35	911.83		426.43	46.77%
36	1656.40	1.52		0.09%
37	4645.83	28.60	1982.90	43.30%
TOTALS	166145.2	2336.94	11507.80	8.33%

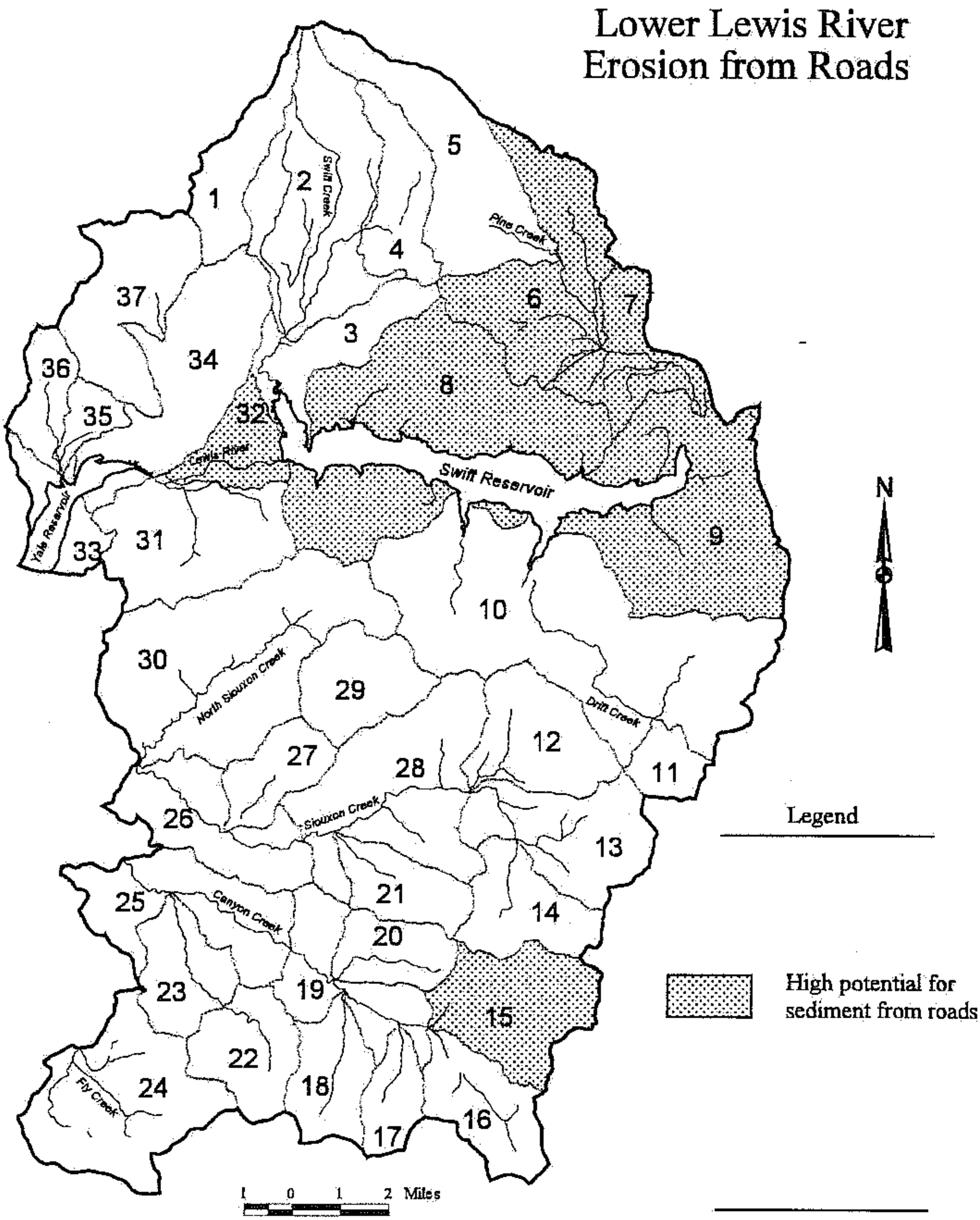


Figure 10. Sub-basins with the highest potential for moving sediment from roads to streams.

Table 2. Vegetation Zones. Calculations exclude non-National Forest lands.

Vegetation Zone	Acres	Percent of Watershed
Western Hemlock	31,131	36%
Pacific Silver Fir	45,665	52%
Wetland	1192	1%
Water	257	trace
Non-Forest	9275	11%

Table 3. Vegetation Zones by Sub-basin. Calculations exclude non-National Forest lands.

Sub-Basin	Acres N.F. Land	Western Hemlock	Pacific Silver Fir	Wetlands	Water	Non-Forest
01	2593	2	46	-	-	53
02*	5749	21	45	-	-	33
03*	390	38	60	-	-	1
04*	2463	3	75	7	-	15
05*	4563	9	51	1	1	39
06*	2317	56	28	1	-	15
07*	319	86	-	-	-	13
08*	154	trace	94	-	-	-
09*	1769	43	51	1	3	2
10*	8663	28	67	2	2	1
11*	1191	15	84	-	-	2
12	3686	4	95	-	-	1
13*	4343	19	78	-	-	3
14*	2909	5	90	2	-	3

Stand Structure

From an ecological/functional perspective, stand structure is often more informative than stand age or seral (successional) stage. Stand structure definitions have been developed based on a number of different criteria (Hall et al. 1985), and were recently expanded to include a total of 16 categories (Appendix E, Structural Stage Definitions).

Approximately 47 percent of the watershed is in non-National Forest ownership. Because analyses are of National Forest lands only, the ecological conditions of the entire watershed are not depicted and constitute a large data gap. For ease of interpretation, structural stages are combined into seven groups based on ecological functions at a more coarse scale (Table 4 Vegetation Structure Stages). The percentage of each sub-basin in non-National Forest is included in Table 5 (Percent Grouped Vegetation Structure Stages, and Percent Harvested, by Sub-basin) to indicate areas where more vegetation information is needed. Since a large portion of the non-Federally owned lands have been harvested, the percentages for the different structural stages would vary considerably from what is shown here and would be higher in the young tree stages and lower in the large tree component. Figure 11 shows the grouped vegetation structural stages.

Since about 1940, approximately 31 percent of the National Forest lands within the watershed have been harvested. See Figure 12, Harvested Lands. A much higher proportion of the non-National Forest lands have also been harvested. This has created a mosaic of small patches across the landscape. Table 5 (Percent Grouped Vegetation Structural Stage, and Percent Harvested, by Sub-basin) summarizes the harvesting activity on National Forest lands by sub-basin. These acres represent approximately half of the seedling, sapling, pole and small tree component within the watershed. The remaining 37 percent of the young stands are the result of natural disturbance processes, primarily wildfire and volcanic activity.

Table 4. Vegetation Structural Stages. Calculations exclude non-National Forest lands.

Structure Stage	Percent	Grouped Structure Stage	Percent
Grass/Forb	8	Grass/Forb/Seedling	16
Shrub/Seedling	8		
Remnant Forest	trace		
Open Sapling/Pole	6	Open Sapling/Pole/Small Tree	13
Open Small Tree	7		
Closed Sapling/Pole	11	Closed Sapling/Pole/Small Tree	39
Closed Small Tree	28		

Sub-Basin	Acres National Forest	% Non-Federal Lands	Percent Harvested	Grass/ Forb/ Seedling	Open Sap/Pole/ Sm Tree	Closed Sap/Pole /Sm Tree	Lg Tree Single Layer	Lg Tree Multi Layer	Hard-wood	Non-Forest
15*	4371	<1	47	34	10	14	10	22	-	10
16*	3019	<2	31	33	8	8	11	28	-	12
17	1562	0	47	38	5	15	24	14	-	4
18	2457	0	53	28	17	34	9	9	-	3
19	3173	0	64	40	14	18	8	20	-	-
20	2049	0	62	50	9	11	10	20	-	-
21	2204	0	17	13	13	40	2	24	-	8
22	2849	0	59	42	4	26	4	22	-	1
23*	1530	40	29	11	4	34	37	13	1	-
24*	982	85	34	26	11	44	2	16	-	1
25*	2602	43	63	43	3	35	2	15	-	2
26*	2090	47	2	2	1	86	-	-	10	1
27*	362	82	-	-	-	96	-	-	4	-
28*	6661	3	3	2	4	82	1	5	-	6
29*	1099	64	-	-	1	57	2	32	-	8
30*	2	100	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a
31*	0	100	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a
32*	199	90	29	12	-	22	-	64	-	2
33*	0	100	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a
34*	4508	27	16	3	5	55	-	1	-	36
35*	604	34	7	-	7	45	-	48	-	-
36*	37	98	78	-	85	-	-	15	-	-
37*	4086	12	50	11	13	63	-	9	-	4

* Sub-basin with non-National Forest land ownership.

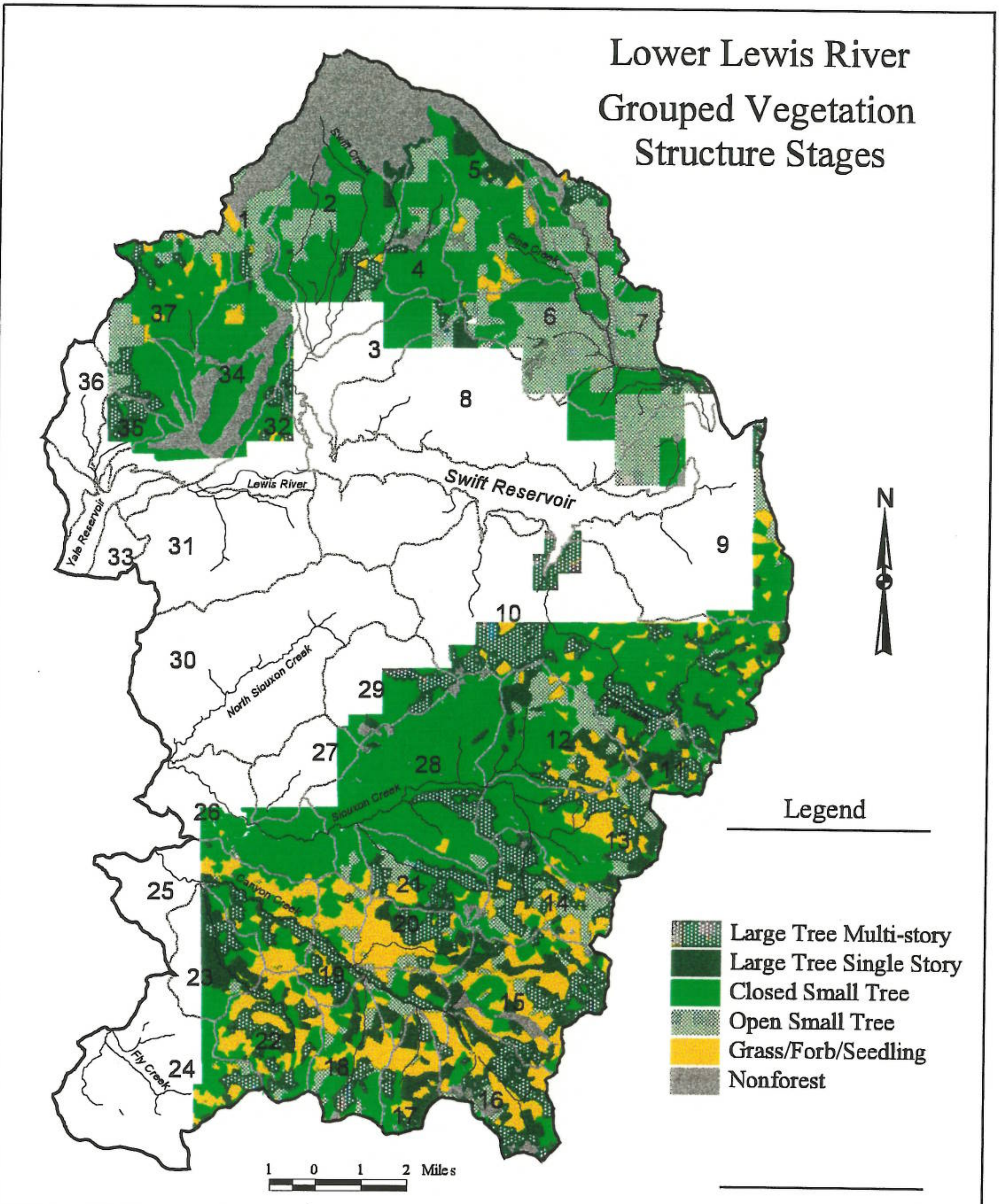


Figure 11. Grouped Vegetation Structural Stages in the Lower Lewis River Watershed. Non-National Forest lands (white) are not classified into Structural Stages.

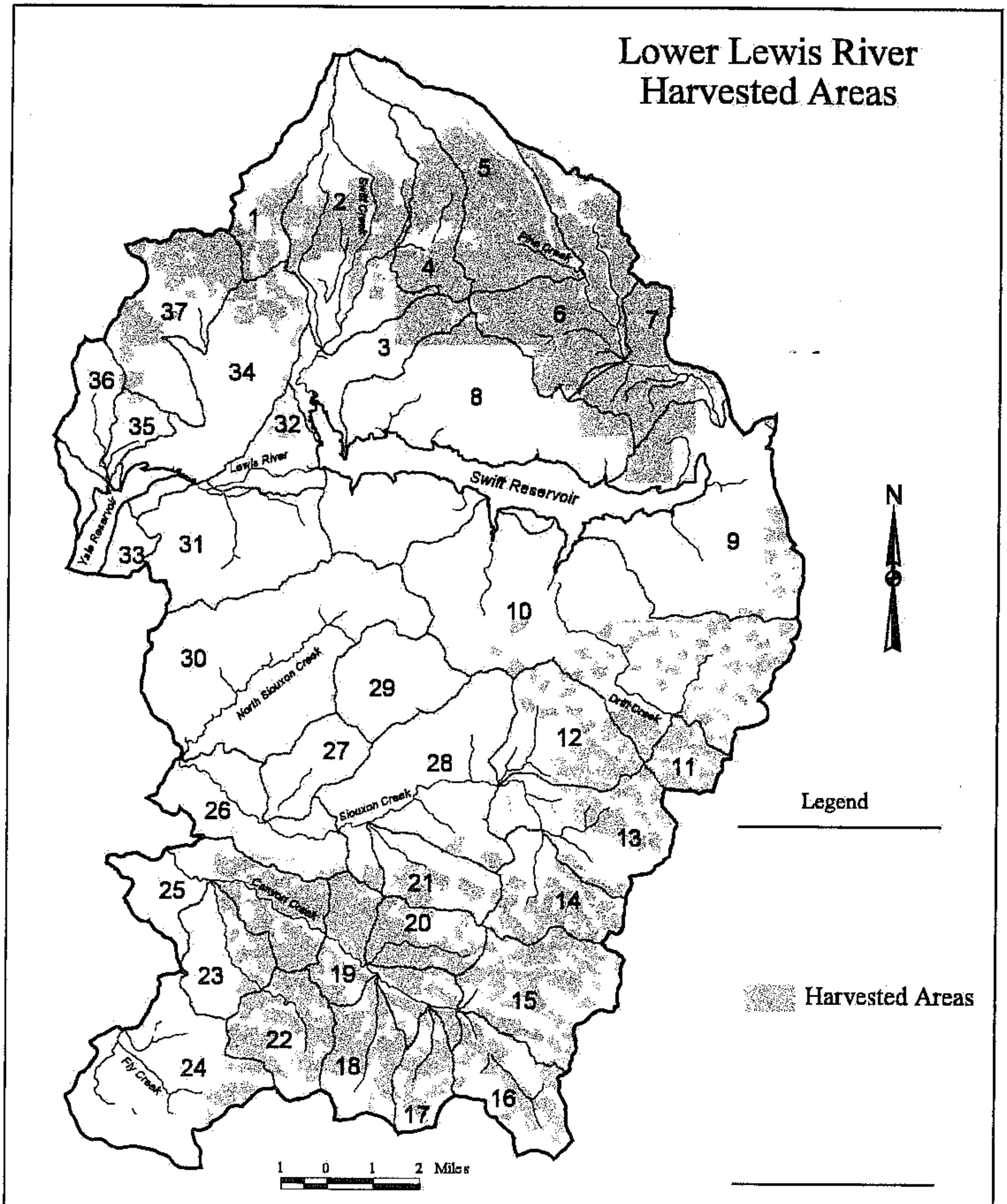


Figure 12. Harvested Area on National Forest lands within the Lower Lewis River Watershed.

Table 7. Percent Grouped Vegetation Structure Stages of Stream Riparian Reserves by Sub-basins. Calculations are based upon Stream Riparian Reserves on National Forest lands only.

Sub-Basin	Stream Riparian Reserve	Harvested Stream Riparian Reserve	Grass/ Forb/ Seedling	Open Sap/Pole /Sm Tree	Closed Sap/Pole /Sm Tree	Lg Tree Single Layer	Lg Tree Multi Layer	Hard-wood	Non-Forest
01	26	38	6	35	4	-	3	-	52
02*	33	46	1	22	34	2	8	-	33
03*	23	35	-	15	20	-	55	-	4
04*	26	73	-	20	54	2	5	-	19
05*	24	36	trace	15	25	5	-	-	55
06*	29	77	1	74	2	1	3	-	19
07*	43	23	-	23	trace	-	42	-	30
08*	28	64	-	59	4	1	12	-	-
09*	29	12	11	7	65	2	2	-	8
10*	30	15	11	3	45	2	34	1	4
11*	23	48	18	9	22	22	29	-	-
12	30	24	13	22	45	13	5	-	2
13*	30	40	23	6	46	2	20	1	2
14*	22	32	13	24	6	-	51	-	6
15*	25	49	36	11	11	12	21	-	9
16*	24	34	43	3	4	12	30	-	8
17	23	57	48	10	10	10	19	-	3
18	23	62	34	21	23	8	12	-	2
19	33	54	31	17	16	7	29	-	trace
20	34	68	56	8	8	11	17	-	trace
21	26	19	10	21	37	1	20	trace	11
22	31	61	43	2	19	4	32	-	trace
23*	39	11	3	4	20	54	17	2	-
24*	27	31	32	7	39	1	20	1	trace

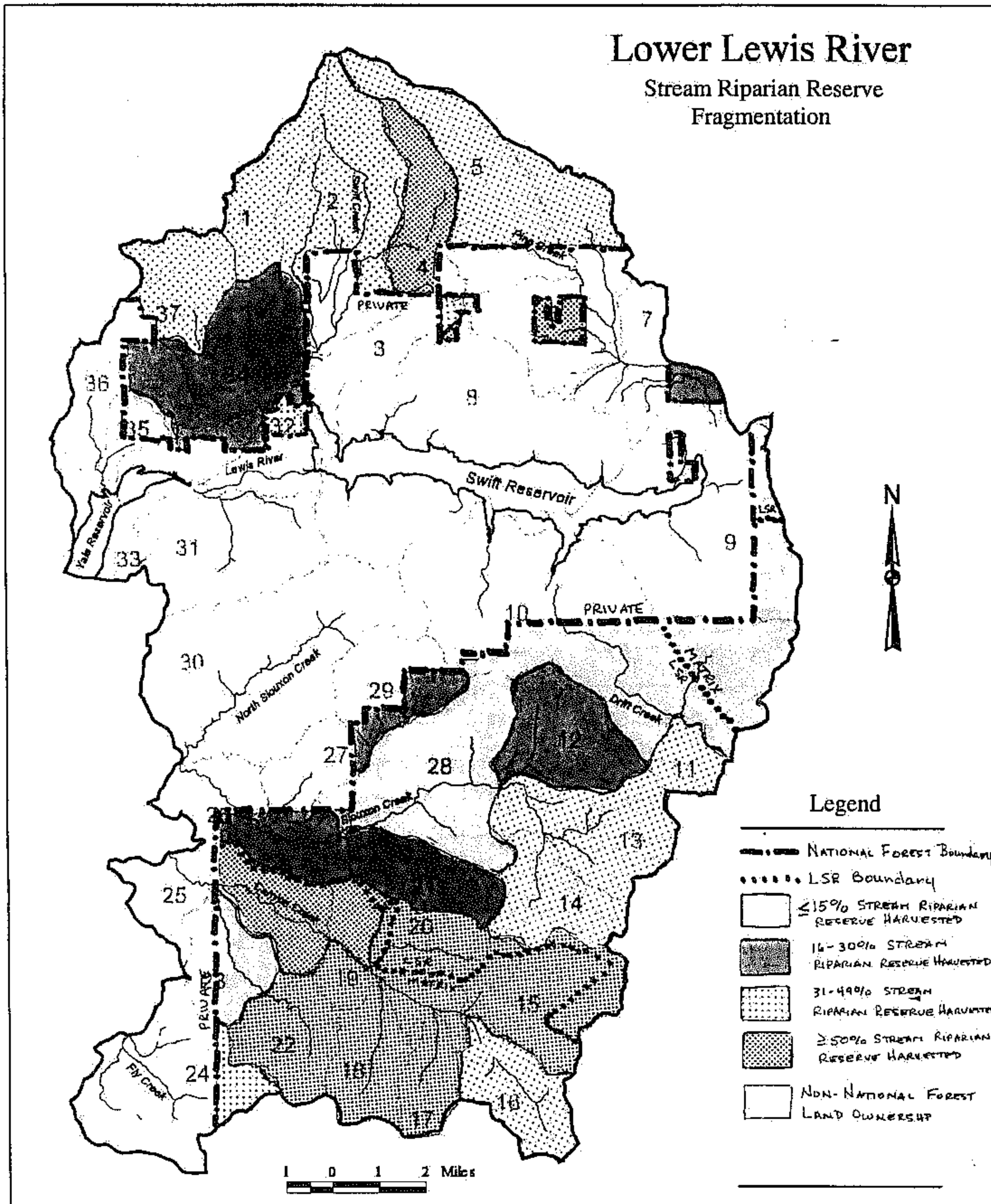


Figure 13. Stream Riparian Reserve Fragmentation. Stream riparian reserves provide important habitat and migration corridors for many plants and animals. Commercial timber harvest has disrupted the continuity of many of these areas. Sub-basins with different levels of harvest within the stream riparian reserves are illustrated. Roughly two thirds of the National Forest lands within the watershed have had over 30% of the stream riparian reserves harvested.

SPECIES	FEDERAL STATUS	STATE STATUS	C-3 STATUS	Lower Lewis	MSH UNIT
Montia diffusa	-	S	-	-	D
Ophioglossum vulgatum	-	T	-	-	Sus
Orobanche pinorum	-	S	-	-	Sus
Parnassia fimbriata v hoodlana	-	S	-	-	Sus
Pedicularis rainierensis	-	S	-	-	Sus
Platanthera sparsiflora	-	S	-	-	Sus
Pleuricospora fimbriolata	-	**S**	-	**D**	**D**
Poa nervosa v nervosa	-	S	-	-	Sus
Polemonium carneum	-	T	-	-	Sus
Polystichum californicum	-	S	-	-	Sus
Saxifraga debilis	-	S	-	-	Sus
Sisyrinchium sarmentosum	-	T	2	-	D
Utricularia intermedia	-	S	-	-	Sus
Veratrium insolitum	-	S	-	-	Sus

State/Federal Status: T = Threatened E = Endangered S = Sensitive
C-3 Status: 1 = Manage known sites
2 = Survey prior to activities & manage sites
3 = Conduct extensive surveys and manage sites
4 = Conduct general regional surveys

D=Documented occurrence Sus=Suspected occurrence

Corydalis aquae-gelidae (Clackamas corydalis/cold-water corydalis)

Found beside and growing in cold, rocky streams, springs, and seeps in the western hemlock and Pacific silver fir zones. This species is a regional endemic to SW Washington and NW Oregon. Streams inhabited by this plant are usually perennial, but not necessarily fish bearing. Substrate is typically course gravels free of other understory competitors. Riparian buffers are especially important for this species.

Pleuricospora fimbriolata (fringed pinesap)

Found in the duff and humus layer in shaded coniferous forests from southern Washington to California. Typically occurs in late-successional stands.

residential development. The known nest is on a parcel of National Forest land that has been withdrawn from development. Large communal roosts exist along the Lewis River east of Swift Reservoir. The nest site is in an area that is administratively withdrawn from timber harvest, and the roost and foraging areas would likely be protected within Riparian Reserves. Recreation activities near the nest site are occurring and may be having an impact.

Spotted owl, Goshawk

These species have similar habitat requirements, so the current habitat condition in the watershed would apply to both. Both spotted owls and goshawks are known to nest in the watershed. Table 10 shows the acreage of nesting, foraging and dispersal habitat for spotted owls by sub-basin, and the percent of the sub-basin with that type of habitat.

Table 10. Spotted Owl Habitat in the Watershed (National Forest Lands only)

Sub-basin	Nesting acres and percent		Foraging acres and percent		Dispersal acres and percent	
1	0		27	1%	136	5%
2	0		556	10%	258	4%
3	0		124	32%	35	9%
4	0		83	3%	82	3%
5	0		292	6%	103	2%
6	129	6%	2	-	63	3%
7	0		101	32%	15	5%
8	0		0		16	10%
9	22	1%	840	47%	394	22%
10	2,414	28%	1,735	20%	2,166	25%
11	174	15%	300	25%	0	
12	248	7%	1,436	39%	724	20%
13	882	20%	336	8%	1,534	35%
14	630	22%	583	20%	252	9%
15	815	19%	940	21%	27	1%

Table 11 Distribution of spotted owl habitat within Northwest Forest Plan allocations.

ALLOCATION	NESTING		FORAGING		DISPERSAL		TOTAL	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
MATRIX	3,898	38%	5,862	35%	3,086	23%	12,846	32%
LSR	5,745	56%	6,881	41%	9,735	72%	22,361	55%
CWA	66	1%	3,923	23%	471	4%	4,460	11%
AWA	471	5%	221	1%	162	1%	854	2%
Totals	10,180	100%	16,887	100%	13,454	100%	40,521	100%

As shown in the table above, approximately two-thirds of the spotted owl habitat in the watershed is protected within management allocations that restrict timber harvest. It is likely that the amount of nesting habitat and foraging habitat will increase, and fragmentation will decrease as young stands in these restricted management allocations mature.

There are fifteen spotted owl activity centers located on National Forest Lands within the watershed. In addition, there are two located on lands managed by the Washington Department of Natural Resources. The home range surrounding an activity center is considered viable if at least 40 percent of the area within the home range is suitable nesting or foraging habitat. To meet this threshold there must be 500 acres of suitable habitat within 0.7 miles of the activity center, and 2,663 acres of suitable habitat within 1.82 miles. The table below displays the amount of suitable habitat within the home ranges of the spotted owls on National Forest land in the watershed.

Table 12 Suitable habitat within the home ranges of spotted owl activity centers on National Forest land.

ACTIVITY CENTER #	ALLOCATION	SUITABLE ACRES WITHIN 0.7 MI.	SUITABLE ACRES WITHIN 1.82 MI.
#103	Matrix	382	2,787
#801	Matrix	395	2,085

as **Scattered Patch** is not suitable because the patch size is less than 40 acres.

Habitat patches on the eastern edge of the map that appear to be small and isolated (but are shown as Large Patch) are actually part of large patches in the adjacent watershed (Middle Lewis).

The Large Patch and Aggregated Patch habitat is higher quality habitat because it has the least amount of fragmentation. Within the Lower Lewis watershed, this habitat is found primarily in the LSR, and is well connected to other Large Patch habitat within the LSR outside of the watershed by Dispersed habitat patches. There is a significant amount of Dispersed habitat along Canyon Creek. While these patches are too small and narrow to be considered high quality habitat, they may be important corridors for movement of animals within the watershed.

Habitat north of the Lewis River occurs almost exclusively as Isolated Patches or Scattered Habitat. Spotted owl pair #103 is located in this area, but it's likely that the home range is not viable because of lack of sufficient suitable habitat, and isolation from habitat elsewhere in the watershed.

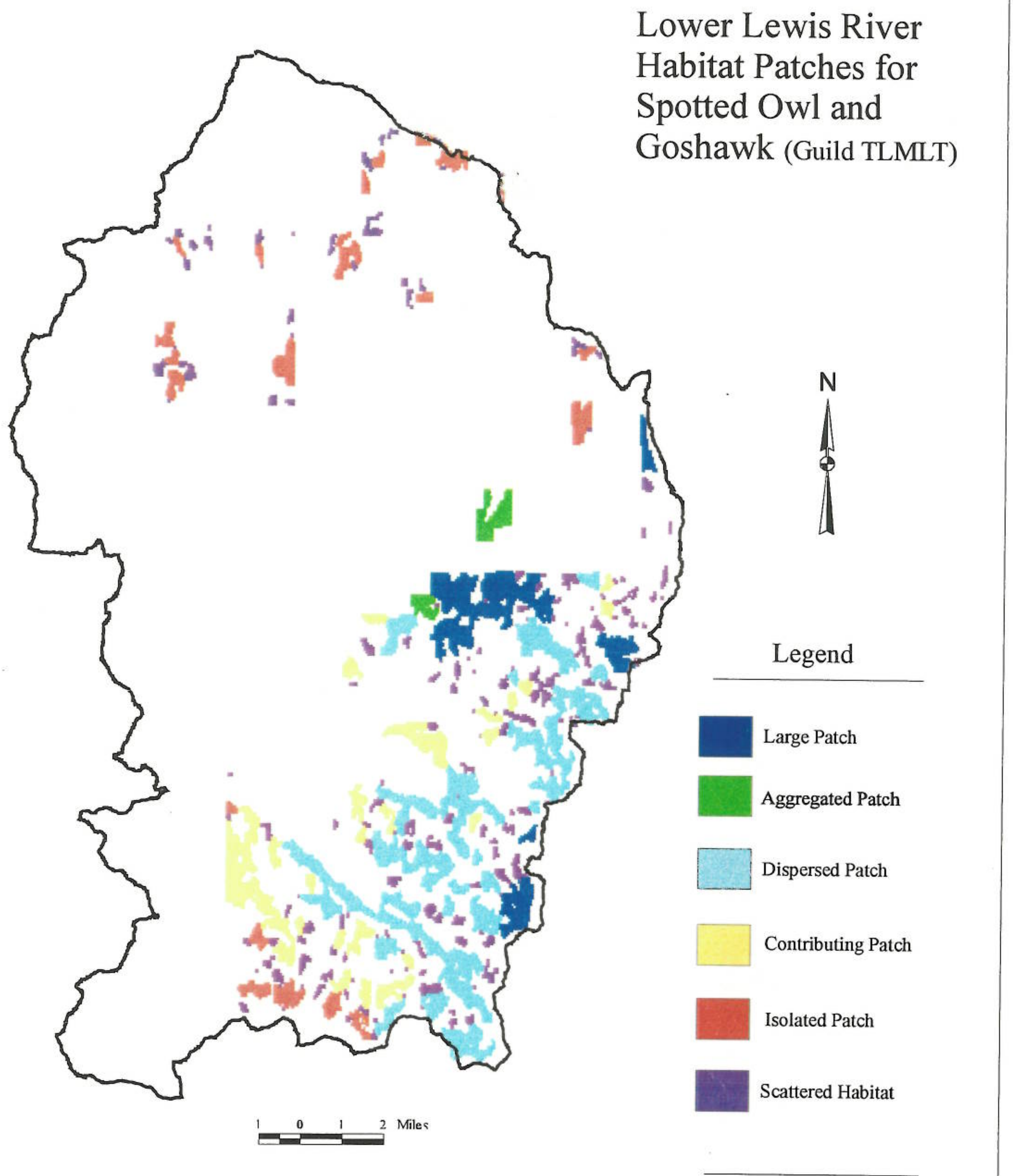


Figure 15. Suitable habitat in the watershed for the guild to which Spotted Owl and Goshawk belong. The habitat patches are characterized by their size and distribution across the watershed.

Peregrine falcon

There are no known active of historical eyries in the watershed. Surveys for potential nest cliffs utilizing maps and aerial photos identified two locations in the watershed. The locations are at Eagles Cliff, on private land near the eastern tip of Swift Reservoir, and Mount Mitchell, which is on State Department of Natural Resources land south of Swift Reservoir. Other potential sites are located on National Forest land just outside of the watershed, at Goat Mountain, Butte Camp Dome, and Ape Canyon. Birds that would nest at these sites would probably forage within the watershed.

These last three sites are within the boundary of the National Volcanic Monument, so disturbance associated with recreational use is the most likely management concern. Hiking trails 238 and 238A are near Butte Camp Dome. Trails also pass near Goat Mountain and Ape Canyon. The amount of off-trail hiking in these areas during the summer months is probably low, but any hiking off the trails or climbing at these sites would affect their suitability for peregrines.

Gray wolf

There have been six reports of gray wolves in the watershed. Five of these reports are howls that were heard during surveys in the summer of 1991, and one report from 1992 was an observation of two adult wolves. It is not known if these reports represent full-blooded wolves or if they were wolf/dog hybrids. Hybrids are raised and kept at various locations in the Amboy and Cougar area. The probability that these sightings were hybrids is unknown; however, the locations of the detections are five to ten air miles from the nearest human habitation (Northwoods).

The five detections in 1991 were all at the eastern edge of the relatively unroaded Siouxon area. Because of the low road density in this area, if wolves do occasionally inhabit the watershed this would be the most likely place for them to be. A road density of less than one mile per square mile over a large area is generally considered a requirement for suitable habitat for wolves. There are three sub-basins in the Siouxon Creek area (27, 28, and 29) that have a road density of less that one mile per square mile. In addition, significant portions of sub-basins 21, 26, 30, and 31, which are also in the Siouxon Creek area, are unroaded. These sub-basins total about 33,700 acres, or almost 53 square miles. In addition to National Forest, this area includes private land and land managed by the State Department of Natural Resources.

Other sub-basins with a road density of less than 2 miles per square mile (1, 2, 4, 5, 34, and 35) are located on the south slope of Mount St. Helens. The remainder of the watershed has a relatively high road density, ranging from 2.56 miles per square mile in Sub-basin 26 to 7 miles per square mile in Sub-basin 36.

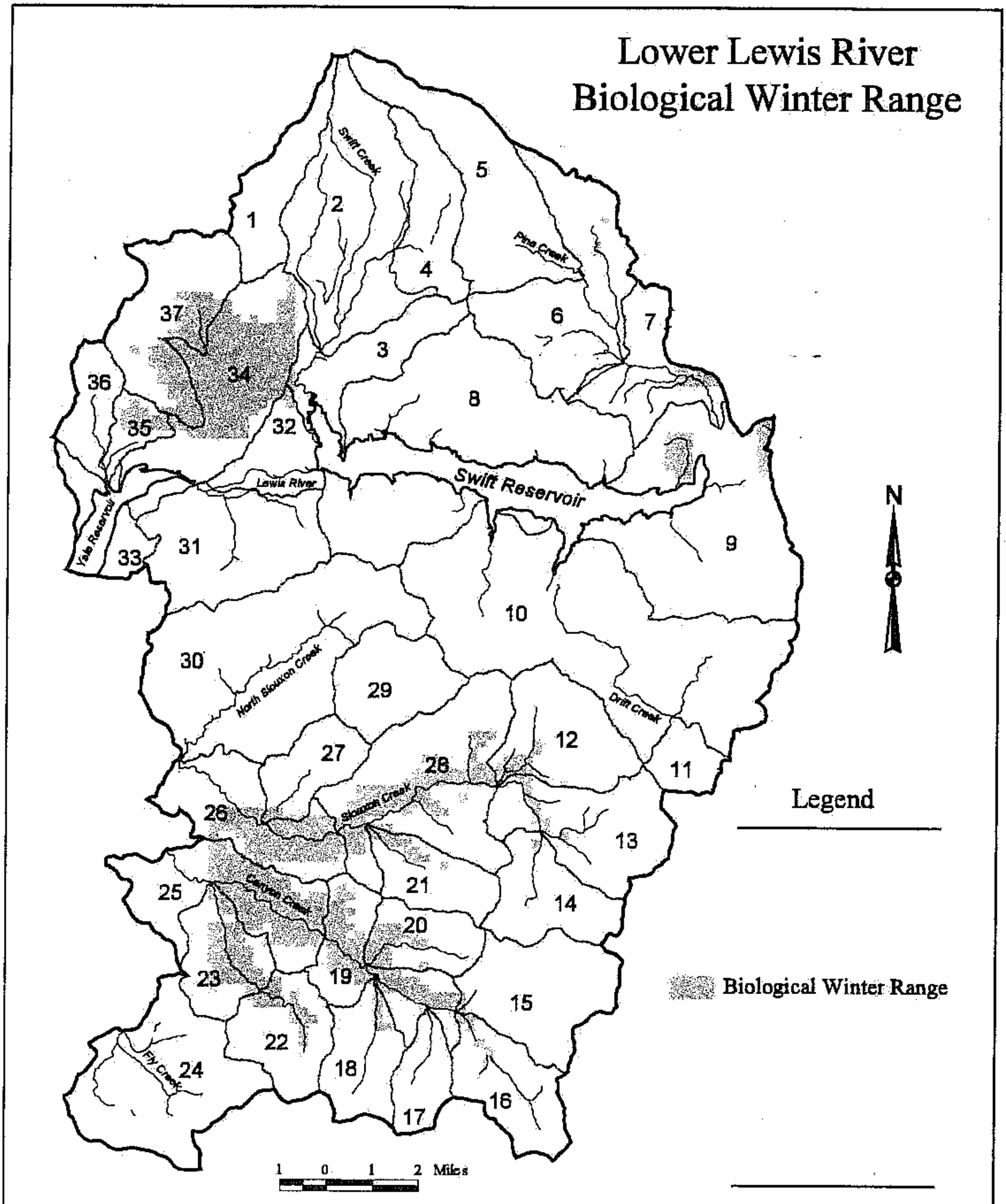


Figure 16. Elk and deer biological winter range.

Table 14 shows the acres of each age class by sub-basin, and an estimate of the percentage of the habitat potential for cavity excavating birds provided. Only National Forest lands are considered.

Table 14. Acres in each age class by sub-basin, and percent of the potential cavity excavator population.

Sub-basin	0 - 40 yrs	41 - 80 yrs	81 - 160 yrs	160+ yrs	% of potential pop.
1	1,312	0	1,206	75	31%
2	3,964	220	1,272	291	20%
3	205	1	195	0	29%
4	1,854	270	338	0	13%
5	4,061	11	452	0	6%
6	2,038	0	107	172	10%
7	201	0	0	0	0
8	127	1	18	0	7%
9	410	0	330	676	62%
10	1,728	141	3,789	2,756	60%
11	681	33	121	356	37%
12	999	2	971	1,667	62%
13	1,131	17	1,740	1,235	55%
14	1,269	0	347	1,140	49%
15	2,060	6	787	1,174	41%
16	1,118	36	286	1,490	57%
17	722	46	87	649	48%
18	1,202	253	427	539	37%
19	2,045	20	14	1,045	34%
20	1,267	0	159	614	35%
21	540	0	814	706	58%

Hydrologic changes

A peak flow analysis was conducted using the State of Washington "Standard Methodology for Conducting Watershed Analysis" procedure. The analysis models changes in stream discharge resulting from vegetation removal. As recommended in the procedure, a two-year storm event was modeled. Note that this analysis does not include information on State or privately-owned land due to the lack of GIS vegetation data. General observations made from orthophoto interpretation indicate that most of the private land has been recently harvested while the large State block in the Siouxon Creek area is still intact. Plans for the State block involve a series of timber harvest entries in the near future.

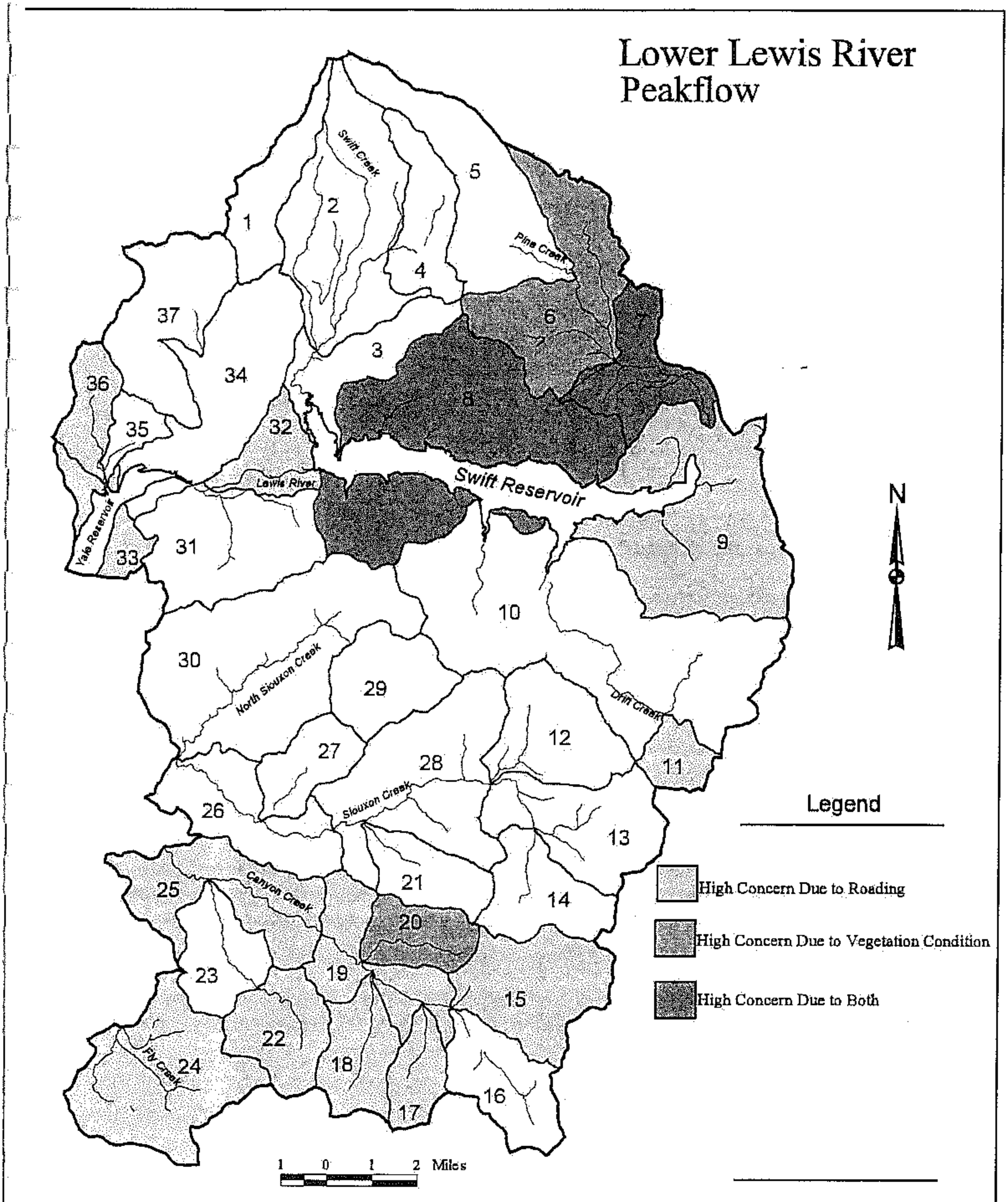
Table 15 below displays sub-basins that, when compared to a fully forested condition, currently have increased peak flows more than 10 percent (see Figure 17, Peak Flow). This threshold is used by the State of Washington to indicate areas that have a possibility for adverse watershed effects due to peakflow increases.

Table 15. Peak Flow Increases

Sub-basin	Peak Flow Increase
6	10%*-17 %**
7	12%*-22%**
8	10%*-19%**
20	12%*-22%**

* - peak flow increase for an average two year storm
** - peak flow increase for an unusually strong two year storm

Another phase of the peak flow analysis examines the extension of the stream channel network by roads and ditch lines in roads. These factors may increase peak flows through road cut slope interception of subsurface flow and routing of surface waters through road ditch lines as "pseudo channels." The following table displays sub-basins where roads have increased the length of natural stream miles by 40 percent or more. (see Figure 17, Peak Flow).



'igure 17. Areas of high peak flow concern. These are defined as sub-basins with peak flow increases greater than or equal to 10% due to vegetation removal, sub-basins that have increased channel length by at least 40% from ɔading, or areas that meet both of these criteria.

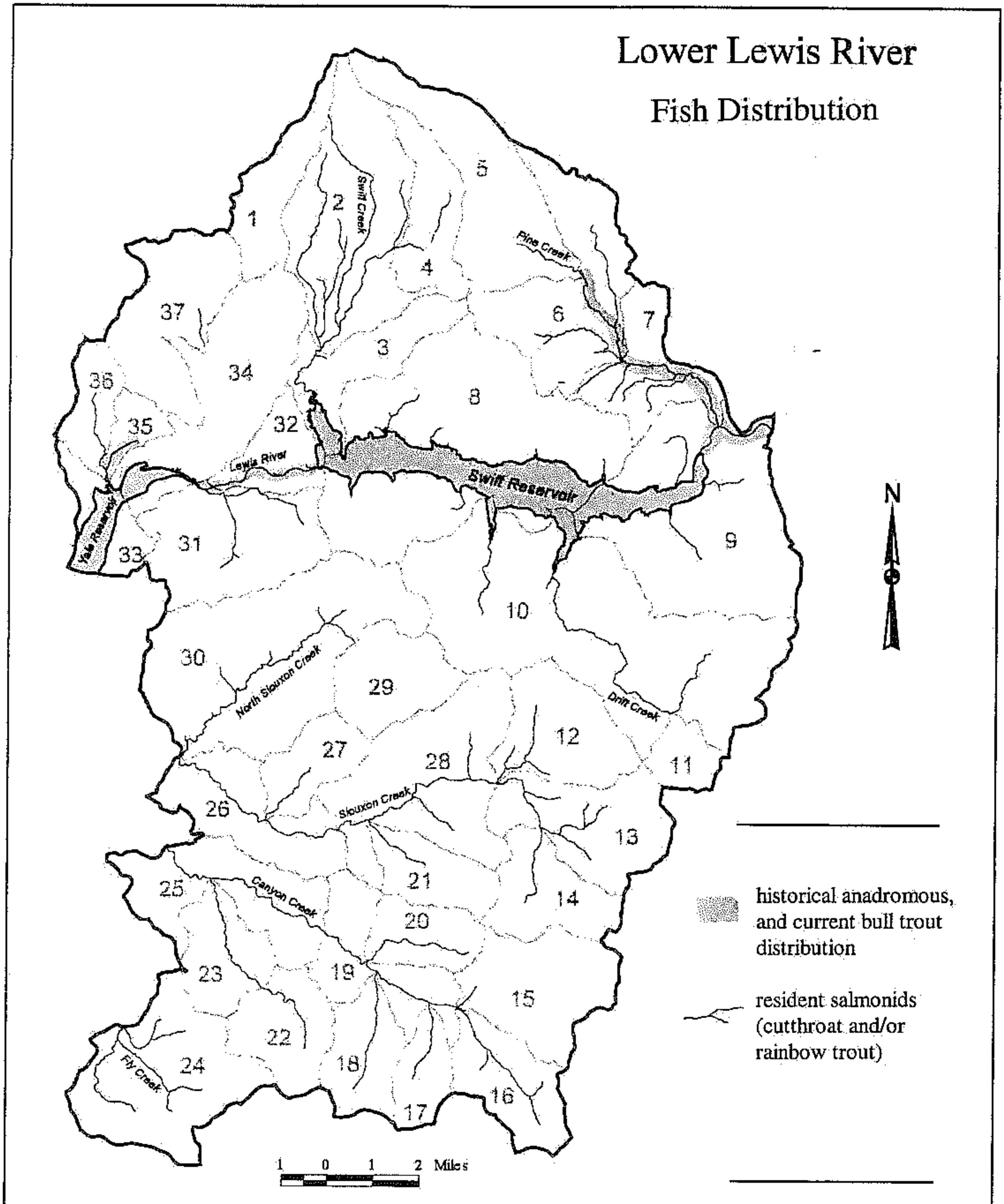


Figure 18. Lower Lewis River Watershed stream fish distributions of resident fishes (rainbow and cutthroat trout) and bull trout. Swift Reservoir and Yale Lake have rainbow, cutthroat, and bull trout, whitefish, and suckers. Kokanee salmon are present in Yale Lake. Historical anadromous fish distribution is a "guesstimate" based on upstream fish passage barriers.

a rating of good, fair or poor. Streams in good condition meet or exceed the standard of 80 pieces per mile. Streams in fair condition contain 40-79 pieces of LWD/mile, and streams in poor condition contain less than 40 pieces of LWD per stream mile. Stream survey data indicate, approximately 66 percent of the surveyed streams are rated as poor, approximately 19 percent are rated as fair, and 15 percent are rated as good. Figure 19 shows the stream segment LWD ratings for surveyed streams.

Sub-basins where more than 30 percent of the stream-side riparian areas have been logged are considered to have low potential for LWD recruitment because of the time needed for conifer trees along the streams to mature and grow more dense. The harvest level was determined using USFS GIS data for Forest Service lands, and an "ocular estimate of harvest" on non-Forest Service lands. Figure 20 displays the sub-basins having low potential for LWD recruitment.

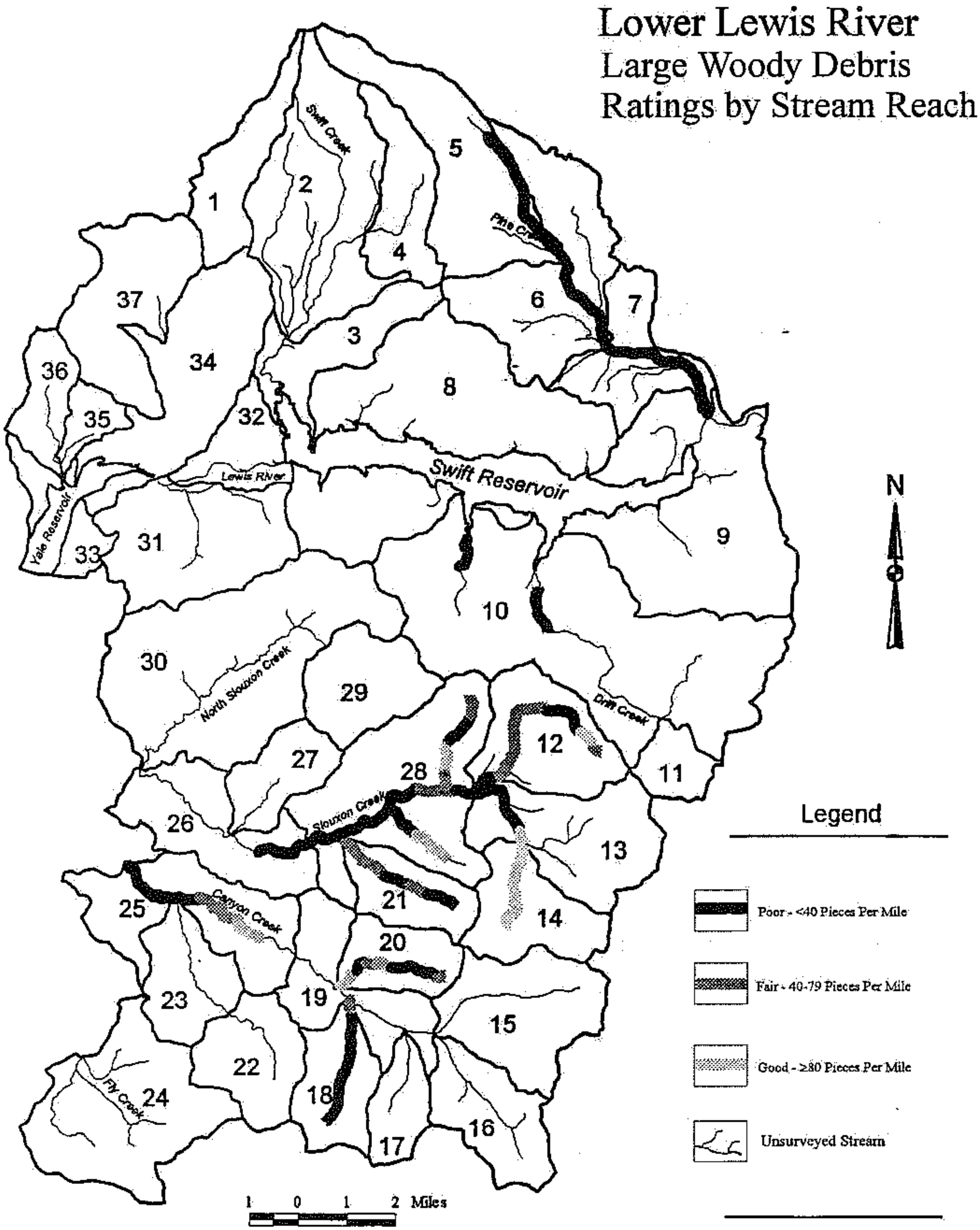


Figure 19. Large Woody Debris (LWD) ratings per mile ratings for surveyed streams in the Lower Lewis River Watershed.

Primary Pools per Mile

Pools provide thermal refuge for aquatic organisms dependent on cool stream temperatures; protective cover for rearing; and act as holding areas for LWD flowing through the stream system. The quality of habitat formed by pools is based on several factors including: pool depth, stream width, amount of LWD in place, and the complexity of sub-habitats within the pool. The number of pools increases as the stream size decreases. Channel morphology influences where pools are formed in the stream channel, and determines the hydraulic controls that create the pools.

The CRBPIG establishes standards for quantities of pools per mile in streams, based on stream width, to provide quality salmonid habitat. The "existing condition" (identified in stream surveys) is evaluated against this standard to determine a rating of good, fair or poor. Streams in good condition meet or exceed the quantity of pools; streams in fair condition contain 50-99 percent of the desired number of pools; and streams in poor condition contain fewer than 50 percent of the desired pools per mile. Stream survey data indicate, approximately 53 percent of the surveyed streams are rated as poor, approximately 4 percent are rated as fair, and approximately 43 percent are rated good (Figure 21).

Stream Temperature

Stream water temperature is a major factor influencing the composition and productivity of aquatic ecosystems. Fish, aquatic macroinvertebrates, and other aquatic organisms are affected directly and indirectly by changes in water temperatures. Specifically for salmonids, stream temperature influences the timing of migration, spawning, incubation rates, growth, distribution, resistance to parasites, food supply and quality, and tolerances to diseases and pollutants (Bjornn and Reiser 1991). Aquatic organisms are often able to withstand short term increases in stream temperature, and adjust by locating optimum habitat within the channel. Long term changes or peaks in water temperature may directly alter the established patterns of the salmonid populations.

Twelve monitoring stations have collected surface water temperature data in the Lower Lewis River Analysis Area (See Figure 22 - Water Temperature Monitoring Stations). Of those 12 stations, five have recorded temperatures that have exceeded the State water quality standards of 16° Celsius. Those five stations are located on Pine Creek, Canyon Creek, Siouxon Creek, Puny Creek and Sorehead Creek. Number of days stream temperatures have exceeded the State water quality standard of 16° Celsius is shown in Figure 23.

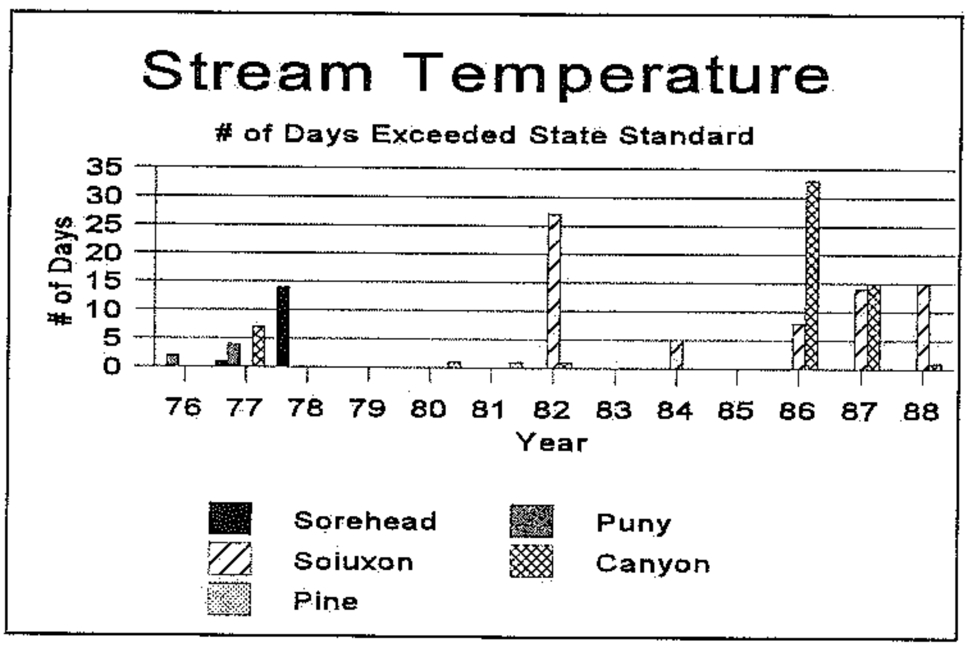


Figure 23 - Number of days the State water temperature standard of 16 degrees Celsius was exceeded for monitoring stations in the Lower Lewis area.

Conclusions reached in a 1992 study of aquatic parameters in Siouxon and Canyon Creeks suggest that causes of high water temperatures in the National Forest portion of Siouxon Creek are "inconclusive" and "mandate more thorough investigation" (Conklin, 1992). High stream temperatures below the mouth of the North Fork Siouxon Creek and in Canyon Creek (State and private ownership) were determined to be caused by "insufficient streamside shade protection" left after logging along these streams. The cause of high stream temperatures in Pine Creek is not well understood. It is suspected that channel widening from timber harvest, and the 1980 mudflow, along with streamside vegetation removal, have probably contributed to the high water temperatures.

Roads have been identified as an important factor in the decline of fish populations. Culverts that do not pass fish, and/or other road crossings that alter the flow of LWD and sediment through the system fragment the aquatic system. Roads and culverts can not only block upstream migration of resident fish, they can alter the flow pattern of LWD through the system, and increase sediment input (Furniss et. al. 1991). Figure 24 displays a map of the road network and Class 1-4 streams. The number of stream crossings in each sub-basin range from 2 to 423. There are a total of 2493 stream crossings within the Lower Lewis River Watershed (Table 21).

Road densities within a sub-basin that exceed 3.0 miles per square mile of area are viewed as "red flags" and indicate where road related problems are most likely to occur. This value is based on several years of observations by Gifford Pinchot National Forest hydrologists and fishery biologists. Currently the average road density in the entire watershed is 3.41 miles per square mile. Individual sub-basins road densities range from 0.4 up to 7.0 miles per square mile (Table 22. Road Densities, etc.). Figure 25 highlights those sub-basins that exceed 3.0 miles per square mile.

Riparian reserve aquatic habitat is adversely affected by each instance where a road crosses a stream. The flow of fish, LWD, and sediment can be interrupted, i.e. the habitat becomes fragmented. The degree of this fragmentation/impact can be gauged (and sub-basins can be compared) by the number of road/stream crossings per mile of stream length. High sub-basin aquatic habitat fragmentation values, defined as greater than 1.5 road/stream crossings per stream mile (see the Upper Lewis River, Middle Lewis River and the Upper East Fork Lewis River Watershed analyses), are highlighted in Figure 26.

The Lower Lewis watershed is the most highly fragmented watershed examined to date within the Lewis River watershed, with a maximum sub-basin fragmentation index value of 4.2.

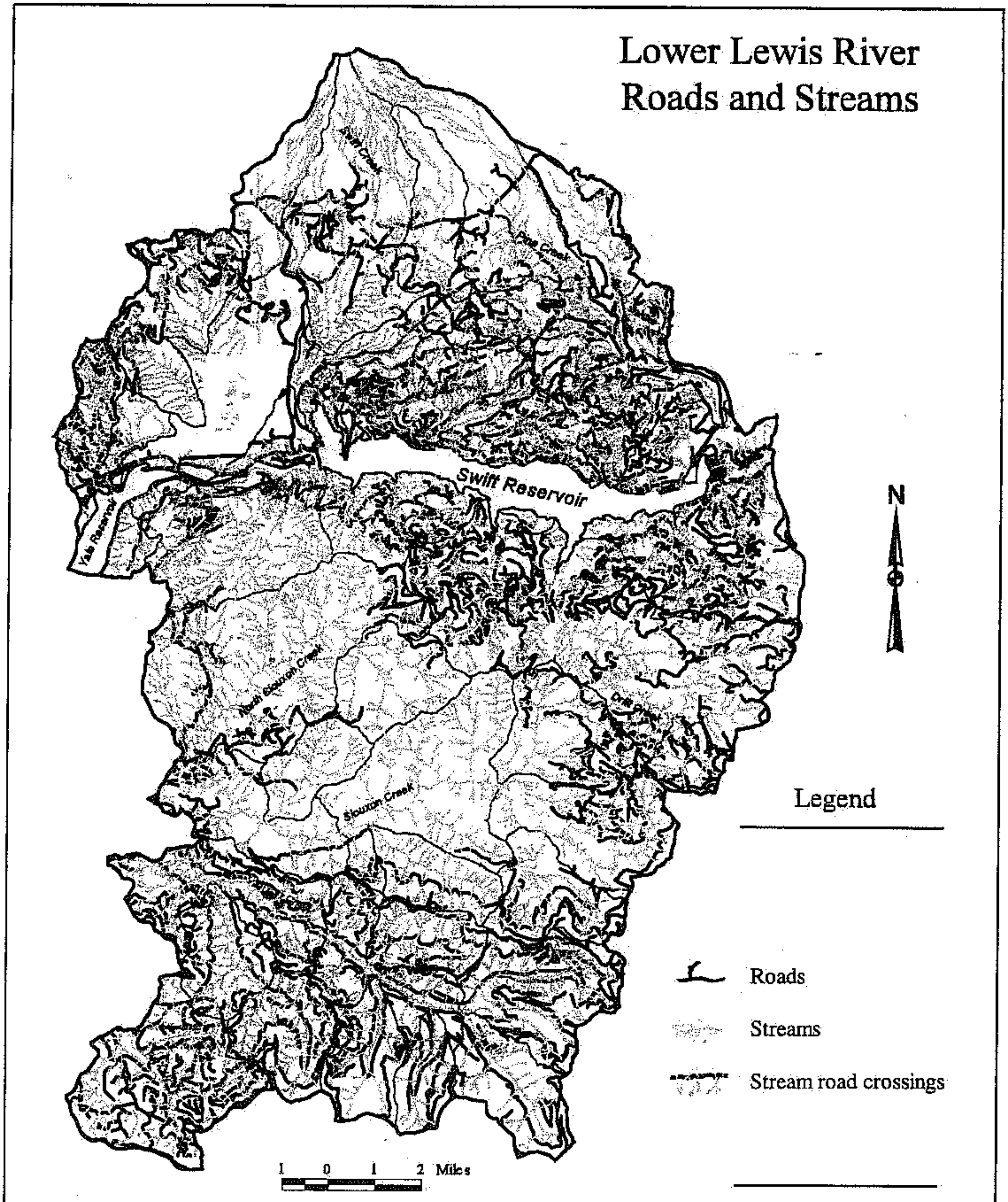


Figure 24. Display of where the road network crosses Class I - 4 streams in the Lower Lewis River Watershed. Stream crossings are shown as "light lines" bisecting the road network.

Sub-Basin	Road Densities (mi/mi-2)	Number of Stream Crossings	Number of Road Crossings per Mile of Stream
25	5.12	106	2.44
26	2.56	53	1.67
27	0.60	2	0.10
28	0.36	16	0.27
29	0.60	3	0.13
30	1.60	74	0.72
31	1.76	48	0.71
32	5.39	34	2.65
33	3.10	35	3.19
34	1.93	37	1.75
35	1.82	10	1.19
36	7.00	102	4.25
37	3.51	77	1.75

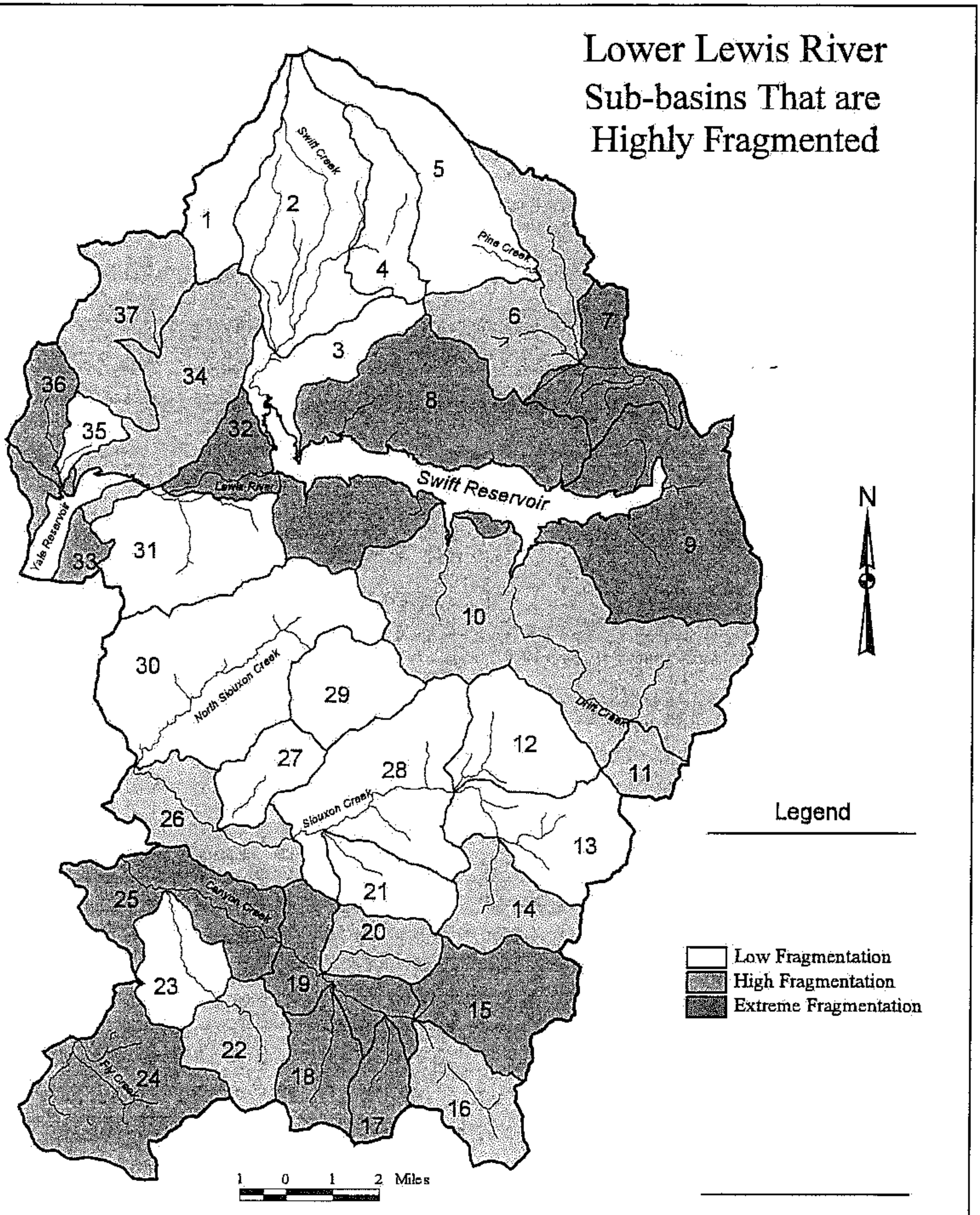


Figure 26. Lower Lewis River Watershed sub-basin stream fragmentation values. Low is less than or equal to 1.5 crossings/stream mile. High is greater than 1.5 road crossings/stream mile. Extreme is greater than 2.26 road crossing/stream mile (these sub-basins are within the upper 1/3 of stream fragmentation values for the Watershed.

Erosion-Transport-Response Reaches

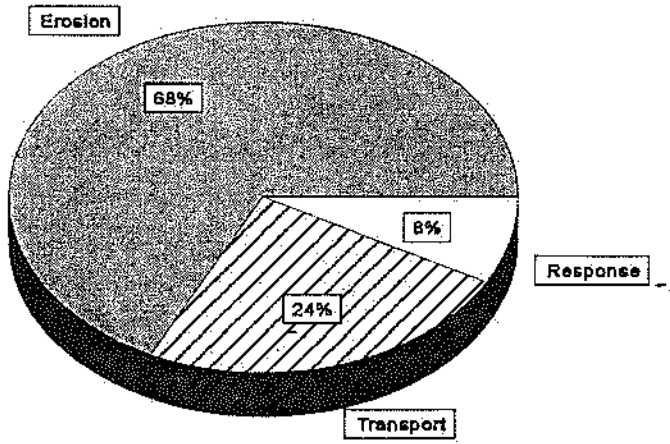


Figure 27 - Percent of reaches that were classified as either erosion, transport, or response.

- The other reaches that contain high quality beneficial use areas have shown slight changes in channel width (0-20 percent) during the air photo record. This is probably an indication of either the lack of vulnerability to sediment input (reach is transport type) or their is a balance of sediment input vs. deposition. This could also be due to a lack of large woody debris in the channel, so sediment is not being stored (which would lead to channel widening).

- Locations of all other response reaches that would be sensitive to sediment input are shown on Figure 28 - Stream Segments.

Refer to the discussion of geologic processes for potential sources of sediment input in the analysis area.

Recreation Use

Most visitors to the Lower Lewis River watershed come for the purpose of recreation. The northern portion of this area is dominated by Mount St. Helens and the geologic features which caused it to be declared a national monument in August 26, 1982. Recreational use of the Mount St. Helens National Volcanic Monument averages has averaged 2,000,000 visitors each season over the past six years. A significant number of visitors travel through the watershed area. In 1995, 440,000 traveled on Road 90, while 360,000 accessed the south side of Mount St. Helens on Roads 83 and 81.

Popular activities include climbing Mount St. Helens, driving for pleasure, hiking, fishing, snowmobiling, cross country skiing, and cave exploration. Climbing Mount St. Helens is managed under a permit system which allows 100 climbers a day (May 15-Nov. 1) above the 4800 foot level. On average, 16,000 people obtain climbing permits each season. During the winter permits are not required due to reduced demand.

This analysis will focus on an assessment of recreation demand and identifying locations where this is not being met. Parking is a limiting factor which is examined using historic use records, and the anticipated increase in recreation demand.

Winter Recreation

When snow begins to fall in early winter, skiers and snowmobilers are attracted to the area. The season usually lasts from the first of December through April fifteenth. In cooperation with the Washington State Parks and Recreation Commission, two Sno-Parks have been established. The Cougar Sno-Park provides parking for twenty vehicles, while Marble Mountain Sno-Park has parking for 40 vehicles with trailers, a large central warming shelter, and restrooms. Snow is plowed from parking areas and Road 83 daily.

Winter recreation opportunities include 62 miles of snowmobile trail (27 miles groomed), and 28.6 miles of ski trail. As more winter recreationists discover the area, use has grown. The Mount St. Helens Winter Recreation Area now accounts for over 50 percent of winter recreation use on the Gifford Pinchot National Forest. Average daily traffic counts for peak-use winter days have shown an increase over the past three years. Traffic problems occur on high-use weekends.

A decision was made to delay development of a snow-play area until a suitable site was identified along Road 83. It was considered unsafe to mix snow-play with motorized or skier use, and a separate area needed to be designated for this purpose.

A high demand exists for snow-play opportunity as expressed by public inquiry, and attempts of visitors to use any available sloping snow surface for sledding. This activity often takes place in unsuitable, or dangerous areas, such as on road cuts, or in timbered areas with obstacles.

Sanitation

Winter sanitation facilities are provided at the Marble Mountain Sno-Park, and Trail-of-two-forests only. A need exists at the Cougar Sno-Park for restroom facilities, particularly if parking capacity is expanded.

Ape Cave

Ape Cave is the most heavily visited recreation site on the south side of Mount St. Helens. When compared with other developed caves across the United States, it falls within the top ten most visited caves. In partnership with the Northwest Interpretive Association, the cave's Headquarters is operated as a visitor contact point. Available on site are lantern rentals, and interpretive book sales. Free interpretive walks are provide during the summer season by Monument naturalists. The Ape's Headquarters is staffed from May through October most years.

Ape Cave is open year-round for self exploration, but during the winter visitors must walk or ski from Trail-of-two-forests, which is as far as Road 8303 is kept plowed. The area is managed for non-motorized winter recreation.

A marked increase in summer use has occurred in the past two years, with attendant parking capacity problems. Parking capacity is at 30 percent of that needed to accommodate use for the next decade.

CHAPTER IV REFERENCE CONDITIONS

This chapter explains how the existing conditions from Chapter III have changed over time as a result of human influence and natural disturbances. The following paragraphs describe the known or inferred history of the landscape so we may know what was sustainable in the past and what changes have occurred to affect sustainability.

Geology and Physical Processes

Mass wasting

Volcanic and glacial activity in the Lower Lewis River Watershed have been a major processes in forming the landscape as we see it today. Folding, faulting, wind and water have also influenced the shape of the land. Volcanic flows from Mount St. Helens have created the cave basalts in the northwest part of the watershed and also numerous lahars (mudflows) such as seen in the gorge forming Pine Creek in the northeast part of the watershed. The southern half of the watershed (which lies south of Swift Reservoir) has been formed by older volcanic activity along with the action of wind and water. The watershed is continually changing through natural means as well as management activity that has occurred since humans have been in the area. Much of the geology has been dated to 10 to 30 million years of age. It consists of interbedded materials of basalt/andesite with pyroclastic flows. Most of the watershed's large deep-seated landslides have occurred in the past in the areas of pyroclastic flows and near the margins of the basalts and pyroclastic materials. There is still evidence of movement in these areas today.

Surface erosion

Natural conditions leading to relatively high rates of surface erosion during storms include (1) high intensity burns that consumed vegetation leaving bare slopes, and (2) eruptive deposits from volcanic activity. No quantitative information is available about the amounts of sediment these processes created. It can be assumed, however, that management activities (particularly logging and road building) have probably increased the amount of sediment moving to streams above the "natural" levels. This is evident from the heavy damage which occurred during recent storm events in the watershed.

Vegetation

According to the report from the Regional Ecosystems Assessment Project (REAP) (Diaz & Apostol 1992), the Lewis River Basin was historically covered with broad continuous conifer stands of varying age classes. Large-scale disturbances were created by fire and the eruption of Mount St. Helens about every 200 years. These continuous stands were characterized by diverse species composition and structure, including older remnant live trees, standing dead trees, and downed logs. Wetlands and other special habitats were scattered across the that did not kill many of the overstory trees. Because of this, riparian areas in the watershed could have functioned as corridors through younger age class stands for species dependant on mature forest.

Old growth habitat that existed on what is today privately-owned land, played an important function in maintaining species that require this habitat across the landscape. Most old growth on private land is now gone and is not likely to be replaced, so this type of habitat on the National Forest is especially important.

Until the 1950's, the Lewis River supported an anadromous fishery that likely would have supported more bald eagles than today. It is probable that wolves were never very numerous in the watershed, because even though the watershed was secluded, it is likely that prey populations of large ungulates were not as high as today.

Caves in the watershed were probably infrequently, if ever, visited by humans. Since there was little or no disturbance at suitable caves, populations of Townsends big-eared bat in the watershed were probably higher historically than today.

Hydrologic Changes

According to streamflow records from two gaging stations (the Lewis River above Muddy River and the Lewis River at Aerial) major flood events occurred on the Lewis River in 1934, 1972, 1973 and 1974. The pre-1972 floods were probably associated with rain-on-snow precipitation events that coincided with major fires or volcanic eruption. This combination of disturbance processes in time was probably the primary mechanism causing large scale floods in the past. REAP suggests that (for the entire Lewis River Basin) between four and five percent of the Basin was in a disturbed state at any one time. Since volcanic eruption occurred at relatively frequent intervals in the Lower Lewis portion of the Lewis River Basin, one could logically infer that more than five percent of the Lower Lewis was in a disturbed state at any one time.

Road construction, as a contributor to peak flow increases, was not a factor prior to the 1930's.

Aquatic Animals and Habitat

Historical aquatic habitat and population information in the watershed is poorly documented. The distribution of resident and anadromous fish has been altered by road construction and dams in the Lower Lewis River Watershed. Assumptions about historical anadromous fish distribution (Figure 17) is based on known barriers to upstream fish passage located above Swift Reservoir. It is assumed that anadromous fishes (most likely coho and/or steelhead) utilized streams up to these barriers prior to the construction of Swift and Yale Reservoirs.

Human Dimension

Even though the Lower Lewis River Watershed has had a long period of human use (mostly prehistoric), most human-caused environmental changes have occurred since 1940. Since that time, logging and associated road building have become dominant processes in the landscape. Intense logging of privately-owned and National Forest System lands has created a patchwork of even-aged stands and an extensive network of logging roads. Logging roads further provided recreational access where previously only trails existed. Big game herds increased in logged-over areas closely followed by hunters seeking deer and elk.

The eruption of Mount St. Helens in 1980 marked yet another change in the northern portion of the watershed. The May 18,1980 eruption destroyed virtually all recreation developments surrounding Mount St. Helens. This created a deficit in facilities, making it impossible to accommodate prior use levels. Following establishment of the Mount St. Helens National Volcanic Monument in August of 1982, facilities including trails, roads, warming shelters, visitor contact stations, and parking areas were constructed to accommodate increased use.

Recreation use of the area continues to increase, particularly at Ape Cave, and at winter recreation sites. (See vehicle counts, and Ape Cave visitor use tables in Chapter III.)

CHAPTER V INTERPRETATION

Chapter V compares the existing, historical, and reference conditions of specific ecosystem elements by explaining significant differences, similarities, or trends and their causes. The capability of the system to achieve key management plan objectives is also explored.

The issues, such as mass wasting, surface erosion from roads, etc., are each addressed in turn. The comparisons, explanations, and discussions for each issue are presented in a similar series of tables and paragraphs to enable the reader to follow the logic of the analysis.

Using the information detailed in the above mentioned tables and paragraphs, the team began integrating this information spatially, i.e. displaying which sub-basins were of concern and correlating relationships between sub-basins across the watershed. This integration and synthesis of information is portrayed in four packages. Each package contains an explanation, a table of information, and a map. The first package deals with aquatic concerns. The second and third packages address terrestrial concerns, while the fourth package deals with social/economic factors. Through this analysis, sub-basins having more than one ecological concern are readily apparent. Also, the various linkages between, and flows of, elements within the ecosystem can be viewed spatially . These displays of data, information, and interpretations form the basis for recommendations which are explained in Chapter VI.

Dominant Processes

During the analysis of current and reference conditions in the watershed, and the identification of issues and key questions for geology and physical processes, fire history, vegetation, wildlife, hydrology, fisheries, wildlife, and the human component, several processes that shaped the watershed became obvious. These processes were both natural and human induced. The processes that shaped the watershed at the landscape level are described below.

Because of the complexity of ecological systems, the interrelatedness of all ecosystem components, the scale at which the analyses were performed, and the limitations of humans to accurately identify key biotic and abiotic processes that influence an ecosystem, it is unlikely that all processes were necessarily identified. The following list serves as a starting point for future analyses. To minimize redundancy, the tables and paragraphs that follow the processes list will reference these process descriptions.

Volcanic and Seismic Activity:

Volcanic and seismic activity in the watershed have been occurring for millions of years with a concentration of events in the last 40,000 years around Mount St. Helens. This

Roading:

Roading in this area has extended the stream channel network through roads and ditch lines along roads. These features may increase peak flows through road cut slope interception of subsurface flow and routing it to surface waters using road ditch lines as "pseudo channels". Some culverts do not allow fish passage resulting in fragmentation of fish habitat. Roads and culverts can not only block upstream migration of resident fish, they can alter the flow pattern of large woody debris through the system and increase sediment input (Furniss et.al. 1991).

Road access to some portions of the watershed has resulted in heavier harvesting pressures on some Special Forest Products. Harvest pressures will increase as more people come to the area.

Flooding:

Flooding can modify both upslope and aquatic terrain through initiation of landslides and removal, transport, and deposition of wood, water and sediment. In the case of debris torrents, floods can remove much of the channel complexity (LWD, sediment) and transport it to other reaches in a stream. This will simplify some sections of stream while making other sections more complex. This may influence success of some beneficial uses such as fish by altering use patterns. Flooding can also increase bank erosion and sediment introduction in general. Floods may also damage structures such as campgrounds and roads, thus altering use patterns. Flooding can also be very beneficial by adding LWD that is stored in small tributaries, to main channels as well as adding gravels for spawning and rearing.

Timber Management:

Intensive timber harvesting in this watershed began in the early 1950's and has continued throughout the last 4 decades. The objective of forest management on both federal and non-federal lands was to increase conifer growth by clearcutting slow growing, older stands and replacing them with fast growing, young conifers. Harvest units on federal lands tended to be smaller than non-federal harvest areas and were usually dispersed in small patches across the watershed. Subsequent reforestation and stand tending operations were implemented with the objective of increasing the number and growth of conifer species.

Recreation Activities:

The close proximity of this area to large population centers, and ease of access, attracts large numbers of visitors. Increased recreational demand has exceeded the ability of

Issue: Mass Wasting

Summary

Most of the landslides in the watershed are naturally occurring. Some slides (the shallow rapid torrents and flows) have been activated by management activities and are typified by the torrent that came down Marble Creek in February of 1996. The potential for future landslides in the watershed is very probable in that there are many soils susceptible to sliding as well as steep slopes. There is also the potential for existing landslides to continue to move and possibly increase due to management activities.

Components of Issue	Locations	**Current** Conditions Compared to **Reference** Conditions	Dominant **Processes**	Significant **Trends Or** Rates of Change
Fire		Decrease in high intensity fires means more vegetation which helps stabilize slopes	Fire and Wind	Possible decrease from fire
Harvest Techniques	Throughout watershed	Clear cutting has removed vegetation which has increased groundwater levels which in turn will increase potential for movement of the ground on steep slopes	Higher water tables	Has been a definite increase since harvesting has taken place.
Soils	Sub-basins 6, 7, 9, 10, 22, 23, 26, 28, 34, 35, 37	Soils probably haven't changed from reference conditions	Silts and clay soils on steep slopes	No change
Water		Changes in precipitation over time may increase movement of the ground	Rain and groundwater levels	Increase in movement in years where there is a higher amount of rainfall.

Issue: <u>Erosional Processes</u>

Summary: Road construction has had a tendency to increase sediment into streams over the past century. Most of this increase occurs in the first 2 to 5 years of construction or until an increase in vegetation on the fills and cuts starts to reduce soil movement. The amount of sediment in transport from roading depends on many variables which makes it difficult to quantify the amount of sediment eroding from any portion of the road. These quantified numbers are based on some data in the basin and on interpretation of data from similar roads that have survey data available. These numbers show a low to moderate amount of sediment being tranported from the roads to streams compared to other areas on the forest.

In the past fire has been a major process for soil movement. Fires such as the Siouxon burn destroyed much of the organic matter, which left soils susceptible to erosion during subsequent storm events. These fires also volatilized some of the nutrients which in turn slowed the growth of new vegetation. This left the slopes bare for a longer period of time causing more erosion to occur.

Volcanic activity especially from Mt. Saint Helens has had a major impact on the area north of Swift Reservoir from about 40,000 years ago up to the present. Volcanic activity has been happening in cycles of about 150 years over the past 2000 to 4000 years. This volcanic activity can easily change the landscape as has been seen from the 1980 eruption. Mud flows not only remove any thing in there path initially but over long periods of time have a tendancy to be very erosive making it hard for vegetation to re-establish on steeper slopes.

Component of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends Or Rates of Change
Glacial	Sub-basins 1, 2, 4, & 5	Glacial activity is also at a low compared to referance conditions. It is one factor in shaping the landscape as we see it today.		No trend noticable.

Issue: Erosional Processes(Continued)

Components of Issue	Existing Management Objectives and Desired Future Conditions	Current Conditions Compared to Management Objectives & Desired Future Conditions
Roading	For each existing or planned road, meet the Aquatic Conservation Strategy. ROD C32 & B11 Minimize sediment delivery to streams from roads. ROD C33	Existing roads need to be evaluated for their capability to introduce sediment into the stream system. New construction should follow the Aquatic Conservation Strategies for road management
Fire	Current management objectives are to suppress fire in the basin which would keep erosion at a low.	

Components of Issue	Locations	**Current** Conditions Compared to **Reference** Conditions	Dominant **Processes**	Significant **Trends** Or Rates of Change
Proportion of Age Classes	The watershed as a whole	Proportion of young and old forest stands are outside the reference range. Approximately half the vegetation is in the Sapling, Pole or Small Tree structural stage. Late-successional stands on Forest Service lands have been reduced from approximately 50% to 20%. A large percentage of non-federal lands have been converted to early successional stands.	Fire Volcanism Floods Landslides Timber Harvest	Natural succession has been disrupted by human management activities and the progression back towards historic conditions would take many decades.
Distribution of Structure Stages Across Watershed	All sub-basins, but <u>greatest change</u> is in southern portion (portions of sub-basins 11-14, and all of sub-basins 15-20, 22 & 25).	Many of the large contiguous even-aged stands have been replaced by a mosaic of small patches of varying age. Some large contiguous areas still exist as a result of past fires and timber harvest.	Timber Harvest	It will take several decades, and in some cases, a century or more, to restore historical vegetation patterns. With the combination of volcanic activity, matrix and non-federal lands, the age class proportions in the REAP report will likely never be achieved.

Issue: Vegetation Structure and Composition (continued)

Components of Issue	Existing **Management Objectives** and **Desired Future** Conditions	**Current** Conditions Compared to **Management Objectives & Desired Future** Conditions
Proportion of Age Classes	The watershed should be a mix of early, mid and late-successional stands. Late-successional stands should comprise greater than 50% of the federal lands within the watershed.	Age class proportions are outside the Desired Future Condition.
Distribution of Structure Stages Across Watershed	The desired distribution of structure stages varies by Management Area Category (MAC). Matrix lands should contain a mix of age classes including the majority of younger stands. Late-successional Reserves should be comprised primarily of late-successional habitat.	The distribution of age classes varies considerably from the Desired Future Condition.
Stand Structure Diversity	All forest stands should contain a diversity of different aged trees, canopy layers, snags and logs. This diversity should be greatest on lands outside the Matrix.	Stand structural diversity is below desired future conditions.
Biodiversity	Survey & Manage Standards and Guidelines provide protection to vascular plants, lichens, bryophytes, and fungi on all lands.	Biodiversity is below desired future conditions.

Components of Issue	Locations	**Current** Conditions Compared to **Reference** Conditions	Dominant **Processes**	Significant **Trends** Or Rates of Change
Reduced Conifers in Stream Riparian Areas and Adjacent Uplands	Sub-basins 1, 2, 3*, 4, 5, 6, 8*, 9*, 10*, 11, 12, 13, 18, 21, 24*, 26, 27*, 28, 30*, 31*, 32*, 33*, 34, 36*, 37	Large coniferous trees are present in amounts substantially below historic levels.	Timber Harvest Volcanism Fire Floods	It could take a century or more before historic levels are reached.
Impaired Functional Roles of Stream Riparian Ecosystems	Sub-basins 1, 2, 3*, 4, 5, 6, 8*, 9*, 10*, 11, 12, 13, 18, 21, 24*, 26, 27*, 28, 30*, 31*, 32*, 33*, 34, 36*, 37	Because of reduced structural and compositional diversity, some stream riparian ecosystem functions are impared.	Timber Harvest Volcanism Fire Floods	It could take a century or more before some historic functional roles are restored, especially large woody debris input.

Issue: Stream Riparian Reserve Fragmentation and Riparian Habitat (continued)

Components of Issue	Existing **Management Objectives** and **Desired Future** Conditions	**Current** Conditions Compared to **Management Objectives & Desired Future** Conditions
Reduced Structural Diversity	Restoration and maintenance of environmental quality are of critical importance.[1]	Structural diversity is below desired future conditions.
Reduced Hardwood Component	Hardwoods should be managed to provide mature and older stands for wildlife habitat.[2]	The hardwood component is substantially below desired future conditions.

Issue: Habitat for Threatened, Endangered, and Sensitive Plants and C3 Species

Summary

Many TES plants and C3 plants, lichens, mosses and fungi are associated with specific habitats such as stream and wetland riparian areas and late-successional stands. Because many sub-basins have had at least 25 percent of the stream riparian areas harvested, and because all but two have less than 45 percent of the sub-basin in late-successional stands, habitat for some TES plants and C3 plants, lichens, mosses and fungi has probably decreased. This could adversely impact population viability and dispersal processes for some species. Land management activities within sub-basins with a high proportion of non-Federally owned lands could also adversely impact population viabilities. (*Indicates sub-basins with a high proportion of non-Federal lands, or where non-Federal lands have already been heavily harvested).

Components of Issue	Locations	**Current** Conditions Compared to **Reference** Conditions	Dominant **Processes**	Significant **Trends Or** Rates of Change
Reduced Late-Successional Habitat	All sub-basins **except** 23 and 35.	These sub-basins have less than 45 percent late-successional vegetation, which is below the REAP (Diaz & Apostle 1992) estimate.	Timber Harvest Volcanism Fire Floods	It may take many decades to return to historic conditions.
Reduced Stream Riparian Reserve Habitat	Sub-basins 1-6, 8, 11, 13-20, 22, 24, 25, 36, 37	These sub-basins have ≥ 25 percent of the Stream Riparian Reserve harvested.	Timber Harvest Volcanism Fire Floods	It may take many decades to return to historic conditions.
Population Viability and Dispersal Capabilities	All sub-basins **except** 23 and 35.	Late-successional and stream riparian conditions are below historic conditions.	Timber Harvest Volcanism Fire Floods	It may take many decades to return to historic conditions.

Issue: HABITAT FOR TES ANIMAL SPECIES

Summary

The watershed contains habitat for several species listed as threatened, endangered, or sensitive. Habitat conditions for bald eagles in the watershed are discussed in the Middle Lewis Watershed Analysis. The Lower Lewis Watershed contains a largely unroaded block of land in the Siouxon Creek area that totals about 53 square miles. Only about 25 percent of the elk and deer winter range in the watershed is optimal thermal cover. A majority of the suitable spotted owl habitat in the watershed is contained within management allocations that restrict timber harvest. The stream riparian reserves in the watershed are heavily fragmented, affecting ability of old growth dependant species, and amphibians to disperse.

Components of Issue	Locations	**Current Conditions** Compared to **Reference** Conditions	Dominant **Processes**	Significant **Trends Or** Rates of Change
Conditions for species requiring late-successional habitat.	Watershed-wide.	Amount of late-successional habitat less than reference conditions. (Approximately 19% compared to 45% - 70% historically). Existing late-successional habitat is more fragmented than historical conditions. Snag density in the watershed is lower than reference.	Fire, timber harvest.	Trend is toward an increase in large tree habitat, and multi-storied habitat through forest succession in the LSR, and other areas withdrawn from timber harvest.
Conditions for species requiring seclusion from human disturbance (low road density).	Watershed-wide.	The road density is higher than reference conditions, and human use of the watershed is significantly higher. Opportunities for seclusion are best in the Siouxon Creek sub-basins (21, 26, 27, 28, 29, 30, 31).	Road construction for timber harvest.	Under the Northwest Forest Plan the trend is toward a reduction in road density through watershed restoration projects.

Components of Issue	Locations	**Current** Conditions Compared to **Reference** Conditions	Dominant **Processes**	Significant **Trends Or** Rates of Change
Conditions for Townsend's big-eared bat.	Lava tubes within the legislated Monument.	At least three of the occupied hibernacula receive regular use by recreationists in the winter. This disturbance may cause death of individuals, and loss of the population. There was little to no disturbance of these sites in the winter historically.	Road building has improved access.	Increased visitor use can be expected with the growth of the Vancouver and Portland metro areas. Requirements in the ROD to protect cave habitat will help to preserve habitat.
Conditions for Larch Mountain Salamander.	Lava tubes within the legislated Monument, and the Canyon Creek drainage.	Recreational use in the caves may cause the death of individuals and loss of scattered populations. Timber harvest activities may have habitat unsuitable in Canyon Creek by removing overstory cover on talus sites.	Timber harvest, including road construction that improved access to the lava tubes.	Increased visitor use can be expected with the growth of the Vancouver and Portland metro areas. Surveys required in the ROD for this species will help to minimize impacts to this species from timber harvest.

Issue: HABITAT FOR TES ANIMAL SPECIES (continued)

Components of Issue	Existing Management Objectives and Desired Future Conditions	Current Conditions Compared to Management Objectives & Desired Future Conditions
Conditions for species requiring late-successional habitat.	Landscape areas where little late-successional forest persists should be managed to retain late-successional patches. This standard and guideline will be applied in 5th field watersheds in which federal forest lands are currently comprised of 15% or less late-successional forest. Protect and enhance conditions of late-successional and old growth forest ecosystems in LSR's	Currently, about 19% of the watershed is late-successional habitat. About 55% of the spotted owl nesting, foraging, and dispersal habitat on National Forest in the watershed is in the LSR. The LSR constitutes 38% of the watershed. There are young stands within the LSR that, over time will develop into habitat suitable for old growth species.
Conditions for species requiring seclusion from human disturbance.	In Key Watersheds: No new roads will be built in roadless areas. Reduce existing system and non-system road mileage outside roadless areas. If funding is insufficient to implement reductions, there will be no net increase in the amount of roads in Key Watersheds. Roads not required for resource use, protection, or some other demonstrated access need should be closed or decomissioned.	There are opportunities to decommission roads as part of watershed resoration.

Issue: <u>HYDROLOGIC CHANGE</u>

Summary

In general, sub-basins within the analysis area are recovering from fires and timber harvest. Analysis found that 57% of the sub-basins in the area have increased peak flows of 5% or greater, due to removal of the mature conifer vegetation component by these fires and timber harvest. It should be noted that vegetation information is missing for all the non-National Forest Land. Roading has also contributed to the situation by increasing stream lengths in the area by 33%, thus contributing more surface water to streams.

Components of Issue	Locations	**Current** Conditions Compared to **Reference** Conditions	Dominant **Processes**	Significant **Trends** Or Rates of Change
Peak Flow Increase - Vegetation Related	6,7,8,20	44% of the watershed in early successional stands currently compared to 8-18% (USDA, 1993) of the watershed historically.	Fire and timber harvest	Recovering as large conifers return to the sub-basins.
Peak Flow Increase - Road Related	7,8,9,11,15, 17,18,19,22, 24,25,32,33, 36	Approximately 1905 miles of stream channel currently compared to 1433 miles historically.	Road systems have increased the length of stream channels	Number of miles increasing due to increasing road miles.

Issue: Key Habitat Attributes for Salmonids

Summary for Key Habitat Attributes for Salmonids: Components of salmonid habitat in the Lower Lewis River Watershed are affected by the following natural and human induced processes: fire, harvest/management activities, road construction, and dams. Each of these processes has influenced the condition of habitat in the watershed.

Large catastrophic fires have resulted in relatively young even-aged (e.g., 70-90 years) riparian areas. This has resulted in a limited supply of large woody debris that is available to the stream channel. Lack of LWD in the channels could be contributing to a lack of pools in the channels as well, which results in a lack of quality habitat for the salmonid species that use this watershed.

Road construction resulted in loss of available habitat when fish were not provided adequate passage facilities through culverts. Roads constructed on native surfaces also deliver additional sediment to the stream channels that can alter in-channel conditions decreasing quality habitat (i.e., filling in pools, silting in spawning beds, etc.).

Dams on the Lewis River have prevented upstream passage of anadromous (and resident) fishes, and the downstream movement of LWD since the 1930s. Historical spawning areas were obliterated by the reservoirs. The reservoirs also serve as sediment storage basins. Fish stocked in the reservoirs may be impacting wild stocks of native fishes, e.g., increased competition for habitat and food, increased fishing pressure, and dilution of the wild fishes genetic pool.

The following information is provided for each component of salmonid key habitat attributues addressed in this watershed analysis: locations (each stream (and sub-basin) is listed where the habitat attribute is below desired management objectives), current conditions compared to reference conditions, what the dominant processes are affecting the attribute, and how the attribute is changing (or expected to change with current management policies).

Components of Issue	Locations	**Current** Conditions Compared to **Reference** Conditions	Dominant **Processes**	Significant **Trends** Or Rates of Change
Stream Tempera-ture	Canyon Cr-25 Siouxon Cr-26, 28 Puny Cr-15 Sorehead Cr- 20, Pine Cr-7	Exceeds State Water Quality Standard	Exposed channels due to fire regimes, timber harvest, and roadbuilding	Temperature decreasing as canopies develop and mature with implemenation of riparian reserves
Aquatic Habitat Fragmenta-tion	Sub-basins: 6-11, 14-20, 22, 24-26, 32-34,36,37	Fragmentation has increased due to road building	Road building without fish passage	Fragmentation is decreasing as ROD is implemented, and roads are decommissione d, and culverts replaced
		Flow of LWD thru system has decreased	Road Maintanance removes LWD at crossings	Maintain/Slight increase of LWD

Issue: Key Habitat Attributes for Salmonids (continued)

Components of Issue	Existing **Management Objectives** and **Desired Future** Conditions	**Current** Conditions Compared to **Management Objectives & Desired Future** Conditions
In-Channel Large Woody Debris	> 80 pieces per mile that are > 50' long and 36" DBH (Columbia River Policy Implementation Guide)	Of the total length of surveyed streams, 66 percent are outside the management objectives (i.e., have a poor rating).
Large Woody Debris Recruitment Potential	Aquatic Conservation Strategy Objectives (ROD B-11)	Riparian areas not currently supplying amounts and distributions of LWD sufficient to sustain physical complexity and stability.
Stream Tempera-ture	Stream Temperatures shall not exceed 16°C due to human activities (Water Quality Standards for Waters of the State of Washington)	Stream water temperature is outside management objectives for Siouxon Cr, Canyon Cr, Puny Cr, Pine Creek, and Sorehead Cr.
Primary Pools Per Mile	The number of pools per mile are established by the CRBPIG and relate to the average wetted width of the channel (CRBPIG)	Of the total length of surveyed streams, 53 percent is outside the management objectives (i.e., have a poor rating).
Aquatic Habitat Fragmenta-tion	Provide and maintain fish passage at all road crossings of existing and potential fish-bearing (ROD S&G's C-33) New stream crossings on fish-bearing streams should be designed to allow fish passage (GPNF Forest Plan)	Some existing culverts do not provide fish passage, these are not meeting management objectives.

Issue: <u>RECREATION USE</u>

Summary

Recreation use of this area has doubled since many of the facilities were constructed in the 1980's This is now causing parking lots to fill to overflowing early on high use days. Use is now limited by the availability of parking at Cougar and Marble Mountain Sno-Parks, and at Ape Cave. Only 33% of the carrying capacity of these sites is utilized. Parking capacity of existing sites can be tripled before the carrying capacity of winter trails, or Ape Cave are reached.

A high demand for sno-play (sledding, innertubing, and playing in the snow) exists, but facilities to accommodate use are lacking. Demand is indicated by frequent inquiries, and visitor's attempts to use unsuitable areas.

Winter observations in the vicinity of the Cougar Sno-Park indicate the lack of restrooms create an unsanitary condition. As use continues to increase, sanitation concern also increases.

Components of Issue	Locations	**Current** Conditions Compared to **Reference** Conditions	Dominant **Processes**	Significant **Trends** Or Rates of Change
Parking Capacity	Sub-basins 1, 2, 4, 34	Doubling of recreation use since construction of Sno-Parks and remodeling of facilities at Ape Cave in 1988.	Increased recreational use	Increase in winter recreation is expected. Summer use at Ape Cave is expected to increase.
Recreation Demand	Sub-basin 2	No facilities to accommodate snow-play. Historically this opportunity was provided at Spirit Lake, but has not been available since 1980.	Increased recreation use and demand for sno-play for children.	Public demand for snow-play opportunities is expected to increase.

Issue: RECREATION USE (continued)

Components of Issue	Existing **Management Objectives and Desired Future** Conditions	**Current** Conditions Compared to **Management Objectives & Desired** Future Conditions
	Parking capacity will be increased to accommodate current sno-park parking demand, and that expected within the next decade. Marble Mountain Sno-Park will be increased from 80 to 240 parking spaces, and Cougar Sno-Park from 20 to 60 spaces. Additional parking will be developed at Ape Cave, increasing parking from 40 to 120 vehicles. Parking will accommodate an increase in tour-bus and RV use.	Recreation opportunity provided by winter trails is not being fully utilized due to inadequate parking. Only 33% of the winter trails carrying capacity is being utilized. Recreation use is now limited by available parking. Existing parking can be tripled before carrying capacity is reached. Ape Cave will reach its carrying capacity when parking is increased to 120 vehicles. An increase in tour-bus operations is expected over the next decade.
Recreation Demand	Snow-play facilities will be developed to accommodate at least 60 vehicles.	Demand for snow-play is high, and expected to increase over the next decade.
Sanitation	Restrooms will be placed at the Cougar Sno-Park when parking is increased. Restrooms will also be provided when a sno-play area is developed. The management objective is to provide restroom facilities at developed recreation sites where the length of stay is more than thirty minutes.	Currently winter users are not provided restrooms, leading to concern over sanitation. Where restrooms are missing, sanitation problems will increase as visitation to the area increases.

and timber harvest, and high surface erosion with sensitive stream channels. These poor conditions are due mostly to timber harvest and road construction, but also partially from the mudflow that occurred in the 1980 eruption of Mount St. Helens.

It should be noted that the Siouxon Creek basin has some poor aquatic conditions due to past fires. The mainstem has high stream temperatures and some poor channel conditions but should continue to recover as large trees develop along the riparian areas.

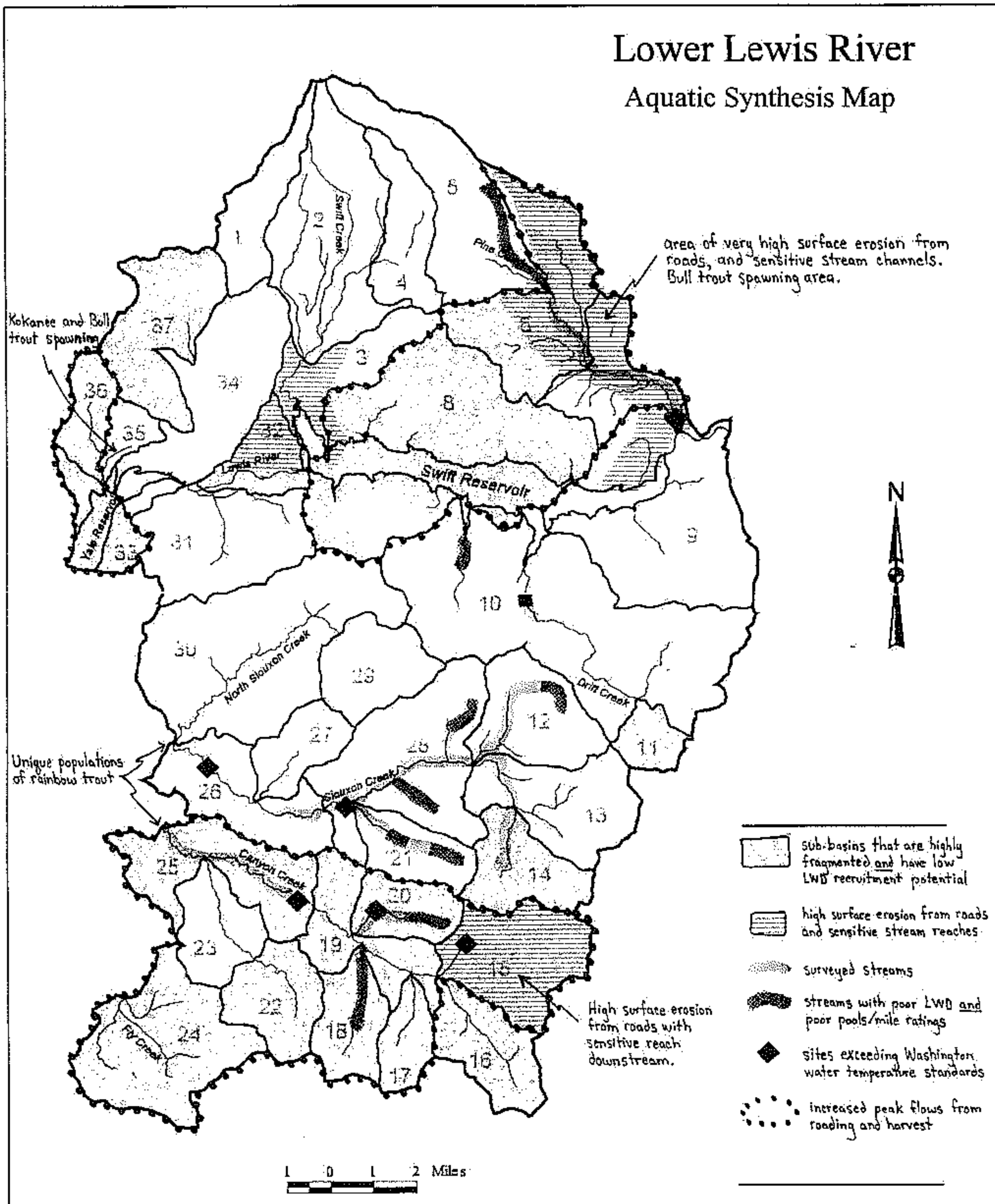


Figure 29. Synthesis of data showing sub-basins and stream reaches that have known problems, based on in-channel and up-slope conditions.

Terrestrial Synthesis Explanation

The central portion of the watershed is comprised of non-Federal lands. Approximately two-thirds of these lands will likely be managed for timber production on short rotations, with very little late-successional habitat remaining. The remaining one-third are lands managed by the Washington Department of Natural Resources (DNR), which will likely be managed to provide habitat for the Northern spotted owl. This watershed analysis did not analyze vegetation conditions for these lands.

The Late-successional Reserve (LSR) roughly coincides with the portion of the watershed where historical unfragmented vegetation patterns still exist. Adequate nesting, foraging, and dispersal habitat for the spotted owl exists within most of the LSR; however, there are some areas where snag densities are low and fragmentation high. These areas stand out as having potential for restoration.

Matrix lands comprise the southern portion of the watershed, as well as a small area in the central portion and about half of the northern portion. The majority of timber harvest has occurred in Matrix, and snag densities are likely low on these lands. The northern portion of the watershed does not contain the fragmented mosaic of small stands with different age classes which exists in the southern portion, but the large tree component is almost absent in this area. Most of the sub-basins in the Matrix do not contain adequate dispersal habitat for spotted owls, and have had intensive timber harvest on over one-quarter of the stream Riparian Reserves. Some sub-basins have had greater that fifty percent of the stream Riparian Reserves converted from large tree structural stage to plantations.

Threatened, endangered, and sensitive animal sightings in the watershed have included bald eagle, gray wolf, Townsend's big-eared bat, and Larch Mountain salamander. Potential nesting habitat for peregrine falcon exists on non-Federal land in the watershed. Larch Mountain salamander populations have been found in two sub-basins along Canyon Creek (16 and 25), and the potential exist for more populations to be found in the sub-basin that lies between these two (19). Other known populations of this species and of Townsend's big-eared bat are in the Congressionally withdrawn monument.

A fairly large block of land, that is comprised of DNR lands and National Forest, with a relatively low road density exists in the central part of the watershed. Just to the east of the watershed boundary, the Trapper Creek wilderness contributes additional unroaded acres to this area.

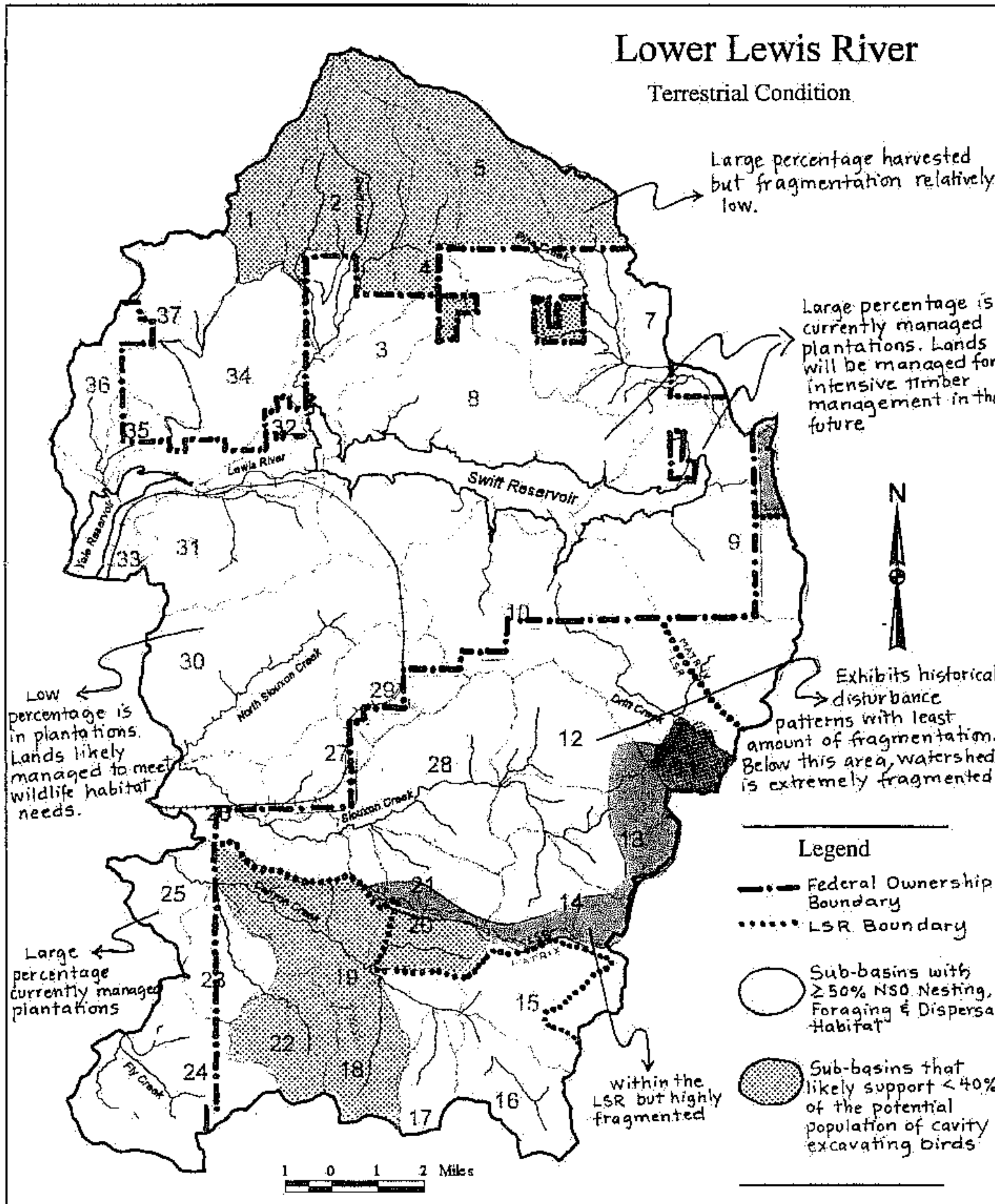


Figure 30 Terrestrial vegetation condition as it relates to historical versus current disturbance patterns, areas of intensive timber harvest, and cavity excavator habitat.

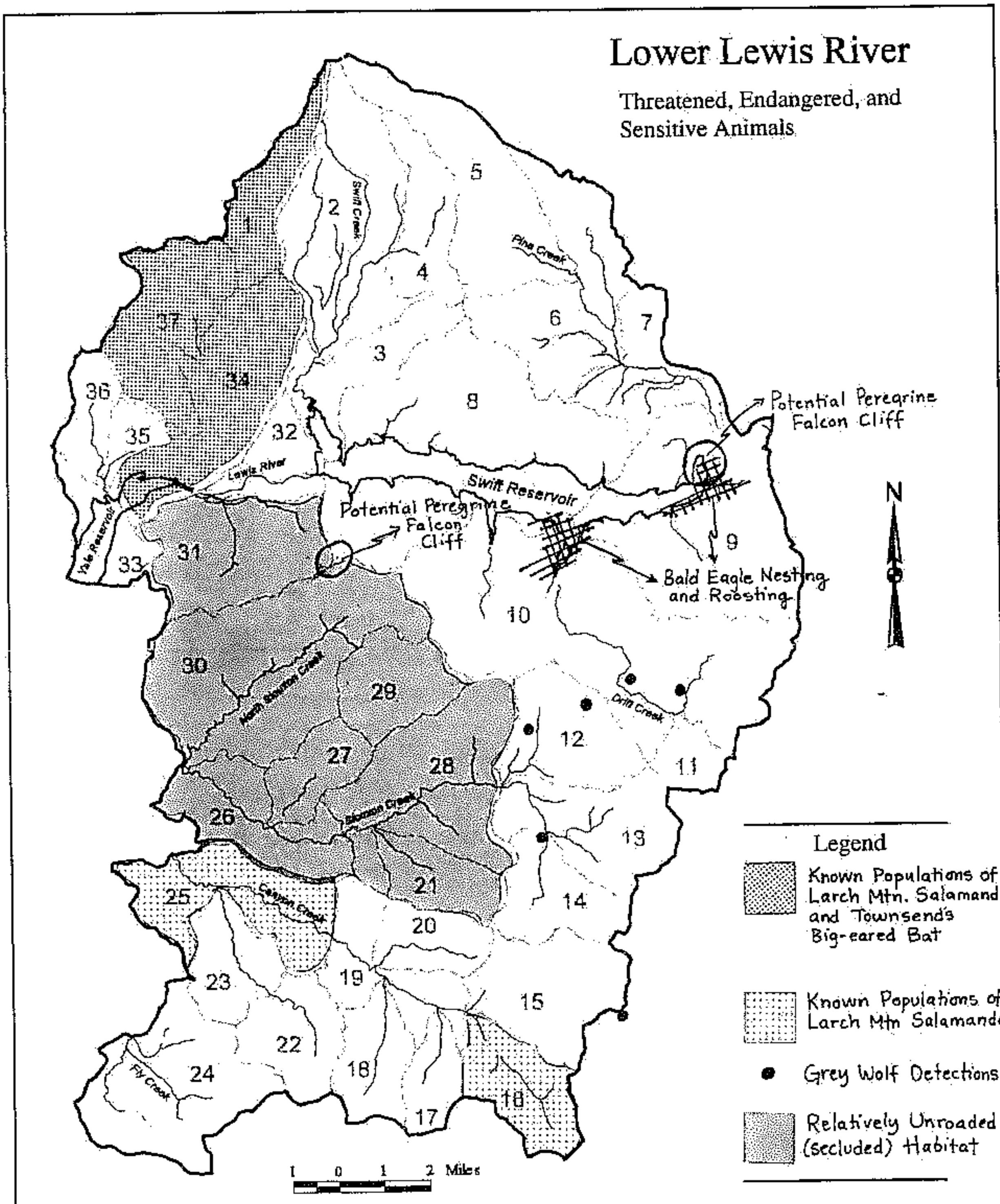


Figure 31. Sub-basins where threatened, endangered, or sensitive species have been detected, and where important habitat exists.

Social and Economic (Recreation) Synthesis Explanation

The synthesis table shows important parameters for recreation use within the watershed. Of particular importance is recreation use in sub-basins 34 and 2. Here are found Ape Cave, Trail-of-two-forests, Cougar Sno-Park, Marble Mountain Sno-Park, Climbers Bivouac and Ptarmigan Trailhead, and a network of summer and winter recreation trails. These sub-basins account for the heaviest recreational use, and demand, on the south side of Mount St. Helens. Only Ape Cave and Trail-of-two-forests are located within the legislated boundary of Mount St. Helens National Volcanic Monument (Figure 32).

Within sub-basins 34 and 2 can be found year-round road access to recreation sites. Recreation use here is high, and increasing yearly. This creates parking congestion at both sno-parks and Ape Cave. At these sites recreation use frequently exceeds available parking space, creating unsafe conditions for recreationists who, while attempting to park, frequently block roads 83 and 8303. No restroom facilities are provided at Cougar Sno-Park, leading to a sanitation concern.

Demand for snow-play (sledding or using inner tubes for sliding) is high around the two sno-parks and along roads 83 and 8303. No facility for this activity exists, tempting visitors to use unsuitable, or unsafe spots for sledding. Sledding off road banks onto plowed roads is frequently observed by snow rangers and law enforcement personnel.

Businesses along the North Fork Lewis River are developing an ever-increasing dependence upon recreational visitors for income. Recreational opportunities within sub-basins 34 and 2 include hiking, snowmobiling, cross-country skiing, driving for pleasure, picnicking, cave exploration, fishing, mountain climbing, nature study, camping, boating, and hunting. An average of 800,000 recreationists visit the area each season, while 16,000 climb Mount St. Helens each year. A shift from a logging to a service-based economy has evolved since the eruption of Mount St. Helens and establishment of the National Volcanic Monument.

The future challenge to recreational management is keeping pace with increasing use through improved parking, and development of facilities to accommodate snow-play within the Winter Recreation Area. Summer use at Ape Cave is on the rise, demanding ever increasing interpretive services including guided cave walks, and staff to operate the Ape's Headquarters contact station. Ape Cave is one of the ten most visited caves in the United States, with visitation exceeding that of Oregon Caves National Monument. Stairways in Ape Cave are deteriorating and are in need of replacement.

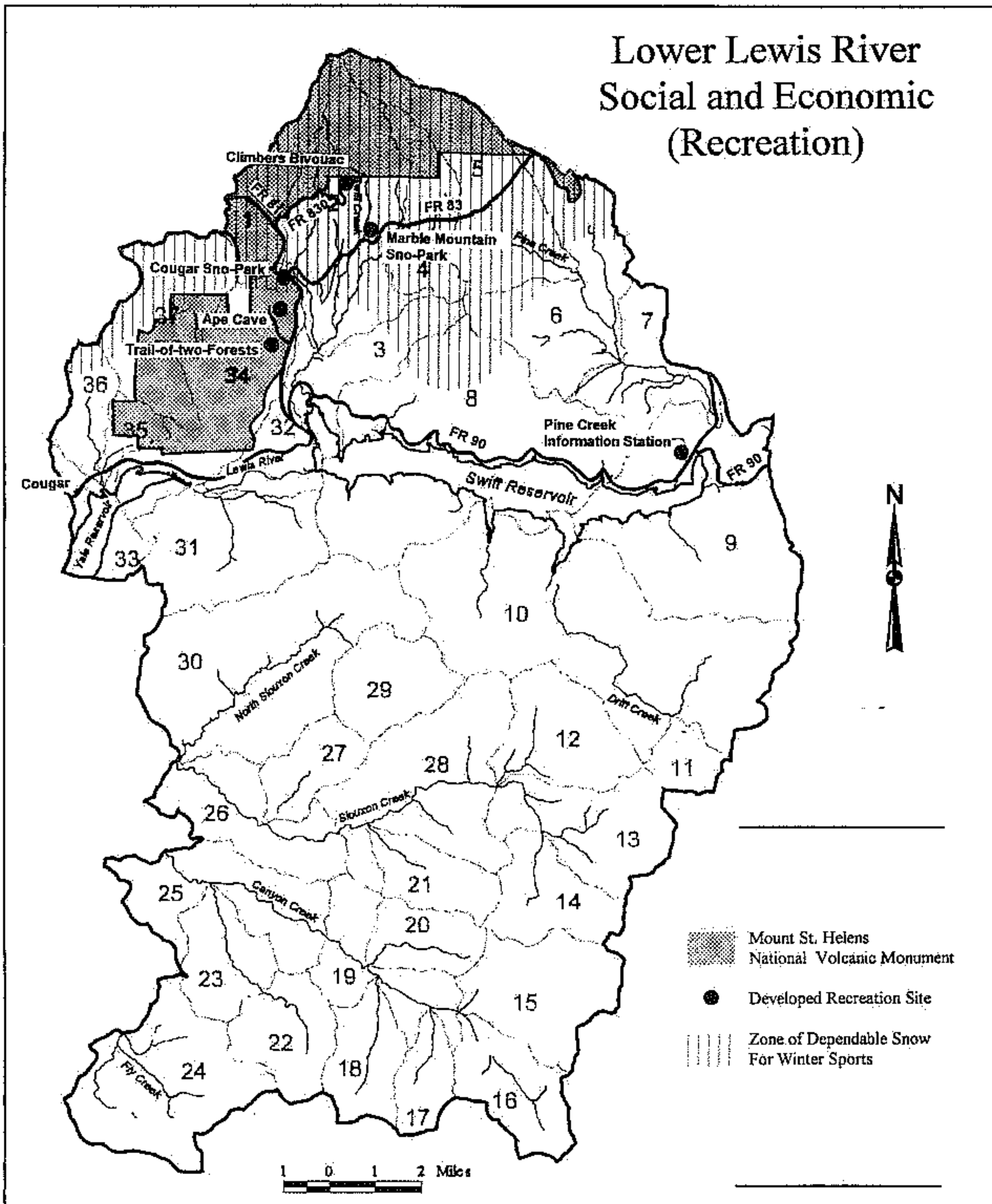


Figure 32. Heavily used recreation sites are found within or adjacent to Mount St. Helens National Volcanic Monument in the northern portion of the watershed. These sites attract both summer and winter recreation use. Parking at Ape Cave, Cougar Sno-Park, and Marble Mountain Sno-Park frequently exceed capacity. The demand for snow-play is high, but not met with existing facilities.

Table 27 Aquatic, Terrestrial, and Social and Economic Synthesis Elements by Sub-basin.																		
	Aquatic					Terrestrial						Social and Economic						
	High Frag. & Low LWD Potential	High Risk of Inc. Peak Flow	High Sediment	Extremely Poor Fish Habitat	High Water Temperature	50-11-40 Not Met	> 25% Stream RR Harvest (*>50%)	>50% Hrvstd & <15% Lrg Tree Rmains	< 40% Potent. Pop. of Cvity Excvtrs	Highly Frag. Veg. Pattern	Lrch Mt. Salmndr/Twnsnd's Big-eared Bat	High Summer Use	High Winter Use	Adequate Snow	Sanitation Problems	Use Increasing	Parking Problems	High Snow Play Demand
1 Lava Caves						X	X	X	X		X		X	X		X		
2 Upper Swift Cr.						X	X	X	X			X	X	X		X	X	X
3 Lower Swift Cr.			X			X	X		X				X	X		X		
4 Wapiti Meadow						X	X*	X	X					X				
5 Upper Pine Cr.				X		X	X	X	X			X	X	X		X		
6 Middle Pine Cr.	X	X	X			X	X*	X	X			X	X	X		X		
7 Lower Pine Cr.		X	X		X	X			X					X				
8 Middle Swift Res. Tribs	X	X				X	X*	X										
9 Tribs. to Swift Res.			X					X										
10 Drift Cr.				X														
11 Timber Cr.	X					X	X		X	X								
12 Chinook Cr.				X														
13 Upper Siouxon Cr.							X			X								
14 Calamity Cr.	X						X			X								
15 Puny Cr.	X	X	X		X	X	X*			X								
16 Upper Canyon Cr.	X					X	X			X	X							
17 Pelvy Cr.	X	X				X	X*			X								
18 Jakes Cr.	X	X		X		X	X*		X	X								
19 Middle Canyon Cr.	X	X				X	X*		X	X								
20 Sorehead Cr.	X	X		X	X	X	X*		X	X								
21 West Cr.				X						X								
22 Upper Big Rock Cr.	X	X				X	X*		X	X								
23 Lower Big Rock Cr.		X								X								
24 Fly Cr.	X	X				X	X			X								
25 Lower Canyon Cr.	X	X			X	X	X*		X	X	X							
26 Lower Siouxon Cr.					X													
27 Siouxon Unnamed Trib.																		
28 Middle Siouxon Cr.				X	X													
29 Upper N. Siouxon Cr.																		
30 North Siouxon Cr.																		
31 Ole Cr.																		
32 Lower Lewis River Tribs.	X		X															
33 Upper Yale Lake Tribs.	X	X																
34 Green Mountain						X					X	X	X	X	X	X	X	X
35 Lower Cougar Cr.														X				
36 Panamaker Cr.	X	X				X	X*							X				
37 Upper Cougar Cr.	X					X	X				X			X				

CHAPTER VI RECOMMENDATIONS

From the information gathered, synthesized, interpreted and displayed in previous chapters, the ID team identified those management activities that could move the system toward reference conditions or management objectives, as appropriate.

The management activities are sorted into three categories:

- Restoration Activities
- Monitoring Activities, and
- Commodities and Development

For each of the 23 recommended activities, an explanation of the rationale for the recommendation is presented. This is displayed under four sub-headings for each recommendation in turn, as follows:

A. What is it? Specific description of the recommended activity.

B. Ecosystem conditions and/or functions that would be altered, maintained, or restored.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

D. The anticipated rates and time lines for achieving the management objectives.

Priorities: In the paragraphs describing each recommendation, the priority sub-basins to which a particular recommendation applies is shown.

For the restoration grouping, the types of recommendations are prioritized as High or Moderate as follows:

High	Road Decommissioning
Moderate	Road Weatherization
Moderate	Silvicultural Treatment of Upland Stands
Moderate	Silvicultural Treatment of Riparian Stands
Moderate	Stream Enhancement
Moderate	Snag Creation
High	Erosion Control/Slope Stabilization
High	Cooperative Restoration Among Landowners

The team could see no purpose in applying priorities to the other two groupings: Monitoring and Commodities/Development.

It is expected that priorities will be used later to decide which proposed projects will be

Restoration Activity

ROAD DECOMMISSIONING

A. What is it?

Road decommissioning is the action of removing a road from the transportation system and returning to a stable configuration to revegetate and recover. This action includes but is not limited to culvert removal, construction of water bars and cross-drains to control surface water runoff (such as where ephemeral draws cross the roadway), fill slope removal in areas of unstable road fill, and subsoiling or ripping of the road running surface in areas of soil compaction. Subsoilers are large shanks attached to a tool bar mounted to the rear of a crawler tractor.

Following equipment operations, all exposed soil is seeded and fertilized. Annual grasses such as cereal rye are utilized to provide quick cover while not adversely affecting the re-establishment of native vegetation (native species are preferred and if available will be used). Conifers may also be planted on these sites. Native species are preferred for re-establishment of vegetation. Finally, a closure berm is constructed to prevent vehicular access to the treated area.

B. Ecosystem Conditions and/or functions that would be altered, maintained or restored?

The purpose of decommissioning roads is to reduce habitat fragmentation in uplands and Riparian Reserves, erosion rates from roads, mass wasting hazards, and peak flows. It will also improve habitat quality for wildlife species that are sensitive to human activity and provide quality hunting, fishing, and recreation areas.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Sub-basins that are a high priority for this treatment include 6, 7, 8, 15, and 32. Sub-basins that are a medium priority for this treatment include 3, 16, 17, 18, 19, 20, 22, 24, 25, 33, and 36. Priority areas were identified as those places where multiple road related concerns exist. These include sub-basins that had high aquatic fragmentation, high surface erosion, adjacent beneficial uses, and road related peakflow concerns.

Among restoration recommendations for the watershed, this is given a high priority.

D. The anticipated rates and time frames for achieving the management objectives.

Benefits derived from reducing aquatic fragmentation begin immediately after project implementation. It takes 20 or more years to realize the benefits related to reducing upland habitat fragmentation. One immediate benefit is reduced sedimentation. The benefits relating to reduced surface erosion and reduced peak flows are realized within five years as vegetation is established on exposed soil. The time line for achieving these benefits is dependent on funding available later.

Restoration Activity

SILVICULTURAL TREATMENTS TO ACCELERATE DEVELOPMENT OF UPLAND SAPLING/POLE & SMALL TREE STANDS.

A. What is it?

Precommercial thinning: Chain saws are used to fell trees in closed sapling/pole stands (less than 8 inches D.B.H.). Lacking a market, felled trees are left in place where they fall. Minor species in the stand are favored as leave trees to promote species and structural diversity. Leave trees are irregularly spaced to promote structural diversity.

Commercial thinning occurs in stands of closed small tree stands, generally about 8 inches to 15 inches D.B.H.. Felled trees are bucked and yarded to a landing and are hauled to markets by truck.

Fertilization: Helicopters are used to spread nitrogen fertilizer in urea form over young managed stands which have been previously thinned. Application is done in the spring or fall when temperatures are relatively cool but not during heavy rains.

Interplanting and planting: Tree and shrub seedlings are hand planted in areas where vegetation or species diversity is lacking.

B. Ecosystem Conditions and/or functions that would be altered, maintained or restored?

Upland silvicultural treatments accelerate development of large diameter trees and species and structural diversity in stands. The result is quicker development of stand characteristics towards mid and late successional size and structure.

Thinning (precommercial and commercial) results in fewer trees using limited resources (nutrients, moisture, light). Residual trees respond with accelerated diameter growth. Variations in tree species, genetic traits, and microsites, along with some gradual inseeding of new trees, result in variable height growth of trees and gradual development of different canopy levels. The diverse stands which develop provide quality habitat for many wildlife species and provide root strength and snow interception for watershed protection.

Fertilization results in a temporary increase in available nitrogen (approximately 10 years duration). Trees respond with accelerated height and diameter growth. Variable responses among trees result in enhanced development of different canopy levels. The resulting structural diversity provides quality wildlife habitat and root strength and snow interception for reduced peak flows and watershed protection.

Interplanting and planting results in establishment of diverse vegetation on exposed sites. This initiates or enhances development of quality wildlife habitat and reduces erosion and peak flows.

Resoration Activity

SILVICULTURAL TREATMENTS TO ACCELERATE DEVELOPMENT OF RIPARIAN SAPLING/POLE & SMALL TREE STANDS.

A. What is it?

The objective is to encourage development of a mixed stand of hardwoods and large conifers.

Interplanting of conifer, hardwood, and shrub seedlings will (1) increase the conifer component of riparian stands, (2) enhance species and structural diversity, and (3) allows for future recruitment of quality large woody material. Conifer seedlings (western redcedar, western hemlock, and Douglas-fir) are hand planted in areas where vegetation or species diversity is lacking. Trees are planted between 100 feet and 300 feet from channels, in existing openings or small openings which are created with chain saws to facilitate open growing of seedlings. Seedlings may be protected with vexar tubing or netting to prevent browse damage.

Thinning of conifers in riparian areas will accelerate development of large conifer trees: Chain saws are used to fell young conifers. Trees are left in place where they fall. Minor species in the stand are favored as leave trees to promote species and structural diversity. In riparian reserves, emphasis is on thinning wide enough to avoid the need for future thinning or other stand manipulation (falling of larger trees may be more likely to result in soil disturbance).

B. Ecosystem Conditions and/or functions that would be altered, maintained or restored?

Interplanting of conifers, hardwoods, and shrubs enhances species diversity. Thinning of conifers results in fewer trees using limited resources and residual trees respond with accelerated diameter growth. Accelerating conifer development in riparian areas provides quality future habitat for fish and wildlife and reduces erosion and peak flows.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Treatments are conducted spring through fall when areas can be accessed.

These treatments are a priority in sub-basins with riparian areas lacking in large conifers. The highest priority sub-basins to evaluate for treatment are 18 and 20. These two sub-basins have had high riparian harvest, are highly fragmented, and have streams with both poor LWD and poor pool ratings. Other priority sub-basins to evaluate include 1, 2, 3, 4, 6, 8, 9, 10, 11, 12, 13, 17, 19, 20, 21, 22, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 36, and 37.

Potential treatment areas should be walked by an integrated resource staff group with expertise from silviculture, watershed/fisheries, and wildlife/ecology to evaluate site specific treatment needs and methods.

Among restoration recommendations for the watershed, these treatments were assigned a

Restoration Activity:

STREAM ENHANCEMENT

A. What is it?

Stream channels would be modified through the addition of LWD or boulders to create additional or higher quality salmonid habitat. Structures could be added in several ways 1) large machinery used to place boulders/LWD, 2) helicopters used to place boulders/LWD 3) hand winching of existing on-site material into different locations or 4) a combination of one or all of these methods. Large woody debris would not be removed from existing riparian areas, but instead would be located through reconnaissance of blow-down sites, and from other off-site locations.

B. Ecosystem Conditions and/or functions that would be altered, maintained or restored?

Channel morphology indicates that specific reaches are better able to "use" large woody debris. These reaches are likely suitable for stream enhancement of existing condition to bring the channel into the range of natural variability for pools per mile and pieces of LWD per mile. Channels would become more complex, and pools would be created enhancing salmonid habitat for both spawning and rearing.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Stream enhancement projects should be done only after upslope stabilization problems have been corrected. Enhancement activities could proceed after an intensive stream survey of the reach is completed, and designs for the structures are developed. Design of the project would receive peer review prior to implementation. Work would likely occur during the late summer (low water times). Sub-basins on USFS lands where this activity may be appropriate include: 5, 10, 12, 18, 20, 21, and 28.

Among restoration activities, this is rated as a moderate priority.

D. The anticipated rates and time frames for achieving the management objectives.

Time frames for this activity are dependant on receiving restoration funding. A project of this scope and scale could cost as much as $100,000, and would need to be prioritized with other restoration activities both in this sub-basin and across the Forest.

Restoration Activity

EROSION CONTROL/SLOPE STABILIZATION

A. What is it?

Erosion control/slope stabilization is the action of stabilizing actively eroding areas such as mass wasting sites, dispersed recreation sites, rock quarries, road cut and/or fill slopes, and stream banks, in an effort to reduce sediment input. This involves primarily soil bioengineering techniques such as planting trees and shrubs, live fascine bundles and live staking, erosion control blankets, hydromulching, and installing live cribwalls.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

The major condition restored are sediment regimes that more reflect historic conditions.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Sub-basins where this treatment is a priority are those areas that are known or suspected sediment sources that have the potential to deliver sediment to beneficial use areas.

Sub-basins that are a priority for this treatment are: 6, 7, 8, 9, 15, and 32. A problem site that was identified as needing restoration is the Ridge Quarry that is adjacent to the Marble Mountain Snow Park in sub-basin 4.

Among restoration recommendations for the watershed this is given a high priority.

D. The anticipated rates and time frames for achieving the management objectives.

Benefits relating to reducing surface erosion and mass wasting will take three to five years after project implementation to begin to see results of reduced sedimentation. This is due to the time necessary for the vegetation to establish on exposed soil. Time frames for achieving these benefits are dependent on availability of restoration funding.

Monitoring Activity:

RECREATION USE

A. What is it?

Track changes in recreation through use of traffic counters located on access roads to developed recreation sites. By monitoring traffic use, total visitor use of the area can be monitored and quantified. By comparing this data with previous years, trends in use and recreation demand can be determined.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

Monitoring will identify areas where use levels are changing, and where use conflicts are developing. By monitoring for peaks in recreation use, strategies can be developed to spread use over time, or identify areas where changes in facilities are needed.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Monitoring would be conducted year-round on roads in or providing access to the following sub-basins: 1, 2, 4, 5, 6, 7, 8, 9, 21, 26, 28, 32, and 34.

D. The anticipated rates and time frames for achieving the management objectives.

Traffic monitoring is currently active and will continue indefinitely.

Monitoring Activity:

STREAM SURVEYS.

A. What is it?

Stream surveys would collect data on the condition of aquatic and riparian habitat, and may include characterization of riparian vegetation, channel type and stability, bank stability, substrate type, and fish species present and their distribution.

B. Ecosystem Conditions and/or functions that would be altered, maintained or restored?

Collecting stream survey data would help to identify which stream reaches do not meet the desired condition. These streams would then be a priority for restoration.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Sub-basins that are a priority for this monitoring are those for which there is no existing stream survey data, and/or where there is a high likelihood of future management actions. These USFS land sub-basins in prioritized order are: 16, 17, 19, 22, and 23 (Canyon Creek sub-basins), 10 (Drift Creek sub-basin), and 2 (Swift Creek sub-basin). Class I and II streams within the remaining sub-basins should also be surveyed.

Since this type of monitoring is ongoing, there is only a medium priority to emphasize in comparison to other monitoring needs.

D. The anticipated rates and time frames for achieving the management objectives.

Stream surveys are completed at a rate of about 12-20 miles per year (over the entire Lewis River Watershed), depending on availability of funding and management activity levels. There are approximately 94 miles of Class I and II streams in the Lower Lewis River Watershed sub-basins that have not been surveyed. At current funding and management activity levels these surveys would be completed within a minimum of six to eleven years.

Monitoring Activity:

AMPHIBIANS.

A. What is it?

Monitoring for the presence of Larch Mountain salamander and Van Dyke's salamander.

B. Ecosystem Conditions and/or functions that would be altered, maintained or restored?

The objective of this monitoring is to increase knowledge about the types of habitat where these species are most likely found. It will allow better decisions to be made in the future regarding what is needed to preserve these species.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Sub-basins that are a priority for this monitoring are those that are in Matrix where these species have been found in the past, are adjacent to sub-basins where these species have been found in the past, or other sub-basins with suitable habitat. Sub-basins with the highest priority are 16, 19, and 25.

Surveys would be done according to established protocol, which requires surveys to be conducted generally in October and November or in April and May.

D. The anticipated rates and time frames for achieving the management objectives.

Monitoring should begin as soon as funding is available, or as timber sales and other ground-disturbing activity in planned. Increased knowledge gained from monitoring would be an immediate benefit.

Monitoring Activity:

VERIFICATION OF ECOLOGICAL INVENTORY DATA.

A. What is it?

Much of the vegetation, soil, and water data used in this analysis is from air photo and map analysis and has not been field verified. The highest priority need is verification of locations of and ecological conditions within large tree stands, and locations and ecological data for TES species, C-3 species, class IV streams, wetlands, and potentially unstable soils. Field vegetation surveys have been completed on approximately 50 percent of the watershed. Less than 5 percent of the watershed has been surveyed for TES species and there have been no field surveys for C-3 species in the watershed.

B. Ecosystem Conditions and/or functions that would be altered, maintained or restored?

An accurate inventory will enable better decisions to be made regarding potential projects.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Field verification of ecological data is a high priority in all sub-basins.

D. The anticipated rates and time frames for achieving the management objectives.

The most efficient and effective way to verify ecological data is to use systematic surveys throughout the watershed. Areas in the watershed should be stratified based on conditions and issues and prioritized for surveys. Funding for ecosystem condition surveys has been very limited. The best opportunities for field surveys have been during project analysis. The amount of funding available along with the scope of issues will determine actual survey priorities and accomplishment levels. Since most projects are anticipated to occur in the Matrix, a higher amount of field verification is expected to occur in Matrix lands than in Administratively Withdrawn areas.

Monitoring Activity:

HIBERNACULA DISTURBANCE

A. What is it?

Monitor the amount of human disturbance at five sites which are used by hibernating bats. Monitoring will be done through the installation of trail counters that will register the number of disturbance events during the winter hibernation period.

Monitor populations of hibernating bats on a bi-annual basis to detect population trends.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

It is known that if hibernating bats are disturbed more than twice during the course of the winter, their chances of surviving are significantly reduced. The objective of the monitoring would be to determine where human disturbance during the hibernation period is affecting the survival of bat populations. If necessary, disturbances could then be eliminated through the installation of gates at the cave entrances. Bi-annual population monitoring will be used to determine the effect of the identified disturbance on populations, and determine the effect of gates if they are installed.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Monitoring equipment will be installed prior to the winter of 1996/1997, and monitoring will continue for three seasons before a decision is made on whether gates are needed. The monitoring will be conducted at caves in sub-basin 34.

D. The anticipated rates and time frames for achieving the management objectives.

The objective of protecting bat populations in these caves can likely be met with the installation of effective entrance gates. An evaluation of the necessity of installing gates will be made based on the monitoring results in three years.

Commodities and Development:

LARGE TREE REMNANTS

A. What is it?

The ROD, page C-44, explains the importance of retaining old-growth fragments in watersheds where little remains. The Lower Lewis Watershed contains an estimated 19 percent of the watershed overall. Some of the 37 sub-basins have very little mature and old growth conifer habitat remaining. In addition, the Riparian Reserves in this watershed have been heavily harvested. Twenty-one of the sub-basins have had more than 25 percent of the stream Riparian Reserves harvested. Harvest of mature timber should be planned in sub-basins where riparian reserves are relatively intact and late-successional habitats are not severely limited.

It is recommended that harvest of mature timber in sub-basins where only remnant large tree stands remain, be deferred, or restricted to moderate and heavy retention until younger stands in these sub-basins mature. Criteria for selecting sub-basins for the no regeneration harvest recommendation are listed below:

1. Sub-basins where more that 25 percent of the stream Riparian Reserves have been harvested, and

2. Where at least 50 percent of the sub-basin has been harvested, and less than 15 percent large tree habitat remains in the sub-basin, and

3. Do not have habitat sufficient to meet the 50-11-40 rule for spotted owls (dispersal habitat lacking).

Sub-basins where harvest of large tree stands would be limited to moderate or heavy retention are likely those that have one or more of the conditions listed above.

B. Ecosystem Conditions and/or functions that would be altered, maintained or restored?

Maintaining remnant stands in sub-basins where little mature and old growth timber remains would preserve pockets of plant and animal species that are restricted to this type of habitat. These isolated populations can serve as sources for repopulating other portions of the sub-basins as young stands mature.

Commodities and Development:

INCREASED RECREATION PARKING

A. What is it?

Increase parking at developed sites to accommodate recreation use up to the carrying capacity of the facility. Increased parking capacity should include both summer and winter recreation.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

The objective of this recommendation would be to manage recreation based upon sound recreation management practices. This concentrates on maintaining present ecosystem conditions within acceptable standards, and to deter future degradation by unplanned use. Facility expansion will incorporate the following:

1. Expansion of parking at three sites.
2. Mitigation of parking lot runoff through use of appropriate oil collectors/filters. Existing parking lots will be upgraded to meet new standards where necessary.
3. Development of restroom facilities at Cougar Sno-Park.
4. Encourage use during non-peak periods through press releases.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Priorities for increased parking are the Marble Mountain Sno-Park, Cougar Sno-Park, and Ape Cave interpretive site. These sites are located within sub-basins 2 and 34.

D. The anticipated rates and time frames for achieving the management objectives.

Planning and survey work needs to be started immediately to determine the most suitable manner to expand parking. Preliminary field work is necessary to prepare proposals for funding.

Commodities and Development

OPPORTUNITIES FOR TIMBER HARVEST

A. What is it?

The Lower Lewis River Watershed Team reviewed current and desired conditions and identified sub-basins appearing to have the most timber harvest opportunities in the next five years. Harvest operations would include regeneration harvest, commercial thinning, overstory removal, and salvage harvest. These treatments are described in Amendment 11 of the Gifford Pinchot National Forest Land and Resource Management Plan.

B. Ecosystem Conditions and/or functions that would be altered, maintained or restored?

Timber harvest provides commodities for human social and economic benefit including raw materials for wood products and associated employment. A large portion of the Lower Lewis River Watershed is in allocations suitable for timber harvest. The goal on these lands is to have highly productive and diverse stands which yield a sustained timber supply and meet a variety of other resource objectives. The desired condition on lands suitable for timber production is to maintain a range of different aged forest stands, including the majority of younger stands. Retention of older or unmanaged forest stands within these areas is intended to provide habitat for wildlife and plant species, protect aquatic resources, and meet other resource demands such as visual aesthetics.

Many of the forested stands within the timber emphasis areas are beyond biological maturity (culmination of mean annual increment). These stands are not producing timber at optimum rates and represent regeneration harvest opportunities. Younger immature and mature stands are similarly in need of commercial thinning to maintain or enhance growth rates for timber production and habitat development. Many of these younger stands are managed plantations.

However, opportunities for timber harvest are limited within this watershed because of poor watershed and vegetation conditions in several sub-basins. Additional ground disturbance in areas with high risk of increased peakflow, existing high sediment levels, and poor fish habitat is not desirable. The present network of riparian reserves is highly fragmented and, in many areas, it does not meet the desired condition. Late-successional connectivity, which is supposed to be provided for in the riparian reserves, is similarly lacking in most of the sub-basins within allocations in which timber is programmed for harvest. The watershed analysis team recommended sub-basins where no harvest should occur until the sub-basin recovers, areas where no late-successional stands should be harvested at all, and areas where late-successional stands can be harvested but need to retain moderate or heavy amounts of existing vegetation. Commercial thinning opportunities are the least restrictive, and would depend mostly on access and economics.

Figure 33 shows lands suitable for timber harvest. It is included here to provide an approximate idea of harvest potential within the watershed, including existing plantations. The map excludes

Guidelines for harvest design include:

Harvest units should be designed to resemble openings created from natural disturbances such as fire and windfall. For regeneration units, the opening size and level of forest retention should vary depending on the vegetation zone, management objectives, and stand condition. Where regeneration activities are restricted, harvest within late-successional stands should retain moderate to heavy amounts of vegetation. Regeneration units located adjacent to previous openings will avoid further fragmentation of late-successional habitat.

Thinning operations should be designed to increase growth and provide species and structural diversity.

In areas where visual aesthetics is an objective, proposed harvest operations should consider beginning the regeneration process since it is likely that the entire stand can never be regenerated at one time.

Riparian Reserve Widths Interim Riparian Reserve Widths

Current condition of the riparian reserves is not conducive to reducing the interim widths that have been established by the ROD. Currently 57% of sub-basins in the analysis have more than 25% of the stream Riparian Reserves that have been harvested, which is an indication of some widespread impaired condition. This decision should be visited in future iterations of watershed analysis, to assess recovery of the area and determine if the Riparian Reserve is in sufficient condition to consider reducing the width. It is recommended that consideration be given to increasing the interim widths in some areas due to channel sensitivity. These areas are in the Pine Creek and Swift Creek sub-basins. As discussed at length in the current condition section, these streams are cut through lahar deposits from Mount St. Helens, which make them very sensitive and quick to degrade. These channels are also very slow to recover once disturbed. Sub-basins that contain these channels include 1, 2, 3, 4, 5, 6, 7, 9, and 32. Site-specific project analysis should aid in determining specific prescriptions in these areas.

APPENDIX A

GLOSSARY

GLOSSARY

303(d): Sections of rivers, coastal waters, estuaries, and lakes that don't meet the state of Washington water quality standards. These standards include temperature, bacteria, siltation, oxygen levels, nutrients, and toxic compounds or heavy metals. These sections are identified by the Washington State Department of Ecology as a result of the Clean Water Act.

C-3 species: Old-growth associated species identified in the ROD to be protected through survey and management standards and guidelines. Four Survey Strategies have been identified in the ROD:

1: manage known sites
2: survey prior to activities and manage sites
3: conduct extensive surveys and manage sites
4: conduct general regional surveys

DBH: Diameter of a tree at breast height.

Guild - Groups of wildlife species that would be expected to react to different distributions and amounts of habitats in similar ways.

Limits of Acceptable Change (LAC): A pre-determined threshold or limit to the amount a site or area can change without exceeding acceptable standards for that site or area..

People At One Time (PAOT): The capacity of a recreation site in terms of People-At-One-Time (PAOT). The number of people that can use the area all at the same time.

Policy Implementation Guide (PIG): This refers to the Columbia River Basin Policy Implementation Guide which was developed in 1991 to document the implementation schedule for salmon restoration in the Columbia River Basin.

President's Forest Plan Allocations:

LSR - Late Successional Reserves - Lands with objectives to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth forest related species including the northern spotted owl.

Riparian Reserves - As a key element of the Aquatic Conservation Strategy (ROD, page B-9), the Riparian Reserves provide an area along all streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian dependent resources receive primary emphasis.

APPENDIX B

REFERENCES

APPENDIX B REFERENCES

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APPENDIX C

ISSUES AND KEY QUESTIONS

APPENDIX C ISSUES AND KEY QUESTIONS

Issue: Mass Wasting

The Lower Lewis River has numerous landslides and debris flows within its boundaries. Management activities may have activated or worsened a number of these features, sometimes impacting streams. The major storm event of February 1996, which caused numerous landslides and debris torrents, demonstrated the magnitude these recurring disturbances can attain.

Key Questions:

1. Is there evidence of, or potential for, mass wasting in the watershed?

2. What mass wasting processes are active?

3. How are mass wasting features distributed throughout the landscape?

4. What physical characteristics are mass wasting features associated with?

5. Do landslides deliver sediment to stream channels or other waters?

6. Do forest management activities create or contribute to instability?

7. What areas of the landscape are susceptible to slope instability?

Issue: Surface Erosion From Roads

Surface erosion from roads has been a major contributor to sedimentation to streams in the past. New construction and within the first two to three years is when most of the sediment is transported. After this time growth on the fill slopes and cut slopes help alleviate this problem but in areas near stream crossings the problem can continue to influence stream habitat for many years. Poor construction practices in the past have created numerous problems recently from fill slope failures that directly and indirectly move sediment into many streams. This is especially evident since the storm event of February 1996.

6. What are the implications for future conditions?

Issue: Riparian Reserve Habitats and Fragmentation

Some critical components of terrestrial habitat within the Riparian Reserves have been altered. This influences the capability of these ecosystems to provide effective habitat for riparian dependant plant and animal species, and other species that may use Riparian Reserves as habitat connections between larger habitat blocks.

Key Questions:

1. What is the current distribution of age classes, and stand structure types within Riparian Reserves?

2. Where are Riparian Reserves inadequate in providing dispersal habitat for species of concern?

Issue: TES and C-3 Plant Species

The Endangered Species Act and the Northwest Forest Plan mandate that we monitor for threatened, endangered, and sensitive (TES), and late successional dependent (C-3) plant species respectively. Less than about 5% of the watershed has been surveyed for TES species, and none of the watershed has been surveyed for C-3 species.

Key Questions:

1. Which TES species are present, and where?
2. Which TES and C-3 species are likely to occur, and in which habitats?
3. Has habitat fragmentation impacted TES or C-3 population viability?
4. How can population viability of TES and C-3 species be monitored?
5. Has disruption of dispersal corridors impacted population viability?

Issue: Habitat Condition for Threatened, Endangered, and Sensitive Animal Species

The watershed contains suitable, or potentially suitable habitat for threatened, endangered, and sensitive species including spotted owl, peregrine falcon, gray wolf, bald eagle, Townsend's big-eared bat, and Larch Mountain salamander.

<u>Issue</u>: Hydrologic Changes

Past disturbances such as wildfire in the analysis area may have influenced basin hydrology by increasing peak flows during fall and winter storms, and decreasing summer low flows. Human activities have occurred throughout the watershed, and may influence the timing and quantity of runoff as well.

Key Questions:

1. What are the current watershed conditions influencing hydrologic response?

2. How do management activities and past disturbances influence streamflow regimes? Where are these influences occurring?

3. What is the history of floods and disturbance of hydrological significance?

4. What is the effect of changes in water available for runoff of flood peaks?

5. What is the future trend of the basin hydrology?

6. Are their any restoration and/or monitoring possibilities?

<u>Issue</u>: Water Quality and Key Habitat Attributes for Resident and Anadromous Salmonids.

Current aquatic habitat conditions are a result of past natural and human induced processes that have occurred in the watershed. Road building, dams, and fire regimes, combined with timber harvest and increased human populations in the watershed have through time altered stream habitats and aquatic communities. Degraded water quality from sediment and high water temperatures may be affecting habitats for bull trout, kokanne, and cutthroat trout. State water quality regulations are in place to protect existing and designated uses of water (i.e., beneficial uses). Due to time and analysis information limitations the focus will be on fish spawning and rearing.

Key Questions:

1. What is the current and historic range, and species composition of salmonids in the analysis area.

APPENDIX D

LIMITATIONS OF THE ANALYSIS, CONFIDENCE IN THE ANALYSIS, DATA GAPS, AND IMPLICATIONS OF THESE LIMITATIONS FOR MANAGEMENT

APPENDIX D

LIMITATIONS OF THE ANALYSIS, CONFIDENCE IN THE ANALYSIS, DATA GAPS, AND IMPLICATIONS OF THESE LIMITATIONS FOR MANAGEMENT

Terrestrial Vegetation Analysis - By Chiska Derr, Botanist

Confidence in Analyses

This section identifies concerns about the quality and accuracy of data that were used to analyze this watershed. All data came from GIS files; there was no ground verification of the numbers or categories produced by GIS.

The GIS vegetation layers were created primarily from timber inventory data and photo interpretation. The GIS specialist estimated that more than half of the total Central Skills Center vegetation layer was based on photo interpretation, and has never been ground verified. Timber inventory data are not ecological data. Unfortunately, as the only data we have, they were used to make the ecological interpretations within this document. Each issue is rated based on confidence in data, and data gaps and limitations.

Issue: Stand Structure and Composition

Confidence: LOW to MODERATE

Discussion: Nearly half of the watershed is in non-Federal land ownership. Many of these lands have been or will be managed for intensive timber harvest. There are no data on stand structure and composition other than what can be inferred from a few aerial photographs, which inhibited analysis at the watershed level.

Data Gaps:

* none of the GIS stand structure data were field verified

* none of the GIS stand composition (ecoclass) data were field verified

* no comprehensive plant inventories have been conducted

* there are no data for non-Federal lands

Threatened, Endangered, and Sensitive Wildlife - by Mitch Wainwright, Wildlife Biologist

Confidence in Analysis - Low to Moderate

My confidence in the acreage figures of the different structure stages within the watershed is moderate because a majority of the data has not been verified on the ground. However, I think the data is sufficiently accurate to be able to make the conclusions in the analysis, and these conclusions would not radically change if more accurate data were available.

My confidence in the analysis of potential population levels of cavity excavators is low because it's based on a model that has not been tested, and it's based on stand age data with little knowledge about what management may have occurred in the older stands (i.e. salvage and snag removal).

My confidence in road density data is moderate, but it's likely that there are many low maintenance roads that are being used on Federal and non-Federal land that don't appear on Forest Service Records.

Data Gaps:

Except for spotted owl, there is little to no survey information for the species analyzed in the watershed. There is litte information available on the effects of riparian habitat fragmentation on the species discussed. There is no established threshold for what would be excessive fragmentation for most species.

A large portion of the watershed is in non-Federal ownership, and data for these lands is totally lacking. Again, except for spotted owl surveys on State land, there is no or very little survey information

Key Aquatic Habitat Attributes, and Aquatic Habitat Fragmentation

Confidence Estimates

Following is a discussion of the confidence in the analysis, limitations of the analysis, data gaps, and implications of these limitations for management. This discussion is presented by analysis group (LWD/Mile and LWD recruitment, Primary Pools/Mile, Sediment and Stream Temperature, and Aquatic Habitat Fragmentation).

LWD/Mile - by Steve Lanigan, Fisheries Biologist

Confidence in analysis: **Low - High**

Limitation of the Analysis include:

Data for this analysis came from the disticts stream survey files and database. There is a moderate confidence in the original data collected due to the protocol used to identify large pieces of wood (i.e., visual estimation of size) during the stream surveys. This is an acceptable level of confidence, however, data are only available for approximately fifty-five percent (43 miles) of the fish bearing streams in the Watershed on USFS lands. Approximately fourteen percent (8 miles) of stream on private lands have been surveyed. Using this limited amount of data compromises the confidence.

Standards have been set at the Regional level, however, no watershed or basin wide analysis has been completed to verify these standards for this area. The stream channels in this area are high gradient channels that transport material such as wood and sediment fairly quickly. A standard of 80 pieces per mile may be too high, based on the channel morphology of this watershed.

LWD Recruitment - by Steve Lanigan, Fisheries Biologist

Limitation of the Analysis include:

Recruitment potential of LWD was based the percent streamside riparian area harvested. GIS data were used for USFS lands. The confidence in this portion of the analysis is high. Aerial photos were examined to estimate the percent riparian harvest on non-USFS lands. While confidence in using this technique is moderately high, the aerial photos used were from 1989. It is known that a great deal of additional harvest has occured to date on non-USFS lands, so we have probably underestimated riparian harvest. Therefore, the overall confidence for LWD recruitment potential on non-USFS lands is low.

Fire history was not used in the analysis, so areas burned in the early 1900's may

Implications for Management:

Managers need to consider the small amount of data and the lack of data available for this analysis, and recognize that this analysis is not complete and needs to be verified in the field at the sub-basin level, before management decisions are made. Consideration also needs to be given to the fact that until pool standards are developed at the watershed scale for each watershed in the Forest we will not have an accurate picture of the severity of the existing situation.

<u>Sediment and Stream Temperature</u> - by Mark Kreiter, Hydrologist

Confidence in analysis - Moderate-High

Limitations of the analysis - Limitations of this analysis include:

Reference conditions were determined primarily from 1959 air photos. Some information from other sources such as REAP was used to supplement the air photo information. This leads to fairly good relationships back to the mid-1940's, but very unclear prior to this time.

Stream temperature analysis only used existing data available at the time of the analysis. This was limited to two stations in the analysis area.

Data Gaps:

Stream temperature data was not available for a majority of the streams in the analysis area.

Field data that was pertinent to hydrologic interpretations such as width/depth ratios, pebble counts, v* was missing. This needs to be collected as part of stream surveys.

Historic and reference information on stream temperatures and other physical stream channel parameters such as pools per mile and amounts of LWD is lacking for this area.

There is a need to complete level II road surveys so possible restoration opportunities as well as potential sediment sources can be identified.

Implications for Management:

Management decisions relating to activities such as restoration or timber harvest may not be as fully informed using this general information. Accurate identification of priority restoration areas may be less likely without the more specific information, due to the lack of establishment of cause and effect relationships. We might focus

Human Dimension - by Jim Nieland, Recreation Planner

Confidence in Analysis - **High**

Limitations of the analysis Include:

Additional recreation use occurs in the watershed which was not analyzed. This includes hiking, fishing, driving for pleasure, mountain climbing, hunting, and cave exploration. These activities contribute to annual use, but appear to be adequately serviced by existing developments.

Data Gaps:

- Cultural and historic resource have only been surveyed for in conjunction with recent recreational developments, or timber sales. Much of the planning area has not been investigated for these resources.

- Baseline data on the impact of recreation use on natural resources has been developed only for south-side climbing routes. Impacts caused by camping, cave exploration, and trail use have not been monitored or evaluated except in isolated instances.

Implications for Management:

With a lack of baseline data on natural resources, it is possible for impacts may accumulate over time. These impacts may eventually require changes in recreation use management, or rehabilitation of impacted areas.

APPENDIX E

VEGETATION STAND STRUCTIURE DEFINITIONS

STAND STRUCTURE DEFINITIONS FOR GPNF

Chiska Derr, Mt. St. Helens Botanist
10 July 1996

Stand structure/seral stage definitions have been developed for Western Oregon and Washington based on a number of different criteria (Hall et al. 1985). Structure definitions based in part on above work combined with Forest stand data available in the vegetation database are briefly described below (as based on the 1/11/95 seral meeting). Ecoclasses are specified based on potential plant associations (Brockway et al. 1983: Topic et al 1986; Topic 1989). Major tree species can be a single species or combinations of conifer species present on the Gifford Pinchot National Forest, and are not specified.

Acceptable ecoclass codes for below stages are for coniferous forest only (codes that start with "C").

Grass/Forb /Seedling

Early seral. **Conifer openings** dominated by grasses, forbs, some shrubs and conifer seedlings less than 4.5' tall (or diameter breast height (dbh) less than 1.0 inches), either of natural or human origin. Pioneer species dominate and species richness is often high. Provides foraging opportunities but no cover. Condition typically lasts two to five (occasionally 10) years.

Shrub/Seedling

Early seral. **Coniferous** stands dominated by shrubs, and a mixture of conifer seedlings and saplings (0-20' tall, 0 to 4.9 inches dbh); natural or human origin. Pioneer species dominate and species richness is high. Provides foraging opportunities but no hiding/thermal cover. Condition typically lasts 3 to 10 years, but may persist 20 to 30 years if tree regeneration is delayed. **May provide hiding cover depending on height and density of shrubs and trees.**

Remnant Forest (Light Forest)

Early seral; ecoclass either western hemlock, Douglas-fir, or western red cedar. Stands with little understory development (grass and forbs present) and an open canopy (0% to 40% cover) of large trees. Cover results from residual conifers larger than 21 inches dbh. These stands are commonly a result of recently harvested shelterwood, or green tree retention units. Provides foraging opportunities, limited thermal protection, and may provide hiding cover. Also provides propagules of C-3 lichens and bryophytes, as well as habitat for C-3 lichens, bryophytes, fungi, arthropods and mollusks.

Open Sapling/Pole

Early seral. **Coniferous** stands with an open canopy (0% to 40% cover) that are dominated by sapling and pole-sized conifers of 4.5 feet tall up to 9" dbh. A shrub dominant understory is common. Provides some forage and limited

OR: 2) Ecoclass silver fir, mountain hemlock, lodgepole pine, park-like mountain hemlock/subalpine fir, or Engelmann spruce, and stand average dbh greater than 18 inches.

These stands are the result of large-scale disturbances (fire, windthrow, volcanic activity, timber harvest) and have limited understory development. Typically they lack snag development and downed woody material limiting their **current quality** as wildlife habitat (Hall et al. 1985), **although they do provide thermal cover and dispersal habitat. These stands have excellent potential for restoration activities to mimic old-growth conditions.**

Large Tree Multi-Storied

Mid to late seral. Closed **coniferous** canopy (between 40% and 100%) with two or more canopy layers AND one of two following size criteria:
1) Ecoclass either western hemlock, western red cedar, Douglas-fir, or grand fir and stand average dbh greater than 21 inches,
OR: 2) Ecoclass silver fir, mountain hemlock, lodgepole pine, park-like mountain hemlock/subalpine fir, or Engelmann spruce, and stand average dbh greater than 18 inches.

Stand structure is high in these stands (various size and layers of trees, snags, down wood). Plant diversity is also high in many cases and strongly favors shade tolerant species. Stands of old-growth are included in this category. When this stand structure is present and Douglas-fir and western hemlock codominate, optimum wildlife habitat conditions can be met (Hall et al. 1986), including thermal cover, snow interception, and optimal nesting, foraging and roosting habitat for owls.

Hardwood Shrub/Seedling

Early seral, areas where ecoclass is a hardwood type ("H" codes). Does not include areas that are of coniferous forest climax that currently have an abundance of hardwoods. Dominated by hardwood species less than 4.9 inches dbh. Typically occuring on wet or bottomland soils and/or those closely associated with riparian areas and channel disturbance regimes. When alder is present, soil is enriched by nitrogen input. Provides good habitat for birds and other small wildlife species. When deciduous shrubby hardwood pockets are interspersed within larger conifer stands, they provide valuable seasonal canopy gaps and enhance C-3 lichen and bryophyte habitat and diversity (Neitlich & McCune 1995).

Hardwood Sapling/Pole

Early seral. Areas where ecoclass is a hardwood type ("H" codes). Does not include areas that are of coniferous forest climax that currently have an abundance of hardwoods. Stands are dominated by young hardwood trees between 4.9 and 8.9 inches dbh; small conifers may be present, but are not dominant. Typically occuring on wet or bottomland soils and/or those closely associated with riparian areas and channel disturbance regimes. When alder are present, soil is enriched by nitrogen input (up to 320 kg/ha/yr; Pojar & MacKinnon 1994). Provides good habitat for birds and other small wildlife species. When pockets of deciduous hardwood saplings and poles are interspersed within larger

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