POTAMUS ECOSYSTEM ANALYSIS

Umatilla National Forest
Heppner and North Fork John Day Ranger Districts

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INTRODUCTION

Document Purpose

Ecosystem Analysis at the Watershed Scale is the process used by the Umatilla National Forest to characterize the historic and current physical and biological conditions for individual watersheds. It is a systematic way of organizing ecosystem information to better understand the impact of management activities and disturbance processes within a watershed.

This document presents the results of the Potamus Ecosystem Analysis. The purpose of the analysis was to collect, analyze and synthesize existing information about the Potamus watershed to: 1) provide a picture of historic and current watershed conditions; 2) determine what changes have occurred since the arrival of Euro-Americans and how those changes have affected ecosystem sustainability; and 3) to determine what activities could or should be undertaken in order to restore ecosystem function and resiliency in these particular watersheds.

The document addresses primarily Umatilla National Forest lands within the watershed. The primary exception is the aquatics analysis, which was based heavily on an extensive subbasin summary of the entire Potamus subbasin completed by the Northwest Power Planning Council (Gephart and Nordheim 2001). This report provided an excellent characterization of the subbasin, and an in-depth analysis of aquatic resources, and a significant portion of the aquatics report in this document uses this material to analyze the aquatic resources in the entire Potamus watershed.

Document Organization

This document is organized consistent with Ecosystem Analysis at the Watershed Scale; Federal Guide to Watershed Analysis (version 2.2, 1995). Each specialist report includes:

- The introduction presents the document purpose and organization followed by a characterization of the dominant physical and biological processes relevant to this watershed. Land allocation and management direction decisions from the Umatilla forest plan and relevant regulatory constraints are included as appropriate.
- Issues and key questions related to the ecosystem elements described in the watershed characterization, especially in relation to management.
- Current and reference conditions are described for the ecosystem elements relevant to the key issues. Condition descriptions are based on both quantitative and qualitative data and professional experience. Reference conditions were interpreted from historic maps, historical society information, early Forest Service records, historic journals, and oral histories.
- Recommendations for management, both at the subwatershed and watershed level, are described.

(footnote to first page Editors note: In order to include color maps and selected color figures with the Potamus ecosystem analysis, we created a separate map appendix. Color maps are referenced to the Map Appendix).

KEY QUESTIONS AND ISSUES

Overview

Identification of issues and key questions is the second step in the six-step process for ecosystem analysis at the watershed scale. The purpose of this step is to focus the analysis on key elements of the ecosystem that are most relevant to the management questions and objectives, human values, or resource conditions within the watershed. Key questions are formulated from indicators commonly used to measure or interpret the key ecosystem elements (Regional Ecosystem Office 1995). Key questions were used to focus the analysis. The Federal Guide stresses that watershed analysis is an informational undertaking, not a decision process (Federal Guide for Watershed Analysis 1995).

Development of issues in this analysis was guided by input from the Heppner and North Fork John Day Ranger Districts and Forest staff (see Appendix A). Additional issues were developed by the Watershed Analysis team based on preliminary field review, overview of GIS information and further conversation with District personnel. "Issues" concerning related topics were ultimately combined into larger groupings to facilitate a more streamlined analysis process. These groupings include: hydrology, aquatic habitat and fisheries, upland forests, botanical resources, heritage resources, terrestrial vertebrates, and noxious weeds. An important factor in the analysis process was the considerable amount of overlap and interplay among issues that were generally considered singly, according to the "dominant" discipline involved. For example, the condition of riparian habitat, addressed under the Hydrology, Aquatic Habitat and Fisheries analysis, has obvious importance for terrestrial plants and animals as well.

Hydrology

The upper Potamus and Pataha watersheds are major source areas for downstream water supplies. Streams, floodplains, and riparian areas within these watersheds buffer water quality, provide water storage functions, and offer essential habitat for fish and wildlife (including endangered salmon in the Potamus River). Concerns include: maintaining and improving adequate water supplies, maintaining and restoring water quality, and improving overall conditions of streams, floodplains, and riparian ecosystems.

Information provided in this report will supplement information available in the Draft Potamus Subbasin Summary, (August 3, 2001) prepared for the Northwest Power Planning Council (citation).

Key Questions:

- What are the principle physical characteristics of the upper Potamus and Pataha watersheds and how are they related to erosion processes, stream conditions, and water quality? Where and to what extent have land uses altered erosion rates, channel processes and water quality?
- What are the existing water temperature and instream sediment conditions in the upper Potamus River and Pataha Creek and major tributaries? What are the current levels of bacteria in upper Pataha Creek?

- What are the current and potential distributions of riparian vegetation and stream channel types?
- What are the general goals for managing multi-ownership lands in the upper mainstem Potamus River corridor and what tools are available to reconcile conflicting uses? What management actions should be taken to meet common objectives and reconcile differences?

Aquatics

The contemporary character of the fish habitat in the Potamus drainage has been shaped through natural disturbance and human use of the land and water. Road building and maintenance, urban and agricultural development, rural development, grazing, tilling, deforestation, water regulation, and flood control structures have combined to alter vegetation, soil properties, topography, runoff, water temperatures, instream flows, and sedimentation. Changes to the watershed processes have yielded a mosaic of aquatic habitat ranging from high quality in the headwaters to severely degraded lower in the drainage. The most severely degraded fish and wildlife habitat areas tend to be below the Forest boundary in the lower portions of the Potamus and Pataha watersheds where most development and human alteration of the landscape has occurred

Key Questions:

- What is the current status of fish populations
- How have recent hydrologic disturbances affected instream aquatic habitat
- What are the major factors limiting fish habitat

Upland Forest Vegetation

Over the last 30 years, Blue Mountains forests have experienced increasing levels of damage from wildfire, insects, and diseases. Scientific assessments and studies have documented the high damage levels and speculated about their underlying causes (Caraher and others 1992, Gast and others 1991, Lehmkuhl and others 1994, Powell 1994, Shlisky 1994). Partly in response to the scientific assessments, the Blue Mountains area gained national notoriety for its forest health problems (Boise Cascade Corporation 1992, Joseph and others 1991, Lucas 1992, McLean 1992, Petersen 1992, Phillips 1995, Wickman 1992). In response to high levels of concern about forest health, both from the scientific community and the general public, the primary issue used in this analysis of upland forests was forest sustainability. Forest sustainability is defined as an ecosystem-oriented approach that allows the utilization of forests for multiple purposes (e.g., biodiversity, timber harvesting, non-wood products, soil and water conservation, tourism and recreation) without undermining their availability and quality for present and future generations (Gardner-Outlaw and Engelman 1999). This means that sustainable forests contain insects, diseases and other tree-killing agents, but not to the extent that they jeopardize the long-term integrity, resiliency, and productive capacity of the forest.

Key Questions:

- How do current forest conditions compare to those that existed historically?
- Are current forest conditions considered to be ecologically sustainable over the long term?

- If current forest conditions are considered to be unsustainable, how could they be changed in order to create a more sustainable situation?
- How have disturbance processes shaped existing forest conditions, and what role might we expect them to play in the future?

Wildfire Risk

The risk of severe wildfire and associated negative resource effects is a significant problem throughout the Blue Mountains. Past management practices have contributed to live and dead fuel accumulations that well exceed typical conditions in Blue Mountain forests. The primary issue centers on how to mange these fuel accumulations within budgetary and other resource constraints.

Key Questions:

- What are the current fuel profiles in the watersheds? Have these significantly increased the risk to habitats and water quality? How has this affected our ability to successfully manage wildland fire safely at the least cost?
- Can we continue to maintain, preserve and protect the natural resources in the watersheds and meet the goals of the Umatilla National Forest Plan? Can we restore the resilience to the ecosystems? What management practice should be employed to meet the expectations of the Umatilla National Forest Plan?

Botanical Resources

The primary issue with botanical resources in the Potamus watershed is continuation of the sensitive plant monitoring and surveying programs. These programs are designed over the long-run to address the key questions below.

Key Questions:

- What vascular plant species presently occur in the Potamus analysis area? How does this compare with historic plant community composition?
- What is the floristic richness of the Potamus analysis area in comparison with the rest of the Heppner and North Fork John Day Ranger Districts, and within the Umatilla National Forest?
- How have disturbance processes shaped existing floristic conditions, and what role might we expect them to play in the future?
- What are the occurrences of historically-listed or presently-listed sensitive plant species within the analysis area?
- What activities occurring in the analysis area affect plant species that have historically been considered sensitive?
- What other plant species might be "at risk" in the analysis area?
- What are the culturally significant plant species in the analysis area? Are any of them "at risk" because of management activities (including fire suppression)?
- What plant species may come under harvesting pressure as "special forest products"?
- What native plant species could be important for revegetation/resoration projects within the watershed?

Noxious weeds

Twelve invasive weed species are present on Forest Service lands in the Potamus watershed, including diffuse and spotted knapweed, yellow starthistle, Canada thistle, bull thistle, Russian thistle, Scotch thistle, hound's tongue, Scotch broom, toadflax, Klamath weed (St. John's wort), and tansy ragwort. Of greatest concern are the 17 yellow starthistle sites, the 132 spotted/diffuse knapweed sites, and the 4 sites infested by tansy ragwort.

Key Questions:

- What noxious weeds occur in the analysis area, and what are their affinities for ecological settings?
- What activities affect the spread and/or distribution of noxious weeds, and what can be done to mitigate spread?

Vertebrates

The primary issues and concerns for terrestrial vertebrates include maintaining and enhancing late and old structure forests (LOS) and wetland and riparian habitats in the watershed. Habitat for big game winter range, bighorn sheep habitat, and snags and downwood are also of concern. The habitat needs for land birds in the watershed also need to be assessed.

Key Questions:

Habitat

- How have habitat types and forest structure changed over the last 67 years (1935-present)?
- What is the existing habitat condition in the watershed?
- How have size and distribution of habitats changed in the watershed?
- How has late and old structure changed over the last 67 years?
- How are patches of existing late-old forest distributed across the landscape?

Species

- What is the species composition in the watershed?
- How has habitat availability for Management Indicator Species (MIS) changed, when compared to 1935?
- What TE&S species have the potential to occur in the analysis area?
- What is the existing habitat condition for species of "concern" or "interest?"
- What is the status of neo-tropical migratory bird?
- What is the current condition of bighorn sheep habitat and population trends in the watershed?

SOILS AND GEOLOGY

Characterization

Ecological Setting

The Potamus watershed lies within the Blue Mountains section (also, Province) of the Ecological Hierarchy (USFS GIS; Clark & Bryce 1997). It includes 3 subsections (see Figure 2-1, Subsection Map in the Appendix) as follows, in order of larger acreage to smaller, tabular descriptions following:

Subsections

SUBSECTION NAME (CODE)		PERCENT AREA
Ukiah Plateau	(M332Gj)	83%

(other names: Ukiah Mountain Slopes; Columbia River Basalts Plateau- Continental)

See Table 2-1 below.

Kimberly-Paulina Hills	(M342Ha)	12%

Central Oregon volcanics geologic region. Off-Forest area with little data. No further description or discussion for this unit.

Tower-Desolation Highlands	(M332Gg)	5%

(other names: John Day-Clarno Mountains; Elkhorn-Greenhorn Flanks)

See Table 2-2 below.

The following tables provide description of the Subsections on Forest.

Table 2-1. Subsection Description, Ukiah Plateau (CRB Plateau, continental)

SUBSECTIONS Blue Mountains Province				
Ecological Framework: Subsection, Province, Subbasin	Geomorphology Process, typical landform, top features, drainages	Geology Lithology, structure, hard fracture	Inferred climate, Potential Natural Vegetation, unique features	Natural disturbance; Fire, flooding, slope stability, and flow regime
M332Gj **Ukiah Plateau** **Propose:** **CRB Plateau-continental**	Major process: Volcanism, fluvial erosion (stream incision) Major landforms: Uplifted but dominantly flat-lying basalt plateaus with fluvial dissection. Gently sloping to flat weak to strongly dissected plateaus with canyons on the margins. Drainage patterns: Dendritic in general to trellace in fault zones.	Multibedded, basic igneous flows (Columbia River and some Picture gorge basalts). Weak lateral faulting generally in line with Olympic Wallowa linament. Volcanic ash and local loess are significant to water storage.	Continental with some maritime influence. Cool dry and some moist forests. Dry grand fir to ponderosa pine with grasslands common on south aspects and windblown plateau surfaces and moist grand fir on north aspects. Vegetation patterns strongly affected by aspect and surficial sediments. Convective storms are common in the summer.	Stable slopes. Dominantly spring snowmelt runoff with low base flows and flashy runoff due to impermeable bedrock. Ice jams flows are periodic sources of stream scour. Fire regime I and II.

Table 2-2. Subsection description, Tower-Desolation Highlands (Elkhorn/Greenhorn flanks)

SUBSECTIONS Blue Mountains Province				
Ecological Framework: Subsection, Province, Subbasin	Geomorphology Process, typical landform, top features, drainages	Geology Lithology, structure, hard fracture	Inferred climate, Potential Natural Vegetation, unique features	Natural disturbance; Fire, flooding, slope stability, and flow regime
M332Gg **Tower-Desolation Highlands** **Propose: Elkhorn/Greenhorn Flanks**	Major process: Fluvial erosion with solution weathering and mass wasting, with localized weak glaciation of uplifted blocks. Major landforms: moderately dissected rolling mountains and hills interspersed with structural basins (meadows) and some canyons. Includes Madison Butte/Arbuckle Mt. unit with sandstones, granitic core producing late season flows	Mixed, acid igneous (rhyollitic tuffs and granite), intermediate (Clarno) pyroclastic flows, tuffs and breccias, argillites and metavolcanics of accreted terrains, with some basic igneous flows (basalts). Highly fractured exotic terranes and very permeable rhyolitic tuffs to massive and relatively impermeable basalts, andesites and core granites.	Continental with some maritime influence. Cool to cold moist forests dominate and include subalpine fir, moist grand fir and lodgepole. Lower elevations and south aspects are cool dry forests with dry grand fir, Douglas fir and ponderosa pine. Convective storms are common in the summer.	Mass wasting significant where downcutting has exposed soft tuffs under hard volcanic caprock (Qls). Dominantly snowmelt runoff. High runoff and rapid downcutting near adjacent mountain peak units. Summer convective storms produced localized flooding. Moderate late season flows but flow regime variable as geology. Major stream flows based in adjacent high elevations. Fire regime I and III (minor area assoc. with lower elevations), areas of IV associated with true fir & lodgepole forests.

The dominant Ukiah Plateau area includes the gently sloping and steep canyons of Grande Ronde and Picture Gorge basalts. They are generally impermeable and produce flashy streams.

The Tower-Desolation Highlands, though small in extent, is of interest as it includes rock types that are quite permeable allowing precipitation to infiltrate and influencing late season stream flow volume and perhaps temperature in the lower canyons.

Land Type Association

The Potamus watershed contains 16 different Land Type associations (USFS GIS), (Figure 2-2 in the Appendix).

Table 2-3 below includes names and brief descriptive information for the Land Type Associations covering the Potamus watershed.

Table 2-3. Land-type Associations (LTA)

LTA MAP UNIT NUMBER	LTA NAME	FS ACRES % area	SLOPE GRADIENT %	CURRENT LANDFORM PROCESS	PRIMARY/ SECONDARY LANDFORM PROCESS
115	Moist Forest-Basic Igneous-Colluvial Basins	1905 2%	15-50%	Colluvial and eolian deposition	Volcanic flows, with uplift and dissection
116	Moist Forest-Basic Igneous-Gentle Slopes	17646 17%	0-30%	Eolian deposition, weak pluvial erosion	Volcanic flows, weak dissection
117	Moist Forest-Basic Igneous-Steep Slopes	3476 3%	30-60%	Colluvial and eolian deposition, weak pluvial	Volcanic flows, moderate dissection
118	Moist Forest-Basic Igneous-Canyons	571 <1%	60-90%	Colluvial and eolian deposition, weak pluvial	Volcanic flows, strong dissection
124	Moist Forest-Clay Producing-Land Slide	2043 2%	0-60%	Mass failure, weak pluvial	Volcaniclastic deposits, moderate to strong dissection
126	Moist Forest-Clay Producing-Gentle Slopes	8206 8%	0-30%	Colluvial and eolian deposition, weak mass failure potential	Volcaniclastic deposits, weak dissection
127	Moist Forest-Clay Producing-Steep Slopes	29 <1%	30-60%	Colluvial and eolian deposition, moderate to strong mass failure potential	Volcaniclastic deposits, moderate dissection
216	Dry Forest-Basic Igneous-Gentle Slopes	49687 47%	0-30%	Weak to moderate pluvial erosion, weak eolian deposition	Volcanic flows, weak dissection
217	Dry Forest-Basic Igneous-Steep Slopes	4487 4%	30-60%	Moderate pluvial erosion, weak eolian deposition	Volcanic flows, moderate dissection
218	Dry Forest-Basic Igneous-Canyons	7544 7%	60-90%	Moderate to strong pluvial erosion	Volcanic flows, strong dissection

LTA MAP UNIT NUMBER	LTA NAME	FS ACRES % area	SLOPE GRADIENT %	CURRENT LANDFORM PROCESS	PRIMARY/ SECONDARY LANDFORM PROCESS
224	Dry Forest-Clay Producing-Land Slide	9 <1%	0-60%	Rotational slumps and flows, moderate pluvial erosion	Metavolcanic and metasedimentary uplifted block, moderate to strong dissection
316	Dry Non-Forest-Basic Igneous-Gentle Slopes	7899 7%	0-30%	Moderate to strong pluvial erosion, weak eolian deposition	Volcanic flows, weak dissection
317	Dry Non-Forest-Basic Igneous-Steep Slopes	314 <1%	30-60%	Moderate to strong pluvial erosion,	Volcanic flows, moderate dissection
318	Dry Non-Forest-Basic Igneous-Canyons	216 <1%	60-90%	Strong pluvial erosion, weak to moderate debris flows	Volcanic flows, strong dissection
416	Moist Non-Forest-Basic Igneous-Gentle Slopes	1021 1%	0-30%	Weak to moderate pluvial deposition and weak pluvial erosion	Volcanic flows, weak dissection
516	Rock/Non-Vegetated-Basic Igneous-Gentle slopes	311 <1%	0-30%	Weak to moderate eolian erosion, weak to moderate pluvial erosion	Volcanic flows, weak dissection

The Meadowbrook subwatershed (East Fork in particular) includes areas of landslide terrain and clay-producing geologic formations (Clarno). These provide increased incidence of instability relative to the other areas in the watershed and somewhat different drainage patterns. These areas of mass movement occurred several hundred to thousands of years ago and do not appear to be prone to reinitiation in the absence of large, landscape level disturbance (e.g. high intensity fire over large areas) or earthquakes. Typical forest management activities have not and would not be expected to initiate new mass movement. Localized slumping from materials removal from a full-bench road cut or similar activity could be expected

Subsoils in the Clarno regions tend to have higher clay content and may provide impervious layers for surface or subsurface water. The bedding characteristics of the Clarno are not entirely predictable as far as depth of each of the layers. Generally finer suspended sediment particle size would be anticipated in these areas as running water accesses and suspends these materials.

Soils

The Umatilla National Forest Soil Resource Inventory (USFS 1977) is (still) the primary source of information for mid-scale soil survey. The Blue Mountains Terrestrial Ecological Unit Inventory

(TEUI, in progress) has mapped in this area but this (more detailed) soil and potential vegetation information is still in process and not yet available for analysis.

Table 2-4. Summary Top Ten Soil Types from Soil Resource Inventory

SRI MAP UNIT NUMBER 2 digit = single type 3 digit = complex	ACRES & PERCENT OF WATERSHED	BRIEF DESCRIPTION
06;064 High erosion potential Stable	12,000 11%	Shallow to moderately deep, residual surface flow volcanics, Ponderosa pine-Douglas fir communities.
91; 914; 915; 922; 924 High erosion potential if non-rock Moderately stable; may have talus	11,659 11%	Shallow, or rock with mod. deep to deep drainages, surface flow volcanics, steep canyons, Bunchgrass and mixed conifer
07;076; 376 Moderate to high erosion potential; Stable	10,140 9%	Moderately deep, ash over residual surface flow volcanics, Mixed Conifer.
04;041;043;046 High erosion potential; Stable	8,219 7%	Shallow, residual surface flow volcanics, Ponderosa pine-bunchgrass.
01;012;013;014 High erosion potential Stable	8,065 7%	Shallow, residual surface flow volcanics. Non-forest vegetation, Grasses & sage.
21; 212; 321 Moderate erosion potential Stable	7,753 7%	Deep, ash over residual Pyroclastic with surface flow volcanics, gentle slope, Grand fir communities.
24; 242; 245; 249; 324 High erosion potential Stable	5,624 5%	Mod. deep, colluvial pyroclastic with surface flow volcanics, Mixed conifer to Ponderosa pine
03; 034 Very high erosion potential Very stable	5,333 5%	Shallow, residual surface flow volcanics. Non-forest, incl. mountain mahogany& juniper.
22; 224; 229; 322 High erosion potential Stable	4,646 4%	Mod. deep to Deep, ash over residual Pyroclastic with surface flow volcanics, steep slope, Grand fir communities.
05; 524; 567 Very high erosion potential Moderately stable	3,899 4%	Shallow to mod. deep, residual surface flow volcanics, steep, bunchgrass communities.

Residual and shallow ash soils have high to moderate erosion hazard with disturbance. The moderately deep and greater (depth) soils, especially with ash mantles, have higher infiltration rates (and water storage capacity) and are more resilient with disturbance. Once concentrated erosion is initiated, however, there is greater hazard of soil loss to larger volumes of soil material and moderate cohesiveness. The ash soils are quite susceptible to disturbance when dry due to dusting and wind erosion. The shallow, residual soils have high strength and are less prone to dusting when dry, but are very susceptible to puddling (rutting) when wet.

Subsoils in the Meadowbrook drainage (Clarno materials) have greater clay contents creating some lateral subsoil moisture. The landslide terrain found in the area is indicative of this formation and soil conditions. The one slump area identified in the SRI on Forest Service administered lands is in this drainage. The other two are on private land in Upper Ditch Creek.

Existing Condition

The primary factors modifying productivity are roads, timber harvest activity, and livestock grazing. Large ungulates (elk) effect winter range (John Day breaks) soil conditions in winter and early spring via trampling but it is not known if this is different than historic conditions.

Sheep grazing in the late 1800's and early 1900's were a large disturbance agent impacting most of the gently sloping non-forested meadows. Steeper sideslope pasture was impacted to lesser extents. Topsoil was lost from the dry meadows from wind erosion as protective plant cover was disturbed due to the large numbers of sheep. There is no sheep grazing occurring at present. Impacted areas are recovering slowly but (are) limited in some areas (primarily the shallow-soil dry meadows) by vegetative species changes to exotic and weedy species.

Cattle grazing has had adverse impact historically, primarily in easily accessible riparian areas. Current cattle grazing management is successfully balancing impacts to range soils while utilizing and retaining grazing capability. Current problem areas are limited in extent and not widespread at a watershed scale. Effects from horses pastured in the watershed are not well known but assumed to be limited to lower elevations and closer to private land.

Prior to European settlement, invasive weed (and other) plant species were assumed to be non-existent. Changes in productivity have since occurred with the introduction of a variety of non-native grasses and forbs.

Road construction has created the most enduring and highest degree of direct impacts on soil productivity. Miles of roads, density of roads, and (further) discussion can be found in the hydrologic section discussion. Stability of road surfaces and cut and fill is of importance to water quality but requires more detailed information than is currently available.

Timber harvest related impacts have been sporadic until the 1970s when the road network was expanded and allowed ready access. Table H-8 shows historic harvest levels (in gross acres) in the watershed sorted by subwatershed. Most of the harvest activity has occurred on the (more) readily accessible level to moderate sloping areas in the upper watershed on both sides of the North Fork John Day River. These areas become accessible as the road network was constructed with much of the harvest systems utilizing ground-based machinery for skidding and site preparation activity. Harvest operations did not adopt systematic skidding operations on a general scale until the late 1980's. As such, compaction and displacement levels remaining in the regeneration units are greater than contemporary operations.

Erosion control practices were more broadly adopted in earlier operations so erosion losses from direct harvest activity was not a common problem, but occurred in some locations, especially where non-engineered roads were used. Soil loss from 'dusting out' during skidding operations was more common as dry soil (ash in particular) was driven through with tractor tires or tracks, and logs dragged along the ground. This is not particularly extensive on an acreage basis, but locally intensive when operations occurred in adverse conditions.

Detailed assessment on a unit basis is required to determine if existing effects from machine trafficking (in particular) would warrant restoration treatments to improve either soil structure (from compaction or puddling impacts) or organic matter levels losses from displacement impacts.

Key Findings

- East Fork Meadow Creek subwatershed contains extensive areas of geologic landslide terrain. The formations in this area are not active and are not of particular concern for typical land management activities. The exception to this would be new road construction activities involving large cut-and-fill sections, or should large, contiguous-area (500+ acres) high severity wildfire occur. Some localized mass movement might be anticipated in such circumstances.
- Geological formations in the upper Potamus, Ditch, and Mallory Creek have relatively high infiltration rates. Although relatively small in area, higher infiltration characteristics (compared to the dominant basalt flows) appear to translate into favorable stream flow conditions downstream.
- Historic land uses have had negative impacts on productive capacity in some areas but have stabilized and are generally on an improving trend. Some areas, such as shallow-soil dry meadows for example (‘scabs’), may require active restoration due to invasive species and very limited topsoil (‘disclimax’ condition).
- Productive capacity of much of the Dry Forest areas is shifting to above-ground biomass as shade-tolerant species invade otherwise more open stands (see Forest Vegetation).

Recommendations

Harvest Areas

Detailed assessment will be required on a unit basis. Restoration activities could include tillage treatments of compacted areas, organic matter amendments or topsoil replacement where surface layers were removed by piling. Activity will generally occur in conjunction with timber stand improvement or regeneration activity.

Roads

Road surface drainage and cut and fill slope stability are of greatest importance for road system integrity and elimination of water quality effects. Segment identified detail assessment will be necessary to determine where problem areas are remaining. The district travel and access management plan should provide guidance on any roads excess to the present and future need of the Forest.

Dry (Scab) Meadows

Rehabilitation of degraded (scab) dry meadows might include soil amendments and reestablishment of native plant species. Prescribed burning prescriptions should attempt to provide a balance between the need for removal of dead wood and retention of it for long-term productivity and wildlife needs.

Literature Cited

Clark & Bryce 1997. Hierarchical Subdivisions of the Columbia Plateau and Blue Mountains Ecoregions, Oregon and Washington.

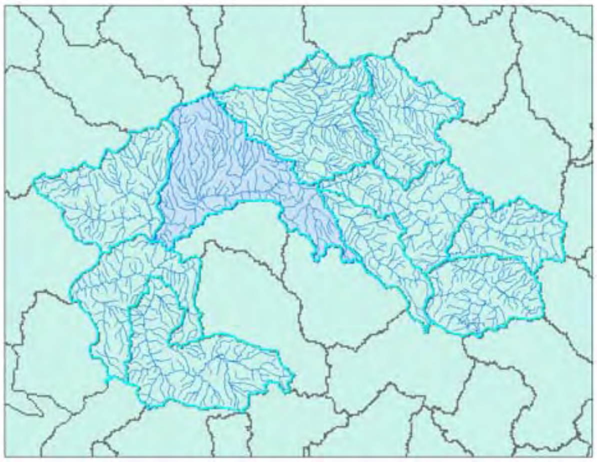
USFS GIS. Unpublished data stored in Umatilla NF GIS files.

USFS 1977. Soil Resource Inventory, Umatilla National Forest.

North Fork John Day/Potamus Watershed
"At-A-Glance"

Hydrologic
Units: North Fork John Day Subbasin, HUC 17070202 (HUC 4)
North Fork John Day/Potamus, HUC 1707020207 (HUC 5)

Facts: NFJD Subbasin Drainage Area = 1830 Sq. Mi.
NFJD/Potamus Drainage Area = 289.5 Sq. Mi. (16% of the NFJD).



As the largest watershed in the NFJD subbasin, the NFJD/Potamus is a "composite" watershed (in contrast to "pure" or "classic" watershed). The watershed contains the mainstem of the NFJD River from River Mile 22.5, at the confluence of Wall Creek, and numerous tributaries, of which the largest is Potamus Creek, located at River Mile 37.5. The upstream boundary of the watershed is located at the confluence of Desolation Creek, at River Mile 60.

Figure 3-0. NFJD Subbasin and Potamus Watershed

The NFJD/Potamus watershed has 11 subwatersheds ranging in size from 17.6 Sq. Mi. (11274 acres) to 34.9 Sq. Mi. (22315 acres). Umatilla National Forest ownership ranges from 2.5 to 96.9 percent of individual subwatersheds (Table 3-1).

Table 3-1. Subwatershed and National Forest Acres in NFJD/Potamus Watershed.

Subwatershed Name (HUC 6)	Proposed name*	Subwatershed #	Acres	Mi2	UNF Acres	% UNF
EAST FORK MEADOW		170702020701	18249	28.5	13041	71.5
MEADOW BROOK		170702020702	11274	17.6	8517	75.5
DEERHORN		170702020703	14614	22.8	4947	33.9
DEERHORN	JERICHO	170702020704	18994	29.7	1270	6.7
STONY/MATLOCK		170702020705	22315	34.9	13486	60.4
UPPER POTAMUS		170702020706	15409	24.1	14936	96.9
LITTLE POTAMUS		170702020707	15593	24.4	13867	88.9
MALLORY		170702020708	19927	31.1	15830	79.4
UPPER DITCH		170702020709	17245	26.9	12453	72.2
DEERHORN	WRIGHTMAN	170702020710	15420	24.1	390	2.5
DEERHORN	CABIN	170702020711	16244	25.4	831	5.1
		TOTALS	**185283**	**289.5**	**99568**	**53.7**

* see Recommendations Section

Watershed Characterization

Climate, Geology, and Landforms

The Potamus watershed has a continental climate, characterized by seasonal extremes of precipitation and temperature. Elevation strongly influences precipitation accumulation, which ranges from 10 inches per year in the lower elevations, to 40 inches per year at the highest elevations. The majority (> 70%) of precipitation accumulates from November through May. The overall average is about 20 inches annually for the watershed, relatively low compared to other Umatilla National Forest watersheds. Annual precipitation at Arbuckle Mountain and Madison Butte SNOTEL sites, representative of the higher elevations, are 38 and 24 inches, respectively (Figure 3-1). The Arbuckle station is at 5400' elevation and has a more northerly latitude (marine influence), has higher annual precipitation, compared to Madison Butte, at 5250' elevation, more continental ("rain-shadow"). Annual precipitation totals over the last decade show drier than average conditions in 1992, 1994, and 2000-2003, and wetter than average conditions 1993, 1995-1997, and 1999 (Figure 3-1).

Dominant geology is volcanic in origin, with flows from the Columbia River Basalt Group occurring across the north and central portion of the analysis area (including Picture Gorge basalts), and older John Day volcanics occurring across the southern portions of the analysis area. Small sections in the headwaters of Potamus and Ditch Creek contain a mix of rock types from the "Clarno" unit, including sedimentary and volcanics. The Meadowbrook subwatershed contains areas mapped as volcanic, sedimentary, and at the headwaters, areas of Quaternary landslide deposits.

Climate and geology strongly influence surface and groundwater conditions. Upper Ditch, Potamus, and Mallory, in a higher precipitation zone, also have the mixed sedimentary-volcanic geology of the Clarno formation, with relatively high permeability. The mid elevations, dominated by Grande Ronde basalts, have generally lower permeability, so streams flowing through these areas typically exhibit lower baseflows. The Grande Ronde basalt interbeds (layers between flows), generally more permeable, are zones of lateral flow moving groundwater towards the stream channels downstream, and helping sustain low flows.

Elevations range from 2042 feet at the downstream "outlet" of the watershed, to 5847 feet at the highest point, located on Arbuckle Mountain, in the Potamus subwatershed. The NFJD River flows west-southwest. Watershed aspects north of the river are dominantly south and west-facing, compared to north-northwest aspects for areas south of the river. A strong break in slope occurs at the contact between the Columbia River basalts, which form gently sloping uplands, and the steeper, more dissected slopes of the Picture Gorge basalts, at an elevation of approximately 4100 feet.

Landforms are dominated by upland plateaus and fluvialy dissected slopes with deep V-shaped valleys associated with major tributaries and the main NFJD River valley. Slope shape shows differential weathering of rock units resulting in stepped profiles, with steep vertical rock faces and longitudinal stream profiles that are generally convex. Valley forms include shallow, gentle swales in the uplands, moderate to deeply confined V-shaped valleys in major tributaries, and alluvial fans and debris cones at the mouths of tributaries. Numerous small springs and seeps occur at the interface between rock units.

Hydrology

Like all rivers, the North Fork John Day River has a distinctive pattern in its natural hydrograph (Figure 3-2). Snow accumulates in the higher elevations from November through March, melting between March and June. Occasional winter storms produce strong rises that may generate snowmelt (1996, 1997). Low flows occur in August and September, during the warm, dry season. The magnitude of floods, high flows, and low flows varies from year to year but the overall pattern repeats every year. Annual variability in water yield, peak flows, and low flows, strongly reflect climatic conditions. The hydrograph for the years 1992 to 2002 shows wetter periods in the first half of the decade and drier years in the second, reflecting annual precipitation patterns. Overall, total annual precipitation, winter distribution, characteristics of frontal storms, and spring melt conditions control seasonal snowmelt patterns and summer low flow conditions.

Locally, in smaller streams, surface runoff is also controlled by physical factors, but is may also be influenced by land uses. There are no large dams on the main-stem of the NFJD, however, many small dams, impoundments, and diversions locally alter natural runoff characteristics (i.e. Penland Lake and Smith Ditch). Historic grazing, logging, roads, and recreation uses have altered natural flow characteristics along segments of smaller streams. Detecting changes in flows is unlikely at the scale of the analysis area, especially given a composite watershed with substantial contributing area upstream. The subwatershed scale was used for evaluating current and reference conditions and potential for flow changes in tributary streams.

Table 3-2. Characteristics of Analysis Subwatersheds

Subwatershed Name	Drainage Area	Approx. Mean Elevation	Dominant Aspect	Dominant Geology/ Ecological Subsections
Meadowbrook (combined)	46.1	4100	N	Picture Gorge basalt/CRB Plateau-continental
Stony-Matlock	34.9	4300	S, SW	Grande Ronde basalt/CRB Plateau-continental
Potamus (combined)	48.5	4460	S, SW	Grande Ronde and Picture Gorge/Elkhorn-Greenhorn Flanks CRB Plateau-continental
Mallory	31.1	4300	S, SE	Grande Ronde and Picture Gorge/ CRB Plateau-continental
Ditch	26.9	4200	S, SE	Grande Ronde and Picture Gorge/ Elkhorn-Greenhorn Flanks CRB Plateau-continental Kimberly-Paulina Hills

A complete map of stream types was not available for the analysis area because Forest maps only cover the National Forest lands. The Forest Service-Region 6 is in the process of developing complete stream maps that cross all ownerships for the Pacific Northwest, however, this process in not complete and stream maps were unavailable for this analysis. As a result, a stream map for the analysis area was generated using 10-meter digital elevation model data. Stream order, a hierarchical stream classification system derived using ArcMap Hydromodeler, was used to characterize and analyze watershed conditions (Strahler, 1964). The resulting data provide a reasonable approximation of the total miles and distribution of stream sizes/types in the analysis area. Under the Strahler system, a stream of a given order is initiated at the junction of two streams of the next lower order (Table 3-3, Figure 3-4). Overall stream density was 2.3 miles of stream per square mile of watershed, relatively low compared to other Forest watersheds, but a reasonable approximation in this semi-arid environment. The majority (over 70 percent) of stream miles in the analysis area are seasonal (intermittent or ephemeral), again reflecting climatic conditions (precipitation total, seasonal distribution). Riparian types were generalized from stream order and watershed position; streams in upland areas are typically herbaceous meadow or forested types, in lower elevations, hardwoods and scattered conifer are dominant.

Table 3-3. Stream Miles, Stream Order, and General Riparian Types.

Stream Order	Miles	Density (mi/mi^2)	General Stream Type	General Riparian Type	Examples
1	328.3	1.1	Ephemeral/ intermittent	Forest upland, herb. meadow	Kelly Prairie, South Jones Prairie
2	161.4	0.6	Ephemeral/ intermittent	Forest upland, herb. meadow	Brush, Martin, Mallory (upper)
3	97.9	0.3	Intermittent/ perennial	Riverine, conifer and/or hardwood	Deerhorn, Matlock, Little Potamus
4	45.6	0.2	Perennial	Riverine, conifer and/or hardwood	Stony, Potamus, Ditch
5	3.0	0.0	Perennial	Riverine, conifer and/or hardwood	Lower Meadowbrook
6	3.2	0.01	Perennial	Riverine, conifer and/or hardwood	NFJD ab. Camas
7	33.9	0.1	Perennial	Riverine, conifer and/or hardwood	NFJD bel. Camas
All	**673.3**	**2.3**			

Water Quality/303d

General designated beneficial uses, as defined by the State of Oregon for the John Day River Basin, include public and private domestic water supply, industrial water supply, irrigation, livestock watering, fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, and aesthetic quality. Table 3-4 lists the water quality criteria associated with these general beneficial uses. Revised rules for specific designated fish uses, recently approved by EPA (March 2, 2004) identify salmon and trout rearing and migration habitat (temperature criteria 18°C, critical period is July and August) in the Potamus watershed, within the John Day Basin.

The Oregon Department of Environmental Quality (ODEQ) is developing Total Maximum Daily Loads (TMDLs) for the John Day Basin. ODEQ is in the process of collecting data, and developing models for purposes of calculating pollution loads and developing load reduction targets. TMDLs will include water quality management plans, to be developed cooperatively with landowners and local watershed groups. It is the Forest Service's responsibility to participate in and contribute to TMDL and Management plan development and implementation.

Table 3-4. General Designated Beneficial uses and water quality criteria for the John Day Basin.

Beneficial Use	Water Quality Criteria
Public Domestic Water Supply	Turbidity, chlorophyll a
Private Domestic Water Supply	Turbidity, chlorophyll a
Industrial Water Supply	Turbidity, chlorophyll a
Irrigation	None
Livestock Watering	None
Fish and Aquatic Life[1]	Dissolved oxygen, pH, sedimentation, temperature, toxics, turbidity
Wildlife and Hunting	None
Fishing	Aquatic weeds or algae, chlorophyll a, nutrients
Boating	None
Water Contact Recreation	Aquatic weeds or algae, bacteria, chlorophyll a, nutrients, pH
Aesthetic Quality	Aquatic weeds or algae, chlorophyll a, nutrients, turbidity
1 See also Fish use designations for this basin	

The Forest Service 303)(d) Protocol (USDA/USDI, 1999) includes the following components to address water quality: validate the current 303(d) list and rationale, work with states and tribes to set priorities and timelines for addressing listed waterbodies, identify where sufficiently stringent management measures are in place to protect water quality, organize existing plans to serve as Water Quality Restoration Plans (WQRPs) where they adequately address 303(d) listed streams, combine WQRP requirements with other analysis and planning efforts, revise the MOAs to reflects current conditions, make the restoration of 303(d) listed waterbodies an agency priority.

Table 3-5. 303(d) Streams in Potamus watershed.

Waterbody Name	River Mile	Parameter	Season/Use	Criteria	Listing Status
Ditch Creek	0-19.5	Temperature	Summer rearing	17.8°C	1998
Mallory Creek	0-14.3	Temperature	Summer rearing	17.8°C	1998
NFJD	0-31.7	Temperature Temperature	Mar-Jul Spawning Summer rearing	12.8°C 17.8°C	2002 1998

NFJD	31.7-86.2	Temperature	Mar-Jul Spawning Summer rearing	12.8°C 17.8°C	2002 1998
Potamus	0-18.4	Temperature	Summer rearing	17.8°C	1998
Stalder	0-4.1	Temperature	Summer rearing	17.8°C	1998

Water Rights and Uses

Two types of water rights exist on the public lands: federal water rights consist of reserved water rights that originate under federal law, and water rights that are acquired under State water law. On the National Forest, water rights acquired under State water law are held both in the name of the Forest Service and in the name of others.

General beneficial uses, as defined by the State, in the watershed include domestic water supply, industrial water supply, irrigation, livestock watering, fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, and aesthetics. The most common uses on the National Forest are fish and aquatic life (instream uses) and livestock and wildlife (consumptive uses). The most common type of water development on the Forest is small in-channel impoundment for water storage for late season stock watering.

There are a number of State certificated water rights in the name of the Federal Government on the National Forest. State certificated water rights in the name of others also occur–both on-Forest and off-Forest.

Rights of others on Federal lands include Smith ditch in the headwaters of Ditch Creek, which diverts water into the Willow subbasin for agricultural uses.

Special Designations

The Omnibus Oregon Wild and Scenic Rivers Act of 1988 designated 54.1 miles of the North Fork of the John Day River from its headwaters in the North Fork John Day Wilderness to its confluence with Camas Creek. The downstream-most segment from Texas Bar Creek to Camas Creek is designated Recreational. The lower 3 miles of this 8.3-mile segment fall within the analysis area. The NFJD river corridor is recognized as providing a wide variety of recreational activities.

The North Fork of the John Day River was designated State Scenic waterway in 1988. The designated reach extends approximately 56.2 miles from near Monument upstream to the wilderness boundary. The Oregon Parks and Recreation Department administers rules governing the program to maintain the natural beauty of the river.

Issues and Key Questions

The North Fork John Day-Potamus watershed is an important source area for downstream water supplies and includes approximately 37.5 miles of the mainstem of the North Fork John Day (NFJD) River. Streams, floodplains, and riparian areas within the watershed buffer water quality, provide water storage functions, and provide habitat for fish, aquatic life, and wildlife (including threatened and endangered salmonids in the NFJD River and major tributaries). Water resource concerns include:

1) maintaining and improving natural flow regimes for channel and riparian function, and water supply purposes;
2) maintaining and restoring water quality (physical, chemical, and biological), and,
3) improving overall conditions of streams, floodplains, and riparian ecosystems.

Key Questions:

- *What are the principle physical characteristics of the North Fork John Day-Potamus watershed and how are they related to erosion processes, stream conditions, and water quality? Where and to what extent have land uses altered erosion rates, channel processes and water quality?*
- *What are the existing water temperature and instream sediment conditions in the North Fork John Day River and major tributaries? Other water quality concerns?*
- *What is the current and potential distribution of riparian vegetation and stream channel types?*
- *Given the overall condition of uplands and tributaries, what are management options for moving to desired conditions?*
- *What are the general goals for managing multi-ownership lands in the North Fork John Day River corridor and what management options are appropriate to meet common objectives and reconcile differences?*

Other related planning and monitoring projects

The Umatilla National Forest Watershed Prioritization report was completed in 2002, and included evaluation of the NFJD/Potamus watershed. The overall rating for the watershed, which assimilated multiple resource factors, was moderate priority for restoration. The watershed condition rating, considering only physical factors, was Class 2, or "moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. Portions of the watershed may exhibit an unstable drainage network. Physical, chemical, and biologic conditions suggest that soil, aquatic, and riparian systems are at risk in being able to support beneficial uses".

Subbasin planning, through the Northwest Power Planning Council, has been underway over the past year, see John Day Subbasin Draft plan, 2004.

NMFS coordinated monitoring – Chris Jordan and Carol Volk are collecting historical aquatic monitoring data for the John Day as part of a larger monitoring strategy pilot study in three Columbia basins (John Day, Wenatchee, and Salmon) to establish what is known about fish populations and aquatic habitat.

The Oregon Department of Environmental Quality (ODEQ) is developing TMDLs in the John Day basin. These are scheduled for completion by 2007. Current efforts are focused on data collection to support pollution load modeling.

The Bureau of Land Management manages a significant (24 percent) of the NFJD River corridor and adjacent lands within the analysis area. The John Day River Management Plan (USDI, 2001) is the guiding document for management of BLM lands on these lands. Water quantity and water quality were important issues in development of the plan. A variety of activities is identified in the ROD to improve flows and water quality.

Current Conditions

Land uses, disturbances and general effects on hydrologic processes

A variety of land uses in the NFJD-Potamus watershed have potential to affect hydrology and water resources by accelerating runoff, erosion and sedimentation rates, reducing streamside shade (increased water temperatures), and altering channel processes (bank erosion, incision, channel widening, and pool filling). The dominant land management activities on National Forest lands in the analysis area are: livestock grazing, roads, timber harvest, developed and dispersed recreation, and water development (ponds, spring developments and diversions).

Natural disturbances also have potential to alter hydrologic processes of runoff, erosion streamflow, and channel morphology both locally, at the stream reach scale, or more widespread, at the watershed-scale. Disturbances include climatic-driven (winter rain-on-snow floods, isolated summer convective storms, drought), vegetation (mortality from insects and disease, effects of fire suppression on stand density), and wildfire.

Livestock Grazing

See Forest Vegetation report for a discussion of historic grazing numbers in the John Day. The number of sheep in the basin peaked sharply first around 1900, and again around 1930, with over 300,000 head in Morrow County alone. Cattle numbers were much lower in the early 20th century, but gradually increased, reaching maximum in the 1950s. Sheep no longer graze in the Potamus watershed, on the National Forest. Overall numbers of cattle increased from 1890 to the 1950s and have declined slightly or remained the same since then. General effects of intense grazing pressure on watershed conditions in the 20th century have been described elsewhere (see for example Kauffman and Kreuger, 1984, and Belski et al, 1997). Legacy effects to uplands (soil erosion, compaction, change in cover characteristics), stream channels (bank stability, channel incision) and riparian areas (loss or reduction of shrub communities) persist in many areas within the Potamus watershed. Areas of greatest impact include higher elevation dry grass and shrublands, moist meadows and streamside areas where stock concentrated during the summer, and lower elevation streamside zones, where animals were held during winter.

Livestock have potential to change watershed conditions by a wide variety of mechanisms, from altering upland soil and vegetative cover characteristics, impacting riparian vegetation and streambanks, to related effects on water quality (stream temperature, sediment, and bacteria). Ongoing effects of grazing management on the National Forest livestock were described in the Oregon Range Evaluation Project (Quigley et al 1989) and in the North Fork John Day Biological Assessment for ongoing activities.

Since the mid 1980s, many miles of perennial stream have been fenced or excluded from grazing on the National Forest, and grazing strategies have been adjusted to reduce watershed impacts. Overall, effects from livestock grazing have been moderated in recent years through reduced numbers, modified grazing strategies, and riparian fencing, but legacy effects persist in some areas, and ongoing use continues to have detrimental effects in localized areas.

Roads and Timber Harvest

There are approximately 580 miles of road in the Umatilla National Forest database in the NFJD-Potamus watershed (See Data limitations discussion). Located in a variety of slope positions (valley bottoms, mid slopes, and uplands), roads influence watershed hydrology in a variety of ways. Valley bottom roads have the most direct effect on streams and riparian areas, accelerating erosion and sediment delivery to channels, reducing streamside shade, and increasing the number of road-stream crossings. Mid slope roads intercept subsurface flow, extend channel flow networks, and accelerate erosion. Ridge top roads influence watershed hydrology by channeling flow into small headwater swales and extending surface flow networks. Adequate drainage reduces the effect of extension of the drainage network by moving water rapidly off road surfaces and allowing infiltration. In general, roads increase the efficiency of runoff, and may contribute to higher, earlier peak flows, and reduced baseflows (Wemple et al, 1996).

In the NFJD-Potamus watershed, the highest National Forest road densities are in headwater areas (see Data limitations section for discussion of road data). Total road densities for subwatersheds with more than 50 percent National Forest ownership range from 2.3 to 3.6 mi/mi^2 (Table 3-5). Road densities greater than 2 mi/mi^2 were identified as a concern in the National Marine Fisheries Service (NMFS) Biological Opinion on the Umatilla National Forest Land and Resource Management Plan (NMFS 1995). Roads located adjacent to stream courses result in relatively high densities of roads within RHCAs, specifically in the Meadowbrook, Mallory, Upper Potamus and Ditch subwatersheds.

Examples of streamside roads include: NFJD River road and US Highway 395 (NFJD River), US 395 (NFJD River, Meadowbrook Creek, EF Meadowbrook Creek), 3974 (Brush Creek), 5316 (Thompson Creek), 2104-150 (Graves Creek). Examples of midslope roads include: 5300, 5320, and 2105. Road restoration efforts in the last 10 years include road closure, decommissioning, and culverts replaced with dips (Graves Creek).

Changes in forest stand and canopy density caused by harvest, fire, or insect and disease may alter the distribution of the snow pack, increase the rate of melt of the snow pack, and cause the timing of the melt to be earlier. These factors may lead to changes in peak flow. In addition, change in stocking density changes the overall vegetative use of water, increasing or decreasing the amount of water available for runoff. Changes in water yield and in peak flow have the potential to destabilize channels, causing increased erosion and sedimentation in channels. Reliable methods for predicting effects of changes in forest cover on water yields and peak flows are not available in large part because the relationship between amount of cover removed and flow change is highly variable (Sherer 2000). Other factors such as climate, topography, and soils influence watershed hydrology and "confound" detection of effects.

One method commonly used to evaluate harvest effects on water yield and peak flow is the Equivalent Clearcut Acre analysis (King 1989). A procedure was developed for the Forest as part of Endangered Species Act (ESA) consultation (Ager and Clifton 1995) The procedure was recently updated and renamed "Equivalent Treatment Area Calculator", or ETA, to account for the broader range of treatment and effects to forest vegetation (Ager and Clifton, in review). ETA's were calculated following the Forest protocol to determine existing levels of harvest and estimate water yield effects in the analysis area. Percent ETA measures the extent of harvested openings and is used as an indirect measure of the hydrological effects (increases in water yield and peak flow) of harvesting. The procedure to determine percent ETA includes harvest method and vegetative recovery rates developed for the Blue Mountains.

Guidelines in ESA consultation documents place an upper limit on ECA at 15 percent (for concurrence on Not Likely to Adversely Affect determinations). Results show low likelihood of harvest effects to flows (< 10 percent ETA) in the Potamus analysis area on subwatersheds with majority National Forest ownership. Individual subwatersheds ranged from 0 to 8 percent ETA (Table 3-7). Harvest has occurred within Riparian Habitat Conservation Areas, indicating potential for other types of effects from logging such as skidding (impacts to soils), removal of large conifers (reduced potential for recruitment of instream wood). Subwatersheds with relatively high levels (> 20 percent) of RHCA harvest are: EF Meadowbrook, Stony/Matlock, Upper Potamus, Potamus, and Ditch Creek (Table 3-7).

Recreation

The dominant recreational activities on the National Forest lands are pleasure driving, dispersed camping, picnicking, and hunting. Numerous dispersed camping sites have been established along roads and streams. Peak use occurs during fall hunting season. There are two developed recreation sites within the Forest boundary; the Coalmine Hill Snowpark, and Penland Lake picnic area. The majority of the Penland Lake area is in private ownership and has 25-30 cabins on the lakeshore or immediately adjacent. Changes in land ownership and public access resulting from land exchanges significantly increased BLM land ownership on the North Fork John Day River in 2000. Interim management emphasis is placed on fish, wildlife, and recreation, until longer term management plans are completed.

Natural Disturbance Processes

Periodic floods, drought, wildfire, and change in forest cover (blow-down, insects and disease, suppression effects on stand density) are naturally occurring events within the Potamus watershed.

Streamflow has been gaged on the North Fork John Day at Monument since 1911. The five largest flood years since recording began are: 1932, 1965, 1991, 1996, and 1997. The highest floods are generally winter events, produced by heavy precipitation in combination with a melting snowpack. Floods alter and maintain stream morphology by scour and deposition of sediment and large wood. More frequent floods, occurring every 1-2 years, maintain channel form while larger floods shape valleys, shift channel position, and move significant volumes of sediment. The 1996 and 1997 floods affected streams in the analysis area, for example, culverts on the 2105 road on Potamus Creek were damaged by high water and debris backed up by the road fills.

Many short term droughts and a few long term droughts have occurred over the last century, most recently, 1985-1994 is considered a dry period across the state and a known contributor to forest health decline. Trees weakened by water shortage are more susceptible to insects and disease. Earlier drought periods include 1976-1977, 1965-1968, 1939-1941, and 1917-1931 (Taylor and Hatton, Oregon Climate Service). Years of large fire occurrence and vegetation mortality are described in the Forest Vegetation and Fire and Fuels report.

Table 3-6. Stream, Roads, and RHCA Roads*.

Subwatershed Name	Area (mi^2)	Stream Miles	Stream density (mi/mi^2)	FS DB Roads (mi)	FS DB Road density (mi/mi^2)	RHCA Road miles	RHCA Road density (mi/mi^2)
EAST FORK MEADOW	28.5	63.6	2.2	102	3.6	19.4	0.7
MEADOW BROOK	17.6	39.5	2.2	41	2.3	13.8	0.8
DEERHORN	22.8	51.4	2.3	31	(1.4)	(9.7)	(0.4)
JERICHO (prop.)	29.7	73.9	2.5	15	(0.5)	(3.9)	(0.1)
STONY/MATLOCK	34.9	86.6	2.5	84	2.4	16.7	0.5
UPPER POTAMUS	24.1	53.0	2.2	83	3.4	16	0.7
LITTLE POTAMUS	24.4	59.2	2.4	60	2.5	12.2	0.5
MALLORY	31.1	74.5	2.4	86	2.8	18.6	0.6
UPPER DITCH	26.9	57.8	2.1	89	3.3	22.23	0.8
WRIGHTMAN (prop.)	24.1	56.5	2.3	13	(0.5)	(0.4)	(0)
CABIN (prop.)	25.4	57.3	2.3	7	(0.3)	(0)	(0)

* FS DB = Forest Service Database, RHCA = Riparian Habitat Conservation Area, NA=Not Applicable. Values in () do not reflect actual values for the subwatershed, only FS data/lands.

Table 3-7. Equivalent Treatment Area – Harvest and Roads*.

Subwatershed Name	SWS Area (mi^2)	% UNF	% UNF Potentially Forested	UNF ETA Acres	UNF ETA % Forested	Roads % SWS Area
EAST FORK MEADOW	28.5	71.5	58	444	4	1.7
MEADOW BROOK	17.6	75.5	50	18	0	1.1
DEERHORN	22.8	33.9	28	(74)	(2)	0.6
JERICHO (prop.)	29.7	6.7	4	(2)	(0)	0.2
STONY/MATLOCK	34.9	60.4	51	427	4	1.1
UPPER POTAMUS	24.1	96.9	90	1107	8	1.6
LITTLE POTAMUS	24.4	88.9	73	568	5	1.2
MALLORY	31.1	79.4	52	478	5	1.3
UPPER DITCH	26.9	72.2	62	825	8	1.5
WRIGHTMAN (prop.)	24.1	2.5	0	NA	NA	0.3
CABIN (prop.)	25.4	5.1	1	(0)	(0)	0.1

* SWS = Subwatershed, UNF = Umatilla National Forest, ETA = Equivalent Treatment Area, UNF ETA % For. = % ETA of potentially forested acres on the UNF, NA=Not Applicable. Values in () do not reflect actual values for the subwatershed, only FS data/lands.

Effects of Land Uses and Disturbances on Watershed Processes

Erosion – see also Soils Report

Natural background erosion and sediment yields vary by geology, landtype, slope, and other factors. Annual sediment yields from nearby gauged catchments in the Wall Creek watershed (upper Skookum) ranged from 2 to 168 t/ mi^2/yr over an 11 year period. The dominant erosion process in the analysis area is surface erosion, with localized areas of mass wasting in specific landtypes (landslide deposits in EF Meadowbrook). Land uses and disturbances alter natural sediment yields by changing cover conditions, soil properties, increasing potential for instability, runoff and erosion rates, and altering stream channel conditions (channel shape, substrate, sinuosity, gradient). The potential for elevated erosion and sediment yields is highest in areas with higher road densities, streamside logging, on unstable landtypes, and in steeper terrain, for example in EF Meadowbrook Creek, upper Potamus, and Ditch Creek.

Table 3-8. Riparian Harvest*.

Subwatershed Name	Total acres of harvest on UNF	Acres of harvest in UNF RHCA	% UNF RHCA harvested
EAST FORK MEADOW	3623	523	22
MEADOW BROOK	1074	118	7
DEERHORN	1112	58	4
JERICHO (prop.)	24	0	0
STONY/MATLOCK	8366	1689	52
UPPER POTAMUS	5123	1056	44
LITTLE POTAMUS	3990	701	23
MALLORY	3044	553	17
UPPER DITCH	5610	1018	48

Subwatershed Name	Total acres of harvest on UNF	Acres of harvest in UNF RHCA	% UNF RHCA harvested
WRIGHTMAN (prop.)	0	0	0
CABIN (prop.)	8	0	0

Hydrology

Changes in flow regimes at the scale of the North Fork John Day River are possible and have been reported by others (Wissmar et al 1994) but are unlikely to be detectable with existing flow records, which began well after settlement. Flows on the North Fork John Day River in the analysis area are largely controlled by the larger contributing watershed upstream. Regardless, detection of changes in flow regime at the watershed or subbasin scale would be unlikely because of natural variability and complex controls on streamflow. Change in flow regime is more likely to occur and be detectable at the subwatershed or catchment scale, however, based on nearby small watershed studies (High Ridge and Skookum Experimental Watersheds), measurable changes in water yield or peak flows are unlikely. This does not imply changes have not occurred, rather that long term precise records are needed, and detailed analysis, accounting for climatic variability, which tends to overwhelm management effects.

Stream channels and riparian areas

Major changes in channel morphology and riparian ecosystems (meadows, riverine) probably occurred decades past, during or immediately following the peaks in grazing and logging activities (1930s-1980s). Changes include channel incision (downcutting), widening, increased bedload, reduction of instream wood, and reduction of native broadleaf vegetation communities. Many affected streams are recovering and in a quasi-stable state today, however, some areas remain in an unstable condition. Active riparian management is occurring in some areas. Examples include projects to enhance or recover aspen and other hardwood communities.

Water quality

In general, the physical, chemical and biological quality of water on the National Forest is considered good, however, water temperature in the main tributaries is not at optimum, and bacteria may be a concern where livestock have access to perennial water.

Water temperatures have been measured at 12 locations in the analysis area, with over 10 years of data for some locations (Figure 3-5, Table 3-9). High summer temperatures are a key limiting factor for fish and aquatic life, and are also related to other potential water quality concerns, including development of nuisance algae and low dissolved oxygen levels. Water temperature is strongly controlled by seasonal changes in streamflow and air temperature, and generally reaches maximum during the month of July, when streamflows are near their lowest and air temperatures are at maximum (Figure 3-6). The annual 7-day average of the daily maximum provides a summary value of year-to-year maximum temperatures occurring during summer months. Despite 10 years of data for many stations, no obvious trends are apparent for any station from the moving average values. What is apparent is year to year variability that is largely driven by climatic conditions. For example, all stations show high 7-day maximum values for drier than average years 2000-2003. Upper Ditch Creek above the Smith diversion and Potamus at the FS boundary met the State temperature criteria. Ellis Creek, Hinton Creek, and Mallory Creek met the criteria in some years but not in others. All other stations did not meet State temperature criteria in any of the years.

In summary, land use effects on water temperature, instream sediment, channel morphology include reduction in streamside shade, accelerated erosion and sediment delivery to streams, channel instability (incision, widening), and reduction in shallow subsurface storage potential. Subwatersheds with moderate to high levels of riparian harvest, roads, and past heavy grazing impacts are more likely to exhibit impaired water quality and channel function as a result of management activities. EF Meadowbrook, Stony/Matlock, upper Potamus, Little Potamus, Mallory, and Ditch subwatershed all have moderate to high surrogate indicators of impaired function (riparian harvest and roads) and direct measurement of water temperature exceedance.

Table 3-9. Stream Temperatures – Annual 7-Day Average of the Daily Maximum, Years 1993 – 2003, Degrees Fahrenheit and Celsius (BOLD).

Stream name/location	Year										
	93	94	95	96	97	98	99	00	01	02	03
Ditch Cr # 2 / lower / @ Gilman Flat	75	75e	76	79	76	77	77	79	78	81	76
	24	**24e**	**24**	**26**	**24**	**25**	**25**	**26**	**26**	**27**	**24**
Ditch Cr # 1/ blw 2104 Rd / middle	76	77?	72	78	77	72	73	76	69e	e	76
	24	**25?**	**22**	**26**	**25**	**22**	**23**	**24**	**21e**		**24**
Ditch Cr abv Smith Ditch Cr	55	59	55	59	59	60	NVD	62	63	64	64
	13	**15**	**13**	**15**	**15**	**16**		**17**	**17**	**18**	**18**
Ellis Cr abv Potamus Cr		X	X	65	65	65	63	64	64	66	66
				18	**18**	**18**	**17**	**18**	**18**	**19**	**19**
Hinton Cr @ mouth	66	X	62	X	63	70	65	71e	64e	e	e
	19		**17**		**17**	**21**	**18**	**22e**	**18e**		
Mallory Cr @ FS Bdy [HEPP]			60	79e	65	66	62	67	70	Lost	72
			16	**26e**	**18**	**19**	**17**	**19**	**21**		**22**
Meadowbrook Cr @ mouth / main	68	X		X	74		NVD	74	75	77	76
	20				**23**			**23**	**24**	**25**	**24**
NFJD Rvr abv Camas Cr			72	76	X	76	74	78	77	80	80
			22	**24**		**24**	**23**	**26**	**25**	**27**	**27**
Pole Creek abv Potamus Cr							80	76	75	76	NVD
							27	**24**	**24**	**24**	
Potamus Cr # 1 / lower Kelly Prairie	78	78	74	70	67	76	72	72	68e	e	e
	26	**26**	**23**	**21**	**19**	**24**	**22**	**22**	**20e**		
Potamus Cr # 2 / middle / abv Rd 2105	73	78	69	74	70	72	72	74	76	80	77
	23	**26**	**21**	**23**	**21**	**22**	**22**	**23**	**24**	**27**	**25**
Potamus Cr # 3 / @ FS Bdy	68		67	63	62	62	62	61	61	62	61
	20		**19**	**17**	**17**	**17**	**17**	**16**	**16**	**17**	**16**

Notes: X, NVD = suspect or missing data to calculate 7DADM, e = missing or suspect data, value estimated by interpolation or correlation.

General Watershed Condition Rating

The NFJD-Potamus watershed was rated as Watershed Condition Class 2, and high priority for restoration in the 2001 Umatilla National Forest Watershed Prioritization report.

Overall, watershed conditions in Potamus have likely been improving for the last 10 years with implementation of Forest Plan and PACFISH standards and guidelines, and consequent changes in logging and livestock grazing practices, and the reduction in direct impacts to stream and riparian areas. However, based on current conditions (legacy effects, levels of roads, riparian harvest), overall watershed condition rating remains at condition class 2, “moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. Portions of the watershed may exhibit an unstable drainage network. Physical, chemical, and biologic conditions suggest that soil, aquatic, and riparian systems are at risk in being able to support beneficial uses”.

Reference Conditions

Reference conditions help determine to what degree watershed conditions have changed over time as a result of human activities and natural disturbance. Reference conditions also provide a benchmark to evaluate current condition, management objectives, departure from reference, and desired future condition. Three approaches to analyzing reference conditions are commonly used:

- Compare to historic, pre-settlement or early settlement period, using for example trapper journals and early surveys (i.e. General Land Office survey notes).
- Compare to conditions in biophysically-similar watersheds with minimal management impacts, using a “space for time” analysis approach.
- Compare to standards or benchmarks, for example, State water quality criteria, PACFISH, and statistical analysis of large populations of data (Archer et al, 2004).

Wissmar et al (1994) reviewed the history of resource use and disturbance in the John Day river basin, summarizing early settlement and land use patterns, and pre-development conditions. Early fur traders noted thick cottonwood galleries on the main John Day River at Picture Gorge and beaver were reported to be abundant (Wissmar et al 1995). Of note are the settlement and development patterns in the John Day basin, which started first with beaver trapping, followed by mining, domestic livestock, logging, and road system development. The upper North Fork John Day was an important area for mining, the river immediately upstream from the Potamus watershed was dredged for gold as late as the 1950’s. The town of Shaniko, to the west, was famed as a sheep shipping port. The North Fork John Day River corridor was and still is an important access and travel route.

There are no comparable reference watersheds for the entire NFJD-Potamus watershed, however, areas within the watershed exhibit reference characteristics for tributaries, with intact functioning stream and riparian communities, and cold water sources. For example, the lower canyon of Potamus (from approximately 2700 to 4400 feet elevation) has minimal impacts with few roads and limited grazing use. Baseflows appear to be supported by groundwater, with the result that stream and riparian conditions exhibit functioning characteristics (stable channel, diverse vegetation communities) and water temperatures meet state standards (Figure 3-6). Other tributaries including Ditch Creek and Little Potamus in this elevation zone are also minimally altered by land uses, having limited roads and livestock access, and potential groundwater influence.

Other sources of reference conditions or benchmarks include standards and guidelines (State water quality and PACFISH), and regional assessments such as Overton et al, 1995 (cited in Aquatics report) and PACFISH-Infish Effectiveness monitoring. These provide another means to evaluate existing compared to reference conditions. State water quality criteria for temperature were developed based on biological requirements. Four tributary streams and the mainstem North Fork John Day in the Potamus watershed do not meet temperature criteria in part as a result of human impacts. Natural "impairment" may be a contributing factor where climate and geology conditions limit stream potential. Some streams such as lower Potamus are relatively stable thermally as a result of groundwater influence (Figure 3-6). Overton et al (1995) and PACFISH RMOs are addressed in the Aquatic resources section. In future years the PACFISH effectiveness monitoring data may provide a means to quantitatively evaluate trends in stream and aquatic conditions. Over the short term, progress will continue to be gauged by surrogate management indicators such as road density and State water quality criteria.

Synthesis and Interpretation

Departure from reference conditions include: alteration of runoff and erosion rates, volume and timing of flows, channel conditions (morphology, stability), riparian communities, and water quality (stream temperature). Overall, effects are variable and most likely to persist where land uses are most intense, in subwatersheds with relatively high road density, riparian harvest, and past or ongoing grazing impacts. Subwatersheds with moderate to high road density and riparian harvest include: EF Meadowbrook, Stony/Matlock, upper Potamus, and Ditch.

Summary of Key Findings

- Overall, the continental climate with relatively low precipitation (15-45") strongly influences summer baseflows and stream temperatures. The general pattern of fall-winter precipitation produces a spring snowmelt-dominated hydrograph.
- Climate and geology strongly control runoff and stream hydrology characteristics. Higher elevation zones in the upper Ditch, Potamus, and Mallory Creek have relatively high infiltration rates, moderate runoff, and provide a source for groundwater recharge to lower elevation streams. Stream temperatures are more buffered in groundwater-supported reaches.
- Legacy effects from historic grazing, roads and logging persist in some streams and riparian areas. Effects include incised and unstable stream channels, reduction of streamside shade, loss of floodplain and meadow subsurface shallow aquifer storage, and water quality impairment (elevated stream temperatures).

Effects are most pronounced in areas with streamside roads, dispersed recreation, and in areas with past or ongoing grazing effects.

- Streamflows may be locally altered as a result of change in soils and vegetation, including more rapid runoff in non-forested uplands. Change in forest vegetation cover has also likely affected the water balance, with confounding effects: harvested areas would be expected to yield more water, however, in areas with denser forest cover, more water use by vegetation would be expected to decrease water yields. Effects would not be detectable at the watershed scale. Detection at the subwatershed scale would be unlikely, given other factors influencing streamflow.
- Water temperatures are likely elevated in major tributaries, however, some reaches appear to be thermally buffered (groundwater-supported). Potamus at the Forest Service boundary meets state temperature criteria, however, the upstream segment does not. More detailed analysis of monitoring data including shade and groundwater modeling would be needed to estimate potential stream temperature. Stratification by geology and analysis using climate data would help identify streams that are thermally buffered (groundwater-supported). Streams that are not thermally buffered and have management impacts should be higher priority for active restoration.
- Invasive plants may locally alter hydrology and erosion characteristics. Reduction in riparian shrub communities is a likely contributing factor to increased stream temperatures and channel instability in some stream systems.
- Some recovery is evident as a result of changed management and improved stream stability and riparian conditions. Areas with greatest recovery are in riparian exclosures, and in allotments with reduced numbers and improved grazing strategies.

Relationship to other resource issues:

Forest vegetation – fire regime/condition class, priority areas for reduction of hazard fuels need to consider water quality conditions and potential effects of treatments on watershed conditions. Need more rigorous evaluation of the likelihood of improving watershed conditions over the long term by reducing risk of uncharacteristic wildfire compared to short term effects of treatments. See also comments under riparian management.

Invasive plants – strategies for treating invasives need to address role of stream network as a vector for spread, riparian invasive control, and appropriate methods for treatment that protect water quality.

Riparian management – the Forest and Region lack an integrated strategy for management of riparian ecosystems. All resource areas in this report consider and to some degree address riparian issues, however, we lack adequate spatially-explicit maps and appropriate vegetation classification, have no information on existing riparian condition, and a management strategy that emphasizes limiting adverse impacts (PACFISH is generally applied as passive rather than active management within riparian habitat conservation areas). This strategy has conflicted with fire and fuels management objectives, hardwood restoration, and other active management strategies in recent years.

Recommendations

Watershed and Aquatic Restoration

The John Day is a high priority basin for aquatic restoration in the Pacific Northwest. Within the North Fork John Day subbasin, the Potamus watershed is moderate priority for restoration. Restoration efforts in the watershed should be coordinated with the BLM and other ownerships to achieve maximum benefit. To that end, a restoration implementation plan that identifies high priority needs and coordination and funding opportunities should be developed for the watershed. Both passive and active restoration measures should be considered. Among others, key organizations to include are The North Fork John Day Watershed Council, BLM-Prineville, and Warm Springs Tribes. Specific actions needed on the National Forest to support development of a restoration plan follow:

Roads

Inventory the condition of maintenance level 1 and 2 roads for active surface erosion, accelerated mass wasting, flow impairment, road-stream crossing hazard (potential failure). Identify roads impairing hydrologic function and identify appropriate treatment options. Specific examples of roads needing work include:

The 5300-701 crossing of Pole Ck needs work and is a passage barrier. The 5300-170 road needs work for 3/4 mile north and 3/4 mile south of 5300-701 (Rick's old map). The 5300-210 road across Kelly Prairie is in poor condition. It is used as a dispersed site, and should be improved to the site, but blocked at the site so campers can't drive into meadow. Also needs outhouses. The 5300 road culvert at Kelly Prairie (Potamus Ck) is a passage barrier. Possible erosion/restoration site at the end of the 2100-052 road in T5S, R28E, section 8, NE/SE (Rick's old map). ATVs are improperly using 5300-180, 182, and trail 3162 to access Pole Ck and Potamus Ck. They should be blocked and educational signs installed. Forest Road 5300-750 road across private land in Herren Meadow has several culvert problems. Landowner Dick Wilkinson is willing to cooperate. That is also site of diversion of Ditch Ck to Willow Ck. The first mile of Forest Road 2103 is reducing flood plain connectivity along Butcher Bill Ck, trib of Ditch Ck. This section is a Morrow County road, and is opportunity for cooperation. (from Tom McLain, 9-29-2004)

Develop a strategy to upgrade and decommission high hazard roads and roads not needed for management. Include reducing road density in priority areas as a management goal. Set targets with timeframes, for example, reduce road densities to 2 mi/mi^2 in National Forest subwatersheds by 2009. Work cooperatively within and outside the agency to achieve goals, and seek funding opportunities to accomplish objectives.

Riparian Management

Need integrated mapping and classification of riparian areas on the Forest, and a sampling strategy to determine riparian conditions, trends, and potential. Develop specific riparian objectives during project planning to enhance riparian conditions. Coordinate with Aspen and other hardwood restoration activities.

Water Quality

Design projects to improve water temperatures in impaired reaches where temperatures are likely controlled by streamside shade and channel morphology.
Validate 303(d) list and rationale on an ongoing basis, provide updated information to States during listing.

Participate in development of TMDLs and Water Quality Management Plans. Ensure consistency with TMDL objectives in National Forest project planning.

Address 303(d) listed streams in project-level planning at the District. Ensure plans are consistent with CWA requirements (identify beneficial uses, water quality criteria, affected 303(d) streams, and appropriately address effects using design criteria, mitigation, and restoration.

Conduct more detailed analysis of stream temperature records for trends related to management and climatic conditions.

Monitoring and Evaluation

Develop a watershed monitoring strategy, to include tracking of watershed improvement/restoration progress, and implementation and effectiveness of management practices.

Strategically link baseline, project, watershed and Forest Plan monitoring, considering large-scale programs to the extent possible (PIBO and LUCID).

Analyze backlog of temperature monitoring data to help identify impaired reaches, focus restoration efforts, and improve efficiency of stream temperature monitoring network.

Incorporate priority management actions resulting from Watershed Analysis into Forest Plan strategic objectives, including watershed restoration priorities. Target funding and work priorities to address watershed and aquatic resource concerns.

Information Management

Core GIS layers:

> Hydrologic Unit Names: replace duplicate subwatershed names (Deerhorn occurs in 4 subwatersheds), propose new names for 3 subwatersheds using largest named tributary (Table 3-1). Changes need to be implemented by GIS Data Steward for CSA.
>
> Streams: the Hydro-Framework project (stream integration) and NHD modeling streams layer so common data are used in future analysis.

Corporate Databases:

> NRIS-Water – maintain and update the Aquatic Inventory sub-module, invest in data migration into the Watershed Improvement Tracking database, and complete initial data migration effort for the Water Uses Tracking System.

Data gaps, assumptions, and level of confidence

Stream coverage: lack complete coverage for the watershed because ongoing Regional stream integration effort has not been completed in the John Day. We used ARC Hydro to produce a stream layer for purposes of this analysis.

Land use data (roads, harvest) for non-federal lands not readily available, analysis focused on Federal lands. Specifically,

> Roads data: Forest Service database included classified National Forest roads, some County roads, other public roads, and some private roads. Coverage is incomplete, and not representative of total miles of road in the Analysis Area. At the subwatershed scale, road coverage is reasonably complete for dominantly National Forest ownership. All roads were used in the analysis, regardless of operational maintenance class. Some roads may be closed and in a stabilized condition, and not contributing to changes in hydrology. Unclassified roads are not included in the data. Road areas were calculated using an assumed 3/acres per miles of road. Actual road area varies by road maintenance class and slope position, among other factors. Analysis results are applicable only for areas with substantial National Forest ownership, and should be interpreted with caution.
>
> Harvest data: Forest Service database includes only harvest on the National Forest. Missing records were assigned default values for ETA (.5) and Recovery (.036) where harvest prescription and potential vegetation data were missing (88 records). Default values for Recovery rate (.03) were assigned for harvest in areas classified as not potentially forested. Overall, missing values represented a relatively small percent of the data (5% missing prescription). The level of harvest on classified non-forested area (11%) and in Riparian Habitat Conservation Areas (28%) is an indicator of lower potential for recovery and may indicate areas of persistent stream and water quality impairment.

Analysis is limited to summary of key attributes, with no detailed analysis of roads data. Overall, moderate confidence in analysis results on seven dominantly National Forest-owned subwatersheds. Low confidence in results on four dominantly “other-ownership” subwatersheds.

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AQUATIC SPECIES

Watershed Characterization

This fisheries analysis discusses fish and fish habitat conditions within the Potamus Creek watershed (HUC 1707020207) in the context of its geographic location within the North Fork John Day River Subbasin. The discussion focuses primarily on conditions on National Forest System lands within the watershed, but includes discussion of off-forest conditions in the watershed where information is available. Much of the following discussion is drawn from the draft 2004 John Day Subbasin Plan.

The current state of fish habitat in the Potamus watershed has been shaped through natural disturbances interacting with natural topography and human use of the land and water. Natural disturbances include both wildfire and flood. Road building and maintenance, grazing, fire suppression, logging, water withdrawals and regulation, compounded in places by uncharacteristically severe wildfires and 100-year floods, have all contributed to changes in vegetation, runoff, water temperatures, instream flows and sedimentation over the past 150 years in this watershed. Changes to watershed processes and physical structure of the landscape have yielded a mosaic of aquatic habitat ranging from high quality in headwaters and middle reaches and created relatively lower habitat quality in the lower watershed below the Forest.

The contemporary character of the fish habitat in the Potamus watershed has been shaped through natural disturbance and by human use of the land and water. Road building and maintenance, agricultural development, grazing, timber harvest, fire suppression, water withdrawals and regulation, compounded in places by wildfire and 100-year floods, have combined to alter vegetation, water temperatures, instream flows, instream habitat structure and sedimentation. Changes to watershed processes have yielded a mosaic of aquatic habitat ranging from high to low quality, depending upon the drainage. Habitat aspects most needing restoration include fish passage, temperature reductions, pool and large wood recruitment.

This watershed displays a wide range of human impact between streams, from relatively little, to highly impacted, as well as a wide range of natural fish habitat capability between streams regardless of human impact. Inherent differences between streams are reflected in part by the fact that the Potamus Watershed is a composite watershed comprising several separate stream systems draining independently off-Forest into a common receiving river segment (North Fork John Day River), which are mapped as being within the same 5th field HUC.

Ditch, Mallory, Potamus, Deerhorn, Hinton, and Meadowbrook creeks all begin on-Forest. Each are third order or greater streams with the exception of Hinton Creek (first order in its entirety). Stream names are listed sequentially upstream in the order that they adjoin the River. Confluences of these tributaries with the river are all located off-Forest. A number of other off-Forest smaller first and second-order streams in this composite watershed enter the river independently. There is no habitat information available for these streams, which are predominantly located on BLM and private lands below the forest. Stony Creek is an off-Forest 3d order tributary to the river, whose principal flow comes from Matlock and Thompson Creek tributaries, both of which head on-Forest.

The following elements of fish habitat were analyzed: fish distribution, water quality, and distribution of pools, in-stream wood, and substrate composition, associated with climatic variability between water years, episodic large-scale natural disturbances and development impacts. A variety of information sources were used for analysis, the most important ones of which are described in Appendix Table 4-1. Areas most vulnerable to management impacts include the headwaters of Ditch Creek and the entire Meadowbrook Creek drainage. Opportunities for active restoration are limited. The areas most in need of restoration attention tend to be below the Forest boundary in the lower portions of the Meadowbrook and Mallory Creek sub watersheds (John Day Draft Sub Basin Plan, 2004).

Key Questions

- *What is the current status of fish populations?*
- *How have large fires and hydrologic disturbances affected instream aquatic habitat over the past 40 years?*
- *How might various fire regimes in the watershed affect instream aquatic habitat when natural fire return intervals are operating?*
- *How have wildfires affected instream aquatic habitat in the watershed when natural fire return intervals have been altered?*
- *What are the major natural and human-caused factors limiting fish habitat?*

Reference Fish Habitat Conditions

Historical descriptions of the John Day Subbasin indicate that the John Day River itself was once a relatively stable river with good summer streamflows and water quality, and heavy riparian cover. Large spring and fall anadromous migrations indicated that John Day River waters contained a high degree of instream habitat diversity. Under natural conditions, streams in the Potamus watershed were most likely very similar in many respects, particularly in wood frequencies and pool frequencies, to natural condition streams of similar size and geologies analyzed in Idaho by Overton et al (1995). Primary differences from natural condition Idaho streams are likely to be related to the innate character of south-facing drainages in the Potamus watershed, particularly Potamus, Mallory and Matlock Creeks, which become intermittent in most years by mid- summer, and are naturally flow-limited, particularly on-Forest in the headwaters. Over-riding climatic and geologic factors appear to interact to cause natural flashiness and intermittency in these streams. These geographic and climatic differences between unmanaged, aka “reference” streams in the Blue Mountains and streams in the Potamus watershed have been calibrated through use of wetted width measurements taken at the time of each survey. Tables 4-3 and 4-4 show watershed-scale wood and pool conditions from the most recent surveys in Potamus streams contrasted with reference wood and pool conditions drawn from unmanaged streams of similar wetted widths in the Blue Mountain province (McKinney et al 1996).

Changes in pool, substrate and large wood habitat elements for individual streams cannot be directly quantitatively compared through time, since beginning and ending points of survey reaches have not been held constant for any stream where multiple surveys have been conducted over the past 40 years. To enable some level of interpretation, beginning and ending points of reaches have been used within a given survey year where noted to allow for relative changes within similarly located lengths of these same streams in later survey years (Tables 4-5 to 4-14).

Current Fish Habitat Conditions

Potamus Watershed relative to North Fork John Day Subasin.

Fish habitat below the Forest boundary has been degraded as a result of grazing, logging, road development, water development and catastrophic fire followed by catastrophic floods. Agricultural and livestock management practices coupled with climate have contributed to a general reduction of riparian vegetation and increased sedimentation. Loss of riparian vegetation, water withdrawals and loss of beaver have likely contributed to elevated stream temperatures observed in the North Fork John Day River. Relevant information about species, habitat conditions and restoration actions pertinent to the Potamus watershed are described in the Draft John Day Subbasin Analysis 2004, and is incorporated by reference.

Most of the streams in this subbasin are considered in relatively good condition, with the exception of elevated late summer water temperatures that do not meet ODEQ standards for steelhead and Chinook rearing habitat (Draft John Day Subbasin Plan 2004). Summertime water temperatures in RM 20-60 of the North Fork John Day River today favor introduced warmwater species such as smallmouth bass. Most streams monitored in the watershed commonly exceed suitable summer temperatures, albeit they have not been 303(d) listed to date. Two of the primary streams in this Watershed, Potamus and Mallory Creek are listed by Oregon Department of Environmental Quality for temperature. Stalder Creek, also 303(d) listed for temperature, contributes excessively warm water to Mallory Creek as well. Because the North Fork John Day River (including its primary tributary, the Middle Fork, just downstream from Ditch Creek) contributes 60 percent of the flow to the mainstem John Day (OWRD 1986), the influence of the North Fork on mainstem temperature is significant. The hydrology chapter provides further discussion.

The lowest reach of Potamus provides flows through a deep narrow canyon as it leaves the Forest, and waters in Reach 1 have maintained suitable rearing and migration temperatures consistently for the past 8 years even though surface flow becomes intermittent during summer low-flow periods. Middle and upper reaches continue to exceed suitable rearing temperatures for juvenile steelhead. Most streams in the watershed tended to be elevated above the 64 degree steelhead rearing standard during the period of record, the only exceptions being Ellis Creek, which typically hovers at or near the 64-degree standard, and uppermost Ditch Creek. The surface flow in upper Ditch Creek is disconnected from the rest of the watershed by a diversion dam that sends that water into the Willow Creek subbasin and thence directly into the Columbia. The waters in this unmaintained diversion ditch handily support resident redband trout that enter from above the diversion, which is a complete fish barrier. The diversion has been in place for decades and is legally part of the Willow Creek system.

Distribution and Habitat Use: Current fish distribution of salmonids and other fish species in tributaries is likely similar to historic conditions, despite seasonal high temperatures in the river and tributaries (Table 4-1). Even so, 41 culverts at road crossings on fish-bearing streams have been identified as physical passage barriers in the watershed since 2000 (Table 4-1). The degree to which these culverts have affected distribution is unknown at this time; further analysis of these culverts will need to be performed on a project-specific basis. ODFW records from Streamnet show no artificial truncation of fish distribution for salmonids in this watershed. Detailed species distribution and habitat use data are presented in Appendix 4.

Table. 4-1. Steelhead/Redband Distribution among Forest Streams (measured from confluence)

Stream Name	Steelhead Use (mi)	Redband Use (mi)	Chinook Use (mi)
NF John Day River[1]	40	40	40
Ditch	19.5	19.5	1.9
Mallory	10.6	14.3	4
Stalder[2]	.8	.8	0
Graves	2.8	2.8	0
Jones	100 ft	0	0
Potamus	14.5	18.4	0.6
Brush (Potamus trib)	0	2.1	0
Pole	3.5	5.2	0
Ellis	2.2	2.2	0
Deep	.3	3.6	0
Little Potamus*	3.5	10	0
Wilson	0.7	2.5	0
Matlock	4	5.9	0
Matlock, unnamed trib	0	2.8	0
WF Meadowbrook	6.8	8.6	0
Smith	1.5	4.8	0
EF Meadowbrook*	0.6	11.4	0
Bully	0	1.9	0
Hinton***	0	4.9	0

[1] This river segment (RM20-RM60) serves as migratory/rearing habitat for steelhead and Chinook, and as year-round habitat for redband trout.
[2] Streamnet shows Stalder with 2.3 miles and 4.1 miles used by steelhead and redband respectively. District surveys have refined the area of actual known use.
* *30-foot natural falls @RM 0.6 on EF Meadowbrook Creek blocks upstream passage for steelhead, redband.
* Steelhead distribution ends at natural falls at RM 3.0 on Little Potamus.
*** 35-foot natural falls @RM 2.6 on Hinton Creek blocks upstream passage. Oral history from longtime residents of the area indicate that these falls developed within the past 100 years (K.Groves, pers. comm.)

Table 4-2. Fish passage barriers (artificial) within the Potamus Watershed[a, 1]

Stream	# Culvert Barriers	Steelhead Affected	Redband Affected	Bull trout Affected
Ditch	5 (2)	Y	Y	N
Potamus	3	Y	Y	N
Pole	2	Y	Y	N
Jones Canyon	1	N	N	N
Mallory	2	Y	Y	N
Little Potamus * (+unnamed tributary)	1 (2)	N[2]	Y	N
Gilbert	3 (3)	Y	Y	N
Ellis	1	Y	Y	N
Deep	1	Y	Y	Y
Matlock(+unnamed tribs)	2 (1)	Y	Y	N
WF Meadowbrook** (+tribs)	8 (1)	Y	Y	N
Smith	1			N
EF Meadowbrook***	3	N	Y	N
Brush	1		Y	N
Rush trib (Stony trib)	1	Y	Y	N
Martin	1	N	Y	N

* Unnamed falls at RM 3.0 on Little Potamus.
** 7 culverts associated with State Highway 395, within State Right-of-Way.
*** Unnamed falls at RM 0.6 on EF Meadowbrook.
[1] (#) indicates # culverts on lands managed by USFS.

[2] State (Streamnet) distribution data revised by local knowledge (T. McLain, pers. comm..).

Stream Survey Data on the National Forest

An ongoing standardized stream survey effort for streams on the National Forest has been active since 1989, using methods in the Stream Inventory Handbook, USDA Forest Service, Region 6. Seventeen streams consisting of approximately 100 stream miles have been surveyed in this watershed since 1989, with multiple surveys for Potamus done in 1993 and 2004, and multiple surveys for Ditch Creek done in 1990 and 1998.

Earlier surveys were done in 1963 on 4 streams, 2 years following the 1961 Ditch Creek Fire, which consumed approximately 20,000 acres of the lower Ditch and Mallory Creek drainages, including virtually all of the Graves Creek drainage. Streams surveyed following the fire were Graves, Mallory, Ditch and Potamus. This first survey year was a drought year, evidenced by the fact that Ditch, Mallory and Graves creeks were all intermittent from the confluence to the very headwaters. The lack of flow in Graves Creek, despite drainage-wide removal of vegetation in the fire 2-years previous, indicates this drainage has very little natural capacity for water storage and is naturally flow-limited. The Potamus drainage was not affected by the 1961 fire and remained perennial in 1963, with flows of <u>15 cfs</u> in upper reaches and a flow of 2.5 cfs at the mouth (interpreted as heavily aggraded fan and stream subbing in the fan). This stream survey helps to calibrate and interpret data from this period in the other three streams which had been affected by the fire. Potamus Creek maintained perennial flows that year, reflecting meadow-type floodplain water storage and late-season release in the upper and middle reaches. In January 1965, 3.5 years after the fire, a 100-year flood struck northeastern Oregon, the North Fork John Day, Umatilla and Walla Walla Rivers. Peak flow recorded for this flood at the Monument gauge, was nearly 34,000 cfs, whereas more than 50 percent of the 75 years on record, annual peak flows have run at 10,000 cfs or less. Streams across northeastern Oregon, including the lower North Fork John Day River at Monument were struck by slightly smaller second and third 100-year floods in 1996 and 1997, possibly impacting some or all of the lower North Fork John Day tributaries as well. The Graves Creek drainage was completely burned again in 2001 with the Mallory Creek fire, but has not been resurveyed since that fire. Two or more surveys have been completed on each of the four streams surveyed in 1963.

Wood and Pool Habitat Structure

Tables 4-3 and 4-4 below describe current habitat conditions within the watershed, based on the most recent surveys for each stream:

Table 4-3. In-Stream Wood Frequencies within the Potamus Watershed .

Wetted Width	Stream Miles Surveyed (most recent surveys each stream)	% miles meeting default PACFISH RMOs (20 pieces/mile)	%miles meeting or exceeding median values achieved by upper 50% of unmanaged Blue Mountain streams[a]	%miles meeting values met or exceeded by 75% of unmanaged Blue Mountain streams
0-5	25	49	2	40
5-10	46.6	50	16	59
10-15	15	85	0	85
15-20 (BLM/pvt)	2.2	0	0	0

[a] Blue Mountain "unmanaged" values are based on channel wetted widths (McKinney et al 1995; USDA 1995). 50% of unmanaged Blue Mtn. streams of similar size meet or exceed median values. 75% values indicate that 75% of unmanaged Blue Mountain streams meet or exceed the value given.

Table 4-4. Pool Frequencies within the Potamus Watershed[a]

Wetted Width	Stream Miles Surveyed	% miles meeting PACFISH default RMOs	%miles meeting or exceeding Blue Mtn median values (met or exceeded by 50% of unmanaged Blue Mountain streams[b]	%miles meeting values met or exceeded by 75% of unmanaged Blue Mountain streams[b]
0-5[c]	25	0	2	17
5-10	47.1	0	31	62
10-15	15	0	100	100
15-20 (BLM/pvt)	2.2	0	0	0

[a] Blue Mtn/PACFISH values are based on channel wetted widths. (McKinney et al 1995; USDA 1995) .

[b] 50% of unmanaged Blue Mtn. streams of similar size meet or exceed median values. Values given at 75% indicate that 75% of unmanaged Blue Mountain streams meet or exceed values given. C.Hirsch (unpublished) used weighted average median values for unmanaged Blue Mountain streams based on McKinney et al (1996), as the threshold for making "Functioning Appropriately/Properly Functioning" stream pool condition ESA determinations at Watershed scale for steelhead within the NFJD Subbasin. Both median and 75% values are evaluated in this analysis with regard to modifying PACFISH RMOs in the Potamus Watershed.

As the tables above reveal, streams in this watershed become relatively less pristine with decreasing wetted width, in terms of both pools and wood frequencies, regardless of which measure of natural or desired conditions is used for comparison. The smaller the stream, the less it currently resembles either unmanaged stream conditions or PACFISH defaults. Forest Plan direction prior to PACFISH, directed management of trees within 1 tree height of Class III (perennial non-fishbearing) streams, for maintenance of a continuous supply of instream large woody material. Direction for Class IV (intermittent channels) was to manage for a continuous instream wood supply where analysis identified such intermittent channels played a critical role in wood delivery to perennial reaches.

The above Forest Plan direction provided for management of these smaller Class III and Class IV streams based on their recognized potential wood contributions to fish habitat values in downstream reaches, as well as their role in preventing soil movement downstream. Direction for

Class II (resident fish-bearing) and Class I (anadromous) streams both incorporated and added to this basic direction.

Given the increasing trend in departure from unmanaged/desired condition in this watershed as streams grow smaller, the above pre-PACFISH direction either proved ineffective when applied to non-fishbearing reaches, or impacts had already occurred before the value of these smaller stream reaches was recognized (pre-Forest Plan), or both. Conditions in streams 15-20 feet wide are represented solely by Potamus Creek from the 2004 survey, which occurred during a good water year. Potamus Creek conditions may or may not be representative of other streams on Forest of this size.

Subwatershed-specific habitat conditions are described in Tables 4-5a-b through Tables 4-12a-b. Tables present information sequentially downstream in each subwatershed. Indented streams are tributary to the unindented stream directly above. Data for multiple tributaries in same receiving reach are presented sequentially downstream in the order that they enter the receiving reach.

Ditch Creek Subwatershed

Ditch Creek has been surveyed a number of times. Brook trout are present and thriving. Based on observations from longterm district employees (pers. comm. A. Scott), middle (meadow) sections of Ditch Creek have shifted from Rosgen C channel morphology to E channel morphology over the past 10 years since 1994, corresponding to changes in livestock management that have contributed to restoration of very narrow width:depth ratios and improved wet meadow function. Professional judgement by local fish biologists identified Ditch Creek as of 1996 as an ecologically “Healthy” stream relative to other streams in the general Heppner District area, based on factors other than channel morphology or Large Wood, i.e. cold-water salmonids present, stream shade, streambank vegetation, water temperature, dissolved nutrients and food supply (Lamb, 1996). PACFISH default values for pools are much higher than unmanaged Blue Mountain streams typically attain (McKinney et al 1996), as demonstrated in Table 4-5a.

Availability of large wood is a key factor in pool formation in many stream systems. Pool frequencies increased between 1990 and 1998 (Table 4-5a) in some segments of the channel while wood levels dropped (Table 4-5b) in these same segments. Channel hydraulics may have interacted with wood to create new pool habitat as wood mobilized and routed from the system during this interval, perhaps during the regional flood events that occurred in 1996 and 1997, recorded as 100-year events on the North Fork John Day River at Monument.

Table 4-5a. Ditch Creek Subwatershed (6th HUC 170702020709)-Recent Pool Frequencies. Results from the 2 most recent survey years are presented for purposes of trend and system dynamics discussion.

Stream Reach (and year surveyed)	Wetted width (ft)/ mile (riffle)	PACFISH RMO (pools/mi)	BlMtn 50% norm	BlMtn 75% norm	Current Pools/ mile	Meets PACFISH?	Meets BlMtn 50%?	Within upper 75% Blue Mtn?
Ditch 98 R6	3.3	96+	39	24	13	N	N	Y
Ditch 98 R5 ***	6.4	96+	23	12	11	N	N	N
Ditch 98 R4***	3.4	96+	39	23	18	N	N	N
Ditch 98 R2- 3 **	6.2-10	96+	15-39	8-13	13	N	N	Y
Ditch 98 R1 *	12.3	88	12	6	20	N	Y	Y
%surveyed miles meeting norms/ stds						**0%**	**24%**	**36%**
Ditch R3 90 ***	6.3	96+	23	13	1	N	N	N

Horse Heaven94 R2	4.3	96+	39	18	5	N	N	N
Horse Heaven94 R1	<10 (est.)	96+	15-39	16-39[2]	4	N	N	N
Martin92 R2	6.1	96+	24	13	4	N	N	N
Martin92 R1	4.7	96+	39	17	6	N	N	N
Ditch R2 90 **	8.2	96+	18	10	8	N	N	N
Ditch R1 90 *	10	96	15	8	8	N	N	N
%surveyed miles meeting norms/ stds[1]						**0%**	**0%**	**0%**

* Reach 1 in 1990 is approximately same location (RM 0-6.3), as Reach 1 in 1998 (RM 0-4.5).
** Reach 2 from 1990 is approximately same location (RM 6.3-9.9) as combined Reaches 2-3 (RM 4.5-9.6) from 1998.
*** Reach 3 from 1990 is approximately same location (RM9.9-16.2) as combined Reaches 4-5 (RM9.6-16.4) from 1998.
1 "Norms" refer to values for upper 50-75% Blue Mountain unmanaged streams. "Standards" refer to PACFISH default values
2 The Blue Mountain median value supports using 39 as a maximum value for channels less than 2 feet wide

Table 4-5b. Ditch Creek Subwatershed (6th HUC 170702020709)-Recent Wood Frequencies.
Results from the 2 most recent survey years are presented.

Reach	Wetted width (ft)/ mile (riffle)	Current PACFISH-Wood/Mile	BlMtn 50% (median pc/mi)	BlMtn 75%	Meets BlMtn 50%?	Meets PACFISH (20 pc/mi.)?	Meets BlMtn 75%?
Ditch 98 R6	3.3	24	224	42	N	Y	N
Ditch 98 R5 ***	6.4	6	115	21	N	N	N
Ditch 98 R4 ***	3.4	5	224	104	N	N	N
Ditch 98 R2 -3 **	6.2-10	7	74-115	14-22	N	N	N
Ditch 98 R1(BLM)*	12.3	24	60	11	N	Y	Y
%surveyed miles meeting norms/ stds					**0%**	**36%**	**28%**
Ditch R3 90 ***	6.3	14	115	22	N	N	N
Horse Heaven94 R2	4.3	11	172	32	N	N	N
Horse Heaven94 R1	<10 (est.)	0	20-115	14-69	N	N	N
Martin92 R2	6.1	54	74	22	N	Y	Y
Martin92 R1	4.7	67	157	29	N	Y	Y
Ditch R2 90**	8.2	45	90	17	N	Y	Y
Ditch R1 90 (BLM)*	10	73	74	14	N	Y	Y
%surveyed miles meeting norms/ stds[1]					**0%**	**32% (39)[2]**	**32% (39)[2]**

* Reach 1 from 1990 is approximately same location (RM 0-6.3) as Reach 1 in 1998 (RM 0-4.5).
** Reach 2 from 1990 is approximately same location (RM 6.3-9.9) as combined Reaches 2-3 (RM 4.6-9.6) from 1998.
*** Reach 3 from 1990 is approximately same location (RM9.9-16.2) as combined Reaches 4-5 (RM9.6-16.4) from 1998.
1 "Norms" refer to values for upper 50-75% Blue Mountain unmanaged streams. "Standards" refer to PACFISH default values.
2 ( ) = based on Ditch Creek reaches only.

Despite or perhaps because of the possible impacts of the 1996-97 regional flood events, pool conditions in Ditch Creek are beginning to match values met or exceeded by 75 percent of unmanaged Blue Mountain streams. Given that Ditch Creek was already considered a "healthy" system by local professionals as of 1996, 50 percent unmanaged values may be an excessive goal for wood RMOs in this watershed. Wood may play a valuable role in the system with respect to pool formation, based on wood-pool dynamics that occurred in the 8 years between 1990 and 1998. Adjusting pool RMOs to the 75 percent level would bring Ditch Creek conditions well within the natural range for unmanaged Blue Mountain streams. Adjusting wood RMOs for streams to the 75 percent level with 20 pieces per mile minimum, would bring Ditch Creek conditions well within the natural range for "unmanaged " Blue Mountain streams. Because no analysis has been conducted regarding natural fire regime relationships to the unmanaged Blue Mountain streams from which these values were derived, the sustainability of the 75 percent level for wood will need to be validated at a later date based on the upland timber types and associated fire regimes associated with each reach (Olson, 2000).

Mallory Creek Subwatershed

Mallory subwatershed is lacking in pool habitat for both juvenile steelhead and redband trout. PACFISH default values for pool frequencies are typically much higher than those characterizing unmanaged streams in the Blue Mountains (McKinney et al 1996). Even so, Mallory pool frequencies are significantly lower than those found in unmanaged Blue Mountain systems (Table 4-6a). At the same time, the large wood supply resembles both PACFISH RMOs and values for unmanaged Blue Mountain streams of this size at the 75 percent level (Table 4-6b). Availability of large wood is a key factor in pool formation in many stream systems, but does not appear to be a key factor in pool formation in Mallory subwatershed. Pool formation in this system appears heavily dependent on factors other than the presence of large wood.

One possible explanation for the absence of pools is that the system appears to be bedrock-controlled and naturally flow-limited, both of which can limit pool formation. The entire Graves Creek drainage burned severely in 1961, presumably providing a large supply of wood to the system in subsequent years. The fire possibly increased water supply due to reduced transpiration for a period of years, yet both Graves and Mallory still went intermittent in 1963 following the fire (USFS, unpub.), displaying a pattern that is present most years where we have data, including 1992 when the second survey was conducted. Graves Creek burned again in the 2001 Mallory Creek fire, and has not been resurveyed since. The 1961 fire only affected the lower 3 miles of Mallory Creek below the Forest, hence not affecting wood supply on-Forest (the 1991 Mallory survey only included Forest miles) but flow has been somewhat altered for decades. The construction of the Penland Lake dam and reservoir in 1969-70 in the uppermost headwaters disconnected the upper 1200 acres of Mallory Creek from the rest of the system hydrologically. However, aerial photos from 1939 of Reach 2 indicate that this section below the dam was always extremely flow-limited, evidenced by historic and current lack of riparian shrubs (T. McLain, pers. comm.).

Table 4-6a. Mallory Creek Subwatershed (6th HUC 170702020708)-Recent Pool Frequencies

Stream Reach (and year surveyed)	Wetted width (ft)/ mile (riffle)	PACFISH RMO	Blue Mtn. 50%	BlMtn 75%	Measured Pools/ mile	Meets PACFISH?	Meets BlMtn 50%?	Meets BlMtn 75%
Mallory91 R2	6.9	131	21	11	2	N	N	N
Mallory91 R1	9.2	96	16	9	9	N	N	Y
Stalder92 R1	5.4	96+	27	15	6	N	N	N
Graves92 R1	1.4	96+	39	39[2]	1	N	N	N
%surveyed miles meeting norms/stds [1]						**0%**	**0%**	**29%**

[1] "Norms" refer to values for upper 50-75% Blue Mountain unmanaged streams. "Standards" refer to PACFISH default values

[2] The Blue Mountain median value supports using 39 as a maximum value for channels less than 2 feet wide

Adjusting pool RMOs to the 75 percent level for streams in this subwatershed would promote a goal of bringing overall conditions in the Mallory subwatershed into the range of the upper 75 percent of unmanaged Blue Mountain streams. Adjusting wood RMOs for Mallory and Stalder Creeks to the Blue Mountain 75 percent level would help bring overall subwatershed conditions into the natural range for "Blue Mountain unmanaged streams.

The paucity of wood and pools in Graves Creek appears to reflect the logging history of the area as well as the frequency at which this drainage has burned in the past 40 years (Map 4-1), suggesting that the current PACFISH wood RMO of 20 pieces per mile, is most appropriate for this particular stream at this time. An RMO of 39 pools per mile may or may not be achievable in Graves Creek for various reasons discussed above. Even so, adjusting the pool RMO for Graves to the 75 percent Blue Mountain level would provide a goal against which to evaluate recovery capability.

Table 4-6b. Mallory Creek Subwatershed (6th HUC 170702020708)-Recent Wood Frequencies.

Reach	Wetted width (ft)/ mile (riffle)	Current PACFISH Wood/Mile	BlMtn 50% (median pc/mi)[2]	BlMtn 75%	Meets BlMtn 50%?	Meets PACFISH (20 pc/mi.)?	Meets BlMtn 75%?
Mallory91 R2	6.9	31	107	20	N	Y	Y
Mallory91 R1	9.2	33	80	15	N	Y	Y
Stalder92 R1	5.4	ND	137	25	ND	ND	ND
Graves92 R1	1.4	5	528	69	N	N	N
%surveyed miles meeting norms/stds[1]					**0%**	**81%**	**81%**

[1] "Norms" refer to values for upper 50-75% Blue Mountain unmanaged streams. "Standards" refer to PACFISH default values.

Upper Potamus Creek Subwatershed

The upper Potamus subwatershed is lacking in pool habitat for both juvenile steelhead and redband trout. PACFISH default values for pools are much higher than unmanaged Blue Mountain streams typically attain (McKinney et al 1996), as demonstrated in Table 4-7a**.** Even so, pool frequencies in upper Potamus streams with the exception of Brush Creek, are noticeably lower than those found in unmanaged Blue Mountain systems (Table 4-6a). At the same time, the large wood supply meets PACFISH RMOs and falls well within values typifying the upper 75 percent of unmanaged Blue Mountain streams (Table 4-7b). Availability of large wood is a key factor in pool formation in many stream systems, but may not be the driving factor in pool formation in the upper Potamus subwatershed. Pool formation in this system appears heavily dependent on factors in addition to the presence of large wood.

Professional judgment by local fish biologists identified Potamus, Brush and Pole Creeks as of 1996 as ecologically "Healthy" streams relative to other streams in the general Heppner District area, based on factors other than channel morphology or Large Wood, i.e. cold-water salmonids present, stream shade, streambank vegetation, water temperature, dissolved nutrients and food supply (Lamb, 1996). Brush and Pole Creeks' conditions for wood and pools mostly resemble the upper 75 percent of unmanaged Blue Mountain streams, though Pole Creek pool habitat is limited.

A review of pool conditions in a segment of upper Potamus Creek comparable between 1993 and 2004, RM 10-18, reveals that substantial pool development has occurred in this section over the past 11 years, and are now approaching values for unmanaged Blue Mountain streams (Table 4-7a). A review of wood conditions shows little change in large wood quantities in this same section of the channel over the same 11 year period. The persistent presence of large wood indicates the relative stability and retention of this size class in the system. Although large wood quantities remained essentially unchanged during the 11-year period, relatively greater numbers of new pools developed in the same sections, which may reflect effects of the 199697 regional floods. If so, pool formation may require flows greater than the bankful event before the channel can effectively interact with the wood and substrate already in the system to form additional pools. Because no analysis has been conducted regarding natural fire regime relationships to the unmanaged Blue Mountain streams from which these values were derived, the sustainability of the 75 percent level for wood will need to be validated at a later date based on the upland timber types and associated fire regimes associated with each reach (Olson, 2000).

Table 4-7a. Upper Potamus Creek Subwatershed (6th HUC 170702020706)-Recent Pool Frequencies

Results from the 2 most recent sets of survey years are presented for purposes of trend and system dynamics discussion.

Stream Reach (and year surveyed)	Wetted width (ft)/ mile (riffle)	PACFISH RMO	BlMtn 50%	BlueMtn 75%	Current Pools/ mile	Meets PACFISH?	Meets BlMtn 50%?	Meets BlMtn 75%
Potamus04 R5 [1]	3.5	96+	39	23	17	N	N	N
Potamus04 R4 [1]	4.8	96+	39	16	8	N	N	N
%surveyed miles meeting norms/stds						**0%**	**0%**	**0%**
Potamus 93 R4	1.9	96+	39	39[2]	1	N	N	N
Pole92 R1	5.5	96+	27	14	4	N	N	N
Potamus93 R3 [1]	10.9	76	12	7	2	N	N	N
Wilson92 R2	3.7	96+	39	21	2	N	N	N
Wilson92 R1	5	96+	39	16	3	N	N	N
Potamus93 R2 [1]	8.1	96+	18	10	4	N	N	N
Brush92 R1	5.9	96+	25	13	15	N	N	Y
%surveyed miles meeting norms/stds						**0%**	**0%**	**0%**

[1] Reaches 2-3 in 1993 are approximately same location (RM 10-18), as Reach 4-5 in 2004 (RM 10.6-17.5).
[2] "Norms" refer to values for upper 50-75% Blue Mountain unmanaged streams. "Standards" refer to PACFISH default values
[3] The Blue Mountain median value supports using 39 as a maximum value for channels less than 2 feet wide

Table 4-7b. Upper Potamus Creek Subwatershed (6th HUC 170702020706)-Recent Wood Frequencies and Potential.

Results from the 2 most recent sets of survey years are presented.

Reach	Wetted width (ft)/ mile (riffle)	Current PACFISH-Wood/Mile	BlMtn 50% (median pc./mi.)	BlMtn 75%	Meets BlMtn 50%?	Meets PACFISH (20 pc/mi.)?	Meets BlMtn 75%?
Potamus04 R5 [1]	3.5*	12	211	39[2]	N	N	N
Potamus04 R4 [1]	4.8*	29	154	29	N	Y	Y
%surveyed miles meeting norms/stds (Potamus RM 10.6-RM 17.5)					**0%**	**59%**	**59%**
Potamus 93 R4	1.9	20	389	69	N	Y	N
Pole92 Reach 1	5.5	267	134	25	Y	Y	Y
Potamus 93 R3 [1]	10.9	3	68	13	N	N	N
Wilson92 Reach 2	3.7	47	200	37	N	Y	Y
Wilson92 Reach 1	5	90	148	27	N	Y	Y
Potamus 93 R2 [1]	8.1	36	91	17	N	Y	Y
Brush92 Reach 1	5.9	355	61	23	Y	Y	Y
%surveyed miles meeting norms/stds w/in SWS (Potamus RM 10-RM18)[3]					**38%**	**86%**	**86%**

[1] Reaches 2-3 in 1993 are approximately same location (RM 10-18), as Reach 4-5 in 2004 (RM 10.6-17.5).
[2] "Norms" refer to values for upper 50-75% Blue Mountain unmanaged streams. "Standards" refer to PACFISH default values
[3] The Blue Mountain median value supports using 39 as a maximum value for channels less than 2 feet wide

Potamus, Brush and Pole creeks were already locally considered "healthy" systems in 1996, represented by data from 1993. Adjusting both wood RMOs for streams in the upper Potamus subwatershed to the 75 percent level with 20 pieces per mile minimum, would bring stream conditions in this subwatershed well within the natural range for unmanaged "Blue Mountain streams. Adjusting pool RMOs in upper Potamus subwatershed to the 75 percent level for unmanaged Blue Mountain streams would bring conditions well within the natural range for "Blue Mountain streams.

Although Brush Creek and Pole Creeks currently far exceed most unmanaged streams in the Blue Mountains for wood quantities, wood does not appear to be a major factor in pool formation in these streams, though likely serving other ecological functions such as sediment storage. Existing wood quantities in these tributaries reflects a mixture of a landscape in-out of balance with the natural fire regime. While Pole Creek is embedded in a high severity-low return interval (>200 years) landscape and current wood values may be sustainable for several more decades were the surrounding terrain in balance with its respective fire regimes, which much of the terrain is not (Map 6-1). Brush Creek is embedded in a mixed-severity 35-100 year return interval landscape which has missed at least 1 fire cycle. Wood quantities in Brush Creek probably represent excessive amounts relative to natural conditions given the natural fire cycle. Setting wood goals in Potamus Creek itself to reach the 75 percent unmanaged level for streams this size, retaining minimums at 20 pieces per mile, is likely sustainable in the longterm, considering that most of Potamus Creek is embedded in Fire Regime 1 (low intensity, high frequency) (Map 4-1).

Further analysis will be needed at some point to validate whether a) the 50 percent level in Brush Creek is compatible with the natural fire regime and plant association group, b) the 75 percent level in Pole Creek is compatible with the natural fire regime and plant association group, or whether current conditions reflect riparian corridors out of step with the associated natural fire cycle. If sustainable, Brush Creek RMOs could be adjusted up to the 50 percent level. If not sustainable in the face of a natural fire regime, wood RMOs for Brush Creek would need to be adjusted either back to the PACFISH default or to the 75 percent level if the 75 percent level is believed sustainable once the drainage is returned to its natural fire regime.

Lower Potamus Creek Subwatershed

Lower Potamus Creek is lacking in pool habitat for both juvenile steelhead and redband trout. PACFISH default values for pools are much higher than unmanaged Blue Mountain streams typically attain (McKinney et al 1996), as demonstrated in Table 4-8a. Pool frequencies in lower Potamus Creek are low relative to frequencies represented by the upper 75 percent of unmanaged Blue Mountain streams (Table 4-8a).

As with upper Potamus Creek, approximately comparable segments of lower Potamus Creek show noticeable apparent improvement in pool frequencies over the 11 years since the 1993 survey. Comparisons within this watershed are somewhat less reliable than for upper Potamus. Although the upper end of the segment is located in essentially the same place, the lower end of the comparable segment was measurably different between the two years, which affects the basis for comparisons.

Though some wood may have been lost between surveys, wood frequencies likely remained relatively stable over the last 11 years, given the uncertainty associated with reach comparability between survey years discussed above (Table 4-8b). PACFISH values are still being met and exceeded in Potamus Creek itself (segment compared between years). The range of variability above PACFISH objectives suggests that PACFISH objectives are a lower limit for large wood capability, and that values meeting the Blue Mountain 75 percent can be achieved and maintained. Because no analysis has been conducted regarding natural fire regime relationships to the unmanaged Blue Mountain streams from which these values were derived, the sustainability of the 75 percent level for wood will need to be validated at a later date based on the upland timber types and associated fire regimes associated with each reach (Olson, 2000).

Although wood remained stable during the 11-year period, relatively greater numbers of new pools developed in the same section (Table 4-8a), which may reflect effects of the 1996-97 regional floods. If so, pool formation may require flows greater than the bankful event before the channel can effectively interact with wood and substrate already in the system to form additional pools.

Table 4-8a. Lower Potamus Subwatershed (6th HUC-170702020707)-Recent Pool Frequencies.
Results from the 2 most recent sets of survey years are presented.

Stream Reach (and year surveyed)	Wetted width (ft)/ mile (riffle)	PACFISH RMO	BlMtn 50%	BlMtn 75%	Current Pools/ mile	Meets PACFISH?	Meets BlMtn 50%?	Meets BlMtn 75%
Potamus 04 R3 [a]	12.3	88	12	6	36	N	Y	Y
Potamus04 R2 [a]	13.4	84	11	6	26	N	Y	Y
Potamus04 R1	20	56	7	4	21	N	Y	Y
%surveyed miles meeting norms/stds w/in SWS						**0%**	**100%**	**100%**
Potamus93 R1 (RM 4-10)[a]	11.4	92	13	7	12	N	N	Y
Gilbert92 Reach 3	5.9	96+	25	13	1	N	N	N
Gilbert92 Reach 2	6.5	96+	23	12	14	N	N	Y
Gilbert92 Reach 1	5.2	96+	28	15	2	N	N	N
Little Potamus92 Reach 3	6	96+	25	13	3	N	N	N
EF Brown94 R1	3	96+	39	26	5	N	N	N
Little Potamus92 Reach 2	5.6	96+	26	14	6	N	N	N
Little Potamus 92 Reach 1	5.7	96+	26	14	15	N	N	Y
%surveyed miles meeting norms/stds						**0%**	**0%**	**53%**

[a] Reach 1 in 1993 is approximately same segment (RM 4-10), as Reach 2-3 in 2004 (RM 2.25-10.6).

Table 4-8b. Lower Potamus Subwatershed (6th HUC-170702020707)-Recent Wood Frequencies.

Results from the 2 most recent sets of survey years are presented.

Reach	Wetted width (ft)/ mile (riffle)	Current PACFISH Wood/Mile	BlMtn 50%* (median pc/mi)	BlMtn 75%	Meets BlMtn 50%?	Meets PACFISH (20 pc/mi.)?	Meets BlMtn 75%?
Potamus04 R3[a]	12.3	23	60	11	N	Y	Y
Potamus04 R2[a]	13.4	26	55	10	N	Y	Y
Potamus04 R1 (BLM-pvt)	20	4	37	7	N	N	N
%surveyed miles meeting norms/stds					**0%**	**76%**	**76%**
Potamus 93 R1 [a]	11.4	56	65	12	N	Y	Y
Gilbert92 R3	5.9	76	125	23	N	Y	Y
Gilbert92 R2	6.5	92	114	21	N	Y	Y
Gilbert92 R1	5.2	1	142	26	N	N	N
Little Potamus 92 R3	6	179	123	23	Y	Y	Y
EF Brown R1	3	0	246	46	N	N	N
Little Potamus 92 R2	5.6	100	132	24	N	Y	Y
Little Potamus 92 R1	5.7	269	130	24	Y	Y	Y
%surveyed miles meeting norms/stds					**19%**	**93%**	**93%**

[a] Reach 1 in 1993 is approximately same segment (RM 4-10), as Reach 2-3 in 2004 (RM 2.25-10.6).

Matlock Creek Subwatershed

Matlock Creek is lacking in pool habitat for both juvenile steelhead and redband trout**.** PACFISH default values for pools are much higher than unmanaged Blue Mountain streams typically attain (McKinney et al 1996), as demonstrated in Table 4-9a.

While pool frequencies fall within the range of 75 percent of unmanaged Blue Mountain streams in Reach 2 (Table 4-9a), wood quantities in Reach 2 are essentially absent (Table 4-9b). The following observations by stream surveyors in 1998 indicate that wood on the 50-year floodplain is an important channel influence in this system, and that instream wood recruitment is currently supply-limited due to harvest within the past 30-50 years and also due to the fact that Reach 2 is non-forested meadow reach. Reach 1 pools fall within the range of the upper 50 percent of unmanaged Blue Mountain streams whereas wood frequencies in the reach fall below the upper 50 percent range of unmanaged Blue Mountain streams. Variability in the wood-pool relationship between reaches indicates that pool formation is likely influenced by other factors in addition to presence of large wood in this system. As the stream surveyors noted, Matlock Creek is wholly situated in an alluvial valley with deep alluvial fill of gravel and larger substrate. Soil formation is limited and contributes to the lack of surface flow following spring runoff, since the coarse valley fill allows for extremely high rates of infiltration. Most of the annual flow takes the form of groundwater moving through the substrate following spring runoff. The channel is unstable through both reaches, and channel location appears to have moved in several places following the floods of 1996 and 1997, without degrading habitat conditions.

Adjusting wood RMOs for streams in the Matlock subwatershed to the 75 percent level with 20 pieces per mile minimum in Reach 1, would bring stream conditions in this subwatershed well within the natural range for wood in unmanaged Blue Mountain streams. Wood RMOs do **NOT** apply to Reach 2, a meadow reach, as noted by PACFISH. Resetting pool RMOs in Matlock subwatershed to the 50 percent level for unmanaged Blue Mountain streams appears achievable and would bring conditions well within the natural range for unmanaged Blue Mountain streams. . Because no analysis has been conducted regarding natural fire regime relationships to the unmanaged Blue Mountain streams from which these values were derived, the sustainability of the 75 percent level for wood in Reach 1 will need to be validated at a later date based on the upland timber types and associated fire regimes associated with the reach (Olson, 2000).

Table 4-9a. Matlock Creek Subwatershed (6th HUC 170702020705)-Recent Pool Frequencies

Stream Reach (and year surveyed)	Wetted width (ft)/ mile (riffle)	PACFISH RMO	BlMtn 50%	BlMtn 75%	Current Pools/ mile	Meets PACFISH?	Meets BlMtn 50%?	Meets BlMtn 75%?
Matlock98 R2	5.8	96+	25	14	17	N	N	Y
Matlock98 R1	7.8	96+	19	10	24	N	**Y**	Y
%surveyed miles meeting norms/stds						**0%**	**27%**	**100%**

Table 4-9b. Matlock Creek Subwatershed (6th HUC 170702020705)-Recent Wood Frequencies

Reach	Wetted width (ft)/ mile (riffle)	Current PACFISH Wood/Mile	BlMtn 50% (median pc./mi.)	BlMtn 75%	Meets BlMt 50%?	Meets PACFISH (20 pc/mi.)?	Meets BlMtn 75%?
Matlock98 R2	5.8	1	127	24	N	N	N
Matlock98 R1	7.8	20	95	18	N	Y	Y
%surveyed miles meeting norms/stds					**0%**	**27%**	**27%**

Deerhorn Creek Subwatershed

Hinton Creek, the primary fish-bearing stream on-Forest in this subwatershed, is lacking in pool habitat for both juvenile steelhead and redband trout. PACFISH default values for pools are much higher than unmanaged Blue Mountain streams typically attain (McKinney et al 1996), as demonstrated in Table 4-10a. Pool quantities in Hinton Creek are generally low relative to conditions represented by unmanaged Blue mountain streams (Table 4-10a).

This system has experienced little or no harvest on National Forest System lands over the past 50 years (Map 4-2), nor have any measurable wildfires occurred in the drainage on-Forest in recent decades. Map 4-2 only shows harvest while under Forest Service ownership however. The riparian zone in Reach 4 was logged prior to 1990 by Louisiana Pacific; this land had been acquired by the Forest Service as of 1990. Wood conditions along the majority of Hinton Creek (including cut-over former LP lands), either exceed or are approaching values achieved by at least 75 percent of unmanaged streams of similar size in the Blue Mountains, (McKinney et al 1996). Pool frequencies in Hinton Creek appear dependent upon other factors besides wood for pool-creation, based on the general paucity of pools at the time of survey, despite wood falling within values matched by at least 75 percent of unmanaged streams in the Blue Mountains.

Table 4-10a. Deerhorn Creek Subwatershed (6th HUC 170702020703)-Recent Pool Frequencies

Stream Reach (and year surveyed)	Wetted width (ft)/ mile (riffle)	PACFISH RMO	BlMtn 50%[c]	BlMtn 75%[d]	Current Pools/ mile	Meets PACFISH?	Meets BlMtn 50%?	Meets BlMtn 75%?
Hinton90 R4	4.7	96+	39	17	1	N	N	N
Hinton90 R3	5	96+	39	16	24	N	N	Y
Hinton90 R2	4.5	96+	39	18	12	N	N	N
Hinton90 R1	3.6	96+	39	22	3	N	N	N
%surveyed miles meeting norms/stds						**0%**	**0%**	**19%**

Table 4-10b. Deerhorn Creek Subwatershed (6th HUC 170702020703)-Recent Wood Frequencies

Reach	Wetted width (ft)/ mile (riffle)	Current PACFISH Wood/Mile[b]	BlMtn 50% (median pc/mi)[c]	BlMtn 75%	Meets BlMtn 50%?	Meets PACFISH (20 pc/mi.)?	Meets BlMtn 75%?
Hinton 90 R4	4.7	50	157	29	N	Y	Y
Hinton 90 R3**	5	58	148	27	N	Y	Y
Hinton 90 R2	4.5	46	164	30	N	Y	Y
Hinton 90 R1	3.6	19	205	38	N	N	N
%surveyed miles meeting norms/stds					**0%**	**83%**	**85%**

[a] See discussion in text above regarding implications of fire and harvest history in this drainage.
[b] Wood and pool data comes from hardcopy Hinton Cr 1990 SMART Survey Summary Report on-file at NFJD District Office. Hinton Creek 1990 survey was apparently never entered into SMART database-not on Streambank CD.
[c] 50% of unmanaged Blue Mountain streams meet or exceed these value given.
[d] 75% of unmanaged Blue Mountain streams meet or exceed these values.

Adjusting both wood and pool RMOs for streams to the 75 percent level with 20 pieces per mile minimums for wood, would eventually bring Hinton Creek conditions well within the natural range for unmanaged Blue Mountain streams. Because no analysis has been conducted regarding natural fire regime relationships to the unmanaged Blue Mountain streams from which these values were derived, the sustainability of the 75 percent level for wood will need to be validated at a later date based on the upland timber types and associated fire regimes associated with each reach (Olson 2000).

West Fork Meadowbrook Creek Subwatershed

PACFISH default values for pools are much higher than unmanaged Blue Mountain streams typically attain (McKinney et al 1996), as demonstrated in Table 411a. Here, pool quantities presently show limited direct relationship to wood supply, in that Reaches 5 and 6 of West Fork Meadowbrook Creek are completely devoid of wood (Table 4-11b), yet pool frequencies are within the upper 50 percent of pool frequencies achieved by unmanaged Blue Mountain streams (Table 4-11a). Reach 7 pool frequencies match those achieved by at least 75 percent of unmanaged streams as well, despite the reach being devoid of wood.

In places, riprap at the base of the highway fill slope forms the banks of the channel, affecting the channel's ability to form or regain a natural stream bed morphology, including pool formation. Pool formation in this system is currently dependent on factors other than large wood, particularly the presence of bedded clay layers distributed through the entire length of the channel profile, which in many places comprise the bed of the channel itself, forming steps that pose possible barriers to fish-passage at low flow (USDA-FS, 1996).

Most other streams examined in the Potamus watershed, including Smith Creek, contain at least some large wood moderately well-distributed throughout the channel profile. Most Potamus sub watersheds, Matlock, Ditch Creek and West Fork Meadowbrook systems excepted, come close to meeting PACFISH wood RMOs at the subwatershed scale.

Table 4-11a. West Fork Meadowbrook Creek Subwatershed (6th HUC 170702020702)-Recent Pool Frequencies

Stream Reach (and year surveyed)	Wetted width (ft)/ mile (riffle)	PACFISH RMO	BlMtn 50%	BlMtn 75%	Current Pools/ mile	Meets PACFISH?	Meets BlMtn 50%?	Meets BlMtn 75%?
WF Mdwbrook96 R8	4	96+	39	20	3	N	N	N
WF Mdwbrook96 R7	4.3	96+	39	18	23	N	N	Y
WF Mdwbrook96 R6	4.1	96+	39	19	52	N	**Y**	Y
WF Mdwbrook96 R5	5.8	96+	25	15	32	N	**Y**	Y
WF Mdwbrook96 R4	1.2	96+	39	39	16	N	N	N
WF Mdwbrook96 R3	<10 (est.)	96+	NA	NA	ND	NA	ND	ND
WF Mdwbrook96 R2	7.7	96+	19	10	24	N	**Y**	Y
WF Mdwbrook96 R1	< 10 (est.)	96+	NA	NA	ND	NA	NA	NA
NF Smith Cr96 R5	4.3	96+	39	18	8	N	N	N
NF Smith Cr96 R4	5.7	96+	26	14	27	N	**Y**	Y
NF Smith Cr96 R3	5.6	96+	26	14	56	N	**Y**	Y
NF Smith Cr96 R2	7.1	96+	21	11	28	N	Y	Y
NF Smith Cr96 R1	9	96+	16	9	56	N	**Y**	Y
%surveyed miles meeting norms/stds w/in SWS						0%	**70%**	72%

b

*

West Fork of Meadowbrook is encroached closely by state Highway 395 for most of its length. The RHCA and stream channel are both highly affected by highway management, which may explain the overall impoverishment of its wood supply relative to unmanaged streams. The highway corridor is managed to state and federal highway standards for safety. This includes timber management within the highway Right-of-Way to reduce shade and related icing of the highway in winter, and removal of standing dead or dying trees that could fall on the roadway (pers. obs). Ongoing state management for highway safety may never allow wood supplies to the channel to meet PACFISH objectives for Large Wood (Table 4-11b) and establishing a higher wood standard in the West Fork to match the upper 75 percent of unmanaged Blue Mountain streams would likely be pointless. The default PACFISH wood RMO may be attainable, achievement of any higher value is unlikely given highway management safety objectives. Adjusting pool RMOs to the 75 percent level would maintain or promote West Fork Meadowbrook subwatershed conditions well within the natural range for pools in unmanaged Blue Mountain streams whereas creating a goal of meeting 50 percent unmanaged pool values may unintentionally support the acceptability of further downcutting and creation of additional clay-bed steps in the channel profile.

Most of Smith Creek, including the most affected reach (R5) from River Mile 2.5 to River Mile 3.7, was in private ownership in 1977 (1977 Forest Travel Map), and has come under federal management through land exchanges in the past 25 years (1990 Forest Travel Map). Little harvest in the RHCA has occurred under federal management (Map 4-1). Harvest history prior to federal ownership is unknown. Although both wood and pool quantities in Smith Creek are low by PACFISH standards, reaches below Reach 5 fall within the upper 50 percent of pool values for unmanaged Blue Mountain streams of this size. This finding suggests that pool formation in Smith Creek depends on factors other than presence of large wood. Smith Creek too is characterized by interbedded clay layers in the channel profile, which likely influence pool formation more strongly than large wood does in this system.

Table 4-11b. West Fork Meadowbrook Creek Subwatershed (6th HUC 170702020702)-Recent Wood Frequencies

Reach (reach length= mile)	Wetted width (ft)/ mile (riffle)	Current PACFISH Wood/Mile	BlMtn 50%* (median pc/mi)	BlMtn 75%	Meets BlMtn 50%?	Meets PACFISH (20 pc/mi.)?	Meets BlMtn 75%?
WF Mdwbrook96 R8	4	0	185	34	N	N	N
WF Mdwbrook96 R7	4.3	0	172	32	N	N	N
WF Mdwbrook96 R6	4.1	0	180	33	N	N	N
WF Mdwbrook96 R5	5.8	6	127	24	N	N	N
WF Mdwbrook96 R4	1.2	0	616	39	N	N	N
WF Mdwbrook96 R3	<10 (est.)	ND	NA	NA	ND	ND	ND
WF Mdwbrook96 R2	7.7	15	96	18	N	N	N
WF Mdwbrook96 R1	<10 (est.)	ND	NA	NA	ND	ND	ND
NF Smith Cr 96 R5	4.3	12	172	32	N	N	N
NF Smith Cr 96 R4	5.7	6	130	24	N	N	N
NF Smith Cr 96 R3	5.6	9	132	24	N	N	N
NF Smith Cr 96 R2	7.1	17	104	19	N	N	N
NF Smith Cr 96 R1	9	9	82	15	N	N	N
%length of channels surveyed meeting norms/stds					**0%**	**0%**	**0%**

East Fork Meadowbrook Creek Subwatershed

PACFISH default values for pools are much higher than unmanaged Blue Mountain streams typically attain (McKinney et al 1996), as demonstrated in Table 4-12a**.** Pool quantities in East

Fork Meadowbrook Creek fall well within values for the upper 50 percent of unmanaged Blue Mountain streams (Table 4-12a), but far below PACFISH RMOs.

Here, large wood falls well within PACFISH ranges as well as within ranges achieved by the upper 75 percent of unmanaged Blue Mountain streams (Table 4-12b), but does not match the upper 50 percent of unmanaged Blue Mountain streams. This variance between wood and pool conditions indicates that while pool formation in this system is somewhat related to presence of Large Wood, it is also strongly influenced by other factors, one of which may be the presence of bedded clay layers distributed through the entire length of the channel which in many places form "bedrock" steps in the channel profile.

Adjusting pool RMOs for streams in the East Fork Meadowbrook subwatershed to the 50 percent level and wood RMOs to the 75 percent level (20 pieces of wood per mile minimums for reaches where the 75 percent wood level would provide less than 20), would maintain East Fork Meadowbrook Creek conditions well within the natural range for unmanaged Blue Mountain streams. Because no analysis has been conducted regarding natural fire regime relationships to the unmanaged Blue Mountain streams from which these values were derived, the sustainability of the 75 percent level for wood will need to be validated at a later date based on the upland timber types and associated fire regimes associated with each reach (Olson 2000).

Data have not been stratified for elevation or associated timber type for East Fork Meadowbrook Creek. An examination of Potential Vegetation (Map 6-1) shows the lower end of the channel dominated by dry forest as the potential dominant type of vegetation, shifting upstream into cold forest in the headwaters. Cold forest typically operates on a longer fire return cycle than dry forest, and often results in high-severity fire when it burns. Wood quantities in the current phase of the cold-forest fire regime in this drainage likely reflect background rates of mortality in the absence of stand-replacing fires in the upper watershed (Map 4-2). In the middle and lower portions of the drainage, wood quantities likely reflect mortality in overstocked dry-forest stands that have experienced fire suppression for decades.

Table 4-12a. East Fork Meadowbrook Creek Subwatershed (6th HUC 170702020701)-Recent Pool Frequencies [a]

Stream Reach (and year surveyed)	Wetted width (ft)/ mile (riffle)	PACFISH RMO	BlMtn 50%	BlMtn 75%	Current Pools/ mile	Meets PACFISH?	Meets BlMtn 50%?	Meets BlMtn 75%
EF Mdwbrook97 R4	8.4	96+	17	9	27	N	Y	Y
EF Mdwbrook97 R3	9.3	96+	16	8	35	N	Y	Y
EF Mdwbrook97 R2	9	96+	16	9	65	N	Y	Y
EF Mdwbrook97 R1	<10 (est.)	96+	NA	NA	ND	ND	ND	ND
%surveyed miles meeting norms/stds						**0**	**100%**	**100%**

a Blue Mountain/PACFISH values are derived from wetted widths measured during each survey. (McKinney et al 1996; USDA 1995)

Table 4-12b. East Fork Meadowbrook Creek Subwatershed (6th HUC 170702020701)-Recent Wood Frequencies.[a]

Reach	Wetted width (ft)/ mile (riffle)	Current PACFISH Wood/Mile	BlMtn 50% (median pc/mi)	BlMtn 75%	Meets PACFISH (20 pc/mi.)?	Meets BlMtn 50%?	Meets BlMtn 75%?
EF Mdwbrook 97 R4	8.4	42	88	16	Y	N	Y
EF Mdwbrook 97 R3	9.3	51	79	15	Y	N	Y
EF Mdwbrook 97 R2	9	30	82	15	Y	N	Y
EF Mdwbrook 97 R1	<15 (est.)	ND	NA	NA	ND	ND	ND
% surveyed miles meeting norms/stds?					**100%**	**0%**	**100%**

a Blue Mountain/PACFISH values are derived from wetted widths measured during each survey. (McKinney et al 1996; USDA 1995)

Sediment Characterization of Select Streams

Ditch Creek has been described since 1963 as possessing "sandy" substrate intermittently distributed throughout the drainage from bottom to top. Data from 1998 used Wolman pebble counts, which do not permit quantifiable substrate characterization and sediment routing characterization as effectively for the current purpose as do the earlier data from 1990. Using similar data sources permits sediment discussion and contrast between Ditch and Potamus Creeks.

Analysis of 1990 substrate data (Table 4-13a) shows that the meadow system in the upper end of Reach 3 is the primary source of sand for the system, but that gravel becomes dominant in the lower end of the reach with either sand or cobble subdominant. Rosgen E-type channels, such as this section currently contains 14 years later, typically provide excellent rearing habitat for salmonids.

Tables 4-13a. Ditch Creek Sediment Characterization, headwaters, 1990.[1]

Ditch Creek 1990 Reach 3 (River Mile 9.9-16.2)	#Habitat Units-Substrate Dominance[2]					
	Sand	Gravel	Cobble	Small Boulder	Bedrock	No Data
Substrate subdominant						
Sand	1	**60**	29	2	-	-
Gravel	**311**	-	**109**	6	-	-
Cobble	12	**166**	-	1	-	-
Small Boulder	-	-	4	-	-	-
No data	6	5	-	-	-	5
Total Units by Dominant Substrate	**330**	231	142	9	0	5

Reach 2 (Table 4-13-b) and the lower end of Reach 3 provide excellent spawning habitat in this system. Reach 1 (Table 4-13c) provides some spawning habitat in terms of gravel pockets sprinkled through the reach as subdominant substrate within many channel units.

Gravel remains dominant at the head of Ditch Creek Reach 2 (Table 4-13b) which provides excellent spawning habitat throughout, being primarily a Rosgen B4 (subdom cobble) eventually coarsening to a Rosgen B3 (gravel subdominant) by the lower end of Reach 2 into Reach 1, which becomes coarser-bedded, characterized by clean cobble with small boulders subdominant (Table 4-13c).

Table 4-35b. Ditch Creek Substrate Composition, middle reaches, 1990

Ditch Creek 1990 Reach 2 (River Mile 6.3-9.9)	#Habitat Units-Substrate Dominance*					
	Sand	Gravel	Cobble	Small Boulder	Bedrock	No Data
Substrate sub dominance by:						
Sand	-	8	8		-	-
Gravel	2	-	**137**		5	-
Cobble	4	**160**	-		29	-
Small Boulder	-	12	-	-	1	-
Bedrock	-	1	6	-	-	-
No data	-	-	-	-	-	-
Total Units by Dominant Substrate	6	**181**	151	0	35	-

*Well-balanced clean gravel-cobble mixture throughout the reach; gravel dominates. Bedrock-control and gradient function to move fine substrate through the reach.

Table 4-13c Ditch Creek Substrate Composition, Lower Reach

Ditch Creek 1990 Reach 1 (River Mile 0-6.3)	#Habitat Units-Substrate Dominance					
	Sand	Gravel	Cobble	Small Boulder	Lg Boulder	Bedrock
Substrate subdominant						
Sand		21	25	7	1	3
Gravel	22	1	**117**	1	-	2
Cobble	13	**69**		16	-	3
Small Boulder	3	2	43	-	-	1
Large Boulder		-	1	-	-	-
Bedrock	2	-	5	-	-	-
No data	-	-	1	-	-	-
Total Units by Dominant Substrate	40	93	**192**	24	1	9

*Cobble dominance throughout reach, boulder material more visible toward lower end of reach. Reach displays poor sorting of material relative to Reaches 1 and 2.

Table 4-14a. Potamus Sediment Characterization.

Potamus Creek 2004 Reach 5 (River Mile 14.7-17.5)	#Habitat Units-Substrate Dominance*					
	Sand	Gravel	Cobble	Small Boulder	Bedrock	No Data
Substrate sub dominance by:						
Sand		**54**	1	-	-	-
Gravel	**69**	-	-	-	-	-
Cobble	-	-	-	-	-	-
Small Boulder	-	-	-	-	-	-
No data	14		-	-	-	3
Total Units by Dominant Substrate	**83**	**54**	1	-	-	-

Potamus Creek's sediment-substrate transport longitudinal profile is similar to that of Ditch Creek, (Tables 4-14a-e), with a source reach dominated by sand in the uppermost headwaters (Table 4-

14a), though not as extensive as the Rosgen E6 channel segment in upper Ditch Creek. Potamus Reach 4 (Table 4-14b) provides excellent gravel-dominated spawning habitat but shows some evidence at the head of the reach, of fine sediment accumulations from upstream.

Table 4-14b. Potamus Sediment Characterization

Potamus Creek 2004 Reach 4 (River Mile 10.6-14.7)	#Habitat Units-Substrate Dominance*					
	Sand	Gravel	Cobble	Small Boulder	Bedrock	No Data
Substrate sub dominance by:						
Sand		**9**	-	-	-	-
Gravel	**2**	-	**36**	-	-	-
Cobble	-	**24**	-	-	-	-
Small Boulder	-	--	1	-	-	-
No data						20
Total Units by Dominant Substrate	**2**	**33**	37	-	-	20 (falls, culverts etc.)

Substrate in Potamus Creek gradually coarsens downstream, becoming dominated by clean cobble-gravel substrate with few fines through Reach 3 (Tables 4-14c-e). Clean spawning gravels are available, dispersed among the dominant larger substrates down through Reach 1.

Table 4-14c. Potamus Sediment Characterization

Potamus Creek 2004 Reach 3 (River Mile 7.7-10.6)	#Habitat Units-Substrate Dominance*					
	Sand	Gravel	Cobble	Small Boulder	Bedrock	No Data
Substrate sub dominance by:						
Sand	-		1			
Gravel	**-**		**70**			
Cobble	-	**23**		4		
Small Boulder	-		13		1	
Bedrock	-					
No data	-					16
Total Units by Dominant Substrate	**-**	**23**	84	4	1	16 (falls, culverts, etc.)

Table 4-14d. Potamus Sediment Characterization

Potamus Creek 2004 Reach 2 (River Mile 2.25-7.7)	#Habitat Units-Substrate Dominance*						
	Sand	Gravel	Cobble	Small Boulder	Bedrock	Unsorted Mix (gravel present)	No Data
Substrate sub dominance by:							
Sand							
Gravel			**101**	3			
Cobble		**39**	1	31			
Small Boulder		2	36				
Unsorted Mix (gravel present)			11		1	18	
No data							22

Potamus Creek 2004 Reach 2 (River Mile 2.25-7.7)	#Habitat Units-Substrate Dominance*					
	Sand	Gravel	Cobble	Small Boulder	Bedrock	Unsorted Mix (gravel present)	No Data
Total Units by Dominant Substrate		**41**	149	34	1	18	22(falls, culverts, etc.)

Table 4-14e. Potamus Sediment Characterization

Potamus Creek 2004 Reach 1 (River Mile 0-2.25)	#Habitat Units-Substrate Dominance*						
	Sand	Gravel	Cobble	Small Boulder	Bedrock	Unsorted Mix (gravel present)	No Data
Substrate sub dominance by:							
Sand	-	-	3	-	-	-	
Gravel	**-**	-	**61**	-	-	-	
Cobble	-	**37**	-	-	2	-	
Small Boulder	-	-	-	-	-	-	
Unsorted Mix (gravel present)	-	-	7	-	-	-	
Bedrock	-	-	1	-	-	-	
No data	-	-	-	-	-	-	12
Total Units by Dominant Substrate	**-**	**37**	72	-	2	-	12 (falls, culverts,etc.)

Riparian Fire Regime Interactions with In-stream Wood Recruitment and Retention.

Olson (2000), studied fire return intervals in riparian zones in proximity to either upland dry forest types with low-severity, high return frequency regimes, or in proximity to more mesic mixed conifer mixed-severity regimes in the Blue Mountains and southern Cascades. She found that riparian fire return intervals resembled return intervals for the adjacent upland forest types, with minor extensions of the return intervals. She also found that riparian fire return intervals varied with aspect. She postulated that the wood supply in dry forest systems would possess smaller diameters with relatively short instream residence times, and would occur as chronic low-quantity inputs through time. This hypothesis implicitly assumes no fire suppression and that no fire cycles are missed for this low-severity, high frequency fire regime.

Conversely, where in proximity to mesic mixed-severity upland forest types, she postulated that the instream wood supply would be relatively larger diameter, that in-channel duration would be relatively longer, and that wood inputs would more likely occur in periodic pulses. This hypothesis implicitly assumes that mixed-severity, moderate frequency fire regimes have not been altered by fire suppression. Applicability of her hypotheses is further complicated by the degree to which riparian zones in the Potamus watershed had been harvested up to 1995 when PACFISH direction dramatically reduced harvest for the primary purpose of wood production in riparian zones (Maps 4-1 and 4-2). Riparian harvest likely removed some of the wood that would otherwise have entered the channel at some point in the past 50 years. Fire suppression in dry-forest systems may or may not have reduced the frequency of wood inputs into dry-forest streams, since drought-stress and insect activity in over-stocked dry-forest stands may substitute as a process for providing low-quantity chronic wood inputs that would otherwise be provided by frequent fire. Conversely, fire suppression in mixed-severity, moderate frequency regime stands may allow wood frequencies to resemble conditions somewhere between low and mixed-severity regimes, in that retention times would be more similar to those found in mixed severity regimes, but input frequencies may resemble the low quantity, more chronic inputs associated with low-severity, high frequency regimes, due to overstocked stand conditions and associated insect and drought mortality.

Data in the Wood Frequency tables above, suggest that wood frequencies in Smith Creek, Graves and Matlock creeks are consistent with Olson's dry-forest hypotheses at the present time. Graves Creek provides empirical support to Olson's hypotheses, given the lack of instream wood present in the 1992 survey and the span of time between the Ditch Creek fire of 1961 and the time of survey in 1992. These are primarily dry forest systems (Map 5-1) with Fire Regime Class I dominating (Maps 4-1 and 4-2). Other dry-forest stream segments in the watershed, including middle and lower Ditch Creek, and lower Potamus indicate a wood supply at variance with a natural low-severity high-return fire regime. In Ditch Creek and lower Potamus Creek respectively, wood frequencies as of 1990 and 1993 suggest a relatively long accumulation and retention period more indicative of a mixed-severity, moderate frequency fire regime, whereas respective wood frequencies in 1998 and 2004 appear to reflect the impacts of the 1996 flood event, which may have significantly shortened residence times that otherwise might have extended until a landscape scale wildfire occurred or prescribed fire was fully restored to the landscape.

Table 4-15. Probability of fire burning across stream channels in the southern Blue Mountain ecoregion (Olson, 2000)

Reach	Bankful width (ft)/ mile	Strm Size (S<=20ft bankful width; L>20ft bankful width)	Probability of fire burning both sides of stream
Mallory Reaches 1-2	<20	S	High
Stalder Reach 1	<20	S	High
Graves Reach 1	<20	S	High
Ditch98 Reaches 4-6	<20	S	High
Horse Heaven Reach 2	<20	S	High
Martin Reaches 1-2	<20	S	High
Ditch98 Reaches 2-3	<20	S	High
Ditch98 Reach 1* (off-Forest)	<20	S	High
Potamus93 Reach 4	<20	S	High
Pole Reach 1	<20	S	High
Potamus93 Reach 3	<11	S	High
Wilson Reaches 1-2	<20	S	High
Potamus93 Reach 2	<20	S	High
Brush Reach 1	<20	S	High
Potamus93 Reach 1	<20	S	High
Gilbert Reaches 1-3	<20	S	High
Potamus04 Reach 5	<20	S	High
Potamus04 Reach 4	<20	S	High
Potamus04 Reach 3	>30	L	Low
Potamus04 Reach 2	>30	L	Low
Potamus04 Reach 1	>30	L	Low
Little Potamus Reaches 1- 3	<20	S	High
Matlock Reaches 1-2	<20	S	High

Reach	Bankful width (ft)/ mile	Strm Size (S<=20ft bankful width; L>20ft bankful width)	Probability of fire burning both sides of stream
Hinton Reaches 1-4	<20	S	High
WF Meadowbrook Reaches 1-8	<10	S	High
Smith Reaches 1-5	<10	S	High
EF Meadowbrook Reaches 2-4	<10	S	High
EF Meadowbrook Reach 1	<15	S	High

* Stream Survey data from 1963 documented crown fire had occurred on 1 or both sides of the channel within this 5-mile reach. [1] Potamus Creek Reaches 203 in 1993 are approximately same location (RM 10-18) as Reaches 4-5 in 2004 (RM 10.6-17.5)).

Olson's research also documented the high probability of large wildfires crossing channels with bankful widths less than 20 feet wide. Table 4-15 displays the magnitude of wildfire risk to channels within the Potamus watershed. Note that the risk of trans-channel wildfire in the largest streams can vary from high to low in this watershed for the same stream depending on changes in channel morphology between survey years, for example the entire length of Potamus Creek was at high risk in 1993, whereas only the uppermost reaches of Potamus Creek were at high risk of being crossed by large wildfire in 2004, indicating a significant change of channel morphology (widening) in the middle reaches during the interim, most likely reflecting the influence of the 1996 regional flood event.

Synthesis

Of all the streams in the Potamus Watershed, woody structure has been the most impacted in the West Fork Meadowbrook system. South-aspect streams, Mallory and Graves in particular, are naturally flow-limited compared to north-aspect streams such as East and West Forks of Meadowbrook Creek. This is a reflection of aspect, geology and soil differences between the north and south-aspect drainages. Meadow systems in upper Ditch and Potamus are crucial natural water storage systems that provide flow late season for high-value rearing habitat lower in the system, and have shown substantial improvement in riparian and channel structure and function over the past decade corresponding to pro-active changes in livestock management. Spawning reaches directly below the meadow areas could be impacted if meadow conditions deteriorate from their current condition, but sediment supply from the meadows is currently in balance with transport capacity of lower reaches at the present time, and show no signs of degradation.

Large Wood typically meets or closely approximates current PACFISH default values, and frequencies frequently resemble those found in the upper 75 percent of similar-sized unmanaged streams in the Blue Mountains. System conditions for recruitment of large wood vary between streams, which show wide variation in past riparian harvest activity which in the past focused on removal of large pine and Douglas-fir, leaving second-growth late-seral species more vulnerable to fire (see Hydrology section).

The dry-forest sections of the watershed have been heavily harvested (Map 4-1), relative to higher elevation moist and cold forest. At the same time, it is the smallest streams highest in the watershed, which appear to be the most impacted in terms of wood, with impacts decreasing as stream size increases (Table 4-3). Current supplies of Large Wood in the larger streams mostly fall well within the range characterizing the upper 75 percent of unmanaged Blue Mountain streams of similar size (with the exception of Matlock Creek). At the same time, the potential for long-term chronic wood inputs from dry forest associations is uncertain, given the history of fire suppression in the watershed. In the event that crown fires occur in overstocked dry-forest stands, there may be pulses of high input resembling those from mixed moderate-frequency and high-severity, low frequency regimes in moist and cold forest types.

Streams in this watershed show increasing departure from conditions found in comparable unmanaged Blue Mountain streams with decreasing stream size, for both wood and pool frequencies. As is the story with large wood, it is the smallest streams highest in the watershed which appear to be the most impacted in terms of pool frequencies, with impact decreasing as stream size increases (Table 4-4). Current pool frequencies in the larger streams fall well within the range characterizing the upper 75 percent or even upper half of unmanaged Blue Mountain streams of similar size, yet are typically much lower than default PACFISH values, which are likely not achievable for these streams. Pool values tend to be low even where relatively high wood supplies are available, indicating that wood is not a primary factor in pool-formation in these streams.

This trend most likely reflects the management history of the area prior implementation of the Umatilla Forest Plan in 1990. Riparian harvest authorized and contracted in the late 1980's would have been grandfathered and likely not subject to new Forest Plan direction for Class II, III and IV streams, though the contracts may not have been completed until a few years after the Forest Plan was signed in 1990. Fish habitat surveys used in this watershed analysis primarily occurred between 1990 and 1996, and reflect older land management history. The role that smaller streams play in providing fish habitat and their valuable function in contributing to properly functioning stream systems has been increasingly recognized and emphasized in management direction across the Northwest over the past 15 years, as reflected in the 1996 multi-regional Forest Plan amendments known as PACFISH and INFISH, which placed even greater emphasis than before, on protection and restoration of streams of all sizes.

This assessment did not cover the impacts of roads or impacts of off-road vehicular travel due to lack of time. Information is available in stream survey reports and comments contained within the stream survey database, particularly for middle and upper reaches of the several south-aspect streams in this watershed.

Recommendations

Analyze road and off-road impacts to channel morphology, meadow water-storage functions and fish passage in the next round of watershed analysis for south-aspect streams in the Potamus Watershed.

Review previous surveys when planning a repeat survey. Use final reach break locations from previous surveys in planning subsequent surveys, to improve comparability and allow for better monitoring and evaluation of channel condition changes through time.

Use information from the Forest Watershed Prioritization document (Umatilla NF, 2000) and recommended priorities identified for the Potamus Watershed from the North Fork John Day Subbasin Plan (NPCCC, 2004) to determine timing for fish passage restoration projects in the Potamus watershed relative to higher-priority needs elsewhere on the Forest and within the North Fork John Day subbasin.

Continue livestock management practices that promote restoration and protection of meadows in upper Ditch and Potamus Creeks, in terms of soil compaction, width-depth ratios and bank stability. Continued improvement for these variables will be key to restoring maximum storage to provide cooler mid-summer flows and improve water temperatures for rearing steelhead and trout in these streams in compliance with the 303(d) listing for water quality.

Adjust pool frequency RMOs for the streams of the Potamus Watershed to values achieved by 75 percent of unmanaged Blue Mountain streams of similar size, except where otherwise noted in text discussions of specific stream and subwatershed conditions and potentials.

Retain PACFISH Wood RMOs of 20 pieces of wood as a minimum value for forested reaches that provide less than 20 pieces even at the 75 percent level. Where streams can provide more than 20 pieces per mile at the 75 percent level, adjust RMOs accordingly. Streams have demonstrated they can supply this amount in the absence of fire.

The upper end of Reach 3 of Ditch Creek (1990 survey location, RM 9.9-16.2), could be broken as a separate reach best classified as a Rosgen E6. Maintenance of current bank stability, width-depth ratios and avoidance of compaction are the most critical management factors for this headwater meadow.

Gradual restoration of low-severity, high frequency fire regimes in the dry-forest stream reaches would likely shift wood quantities toward those qualitatively hypothesized by Olson (2003), and restore a more reliable if smaller wood supply through time.

Conduct a longterm (10-15 year) administrative study consisting of select “small” stream reaches (<20-foot bankful widths) associated with low-severity, high frequency fire regimes that have missed 1 or more fire cycles, and evaluate wood recruitment and retention rates through time relative to these variables in dry-forest reaches maintained or restored to equilibrium with a low-severity, high frequency regime, with similar harvest histories. Evaluate and compare instream wood recruitment and retention through time in mixed-severity, moderate frequency regime reaches with similar harvest histories, both in and out of synchrony with their fire regime. Use this information to refine and calibrate instream wood characteristics and natural capabilities of Blue Mountain streams functioning within the limits of their inherent fire regimes.

Close monitoring of land management activities affecting Class II and Class III channels (wetted widths 1-10 feet wide) is recommended to determine how well PACFISH and other relevant Forest Plan direction for watershed/fish habitat management is understood and implemented during activities associated with these smallest streams. Validation monitoring will need to be conducted if direction is indeed well-understood and well-implemented, and if effectiveness monitoring reveals lack of pool or large wood recovery over the next 5-10 years.

Projects to improve the supply of future Large Wood and for recovery of pool frequencies through natural processes would be best focused on streams with wetted widths less than 10 feet for the foreseeable future, as these are the streams most in need of recovery for both large wood and for pools.

Wood and pool conditions in other Watersheds should be similarly evaluated to determine whether trends discovered in the Potamus watershed: increasing management impacts with decreasing stream size, are true more widely across the Forest.

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Stream Survey of Ditch, Graves, Mallory and Potamus Creeks, 1963. Unpubl. On-file at Heppner Ranger District.

Appendix 4-1

Table 4-18. Fish Distribution-Steelhead

Stream Name	6th HUC	Stream Length:	Use Type	Mile Points		Use Length (mi)	Cumulative length used per stream
				From	To		
Ditch Creek, trib to North Fork John Day River	170702020709	19.5mi	Primarily spawning and rearing	0.0	19.4	19.4	**19.4**
Mallory Creek, trib to North Fork John Day River	170702020708	14.3mi	Primarily spawning and rearing	0.0	3.0	3.0	3.0
Mallory Creek, trib to North Fork John Day River	170702020708	14.3mi	Primarily spawning and rearing	3.0	10.6	7.6	**10.6**
Graves Creek, trib to Mallory Creek	170702020708	4.9mi	Primarily spawning and rearing	0.0	2.8	2.8	**2.8**
Jones Canyon, trib to Graves Creek	170702020708	5.1mi	Primarily spawning and rearing	0.0	100ft	0.0	**100 feet**
Stalder Creek, trib to Mallory Creek	170702020708	4.1mi	Primarily spawning and rearing	0.0	1.0	1.0	**1.0**
Stalder Creek, trib to Mallory Creek	170702020708	4.1mi	Primarily rearing[1]	1.0	2.3	1.3	**2.3**
Potamus Creek, trib to North Fork John Day River	170702020707, 170702020706	18.4mi	Primarily spawning and rearing	0.0	14.5	14.5	**14.5**
Pole Creek, trib to Potamus Creek	1707020206	5.2mi	Primarily spawning and rearing	0.0	3.5	3.5	**3.5**
Ellis Creek, trib to Potamus Creek	170702020706	8.2mi	Primarily spawning and rearing	0.0	2.2	2.2	**2.2**
Ellis Creek, trib to Potamus Creek	170702020706	8.2mi	Unknown	2.2	4.2	2.0	**4.2**
Deep Creek, trib to Ellis Creek	170702020706	3.6mi	Primarily spawning and rearing	0.0	0.3	0.3	**0.3**
Little Potamus Creek, trib to Potamus Creek*	170702020707	10.0m	Primarily spawning and rearing	0.0	3.5	3.5	**3.5**
Wilson Creek, trib to Potamus Creek	170702020706	2.5mi	Primarily spawning and rearing	0.0	0.7	0.7	**0.7**
Skull Creek, trib to North Fork John Day River (pvt land)	170702020710	2.1m	Primarily spawning and rearing	0.0	0.8	0.8	**0.8**
Stony Creek, trib to North Fork John Day River (pvt land)	170702020705	6.8mi	Primarily spawning and rearing	0.0	5.1	5.1	**5.1**
Rush Creek, trib to Stony Creek (pvt land)	170702020705	7.0mi	Primarily spawning and rearing	0.0	3.0	3.0	**3.0**

[1] State records indicate Stalder is also a spawning stream, local observations indicate stream is used only for rearing (T. McLain, pers. comm.).

Table 4-18 (continued). Fish distribution-Steelhead							
Stream Name	6th HUC	Stream Length:	Use Type	Mile Points		Use Length (mi)	Cumulative length used per stream
				From	To		
Rush Creek, trib to Stony Creek (pvt land)	170702020705	7.0mi	Primarily spawning and rearing	3.0	3.1	0.1	**3.1**
Matlock Creek, trib to Stony Creek	170702020705	9.4mi	Primarily spawning and rearing	0.0	4.0	4.0	**4.0**
Scaffold Creek, trib to Matlock Creek (pvt land)	170702020705	4.6mi	Primarily spawning and rearing	0.0	1.4	1.4	**1.4**
Hunter Creek, trib to North Fork John Day River (pvt land)	170702020704	2.7m	Primarily spawning and rearing	0.0	1.5	1.5	**1.5**
Deerhorn Creek, trib to North Fork John Day River	170702020703	10.1mi	Primarily spawning and rearing	0.0	4.9	4.9	**4.9**
West Fork Meadow Brook, trib to North Fork John Day River	170702020702	8.6mi	Primarily spawning and rearing	0.0	6.8	6.8	**6.8**
Smith Creek, trib to West Fork Meadow Brook	170702020702	4.8mi	Primarily spawning and rearing	0.0	1.5	1.5	**1.5**
East Fork Meadow Brook Creek, trib to West Fork Meadow Brook*	170702020701	11.4mi	Primarily spawning and rearing	0.0	0.6	0.6	0.6

Table 4-19. Fish Distribution-redband trout

Stream Name	6th HUC	Stream Length:	Use Type	Mile Points		Use Length (mi)	Cumulative length used per stream
				From	To		
Ditch Creek, trib to North Fork John Day River	170702020709	19.5mi	Year-round resident	0.0	19.5	19.5	**19.5**
Mallory Creek, trib to North Fork John Day River	170702020708	14.3mi	Year-round resident	0.0	14.3	14.3	**14.3**
Stalder Creek, trib to Mallory Creek	170702020708	4.1mi	Year-round resident	0.0	4.1	4.1	**4.1**
Graves Creek, trib to Mallory Creek	170702020708	4.9mi	Year-round resident	0.0	2.8	2.8	**2.8**
Potamus Creek, trib to North Fork John Day River	170702020706, 170702020707	18.4mi	Year-round resident	0.0	18.4	18.4	**18.4**
Pole Creek, trib to Potamus Creek	1707020206	5.2mi	Year-round resident	0.0	5.2	5.2	**5.2**
Little Potamus Creek, trib to Potamus Creek*	170702020707	10.0m	Year-round resident	0.0	10.0	10.0	**10.0**
Ellis Creek, trib to Potamus Creek	170702020706	?	Year-round resident	0.0	2.2	2.2	**2.2**
Deep Creek, trib to Ellis Creek	170702020706	3.6mi	Year-round resident	0.0	3.6	3.6	**3.6**
Brush Creek, trib to Potamus Creek	170702020706	2.1m	Year-round resident	0.0	2.1	2.1	**2.1**
Wilson Creek, trib to Potamus Creek	170702020706	2.5mi	Year-round resident	0.0	2.5	2.5	**2.5**
Matlock Creek, trib to Stony Creek	170702020705	9.4mi	Year-round resident	0.0	5.9	5.9	**5.9**
Unnamed Stream [1191787451002], trib to Matlock Creek upstream of Dry Matlock Cr.	170702020705	2.8mi	Year-round resident	0.0	2.8	2.8	**2.8**
Rush Creek, trib to Stony Creek (pvt)	170702020705	7.0mi	Year-round resident	0.0	7.0	7.0	**7.0**
Jericho Creek, trib to North Fork John Day River (pvt)	170702020704	3.8mi	Year-round resident	0.0	3.8	3.8	**3.8**
Hinton Creek, trib to North Fork John Day River***	170702020703	4.9m	Year-round resident	0.0	4.9	4.9	**4.9**
West Fork Meadow Brook, trib to North Fork John Day River	170702020702	8.6mi	Year-round resident	0.0	8.6	8.6	**8.6**
Smith Creek, trib to West Fork Meadow Brook	170702020702	4.8mi	Year-round resident	0.0	4.8	4.8	**4.8**
East Fork Meadow Brook Creek, trib to West Fork Meadow Brook*	170702020701	11.4mi	Year-round resident	.6	12.0	11.4	**11.4**
Bully Creek, trib to East Fork Meadow Brook Creek*	170702020701	7.1mi	Year-round resident	0.0	1.9	1.9	**1.9**

FOREST VEGETATION

Introduction

"Ecosystem analysis at the watershed scale" is a process designed to characterize the human, aquatic, riparian, and terrestrial conditions of a watershed. It is a systematic way to organize ecosystem information to better understand the impacts of management activities and disturbance processes in a watershed.

The understanding gained from ecosystem analysis is critical for helping to sustain the health and resilience of natural resources administered on behalf of the American people (REO 1995).

Forest vegetation reflects the interaction of three ecosystem components called composition, structure and process (function).

1. Composition refers to the organisms that make up an ecosystem (Manley et al. 1995); it can range from individual plants, to groups of plants called cover types, and to combinations of cover types called lifeforms (table 5-1).
2. Structure is the arrangement or distribution of vegetation composition (Manley et al. 1995). It occurs both horizontally (the spatial distribution of composition across a landscape) and vertically (plants of varying stature in a multi-layered arrangement).
   Forest structure ranges from tree size classes, to structural classes, and to physiognomic groups (table 5-1).
3. Process refers to the flow or cycling of energy, nutrients, and other materials through space and time (Manley et al. 1995). Process ranges from photosynthesis and nutrient cycling to stand-replacing wildfire and insect outbreaks (table 5-1).
   In the interior Pacific Northwest, disturbance processes influence forest vegetation to a greater extent than other ecosystem processes (Clark and Sampson 1995, Oliver and Larson 1996).

Table 5-1 demonstrates that ecosystem analysis is inherently scale dependent because ecosystem components occur as hierarchies (Haynes et al. 1996). Some components are easily identified at one scale but not at another. This doesn't mean that a component ceased to exist – it is just not apparent at the resolution of a different hierarchical level.

At the fine scale represented by the interior of a forest stand, for example, individual trees are readily distinguished. After moving back to the mid scale, individual trees are imperceptible but species groups (cover types) become apparent. At a broad scale, discrete cover types are no longer recognizable although physiognomic classes (forest, shrub, herb) can then be discerned.

This report provides the results of a forest vegetation analysis for the Potamus analysis area. Table 5-2 describes the most important data sources used for the analysis. The analysis framework was based on ecosystem components (composition, structure, process); multiple indicators were selected to represent each component. Table 5-3 lists the ecosystem components and their corresponding analysis indicators.

Table 5-1. Selected examples of ecosystem components.

Ecosystem Components	Ecosystem Scale (Hierarchical Level)		
	Fine	Mid	Broad
Composition	Individual Trees	Cover Types	Lifeforms (forest/nonforest)
Structure	Tree Size Classes	Structural Classes	Physiognomic Classes
Process	Nutrient Cycling	Insect Outbreaks; Wildfire	Weather; Climate

Notes: Although they are shown individually in this table, it is important to note that ecosystem components are interrelated – from an ecological perspective, they do not operate independently.

Table 5-2. Data sources used for analysis of forest vegetation.

Data Source	Description of Data Source
ADB (Activities Database).	ADB is a database system assembled and maintained by the Heppner and North Fork John Day Ranger Districts. ADB includes information about current and historical timber harvest, reforestation, thinning, and other management activities.
Aerial Detection Surveys.	The impact of forest insects has been monitored since 1947. Aerial sketch maps from 1980 to 2003 were used to characterize insect-caused damage for the Potamus analysis area.
EVG (Existing Vegetation).	EVG stores information about existing vegetation; it was based on interpretation of aerial photography acquired in 1995 or 1997. For the Potamus analysis area, 92% of the polygons were characterized using photo-interpretation data from EVG.
Fire-Related GIS Coverages.	The "Historical Fire Start Locations" and "Large Fires" GIS coverages were used to assess fire-start causes (a point feature set), and to provide spatial data about large fires (a polygon feature set). Other historical mapping for 1900, 1910, 1930s, and 1950s also provided large-fire data.
FSVeg (Stand Exams).	Stand exams are designed to collect information at the stand level. Site, stand and tree data are collected on temporary plots. For the Potamus analysis area, 8% of the area was characterized using stand exams (including walk-through surveys).
GLO (General Land Office) Survey Notes.	The GLO was formed in 1812 to survey the public domain. Their survey notes from the late 1850s to the early 1900s were used as one data source for characterizing historical vegetation conditions.
Historical Aerial Photography.	Historical aerial photography from 1939 was the most important data source for characterizing reference conditions. After first delineating polygons, the photography was then interpreted to characterize vegetation conditions for each polygon.
Potential Vegetation Map (PVeg).	From May to November of 1998, Karl Urban prepared a potential vegetation map for the Umatilla National Forest; it describes potential vegetation types (plant associations, plant community types, plant communities) and this information was used with many vegetation analyses.

Notes: Powell (2004a) provides detailed information about the existing and historical databases used to characterize forest vegetation conditions.

Issues and Key Questions

Over the last 30 years, Blue Mountain forests experienced increasing impacts from wildfire, insects and diseases. Scientific assessments documented the high damage levels and speculated about their underlying causes (Caraher et al. 1992, Gast et al. 1991, Hessburg et al. 1999, Lehmkuhl et al. 1994, Quigley and Arbelbide 1997, Quigley et al. 1996, Shlisky 1994).

Partly in response to the scientific assessments, the Blue Mountains were portrayed in numerous newspaper and magazine articles as having perhaps the worst forest health in the western United States (Durbin 1992; East Oregonian 1992; Gray and Clark 1992; Kenworthy 1992; Lucas 1992, 1993; McLean 1992; Petersen 1992; Phillips 1995; Richards 1992).

In response to high levels of concern about forest health from both the scientific community and the general public, the primary issue used in this analysis was **forest sustainability**.

Forest sustainability is defined as an ecosystem-oriented approach allowing utilization of forests for multiple purposes (e.g., biodiversity, timber harvesting, non-wood products, soil and water conservation, tourism and recreation) without compromising their availability and quality for present and future generations (Gardner-Outlaw and Engelman 1999).

This definition suggests that sustainable ecosystems contain insects, diseases and other disturbance processes, but not to an extent threatening their long-term integrity, resiliency and productivity.

The forest vegetation analysis was designed to respond to four key questions:

1. *How do current conditions (composition and structure) compare to those that existed historically?*
2. *How have disturbance processes shaped current conditions, and what role might we expect them to play in the future?*
3. *Are current conditions considered to be sustainable over the long term?*
4. *If current conditions are not considered to be sustainable, how could they be changed to create a more sustainable situation?*

The key questions were addressed by analyzing ecosystem components (composition, structure, process); multiple indicators were selected for each component and are shown in Table 5-3.

Table 5-3. Ecosystem components and analysis indicators for forest vegetation.

Components	Analysis Indicators	Where Analyzed
Composition and Structure	Forest Cover Type	Cur Con; Ref Con; Syn/Int
	Forest Density	Cur Con; Ref Con; Syn/Int
	Forest Size Class	Cur Con; Ref Con; Syn/Int
	Forest Structural Class	Cur Con; Ref Con; Syn/Int
	Forest Canopy Layering	Cur Con; Ref Con; Syn/Int
	Insect/Disease Susceptibility	Cur Con; Ref Con; Syn/Int
Process	Potential Vegetation	Characterization
	Forest Disturbance	Characterization

Notes: "Where analyzed" shows when the analysis indicator was used – "Cur Con" is current conditions; "Ref Con" is reference conditions; and "Syn/Int" is synthesis and interpretation.

Characterization

When reduced to its essence, forest vegetation conditions can be thought of as the product of two ecosystem elements – potential vegetation, and plant succession following disturbance processes (Powell 2000). This section describes each of those elements.

Landscapes, and the ecosystems comprising them, age through time. The series of changes resulting in forest aging is called plant succession. Plant succession, which begins with reoccupation of disturbed areas by vegetation, refers to temporal changes in species abundance and vegetation structure.

Once initiated, plant succession may follow a variety of pathways and can occur at varying rates of speed (Drury and Nisbet 1973, McCune and Allen 1985). The main factor controlling the speed and direction of plant succession is potential vegetation.

Potential Vegetation.

A distant summer view of the Blue Mountains shows a dark band of coniferous forest occurring above a lighter-colored grassland zone. Each of these contrasting areas seems to be homogeneous, and the border between them appears sharp. A closer view, however, reveals great diversity within each zone and borders that are poorly defined (Powell 2000).

Herbaceous communities and stands of deciduous trees are scattered throughout the conifer forest, and the species of dominant conifer changes from one site to another (Powell 2000).

This vegetation pattern indicates that the Blue Mountains are actually broken up into a myriad of small units, many of which repeat in an intricate, changing pattern. Making sense of this landscape mosaic is possible using a concept called potential vegetation (Powell 2000).

Potential vegetation implies that over the course of time and in the absence of future disturbance, similar groups of plants (plant communities) will occur on similar sites ("similar sites" are defined as those areas with equivalent temperature and moisture regimes) (Powell 2000).

The potential vegetation associated with a particular temperature and moisture regime is called a plant association. A plant association is named for dominant plant species in its vegetation layers – the grand fir/twinflower plant association is dominated by grand fir in the tree layer, and by twinflower in the undergrowth layer. In the Potamus analysis area, 25 forested plant associations were identified (Johnson and Clausnitzer 1992, see table 5-4).

Some late-seral vegetation types persist on the landscape and are referred to as plant community types in potential vegetation classifications. Forested plant community types have one or more tree species in the overstory and a well-developed undergrowth. The undergrowth may reflect the climax composition, but the overstory dominants are often long-lived seral trees that established after a previous disturbance event.

In the Potamus analysis area, 5 forested plant community types were identified (Johnson and Clausnitzer 1992, see table 5-4).

Sites that can support similar potential vegetation types are grouped together as a plant association group (PAG). In a similar way, closely related plant association groups can be aggregated into a potential vegetation group (PVG). The result is a potential vegetation hierarchy ranging from potential vegetation types at the lowest level to PVGs at the highest level (Powell and Johnson 2004).

Table 5-4. Potential vegetation hierarchy for upland forests of the Potamus analysis area.

PVG	PAG	PVT Code	PVT Common Name	Acres
Cold UF	Cold Dry	ABGR/VASC	grand fir/grouse huckleberry	10,625
		ABLA2/VASC	subalpine fir/grouse huckleberry	136
		PICO(ABGR)/VASC/CARU	lodgepole pine (grand fir)/huckleberry/pinegrass pct	65
		PICO(ABLA2)/CAGE	lodgepole pine (subalpine fir)/elk sedge pct	7
		PICO(ABLA2)/VASC	lodgepole pine (subalpine fir)/grouse huckleberry pct	162
	Cool Dry	PICO/CARU	lodgepole pine/pinegrass	82
		PICO(ABGR)/CARU	lodgepole pine (grand fir)/pinegrass pct	251
Moist UF	Cool Wet	ABGR/TABR/CLUN	grand fir/Pacific yew/queencup beadlily	34
		ABGR/TABR/LIBO2	grand fir/Pacific yew/twinflower	14
	Cool Moist	ABGR/CLUN	grand fir/queencup beadlily	102
		ABGR/LIBO2	grand fir/twinflower	5,472
		ABGR/VAME	grand fir/big huckleberry	2,109
		ABGR/VASC-LIBO2	grand fir/grouse huckleberry-twinflower	428
	Warm Moist	PSME/HODI	Douglas-fir/oceanspray	2,518
Dry UF	Warm Dry	ABGR/CAGE	grand fir/elk sedge	11,419
		ABGR/CARU	grand fir/pinegrass	20,302
		ABGR/SPBE	grand fir/birchleaf spiraea	822
		PIPO/CAGE	ponderosa pine/elk sedge	227
		PIPO/CARU	ponderosa pine/pinegrass	110
		PIPO/ELGL	ponderosa pine/blue wildrye	58
		PIPO/SYAL	ponderosa pine/common snowberry	808
		PSME/CAGE	Douglas-fir/elk sedge	11,494
		PSME/CARU	Douglas-fir/pinegrass	2,880
		PSME/PHMA	Douglas-fir/ninebark	1,770
		PSME/SYAL	Douglas-fir/common snowberry	4,082
	Hot Dry	PIPO/AGSP	ponderosa pine/bluebunch wheatgrass	878
		PIPO/FEID	ponderosa pine/Idaho fescue	1,393
		PIPO/PUTR/FEID-AGSP	ponderosa pine/bitterbrush/Idaho fescue-wheatgrass	87
Moist UW	Hot Moist	JUOC/CELE/FEID-AGSP	western juniper/mountain mahogany/fescue-wheatgrass pct	27
		JUOC/FEID-AGSP	western juniper/Idaho fescue-bluebunch wheatgrass	741

Sources/Notes: Based on Powell and Johnson (2004); acres include National Forest System lands only. "Pct" after a common name refers to a plant community type (a seral plant community); all other potential vegetation types (PVT) are plant associations (Johnson and Clausnitzer 1992). "PVG" (potential vegetation group) and "PAG" (plant association group) are two levels of a mid-scale potential vegetation hierarchy; PVG names include the following physiognomic codes: UF is Upland Forest and UW is Upland Woodland (Powell and Johnson 2004).

Upland-forest potential vegetation types occurring in the Potamus analysis area have been assigned to 8 PAGs and to 4 PVGs (table 5-4). Table 5-5 summarizes selected characteristics of the PVGs.

Map 5-1 (see appendix) shows the location and distribution of upland-forest PVGs.

Table 5-5. Selected characteristics for upland forest potential vegetation groups (PVG).

PVG	Area (Acres)	Disturbances	Fire Regime	Patch Size	Elevation (Feet)	Slope (Percent)	Dominant Aspects
Dry Upland Forest	56,329	Wildfire Bark Beetles Harvest	Low Severity	1-2,000	4,361 (2,659-5,710)	18 (1-80)	South Southeast Southwest
Moist Upland Forest	10,678	Defoliators Wildfire Diseases	Mixed Severity	1-10,000	4,719 (3,161-5,642)	16 (1-48)	South Southwest Southeast
Cold Upland Forest	11,328	Wind Bark Beetles Wildfire	Stand Replace-ment	1-1,000	5,000 (4,195-5,633)	13 (2-42)	South East Southeast

Sources/Notes: Area, elevation, slope, and aspect were summarized from the Potamus vegetation database and include National Forest System lands only. Patch size (acres) was taken from Johnson (1993). Disturbances show the primary processes affecting upland-forest ecosystems and were based on the author's judgment. For elevation and slope, values are portrayed in the following format: average (minimum-maximum). Fire regimes have these definitions (Smith 2000):
Low severity: fires generally not lethal to dominant vegetation; generally 80% or more survives fire.
Mixed severity: fires cause selective mortality or varies between understory and stand replacement.
Stand replacement: fires kill or top-kill the dominant vegetation; generally 80% or more is killed.

Forest Disturbance.

Disturbance processes have an important influence on vegetation composition and structure. Many disturbance processes influence forest vegetation conditions in the Potamus analysis area. Information provided by the Pacific Northwest Region's aerial survey program was used to assess forest insect impacts; aerial detection sketch maps for a 24-year period (1980-2003) were used to summarize the spatial extent of recent insect activity (table 5-6).

Defoliating Insects.

Western spruce budworm is an unobtrusive inhabitant of mixed-conifer forests throughout western North America. It feeds primarily on Douglas-fir, grand fir, subalpine fir, and Engelmann spruce. Occasionally, after weather and other environmental conditions become ideal for its growth and survival, budworm populations explode in what is called an outbreak.

Budworm outbreaks tend to be cyclic, with irruptive episodes covering large landscapes every 15 to 30 years. Forests comprised mostly of pines or western larch have little defoliation risk because those species are seldom fed upon by western spruce budworm (Carlson et al. 1983).

The Potamus analysis area experienced two budworm outbreaks during the last 50 years. During the first outbreak (1944-1958), most of the analysis area's budworm-host type was defoliated to some extent by 1950 (Dolph 1980).

In response to budworm defoliation and its associated tree damage (top-killing or mortality), an insecticide was applied to most (if not all) of the Potamus analysis area in 1950 to reduce budworm populations to non-damaging levels. DDT, a chemical insecticide mixed with a fuel oil diluent, was applied during these projects (Dolph 1980).

Table 5-6. Aerial sketch map summary for the Potamus analysis area, 1980-2003.

Year	Mixed-Conifer Beetles	Pine Beetles	Defoliators	Other	Total	Percent of Analysis Area
1980	—	288	—	—	288	0.3
1981	—	—	81	—	81	0.1
1982	—	—	8,331	—	8,331	8.4
1983	—	—	13,833	—	13,833	13.9
1984	—	—	12,033	—	12,033	12.1
1985	—	—	11,026	—	11,026	11.1
1986	—	—	10,574	—	10,574	10.6
1987	—	—	8,921	—	8,921	9.0
1988	88	40	—	—	128	0.1
1989	1,307	210	2,691	—	4,208	4.2
1990	204	17	11,217	—	11,437	11.5
1991	42	—	12,066	—	12,109	12.2
1992	177	33	28	—	239	0.2
1993	—	—	—	—	—	0.0
1994	86	—	—	—	86	0.1
1995	134	43	—	—	176	0.2
1996	—	—	—	—	—	0.0
1997	—	—	—	—	—	0.0
1998	2	28	—	—	30	0.0
1999	192	67	—	—	258	0.3
2000	29	5	—	54	89	0.1
2001	355	53	—	—	408	0.4
2002	320	242	—	—	561	0.6
2003	2,070	254	—	—	2,324	2.3

Sources/Notes: Areas (acres) were derived from aerial detection surveys completed by the Pacific Northwest Region of the Forest Service. Note that area figures include National Forest System (NFS) lands only. "Mixed-conifer beetles" includes Douglas-fir beetle and fir engraver; "pine beetles" includes mountain pine beetle in either lodgepole pine or ponderosa pine, Ips beetle in pine, and western pine beetle; "defoliators" includes western spruce budworm; "other" includes fire. Some map areas show more than one agent; in those instances, only the first (primary) agent was used for this summary. Totals were not computed for the damage columns because when insect activity is ongoing in an area, the same acres are often affected in multiple years (this means that acreage values are not mutually exclusive from year to year). The "percent of analysis area" values were calculated by dividing the "total" values by the NFS acres in the analysis area (99,603 acres for the Potamus analysis area).

After the earlier outbreak collapsed in 1958, spruce budworm remained at endemic levels until 1980, when another outbreak began in mixed-conifer stands near Cove, Oregon. The 1980-1992 outbreak evolved from south to north in the Blue Mountains; the Potamus analysis area experienced moderate defoliation between 1982 and 1987, and from 1989 to 1991 (Table 5-7).

Wildland Fire.

Fire is an important disturbance process in the Potamus analysis area and throughout the Blue Mountains. Historical fire effects were often noted in early journals. A book synthesizes journals from 19th century travelers on the Blue Mountains portion of the Oregon Trail (Evans 1991). When 66 journal accounts from the book were analyzed, 89% of them referred to open ponderosa pine stands and 54% noted burned underbrush or grassy glades, much smoke in late summer and fall, or a lack of underbrush and dense tree thickets (Wickman et al. 1994).

According to these journal accounts, forest conditions at low and middle elevations consisted mainly of ponderosa pine, the pine forests were open and park-like with grass as the predominant undergrowth vegetation, and fire was a common occurrence in late summer and autumn (Wickman et al. 1994).

Large wildfires occurred during Euro-American settlement of the interior Pacific Northwest. Emigrants caused fires, either accidentally or intentionally. Miners set fires to clear away brush and forest debris, thereby exposing rock outcrops for inspection by prospectors (Veblen and Lorenz 1991). Other early fires were started by livestock ranchers to remove brush and promote grass growth (Harley 1918).

A "large fires" geographic information system coverage was queried to determine the extent and location of large wildfires in the Potamus analysis area. This data was supplemented with historical map sources showing wildfire occurrence in 1900, 1910 and the 1950s (Bones et al. 1958; Plummer 1912; Spada et al. 1954, 1960; Thompson and Johnson 1900). The 1930s historical mapping was also examined; it showed no documented wildfires in the Potamus analysis area.

The information in table 5-7 shows that wildfire affected about 60,000 acres in the Potamus analysis area, although the actual total is undoubtedly greater than that because data for fires occurring before 1961 is incomplete.

Map 5-2 (see appendix) shows the location and distribution of large fires in the Potamus area.

Table 5-7. Large wildfires occurring in the Potamus analysis area.

Year	Fire Name	NFS Acres	Total Acres
1900	Fires on the 1900 map	152	152
1910	Fires on the 1910 map	15,778	33,329
1950s	Fires on the 1950s maps	0	16
1961	Ditch Creek	4,876	20,625
1973	Gilbert	3	3
1995	Potamus	23	23
1996	Graves	71	71
1997	French	62	62
2001	Mallory	4,093	4,098
2002	140	0	118
2002	Jack's House	13	13
2003	Bull Springs 2	458	458
Total	Large fires: 1900-2003	25,529	58,968

Sources/Notes: Summarized from Bones et al. 1958; Plummer 1912; Spada et al. 1954, 1960; Thompson and Johnson 1900; and the Umatilla National Forest large-fire GIS layer. "NFS Acres" includes National Forest System lands; "Total Acres" includes all ownerships.

Timber Harvest

Local demand for construction timber – trusses for mine tunnels and wooden viaducts to carry water for dredge mining – resulted in the first timber harvests in the Blue Mountains. Within a year after gold was discovered in the John Day River valley (in June of 1862 near Canyon City, Oregon), an enterprising businessman opened a sawmill to provide lumber for miners building flumes and sluices (Robbins 1997).

During the Euro-American settlement era, timber met a variety of the homesteaders' needs including logs for homes, posts and poles for corrals, and rails for fencing. The resinous, durable woods of ponderosa pine and western larch were ideal for providing many of these necessities (Robbins 1997, Tucker 1940).

In the early days, lodgepole pine was harvested for fuel; the Meacham area, located east of the Potamus analysis area, produced more than 9,000 cords of wood a year (mostly fuelwood) between 1884 and 1924 (Tucker no date).

After World War II, ponderosa pine and other species were intensively harvested to feed a rapidly growing market for clear lumber for home construction, railroad ties, and to produce shipping crates for apples and other fruits (Bolsinger and Berger 1975, Gedney 1963).

Recent timber harvest had a limited impact on vegetation conditions in the Potamus analysis area. For national forest lands in eastern Oregon and eastern Washington, timber harvest levels declined dramatically beginning in 1990 (O'Laughlin et al. 1998). That trend is clearly reflected in the timber harvest history for the Umatilla National Forest (figure 5-1); recent timber harvest levels for the Umatilla National Forest (including national forest lands in the Potamus analysis area) are similar to harvest volumes in the mid 1950s.

Figure 5-1. Timber harvest history for the Umatilla National Forest, 1922-2003.

Current Conditions

Contemporary aerial photography, acquired in 1995 for the North Fork John Day Ranger District and in 1997 for the Heppner Ranger District, was interpreted to provide most of the current conditions information presented in this section (92% of the current conditions data was based on aerial photography). Stand examinations and walk-through surveys were used to derive the remainder of the current conditions data (8%).

Composition

Tree species occur in either pure or mixed stands called forest cover types. Cover types, classified using existing tree composition, are based on a predominance of stocking and they are seldom pure – the grand fir type, for example, has a majority (50% or more) of grand fir trees, but it may also contain Douglas-fir, western larch, ponderosa pine and other species.

Table 5-8 summarizes the area of existing cover types for the Potamus analysis area. It shows that the predominant forest cover type is interior Douglas-fir (37% has Douglas-fir as the plurality or majority species), followed by grand fir (17%), ponderosa pine (13%), and lodgepole pine (7%).

Forests with a predominance of subalpine fir, western larch, Engelmann spruce, western juniper or quaking aspen are uncommon because each of them occupies less than 1% of the Potamus analysis area.

About 24% of the analysis area supports nonforest vegetation, most of which is grassland (21% of the analysis area). Dry meadows and bunchgrass communities (dominated by fescues and bluebunch wheatgrass) are common grassland types. Shrublands comprise a small proportion of the analysis area (1%). About two percent of the analysis area supports forblands (table 5-8).

Map 5-3 (appendix) shows existing cover types for the Potamus analysis area.

Forest Density

Published stocking guidelines were used to analyze existing forest density levels for the Potamus analysis area (Cochran et al. 1994, Powell 1999). By using the stocking guidelines in conjunction with potential vegetation groups, it was possible to assign a forest density rating (high, moderate, low) for each forest polygon; the density analysis protocol is described in Powell (2004b).

Table 5-9 summarizes the area of existing forest density classes for the Potamus analysis area. It shows that the predominant situation is high forest density (70% of the forested portion of the Potamus analysis area), followed by low forest density (18%) and then moderate forest density (12%).

Map 5-4 (appendix) shows existing forest density classes for the Potamus analysis area.

Forest Size Class.

Historically, forest size classes were defined using economically important criteria that emphasized wood product or timber commodity considerations (small sawtimber, large sawtimber, etc.). Size class definitions recently evolved to incorporate a biological approach based on tree size or physiological maturity. This Potamus analysis used size class definitions that reflect tree size (note that size class was based on tree diameter rather than tree height).

Table 5-8. Existing vegetation cover types for the Potamus analysis area.

Cover Type Description	Acres	Percent
Nonforest environments consisting of **forblands**	1,909	1.9
Nonforest environments consisting of **grasslands**	21,160	21.2
Nonforest environments consisting of **shrublands**	880	0.9
Nonforest areas consisting of **water**	9	< 0.1
All nonforest cover types (forb/grass/shrub/water)	23,958	24.1
Forest with interior Douglas-fir as the majority species	24,048	24.1
Mixed forest with interior Douglas-fir as the plurality species	12,446	12.5
Forest with **Douglas-fir** as the majority or plurality species	36,494	36.6
Forest with Engelmann spruce as the majority species	15	< 0.1
Mixed forest with Engelmann spruce as the plurality species	41	< 0.1
Forest with **Engelmann spruce** as the majority or plurality species	56	0.1
Forest with grand fir as the majority species	10,432	10.5
Mixed forest with grand fir as the plurality species	6,721	6.8
Forest with **grand fir** as the majority or plurality species	17,153	17.2
Forest with lodgepole pine as the majority species	5,167	5.2
Mixed forest with lodgepole pine as the plurality species	2,077	2.1
Forest with **lodgepole pine** as the majority or plurality species	7,244	7.3
Forest with ponderosa pine as the majority species	9,993	10.0
Mixed forest with ponderosa pine as the plurality species	2,744	2.8
Forest with **ponderosa pine** as the majority/plurality species	12,737	12.8
Forest with **quaking aspen** as the majority species	8	< 0.1
Forest with subalpine fir as the majority species	67	0.1
Mixed forest with subalpine fir as the plurality species	214	0.2
Forest with **subalpine fir** as the majority or plurality species	281	0.3
Woodland with **western juniper** as the majority species	811	0.8
Forest with western larch as the majority species	576	0.6
Mixed forest with western larch as the plurality species	286	0.3
Forest with **western larch** as the majority or plurality species	862	0.9

Sources/Notes: Summarized from the Potamus existing vegetation database (Powell 2004a); acres and percents include National Forest System lands only.

Table 5-9. Existing forest density classes for the Potamus analysis area.

	Low Density		Moderate Density		High Density	
Potential Vegetation Groups	Acres	Pct.	Acres	Pct.	Acres	Pct.
Dry Upland Forest	7,350	13.1	5,381	9.6	43,599	77.4
Moist Upland Forest	3,722	34.9	2,681	25.1	4,275	40.0
Cold Upland Forest	3,228	28.5	1,137	10.0	6,964	61.5
Total (Upland Forest)	14,300	18.3	9,199	11.7	54,837	70.0

Sources/Notes: Summarized from the Potamus existing vegetation database (Powell 2004a); acres and percents include National Forest System lands only. The protocol for calculating a forest density class for each forest polygon is described in Powell (2004b).

Table 5-10 summarizes the area of existing forest size classes for the Potamus analysis area. It shows that the predominant size class is pole-size trees ranging from 5 to 9 inches in diameter (54% of the forested portion of the analysis area), followed by small trees ranging from 9 to 21 inches in diameter (23%), seedling- and sapling-size trees less than 5 inches in diameter (17%), and large trees whose diameter is greater than 21 inches (6%).

Map 5-5 (appendix) shows existing forest size classes for the Potamus analysis area.

Table 5-10. Existing forest size classes for the Potamus analysis area.

Forest Size Class Description	Acres	Pct. of Total	Pct. of Forested
Trees with a diameter of less than 5 inches	13,488	13.5	17.1
Trees with a diameter of 5 to 9 inches	42,969	43.1	54.3
Trees with a diameter of 9 to 21 inches	17,991	18.1	22.7
Trees with a diameter greater than 21 inches	4,657	4.7	5.9
NA: Nonforest potential vegetation groups	20,498	20.6	

Sources/Notes: Summarized from the Potamus existing vegetation database (Powell 2004a); acres and percents include National Forest System lands only.

Forest Structure

As a forest matures, it experiences predictable changes in its structure. It may begin as a young, single-layer forest, but it does not stay in that condition forever during a normal developmental (successional) process. The Potamus forest vegetation analysis used a structural classification system involving eight developmental classes (O'Hara et al. 1996).

Table 5-11 summarizes the area of forest structural classes for the Potamus analysis area. It shows that the predominant structural class is stem exclusion closed canopy (24% of the analysis area), followed by understory reinitiation and young forest multi strata (13% each), stand initiation (11%), and stem exclusion open canopy (10%).

The old forest single stratum (3%), old forest multi strata (2%), and bare ground (4%) structural classes are relatively uncommon in the analysis area – each of them occupies less than five percent of the analysis area (table 5-11).

Map 5-6 (appendix) shows existing structural classes for the Potamus analysis area.

Forest Canopy Layering.

The vertical arrangement of tree canopy is an important forest attribute. Multi-layered stands provide desirable habitat for pileated woodpeckers on moist-forest sites (Bull and Holthausen 1993) but this structural configuration is often undesirable on dry sites because it functions as ladder fuel, allowing surface fire to transition to crown fire (Graham et al. 1999, 2004).

Table 5-12 summarizes the area of existing forest canopy layers for the Potamus analysis area. It shows that the predominant situation is a single-layer stand structure (51% of the forested portion of the analysis area), followed by a two-layer structure (43%) and then a highly complex layer structure (three or more layers; 6% of the analysis area).

Map 5-7 (appendix) shows existing forest canopy layers for the Potamus analysis area.

Table 5-11. Existing forest structural classes for the Potamus analysis area.

Structure Codes	Forest Structural Class Description	Acres	Pct. of Total	Pct. of Forested
BG	Bare Ground structural class	3,459	3.5	4.4
SI	Stand Initiation structural class	10,750	10.8	13.7
SEOC	Stem Exclusion Open Canopy structural class	9,538	9.6	12.2
SECC	Stem Exclusion Closed Canopy structural class	23,835	23.9	30.4
UR	Understory Reinitiation structural class	12,977	13.0	16.6
YFMS	Young Forest Multi Strata structural class	12,966	13.0	16.6
OFMS	Old Forest Multi Strata structural class	2,246	2.3	2.9
OFSS	Old Forest Single Stratum structural class	2,564	2.6	3.3
WSI	Woodland Stand Initiation structural class	168	0.2	
WSE	Woodland Stem Exclusion structural class	601	0.6	
	NA: Nonforest potential vegetation groups	20,498	20.6	

Sources/Notes: Summarized from the Potamus existing vegetation database (Powell 2004a); acres and percents include National Forest System lands only.

Table 5-12. Existing forest canopy layers for the Potamus analysis area.

Forest Canopy Layer Description	Acres	Pct. of Total	Pct. of Forested
Tree canopy cover occurs in l layer	40,272	40.4	50.9
Tree canopy cover occurs in 2 layers	34,324	34.5	43.4
Tree canopy cover occurs in 3 or more layers	4,508	4.5	5.7
NA: Nonforest potential vegetation groups	20,498	20.6	

Sources/Notes: Summarized from the Potamus existing vegetation database (Powell 2004a); acres and percents include National Forest System lands only.

Forest Insect and Disease Susceptibility.

Susceptibility is defined as a set of conditions that make a forest stand vulnerable to substantial injury by insects or diseases. Susceptibility assessments do not predict when insects and diseases might reach damaging levels; rather, they indicate whether stand conditions are conducive to declining forest health and increasing levels of tree mortality caused by insect and disease agents.

For the Potamus analysis area, susceptibility assessments were completed for seven insects and diseases: defoliators (representing western spruce budworm and Douglas-fir tussock moth), Douglas-fir beetle, fir engraver, bark beetles in ponderosa pine (representing western pine beetle and mountain pine beetle), mountain pine beetle in lodgepole pine, dwarf mistletoe in Douglas-fir, and root diseases (representing laminated root rot and Armillaria root disease).

Species composition and abundance, tree size, forest structure (canopy layering, structural class), tree density, intra-stand variability (clumpiness) and other vegetation factors influence stand susceptibility to insect and disease occurrence (Hessburg et al. 1999, Schmitt and Powell 2002).

Susceptibility to each of the seven agents was rated using four to six biophysical factors (mountain pine beetle in lodgepole pine, for example, had six rating factors); scores from individual factors were summed and this total score used to assign a categorical rating of low, moderate or high. This means that every forest polygon in the analysis area has a susceptibility rating (low, moderate or high) for all seven insect and disease agents; note that nonforest polygons were not rated for insect and disease susceptibility.

The insect and disease susceptibility rating protocols are described in Schmitt and Powell (2002), and in Hessburg and others (1999). Results of the insect and disease susceptibility assessments are summarized in table 5-13; they show that existing susceptibility is particularly high for defoliators (spruce budworm and Douglas-fir tussock moth), dwarf mistletoe in Douglas-fir, Douglas-fir beetle, and root diseases (laminated and Armillaria).

Map 5-8 (appendix) shows insect and disease susceptibility ratings for the Potamus analysis area.

Table 5-13. Existing insect and disease susceptibility ratings for the Potamus analysis area.

	Low Suscep.		Moderate Suscep.		High Suscep.	
Insect or Disease Agent	Acres	Pct.	Acres	Pct.	Acres	Pct.
Bark beetles in ponderosa pine	32,666	41.7	35,256	45.0	10,414	13.3
Defoliators (budworm/tussock moth)	12,862	16.4	22,094	28.2	43,379	55.4
Douglas-fir beetle	16,214	20.7	43,832	56.0	18,290	23.4
Dwarf mistletoe in Douglas-fir	9,394	12.0	33,225	42.4	35,718	45.6
Fir engraver beetle	41,141	52.5	24,042	30.7	13,152	16.8
Mountain pine beetle in lodgepole pine	30,798	39.3	41,925	53.5	5,613	7.2
Root diseases (laminated/Armillaria)	24,486	31.3	38,338	48.9	15,512	19.8

Sources/Notes: Summarized from the Potamus existing vegetation database (Powell 2004a); acres and percents include National Forest System lands only. The protocol for calculating insect and disease susceptibility ratings is described in Schmitt and Powell (2002).

Reference Conditions

Historical aerial photography from 1939 was interpreted to derive the reference condition information presented in this section (first, polygons were delineated on the photography; second, vegetation conditions were characterized and recorded for each polygon).

Composition

Table 5-14 summarizes the area of historical cover types for the Potamus analysis area. It shows that the predominant forest cover type in 1939 was Douglas-fir (27% of upland forests in the analysis area had Douglas-fir as the plurality or majority species), followed by ponderosa pine (23%), lodgepole pine (10%) and then grand fir (9%).

Forests with a plurality or majority of western larch or Engelmann spruce were apparently uncommon because each of them occupied less than two percent of the analysis area.

In 1939, almost 29% of the analysis area supported nonforest vegetation, most of which was grassland (28% of the area). Shrublands and meadow comprised a very small proportion of the analysis area (less than 1% each; see table 5-14).

Map 5-3 (appendix) shows historical cover types for the Potamus analysis area.

Table 5-14. Historical vegetation cover types for the Potamus analysis area.

Cover Type Description	Acres	Percent
Nonforest environments consisting of **grasslands**	27,680	27.8
Nonforest environments consisting of **meadows**	100	0.1
Nonforest areas consisting of **shrublands**	567	0.6
All nonforest cover types (grass/meadow/shrub)	28,347	28.5
Forest with interior Douglas-fir as the majority species	22,583	22.7
Mixed forest with interior Douglas-fir as the plurality species	3,782	3.8
Forest with **Douglas-fir** as the majority or plurality species	26,365	26.5
Forest with Engelmann spruce as the majority species	1,323	1.3
Mixed forest with Engelmann spruce as the plurality species	245	0.3
Forest with **Engelmann spruce** as the majority or plurality species	1,568	1.6
Forest with grand fir as the majority species	6,367	6.4
Mixed forest with grand fir as the plurality species	2,525	2.5
Forest with **grand fir** as the majority or plurality species	8,892	8.9
Forest with lodgepole pine as the majority species	9,056	9.1
Mixed forest with lodgepole pine as the plurality species	1,285	1.3
Forest with **lodgepole pine** as the majority or plurality species	10,341	10.4
Forest with ponderosa pine as the majority species	21,602	21.7
Mixed forest with ponderosa pine as the plurality species	1,524	1.5
Forest with **ponderosa pine** as the majority/plurality species	23,126	23.2
Forest with **quaking aspen** as the majority species	121	0.1
Forest with western larch as the majority species	807	0.8
Mixed forest with western larch as the plurality species	24	< 0.1
Forest with **western larch** as the majority or plurality species	831	0.8

Sources/Notes: Summarized from the Potamus historical vegetation database (Powell 2004a); acres and percents include National Forest System lands only.

Forest Density

Table 5-15 summarizes the area of historical forest density classes for the Potamus analysis area. It shows that the predominant situation in 1939 was high forest density (78% of the forested portion of the analysis area), followed by low forest density (15%) and then moderate density (7%).

Map 5-4 (appendix) shows historical forest density classes for the Potamus analysis area.

Table 5-15. Historical forest density classes for the Potamus analysis area.

Forest Density Class Description	Acres	Pct. of Total	Pct. of Forested
Forest polygons with low forest (tree) density	10,728	10.8	15.1
Forest polygons with moderate forest (tree) density	4,876	4.9	6.9
Forest polygons with high forest (tree) density	55,607	55.8	78.1
NA: Nonforest cover types and juniper woodland PVG	28,377	28.5	

Sources/Notes: Summarized from the Potamus historical vegetation database (Powell 2004a); acres and percents include National Forest System lands only. The protocol for analyzing forest density is described in Powell (2004b).

Forest Size Class.

Table 5-16 summarizes the area of historical forest size classes for the Potamus analysis area. It shows that the predominant forest size class in 1939 was small trees ranging from 9 to 21 inches in diameter (62% of the forested portion of the analysis area), followed by large trees whose diameter is greater than 21 inches (17%), and then pole-sized trees ranging from 5 to 9 inches in diameter (17%). Seedling- and sapling-size trees were relatively uncommon in 1939, occupying only about 4% of the analysis area.

Map 5-5 (see appendix) shows historical forest size classes for the Potamus analysis area.

Table 5-16. Historical forest size classes for the Potamus analysis area.

Forest Size Class Description	Acres	Pct. of Total	Pct. of Forested
Trees with a diameter of less than 5 inches	2,744	2.8	3.9
Trees with a diameter of 5 to 9 inches	11,808	11.9	16.6
Trees with a diameter of 9 to 21 inches	44,276	44.5	62.2
Trees with a diameter greater than 21 inches	12,414	12.5	17.4
NA: Nonforest cover types	28,347	28.5	

Sources/Notes: Summarized from the Potamus historical vegetation database (Powell 2004a); acres and percents include National Forest System lands only.

Forest Structure

Table 5-17 summarizes the area of historical forest structural classes for the Potamus analysis area. It shows that the predominant structural class in 1939 was stem exclusion closed canopy (40% of the forested portion of the analysis area), followed by young forest multi strata (22%), stem exclusion open canopy (15%), old forest single stratum (10%), and then old forest multi strata (8%). The other two forest structural classes (stand initiation and understory reinitiation) were relatively uncommon – each of them occupied less than five percent of the analysis area.

Map 5-6 (see appendix) shows historical structural classes for the Potamus analysis area.

Table 5-17. Historical forest structural classes for the Potamus analysis area.

Forest Structural Class Description	Acres	Pct. of Total	Pct. of Forested
Stand Initiation structural class	2,009	2.0	2.8
Stem Exclusion Open Canopy structural class	10,560	10.6	14.8
Stem Exclusion Closed Canopy structural class	28,428	28.6	39.9
Understory Reinitiation structural class	1,910	1.9	2.7
Young Forest Multi Strata structural class	15,767	15.8	22.1
Old Forest Multi Strata structural class	5,761	5.8	8.1
Old Forest Single Stratum structural class	6,776	6.8	9.5
Woodland Stem Exclusion structural class	31	< 0.1	
NA: Nonforest cover types	28,347	28.5	

Sources/Notes: Summarized from the Potamus historical vegetation database (Powell 2004a); acres and percents include National Forest System lands only.

Forest Canopy Layering

Table 5-18 summarizes the area of historical forest canopy layers for the Potamus analysis area. It shows that the predominant situation in 1939 was a single-layer stand structure (63% of the forested portion of the analysis area), followed by a two-layer structure (37%). A highly complex layer structure (three or more canopy layers) was uncommon in 1939 – it occupied less than one tenth of one percent of the analysis area.

Map 5-7 (see appendix) shows historical canopy layering for the Potamus analysis area.

Table 5-18. Historical forest canopy layers for the Potamus analysis area.

Forest Canopy Layer Description	Acres	Pct. of Total	Pct. of Forested
Tree canopy cover occurs in l layer	44,871	45.1	63.0
Tree canopy cover occurs in 2 layers	26,356	26.5	37.0
Tree canopy cover occurs in 3 or more layers	15	< 0.1	< 0.1
NA: Nonforest cover types	28,347	28.5	

Sources/Notes: Summarized from the Potamus historical vegetation database (Powell 2004a); acres and percents include National Forest System lands only.

Forest Insect and Disease Susceptibility

Table 5-19 summarizes the area of historical insect and disease susceptibility for the Potamus analysis area. It shows that in 1939, there was relatively high susceptibility for bark beetles in ponderosa pine (western pine beetle and mountain pine beetle), defoliators (spruce budworm and Douglas-fir tussock moth), and dwarf mistletoe in Douglas-fir. Moderate susceptibility existed for Douglas-fir beetle and mountain pine beetle in lodgepole pine. There was relatively low susceptibility for fir engraver and root diseases (laminated/Armillaria).

Map 5-9 (see appendix) shows historical insect and disease susceptibility ratings for the Potamus analysis area.

Table 5-19. Historical insect and disease susceptibility ratings for the Potamus analysis area.

	Low Suscep.		Moderate Suscep.		High Suscep.	
Insect or Disease Agent	Acres	Pct.	Acres	Pct.	Acres	Pct.
Bark beetles in ponderosa pine	18,794	26.4	29,301	41.2	23,117	32.5
Defoliators (budworm/tussock moth)	15,530	21.8	30,698	43.1	24,983	35.1
Douglas-fir beetle	13,320	18.7	47,284	66.4	10,608	14.9
Dwarf mistletoe in Douglas-fir	5,684	8.0	39,214	55.1	26,313	37.0
Fir engraver beetle	26,131	36.7	36,205	50.8	8,875	12.5
Mountain pine beetle in lodgepole pine	19,882	27.9	41,401	58.1	9,928	13.9
Root diseases (laminated/Armillaria)	34,639	48.6	22,398	31.5	14,174	19.9

Sources/Notes: Summarized from the Potamus historical vegetation database (Powell 2004a); acres and percents include National Forest System lands only. The protocol for calculating insect and disease susceptibility ratings is described in Schmitt and Powell (2002).

Synthesis and Interpretation

Forest Composition

Forest composition of the Potamus analysis area has been relatively consistent over the last 60 years (tables 5-8 and 5-14), as shown when comparing the top 3 conditions:

Current Conditions	Reference Conditions
Douglas-fir (37%)	Nonforest types (29%)
Nonforest types (24%)	Douglas-fir (27%)
Grand fir (17%)	Ponderosa pine (23%)

The implications of this trend are:

1. Late-seral tree species (particularly Douglas-fir) are more common now than they were historically, primarily because fire suppression caused dry-forest sites to skip several fire cycles and this allowed fire-susceptible, late-seral species to replace fire-resistant species; and
2. Trees invaded (encroached) into nonforest areas, resulting in a substantial increase in forestland between the 1930s and today (forestland increased by 4,389 acres in the analysis area, and this increase represents 5% of the analysis area acreage). Figure 5-2 provides an example of tree stands encroaching on nonforest areas.

HRV Analysis For Composition. To understand the implications of current conditions, it is often helpful to interpret them in an historical context. An analytical technique was recently developed to help put current conditions in their historical context – the historical range of variability (HRV).

Managers often consider HRV to be an indicator of ecological sustainability – historical conditions are believed to reflect sustainable conditions. A key premise of HRV is that native species have evolved with, and are adapted to, the historical disturbance regime of an area. For that reason, ecosystem components occurring within their historical range are believed to represent a sustainable condition (Morgan et al. 1994, Swanson et al. 1994).

The implications of the composition HRV analysis (table 5-20) are:

1. Dry-forest sites currently support too much of the interior Douglas-fir and grand fir forest cover types and too little of the ponderosa pine forest cover type;
2. Moist-forest sites support too much of the interior Douglas-fir forest cover type and too little of the western larch forest cover type; and
3. Cold-forest sites support too much of the grand fir, grass-forb and interior Douglas-fir cover types and too little of the spruce-fir cover type.

The interior Columbia River basin ecosystem management project and other broad-scale assessments concluded that dry-forest sites have an uncharacteristic composition when compared with their historical condition (Caraher et al. 1992, Hessburg et al. 1999, Lehmkuhl et al. 1994, Quigley and Arbelbide 1997).

The Potamus HRV analysis had a similar result because it found that too many dry-forest sites have fire-susceptible cover types (grand fir and Douglas-fir) and too few dry sites support fire-resistant forest types (ponderosa pine and western larch) (table 5-20).

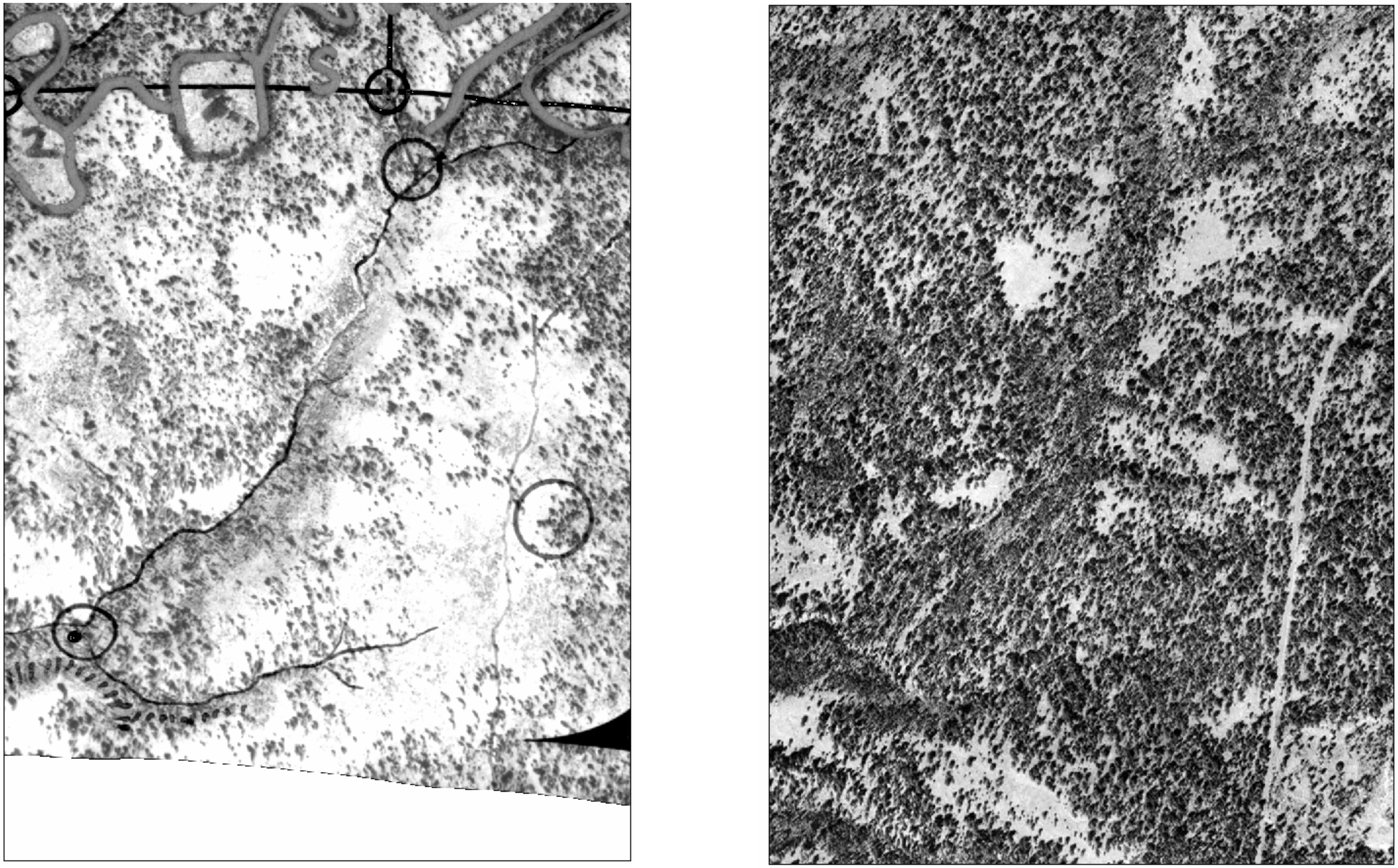

Figure 5-2. Example of forest encroachment (tree invasion) affecting nonforest lands in the Potamus analysis area, 1939-1997. The left image shows an area in 1939; the right image shows the same area in 1997. Tree invasion onto nonforest lands is clearly evident when comparing the two images, as is an increase in forest (tree) density for areas that were forested in both time periods. It is also clear that the riparian zone in the left photograph lost much of its shrub component between 1939 and 1997.

Table 5-20. Historical range of variability analysis for existing vegetation composition.

	Dry UF PVG[2]		**Moist UF PVG**		**Cold UF PVG**	
Cover Type[1]	Historical Range (%)[3]	Current Percent[4]	Historical Range (%)	Current Percent	Historical Range (%)	Current Percent
Grass-forb	0-5	2	0-5	4	0-5	7
Shrub	0-5	< 1	0-5	3	0-15	2
Western juniper	0-5	< 1				
Ponderosa pine	50-90	21	5-15	9	0-5	1
Douglas-fir	5-15	54	15-30	41	0-15	18
Western larch	0-10	1	10-30	< 1	0-15	2
Broadleaved trees			0-5	< 1		
Lodgepole pine	0-5	7	5-30	12	20-60	19
Western white pine			0-5	0		
Grand fir	1-5	15	5-30	29	0-10	51
Whitebark pine					0-5	0
Spruce-fir			0-15	3	20-40	< 1

Source: Adapted from Morgan and Parsons (2000).

[1] Cover types consist of these coding combinations – grass-forb: all grass and forb codes; shrub: all shrub codes; western juniper: JUOC and mix-JUOC codes; ponderosa pine: PIPO and mix-PIPO codes; Douglas-fir: PSME and mix-PSME codes; western larch: LAOC and mix-LAOC codes; broadleaved trees: POTR2, mix-POTR2, POTR5, and mix-POTR5 codes; lodgepole pine: PICO and mix-PICO codes; western white pine: PIMO and mix-PIMO codes; grand fir: ABGR and mix-ABGR codes; whitebark pine: PIAL and mix-PIAL codes; and spruce-fir: ABLA, mix-ABLA, PIEN, and mix-PIEN codes. Cover type codes are described in Powell (2004a).

[2] Potential vegetation groups (PVG) are the middle level of a three-level, mid-scale hierarchy for potential vegetation (Powell and Johnson 2004). PVG codes are described in Powell (2004a).

[3] Historical ranges, derived from Morgan and Parsons (2000), were based on multiple 1200-year simulations representing landscapes in a "dynamic equilibrium" with their disturbance regime.

[4] Current percentages, derived from the Potamus existing vegetation database (Powell 2004a), include National Forest System lands only.

Forest Density

Forest density of the Potamus analysis area has been very consistent over the last 60 years (tables 5-9 and 5-15), as shown when comparing the top 3 conditions:

Current Conditions	Reference Conditions
High density (70%)	High density (78%)
Low density (18%)	Low density (15%)
Moderate density (12%)	Moderate density (7%)

The implications of this trend are:

1. The amount of high-density forest dropped a little between the 1930s and today; and
2. Both reference and existing conditions represent high susceptibility to these insects and diseases that respond positively to an overstocked forest condition: Armillaria root disease (Filip et al. 1989), Douglas-fir beetle (Weatherby and Their 1993), Douglas-fir tussock moth (Filip et al. 1996), fir engraver (Hessburg et al. 1994), Indian paint fungus (Filip et al.

1992), mountain pine beetle (Mitchell et al. 1983), spruce beetle (Schmid and Frye 1976), western pine beetle (Miller and Keen 1960) and spruce budworm (Carlson et al. 1985).

Forest Size Class

Forest size classes have been relatively consistent over the last 60 years (tables 5-10 and 5-16), as shown when comparing the top 3 conditions:

Current Conditions	Reference Conditions
Pole trees (5-9″ DBH; 54%)	Small trees (9-21″ DBH; 62%)
Small trees (9-21″ DBH; 23%)	Large trees (> 21″ DBH; 17%)
Saplings (< 5″ DBH; 17%)	Pole trees (5-9″ DBH; 17%)

The implications of this trend are:

1. Large trees (those with a diameter of 21 inches or greater) are less common now than they were historically; and
2. Seedlings and saplings (trees with a diameter of five inches or less) are more common today than in the 1930s.

Forest Structure.

Forest size classes have been relatively consistent over the last 60 years (tables 5-11 and 5-17), as shown when comparing the top 3 conditions:

Current Conditions	Reference Conditions
SECC (30%)	SECC (40%)
UR (17%)	YFMS (22%)
YFMS (17%)	SEOC (15%)

The implications of this trend are:

1. The dense, stem exclusion structural class (SECC) was common historically and is still abundant today; and
2. Other mid-successional structural classes (particularly YFMS) were abundant in the 1930s and they remain so today.

HRV Analysis For Forest Structure. An HRV analysis was used to evaluate forest structure for the Potamus analysis area. It was based on two primary factors – forest structural classes and potential vegetation (as represented by PVGs).

Results of the forest structure HRV analysis are provided in table 5-21. It summarizes the current percentage of each structural class by potential vegetation group; the historical range for each structural class is also shown.

The implications of table 5-21 are:

1. The SI and SEOC structural classes are above the upper limit of their historical ranges for the cold and moist upland forest PVGs;
2. The SECC and UR structural classes are above the upper limits of their historical ranges for the dry upland forest PVG; and

3. The OFMS, YFMS and OFMS, and OFSS structural classes are below the lower limits of their historical ranges for the cold, moist and dry upland forest PVGs, respectively.

Table 5-21. Historical range of variability (HRV) analysis for forest structural classes.

PVG[2]		FOREST STRUCTURAL CLASSES[1] BG/SI	SEOC	SECC	UR	YFMS	OFMS	OFSS	NFS Acres
Cold	H%[3]	1-20	0-5	5-20	5-25	10-40	10-40	0-5	11,328
	C%[4]	**27**	**16**	9	11	30	**1**	4	
Moist	H%	1-10	0-5	5-25	5-25	40-60	10-30	0-5	10,678
	C%	**18**	**27**	14	7	**24**	**2**	**8**	
Dry	H%	5-15	5-20	1-10	1-10	5-25	5-20	15-55	56,329
	C%	16	8	**38**	**19**	12	3	**2**	

[1] Structural class codes are described in table 5-11. Gray cells show where the current percentage (C%) is above the historical range (H%) for a structural class. Black cells show where the current percentage is below the historical range. *Deviations were noted only when the current percentage differs from the historical range by more than two percent.*

[2] Potential vegetation groups (PVG) are the middle level of a mid-scale hierarchy for potential vegetation (Powell and Johnson 2004). PVG codes are described in Powell (2004a).

[3] Historical ranges (H%) were derived from Hall (1993), Johnson (1993) and USDA Forest Service (1995), and are summarized in Blackwood (1998).

[4] Current percentages, derived from the Potamus existing vegetation database (Powell 2004a), include National Forest System lands only.

Forest Canopy Layering.

Forest size classes have been consistent over the last 60 years (tables 5-12 and 5-18), as shown when comparing the top 3 conditions:

Current Conditions	Reference Conditions
Single canopy layer (51%)	Single canopy layer (63%)
Two canopy layers (43%)	Two canopy layers (37%)
Three canopy layers (6%)	Three canopy layers (<1%)

The implications of this trend are:

1. The relative ranking of forest canopy layering has been consistent through time;
2. The long-term trend is toward increasing complexity of canopy layering because the multiple-layer condition (two or three layers) increased substantially over the last 60 years.

Fire suppression, ungulate grazing and selective timber harvest not only allowed Douglas-fir and other late-seral trees to accumulate on dry-forest sites (see table 5-20), but it also transformed vertical forest structure when leaf area (foliage biomass) shifted downward from a single overstory layer to multiple understory layers (Powell 1994, Riggs et al. 2000). These sub-canopy layers function as ladder fuel, increasing the probability that surface fire will transition into crown fire (Graham et al. 2004).

HRV Analysis For Forest Layers. How much single-layer and multiple-layer structure would have been expected for dry-forest sites? Table 5-22 presents an historical range of variability (HRV) analysis for canopy layering on dry-forest sites. The implications of table 5-22 are:

1. The single-layer canopy condition is within its historical range;

2. The multiple-layer canopy condition (a structure that functions as ladder fuel) is near the upper limit of its historical range.

Table 5-22. Historical range of variability analysis for tree canopy layering on dry-forest sites (dry upland forest PVG).

Canopy Layer Condition	Historical Range (%)	Current Percentage	Interpretation
Single (1 layer only)	25-100	53	Within HRV
Multiple (2 or more layers)	10-55	47	Near upper end of HRV

Sources/Notes: Current percentages, derived from the existing vegetation database (Powell 2004a), include National Forest System lands only. Historical ranges were derived from table 5-21: the single-layer condition combines ranges for SI, SEOC, SECC, and OFSS; the multiple-layer condition combines UR, YFMS, and OFMS.

Forest Insect and Disease Susceptibility

Forest insect and disease susceptibility has been relatively consistent over the last 60 years (tables 5-13 and 5-19), as shown when comparing the top 3 conditions (percentages reflect the total of moderate and high susceptibility):

Current Conditions	Reference Conditions
Dwarf mistletoe in Douglas-fir (88%)	Dwarf mistletoe in Douglas-fir (92%)
Defoliators (84%)	Douglas-fir beetle (81%)
Douglas-fir beetle (79%)	Defoliators (78%)

The implications of this trend are:

1. Many of the vegetation characteristics upon which the susceptibility ratings are based (species composition and abundance, tree size, forest structure, canopy layering, forest density, etc.) did not vary much between 1939 and now, so the resulting susceptibility ratings also varied little; and
2. Any vegetation changes caused by disturbance processes such as fire, insects and diseases have been offset by other changes resulting from tree growth and regeneration.

Risk is the probability that insect and disease agents will actually attack stands. Generally, the risk of tree damage caused by insects or diseases increases as their population levels increase, and this means that areas of high susceptibility are not necessarily at high risk if insufficient populations of insects or diseases are available to attack them (Jurgensen et al 1994).

Table 5-6 indicates that insects have affected a relatively small percentage of the Potamus analysis area over the last decade, which suggests that high-susceptibility stands are not necessarily at high risk because they are unlikely to be attacked and killed in the near future.

Assessment of Forest Sustainability.

Forest sustainability was the overarching issue for this analysis (see Issues and Key Questions, page 5-3). A protocol was developed for evaluating forest sustainability at a landscape or watershed scale (Amaranthus 1997). It is based on four criteria (Kolb et al. 1994); the four criteria, and an assessment of how the Potamus analysis area rates for each of them, are provided below.

1. The physical environment, biotic resources, and trophic networks to support productive forests.

Over most of the Potamus analysis area, the physical, biotic, and trophic networks are intact to support fully functioning forest ecosystems. There may be exceptions at the sub-stand level where previous management practices resulted in compacted soils, aggraded stream reaches or similar impacts. Such areas are limited, however, and upland forests of the Potamus analysis area are probably in a sustainable condition when evaluated using this criterion.

2. Resistance to catastrophic change and the ability to recover on the landscape level.

The Potamus analysis area has a moderate threat of stand-replacing disturbances that could modify composition and structure. This threat reflects altered disturbance regimes and is related primarily to 90 years or more of fire suppression. It is likely that dry-forest sites in the analysis area have missed up to five fire cycles, contributing to uncharacteristic fuel accumulations.

Under the recent fire management paradigm (fire exclusion), the influence of fire as an ecological process is markedly reduced, resulting in increased homogeneity of vegetation composition (this is reflected in a deficiency of early-seral forest cover types; see table 5-20). Outbreaks of defoliators and other landscape-scale insects, and propagation of active crown fire, are likely outcomes from this increased level of homogeneity. Based on this second criterion, forests of the Potamus analysis area are probably not sustainable.

3. A functional equilibrium between supply and demand of essential resources.

Eighty-two percent of the Potamus analysis area has tree density levels threatening future sustainability of upland forests (see table 5-9). Nutrient cycling and the availability of water and growing space are undoubtedly impaired on these overstocked sites. In addition, many of the dense stands are vulnerable to crown fire (61% of upland forests have moderate or high canopy fuel load; see table 6-9 in the Fire and Fuels Report).

The primary factor controlling crown fire behavior is canopy bulk density (the volume of forest canopy available for fire consumption), and canopy bulk density varies with species composition and stand density. Dense stands are not only more likely to initiate crown fire behavior, but also to sustain an active (independent) crown fire once it begins. Based on this criterion, forests of the Potamus analysis area are probably not sustainable.

4. A diversity of seral stages and stand structures that provide habitat for any native species and all essential ecosystem processes.

The Potamus analysis area supports a relatively well-balanced distribution of stand structures (as indicated by an HRV analysis for forest structural classes; see table 5-21). Historical forest management practices, however, have changed the spatial pattern of vegetation diversity and complexity, particularly for dry-forest sites where overcrowded, multi-strata forests were rare before ecosystem alterations caused primarily by fire suppression.

These changes created at-risk forests because they contain too many trees, or too many of the "wrong kind" of trees, to continue to thrive. As these forests get older and denser, the competition between trees intensifies, stress increases, resilience and vigor declines, and the probability of uncharacteristic change increases dramatically. Based on this fourth criterion, forests of the Potamus analysis area are marginally sustainable now but if recent trends continue into the future, their sustainability is not assured over the long term.

Recommendations

The recommendations step is the final one in the ecosystem analysis process (REO 1995). Recommendations are designed to respond to issues, concerns and findings identified during the five previous ecosystem analysis steps. Forest vegetation and fuels issues, and the active restoration treatments that could be used in response to them, are described in this section.

Whether the treatment recommendations described in this section can be implemented is influenced primarily by management direction from the Land and Resource Management Plan (Forest Plan) for the Umatilla National Forest, including its amendments such as the Eastside Screens (USDA Forest Service 1995) and PACFISH (USDA Forest Service and USDI Bureau of Land Management 1994); Forest Plan allocations for the Potamus area are summarized in table 5-23.

Table 5-23. Management direction summary for the Potamus analysis area.

Management Area Allocation	Percent of Analysis Area	Suitable Lands?	Harvest Permitted?	Pres. Fire Permitted?
A1: Non-motorized Dispersed Recreation	0.1	No	Yes*	Yes
A3: Viewshed 1	3.4	Yes	Yes	Yes
A4: Viewshed 2	1.3	Yes	Yes	Yes
A6: Developed Recreation	< 0.1	No	Yes*	No
A7: Wild Rivers	0.2	No	Yes*	Yes
A7: Scenic and Recreation Rivers		Yes	Yes	Yes
A8: Scenic Areas	< 0.1	No	Yes*	Yes
A9: Special Interest Areas	0.1	No	Yes*	Yes
C1: Dedicated Old Growth	3.8	No	Yes*	Yes
C2: Managed Old Growth	0.8	Yes	Yes	Yes
C3: Big Game Winter Range	28.5	Yes	Yes	Yes
C4: Wildlife Habitat	19.8	Yes	Yes	Yes
C5: Riparian (Fish and Wildlife)	3.3	Yes	Yes	Yes
C7: Special Fish Management Area	0.1	Yes	Yes	Yes
C8: Grass-Tree Mosaic	6.8	No	Yes*	Yes
E1: Timber and Forage	6.4	Yes	Yes	Yes
E2: Timber and Big Game	25.4	Yes	Yes	Yes
Riparian Habitat Conservation Areas (PACFISH)	NA	No	Yes*	Yes

Sources/Notes: Management area allocations are from the Umatilla NF Forest Plan (USDA Forest Service 1990). The "percent of analysis area" item shows the percentage of NFS lands in the analysis area allocated to each management emphasis; the "suitable lands?" item shows whether capable forested lands in the management area are designated as suitable for timber production by the Forest Plan; and the "harvest permitted?" and "prescribed fire permitted?" items show whether these activities are allowed by the standards and guidelines for each management area. NA is shown for the PACFISH "percent of analysis area" value because RHCA areas are not mapped independently (in other words, they are included in other Forest Plan management allocations).

* Timber harvest is permitted for these allocations but with restrictions (the Forest Plan provides further details).

Forest Vegetation Understandings (Findings)

1. On dry-forest sites (the dry upland forest PVG):

   a. The ponderosa pine forest cover type is less abundant now than would be expected from the historical range of variability (HRV); and

   b. The Douglas-fir and grand fir cover types are more abundant now than would be predicted by HRV (see table 5-20).

2. On moist-forest sites (the moist upland forest PVG):
   a. The western larch forest cover type is less abundant now than would be expected from the historical range of variability; and
   b. The Douglas-fir cover type is more abundant now than would be predicted by HRV (see table 5-20).
3. On cold-forest sites (the cold upland forest PVG):
   a. The Engelmann spruce-subalpine fir cover type is less abundant now than would be expected from the historical range of variability; and
   b. The Douglas-fir and grand fir cover types are more abundant now than would be predicted by HRV (see table 5-20).
4. On upland-forest sites in the Potamus analysis area, forest density levels are uncharacteristically high (82% of the area is currently overstocked; see table 5-9).
5. On dry-forest sites (the dry upland forest PVG):
   a. The stem exclusion closed canopy and understory reinitiation structural classes are more abundant now than would be expected from the historical range of variability; and
   b. The old forest single stratum structural class is less abundant now than would be predicted by HRV (see table 5-21).
6. On moist-forest sites (the moist upland forest PVG):
   a. The stand initiation, stem exclusion open canopy and old forest single stratum structural classes are more abundant now than would be expected from the historical range of variability; and
   b. The young forest multi strata and old forest multi strata structural classes are less abundant now than would be predicted by HRV (see table 5-21).
7. On cold-forest sites (the cold upland forest PVG):
   a. The stand initiation and stem exclusion open canopy structural classes are more abundant now than would be expected from the historical range of variability; and
   b. The old forest multi strata structural class is less abundant now than would be predicted by HRV (see table 5-21).
8. On dry-forest sites (the dry upland forest PVG), forests with multiple canopy layers are near the upper end of their historical range of variability (see table 5-22), and multi-layer canopy structure has high potential to function as ladder fuel in the event of a wildfire.
9. Insect and disease susceptibility is moderate to high for much of the Potamus analysis area; susceptibility to dwarf mistletoe in Douglas-fir, defoliators (western spruce budworm and Douglas-fir tussock moth), and Douglas-fir beetle is especially high (see table 5-13).

Recommended Treatments

Thinning. Thinning responds to six of the forest vegetation issues:

1. It helps reduce the high amount of overstocked forest.
2. It helps transform some of the SECC and UR structural classes to OFSS on dry sites.
3. It helps transform some of the SI structural class to YFMS and OFMS on moist sites.
4. It helps transform some of the SI structural class to OFMS on cold sites.
5. It helps transform multi-layer structure to single-layer structure on dry-forest sites.
6. It helps address insect and disease susceptibility by improving tree vigor.

To be healthy, a tree needs a place in the sun and some soil to call its own (Powell 1999). When crowded by too many neighbors, a tree may not have enough soil and sun to maintain its vigor. A tree eventually dies if its vigor level drops so low that it can no longer heal injuries, resist attack by insects and diseases, or otherwise sustain life (Franklin et al. 1987, Waring 1987).

Thinning removes some trees so that the remaining ones can benefit from additional sunlight, moisture and nutrients. The residual trees quickly improve their vigor and produce more resin and defensive chemicals, which help them ward off attacks from bark beetles and other insects and diseases (Christiansen et al. 1987, Kolb et al. 1998, Safranyik et al. 1998, Wickman 1992).

Thinnings that anticipate competition-related mortality remove trees from beneath the main canopy and are called a low thinning or “thinning from below.” Low thinning can be used to create an open, single-layered canopy structure amenable to reintroduction of low-severity surface fire, an important ecosystem process (Arno et al. 1995).

Over the long run, thinning may be the most effective way to deal with defoliating insects such as spruce budworm. Research from Montana found that thinning improved budworm resistance by increasing stand vigor, by increasing budworm larval mortality during their dispersal period, and by reducing budworm-host species in mixed-conifer forests. Thinning provided short-term protection for treated stands, and presumably contributed to long-term resistance after landscape-sized areas were treated (Carlson and Wulf 1989, Carlson et al. 1985, Powell 1994).

One of the highest priorities is to use thinning on low-severity fire regime sites and thereby make them more resistant to uncharacteristically severe wildfire. On these dry-forest sites, mechanical thinning is used to reduce surface, ladder and canopy fuels, and to raise the canopy base height (Arno et al. 1995, Brown et al. 2004, Pollet and Omi 2002, Stephens 1998).

Thinning is a particularly appropriate treatment for sites where the understory trees are sufficiently large or dense that attempts to kill them with prescribed fire would run a high risk of killing the overstory trees, or of the prescribed fire escaping control (Agee 1996a, Arno and Allison-Bunnell 2003, Brown et al. 2004).

Upland-forest sites with presumptive overstocking (these are the moderate and high forest density classes in table 5-9) should be thinned to address fire risk and forest health issues.

Tables in Powell (1999 and 2004b) provide tree density recommendations by tree species and by potential vegetation category (plant association, plant association group, potential vegetation group). They establish a management zone in which forest (tree) density is presumed to be ecologically sustainable and relatively resistant to insect and disease impacts.

Thinnings should be planned using a "limiting-species approach" by assuming that the species with the lowest stocking level (Cochran et al. 1994, Powell 1999) has the most restrictive growing-space requirements, and that other species with less exacting requirements will develop acceptably under the lower density levels established for the most limiting species.

Thinning treatments should also reduce tree density down to the "lower limit of the management zone" stocking value as specified in Powell (1999).

If possible, thinning treatments should be aggregated as large blocks to emulate the spatial patterns produced by surface fire (minimum of 1,000 acres; see fire history studies such as Heyerdahl and Agee 1996); small treatment areas are not likely to have a positive impact on either fire or defoliator susceptibility because both agents operate at a landscape scale (Anderson et al. 1987).

The challenge for dry-forest sites is to integrate a series of silvicultural treatments that emulate the historical disturbance regime. This approach will produce a semblance of historical forest structures and conditions – a desirable outcome not because they are historic, but because they are sustainable (e.g., vigorous, self-perpetuating, pine-dominated, and with low susceptibility to wildfire and insects).

Desired conditions contributing to a sustainable composition and structure for dry-forest sites include four primary attributes (Fiedler 2000):[1]

1. A moderately open stand density (40 to 70 square feet per acre of basal area).
2. A multi-cohort or uneven-aged structure at the stand level, although discrete clumps in a stand often consist of a single cohort (e.g., even-aged clumps in an uneven-aged stand).
3. A predominance of large trees (up to 60 percent of the basal area per acre would occur in trees whose diameter at breast height was 21 inches or greater).
4. A species composition dominated by ponderosa pine (up to 70 percent of the species composition would consist of ponderosa pine).

Improvement Cutting. Improvement cutting responds to eight of the forest vegetation issues:

1. It helps transform some of the Douglas-fir and grand fir cover types to ponderosa pine on dry sites.
2. It helps transform some of the Douglas-fir cover types to western larch on moist sites.
3. It helps transform some of the Douglas-fir and grand fir cover types to spruce-fir on cold sites.
4. It helps transform some of the SECC and UR structural classes to OFSS on dry sites.
5. It helps transform some of the SEOC structural class to YFMS and OFMS on moist sites.
6. It helps transform some of the SEOC structural class to OFMS on cold sites.
7. It helps remove ladder fuels on dry-forest sites.
8. It helps address insect and disease susceptibility by improving tree vigor.

Improvement cutting is defined as removal of less desirable trees in order to meet objectives related to species composition or vertical stand structure (Helms 1998). Trees of undesirable

[1] These four desired conditions are compatible with four principles of fire-safe forests (Agee 2002).

species or condition[2] are removed from the upper canopy, often in conjunction with an understory thinning. It is often used with mixed-species stands that still contain a viable component of early-seral trees (primarily ponderosa pine or western larch for the Potamus analysis area).

Improvement cutting responds positively to changes resulting from fire suppression, historical partial-cutting timber removals, and herbivory by both domestic and native ungulates. After frequent surface fires were suppressed, and following removal of mature ponderosa pines and larches during selective harvest, the end result was multi-layered, mixed-species forests dominated by late-seral trees (Powell 1994, Sloan 1998).

In these mixed-species, multi-layered stands, an improvement cutting would remove many (but not all) of the late-seral understory trees, thereby releasing growing space for residual ponderosa pines and western larches to improve their vigor and longevity (Fiedler 2000).

Consider improvement cutting for dry-forest sites with multi-layer structural classes (particularly for UR because it exceeds the upper limit of its historical range; see table 5-21) because this treatment could help convert some of them to the single-layer structure that is now deficient.

Note that a single-stratum structure dominated by large old trees was apparently the most common structural condition in the Potamus analysis area historically, occupying up to 55 percent of the dry-forest acreage (see table 5-21). Currently, the OFSS structural class occupies only two percent of dry-forest acreage.

Consider this process for converting some of the multi-layer structure to single-layer structure:

1. In the near term, identify high priority stands in the understory reinitiation structural class (UR);
2. Screen the identified stands to remove areas providing critical wildlife habitat (Forest Plan management allocations can help make this determination);
3. Evaluate the remaining UR stands for improvement cutting or thinning treatments because they represent the best opportunity to quickly move portions of the analysis area toward an OFSS condition;
4. When evaluating the identified UR areas, next determine which stands have a viable component of large diameter ponderosa pine or western larch in good condition. Remove the small- to medium-sized trees in these stands to instantly create OFSS structure;
5. Treat or remove woody residues (lop and scatter or pile slash if accumulations are light, or treat heavy accumulations mechanically);
6. Use prescribed fire to maintain the low density of large-diameter trees created by the treatments as an open, “parklike” structure emblematic of ponderosa pine forest throughout western North America (Cooper 1960, Munger 1917, White 1985, Wright and Agee 2004).

In the long term, some of the stem exclusion closed canopy (SECC) structural class could be thinned to develop a large-tree component as quickly as permitted by site productivity. Stands on dry sites and containing high levels of ponderosa pine should be emphasized. Although ponderosa pine is the preferred species, primarily as mitigation for the selective harvests that

[2] “Desirable” or “undesirable” trees are based on land management objectives. Trees whose characteristics contribute to meeting the objectives of an area are desirable; undesirable trees lack such characteristics. This means that when objectives change, the result could be a different determination of trees that are desirable or undesirable.

discriminated against it historically (Bolsinger and Berger 1975, Gedney 1963), other species should be retained at ecologically appropriate levels to maintain biological diversity.

Regeneration Cutting. Regeneration cutting responds to three of the forest vegetation issues:

1. It helps transform some of the Douglas-fir and grand fir cover types to ponderosa pine on dry sites.
2. It helps transform some of the Douglas-fir cover type to western larch on moist sites.
3. It helps transform some of the Douglas-fir and grand fir cover types to spruce-fir on cold sites.

Regeneration cutting is defined as tree removal to assist regeneration already present (existing seedlings and saplings) or to make future (new) regeneration possible (Helms 1998). If regeneration is not already present before the trees are removed, it becomes established from seed trees left on site or by planting tree seedlings grown in a nursery.

Regeneration cutting could be used on upland-forest sites where early-seral species (ponderosa pine, western larch and lodgepole pine) are no longer present; these sites are successionally advanced and they no longer sustain viable amounts of early-seral species (note: if the vegetation database indicated that viable amounts of early-seral species were present in areas identified for this treatment, then their recommended treatment would have been an improvement cutting).

Regeneration cutting responds primarily to ecologically inconsistent species composition on dry-forest sites. Wildfire suppression, livestock grazing and selective timber harvest altered the disturbance regime on these areas and allowed fire-sensitive species (Douglas-fir and grand fir) to regenerate beneath fire-tolerant species (ponderosa pine and western larch).

If ponderosa pine and western larch are no longer present on dry-forest sites, or if they are present in very low numbers only, then a regeneration treatment (shelterwood or seed-tree cutting), in conjunction with tree planting, would be an effective way to reestablish them.

Aspen Restoration. Quaking aspen is an ecosystem component valued for a wide variety of benefits. Its leaves and buds are a choice food for ruffed grouse, beaver, snowshoe hares, Rocky Mountain elk and other species. And in winter, when foliage is no longer present, elk like to feed on its smooth white bark. After dying, aspen is used by almost as many species as when alive – dead trees are used by woodpeckers, flickers and cavity-nesting species (DeByle 1985).

Although it may be difficult to prove, it is likely that aspen was historically more abundant in the Blue Mountains than it is now – fire suppression, livestock grazing and native ungulate browsing over the last 90 years has undoubtedly reduced its abundance and distribution (Bartos and Campbell 1998, Case and Kauffman 1997, Riggs et al. 2000).

Aspen is a clonal species that regenerates primarily by producing suckers (shoots) from its root system (Schier et al. 1985). Unfortunately, the suckers are highly palatable to elk, deer, and domestic livestock (Riggs et al. 2000). In order to allow the suckers to persist and eventually grow above the browse height of large ungulates, it is a common practice to establish barriers around aspen clones to prevent grazing damage (Shirley and Erickson 2001).

I recommend that the Heppner and North Fork John Day Ranger Districts continue their on-going efforts to develop a GIS layer (and associated database) to monitor the location and status of quaking aspen and other broadleaved tree species. I also recommend that aspen clones without barriers be fenced as soon as possible to exclude cattle, sheep, and big-game herbivory.

Cottonwood Restoration. Black cottonwood has a wide geographical distribution but is mainly a tree of the Pacific Northwest. Like other cottonwoods, its habitat consists of wet areas – along live streams, around seeps, and on floodplains. It can tolerate yearly spring flooding and in some respects almost requires it for survival (Lanner 1984).

Cottonwood growth is enhanced by frequent deposition of nutrient-rich sediments, and the fine gravels and sand supplied by periodic flooding provide an ideal substrate for cottonwood regeneration. After humans altered riverine ecosystems by curtailing spring flooding or by grazing domestic livestock, black cottonwood declined or disappeared altogether (Case and Kauffman 1997, Peterson et al. 1996).

Unlike aspen, black cottonwood does not reproduce from root suckers, but it does sprout from the root collar and occasionally from rhizomes located close to the parent tree. Sticking a branch cutting into moist soil can also propagate this species because cuttings will produce roots (Rose et al. 1998).

Although long-term trend data is unavailable for the Umatilla National Forest, black cottonwood is another species whose distribution is thought to be substantially reduced from historical levels. Grazing by wildlife and livestock (Riggs et al. 2000), and curtailment of periodic spring flooding, have combined with other factors to limit cottonwood regeneration.

I recommend that the Heppner and North Fork John Day Ranger Districts consider reestablishing black cottonwood on ecologically appropriate sites in both the upper portion of the dry forest PVG and in the lower portion of the moist forest PVG. Black cottonwood is not considered an appropriate revegetation species for sites in the cold forest PVG.

White Pine Restoration. Western white pine, a mid-seral tree species, is sometimes found on sites in the cool moist, cool wet, and warm moist plant association groups in the upper montane and lower subalpine vegetation zones (Powell 1998).

Western white pine was characterized as having a restricted geographical range in the Blue Mountains (Haig et al. 1941) but it actually has a relatively wide distribution. It occurs as a minor species, seldom comprising a plurality of the basal area in any individual stand.

Due to changes caused by fire suppression, bark-beetle outbreaks, white pine blister rust and other factors (Fins et al. 2001, Neuenschwander et al. 1999), it is believed that western white pine was more abundant historically in the northern Blue Mountains than at present.

Over the last 15 years, western white pine has increasingly been used in reforestation plantings because it survives well and contributes to biodiversity objectives.

I recommend that rust-resistant sources of western white pine continue to be planted on the moist-forest sites where it is ecologically well adapted. In particular, I recommend that white pine be considered for these plant associations: grand fir/Pacific yew/twinflower, grand fir/twinflower, grand fir/queencup beadlily and grand fir/Rocky Mountain maple (Urban 1996).

In the near future, some of the historical plantations containing white pine will need to be thinned. Although stocking levels have not been developed specifically for white pine, I suggest that the Douglas-fir stocking levels also be used for white pine (Powell 1999), an approach recommended by Seidel and Cochran (1981).

Recommendations Synthesis

Table 5-25 summarizes the forest vegetation issues, the treatment recommendations that respond to them, and the extent of the analysis area (acres) affected by the issue.

Table 5-25. Summary of forest vegetation issues for the Potamus analysis area.

Issue Description (see forest vegetation and fire/fuels issues on pages 31-32)		Treatment	Extent (Acres)
1.	a. Ponderosa pine is under represented on dry-forest sites (based on HRV)	IC*/RC	16,490
	b. Douglas-fir over represented on dry-forest sites (based on HRV)	IC*/RC	21,690
	b. Grand fir is over represented on dry-forest sites (based on HRV)	IC*/RC	5,498
2.	a. Western larch is under represented on moist-forest sites (based on HRV)	IC/RC	1,060
	b. Douglas-fir is over represented on moist-forest sites (based on HRV)	IC/RC	1,171
3.	a. Spruce-fir is under represented on cold-forest sites (based on HRV)	IC/RC	2,257
	b. Douglas-fir is over represented on cold-forest sites (based on HRV)	IC/RC	283
	b. Grand fir is over represented on cold-forest sites (based on HRV)	IC/RC	4,639
4.	Forest density levels are uncharacteristically high on upland forest sites	LT*	64,036
5.	a. SECC struc. class is over represented on dry-forest sites (based on HRV)	LT-IC*	15,644
	a. UR class is over represented on dry-forest sites (based on HRV)	LT-IC*	5,343
	b. OFSS class is under represented on dry-forest sites (based on HRV)	Wait	7,192
6.	a. SI struc. class is over represented on moist-forest sites (based on HRV)	LT	835
	a. SEOC class is over represented on moist-forest sites (based on HRV)	IC	2,367
	a. OFSS class is over represented on moist-forest sites (based on HRV)	Wait	278
	b. YFMS class is under represented on moist-forest sites (based on HRV)	Wait	1,655
	b. OFMS class is under represented on moist-forest sites (based on HRV)	Wait	844
7.	a. SI struc. class is over represented on cold-forest sites (based on HRV)	LT	789
	a. SEOC class is over represented on cold-forest sites (based on HRV)	IC	1,297
	b. OFMS class is under represented on cold-forest sites (based on HRV)	Wait	980
8.	Multi-layer canopy is over represented on dry-forest sites (based on HRV)	LT-IC*	6,790
9.	Susceptibility to dwarf mistletoe, defoliators, and Douglas-fir beetle is high	LT-IC*	68,943

Sources/Notes: Summarized from the Potamus existing vegetation database (Powell 2004a). LT refers to Low Thinning; IC refers to Improvement Cutting; RC refers to Regeneration Cutting; and Wait refers to situations where doing nothing (not taking action) might be the most appropriate response to the issue at this time. A total was not provided for the "extent (acres)" column because many areas respond to more than one issue, so the acres are not mutually exclusive.
* Any density management treatments implemented on dry-forest sites should also consider pruning and/or prescribed fire as follow-up activities.

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FIRE AND FUELS

Introduction

"Ecosystem analysis at the watershed scale" is a process designed to characterize the human, aquatic, riparian, and terrestrial conditions of a watershed. It is a systematic way to organize ecosystem information to better understand the impacts of management activities and disturbance processes in a watershed. The understanding gained from ecosystem analysis is critical for helping to sustain the health and resilience of natural resources administered on behalf of the American people (REO 1995).

Fuel conditions reflect the interaction of three ecosystem components called composition, structure and process (function).

1. Composition refers to the organisms that make up an ecosystem (Manley et al. 1995); it can range from individual plants, to groups of plants called cover types, and to combinations of cover types called lifeforms (table 6-1).
2. Structure is the arrangement or distribution of vegetation composition (Manley et al. 1995). It occurs both horizontally (the spatial distribution of composition across a landscape) and vertically (plants of varying stature in a multi-layered arrangement). Forest structure ranges from tree size classes, to structural classes, and to physiognomic groups (table 6-1).
3. Process refers to the flow or cycling of energy, nutrients, and other materials through space and time (Manley et al. 1995). Process ranges from photosynthesis and nutrient cycling to stand-replacing wildfire and insect outbreaks (table 6-1). In the interior Pacific Northwest, disturbance processes influence fuels conditions to a greater extent than other ecosystem processes (Clark and Sampson 1995, Oliver and Larson 1996).

Table 6-1 demonstrates that ecosystem analysis is inherently scale dependent because ecosystem components occur as hierarchies (Haynes et al. 1996). Some components are easily identified at one scale but not at another. This doesn't mean that a component ceased to exist – it is just not apparent at the resolution of a different hierarchical level.

At the fine scale represented by the interior of a forest stand, for example, individual trees are readily distinguished. After moving back to the mid scale, individual trees are imperceptible but species groups (cover types) become apparent. At a broad scale, discrete cover types are no longer recognizable although physiognomic classes (forest, shrub, herb) can then be discerned.

All wildland plant material eventually becomes fuel and will burn when conditions are right. Fuel is defined as the characteristics of live and dead biomass (considering both mass and density) contributing to the spread and intensity of wildland fire. The term "fuel load" is often used to describe the composition and physical characteristics of fuel for an area.

This report describes the results of a fire and fuels analysis for the Potamus analysis area. Table 6-2 provides the most important data sources used for the fire and fuels analysis. The analysis framework was based on ecosystem components (composition, structure, process); multiple indicators were selected to represent each component. Table 6-3 lists the ecosystem components and their corresponding analysis indicators.

Table 6-1. Selected examples of ecosystem components.

Ecosystem Components	Ecosystem Scale (Hierarchical Level) Fine	Mid	Broad
Composition	Individual Trees	Cover Types	Lifeforms (forest/nonforest)
Structure	Tree Size Classes	Structural Classes	Physiognomic Classes
Process	Nutrient Cycling	Insect Outbreaks; Wildfire	Weather; Climate

Sources/Notes: Although they are shown individually in this table, it is important to note that ecosystem components are interrelated – from an ecological perspective, they do not operate independently.

Table 6-2. Data sources used for analysis of fire and fuels.

Data Source	Description of Data Source
EVG (Existing Vegetation).	EVG stores information about existing vegetation; it was based on interpretation of aerial photography acquired in 1995 or 1997. For the Potamus analysis area, 92% of the polygons were characterized using photo-interpretation data from EVG.
Fire-Related GIS Coverages.	The "Historical Fire Start Locations" and "Large Fires" GIS coverages were used to assess fire-start causes (a point feature set), and to provide spatial data about large fires (a polygon feature set). Other historical mapping for 1900, 1910, 1930s, and 1950s also provided large-fire data.
FSVeg (Stand Exams).	Stand exams are designed to collect information at the stand level. Site, stand and tree data are collected on temporary plots. For the Potamus analysis area, 8% of the area was characterized using stand exams (including walk-through surveys).
Historical Aerial Photography.	Historical aerial photography from 1939 was the most important data source for characterizing reference conditions. After first delineating polygons, the photography was then interpreted to characterize vegetation conditions for each polygon.
Potential Vegetation Map (PVeg).	From May to November of 1998, Karl Urban prepared a potential vegetation map for the Umatilla National Forest; it describes potential vegetation types (plant associations, plant community types, plant communities) and this information was used with many vegetation analyses.

Sources/Notes: Powell (2004a) provides more detailed information about the database used to characterize fire and fuel conditions.

Issues and Key Questions

Over the last 30 years, Blue Mountain forests experienced increasing impacts from wildfire, insects and diseases. Scientific assessments documented the high damage levels and speculated about their underlying causes (Caraher et al. 1992, Gast et al. 1991, Hessburg et al. 1999, Lehmkuhl et al. 1994, Mutch et al. 1993, Quigley and Arbelbide 1997, Quigley et al. 1996, Shlisky 1994, Wickman 1992).

Partly in response to the scientific assessments, the Blue Mountains were portrayed in numerous newspaper and magazine articles as having perhaps the worst forest health in the western United States (Durbin 1992; East Oregonian 1992; Gray and Clark 1992; Kenworthy 1992; Lucas 1992, 1993; McLean 1992; Petersen 1992; Phillips 1995; Richards 1992).

In response to high levels of concern about forest health from both the scientific community and the general public, the primary issue used in this analysis was **forest sustainability**.

Forest sustainability is defined as an ecosystem-oriented approach allowing utilization of forests for multiple purposes (e.g., biodiversity, timber harvesting, non-wood products, soil and water conservation, tourism and recreation) without compromising their availability and quality for present and future generations (Gardner-Outlaw and Engelman 1999). This means that sustainable forests contain insects, diseases and wildland fires, but not to an extent threatening their long-term integrity, resiliency and productivity.

The fire and fuels analysis was designed to respond to four key questions:

1. *How do current conditions (composition and structure) compare to those that existed historically?*
2. *How have disturbance processes shaped current conditions, and what role might we expect them to play in the future?*
3. *Are current conditions considered to be sustainable over the long term?*
4. *If current conditions are not considered to be sustainable, how could they be changed to create a more sustainable situation?*

The key questions were addressed by analyzing ecosystem components (composition, structure, process); multiple indicators were selected for each component and are shown in Table 6-3.

Table 6-3. Ecosystem components and analysis indicators for fire and fuels.

Components	Analysis Indicators	Where Analyzed
Composition and Structure	Canopy Fuel Load	Cur Con; Ref Con; Syn/Int
	Fuel Model	Cur Con; Ref Con; Syn/Int
	Fire Regime Condition Class	Cur Con; Ref Con; Syn/Int
Process	Historical Fire Regime	Characterization
	Disturbance (wildfire only)	Characterization

Notes: "Where analyzed" shows when the analysis indicator was used – "Cur Con" is current conditions; "Ref Con" is reference conditions; and "Syn/Int" is synthesis and interpretation.

Characterization

When reduced to its essence, fuel conditions can be thought of as the product of two ecosystem elements – potential vegetation, and plant succession following disturbance processes (Powell 2000). This section describes each of those elements.

The forest vegetation report provides a detailed description of potential vegetation for the Potamus analysis area, and it also discusses two important disturbance processes not included in this fire and fuels report: defoliating insects and timber harvest.

Historical Fire Regime

Fire regimes characterize the historical fire frequency and severity under which plant communities evolved (Agee 1993). Fire regimes are not an exact reconstruction of historical conditions, defined here as the era before widespread settlement by Euro-American emigrants (pre-1850), but they do reflect historical wildland fire characteristics in the absence of fire suppression (Agee 1996b, Schmidt et al. 2002).

Many fire regime classifications have been developed. This analysis uses a recent modification of Heinselman's (1981) system; his seven regimes based on fireline intensity and return interval were collapsed into five regimes defined by fire frequency and severity (Schmidt et al. 2002). Only four of the five regimes occur in the Potamus analysis area (table 6-4).

Potential vegetation is perhaps the most appropriate ecosystem characteristic for deriving historical fire regimes (Franklin and Agee 2003), and fire regime assignments for the Potamus analysis area were based on a potential vegetation entity (plant association groups). Each plant association group occurring in the analysis area was assigned to one, and only one, historical fire regime; the relationship between plant association groups and fire regimes is presented in table 6-5.

Map 6-1 (see appendix) shows the location and distribution of historical fire regimes.

Table 6-4. Historical fire regimes for the Potamus analysis area.

Code	Fire Regime Description (fire frequency and severity)	Acres	Percent
1	0-35 year frequency; low severity	56,329	56.6
2	0-35 year frequency; stand-replacement severity	19,485	19.6
3	35-100+ year frequency; mixed severity	11,398	11.4
4	35-100+ year frequency; stand-replacement severity	12,382	12.4
5	200+ year frequency; stand-replacement severity	0	0.0

Sources/Notes: Summarized from the Potamus vegetation database (Powell 2004a); acres and percents include National Forest System lands only.

Table 6-5. Crosswalk between plant association groups and historical fire regimes.

Plant Association Group	Fire Regime
Cold Dry Upland Forest	4
Cool Dry Upland Forest	4
Cool Moist Upland Forest	3
Cool Wet Upland Forest	4
Hot Dry Upland Forest	1
Hot Dry Upland Herbland	2
Hot Moist Upland Woodland	3
Warm Dry Upland Forest	1
Warm Low Soil Moisture Riparian Herbland	2
Warm Moderate Soil Moisture Riparian Herbland	4
Warm Moist Upland Forest	3
Warm Moist Upland Shrubland	2

Sources/Notes: Historical fire regime assignments are based on plant association groups. The "plant association groups" column shows those groups occurring in the Potamus analysis area (Powell and Johnson 2004). "Fire regimes" are described in table 6-4.

The fire regime of an area represents the temporal variability in the physical characteristics and resulting effects of wildland fire. Fire regimes are usually defined in terms of fire frequency, severity, size and spatial pattern; table 6-6 summarizes characteristics of the historical fire regimes.

Table 6-6. Selected characteristics for historical fire regimes of the Blue Mountains.

	HISTORICAL FIRE REGIMES (see table 6-4)			
Fire Regime Characteristic	1	2	3	4
Fire return interval (mean; in years)[1]	< 25	< 35	25-90	90-200
Fire severity on overstory cohort[2]	Low	High	Moderate	High
Fireline intensity (flame length; feet)[3]	< 3	< 3	3-10	> 10
Historical burned area (percent)[4]	75	5	15	5
Mean fire extent (acres)[5]	2,953	Unknown	904	Unknown

Fire extent variability (acres; min-max)[6]	47-19,959	Unknown	249-1,936	Unknown
Timing (seasonality)[7]	Summer and fall	Spring and summer	Summer and fall	Summer and fall

Sources/Notes: Definitions for the fire regime characteristics are from Agee and Maruoka (1994).

[1] Fire return interval (years) is the frequency between successive fire events. Table data is taken from Hall (1976), Heyerdahl and Agee (1996) and Maruoka (1994) for fire regimes 1, 3 and 4; and from Schmidt et al. (2002) for fire regime 2.

[2] Fire severity is the effect of fire on dominant plants: at least 80% of dominant plants survive low-severity fire, whereas 80% or more are killed by high-severity fire; moderate-severity fires have survival percentages between these two extremes. Table data taken from Agee (1996b).

[3] Fireline intensity refers to the energy release rate of a fire. Since intensity is typically proportional to flame length, fireline intensity is typically expressed as a flame length, in feet. Table data taken from Agee (1996b).

[4] Historical burned area is an estimate of annual burned area (percent) for the Blue Mountains area prior to the Euro-American settlement era (pre-1850); table data adapted from Agee (1996b).

[5] Mean fire extent provides an indication of average wildfire size (in acres) from a Blue Mountains fire history study (Agee and Heyerdahl 1996).

[6] Fire extent variability shows how historical wildfire size varied (in acres) from a Blue Mountains fire history study (Agee and Heyerdahl 1996). Note that this characteristic might have been affected by the number of fires sampled (fire regime 1 included 210 fires; fire regime 3 included only 8 fires) and because fire size was truncated at the study area boundary for each sampled fire.

[7] Timing refers to the typical season of wildland fire. Table data taken from Agee (1996b).

Wildland Fire

Fire is an important disturbance agent in the Potamus analysis area and throughout the Blue Mountains. Historical fire effects were often noted in early journals. A book synthesizes journals from 19th century travelers on the Blue Mountains portion of the Oregon Trail (Evans 1991). When 66 Oregon Trail journal accounts (Evans 1991) were analyzed, 89% of them referred to open ponderosa pine stands and 54% noted burned underbrush or grassy glades, much smoke in late summer and fall, or a lack of underbrush and dense tree thickets (Wickman et al. 1994). According to these journal accounts, forest conditions at low and middle elevations consisted mainly of ponderosa pine, the pine forests were open and park-like with grass as the predominant undergrowth vegetation, and fire was a common occurrence in late summer and autumn (Wickman et al. 1994).

Large wildfires occurred during Euro-American settlement of the interior Pacific Northwest. Emigrants caused fires, either accidentally or intentionally. Miners set fires to clear away brush and forest debris, thereby exposing rock outcrops for inspection by prospectors (Veblen and Lorenz 1991). Other early fires were started by livestock ranchers to remove brush and promote grass growth (Harley 1918).

Although emigrants caused fires, they also contributed to conditions limiting fire intensity and spread. For instance, immense bands of sheep and other livestock grazed in the Blue Mountains during the late 19th and early 20th centuries (Coville 1898, Galbraith and Anderson 1970, Tucker 1940), consuming herbaceous vegetation that would otherwise have functioned as herbaceous fuel, an important fire spread component (Case and Kauffman 1997, Irwin et al. 1994).

How important were grazing impacts at the turn of the 20th century? Figure 6-1 summarizes historical livestock grazing trends (cattle and calves, sheep and lambs, horses and ponies) for three counties (Grant, Morrow and Umatilla) in which the Potamus analysis area occurs; the data presented in figure 6-1 and other studies (Heyerdahl and Agee 1996) suggests that livestock grazing altered the historical fire regime by influencing fire spread and severity.

Ecologically benign surface fires crept through dry-site forests every 10 to 25 years (this is the fire return interval for historical fire regime 1 from table 6-6), eliminating brush and small trees in their wake (Biswell 1973, Cooper 1960, Everett et al. 2000, Hall 1976).

Suppressing these low-severity surface fires had the unintended consequence of allowing open stands of ponderosa pine to be transformed into dense forests of grand fir and/or Douglas-fir (figure 6-2; Agee 1993, Graham et al. 2004, Powell 1994, Mutch et al. 1993).

The tree species that invaded ponderosa pine forest – grand fir and Douglas-fir – have thin bark, low-hanging branches, highly flammable foliage, and other characteristics rendering them vulnerable to fire damage. With thick bark and few branches close to the ground, ponderosa pine is resistant to the surface fires eliminating firs and other invading tree species (Agee 1993).

Fire Occurrence. A large-fire geographic information system (GIS) coverage was queried to determine the size and location of large wildfires in the Potamus analysis area. This GIS data was then supplemented with historical maps showing wildfire occurrence in 1900, 1910 and the 1950s (Bones et al. 1958; Plummer 1912; Spada et al. 1954, 1960; Thompson and Johnson 1900). The 1930s historical mapping was also examined; it showed no documented wildfires in the Potamus analysis area.

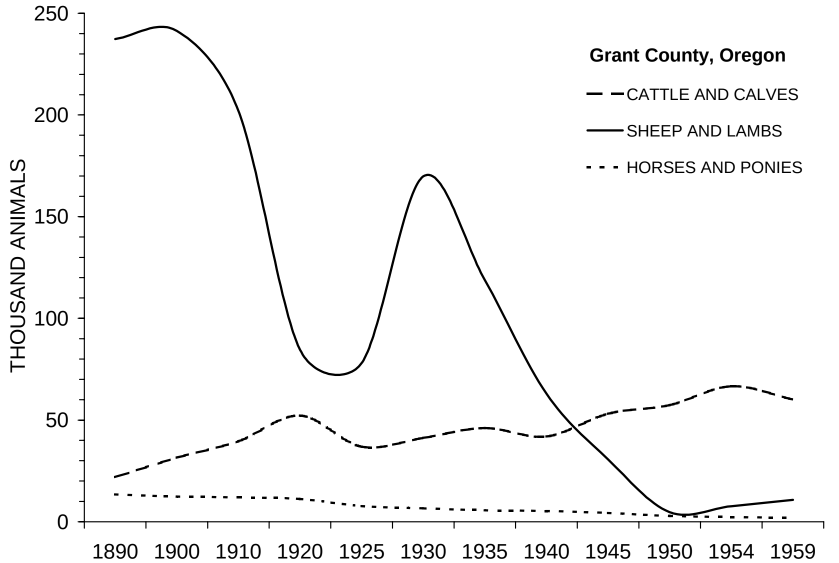
The information in table 6-7 shows that wildfire affected about 60,000 acres in the Potamus analysis area, although the actual total is undoubtedly greater than that because data for fires occurring before 1961 is incomplete.

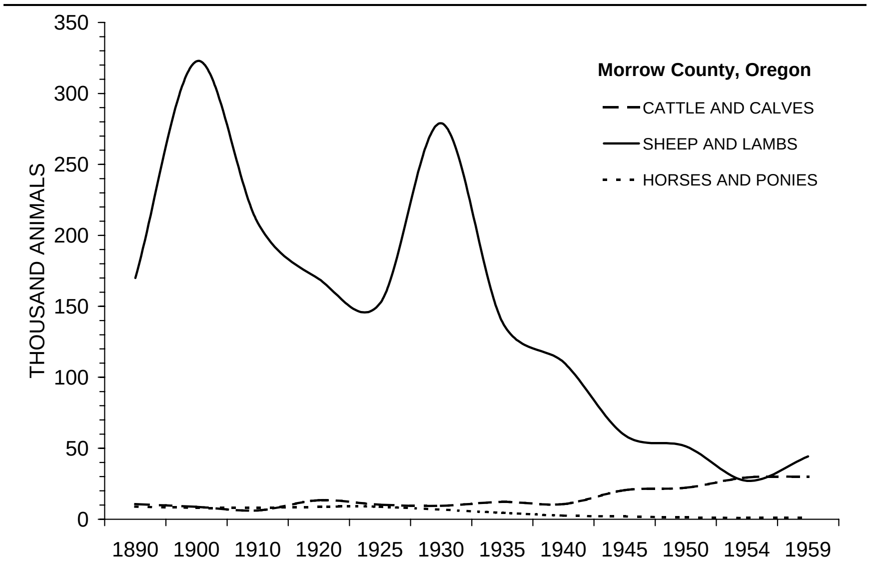
Map 6-2 (see appendix) shows the location and extent of large fires in the Potamus analysis area.

Digital fire atlases provide information about recent fires occurring in the Potamus watershed. This information was used to summarize fire occurrence for a 33-year period (1970-2002), both for the watershed as a whole and for its eleven subwatersheds (table 6-8).

For the 33-year period for which digital fire data was available, the Potamus watershed had 644 fires (table 6-8). This means that the recent fire occurrence rate, when considering the entire watershed, is 19.5 fires per year. Table 6-8 also shows that fire occurrence varied by subwatershed, with the Deerhorn-Jericho and Stony-Matlock subwatersheds having the highest annual rate and the Deerhorn-Cabin subwatershed has the lowest rate.

Further analysis examining fire ignition cause showed that lightning caused 91 percent of the fires (587 of the 644 total fires) and humans caused the remainder (9%; 57 fires). All but a few of the fires were contained to a small size ($^{1}/_{4}$ acre or less).


Grant County, Oregon
CATTLE AND CALVES
SHEEP AND LAMBS
HORSES AND PONIES
THOUSAND ANIMALS
0
50
100
150
200
250
1890 1900 1910 1920 1925 1930 1935 1940 1945 1950 1954 1959


Morrow County, Oregon
CATTLE AND CALVES
SHEEP AND LAMBS
HORSES AND PONIES
THOUSAND ANIMALS
0
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350
1890 1900 1910 1920 1925 1930 1935 1940 1945 1950 1954 1959

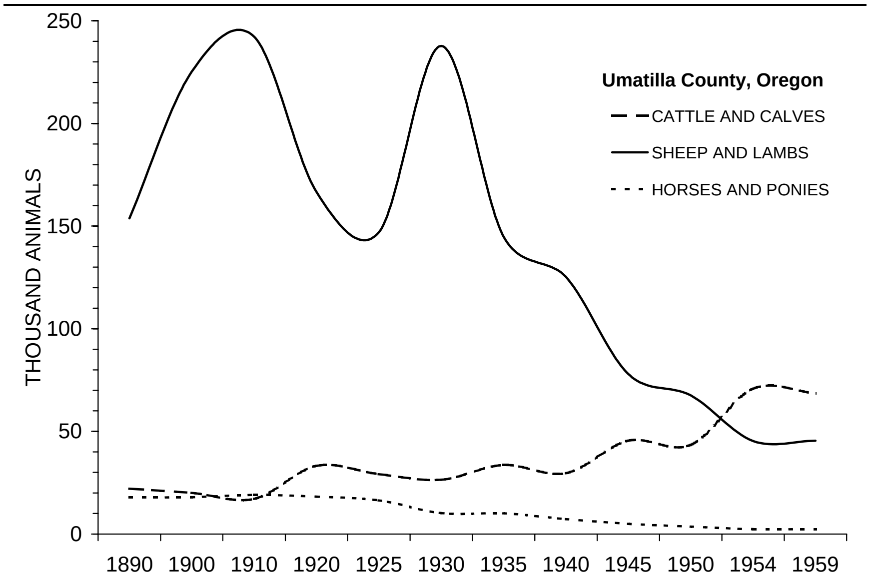
Umatilla County, Oregon
CATTLE AND CALVES
SHEEP AND LAMBS
HORSES AND PONIES
THOUSAND ANIMALS
0
50
100
150
200
250
1890 1900 1910 1920 1925 1930 1935 1940 1945 1950 1954 1959

Figure 6-1. Number of grazing animals for Grant, Morrow and Umatilla Counties, Oregon (from Bureau of Census 1895, 1902, 1913, 1922, 1927, 1932, 1942, 1946, 1952, 1956, 1961).

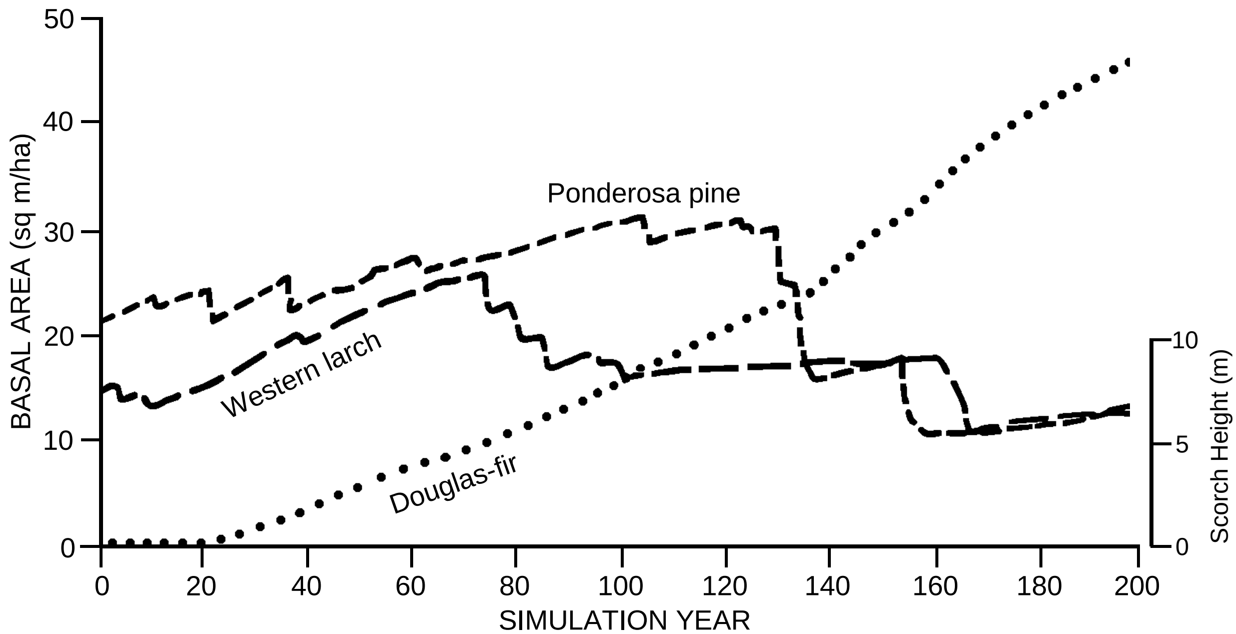

Figure 6.2. Forest succession in the absence of wildfire on the Douglas-fir/mallow ninebark (PSME/PHMA) plant association (which occupies 1,770 acres in the Potamus analysis area; see the forest vegetation report, table 5-4).

In the study results shown above, “compositional shifts from ponderosa pine and larch to Douglas-fir occurred in simulations of 50-yr fire intervals and with fire suppression. The simulated scenario of fire suppression (shown above) resulted in development of dense stands of relatively small trees. Such stands are susceptible to insect and disease infestations. They are also vulnerable to severe damage by wildfires because of heavy accumulations of dead fuels, and continuity of ladder and overstory fuels” (Keane et al. 1990). With fire return intervals of either 10 or 20 years, Douglas-fir was essentially absent from the landscape due to its low fire tolerance in the seedling-sapling stage.

Table 6-7. Large wildfires occurring in the Potamus analysis area.

Year	Fire Name	NFS Acres	Total Acres
1900	Fires on the 1900 map	152	152
1910	Fires on the 1910 map	15,778	33,329
1950s	Fires on the 1950s maps	0	16
1961	Ditch Creek	4,876	20,625
1973	Gilbert	3	3
1995	Potamus	23	23
1996	Graves	71	71
1997	French	62	62
2001	Mallory	4,093	4,098
2002	140	0	118
2002	Jack’s House	13	13

2003	Bull Springs 2	458	458
Total	Large fires: 1900-2003	25,529	58,968

Sources/Notes: Summarized from Bones et al. 1958; Plummer 1912; Spada et al. 1954, 1960; Thompson and Johnson 1900; and the Umatilla National Forest large-fire GIS layer. “NFS Acres” includes National Forest System lands; “Total Acres” includes all ownerships within the Potamus analysis area.

Table 6-8. Fire occurrence summary for the Potamus watershed, 1970-2002.

Subwatershed	Number of Fires	Fires Per Year
East Fork Meadow	63	1.9
Meadowbrook	31	0.9
Deerhorn	82	2.5
Deerhorn-Jericho	88	2.7
Stony-Matlock	88	2.7
Upper Potamus	56	1.7
Lower Potamus	64	1.9
Mallory	69	2.1
Upper Ditch	52	1.6
Deerhorn-Wrightman	29	0.9
Deerhorn-Cabin	22	0.7
Total (Potamus watershed)	644	19.5

Sources/Notes: Summarized from digital fire atlas records (stored at the Kansas City Computing Center for Forest Service records, and from a state of Oregon database for state and private ownerships).

Current Conditions

Contemporary aerial photography, acquired in 1995 for the North Fork John Day Ranger District and in 1997 for the Heppner Ranger District, was interpreted to provide most of the current conditions information presented in this section (92% of the current conditions data was based on aerial photography). Stand examinations and walk-through surveys were used to derive the remainder of the current conditions data (8%).

Canopy Fuel Load

One result of severe wildfire seasons in the late 1990s and early 2000s is that crown fire susceptibility is being evaluated for millions of at-risk acres in the western United States (General Accounting Office 1999, Gorte 1995, Laverty and Williams 2000). These at-risk areas support uncharacteristic levels of foliage biomass (canopy bulk density), rendering them vulnerable to intense crown consumption in the event of a wildfire (Graham et al. 1999, 2004).

In response to this fire hazard issue, an assessment of crown fire susceptibility was completed for the Potamus analysis area. Crown fire susceptibility was assessed using stand density thresholds related to the crown bulk density of canopy foliage (Agee 1996c, Keyes and O’Hara 2002). The crown fire assessment protocol is described in Powell (2004b).

Table 6-9 summarizes the area of existing canopy fuel load (as based on canopy bulk density) for the Potamus analysis area. It shows that the predominant situation is a low amount of canopy fuel load (39% of the forested portion of the analysis area), followed by moderate canopy fuel load (37%) and then high canopy fuel load (25%).

Map 6-3 (appendix) shows existing canopy fuel load for the Potamus analysis area.

Table 6-9. Existing canopy fuel load for the Potamus analysis area.

Forest Canopy fuel load	Acres	Pct. of Total	Pct. of Forested
Low forest canopy fuel load	30,292	30.4	38.7
Moderate forest canopy fuel load	28,680	28.8	36.6
High forest canopy fuel load	19,364	19.4	24.7
NA: Nonforest and woodland PVGs	21,267	21.4	

Sources/Notes: Summarized from the Potamus existing vegetation database (Powell 2004a); acres and percents include National Forest System lands only. The protocol for calculating a canopy fuel load rating for each forest polygon is described in Powell (2004c).

Fuel Model.

Since the early 1980s, surface fuels have been characterized using a "fuel model" system that initially stratifies fuels into four groups – grass and grass-dominated (models 1-3), chaparral and shrubs (models 4-7), timber litter (models 8-10), and slash (models 11-13). These fuel-model groups relate to differences in fuel characteristics and their resulting impact on surface fire behavior; they do not relate to fires burning in aerial or elevated fuels (crown fires).

There are 13 fuel models in total (Anderson 1982) but only 7 of them exist in the Potamus analysis area (table 6-10). Table 6-10 shows that the predominant fuel model is closed timber litter (FM8; 34% of the analysis area), followed by the timber litter and understory fuel model (FM10; 24%), the short grass fuel model (FM1; 21%), the timber and grass fuel model (FM2; 10%), and the long-needled pine litter fuel model (FM9; 7%).

Two fuel models are relatively uncommon in the analysis area; each of them occupies less than two percent of the analysis area – the tall grass (FM3) and brush (FM5) fuel models (table 6-10).

Map 6-4 (appendix) shows existing fuel models for the Potamus analysis area.

Table 6-10. Existing fuel models for the Potamus analysis area.

Fuel Model Description	Acres	Percent
1: Short grass (generally 1 foot or less in height)	21,160	21.3
2: Timber and grass (grass controls fire spread)	9,938	10.0
3: Tall grass (up to 3 feet in height)	1,909	1.9
5: Brush (shrublands; short shrubs of 2 feet or less)	888	0.9
8: Closed timber litter (fuel is mainly litter and duff)	34,005	34.1
9: Long-needled pine litter (ponderosa pine)	7,348	7.4
10: Timber (litter and understory; multi-layer stands)	24,346	24.4
NA: Water (no fuel model assigned)	9	< 0.1

Sources/Notes: Summarized from the Potamus existing vegetation database (Powell 2004a); acres and percents include National Forest System lands only. Fuel model assignments follow Anderson (1982).

Fire Regime Condition Class

The fire regime condition class descriptor was recently devised to characterize an area’s departure from historical fire regimes. Condition class is based on the “historical range of variability” concept.

When existing vegetation characteristics (composition, structural classes, stand age, canopy cover and the spatial pattern of vegetation patches) are functioning much as they did historically, then the existing fire regime is within its historical range of variability (this is condition class one) (Hann et al. 2004, Schmidt et al. 2002).

When existing vegetation characteristics are departed from their historical situation, primarily due to ecosystem alterations caused by fire suppression, timber harvest, livestock grazing and introduction of exotic plant species and insects or diseases, then the existing fire regime is not within its historical range of variability (this description pertains to condition classes two and three) (Hann et al. 2004, Schmidt et al. 2002).

Table 6-11 summarizes the area of existing fire regime condition classes for the Potamus analysis area. It shows that existing vegetation conditions are often departed from their historical range of variability because much of the analysis area is assigned to condition class two or three (59% of the analysis area), followed by condition class one signifying conditions within their historical range (41%).

Map 6-5 (appendix) shows existing fire regime condition classes for the Potamus analysis area.

Table 6-11. Existing fire regime condition classes for the Potamus analysis area.

Fire Regime Condition Class Description	Acres	Percent
Fire regime condition class 1	40,829	41.0
Fire regime condition class 2	41,486	41.7
Fire regime condition class 3	17,279	17.4
Water (no fire regime condition class assigned)	9	< 0.1

Sources/Notes: Summarized from the Potamus existing vegetation database (Powell 2004a); acres and percents include National Forest System lands only. Fire regime condition class assignments follow Schmidt et al. (2002).

Wildland-Urban Interface

The wildland-urban interface (WUI) is commonly defined as a zone where structures and other human developments meet and intermingle with undeveloped wildland or vegetative fuels.[3] A WUI zone poses heightened risk to human life, property and infrastructure and is a dangerous and complicated area for suppressing wildfire (Society of American Foresters 2004).

The National Fire Plan (USDA and USDI 2000), and the Ten-Year Comprehensive Strategy for Reducing Wildland Fire Risks to Communities and the Environment (USDA Forest Service and USDI Bureau of Land Management 2001) and its associated Implementation Plan (USDA Forest Service and USDI Bureau of Land Management 2002), place a priority on federal managers working collaboratively with WUI communities to reduce risk from large-scale wildfire.

The Potamus analysis area does not include any of the WUI communities on a Federal Register list (FR, vol. 66, no. 160, August 17, 2001). The Heppner and North Fork John Day Ranger Districts, however, have draft maps showing WUI areas delineated using criteria and definitions from the Healthy Forests Restoration Act of 2003 (HFRA).

The WUI mapping based on HFRA totals 29,869 acres and is centered on the Penland Lake (northwest corner) and Dale (southeast corner) portions of the analysis area (see map 6-6 in appendix): 18,292 acres are in federal ownership; 9,968 acres are in private ownership; and 1,610 acres are in state ownership.

Reference Conditions

Historical aerial photography from 1939 was interpreted to derive the reference condition information presented in this section (first, polygons were delineated on the photography; second, vegetation conditions were characterized and recorded for each polygon).

Canopy Fuel Load

Table 6-12 summarizes the area of historical canopy fuel load (using canopy bulk density) for the Potamus analysis area. It shows that the predominant situation in 1939 was high canopy fuel load (42% of the forested portion of the analysis area), followed by low canopy fuel load (31%) and then moderate fuel loading (28%).

Map 6-3 (appendix) shows historical canopy fuel load for the Potamus analysis area.

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[3] By definition, a community is considered to be at risk from wildland fire if it lies within the wildland-urban interface (WUI). WUI communities are designated in the Federal Register (FR, vol. 66, no. 160, August 17, 2001), or they can be mapped using definitions and criteria from the Healthy Forests Restoration Act of 2003 (see HFRA Section 101 (16), including its requirement to prepare Community Wildfire Protection Plans).

Table 6-12. Historical canopy fuel load for the Potamus analysis area.

Forest Canopy fuel load	Acres	Pct. of Total	Pct. of Forested
Low forest canopy fuel load	21,872	22.0	30.7
Moderate forest canopy fuel load	19,705	19.8	27.7
High forest canopy fuel load	29,665	29.8	41.6
NA: Nonforest cover types	28,347	28.5	

Sources/Notes: Summarized from the Potamus historical vegetation database (Powell 2004a); acres and percents include National Forest System lands only. The protocol for calculating a canopy fuel load rating for each forest polygon is described in Powell (2004c).

Fuel Model

Table 6-13 summarizes the area of historical fuel models for the Potamus analysis area. It shows that in 1939, the predominant fuel model was short grass consisting primarily of herbaceous vegetation (28% of the analysis area), followed by closed timber litter (24%), timber litter and understory (20%), long-needled pine litter (16%) and then timber and grass (12%).
Two fuel models were relatively uncommon because each of them occupied less than one percent of the analysis area – tall grass and brush/shrub (table 6-13).
Map 6-4 (appendix) shows historical fuel models for the Potamus analysis area.

Table 6-13. Historical fuel models for the Potamus analysis area.

Fuel Model Description	Acres	Percent
1: Short grass (1 foot or less in height)	27,680	27.8
2: Timber and grass (grass controls fire spread)	11,425	11.5
3: Tall grass (up to 3 feet in height)	100	0.1
5: Brush (shrublands; short shrubs of 2 feet or less)	567	0.6
8: Closed timber litter (fuel is mainly litter and duff)	23,963	24.1
9: Long-needled pine litter (ponderosa pine)	15,761	15.8
10: Timber (litter and understory; multi-layer stands)	20,093	20.2

Sources/Notes: Summarized from the Potamus historical vegetation database (Powell 2004a); acres and percents include National Forest System lands only. Fuel model assignments follow Anderson (1982).

Fire Regime Condition Class

Table 6-14 summarizes the area of fire regime condition classes for the Potamus analysis area. It shows that the predominant situation in 1939 was condition class two (50% of the analysis area), followed by condition class one (46%) and then a small amount of condition class three (4%).
Map 6-5 (appendix) shows historical fire regime condition classes for the Potamus analysis area.

Table 6-14. Historical fire regime condition classes for the Potamus analysis area.

Fire Regime Condition Class Description	Acres	Percent
Fire regime condition class 1	45,424	45.6
Fire regime condition class 2	50,192	50.4
Fire regime condition class 3	3,973	4.0

Sources/Notes: Summarized from the Potamus historical vegetation database (Powell 2004a); acres and percents include National Forest System lands only. Fire regime condition class assignments follow Schmidt et al. (2002).

Synthesis and Interpretation

Canopy Fuel Load

Forest canopy biomass has been inconsistent over the last 60 years (tables 6-9 and 6-12), as shown when comparing the top 3 conditions:

Current Conditions	Reference Conditions
Low canopy fuel load (39%)	High canopy fuel load (42%)
Moderate canopy fuel load (37%)	Low canopy fuel load (31%)
High canopy fuel load (25%)	Moderate canopy fuel load (28%)

The implications of this trend are:

1. Crown fire susceptibility (high canopy fuel load) was higher in the 1930s than it is today, suggesting that low-intensity disturbance processes such as defoliating insects, dwarf mistletoes, inter-tree competition, and partial cutting timber harvest reduced canopy bulk density levels between the 1930s and now; and
2. Canopy bulk density reductions between 1939 and today were probably caused by low-severity disturbances because 61% of the forested area currently has moderate or high canopy biomass, and it would not be expected that these bulk density levels could be restored in 60 years following a stand-replacement disturbance (particularly for dry-forest sites).

Areas with moderate or high canopy fuel load represent a good opportunity to use thinning and other density management treatments to address wildfire risk issues, particularly for instances where moderate or high canopy fuel load coincides with the wildland-urban interface (Arno et al. 1995).

Fuel Model

Fuel models have been relatively consistent over the last 60 years (tables 6-10 and 6-13), as shown when comparing the top 3 conditions:

Current Conditions	Reference Conditions
Closed timber litter (34%)	Short grass (28%)
Timber litter and understory (24%)	Closed timber litter (24%)
Short grass (21%)	Timber litter and understory (20%)

The implications of this trend are:

1. The vegetation characteristics upon which the fuel models are based (species composition, and forest structure and density) did not vary much between 1939 and now, so the resulting fuel models also did not vary much; and
2. A reduction in the short grass fuel model between the 1930s and today is at least partially attributable to a loss of nonforest vegetation after it was invaded by trees (forest encroachment).

Fire Regime Condition Class

Fire regime condition classes have been consistent over the last 60 years (tables 6-11 and 6-14), as shown when comparing the top 3 conditions:

Current Conditions	Reference Conditions
Condition class 2 (42%)	Condition class 2 (50%)
Condition class 1 (41%)	Condition class 1 (46%)
Condition class 3 (17%)	Condition class 3 (4%)

The implications of this trend are:

1. Although the relative ranking of condition class has been consistent through time, the long-term trend is a gradually worsening situation because 54% of the Potamus area had uncharacteristic ratings (fire regime condition class two and three) historically and 59% has that condition currently; and
2. The trend for the worst condition class (fire regime condition class three) deteriorated significantly with a 335% increase between 1939 and today.[4]

HRV Analysis For Fire Severity. An HRV analysis was used to evaluate existing vegetation conditions (as characterized using fire regime condition class). The HRV analysis relied on two primary factors – historical fire regime and predicted fire severity. Species composition and fire regime condition class, in combination, were used to derive a predicted fire severity rating (low, moderate, high) for every polygon in the vegetation database.

The current percentage of predicted fire severity, by category (low, moderate, high) and historical fire regime, was then compared with an historical range derived from Agee (1998).

Results of the fire severity HRV analysis are provided in table 6-15. It shows that:

1. The low severity fire regime would have less low-severity burning than expected and more high-severity burning than expected;
2. The mixed severity fire regime would have less low- and moderate-severity burning than expected and high-severity burning is at the upper end of what would be expected; and
3. The stand replacement fire severity regime would have less low- and high-severity burning than expected and more moderate-severity burning than expected.

Table 6-15. Historical range of variability analysis for predicted fire severity.

Historical Fire Regime (FR)	Fire Severity On Overstory Cohort	Historical Range (%)	Current Percent	Interpretation
Low Severity (FR 1)	Low	60-90	19	Well below HRV
	Moderate	20-60	51	Within HRV
	High	10-20	29	Slightly above HRV
Mixed Severity (FR 3)	Low	20-60	6	Well below HRV
	Moderate	50-70	35	Below HRV
	High	20-60	58	At high end of HRV
	Low	10-20	0	Below HRV

[4] Percent change for fire regime condition class 3 acreage was calculated this way:
((current acres – reference acres) ÷ reference acres) * 100 = % change.
((17,279 acres – 3,973 acres) ÷ 3,973 acres) * 100 = % change.
(13,306 acres ÷ 3,973 acres) * 100 = % change.
3.3491 *100 = 334.91% or 335%.

Stand Replacement Severity (FR 2, 4, 5)	Low	10-20	0	Below HRV
	Moderate	10-60	68	Slightly above HRV
	High	60-90	32	Below HRV

Sources/Notes: Historical fire regimes are described in table 6-4; current percents include National Forest System lands only. Fire severity was predicted for each polygon using its cover type and fire regime condition class values. Historical ranges for combinations of fire regime and severity were derived from Agee (1998; see his figure 1).

Assessment of Forest Sustainability.

Forest sustainability was the overarching issue for this analysis (see Issues and Key Questions, page 6-3). A protocol was developed for evaluating forest sustainability at a landscape or watershed scale (Amaranthus 1997). It is based on four criteria (Kolb et al. 1994); the four criteria, and an assessment of how the Potamus analysis area rates for each of them, are provided below.

1. **The physical environment, biotic resources, and trophic networks to support productive forests.**

Over most of the Potamus analysis area, the physical, biotic, and trophic networks are intact to support fully functioning forest ecosystems. There may be exceptions at the sub-stand level where previous management practices resulted in compacted soils, aggraded stream reaches or similar impacts. Such areas are limited, however, and upland forests of the Potamus analysis area are probably in a sustainable condition when evaluated using this criterion.

2. **Resistance to catastrophic change and the ability to recover on the landscape level.**

The Potamus analysis area has a moderate threat of stand-replacing disturbances that could modify composition and structure. This threat reflects altered disturbance regimes and is related primarily to 90 years or more of fire suppression. It is likely that dry-forest sites in the analysis area have missed up to five fire cycles, contributing to uncharacteristic fuel accumulations.

Under the recent fire management paradigm (fire exclusion), the influence of fire as an ecological process is markedly reduced, resulting in increased homogeneity of vegetation composition (this is reflected in a deficiency of early-seral forest cover types; see table 5-20 in the Forest Vegetation Report). Outbreaks of defoliators and other landscape-scale insects, and propagation of active crown fire, are likely outcomes of this increased level of homogeneity. Based on this second criterion, forests of the Potamus analysis area are probably not sustainable.

3. **A functional equilibrium between supply and demand of essential resources.**

Eighty-two percent of the Potamus analysis area has tree density levels threatening future sustainability of upland forests (see table 5-9 in the Forest Vegetation Report). Nutrient cycling and the availability of water and growing space are undoubtedly impaired on these overstocked sites. In addition, many of the dense stands are vulnerable to crown fire (61% of upland forests have moderate or high canopy fuel load; see table 6-9).

The primary factor controlling crown fire behavior is canopy bulk density (the volume of forest canopy available for fire consumption), and canopy bulk density varies with species composition and stand density. Dense stands are not only more likely to initiate crown fire behavior, but also to sustain an active (independent) crown fire once it begins. Based on this criterion, forests of the Potamus analysis area are probably not sustainable.

4. **A diversity of seral stages and stand structures that provide habitat for any native species and all essential ecosystem processes.**

The Potamus analysis area supports a relatively well-balanced distribution of stand structures (as indicated by an HRV analysis for forest structural classes; see table 5-21 in the Forest Vegetation Report). Historical forest management practices, however, have changed the spatial pattern of vegetation diversity and complexity, particularly for dry-forest sites where overcrowded, multi-strata forests were rare before ecosystem alterations caused primarily by fire suppression.

These changes created at-risk forests because they contain too many trees, or too many of the "wrong kind" of trees, to continue to thrive. As these forests get older and denser, the competition between trees intensifies, stress increases, resilience and vigor declines, and the probability of uncharacteristic change increases dramatically. Based on this fourth criterion, forests of the Potamus analysis area are marginally sustainable now but if recent trends continue into the future, their sustainability is not assured over the long term.

Recommendations

The recommendations step is the final one in the ecosystem analysis process (REO 1995). Recommendations are designed to respond to issues, concerns and findings identified during the five previous ecosystem analysis steps. Forest vegetation and fuels issues, and the active restoration treatments that could be used in response to them, are described in this section. Whether the treatment recommendations described in this section can be implemented is influenced primarily by management direction from the Land and Resource Management Plan (Forest Plan) for the Umatilla National Forest, including its amendments such as the Eastside Screens (USDA Forest Service 1995) and PACFISH (USDA Forest Service and USDI Bureau of Land Management 1994); Forest Plan allocations for the Potamus area are summarized in table 6-16.

Fire and Fuels Understandings (Findings)

1. Over 60 percent of upland-forest sites in the Potamus analysis area have moderate or high amounts of canopy fuel load (bulk density); these areas have sufficient forest canopy fuel load to sustain an active crown fire (see table 6-9).
2. Almost 60 percent of upland-forest sites in the Potamus analysis area have fire regimes with moderate or high departures from their characteristic composition, structure and density; these altered areas (fire regime condition class two or three) need to regain their historic composition, structure and density to restore sustainability (see table 6-11).
3. For much of the Potamus analysis area, predicted fire severity differs from what would be expected when evaluated using the historical range of variability:
    a. For the low-severity fire regime, the predicted amount of low fire severity is below HRV and high severity is above HRV;
    b. On mixed-severity sites, both low and moderate fire severity are below HRV; and
    c. On stand-replacement sites, both low and high fire severity are below HRV and moderate severity is slightly above HRV (see table 6-15).

Recommended Treatments

The primary purpose of a fuel treatment is to change the behavior of a fire entering a fuel-altered zone, thus lessening the impact of that fire to an area of concern (using fuel treatment to protect human structures in a wildland-urban interface zone, for example). This change in fire behavior is often quantified as a reduction in fireline intensity (flame length) or rate-of-spread, and manifested on the ground as a change in fire severity or fire growth (the ultimate fire extent).
Five types or categories of fuel treatment are described in this section – thinning, improvement cutting, pruning, prescribed fire and biomass removal. A recommendations synthesis, presented at the end of this section, summarizes the potential spatial extent (in acres) for these treatments.
Thinning. Thinning responds to all three of the fire and fuels issues:

1. It helps reduce crown fire susceptibility on sites with moderate or high canopy fuel load.
2. It helps move condition class two or three areas back toward condition class one.
3. It helps restore predicted fire severity for low-, mixed- and replacement-severity fire regimes.

Table 6-16. Management direction summary for the Potamus analysis area.

Management Area Allocation	Percent of Analysis Area	Suitable Lands?	Harvest Permitted?	Pres. Fire Permitted?
A1: Non-motorized Dispersed Recreation	0.1	No	Yes*	Yes
A3: Viewshed 1	3.4	Yes	Yes	Yes
A4: Viewshed 2	1.3	Yes	Yes	Yes
A6: Developed Recreation	< 0.1	No	Yes*	No
A7: Wild Rivers	0.2	No	Yes*	Yes
A7: Scenic and Recreation Rivers		Yes	Yes	Yes
A8: Scenic Areas	< 0.1	No	Yes*	Yes
A9: Special Interest Areas	0.1	No	Yes*	Yes
C1: Dedicated Old Growth	3.8	No	Yes*	Yes
C2: Managed Old Growth	0.8	Yes	Yes	Yes
C3: Big Game Winter Range	28.5	Yes	Yes	Yes
C4: Wildlife Habitat	19.8	Yes	Yes	Yes
C5: Riparian (Fish and Wildlife)	3.3	Yes	Yes	Yes
C7: Special Fish Management Area	0.1	Yes	Yes	Yes
C8: Grass-Tree Mosaic	6.8	No	Yes*	Yes
E1: Timber and Forage	6.4	Yes	Yes	Yes
E2: Timber and Big Game	25.4	Yes	Yes	Yes
Riparian Habitat Conservation Areas (PACFISH)	NA	No	Yes*	Yes

Sources/Notes: Management area allocations are from the Umatilla NF Forest Plan (USDA Forest Service 1990). The "percent of analysis area" item shows the percentage of NFS lands in the analysis area allocated to each management emphasis; the "suitable lands?" item shows whether capable forested lands in the management area are designated as suitable for timber production by the Forest Plan; and the "harvest permitted?" and "prescribed fire permitted?" items show whether these activities are allowed by the standards and guidelines for each management area. NA is shown for the PACFISH "percent of analysis area" value because RHCA areas are not mapped independently (in other words, they are included in other Forest Plan management allocations).

* Timber harvest is permitted for these allocations but with restrictions (the Forest Plan provides further details).

To be healthy, a tree needs a place in the sun and some soil to call its own (Powell 1999). When crowded by too many neighbors, a tree may not have enough soil and sun to maintain its vigor. A tree eventually dies if its vigor level drops so low that it can no longer heal injuries, resist attack by insects and diseases, or otherwise sustain life (Franklin et al. 1987, Waring 1987).

Thinning removes some trees so that the remaining ones can benefit from additional sunlight, moisture and nutrients. The residual trees quickly improve their vigor and produce more resin and defensive chemicals, which help them ward off attacks from insects and diseases and heal fire wounds (Christiansen et al. 1987, Kolb et al. 1998, Safranyik et al. 1998, Wickman 1992).

Thinning that anticipates competition-related mortality removes trees from beneath the main canopy and is called a low thinning or "thinning from below." Low thinning can be used to create an open, single-layered canopy structure amenable to reintroduction of low-severity surface fire, an important ecosystem process (Arno et al. 1995, Mutch et al. 1993, Scott 1998).

One of the highest priorities is to use thinning on low-severity fire regime sites and thereby make them more resistant to uncharacteristically severe wildfire. On these dry-forest sites, mechanical thinning is used to reduce surface, ladder and canopy fuels, and to raise the canopy base height (Arno et al. 1995, Brown et al. 2004, Mutch et al. 1993, Pollet and Omi 2002, Stephens 1998).

Thinning is a particularly appropriate treatment for sites where the understory trees are sufficiently large or dense that attempts to kill them with prescribed fire would run a high risk of killing the overstory trees, or of the prescribed fire escaping control (Agee 1996a, Arno and Allison-Bunnell 2003, Brown et al. 2004, Mutch et al. 1993, Scott 1998).

Overstory thinning alone – without also thinning small understory trees, treating woody debris created by harvest and thinning treatments, and then using prescribed fire – seldom reduces wildfire susceptibility over the long term (Brown et al. 2004, Fiedler et al. 1992, Gruell 2001).

"Lopping and scattering," a slash treatment where branches are cut from the felled trees and scattered across the site to reduce fuel concentrations (if needed, slash is also pulled back from residual trees), was found to reduce fire behavior but application of this treatment is most effective for areas with light fuel accumulations – less than 9 tons per acre (Kalabokidis and Omi 1998).

Upland-forest sites with moderate or high amounts of canopy fuel load (see table 6-9) should be thinned to reduce their susceptibility to uncharacteristic fire behavior (Arno and Ottmar 1994).

Tables in Powell (1999 and 2004b) provide tree density recommendations by tree species and by potential vegetation category (plant association, plant association group, potential vegetation group). They establish a management zone in which forest density is presumed to be ecologically sustainable and relatively resistant to insect and fire impacts.

Thinnings should be planned using a "limiting-species approach" by assuming that the species with the lowest stocking level (Cochran et al. 1994, Powell 1999) has the most restrictive growing-space requirements, and that other species with less exacting requirements will develop acceptably under the lower density levels established for the most limiting species.

Thinning treatments should also reduce tree density down to the "lower limit of the management zone" stocking value as specified in Powell (1999).

If possible, thinning treatments should be aggregated as large blocks to emulate the spatial patterns produced by surface fire (minimum of 1,000 acres; see fire history studies such as Heyerdahl and Agee 1996); small treatment areas are not likely to have a positive impact on fire or defoliator susceptibility because these agents operate at a landscape scale (Anderson et al. 1987).

Improvement Cutting. Improvement cutting responds to all three of the fire and fuels issues:

1. It helps reduce crown fire susceptibility on sites with moderate or high canopy fuel load.
2. It helps move condition class two or three areas back toward condition class one.
3. It helps restore predicted fire severity for low-, mixed- and replacement-severity fire regimes.

Improvement cutting is defined as removal of less desirable trees in order to meet objectives related to species composition or vertical stand structure (Helms 1998). Trees of undesirable species or condition[5] are removed from the upper canopy, often in conjunction with an understory thinning. It is often used with mixed-species stands that still contain a viable component of early-seral trees (primarily ponderosa pine or western larch for the Potamus analysis area).

Improvement cutting responds positively to changes resulting from fire suppression, historical partial-cutting timber removals, and herbivory by both domestic and native ungulates. After frequent surface fires were suppressed, and following removal of fire-resistant ponderosa pines and larches during selective harvest, the end result was multi-layered, mixed-species forests dominated by fire-susceptible trees (Powell 1994, Mutch et al. 1993, Sloan 1998).

Improvement cutting could also be effective at reducing the susceptibility of the multi-layer structural classes (OFMS, YFMS and UR; see table 5-11 in the forest vegetation report) to

[5] "Desirable" or "undesirable" trees are based on land management objectives. Trees whose characteristics contribute to meeting the objectives of an area are desirable; undesirable trees lack such characteristics. This means that when objectives change, the result could be a different determination of desirable and undesirable trees.

uncharacteristic crown fires. For this objective, improvement cutting would be used to address ladder fuels by removing Douglas-fir or grand fir mid-stories or understories.

First priority for use of improvement cutting to address crown fire susceptibility (Arno and Ottmar 1994) should be areas identified as potential firebreak or fire-control sites (Agee et al. 2000), and areas located in the wildland-urban interface (see map 6-6).

Consider improvement cutting for dry-forest sites with multi-layer structural classes (these areas are classified as fire regime condition class 2 or 3; see table 6-11) because this treatment could help move some of the condition class 2 or 3 areas back toward condition class 1.

This recommendation could be implemented in the following way:

1. In the near term, identify high priority stands that classify as fire regime condition class 2 or 3, or are located in the wildland-urban interface zone;
2. Screen the identified stands to remove areas providing critical wildlife habitat;
3. Schedule the remaining stands for improvement cutting or thinning treatments because they represent the best opportunity to quickly move portions of the analysis area toward fire regime condition class 1; and
4. Treat or remove woody residues (slash) and then use prescribed fire to maintain the low density of large-diameter trees created by the treatments (Arno et al. 1995).

Pruning. Pruning was traditionally used to produce clear, knot-free wood for the lumber trade. But it can also play a role in achieving fuels and other objectives – after pruning trees that are large enough to have developed fire-resistant bark, it would be possible to underburn mixed-species stands without torching the leave trees.

Trees with short, pruned crowns would be less likely to serve as ladder fuels, thereby minimizing the risk of an underburn transitioning into a crown fire (Graham et al. 2004). By addressing ladder fuels, pruning has the most direct effect on crown fire risk because it contributes to a vertical stand structure that prevents overstory trees from igniting in the first place (Keyes 1996).

Pruning must be carefully coordinated with other treatments such as prescribed fire – if trees were pruned too soon, production of epicormic branches or “water sprouts” could increase a tree’s risk of torching in an underburn (Bryan and Lanner 1981, Oliver and Larson 1996).

Low thinning and pruning could be used in tandem to address two primary aspects of crown fire risk – initiation and spread. By removing lower branches, pruning has minimal impact on crown bulk density but effectively reduces initiation by raising crown base height. By removing whole crowns (small trees) from a stand, thinning has the most impact on spread potential.

Pruning could produce a stand to be safely underburned more quickly than waiting for natural pruning. For example, table 6-17 shows that:

1. Ponderosa pine can self-prune relatively quickly, but
2. Dead branches often persist, so
3. Mechanical pruning is advisable if a completely clean, branch-free bole is needed to minimize the risk of crown scorch, torching or extensive bole charring.

Consider pruning, especially in combination with prescribed fire, for these situations:

1. For dry-forest sites that could be underburned without a preconditioning treatment such as low thinning or improvement cutting (dry-forest sites are in the low-severity fire regime; see historical fire regime 1 in table 6-4).
2. As a follow-up practice after implementing low thinning or improvement cutting treatments.

3. As a future treatment for existing young stands that may not need it for 20 years or more, but pruning could then be coordinated with prescribed fire treatments as a way to manage fire risk for dry sites.

Table 6-17. Natural (self) pruning in ponderosa pine.

Age	Height to Base of the Live Crown (Feet)	Bole Length Without Any Dead Branches (Feet)
20	3	1
30	18	2
40	28	3
50	36	4
60	45	7
70	50	11
80	56	19
90	61	27
100	65	29

Sources/Notes: From Kotok (1951). This data shows that ponderosa pine lifts its live crown quickly (2nd column) but that dead branches are persistent; a clean, branch-free bole requires a long time to develop (3rd column). Note that these figures were derived from dense, wild stands; open, thinned stands lift their crowns more slowly than is shown here.

Prescribed Fire. After completing the thinning, improvement cutting or pruning treatments described in this section, prescribed fire would be a logical follow-up treatment, particularly for dry-forest sites and for the lower portion of the moist-forest potential vegetation group (the warm moist, warm very moist, and the lower half of the cool moist plant association groups).

Once ponderosa pines or larches are 10 to 12 feet tall, a prescribed burn could be completed, although a low-intensity fire would leave most of the 6- to 8-foot trees undamaged as well (Wright 1978). Surface fires could then be used on a regular cycle, usually at intervals of 10 to 20 years.

Late summer and fall burns are desirable from an ecological perspective because they replicate the seasonality of the historical fire regime (see table 6-6), and because they result in fewer losses of overmature pines to fire damage or to western pine beetle attack (Swezy and Agee 1991). Spring burning, however, might be needed initially to better manage fireline intensity, particularly for areas with high fuel accumulations from mechanical treatments.

One drawback of fall burning is that some species of root-feeding bark beetles are more common following fall burns. *Hylastes macer*, a root-feeding bark beetle that is probably a vector of black stain root disease in ponderosa pine, was most abundant following fall burning.

Spider abundance was reduced temporarily following either spring or fall burning; spider diversity was significantly higher for fall than for spring burns (Niwa et al. 2001). Jumping spiders and others in the “hunting” spider group are especially effective predators of spruce budworm larvae and other defoliating insects (Mason 1992).

Periodic burning can also help maintain the nutrient capital of a site by rejuvenating snowbrush ceanothus, lupines, peavines, American vetch, russet buffaloberry, and other nitrogen-fixing plants. Fire may also stimulate plants that do not contribute to desired conditions: on mesic and moist areas, burns can favor dominance by bracken fern, western coneflower, and other allelopathic plants inhibiting conifer regeneration (Ferguson 1991, Ferguson and Boyd 1988). Numerous studies documented the slow decomposition rates associated with woody material in the interior West (Harvey et al. 1994). Inherently slow decomposition means that forests of the interior Pacific Northwest may have depended more on nitrogen-fixing flora and surface fire to cycle soil nutrients than on microbial decomposition (Powell 2000).

Providing adequate levels of soil nutrients is important for maintaining tree resistance to insects and diseases (Mandzak and Moore 1994). In central Oregon, for example, Reaves et al. (1984, 1990) found that ash leachates (e.g., the chemical compounds produced when water percolates through the ash produced by a fire) from prescribed burns in ponderosa pine forests had a negative effect on the growth of *Armillaria ostoyae*, cause of Armillaria root disease.

These studies found that much of the Armillaria suppression was related to a fungus called *Trichoderma* – a strongly antagonistic competitor of *Armillaria ostoyae* – and *Trichoderma* apparently benefited from ash leachates (Filip and Yang-Erve 1997, Reaves et al. 1984, 1990).

On poor forest sites (generally dry areas with coarse or shallow soils and thin forest floors), frequent use of prescribed fire may be detrimental from a nutritional standpoint. The short-term benefits of fire might be achieved at a cost of high soil pH, nitrogen and sulfur deficiencies, and other nutritional problems later in a forest’s life (Brockley et al. 1992).

In central Oregon, prescribed fire apparently caused a net decrease in nitrogen mineralization rates and a decline in long-term site productivity (Cochran and Hopkins 1991, Monleon et al. 1997). Cycling of nitrogen and other nutrients is considered by some to be the most important ecosystem service provided by forest biomes (Costanza et al. 1997).

I strongly recommend that the fire regime for dry sites be returned to the historical pattern of frequent, low-severity disturbances. As in other recommendations, large treatment areas should be identified to allow this important ecosystem process to function at a landscape scale (consider a minimum size of 1,000 acres as based on fire history studies such as Heyerdahl and Agee 1996).

The highest priority for prescribed fire is dry-forest areas that could be treated now or would be suitable after completing a mechanical pretreatment. Logical blocks of forestland providing opportunities for controlling large-scale conflagration wildfire in the Potamus analysis area should be treated first to help create fire-safe forests (table 6-18; Agee et al. 2000).

Biomass Removal. Improve the economic viability of adjusting stand structures in the Potamus analysis area by working with local community leaders and the local timber and biomass industries to increase markets for small wood. This will be an essential step in restoring many of the multi-strata stands in the analysis area, where large old trees will be retained and the lower-strata trees that established following fire suppression will be removed.

The need for this restoration work is enormous. A recent Forest Service study found that thinning 60% of fire regime condition class 2 and 3 lands in the western United States (these areas are most at-risk for uncharacteristically severe wildfire) would remove 30 million bone dry tons of wood annually for 30 years. Most of the trees that could be removed (86% of them) are less than 10 inches in diameter (USDA Forest Service 2003).

Table 6-18: Principles of fire-safe forests.

Principle	Effect	Advantage	Concerns
Reduce surface fuels	Reduces potential flame length	Fire control is easier; less torching of individual trees	Soil surface disturbance: less with prescribed burning, more with certain mechanical treatments
Increase height to	Requires longer	Less torching of	Opens understory,

live crown	flame length to begin torching	individual trees	possibly allowing surface winds to increase
Decrease canopy bulk density (fuel load)	Makes tree-to-tree crown fire spread less likely	Reduces crown fire susceptibility	Surface winds may increase and surface fuels may become drier
Favor fire-tolerant tree species	Reduces potential tree mortality	Improves vegetation tolerance to low- and mixed-severity fire	If applied too broadly, it could result in simplified landscape patterns of composition

Sources: Based on Agee et al. (2000) and Agee (2002).

Several efforts are underway in the Blue Mountains to develop processing methods and markets for ever-smaller trees. Examples are an existing cogeneration facility in Heppner, Oregon and proposed facilities near Boardman and La Grande, Oregon.
If these biomass efforts eventually succeed, then future attempts to remove understory trees may become viable by producing biomass material for energy technologies such as ethanol production from cellulose, or for electricity generation (Barbour and Skog 1997, Willits et al. 1996).

Recommendations Synthesis

Table 6-19 summarizes the fire and fuels issues, the treatment recommendations that respond to them, and the extent of the analysis area (acres) affected by the issue.

Table 6-19. Summary of fire and fuels issues for the Potamus analysis area.

Issue Description (see fire and fuels issues on pages 16-17)	Treatment	Extent (Acres)
1. Crown fire potential is moderate or high for much of the upland-forest area	LT-IC*	48,044
2. Fire regime condition class 2 and 3 needs to be restored to condition class 1	LT-IC*	58,765
3. a. Low fire severity is under represented for the low-severity fire regime	LT-IC*	22,912
a. High severity is over represented for the low-severity fire regime	LT-IC*	5,309
b. Low severity is under represented for the mixed-severity fire regime	LT-IC*	1,571
b. Moderate severity is under represented for the mixed-severity fire regime	LT-IC*	1,668
c. Low severity is under represented for the replacement-severity regime	LT-IC	3,187
c. High severity is under represented for the replacement-severity regime	Wait	8,780
c. Moderate severity is over represented for the replacement-severity regime	LT-IC	2,407

Sources/Notes: Summarized from the Potamus existing vegetation database (Powell 2004a). LT refers to Low Thinning; IC refers to Improvement Cutting; RC refers to Regeneration Cutting; and Wait refers to situations where doing nothing (not taking action) might be the most appropriate response to the issue at this time. A total was not provided for the "extent (acres)" column because many areas respond to more than one issue, so the acres are not mutually exclusive.

* Any density management treatments implemented on dry-forest sites should also consider pruning and/or prescribed fire as follow-up activities.

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NON-FOREST VEGETATION, NOXIOUS WEEDS, AND RARE PLANTS

Introduction

This report addresses the condition of non-forested Umatilla NF lands within the Potamus landscape and assesses the threat of noxious weed spread. It also addresses the status of rare plant species within the watershed.

Over 450 species of plants have been documented in the Potamus watershed. Only 15 of these are trees; the rest are shrubs, grasses, and numerous forbs that populate the forest understory as well as the un-forested portions of the landscape. Where deeper soils intersect relatively high moisture/low temperature regimes, especially at higher elevations in the Blue Mountains, forest predominates. Moving down the elevation gradient, continuous tree cover gives way to a mosaic of forest stringers with shrub communities interfacing the grasslands. Areas of shallow soils, common on many local basalt ridges, often support only grasses and smaller shrubs capable of thriving in such a harsh, dry environment.

About 20% of the National Forest lands within the watershed sustain plant communities that support no trees but are dominated by shrubs, grasses and forbs. These habitats have been intensively used, especially in the past, for livestock grazing, in some cases resulting in alteration of the vegetative cover. The high light environment of nonforested habitat, combined with the high levels of disturbance that have typically affected these communities, provide prime conditions for most of the opportunistic exotic plants that we now designate as noxious weeds.

Plant species may be “rare” because their habitat is scarce, especially if they have a narrow tolerance for limiting factors such as moisture, light, or soil type; they may have evolved and remained in a very local range as endemics; they may once have been widespread but have lost habitat, plant numbers or whole populations; or they may have lost the pollinators on which they depend for reproduction. In the Blue Mountain region, the great majority of these losses has followed the intensive use and/or manipulation of the plants’ habitat since non-indigenous peoples arrived.

Grass and Shrublands

Key Questions:

- *How do the plant communities and the extent of grasslands compare to historic conditions?*
- *How do the structure and extent of upland shrub communities compare to historic conditions?*
- *What activities may have affected these plant communities, and what might be done to insure their survival and enhance their internal diversity?*

Overview

The dry grassland communities that occupy harsher sites in the Blue Mountains thrive on less moisture than forest or even shrub communities. Early settlers in the area took advantage of extensive local grasslands to support huge numbers of domestic livestock, resulting in alteration of many of the native plant communities. While some of these communities have retained enough of their original composition to rebound when rested from grazing, others have been permanently degraded and remain in disclimax or support a continuing succession of exotic plant species.

Shrub communities more typically lose structure when overused by domestic grazers and/or wild ungulates. Upland shrubs such as mountain mahogany and bitterbrush and riparian species such as willows, when severely hedged year after year, are reduced to short “brooms” with multiple stems and no opportunity to flower or reproduce. Plants above browse height continue to grow larger, so that a heavily impacted stand will consist of two size classes – very large and decadent old shrubs, with tiny hedged individuals, or none at all, in the understory. Sagebrush, which is not very palatable, may increase in density, while the associated understory plant community typically loses diversity as the native forbs and bunchgrasses give way to annual and exotic species. An altered fire regime can contribute to increased sagebrush densities, but native understory species will persist if the area has not been heavily grazed (Bunting *et al.* 2002). Dry grassland and shrubland, and riparian shrubland vegetation groups are all rated highly susceptible to invasion by noxious weeds (PNW DEIS 2004).

Methods for Assessment

Acres of shrubland present today can be compared to their extent in 1939 to assess loss to forest encroachment. Structural classes of the shrubs present indicate how well the species are surviving and reproducing. Species lists of the understory plants can help determine the overall health of the communities. Range plot data, especially if it covers an extended period of time, may be useful in determining trends in vegetative cover.

Acres of grassland present today can be compared to their extent in 1939 to assess loss to forest encroachment. Species lists from the grass communities would also help in determining presence/absence of native species and noxious weeds and the overall health of the plant communities. Range plot data, especially if it covers an extended period of time, may be useful in determining trends in vegetative cover.

Current and Reference Conditions

Table 7-1. Non-Forest Vegetation; Types and Current Extent

Cover Type		Acres
Shrub		900
Forb		1900
Grass	Dry, upland	20,200
	Riparian, meadow	900
	Total grasslands	21,100
Total Non-Forest		23,900

The shrub cover type includes a range of shrub communities from riparian willows and alders, through mesic upland species such as snowberry, ninebark, and oceanspray, to dry upland sagebrush, bitterbrush and mountain mahogany. While acres of shrubland have not changed significantly since 1939, they may be lower than in pre-European times due to a combination of over-grazing and fire suppression that has allowed forest encroachment into shrub stands. Willow stands may once have been more abundant along some streams than they are today.

In the uplands, sagebrush stands are typically decadent, with little to no regeneration and frequent evidence of soil loss that is probably associated with excessive grazing. Understory forb communities have lost much of their native diversity, and are increasingly being invaded by exotic annual grasses. Mountain mahogany and bitterbrush stands are mostly succumbing to forest encroachment and excessive winter use by elk. Regeneration is almost non-existent due to the combination of heavy browsing that limits reproduction, and low seedling establishment success resulting from both ungulate predation and competition from annual grasses. Historically, all three of these shrub community types may have been more abundant, though probably were still widely scattered. Shrubs would have been reproducing effectively, and a natural fire regime may have provided more opportunity for seedling establishment (Zlatnick 1999; Marshall 1995).

Forbs provide the primary cover under some open forest stands as well as in small wet meadows at creek headwaters. This cover type includes a wide variety of species. There is no data on historic or pre-European extent of forblands, although the 1939 data for meadows may refer to forb-dominated headwater meadows.

The grass cover type includes two major categories: dry, upland grasses and riparian/meadow grasses. Most of the upland communities were once dominated by the larger bunchgrasses. Bluebunch wheatgrass was most widespread, as it tolerates hot dry conditions and variable soils. Idaho fescue was less common, favoring deeper soils and cooler north aspects. Extremely heavy grazing by sheep and then cattle for several decades around 1900, and again in the 1930s and 1940s nearly eliminated the large bunchgrasses from portions of Potamus grasslands, with resulting loss of soil and conversion of some plant communities entirely to exotic species.

In areas such as Thompson Flat, the introduced species intermediate wheatgrass and smooth brome were sown to stabilize soils and replace the forage that had been lost. These grasses persist in solid stands at present, with no sign of reversion to native communities, and are probably spreading into neighboring habitats. In areas where remnant large bunchgrass stands survive, they are usually interspersed with cheatgrass and ventenata.

Sandberg's bluegrass-onespike oatgrass communities occupy relatively few acres of the watershed. While many of the native species persist, most of the "scabflats" that these species occupy are currently dominated in late summer by tarweed (an increaser), and most are being invaded by ventenata. In some areas the small bunchgrasses that do persist show the "pedestalled" bases indicative of soil loss.

A small proportion of grasslands within the watershed include tufted hairgrass communities. Where the water table remains high enough to sustain them, they occupy riparian corridors, especially in the upper reaches of larger streams. Where the water table has dropped, these communities have typically been lost to Kentucky bluegrass.

Table 7-2. Non-Forest Vegetation; Types and Extent in 1939

Cover Type	Acres
Shrub	600
Forb	100
Grass	27,700
Total Nonforest	28,400

Synthesis and Interpretation

Of the riparian species, willows have the highest light requirements, and are intolerant of overstory shading. Along streams where riparian vegetation is in early seral stages, willows often provide the only stream shade. Their high palatability to browsing animals, coupled with uncharacteristically high numbers of ungulates since European settlement, has diminished numbers, size and reproductive capacity of willows throughout the Blue Mountains. There is no data available on the extent of loss of willow communities in the Potamus area. Other riparian shrubs such as alder and red-osier dogwood establish in a high light environment, yet can persist until the overstory canopy becomes quite dense. Lowered water tables from channel down-cutting, along with several endemic diseases in alder, help to account for the loss of some riparian shrub stands and the current variable health of the remainder. Prolonged heavy grazing historically has likely also diminished alder communities (Case & Kauffman 1997).

Many mesic upland shrub species can tolerate some shade, and may grow as patches in forestland or with a partial overstory of conifers. Many of these species are browsed by ungulates, and in areas of intense browsing pressure may have been nearly eliminated from the flora (Riggs *et al.* 2000).

The dry upland shrub communities intergrade with grasslands, but do not tolerate encroachment by overstory forest. Sagebrush stands are showing very little regeneration, probably due to continued soil impacts from a combination of grazing and big game winter use that preclude seedling survival. Eventually these decadent stands will die out. Some remnant mountain mahogany are above browse height and still provide good seed sources, but bitterbrush is often browsed too intensely to flower or set seed. Presence of annual grasses can limit shrub seedling establishment (Zlatnick 1999). Disappearance from the landscape of bitterbrush is most imminent, since its seed sources are severely diminished. Sagebrush and mountain mahogany may not be limited by seed production, but unless opportunities for establishment and survival of seedlings are increased, these two species may also disappear.

Because headwater wetland forb meadows tend to stay saturated throughout the growing season, they may not have been adversely affected by grazing. They may also be resistant to forest encroachment from altered fire regimes because of their high water tables. Some understory or forest edge plant communities may currently be designated as forb lands due to the predominance of "increaser" forbs. These are unpalatable native species, such as mulesears, fleeceflower and western coneflower, that replace grasses lost to heavy grazing. There is little data on reversion of such increaser-dominated sites to grasses, although some higher elevation sites throughout the Blue Mountains are still nearly monocultures of fleeceflower or western coneflower years after the cessation of sheep grazing.

Bluebunch wheatgrass communities are potentially very productive grasslands, and have typically been heavily grazed by livestock. While the native bunchgrasses have extensive root systems that provide cover for the soils on these sites, with overuse they give way to natives such as yarrow and biscuitroot that provide little cover. With severe impacts, the native species are replaced entirely by exotics, especially annual grasses such as bromes, ventenata and medusahead rye. Such sites appear doomed to a succession of exotic species, culminating, if untreated, in occupation by the most aggressive noxious weeds such as yellowstar thistle and Dalmatian toadflax. Forage and habitat for wildlife tend to decrease with loss of native bluebunch communities. Exotic plant species seldom have the soil-holding capacity of the natives that were lost, so erosion may increase (Lacey *et al.* 1989). Slightly altered sites may be restored with a change in grazing regime; however severely altered sites will not recover without active restoration efforts, if then (Bunting *et al.* 2002).

Scabflats, by definition having little soil, probably never supported much of the larger bunchgrasses, but can sustain smaller types such as Sandberg's bluegrass and onespike oatgrass. The latter species are low growing, demanding fewer resources from their substrate and tolerating the heat and drought of summer by going dormant. Numerous native forbs such as onions and biscuitroots are similarly adapted, and have survived on these sites. With their thin soils and relatively harsh growing environment scabflats are far less productive of forage than bluebunch wheatgrass communities. Often vernally moist, they are prone to severe disturbance from early season trampling by cattle and elk (Johnson and Clausnitzer 1992). They become dominated by tarweed or exotic annual grasses as native species and soils are lost. There are no records of attempts to restore native plant communities to such sites.

Tufted hairgrass is the dominant species of the wet meadows in the headwaters of several of the creeks in the watershed. It is indicative of soils that are wet in spring but that may dry to varying degrees later in the summer. Wetter tufted hairgrass sites can support several sensitive plant species that could occur in the Potamus area. These meadows also provide excellent habitat for small wildlife such as rodents (Kovalchik 1987), as well as highly palatable forage for livestock and elk (Crowe and Clausnitzer 1997). Tufted hairgrass can withstand moderate mid to late season grazing, but will be killed by overgrazing. Lowering of the water table can also reduce the capacity of meadow sites to support the hairgrass, and open them to encroachment by increaser forbs, Kentucky bluegrass and other exotic species. Restoration of altered hydrology and raising of water tables will help to support tufted hairgrass and associated species in areas where they have been lost.

Management Strategies and Recommendations

Riparian shrublands are perhaps the easiest of these nonforest plant communities to restore. Exclusion of cattle from existing shrub stands can often produce dramatic results at reasonable cost (Case and Kauffman 1997). Most shrub species are easily propagated and can be successfully reintroduced where they are missing, provided planting sites are chosen that retain appropriate moisture levels to support them. Such plantings must be fenced or otherwise protected for at least five to ten years to allow effective establishment and maturation of any species that are palatable.

A combination of lighter grazing and reduced big game numbers for several decades would probably aid in the recovery of the mesic shrub component in the uplands. Loss of these species is a widespread phenomenon (Riggs *et al* 2000), so fencing small areas may not effect much improvement on a landscape scale. Establishment of big game exclosures could allow, over several decades, a better assessment of the impacts of ungulates on multiple components of the ecosystem.

Upland shrub stands may benefit from fencing out of cattle, but exclusion of big game will be more crucial for the survival and regeneration of sagebrush, bitterbrush and mountain mahogany stands. Several remnant stands of each species could be fenced to preserve, before they are completely lost, seed sources with some locally adapted genetic diversity. Any seed of these species that is found should be collected and stored so that it will be available for future restoration efforts.

Forb communities with unusual species assemblages, such as in headwater meadows, should be protected from grazing impacts. Areas that show heavy concentrations of increaser species could be rested and assessed for their potential to respond to restoration efforts.

Bunchgrass communities that are still relatively intact will maintain their integrity and productivity inversely to their use for grazing. Range monitoring that regularly includes a careful assessment of species diversity can help to define trends in plant community health. Rapid response to any indication of a downward trend is crucial to maintaining these communities. Grass stands that have already been converted to either invasive annual or exotic perennial grasses cannot be restored to native bunchgrasses without intensive and expensive restoration efforts. They can be monitored and treated for noxious weed infestations to reduce seed sources of exotic species that could move into more intact native stands. For grass communities that are only partially degraded, complete rest from grazing for a period of time should be considered, as such passive restoration is far simpler and less costly, as well as more likely successful, than the active restoration needed to regain sites that have been completely converted to non-natives.

Use of scabflats by cattle should be avoided early in the season when soils are wet and vulnerable to hoof action. Because these areas are usually not large, they could be protected by temporary fencing in pastures that are grazed early.

The health of riparian grasslands is most effectively supported by maintaining or restoring water tables to a level that sustains their potential vegetation type, most often tufted hairgrass communities. To maximize ecosystem vigor, these meadows could be fenced to prevent use by cattle. If grazing of such wet meadows is allowed, it should be limited to very light use at a season when soils are dry enough to prevent damage by hoof action.

Noxious Weeds

Key Questions:

- *What noxious weeds occur in the analysis area, and what are their affinities for ecological settings?*
- *What activities affect the spread and/or distribution of noxious weeds, and what can be done to mitigate spread?*

Overview

Legally, a noxious weed is any plant designated by a Federal, State or county government as injurious to public health, agriculture, recreation, wildlife or property (Sheley, Petroff, and Borman, 1999). Such plants are almost always introduced (exotic), rather than having evolved with the local ecosystem. They tend to be invasive, that is, highly competitive and persistent, and they can alter the composition, structure, and ecosystem function of native plant communities (Cronk and Fuller, 1995).

This report examines the current status of noxious weed infestations on the Umatilla National Forest lands of the Potamus watershed. It includes the identification of priority species and treatment areas, and a summary of past and ongoing noxious weed control efforts. Results of a risk model assessing the potential for future noxious weed invasion and spread are also presented. Information pertaining to the location, species composition, NEPA status, and treatment history of noxious weed infestations was obtained from the Forest's Noxious Weed database and current (2003) GIS coverage (fsfiles\ref\library\gis\uma\nw).

Methods for Assessment

A Forest-wide noxious weed risk assessment was conducted in Spring 2000 to evaluate the risk and susceptibility of noxious weed invasion and spread, and to determine priority areas for prevention and control efforts (Umatilla National Forest 2000). The risk model was adapted from one developed by the Wallowa-Whitman National Forest and is based on (1) vegetation and climatic conditions, (2) proximity to existing noxious weed infestations, (3) proximity to roads, and (4) grazing activity. A high overall noxious weed rating was assigned to areas having a high risk of habitat and seed availability (e.g., warm to dry forest plant communities occurring within 5 miles of an existing noxious weed site) and a high potential for spread (e.g., active grazing allotment within 300 feet of an open road). Sources of data used in the model include corporate GIS coverages and databases relating to recent (2002) noxious weed inventories, transportation layers, grazing allotments, existing vegetation, and potential vegetation groups. The Forest-wide GIS coverage is located in */fsfiles/gis/noxweeds/nwrisk.*

Current Conditions

By definition, the reference condition for noxious weeds is the pre-European era when no such species were present in Blue Mountain ecosystems.

A total of 514 noxious weed sites that include 3298 acres have been inventoried in the analysis area (Table 7-3, Map 7-10). The average size of an infestation is 5.7 acres, with individual sites ranging from 0.006 to 130.7 acres. Sixteen weed species are present, as listed in Table 3. Of greatest concern are the 313 spotted/diffuse knapweed sites, 15 sulfur cinquefoil sites, two sites each of Dalmatian toadflax and medusahead, and one each of leafy spurge and yellowstar thistle.

Focal points for the expansion and spread of noxious weeds coincide with major road corridors. Diffuse knapweed and St. Johnswort are the two most widespread species in the northwest portion of the watershed, and are concentrated especially along the 53 and 21 roads and their subsidiaries. Sulfur cinquefoil and scotch thistle predominate in the southeast portion, with major infestations and spread routes along the 3963, 3972, and 3974 roads.

Only 85 of the currently inventoried sites (889 acres) of noxious species were included in the Forest's 1995 Decision implementing the Environmental Assessment (EA) for the Management of Noxious Weeds. The EA established site-specific guidelines for treating weed infestations, including hand, mechanical, and chemical control methods. High priority sites not covered in the 1995 EA, such as nearly 1000 acres of diffuse knapweed and all 277 acres of sulfur cinquefoil, will require additional analysis and new NEPA decision before any treatments other than hand-pulling can be implemented.

Susceptibility and Risk Assessment

Approximately 71% (68,477 acres) of the analysis area was classified as being highly susceptible to noxious weed establishment and spread (Table 7-4). An additional 26% (25,236 acres) of the land base had a medium susceptibility to noxious weed invasion. Most of the acres with low susceptibility that are not heavily forested are in the rocky ground of the breaks of Potamus Creek (Map 7-11). The overall noxious weed risk rating for the watershed is HIGH.

Management Strategies and Recommended Actions

Noxious weeds will likely continue to be a persistent problem in the Potamus watershed due to high habitat potential and seed availability. Containing noxious weed populations to current levels and preventing additional invasion and spread will require unrelenting attention and a strong focus on early detection and control methods. Personnel and financial resources should be directed toward the highest priority species and sites.

The management/statutory status and treatment priorities for the various noxious weed species occurring in the analysis areas are displayed in Table 7-5. "Established" species are widespread across the Forest in large populations and containment strategies are used to prevent their further spread. Species in the "New Invader/Established" category are species such as diffuse knapweed that are presently controllable, but which are approaching "Established" infestation levels. These species are rated high priority for early treatment. Species in the "New Invader" category have limited distributions at present, and can probably be eradicated if early treatment measures are implemented.

Obtaining NEPA clearance for weed infestations not covered by the 1995 Noxious Weed EA is a high priority, especially for new invader species such as sulfur cinquefoil, yellowstar thistle, and aggressively spreading species such as diffuse and spotted knapweeds. The need to manage invasive plants effectively is outlined in the new Pacific Northwest Region Invasive Plant Program Draft Environmental Impact Statement (PNW DEIS, 2004). Proposed timing for the ROD for the Final EIS to be signed is early in 2005, and once in effect it will become an umbrella document amending all Forest plans within Region 6. A Blue Mountain site-specific noxious weed EA will be initiated in FY 2005, and will address all inventoried weed populations.

To help stretch scarce resources and enhance noxious weed management in the analysis area, cooperative agreements for weed inventory and control should be maintained and expanded. Key players include private landowners, federal and state agencies, counties, watershed associations, conservation groups, and other noxious weed managers. It should be noted, however, that cooperative efforts can be quite difficult and complicated due to the different requirements and restrictions on NFS lands in terms of the type of control activities that can be performed, the types of chemicals used, and the level of analysis required prior to treatment.

An additional component of effective noxious weed management is educating and increasing awareness among the public, private landowners, resource managers, and other decision makers as to the adverse impacts of noxious weeds and the consequences of inaction. This can be accomplished through the development of education materials (e.g., "A Pocket Guide to the Weeds of the Umatilla National Forest"), and by cooperating and sharing information with County Weed Boards, State Department of Agriculture, and other landowners and federal agencies.

Table 7-3. Summary of noxious weed sites (2003 inventory) occurring in the Potamus watershed.

Species	Common Name	Alpha Code	Total		NEPA Cleared	
			#sites	#acres	#sites	#acres
Agropyron repens	quackgrass	AGRES	1	1		
Cardaria draba	whitetop	CADR	1	22		
Centaurea biebersteinii	spotted knapweed	CEBI2	12	49	3	15
Centaurea diffusa	diffuse knapweed	CEDI3	301	1415	58	424
Centaurea solstitialis	yellow starthistle	CESO3	1	4		
Cirsium arvense	Canada thistle	CIAR	19	280	7	203
Cynoglossum officinale	houndstongue	CYOF	27	442		
Euphorbia esula	leafy spurge	EUES	1	6		
Hypericum perforatum	St. Johnswort	HYPE	120	733	17	247
Linaria dalmatica	Dalmation toadflax	LIDA	2	9		
Linaria vulgare	butter and eggs	LIVU2	2	.1		
Onopordum acanthium	scotch thistle	ONAC	6	40		
Potentilla recta	sulfur cinquefoil	PORE5	15	277		
Senecio jacobaea	tansy ragwort	SEJA	3	12		
Taeniatherum caput-medusae	medusahead rye	TACA8	2	7		
Tribulus terrestris	puncture vine	TRTE	1	.5		
		Totals	514	3298	85	89

Note: *Individual species data do not sum to the overall totals because inventoried noxious weed sites may be comprised of more than one species.*

Table 7-4. Noxious weed susceptibility and risk rating for the Potamus watershed.

Risk Rating	**Acres**
Low	2,497
Medium	25,236
High	68,477
Total	96,210
Overall Risk/Susceptibility Rating: HIGH	

Risk model acreages do not sum to total in watershed due to approximately 9,253 unclassified acres in riparian areas.

Table 7-5. Status and treatment priorities for noxious weeds species occurring in the Potamus watershed.

Species	Common Name	Management Status	Rating Status[1]	Spread Potential	Treatment Priority[2]
Agropyron repens	quackgrass	New Invader	Class B	Low	Low
Cardaria draba	whitetop		Class B	High	High
Centaurea biebersteinii	spotted knapweed	New Invader/ Established	Class B, T	Very High	Very High
Centaurea diffusa	diffuse knapweed	New Invader/ Established	Class B	Very High	Very High
Centaurea solstitialis	yellow starthistle	New Invader	Class B, T	Very High	Very High
Cirsium arvense	Canada thistle	Established	Class B	High	Low
Cynoglossum officinale	common houndstongue	Established	Class B	High	Medium
Euphorbia esula	leafy spurge	New Invader	Class B, T	Very High	Very High
Hypericum perforatum	St. Johnswort	Established	Class B	High	Medium
Linaria dalmatica	Dalmation toadflax	New Invader	Class B	Very High	High
Linaria vulgare	butter and eggs	New Invader	Class B	High	Medium
Onopordum acanthium	scotch thistle	New Invader/ Established	Class B	Very High	Very High
Potentilla recta	sulfur cinquefoil	New Invader	Class B	Very High	Very High
Senecio jacobaea	tansy ragwort	New Invader	Class B, T	High	High
Taeniatherum caput-medusae	medusahead rye	New Invader	Class B	Very High	High
Tribulus terrestris	puncture vine	New Invader	Class B	Medium	Medium

[1]Oregon uses a rating system of "A", "B", and/or "T". Classes "A" and "T" are priority species for which intensive control actions are required by State law. Class "B" weeds are designated of known economic importance and regionally abundant, but may have limited distribution in some counties. "B" listed species are also listed as "T" if they have been designated as target weeds included in a statewide management plan.

[2]Treatment priorities lower than spread potential indicate that the species is already widespread and/or effective control measures are currently limited, as in the case of medusahead rye.

Rare Plants

Key Questions:

- *What sensitive plant species have been documented in or near the analysis area, and what are their habitat types?*
- *What activities may have affected these plants and/or their habitat, and what might be done to insure their future survival and potential increase?*

Overview

A sensitive species is defined as "A plant or animal that has appeared in the Federal Register as proposed for classification and official listing as an endangered or threatened species, that is on an official state list, or that is recognized by the Regional Forester as needing special management to prevent its being placed on Federal or State lists." (Umatilla NFP, 1990). Table 7-6 shows the status of the species addressed in this report. There are no Federally listed plant species in the Potamus watershed.

Sensitive species can be affiliated with any type of plant community - forested, riparian, shrub-dominated, grassland, or rocky outcrop. To insure that management activities do not contribute to a trend towards federal listing or cause a loss of viability to the species, both potential habitat and current populations of sensitives need to be documented and assessed for vulnerability and for enhancement potential.

Methods for Assessment

Criteria for evaluating the status of sensitive plant species include the presence of populations within or adjacent to the watershed, and the existence within the watershed of potential habitat that might support those same or additional species. Since 1982 botanical field surveys have been performed on all of the Potamus subwatersheds within the Umatilla National Forest. Complete species encounter lists for every survey are stored in database form, and each sensitive plant population that has been documented is mapped in the Forest-wide GIS coverage. Plant associations and types of habitat in which sensitive plant populations occur are recorded on sighting reports, and provide data for assessing the potential for existence of further populations.

The seven sensitive species listed in the following table are known from the Potamus watershed or from contiguous watersheds, or are suspected as present, either currently or historically, based on their affinities for local plant communities.

Table 7-6. Status of Rare Plant Species in Potamus Watershed

Species	Common Name	Status	Present	Habitat Affinity
Carex backii	Back's sedge	R6 Sensitive	yes	riparian shrublands
Mimulus washingtonensis	Washington monkeyflower	Historic R6 Sensitive	yes	Vernal seeps in hot, dry grasslands
Carex interior	inland sedge	R6 Sensitive	adjacent subbasin (<10 mi.)	wet Meadows
Botrychiums	moonworts	R6 Sensitive	adjacent subwatershed (<1 mi.)	lodgepole pine and mixed forest
Thelypodium eucosmum	arrow-leaved thelypody	R6 Sensitive	adjacent subbasin (<15 mi.)	juniper/bitterbrush/grassland
Eleocharis bolanderi	Bolander's spikerush	ONHP S2[1]	no surveys	grasslands in pine/Douglas-fir forest

[1]Species on Oregon Natural Heritage Program Lists 1 and 2 will automatically move onto the R6 Forester's Sensitive Species List at its next update. The next scheduled update is planned for fall 2004. Because Eleocharis bolanderi has not been previously listed, some potential habitat may not have been surveyed at a time appropriate for identification of the species.

Current and Reference Conditions

Because the species considered here evolved and adapted to the landscape before it was affected by European influence, that time before 1800 could be considered "natural" or the reference condition. Without any actual data, such conditions are somewhat speculative. However, some history of the predominant disturbances that have affected these plants - fire, livestock grazing, road construction, and the intrusion of exotic species - is known. Some assumptions about the reference environment are included in this section, and historical changes that may have affected each sensitive species are noted in the section on synthesis and interpretation.

Botrychiums

Of the 7 species of *Botrychium* known on the Umatilla NF, none have been found growing in the Potamus watershed. *Botrychium minganense* is known to grow in the adjacent Wall watershed approximately one mile from the western edge of the Potamus boundary. There is one historically documented population of *B. minganense* within one-eighth of a mile of the northeast boundary of the watershed, on the East Fork of Meadowbrook Creek. There are also at least three species of moonworts about 5 miles southeast of the watershed in the Middle Fork John Day drainage on the Malheur NF. They have not been found below 4200 feet elevation in the Blue Mountains, and more typically occur at about 5000 feet or higher. There is ample potential habitat within the Potamus watershed for moonworts, and much of it has been surveyed for them, at least once.

Carex backii

Within the Potamus watershed, the only documented population of a species currently on the Regional Forester's Sensitive Species Plant List is of Carex backii, an uncommon but widely dispersed sedge. The site in this watershed is on Gilbert Creek, a tributary of Potamus Creek.

Ungrazed streamsides and dense riparian shrubs present at lower elevations before livestock grazing occurred probably provided some more habitat than exists today for Carex backii. Because this species is so palatable, it is possible that more plants were present at that time.

Carex interior

Inland sedge is known on the Malheur NF from relatively low elevation (3500 ft) creekside sites along the Middle Fork John Day River near Galena to 6000 ft. on Vinegar Hill. The best potential habitat for this species in the Potamus watershed appears to be in headwater meadows such as Kelly and Jones Prairies at 5000 ft. elevation or higher.

Less than a quarter of the area providing potential habitat within the Potamus watershed has been surveyed for this species. *Carex interior* is highly palatable to livestock.

Good potential habitat for inland sedge was likely present in the headwater wet meadows of all the larger creeks before down cutting and de-watering of meadows followed road construction and heavy grazing. Along smaller tributary creeks wet stringer meadows above about 4500 ft. elevation could also have provided habitat.

Eleocharis bolanderi

Potential habitat for Eleocharis bolanderi is widespread at the mid and lower elevations: there are over 500 acres of plant communities in which Bolander's spikerush associates occur within the Forest Service lands of the Potamus watershed.

Because its habitat has been heavily used and often degraded by domestic grazing, as well as by uncharacteristic populations of elk, it is possible that this species was present and relatively abundant in the past. Alterations in fire regime are less likely to have affected E. bolanderi and its habitat.

Before domestic grazing, the spikerush may have grown in the vernally moist portions of any of the areas of AGSP/POSE-DAUN plant associations. The exotic annual grasses that compete with the spikerush on nearby sites would not have been present.

Mimulus washingtonensis

This species was on the Regional Forester's Sensitive List until 1999. More than 30 populations of this annual monkeyflower have been documented within the watershed, most of them at lower elevations in the southwestern portion.

Because *Mimulus washingtonensis* is limited primarily by annual moisture regimes, its potential habitat may not have changed much from historical levels. The several exotic annual grasses that have now invaded monkeyflower habitat would not have been present.

Thelypodium eucosmum

Thelypodium eucosmum is a sensitive species that has not been documented in the Potamus watershed, but that is known from hot, dry juniper/grassland environments at several sites in the John Day River basin.

Because common thelypody is limited by moisture and soil type, its potential habitat may not have changed much from historical levels.

Synthesis and Interpretation

Botrychiums

Botrychiums are closely related to true ferns, and many species favor moist habitats such as streamsides or the edges of wet meadows in association with spruce and grand fir. A few species occur at the edges of drier meadows with lodgepole pine and fescue. Moonworts appear to be dependent on periodic disturbance, as they commonly grow at the edges of forest stands, along old road shoulders, on stream banks, and in 20 to 30 year-old silvicultural plantations. Because they are usually associated with forest vegetation, fire regime and the patchiness of canopy cover has probably been more of an influence on the abundance of *Botrychiums* than has grazing. Mechanical damage to individual plants and soil compaction can still harm moonworts in heavily grazed habitat such as drier meadows. *Botrychiums* are most often associated with vegetation types that are subject to stand replacement fires: lodgepole pine stands, or spruce/fir forests. Historic fire regimes that maintained a dynamic mosaic of openings within these forest types would have supported moonwort populations that "followed" the natural disturbance.

Carex backii

Back's sedge prefers shady riparian zones with an overstory of large trees or of dense shrubs, or both. It generally grows at low to mid elevations on substrates that have been disturbed by stream action, such as old silt deposits or gravel bars. One population on the Walla Walla district is colonizing a young gravel bar that has no soil and little other vegetation on it. Documented populations in the Blue Mountains are generally in the floodplains of larger creeks, or of rivers.

Potamus Creek and its side canyons provide more than 8 linear miles of potential habitat, most of it unsurveyed, for Back's sedge. Many of the other streams within the analysis area are too small and/or narrow to provide appropriate habitat for this species, and none support the dense shrub canopy that the sedge requires. *C. backii* is highly palatable to livestock; however, the potential habitat in the steep canyons of Potamus Creek is largely inaccessible to cattle.

Because *Carex backii* is so palatable, it is possible that grazing has directly affected its abundance. Heavy use of riparian areas by cattle also adversely affects riparian shrubs and may have indirectly affected the sedge at lower elevations if the shade canopy on which it relies was reduced or removed. Alterations in fire regimes are less likely to have affected Back's sedge and its habitat, although a burn that kills riparian shrubs will also temporarily reduce shaded habitat.

Carex interior

Carex interior (inland sedge) is a small-leaved sedge that prefers to grow in sunny locations on "swampy" organic substrates that remain moist all year. Because *Carex interior* is highly palatable to livestock, it is possible that grazing has directly affected its abundance. Alterations of hydrology in headwater meadows caused by road construction and/or by heavy grazing with subsequent channel down-cutting could have altered potential inland sedge habitat in areas such as Kelly Prairie. Alterations in fire regimes are less likely to have affected *C. interior* and its habitat.

Because inland sedge was only added to the Regional list in 1999, many of the older surveys on the forest may not have been conducted at a time best suited for its identification.

Eleocharis bolanderi

Eleocharis bolanderi is a small spikerush that, until 2002, was only listed in historical records for eastern Oregon. Since that year it has been found at several sites on both the Umatilla and the Malheur National Forests. The closest known site is an historical record from Fox Valley, about 23 air miles due south of the Potamus watershed. There are also populations at 4200 ft. elevation on the Malheur NF in the Middle Fork John Day drainage, and on the Umatilla NF on the Walla Walla Ranger District at 4200-4800 ft. elevation.

Because it is listed as S2 by the Oregon Natural Heritage Program, *E. bolanderi* will be added to the R6 Regional Forester's Sensitive Species List at its next update, currently slated for fall 2004. Since it was not on the R6 sensitive list in the past, many of the older botanical surveys may not have been conducted at a time best suited for its identification.

Bolander's spikerush has been found in the western Blue Mountains in small to large forest openings and "scabflats", usually surrounded by ponderosa pine and/or mixed conifer forest plant associations. The openings usually support AGSP/POSE-DAUN plant communities, with the spikerush clustered in swales or along small drainages or stream channels that hold water in early spring. By late summer these sites are typically quite dry. Palatability of this graminoid-like species is unknown.

Because botanical surveys have not focused on this species, and because it is an easy one to miss or mis-identify, it is possible that *Eleocharis bolanderi* is present within the Potamus watershed.

Mimulus washingtonensis

Because it is an annual, Washington monkeyflower relies on prolific growth and flowering and rapid seed production in wet years, and long seed dormancy to survive through dry years. Its habitat includes vernally moist draws and seeps on steep slopes and in scabflats with POSE/DAUN, and JUOC/PUTR/FEID-AGSP plant associations.

The steeper habitats that this monkeyflower favors have probably not changed much since pre-European times. Some of the vernal seeps on scabflats and in grass communities where it can also occur may have been degraded by heavy ungulate use, especially domestic grazing. Soil compaction and eventual competition from invasive species are the most likely adverse effects to this plant. Alterations in fire regime are less likely to have affected *Mimulus wahingtonensis* and its habitat.

Thelypodium eucosmum

Arrow-leaved thelypody is a biennial plant that spends its first year as a ground-hugging rosette and bolts to a tall flowering stem during its second season. It has been found in the Blue Mountains most often where seeps or springs occur in soils of Mazama ash. It is usually associated with JUOC/PUTR/FEID-AGSP plant associations, and often grows at lower elevations. It is known to be highly palatable to ungulates.

While habitat potential may not have changed for *Thelypodium eucosmum*, grazing of this species by cattle, as well as by uncharacteristic populations of elk, may well have eliminated any populations that did exist in the watershed. Alterations in fire regime are less likely to have affected *T. eucosmum* and its habitat.

Management Strategies and Recommended Actions

None of the sensitive species discussed are at risk within the Potamus watershed, since *Carex backii* is relatively inaccessible to grazers and none of the other species are currently present. The following comments, however, provide suggestions for enhancing the habitats for these unusual native plants.

Botrychiums

Because they may follow disturbance with an undetermined lag time, surveys for moonworts should be repeated at least every 10 years and especially before any ground-disturbing projects are initiated. Restoration of a more historic fire regime to the watershed is the management activity with the most beneficial impact on *Botrychium* species since it could increase potential habitat.

Carex backii

Improvement and maintenance of riparian shrub communities could benefit *Carex backii*. Eliminating riparian grazing would improve the shrub conditions favored by this sedge, and might expand its potential habitat to some of the smaller streams in the watershed.

Carex interior

Surveys for this sedge could be conducted in association with assessments of grazing regimes and planning of prescribed fire projects. Reducing grazing in wet meadows could protect existing sedge habitat from degradation. Restoration of the water table in meadows that have been de-watered would help return them to reference condition plant communities and increase habitat potential for this species.

Eleocharis bolanderi

Surveys for this spikerush could be conducted in association with assessments of grazing regimes. If any populations are found, they could be protected from grazing and other management impacts. Treatment and control of invasive weeds will help to protect any potential habitat for this species, as will protection of natural patterns of spring run-off.

Mimulus washingtonensis

While *M. washingtonensis* does not currently enjoy any 'official' status, it may be wise to consider known populations during project planning to help ensure it does not regain status as a rare species. Documented sites are stored in a GIS layer of historical sensitive plant populations.

Grazing of areas with known populations of Washington monkeyflower could be limited to light and late season use. This would help to reduce the impacts of trampling on individual plants, and to encourage recovery of surviving native plant communities that are best able to resist weed invasion when in a healthy condition.

Thelypodium eucosmum

Any populations that are found should be promptly protected from domestic livestock.

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TERRESTRIAL WILDLIFE

Characterization

Approximately 75 percent of the Potamus watershed is in forest habitat. The forested habitat is "naturally fragmented" with non-forest types in the lower to mid elevations of the watershed. The landscape is relatively contiguous with stands of lodgepole pine and sub-alpine fir at the highest elevations, to large stands of mixed conifer including grand fir, Douglas-fir and ponderosa pine at mid elevations, to relatively small stands and forested stringers of ponderosa pine in the lower elevations. South-facing slopes are generally drier and grass-dominated, with occasional, shrubby draws, and riparian hardwood communities. The area also consists of a few wet meadows and aspen stands. The area is largely a mosaic of structural stages with a limited amount of old forest types.

The predominate forest landscape provides habitat for a diverse group of terrestrial vertebrate species. Potentially, 204 terrestrial wildlife species occur on National Forest land in the NF John Day/Potamus watershed (Appendix A). These species consist of residents, migrants, predators, carnivores, raptors, primary cavity excavators, and prey species. The area supports several species whose population levels are of concern at a regional, state and national level like, the spotted frog and goshawk. All Forest Management Indicator Species (MIS) occur in the area or have the potential to occur in the watershed. The majority of species with the potential to occur in the watershed are birds and the smallest group of species in the watershed is amphibians. The wild turkey population has grown, and continues to spread to adjacent watersheds. A relatively moderate population of elk and deer occupy the watershed, however, declines in the elk populations have occurred in the last few years. Critical winter range for elk and deer occur near in the mid section of the watershed. The Potamus watershed also contains a small bighorn sheep population, in the Potamus drainage.

Issues and Key Questions

The Watershed Assessment team, the Heppner Ranger District, NF John Day Ranger District, and others interested in the NF John Day/Potamus watershed, developed the following issues and concerns.

Issues and Concerns

- Move the landscape toward a more historic composition and structure of forested and non-forested areas.
- Restore and maintain wetland and riparian habitats
- Maintaining or enhancing late and old structure (LOS) in the watershed, including old growth habitat.
- Maintaining deadwood habitat (snags and downwood) at moderate to high levels in the watershed.
- Restore and maintain the large snag (>21") component throughout the watershed.
- Maintain or improve cover and forage for big game (elk) winter range.
- Maintain and enhance habitats for MIS species that have the potential to occur in the area.

- Maintain and enhance habitats for TES species that have the potential to occur in the area.
- Maintain and enhance habitats for species of interest or concern in the area.
- Maintain and enhance California bighorn sheep habitat in the Potamus drainage.
- Develop and maintain habitat for Neo tropical migratory birds in the area.

Key Questions

Habitat

- *How has habitat structure and composition changed from reference conditions?*
- *How has patch size and distribution of habitats changed in the watershed?*
- *What are the status and trend of late and old structure (LOS) and old growth habitat?*
- *What is the status and trend of deadwood (snags and downwood) in the watershed?*
- *Are there any "unique" habitat types in the watershed.*

Species

- *What is the species composition (diversity) in the watershed?*
- *What is the status and trend of Management Indicator Species (MIS) and their habitats?*
- *What is the status and trend of terrestrial threatened, endangered and sensitive (TES) species in the watershed?*
- *What is the status and habitat condition of species of "concern" and neo-tropical migratory bird?*
- *What is the current condition of bighorn sheep habitat and population trends in the watershed?*

Terrestrial Wildlife Habitat

Habitat Condition

The Vegetation section of this report describes the changes in the vegetative condition for the current (1997) and reference (1939) condition in more detail. This section summarizes that vegetative data in the context of wildlife habitat diversity in the Potamus watershed. To identify changes in habitat, the vegetative reference condition (1939) was compared to the existing (1997) vegetation in the Potamus watershed. Results of that comparison are found in Table 8-1.

Table 8-1: Reference (1939) and current (1997) habitat types (dominate forest species) on National Forest land in the NF John Day/Potamus watershed.

	Reference (1939)		Current (1997)		Difference from Refer [1]	
Cover Type	Acres	Percent [2]	Acres	Percent [2]	Acres	Percent
Engelmann/Subalpine fir	1,568	2%	337	0%	(1,231)	-1%
Lodgepole pine	10,341	10%	7,244	7%	(3,097)	-3%
Grand fir	8,892	9%	17,153	17%	8,261	8%
Douglas-fir	26,364	26%	36,494	37%	10,130	10%
Western larch	830	1%	861	1%	31	0%
Ponderosa pine	23,126	23%	12,737	13%	(10,389)	-10%

Cover Type	Reference (1939)		Current (1997)		Difference from Refer [1]	
	Acres	Percent [2]	Acres	Percent [2]	Acres	Percent
Aspen	0	0%	8	0%	8	0%
Juniper	121	0%	811	1%	690	1%
Shrub	567	1%	880	1%	312	0%
Grass/Meadow	27,780	28%	21,160	21%	(6,519)	-7%
Forb	0	0%	1,909	2%	1,909	2%
TOTAL	*99,590*	*100%*	*99,594*	*100%*		

[1] Numbers with a negative value occur in parentheses ( ) or with a minus sign (-). [2] Percent of National Forest land occupied by the cover type.

The more pronounced changes in forest types include decreases in the amount (acres) of ponderosa pine (-10%) and lodgepole pine (-3%) habitat. Forest types that increased include Douglas-fir (+10%) and Grand fir (+8%) habitat. Changes in habitat type can be reasonably determined from Maps 8-1 (1939) and 8-2 (2004). In 1939 lodgepole pine, Douglas-fir, and ponderosa pine tended to dominate the landscape in large contiguous blocks of habitat. For the exiting condition, Grand fir and Douglas fir dominate the landscape in large contiguous blocks. Other forest habitats generally occur as fragments within these large blocks of habitat.

Changes in non-forest types include a decrease in grass (-7%) and an increase in forb (+2%) habitat. Large expanses of grassland habitat occurred in the southern portion of the watershed in 1939. For the existing condition grasslands still dominate the non-forest types but they are more broken up with stringers of Douglas-fir (Map 8-2).

Most of the vegetation types represented in the reference condition also occurred in the current vegetative condition. Shrub, meadow, western larch, and aspen habitat types are represented the least or show little change. However, most of these habitat types have changed dramatically across the landscape. In addition, some of the low values of occurrence in the analysis maybe attributed to the difference in data collection methods and map resolution for the two data sets.

A comparison of reference and existing condition structural stages is found in Table 8-2. The more obvious changes in structural condition include decreases in the amount (acres) of stem exclusion close-canopy ((SECC) -5%), old forest multi-strata ((OFMS) –4%), old forest single-stratum ((OFSS) –4%), and young forest multi-strata ((YFMS) -3%). Forest types that increased include understory reinitiation ((UR) +11%), and stand initiation ((SI) +9%). In 1939, YFMS and SECC dominated the landscape in large contiguous blocks of habitat (Map 8-3). In 2004, SECC remain prevalent across the landscape and closely followed by UR, YFMS and SI (Map 8-4). However, these structural stages are widely distributed across the watershed as small patches of habitat. All structural stages are represented in the 2004 and 1939 vegetative data (Table 8-2)

Table 8-2. Reference (1939) and current (1997) forest structural stages (percent) on National Forest land in the Potamus watershed.

Structural Stage	Reference (1939)		Current (1997)		Difference from Refer [1]	
	Acres	Percent [2]	Acres	Percent [2]	Acres	Percent
Old Forest Multi-strata	5,761	6%	2,246	2%	(3,515)	-4%
Old Forest Single-stratum	6,776	7%	2,564	3%	(4,211)	-4%
Understory Reinitiation	1,910	2%	12,977	13%	11,068	11%
Young Forest Multi-strata	15,767	16%	12,966	13%	(2,801)	-3%
Stem Exclusion Closed-canopy	28,428	29%	23,835	24%	(4,593)	-5%
Stem Exclusion Open-canopy	10,560	11%	9,538	10%	(1,023)	-1%
Stand Initiation	2,009	2%	10,750	11%	8,741	9%
Bareground	0	0%	3,459	3%	3,459	3%
Non Forest	28,377	28%	21,267	21%	(7,110)	-7%
TOTAL	*99,588*	*100%*	*99,603*	*99%*		

[1] Numbers with a negative value occur in parentheses ( ) or with a minus sign (-). [2] Percent of forested National Forest land occupied by the structural stage.

Since 1939, habitat and structural composition has remained relatively unchanged. However, the distribution and patch size of habitat types and structural stages has changed significantly. Overall, stands have evolved to a more mixed composition, increased structural diversity, and smaller in size resulting in less interior habitat and more "edge effect." These changes can lead to a potential reduction in habitat quality for some terrestrial vertebrate species; especially those that require large blocks of a distinct habitat type. Conversely, the existing habitat condition has resulted in an increase in habitat quality and quantity for terrestrial species generalists and those associated with early successional habitats or small habitat patches (i.e. deer, barred owls, etc.).

Old Growth Habitat

Old Growth units are identified in the Forest Plan as C1 – Dedicated Old Growth or C2 – Managed Old Growth. Old growth units were initially classified as suitable and/or capable habitat for a selected Forest indicator species. Units are to be maintained as old growth tree habitat for the appropriate wildlife species (Forest Service 1990). Old growth (OG) tree habitat occurs in units from 75-300 acres in size and distributed across the Forest so that each 13,000 to 2,000 acre area contains a habitat unit. Unit size and distribution are variable and depend on the vegetation type and Forest indicator species (Forest Service 1990). Old growth management areas in the Potamus watershed are identified on Map 8-5.

Table 8-3. Old growth units on National Forest land in the NF John Day/Potamus watershed.

Management Area	Unit Number	Acres	Potential Vegetation Group	Management Indicator Species	Habitat Status [1]	
					1990	2004
C1	1201	331	Dry Upland Forest	Pileated Woodpecker	Suitable	
C1	1211	72	Dry Upland Forest	Pileated Woodpecker	Suitable	
C1	1211	87	Dry Upland Forest	Pileated Woodpecker	Suitable	
C1	1211	174	Dry Upland Forest	Pileated Woodpecker	Suitable	
C2	1222	25	Moist Upland Forest	Pileated Woodpecker	Capable	
C1	1222	99	Moist Upland Forest	Pileated Woodpecker	Capable	
C1	1222	99	Moist Upland Forest	Pileated Woodpecker	Capable	
C1	1222	124	Moist Upland Forest	Pileated Woodpecker	Capable	
C1	1631	320	Cold Upland Forest	Pileated Woodpecker	Suitable	
C1	1641	91	Dry Upland Forest	Pileated Woodpecker	Suitable	
C1	1641	269	Dry Upland Forest	Pileated Woodpecker	Suitable	
C1	1672	588	Moist Upland Forest	Pileated Woodpecker	Capable	
C1	1681	365	Dry Upland Forest	Pileated Woodpecker	Suitable	
C1	1691	58	Dry Upland Forest	Pileated Woodpecker	Suitable	
C1	1691	117	Dry Upland Forest	Pileated Woodpecker	Suitable	
C1	1691	229	Dry Upland Forest	Pileated Woodpecker	Suitable	
C1	1701	411	Dry Upland Forest	Pileated Woodpecker	Suitable	
C1	1942	25	Dry Upland Forest	Pileated Woodpecker	Capable	
C1	1942	124	Dry Upland Forest	Pileated Woodpecker	Capable	
Total C1		3,608				
C2	1968	106	Dry Upland Forest	Northern three-toed Wp	Capable	
C2	1977	82	Dry Upland Forest	Northern three-toed Wp	Suitable	
C2	1988	104	Cold Upland Forest	Northern three-toed Wp	Capable	
C2	1998	125	Cold Upland Forest	Northern three-toed Wp	Capable	
C2	2007	105	Moist Upland Forest	Northern three-toed Wp	Suitable	
C2	2017	115	Moist Upland Forest	Northern three-toed Wp	Suitable	
C2	2407	78	Moist Upland Forest	Northern three-toed Wp	Suitable	
Total C2		715				

[1] Suitable = existing old growth habitat meets Regional Guide to Northwest Region (1984 (Forest Service 1990)) definition. Capable = Area or acres capable of becoming old growth over time, but not now meeting Regional Guide (1984 (Forest Service 1990))

The analysis area contains 10 C1 units, consisting of 18 stands that total 3,608 acres as identified in Table 8-3. Seven of the C1 units were initially classified, during the Forest Planning process (1985-1990) as "pileated woodpecker, suitable" and three units were classified as "pileated woodpecker, capable. "Seven C1 units (1201, 1211, 1641, 1681, 1691 1701, and 1942) classified as "pileated woodpecker, suitable/capable" should not be considered suitable/capable for pileated woodpecker habitat. The potential vegetative group on these sites is a dry forest upland type and capable pileated woodpecker habitat, as a management indicator species, would be moist forest upland types (grand fir, mixed conifer, etc.). In addition, some of the units are slightly farther apart (0.1 – 0.3) than the recommended maximum quarter mile distance identified in the Forest-wide standards and guidelines (p4-56) and would need to be adjusted to meet the criteria in the Forest Plan. All seven units will remain as C1, dedicated old growth units, but should be re-classified in the database as "Other Inventory Old Growth" (i.e. ###9) because these units do not occur in "capable" habitat. These units will be maintained for other wildlife species (goshawk, Cooper's hawk, white-headed woodpecker, and others) associated with old growth habitat conditions (Forest Service 1990). The remaining three C1 units (1222, 1631, and 1672) do occur in moist or cold upland forest type and will continue to be managed for "pileated woodpecker, suitable/capable."

There are also seven C2 units/stands that total 715 acres in the watershed, identified in Table 8-3. Four of the C2 units were initially classified as "northern three-toed woodpecker, suitable" and three of the units were initially classified as "northern three-toed woodpecker, capable." Two C1 units (1968 and 1977) classified, as "northern three-toed, suitable/capable" should not be considered suitable/capable for northern three-toed habitat. The potential vegetative group on these sites is dry forest upland and capable northern three-toed habitat, as a management indicator species, would be lodgepole pine in the moist or cold forest upland types. Both stands will remain as C2, managed old growth units, but should be re-classified in the database as "Other Inventory Old Growth" (i.e. ###9) because these units do not occur in "capable" habitat. These units will be maintained for other wildlife species (Cooper's hawk, sharp-shinned hawk, Hammond's flycatcher, and others) associated with old growth habitat conditions (Forest Service 1990). The five remaining C2 units (1988, 1998, 2007, 2017, and 2407) do occur in cold or moist upland forest and will continue to be managed for "northern three-toed woodpecker, suitable/capable."

Late and Old Structure

Historical Range of Variability

The wildlife standards in the Regional Forester's Forest Plan Amendment #2 (Forest Service 1995), requires the evaluation of late and old structural (LOS) stages relative to the quantity of late and old structural stages within or outside the historical range of variability. For the purpose of this standard, late and old structural stages include old forest multi-strata and old forest single-stratum

Over time, late and old structure has fluxed throughout the watershed as a result of natural disturbance, stand dynamics, and anthropogenic activities. For example, when comparing late and old structure reference condition (1939) to the current amount (Table 8-2); a 4% reduction in old forest multi-strata and old forest single-stratum occurred in the watershed.

The historical range of variability (HRV) and current amount of old forest for each potential vegetation group (PVG) in the Potamus watershed is shown on Table 8-4. When compared to the historical range of variability (HRV) old forest structure is below the historic range in the cold, moist and dry potential vegetation groups for the multi-strata. In the old forest single stratum group, the current condition is below the historic range only in the dry forest group. Old forest single-stratum is above the historic range of variability in the moist potential vegetation group.

Table 8-4. Historic range of variability (HRV) analysis for late and old forest structural classes[1]***.***

Potential Vegetation Group		Old Forest Multi Strata		Old Forest Single Stratum		NFS Acres (Total)
		Historic Range	Current	Historic Range	Current	
Cold	*Percent*	*10-40%*	*1%*	*0-5%*	*4%*	11,328
	Acres[2]	1,100-4,500	100	0-600	500	
Moist	*Percent*	*10-30%*	*2%*	*0-5%*	*8%*	10,678
	Acres[2]	1,100-3,200	200	0-500	900	
Dry	*Percent*	*5-20%*	*3%*	*15-55%*	*2%*	56,329
	Acres[2]	2,800-11,300	200	8,400-31,000	1,100	
Total						

1 – Mostly based on Table 5-28 of this document. 2 - Acre values are rounded off to the nearest 100 acres.

<u>Connectivity</u>

Additional wildlife standards in the Regional Forester's Forest Plan Amendment #2 (Forest Service 1995), requires late and old structural stands and Forest Plan old growth areas to be connected to each other in the watershed. For this standard, connective habitat does not necessarily need to meet the same description of suitable habitat, but provide "free movement", between late and old structural stands and old growth areas, for a various wildlife species associated with a late and old structural condition.

In 1939, old forest structural stages where not dominant across the landscape (Map 8-6). Old forest stands occurred as clusters in the watershed and well connected to similar late and old structure habitat. Interior habitat was available but was limited by the moderate size blocks of habitat. In 2004, old forest structural stages are smaller and widely scattered across the landscape. Available interior habitat is minimal because of the small patches of habitat but old forest stands remain connected to similar late and old structure and old growth habitat (Map 8-7).

Currently, for the majority of the watershed, late and old structural stands and old growth areas are connected to each other with medium (9 to 14.9 inches diameter breast height) to large trees (greater than 14.9 inches diameter breast height), stands with variable widths greater than 400 feet, and attached with 2 or more different connections. The least connected areas generally includes stands where recent (< 15 years) insect and disease outbreaks, wildfire, and harvest have occurred reducing the density of trees in those areas. Late and old structural habitat remains connected around these areas.

Depending upon the plant association group and the species associated with late and old forest structure and old growth habitat, the current amount, size and distribution of late and old structure could lead to larger home ranges for some species. This could result in an increase in their susceptibility to predation, and greater energy expenditure for survival. Ultimately, this could lead to reduced or lower populations of some species associated with late and old structure.

Historic, high levels of late and old structure may have supported higher populations of some species than the current condition.

Dead Standing Trees (Snags)

Historic information on deadwood (dead standing and downwood) habitats does not occur for the Potamus watershed. However, the general assumptions, based on the vegetative condition in 1939, include, snags and down logs were most likely more abundant in cold and moist conifer stands across the watershed and less abundant in the high frequency fire, dry pine communities. Dead wood densities generally fluctuated with "natural" mortality and the frequency and intensity of large and small-scale disturbances, such as fires, insect and disease, ice storms, and drought that have occurred historically throughout the area.

Current vegetative surveys (CVS) data was used to evaluate deadwood conditions in the watershed. The current vegetative survey (Brown 2004) consists of permanent plots on a 1.7-mile grid that samples the vegetative condition across National Forest Lands. At each plot/point, a variety of vegetative information is collected including, plant association, live trees, dead trees, and downwood, with diameters and heights for each species tallied. Plot data was collected on the Umatilla National Forest between 1993-1995 and re-measured on selected plots in 1997, 1999, and 2002.

For the deadwood (dead standing and downwood) analysis, dead standing tree data was collected on 188-forested CVS plot/points in the Potamus watershed with 147 plot/points in the dry type, 46 plot/points in the moist and 18 plot/points in the cold. Plots are stratified by potential vegetation group (PVG) and size class. Deadwood is tallied for each 2" diameter class in the plot/point then aggregated by potential vegetation group and divided by the number of plot/points to arrive at an average number of deadwood pieces for each size class in a potential vegetation group. This data is used in the analysis to estimate snag and downwood densities at the watershed scale for comparison with Forest Plan standards and guidelines and the Decayed Wood Advisor (Mellen et al 2004).

CVS estimates used in this analysis are <u>not statistically valid at the project scale</u> or for a specific site within the watershed. Snags and downwood tend to occur on the landscape as singles, groups, clumps, patches or piles resulting from "natural" tree mortality and disturbances, such as fires, insect and disease, ice storms, and drought. These random events result in an uneven distribution of snag and downwood across the landscape or watershed. However, estimates derived from <u>CVS inventories are appropriate at the watershed scale</u> (or larger), providing statistically valid estimates for the watershed.

<u>Forest Plan</u>

The Umatilla Forest Plan (Forest Service 1990) established standards and guidelines for dead standing and downwood for various levels of biological potential in each management area. The plan was amended in 1995 by the Regional Forester's Forest Plan Amendment #2 (Forest Service 1995), also known as the "Eastside Screens." This amendment requires the retention of snags and green replacement trees greater than or equal to 21 inches diameter breast height (or the representative diameter of the overstory layer trees if they are less than 21 inches diameter breast height), at 100 percent potential population levels of primary cavity excavators (Thomas 1979). Based on the amended direction, "new" snag requirements and replacement trees objectives were developed for the five vegetative working groups on the Forest and documented in the memo, "*Interim Snag Guidance for Salvage Operation*" (Forest Service 1993).

Table 8-5. Current (2002) dead standing tree (snags) density on National Forest land in the NF John Day/Potamus watershed.

LMRP, Umatilla NF Guidelines		Potamus Watershed (CVS Data)	
Working Group	Density	Potential Vegetation Group	Density
Ponderosa pine	0.75 snags/ac. ≥10" dbh 1.36 snags/ac. ≥12" dbh 0.14 snags/ac. ≥20" dbh *2.25 snags/ac. Total*	*Dry Upland Forest*	7 snags/ac. ≥10" dbh 5 snags/ac. ≥12" dbh 1 snags/ac. ≥20" dbh
South Associated (Mixed conifer)	0.75 snags/ac. ≥10" dbh 1.36 snags/ac. ≥12" dbh 0.14 snags/ac. ≥20" dbh *2.25 snags/ac. Total*	*Moist Upland Forest*	19 snags/ac. ≥10" dbh 14 snags/ac. ≥12" dbh 3 snags/ac. ≥20" dbh
North Associated (Grand fir)	0.30 snags/ac. ≥10" dbh 1.36 snags/ac. ≥12" dbh 0.14 snags/ac. ≥20" dbh *1.80 snags/ac. Total*		
Lodgepole pine	1.21 snags/ac. ≥10" dbh 0.59 snags/ac. ≥12" dbh *1.8 snags/ac. Total*	*Cold Upland Forest*	2 snags/ac. ≥10" dbh 2 snags/ac. ≥12" dbh 1 snags/ac. ≥20" dbh
Subalpine Zone	1.21 snags/ac. ≥10" dbh 0.59 snags/ac. ≥12" dbh *1.8 snags/ac. Total*		

Dead standing tree densities for the Potamus watershed are found in Table 8-5. In general, most of the snags occur in the smaller size classes and moister sites and fewer snags occur in the larger diameter classes and dryer sites. In the Potamus watershed, the greatest number of snags occurred in the moist forest type and the least number of snags occurred in the cold forest type. The Dry Forest potential vegetation group has a total of 7 snags per acre greater than or equal to 10 inches in diameter at breast height and 1 snag per acre greater than 20 inches diameter at breast height. The Moist Forest group contains 19 snags per acre greater than or equal to 10 inches in diameter at breast height and 1 snag per acre greater than 20 inches in diameter at breast height. The Cold Forest type has 2 snags per acre greater than or equal to 10 inches in diameter at breast height and 1 snag per acre greater than 20 inches in diameter at breast height. Overall, snag densities exceed Forest Plan standards and guidelines for each potential vegetation group and each size class group in the Potamus watershed. However, as identified in the Forest Plan (Forest Service 1990, p4-57), snag densities are to be maintained "… for each logical harvest size unit (or no larger than 40 acres units)." While snag densities may appear to be above standards and guidelines across the watershed; densities may be far below standards at the project level and many locations in the watershed. During project development, verify dead standing tree densities at the project level.

Decayed Wood Advisor

Since 2003, the Decayed Wood Advisor (DecAid) by Mellen et al. (2004) has become available for deadwood analysis. DecAid provides information and guidance to land managers in evaluating effects of forest conditions for existing or proposed management activities on organisms that use dead standing (snags), downwood, and other wood decay elements. DecAid is a statistical summary of empirical data from published research on wildlife and deadwood. Data provided in DecAid allows the user to relate the abundance of deadwood habitat for both snags and down logs to the frequency of occurrence of selected wildlife species that require deadwood habitat for some part of their life cycle. This data is presented at 30 percent, 50 percent, and 80 percent "tolerance levels." Tolerance levels are not indicators of population viability or potential populations. Tolerance levels are estimates of all individuals in the population that value a particular parameter (e.g., snag density, snag diameter, downwood density, etc. (Mellen et al. 2004)). Tolerance levels are equivalent to the potential (percent) for individuals to occur in an area that has certain deadwood characteristics. Essentially, the lower the tolerance level, the fewer individuals will likely use the area. DecAid evaluations are best performed at the landscape, watershed, or larger scale. In this analysis, DecAid will be compared to current snag level, determined from current vegetative surveys (CVS) in the Potamus watershed.

Four of the DecAid wildlife habitat types occur in the Potamus watershed. They include Lodgepole Pine forest, Montane Mixed Conifer forest, Eastside Mixed-conifer forest (Blue Mountains), and Ponderosa Pine/Douglas-fir forest. The dominant vegetative coverage in the watershed is ponderosa pine. All structural condition classes occur in the watershed, but the most prevalent structure is the small/medium class. Dead standing tree densities relative to DecAid and the Potamus watershed are found in Table 8-6.

Table 8-6. DecAid tolerance levels and current snag densities on National Forest land in the NF John Day/Potamus watershed.

DecAid Habitat Types	Potential Vegetation Group	Structural Condition	DecAid (30%-80% t.l.) Snag Density (#/ac.)		Potamus Watershed Snag Density (#/ac.)	
			≥ 10" dbh	≥ 20" dbh	≥ 10" dbh	≥ 20" dbh
Lodgepole Pine Forest and Woodland* Montane Mixed Conifer Forest	Cold Upland Forest	Large Small/Medium Open	Not Data	Not Data	2	1
Montane Mixed Conifer Forest Eastside Mixed Conifer Forest - BM	Moist Upland Forest	Large	5-27	4-15	19	3
		Small/Medium	7-32	3-10		
		Open	4-58	1-13		
Ponderosa Pine/Douglas-fir Forest	Dry Upland Forest	Large	5-13	2-10	7	1
		Small/Medium	1-7	1-3		
		Open	3-15	2-5		

Snag densities for the lodgepole pine and montane mixed conifer forests types in the cold upland forest group have not been determined in DecAid and therefore will not be discussed further. For the watershed, the greatest number of snags (19/ac) occurred in the moist upland forest type including montane mixed conifer and eastside mixed conifer forest habitat types. The least number of snags occurs in the cold forest types, however, the number of CVS sample for this vegetation type in the watershed is small and may not provide a good estimate of snag density for this potential vegetation type. Overall, snag densities in the Potamus watershed exceed or meet the 30% tolerance level in the greater than 10-inch and greater than 20-inch group for the moist and dry forest habitat types in the watershed.

Moist Upland Forest

The Forest management indicator species associated with the moist forest type including, montane mixed conifer and eastside mixed conifer consist of the pine marten and the pileated woodpecker. In DecAid, the small/medium/large size classes were combined in the eastside mixed conifer, cumulative species curves for snag density. Current dead standing tree densities (Table 8-6) exceeded the 50 percent tolerance level (16 snags/ac) for the marten but fall short of the 50 percent tolerance (29 snag/ac) for the pileated woodpecker for nesting/denning and roosting habitat for the greater than or equal to 10-inch diameter class. In the greater than or equal to 20-inch diameter class, snag densities in the watershed (Table 8-6) fall short of the 50 percent tolerance levels for marten (5 snag/ac) and pileated woodpecker (7 snags/ac). The 30 percent and 80 percent tolerance levels for both the greater than 10-inch group and 20-inch group are not represented in the DecAid cumulative species curves for these two species. Because of the random distribution of snags across the landscape, some areas will exceed the 80 percent tolerance levels for marten and pileated woodpecker in the 10-inch and 20-inch diameter classes.

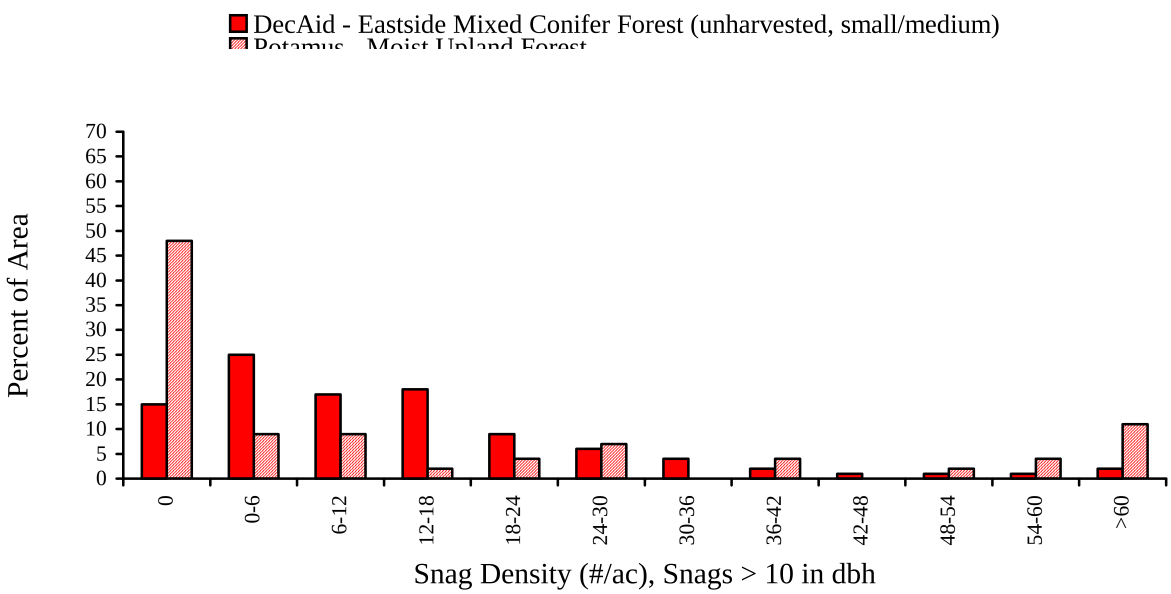

Figure 8-1. The distribution of snag densities ≥ 10 inches diameter at breast height for the Eastside Mixed conifer habitat type and moist upland forest type on National Forest land in the NF John Day/Potamus watershed.

Figure 8-1 compares the current distribution of snags with the unharvested distribution of snags. The distribution of snags in unharvested plots (Mellen et al. 2004) is used as a surrogate to represent a potential “historic” distribution of snags for the Eastside mixed conifer forest type and/or moist upland forests types in the watershed. In the greater than 10-inch class; there is currently more than 3 times as much area (49%) occurs without snags then the amount of area in unharvested (historic) plots ((15%) Mellen et al. 2004). This is further expressed with the current decrease in area for snags in the 0-6, 6-12, 12-18, and 18-24 snag per acre groupings. In addition Figure 8-1 shows the highest snag densities (48-54, 54-60, and >60 snag/ac) consist of approximately 17 percent of the area while potentially these densities occurred on about 4 percent of the area. Overall, snag densities greater than 10-inches diameter at breast height, in the moist upland forest type are distorted at both ends of the distribution curve for the Potamus watershed.

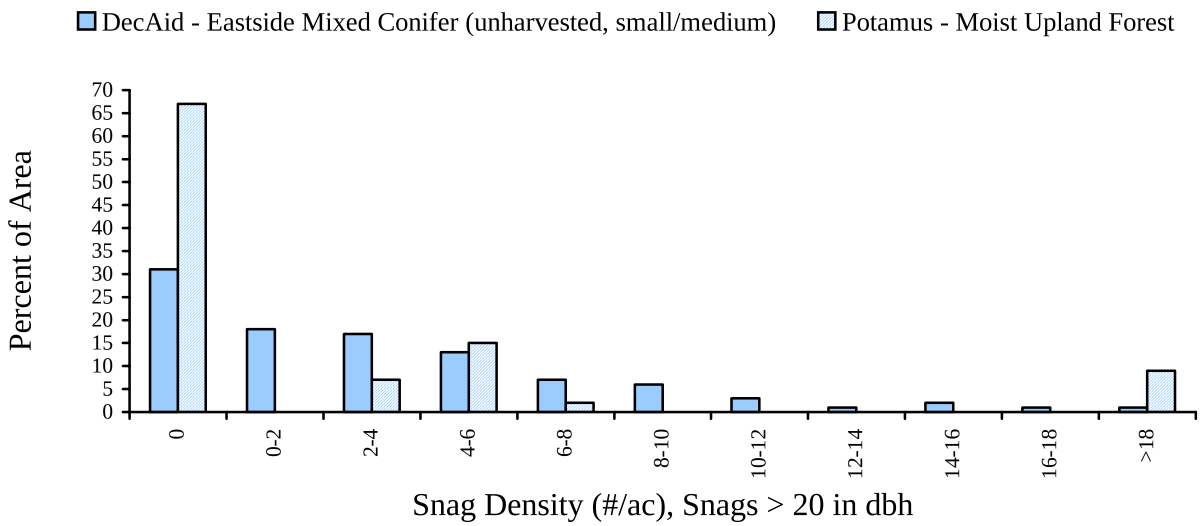

Figure 8-2. The distribution of snag densities ≥ 20 inches diameter at breast height for the Eastside Mixed conifer habitat type and moist upland forest type on National Forest land in the NF John Day/Potamus watershed.

Figure 8-2 compares the current distribution of snags and the unharvested distribution of snags for the moist forest types, greater than or equal to 20-inches in diameter at breast height. Currently, there is more than twice as much area (67%) without snags then the amount of area in unharvested (historic) plots ((31%) Mellen et al. 2004). Also, there is at least a 50 percent decrease in area for snags in the 0-2, 2-4, and 6-8 snags per acre groupings. Figure 8-1 also shows the highest snag density, >18 snag/ac, consist of approximately 9 percent of the area while potentially these densities occurred in about 1 percent of the area. Overall, snag densities greater than 20-inches in diameter at breast height, in the moist upland forest type have the greatest difference at the upper end of the distribution curve for the Potamus watershed.

Dry Upland Forest
The white-headed woodpecker is the best representative for the dry forest type and the ponderosa pine/Douglas-fir habitat type, because potential habitat conditions are closer to historical vegetative condition in the Potamus watershed. In DecAid, the small/medium/large size classes were combined in the ponderosa pine/Douglas-fir forest types, cumulative species curves for snag density. Current dead standing tree densities (Table 8-6) exceeded the 80 percent tolerance level (4 snags/ac) for the white-headed woodpecker for nesting and roosting habitat in the greater than or equal to 10-inch diameter class. In the greater than or equal to 20-inch diameter class, snag densities in the watershed (Table 8-6) are greater than the 30 percent tolerance level but fall short of the 50 percent tolerance levels for white-headed woodpecker (2 snag/ac) across the watershed. Because of the random distribution of snags across the landscape, some areas will exceed the 80 percent tolerance levels for white-headed woodpecker in the 10-inch and 20-inch diameter classes.

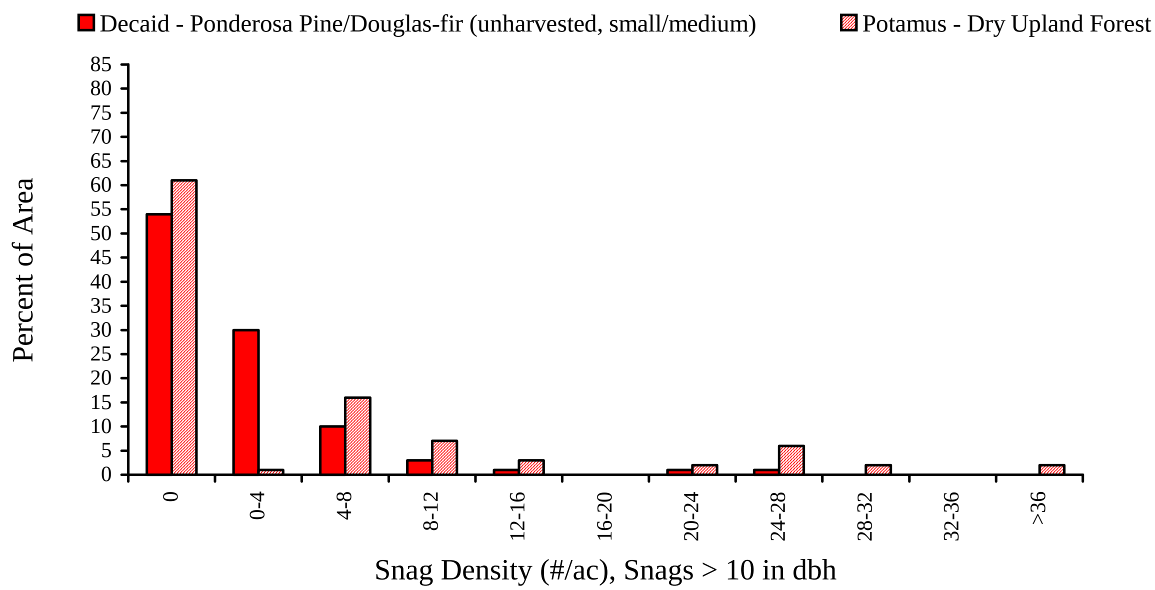

Figure 8-3. The distribution of snag densities ≥ 10 inches diameter at breast height for the ponderosa pine/Douglas-fir habitat type and dry upland forest type on National Forest land in the NF John Day/Potamus watershed.

Figure 8-3 compares the current distribution of snags with the unharvested distribution of snags. As mentioned previously, unharvested plots (Mellen et al. 2004) are used as a surrogate to represent a potential "historic" distribution of snags for the ponderosa pine/Douglas-fir forest type and/or dry upland forests types in the watershed. In the greater than 10-inch class; the current amount of area with zero snags (61%) is relatively close to the amount of area for unharvested (historic) plots ((54%) Mellen et al. 2004). Increases in area by 50 percent or more of the current condition, occur in most of the snag density groupings (4-8, 8-12, 12-16, 20-24, 24-28, 28-32, and greater than 36 snags/ac). The only current decrease in area for the watershed occurs in the 0-4-snags/ac groups, with a 29 percent decrease from potential area.
Figure 8-4 compares the current distribution of snags and the unharvested distribution of snags for the dry forest types, greater than or equal to 20-inches in diameter at breast height. Similar to the greater than 10 inch group, snag in the greater than 20 inch group are relative close to the amount of area currently in the watershed (83%) and the amount of area for unharvested (historic) plots ((71%) Mellen et al. 2004). Increases in area, by 50% or more occur in the 4-6 and 6-8 snag/acre groupings. Decreased occur in the 0-2 and 2-4 snags/acre groupings.

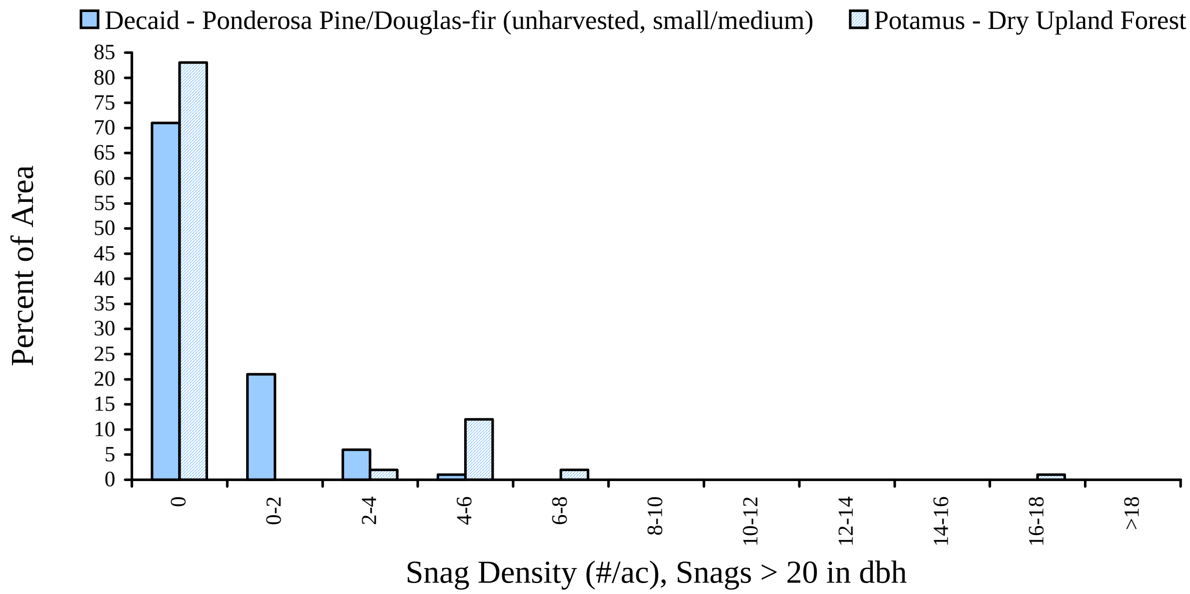

Figure 8-4. The distribution of snag densities ≥ 20 inches diameter at breast height for the ponderosa pine/Douglas-fir habitat type and dry upland forest type on National Forest land in the NF John Day/Potamus watershed.

Snag Replacement Trees

Forest Plan

Snag replacement trees ("green" trees) were analyzed to determine the potential for recruitment of dead tree habitat overtime across the landscape. Current Forest Plan direction for "green" replacement tree (GRT) densities is based on the Regional Forester's Forest Plan Amendment #2 (Forest Service 1995) and Interim Snag Guidance for Salvage Operation (Forest Service 1993). For this analysis, current vegetation survey data was used to provide information on potential replacement trees in the Potamus analysis area.

The Forest's amended standards and guidelines for snag replacement trees and densities for the Potamus watershed are found in Table 8-7. Generally, the dry and moist forest types have the greatest number of replacement tree and most of those trees occur in the 10 and 20-inch diameter class. Fewer replacement trees occur in the larger diameter class (>20 in) all upland forest types. Replacement tree densities in the cold forest type are the lowest. The low densities may be the result of a limited number cold forest CVS plots in the watershed that biased the snag replacement density in the watershed. Overall, snag replacement tree densities exceed Forest Plan standards and guidelines for each potential vegetation group and size class group in the Potamus watershed. However, snag and replacement tree densities may appear to be above standards and guidelines across the watershed, but densities may be far below standards at the project level and other location across the watershed. During project development, verify snag replacement tree densities at the project level.

Table 8-7. Current (2002) snag replacement tree ("green") density on National Forest land in the NF John Day/Potamus watershed.

LMRP, Umatilla NF Guidelines		Potamus Watershed (CVS Data)	
Working Group	Density	Potential Vegetation Group	Density
Ponderosa pine	7.5 trees/ac. ≥10" dbh 13.6 trees/ac. ≥12" dbh 1.7 trees/ac. ≥20" dbh *22.8 trees/ac. Total*	*Dry Upland Forest*	41 snags/ac. ≥10" dbh 27 snags/ac. ≥12" dbh 5 snags/ac. ≥20" dbh
South Associated (Mixed conifer)	5.6 trees/ac. ≥10" dbh 9.1 trees/ac. ≥12" dbh 1.1 trees/ac. ≥20" dbh *15.8 trees/ac. Total*	*Moist Upland Forest*	32 snags/ac. ≥10" dbh 24 snags/ac. ≥12" dbh 8 snags/ac. ≥20" dbh
North Associated (Grand fir)	1.5 trees/ac. ≥10" dbh 6.8 trees/ac. ≥12" dbh 1.1 trees/ac. ≥20" dbh *9.4 trees/ac. Total*		
Lodgepole pine	10.1 trees/ac. ≥10" dbh 4.3 trees/ac. ≥12" dbh *14.4 trees/ac. Total*	*Cold Upland Forest*	10 snags/ac. ≥10" dbh 6 snags/ac. ≥12" dbh 1 snags/ac. ≥20" dbh
Subalpine Zone	13.9 trees/ac. ≥10" dbh 5.3 trees/ac. ≥12" dbh *19.2 trees/ac. Total*		

Dead Downwood

Dead downwood is dependent on disturbances creating snags and snags subsequently falling to the ground. Downwood will remain on site until it "naturally" decomposes, burned up in a wildfire, or physically/mechanically removed. These actions may result in a reduction of downwood, until snag fall occurs again on the site. Generally, downwood occurs as scattered, clustered, and/or piled of logs and/or limbs within the affected area. For this analysis current vegetation survey data was used to provide information on downwood in the Potamus analysis area and across the watershed.

Forest Plan

Current Forest Plan direction for downwood densities is based on the Regional Forester's Forest Plan Amendment #2 (Forest Service 1995). Downwood retention density is designed to meet future down log needs in combination with natural mortality. Logs should be maintained at their current length and not cut into pieces. Longer logs can count as multiple pieces.

The Forest's amended guidelines for downwood densities and densities for the Potamus watershed are found in Table 8-8. Generally, downwood densities are low across the watershed. The exception is the dry upland forest types where, downwood density is greater than the Forest Plan standard. In the moist upland forest type, downwood density is at least 50% below the Forest Plan standard. In the cold upland forest type, downwood density is slightly below the minimum standard for the Forest Plan. However, the low density in the cold upland forest type may be the result of a limited number of CVS plots in the watershed to accurately assess density for cold forest types in the watershed.

Table 8-8. Current (2002) downwood density on National Forest land in the NF John Day/Potamus watershed.

LMRP, Umatilla NF Guidelines		Downwood/ Log Criteria	Potamus Watershed (CVS Data)	
Species	Density		Potential Vegetation Group	Density
Ponderosa pine	3-6 pcs/ac	Small end dia. >12 inches Piece length >6 feet Total length 20-40 feet	*Dry Upland Forest*	10 pcs/ac
Mixed conifer	15-20 pcs/ac	Small end dia. >12 inches Piece length >6 feet Total length 100-140 feet	*Moist Upland Forest*	9 pcs/ac
Lodgepole Pine	15-20 pcs/ac	Small end dia. >8 inches Piece length >8 feet Total length 120-160 feet	*Cold Upland Forest*	14 pcs/ac

Riparian, Wetland, and Aspen Habitats

Historic information for riparian habitats, wetlands, and aspen stands in the Potamus watershed is sketchy and limited to anecdotal accounts. Wetland habitats were probably always limited in both size and distribution across the Blue Mountains, including the analysis area. Many wet meadows, springs and seeps most likely occurred across the analysis area. Unrestricted grazing in the late 1800's and early 1900's resulted in degraded wetland vegetation and lower water tables, reducing the size and distribution of wetland habitats. Old photographs and remnant stands suggest that aspen in the Blue Mountains was more widespread at the turn of the century than today, but mostly occurred in small patches (<25 ac.). Riparian broadleaf communities of cottonwood, alder, and willows occurred along all the major stream and river corridors in the watershed and most likely occurred in larger patches and contained large diameter trees.

The existing vegetation database used for this analysis did not provide detailed information on riparian, wetland, and aspen communities. These communities do occur in the watershed on a limited basis, however, the extent of individual stands is less than the 5-acres in size. The watershed does contain a few small wetlands (moist/wet meadows), generally less than a few acres (2-3) in size. Broadleaf communities primarily occur along the major rivers and streams in the watershed, including Potamus Creek, Five Mile Creek, and Ellis Creek.

In the Blue Mountain, aspen stands occur in small clumps or stringers along stream channels, wet meadows, seeps, and areas where a high water table is present. Occasionally, aspen occur as pure stands, but more commonly are found growing in association with conifers. Stands are generally found between 3,000 to 6,000 feet in elevation. Numerous stands of aspen have been identified in the Potamus watershed that exceeds a total of 50 acres. Most of stands are less than quarter of an acre in size, but some are around one acre in size. These stands are scattered along Morsay Creek, Matlock Creek, Thompson Creek, Five Mile Creek Little Potamus Creek, Ditch Creek, Hinton Creek and Meadow Brook Creek in the Potamus watershed. Map 8-8 shows the general location and distribution of aspen in the watershed. The map represents aspen stand currently in the Forest "aspen" coverage. That cover does not provide an up-to-date representation of aspen on National Forest land in the watershed.

"Unique" Habitats

Rocky outcrops and talus slopes within the watershed have changed very little since the early 1900's. However, access (roads and trails) to these areas and the availability of cover (conifer, shrubs, etc.) around and adjacent to these areas can change the character and resultant habitat suitability of the area. While the significance of cover around these sites is not clear, intuitively it affords a degree of security to move between areas and provides screening from an increasing human presence (i.e. roads, site development, etc.) that could affect survival and reproduction for some species. Large expanses of rock outcrops or "non-forest" areas should remain unroaded as much as possible.

Terrestrial Wildlife Species

Overview

There are about 204 terrestrial vertebrates species that have the potential to occur on National Forest land in the NF John Day/Potamus watershed, including 138 birds, 47 mammals, 12 reptiles, and 7 amphibians (Appendix A). Over half (59%) of these terrestrial animals are considered resident species on the Forest; five of the resident species have been introduced to the area. The remaining species are migrants that come to the area during the winter or summer or through the area in the fall and spring. All of the migrant species are birds and they represent about 62 percent of the bird population in the watershed. In terms of frequency of occurrence, 89 species are common, 97 uncommon, and 18 are considered rare (Appendix A) to National Forest lands in the watershed.

Out of the 204 species with the potential to occur in the watershed, 5 are Forest Plan management indicator species. Three species on the Potamus watershed list are identified as threatened (2) or candidate (1) species by the Fish and Wildlife Service. Six species in the watershed are on the Regional Foresters' Sensitive Animals list. Numerous species in the watershed are listed by the State of Oregon as threatened (2), endangered (2), sensitive "critical"(9), sensitive "vulnerable (6) or sensitive "undetermined status (6). In addition, there are numerous species of "interest" to the public that have the potential to occur in the watershed.

Most wildlife species that occur or have the potential to occur in the Potamus watershed also occurred historically in the drainage. Grizzly bear and gray wolves, once native to northeast Oregon and the Blue Mountains, no longer occur in the area. Some species (bald eagle, wolverine, etc.) may have been widely distributed in the Blue Mountains historically but occur now in limited numbers and at few locations. On the other hand, species like elk and starlings have increased in numbers and distribution since the early 1900's.

The overall goal of wildlife management on the Forest is to maintain "viable populations" of species at the planning scale (36 CFR 219.19). Historic and current population estimates for most species in the watershed is not available. Historical information on species and their distribution is limited to anecdotal accounts from explorers, trappers, and pioneers passing through the region. The most reliable estimates for current populations are from the Oregon Department of Fish and Wildlife big game surveys. Recently, a Terrestrial Wildlife Inventory was conducted in the watershed in 2003. The survey uses current vegetative survey (CVS) sample plots to obtain basic occurrence data for wildlife species at sites that represent a relative sample for the area. Data collected from plots can be used to make inferences about species diversity, distribution, and relative abundance. In addition to the Terrestrial Wildlife Inventory, there are numerous miscellaneous observations of various species observed in the area and on the forest. Finally, formal species inventories have been conducted on the Forest since 1990, including forest carnivores, Neotropical migratory birds, shrews and lynx to name a few.

The results and discussion that follow are based on a compilation of vegetative data and species observations, with the intent to portray trends in habitat quality and quantity and species occurrence. Available data is compared for a select group of species for to two different "snap shots" in time, 1939 (reference condition) and 2004 (current condition). Results of this evaluation should not be viewed as having statistical reliability and, therefore, should be interpreted cautiously. Table 8-9 identifies the parameters used to query various vegetative and topographic conditions that represent habitat feature in this analysis.

Table 8-9. Selected species with habitat indicators used to model current and historic habitat availability on National Forest land in the NF John Day/Potamus watershed.

Species	Habitat	Cover Type	Structural Stage	Tree Cover	Other Habitat Features
Rocky Mountain Elk C3 – Winter Range	SC	ABLA2, PIEN, PICO, ABGR, PSME, PIPO-mix, & Mixed	SECC, YFMS, OFSS, OFMS	≥70%	≥2 Canopy layers
		PIPO (not PIPO-mix)		≥50%	
	MC	ABLA2, PIEN, PICO, ABGR, PSME, PIPO, LAOC, & all Mixed	SECC, SEOC, YFMS, UR, OFMS, OFSS	≥40%	
	F	All stands not classified as SC or MC, except rock			
Rocky Mountain Elk C4 – Wildlife Habitat	SC	All forest cover types	SECC, YFMS, OFSS, OFMS	≥70%	≥2 Canopy layers
	MC	All forest cover types	SECC, SEOC, YFMS, UR, OFMS, OFSS	≥40%	
	F	All stands not classified as SC or MC, except rock			
Rocky Mountain Elk E2 (E1) – Timber & Big Game	SC	ABLA2, PIEN, PICO, ABGR, PSME, PIPO-mix, & Mixed	SECC, YFMS, OFSS, OFMS	≥70%	≥2 Canopy layers
		PIPO (not PIPO-mix)		≥50%	
	MC	All forest cover types	SECC, SEOC, YFMS, UR, OFMS, OFSS	≥40%	
	F	All stands not classified as SC or MC, except rock			
Pileated Woodpecker	R1	PIEN, ABGR, Mix, PSME, HC	OFMS	>=70%	
	R2	PIEN, ABGR, Mix, PSME, LAOC, PIPO, HC	YFMS, OFSS, OFMS	>=50%	
	F1	PIEN, ABGR, Mix, PSME, HC	OFMS		
	F2	ABLA2, PIEN, PICO, ABGR, Mix, PSME, LAOC, PIPO, HC	YFMS, UR, OFSS, OFMS		
Northern three-toed Woodpecker	R1	ABLA2, PICO	OFMS		Elev. ≥4,500 ft.
	R2	PIEN, Mix			
	F1	ABLA2, PIEN, PICO	OFMS, OFSS		
	F2	ABGR, Mix, PSME			
Pine Marten	R1	ABLA2, PIEN, PICO	OFMS	Total Cover >= 40%	Elev. ≥ 4,000 ft.
	R2	Mix, PSME			
	F1	ABLA2, PIEN, PICO	YFMS, OFMS		
	F2	Mix, PSME	YFMS, OFSS, OFMS		
Wolverine	Natal Denning	NF, Rock, Talus	N/A	N/A	Aspects: N, NE, NW, & E Elev.≥ 5,000 ft.
	F1	ABLA2, PIEN, PICO	SEOC, SECC, YFMS, UR, OFSS, OFMS		Elev. ≥4,000 ft.
	F2	ABGR, Mix, PSME, LACO, PIPO, HC			

Species	Habitat	Cover Type	Structural Stage	Tree Cover	Other Habitat Features
Northern Goshawk	R1	ABGR, Mix, PSME, LACO, PIPO	OFSS, OFMS	>= 50%	
	R2	ABLA2, PIEN, PICO			
	F1	ABGR, Mix, PSME, LACO, PIPO	SI, SEOC, SECC, YFMS, UR, OFSS, OFMS		
	F2	ABLA2, PIEN, PICO			

SC= Satisfactory Cover, MC= Marginal Cover, F= Forage, F1= Primary Foraging Habitat, F2= Secondary Foraging Habitat, R1= Primary Reproductive Habitat, R2= Secondary Reproductive Habitat, NF= Non Forest HC= Cottonwood, BU= Burned Area

Management Indicator Species (MIS)

A list of Forest management indicator species (Forest Service 1990) with the potential to occur in the Potamus watershed are found in Table 8-10 along with the representative habitat requirement/condition. The habitat requirements of the selected indicator species are presumed to represent a larger group of wildlife species. The following discussion provides a more specific discussion of reference and current habitat conditions for each MIS in the analysis area.

Table 8-10. Forest Plan management indicator species with the potential to occur on National Forest land in the NF John Day/Potamus watershed.

Species	Habitat Types
Rocky Mountain elk	General forest habitat and winter ranges.
Pileated woodpecker	Dead/down tree habitat (mixed conifer) in mature and old stands.
Northern three-toed woodpecker	Dead/down tree habitat (lodgepole pine) in mature and old stands.
Pine marten	Mature and old stands at high elevations (>4000').
Primary cavity excavators	Dead/down tree (snag) habitat.

<u>Rocky Mountain Elk</u>

The historic population density and distribution of elk in the watershed is not well known. However, antidotal accounts of elk in Bailey 1936 provide some insight on elk population in the Blue Mountains. Accounts from "old settlers" noted, "35 years ago (from 1919) elk were plentiful almost everywhere throughout this section of the (Blue) mountains." And "In crossing the Blue Mountains from the north in 1895-96, they saw old elk horn at the ranches and was told that there were still a few elk in the wildest parts of these mountains." Elk reached their lowest numbers about 1910. Reintroduction from Yellowstone National Park began in 1911 and continued sporadically until 1930 (Bailey 1936 and Cliff 1934). By 1926, transplants and remnant elk population on the Umatilla NF was estimated at 2,035 animals and grew to 3,080 animals in 1933 (Bailey 1936).

Currently, the Potamus watershed primarily occurs in the eastern portion of the Heppner wildlife management unit (wmu) of the Oregon Department of Fish and Wildlife (ODFW). In addition, about 20 percent of the watershed, the southeast corner occurs in the Desolation wildlife unit. The Heppner unit contains about 32 percent public land with most of it National Forest land. As noted in Figure 8-5, elk populations in the unit have remained relatively stable and above the management objective (MO) since 1990 (Schommer and Johnson 2003). More recently (2003 and 2004), elk populations have dropped below the management objective of 2,800 elk for the Heppner wildlife unit. Elk herd composition has remained somewhat stable over the last 14 years (Schommer and Johnson 2003) in the Heppner unit. The number of calves per 100 cows has ranged from a high of 47 (1991) to a low of 18 calves in 2004. Bulls per 100 cows, has remained constant with about 9 bulls, with the management objective at 10 bulls.

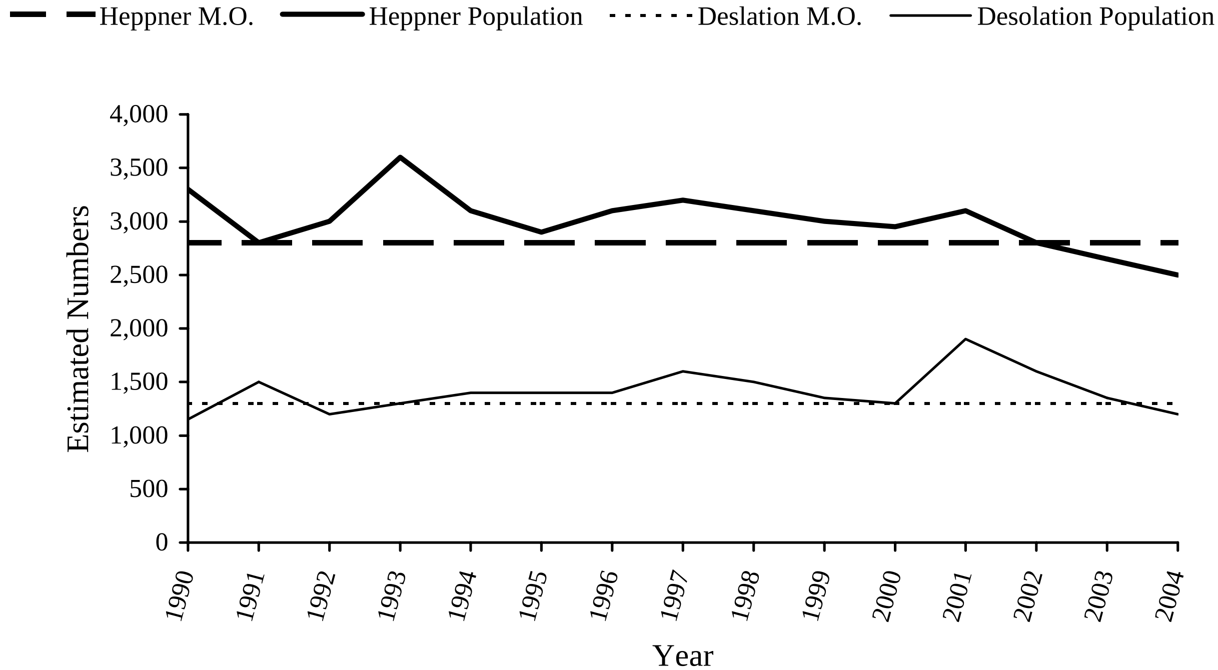

Figure 8-5. Elk population trends for the Heppner and Desolation wildlife management units.

The Desolation unit contains about 87 percent public land and most of it National Forest land. As noted in Figure 8-5, elk populations in the unit have remained relatively stable and near the management objective (MO) since 1990 (Schommer and Johnson 2003). This spring (2004), elk populations fell below the management objective of 1,300 elk for the wildlife unit. The elk herd composition has remained somewhat stable over the last 14 years (Schommer and Johnson 2003) in the Desolation unit. The number of calves per 100 cows has ranged from a high of 52 (1997) to a low of 17 calves in 2003. Bulls per 100 cows, has remained somewhat stable near the management objective of 10 bulls.

Recent declines in the elk population and a particularly, decrease in calf-cow ratios are becoming more of a management concern in these units and northeast Oregon in general. Decreases are widely thought to be the result of increasing populations of cougars and bear and subsequent increases in predation on calves. Additional concerns include changes in habitat conditions that affect winter survival of calves and pregnant cows.

Preferred habitat for elk consists of a mixture of forest and non-forest habitat types and a variety of forest structure to provide cover and forage for summer or winter usage (Forest Service 1990, FEIS 1998). The Potamus analysis area contains both summer and winter habitats. Summer range (forest habitat) occurs throughout the area at mid and high elevations. Winter range (grassland/grass tree mosaic habitat) occurs in the central and northern portion of the watershed, at lower elevations, to the North Fork of John Day River. Approximately 25-35 percent of the analysis area consists of winter range. Three winter ranges are part of the Potamus watershed; they include Monument, Bone Point, and Desolation winter range. Monument winter range is the largest winter range on the Forest and extends into two other watershed to the west and southwest. The Umatilla Forest Plan (1990) standards and guidelines occur for satisfactory cover, total cover and a habitat effectiveness index (HEI) to evaluate the effects of management activities on elk habitat. Each management area has a different set of standards and guidelines.

Elk Habitat

Table 8-11 compares elk habitat components for the reference (1939) and current condition (1997) in the analysis area. Overall, the trend in total habitat availability for elk has not changed significantly (<1%). However, the availability of satisfactory cover has decreased 14%, while marginal cover increased 22%. Decrease in satisfactory and increase in marginal cover are probably the result of insect and disease outbreaks and timber harvest in the watershed since 1939. Satisfactory cover is generally denser than marginal cover. Forage generally consists of grasslands, shrublands, and units recently disturbed (harvest, fire, etc.). Forage in the analysis area decreased 8 percent when compared to reference condition. This could be attributed to the development of regenerating conifer stands in the analysis area since 1939. Essentially, stand that grew out of forage and into marginal cover.

Table 8-11. Reference and current (1997) conditions for Rocky Mountain elk habitat on National Forest land in the NF John Day/Potamus watershed.

	Reference (1939)		Current (1997)		Difference from Refer [1]	
Rocky Mountain Elk	Acres	Percent [2]	Acres	Percent [2]	Acres	Percent
Satisfactory Cover	30,662	31%	17,144	17%	(13,518)	-14%
Marginal Cover	18,930	19%	40,460	41%	21,530	22%
Total Cover	*49,592*	*50%*	*57,604*	*58%*	*8,012*	*8%*
Forage	49,996	50%	41,978	42%	(8,018)	-8%
TOTAL HABITAT	**99,588**	**100%**	**99,582**	**100%**	**(6)**	**0%**

[1] Numbers with a negative value occur in parentheses ( ) or with a minus sign (-). [2] Percent of total habitat on National Forest land.

The Rocky Mountain Elk habitat availability Map for 1939 (Map 8-9) shows satisfactory cover as a very large, block of habitat occurring in all parts of the analysis area. Marginal cover occurs as small to medium size blocks, scattered throughout the area and generally adjacent satisfactory cover. Foraging habitat occurs as large continuous blocks of habitat throughout the analysis area. In 1939, the south portion (Meadow Brook) of the analysis area is predominately forage habitat with scatted small patches of cover. The current Rocky Mountain Elk habitat availability Map (8-10) shows more of a fragmented mosaic dominated by marginal cover and forage. Satisfactory cover occurs in small to medium size patches, widely scattered across most of the analysis area. Marginal cover and forage habitat occurs in small to medium size patches that are interconnected. Forage is somewhat dominant in the south analysis area, but there is a definite increase in cover when compared to 1939. Foraging habitat can occur at all elevations but is primarily found at the lower elevation; often extending onto private land adjacent to National Forest lands. Utilization off-Forest occurs mostly in the winter and spring, when forage is limited across the range or when “green-up” occurs first, in the lower elevations.

Forest Plan

The Umatilla Forest Plan (1990) establishes standards and guidelines for elk habitat for many of the management areas. Table 8-12 compares the Forest Plan standards with the current condition of elk habitat in the analysis area. Map 8-11 identifies the management area evaluated in the analysis. The analysis area contains three winter ranges, two that extend out side the Potamus watershed. Monument winter range is the largest winter range on the Forest and extends into two other watersheds on the Heppner Ranger District. Management area E2 was split, for this analysis because the original size of the area exceeds Forest Plan recommendation for the analysis.

Table 8-12. A comparison of standards and guidelines for Rocky Mountain elk habitat on National Forest land in the NF John Day/Potamus watershed.

Management Area	LMRP, Umatilla NF Guidelines			Potamus Watershed/HEI Analysis [1]			
	HEI	Satisfactory Cover	Total Cover	HEI	Satisfactory Cover	Total Cover	Open Road Density
C3 - Monument Winter Range	70 (No less than)	10% (Minimum) 15-20% (Desirable)	30%	(69)	29%	52%	0.5 mi/sqmi
C3 - Bone Point Winter Range				(59)	(9%)	55%	0.6 mi/sqmi
C3 – Desolation Winter Range				(63)	22%	59%	0.8 mi/sqmi
C4 (Potamus)	60 (No less than)	15% (Minimum) 20% (Desirable)	30%	(52)	25%	71%	2.7 mi/sqmi
C4 (Desolation)				63	30%	64%	0.2 mi/sqmi
E1 (Potamus)	30 (At least)	N/A	N/A	56	18%	65%	2.6 mi/sqmi
E2 (East)	45 (No less than)	10% (Minimum) 15-20% (Desirable)	30%	54	15%	61%	3.0 mi/sqmi
E2 (West)				53	13%	72%	2.8 mi/sqmi

[1] Numbers below the standard occur in parentheses ( ).

Overall, standards for total cover are exceeded in all eight management areas evaluated. Total cover for all eight areas ranged from a low of 52 percent to a high of 72 percent. The Forest Plan standard for satisfactory cover was met in seven out of eight management areas. Satisfactory in five of the management areas occurs within or above the "desirable" range. Bone Point winter range (C3) has 9 percent satisfactory cover, 1 percent below the minimum standard for the management area. Even though most of the HEI analysis areas meet total cover and satisfactory cover requirement, four areas have HEI values below the Forest Plan standard. Three of the areas are winter ranges, Monument, Bone Point, and Desolation. The other low HEI value occurs in the C4 management area in the north portion of the analysis area (Map 8-11). The three winter ranges could be "naturally" limited, because of the large amount of grassland (forage) that occur in the area and contrasting amount of limited cover potential. This would also constrain the shape and distribution of cover-forage in the area, resulting in a low HEI value. The low HEI value for the C4 (Potamus) area is most likely the result of past harvest activities and the lack of appropriate cover-forage spacing in the area.

<u>Pileated Woodpecker</u>

The historic density and distribution of the pileated woodpecker population in the Potamus watershed is unknown. Based on the assessment of available habitat for 1939, this species could have occurred in the Potamus watershed. However, because of the small amount of available habitat and particularly reproductive habitat, the density of pileated woodpecker could have been low to moderate. Based on the distribution of available habitat, the pileated woodpecker was moderately distributed across the analysis area.

In 2003, a Terrestrial Wildlife Inventory (TWI) was conducted across the Potamus analysis area. The inventory detected pileated woodpecker on 19 plots out of 55 plots in the analysis area. The detections primarily occurred across the mid section of the north analysis area ((Potamus) Map 8-13), although some observations occurred in the south end analysis area (Desolations). In addition to the Terrestrial Wildlife Inventory, there are numerous miscellaneous pileated woodpecker observations across the Forest and within the Potamus watershed (NRIS –Fauna). A portion of the observations includes data from avian point count surveys conducted across the Forest since 1992 (Level 2 Bird Monitoring in Old Growth, M.A.P.S.). Since 1990, pileated woodpecker have been widely observed across the Forest in habitats similar to those found in the Potamus analysis area.

Preferred habitat for the pileated woodpecker consists of moist forest types consisting of large blocks of grand fir and mixed conifer in late and old structural stages (Forest Service 1990). Stand should include large diameter (>21" dbh) snags and down wood (Forest Service 1990, Bull and et al 1992, and Bull and Holthausen 1993). In general this habitat occurs in the mid and upper elevations of the Potamus analysis area.

Table 8-13 compares available pileated woodpecker habitat in the reference condition (1939) with the current condition (1997) in the analysis area. Overall, the total habitat available for pileated woodpecker has increased slightly (1%). However, primary and secondary reproductive habitat has decreased (-37%) when compared to the reference condition. Primary reproductive habitat incurred the greatest percent reduction (-54%) in availability and secondary reproductive habitat incurred the greatest amount of available habitat reduced (-4,954 ac). The decrease in reproductive habitat corresponds to an increase in foraging habitat. Essentially, since 1939, reproductive habitat has been changed to foraging habitat. This is most likely due to the reduction in late and old structure and changes in species composition in the analysis area.

Table 8-13. Reference and current (1997) conditions for pileated woodpecker habitat availability on National Forest land in the NF John Day/Potamus watershed.

Pileated Woodpecker Habitat	Reference (1939)		Current (1997)		Difference from Refer [1]	
	Acres	Percent [2]	Acres	Percent [2]	Acres	Percent
Primary Reproductive	3,800	14%	1,732	6%	(2,068)	-54%
Secondary Reproductive	15,175	57%	10,221	38%	(4,954)	-33%
Total Reproductive	*18,975*	*72%*	*11,953*	*45%*	*(7,022)*	*-37%*
Foraging Habitat	7,520	28%	14,781	55%	7,261	97%
TOTAL HABITAT	**26,495**	**100%**	**26,734**	**100%**	**239**	**1%**

[1] Numbers with a negative value occur in parentheses ( ) or with a minus sign (-). [2] Percent of total habitat on National Forest land.

The distribution of available pileated woodpecker habitat for the reference condition is displayed on Map 8-12. Habitat occurs mostly in the upper section of the north analysis area (Potamus). Overall, habitat occurs as interconnected, large to moderate size blocks. Reproductive habitat occurs as small to moderate sized patches interconnected and generally in the moist and cold plant associations (mid to high elevations). Primary reproductive habitat occurs in small to moderate size patches and generally distributed along a northwest to southeast line across the analysis area. Map 8-13 shows the current distribution of available habitat for the pileated woodpecker. Habitat on the current map is widely scattered across the analysis area, and occurs as small to moderate size blocks. Reproductive habitat is scattered and occurs as small patches on the landscape. Primary reproductive habitat is widely scattered in small to moderate size blocks.

Northern Three-toed Woodpecker

The historic density and distribution of the northern three-toed woodpecker population in the Potamus watershed is unknown. Based on the assessment of available habitat for 1939, this species may have occasionally occurred in the Potamus watershed. This is based on the lack of reproductive habitat and the small amount of potential foraging habitat in the analysis area. Therefore the density of northern three-toed woodpecker could have been low or occur in the area occasionally. Based on the distribution of available habitat, the three-toed woodpecker was poorly distributed across the analysis area.

In 2003 a Terrestrial Wildlife Inventory (TWI) was conducted across the Potamus analysis area. The inventory did not detect the northern three-toed woodpecker on any of 55 plots in the analysis area. Some observations have occurred in previous avian point count surveys conducted across the Forest since 1992 (Level 2 Bird Monitoring in Old Growth, M.A.P.S.). Since 1990, the northern three-toed woodpecker has been observed infrequently across the Forest and within the Potamus watershed (NRIS –Fauna). Observations of northern three-toed woodpecker have generally been associated with old lodgepole stands and areas with stand replacing fires.

Preferred habitat for the three-toed woodpecker consists of mature and old lodgepole pine stands with snags and down wood (Forest Service 1990 and NatureServe Explorer 2004). This habitat occurs in scattered patches at high to mid elevations of the Potamus analysis area. A relatively small amount of potential habitat occurs in the watershed.

Table 8-14 compares available northern three-toed woodpecker habitat in the reference condition (1939) with the current condition (1997) in the analysis area. Overall, the total habitat available for three-toed woodpecker has decreased 11 percent in the analysis area. Primary and secondary reproductive habitat did not occur in the reference or current conditions. The reduction in habitat occurs in available foraging habitat. The change in available foraging habitat and the lack of reproductive habitat is most likely due to the reduction in subalpine fir/lodgepole pine habitat in a late and old structural condition in the analysis area (Table 8-1 and 8-2).

Table 8-14. Reference and existing conditions for northern three-toed woodpecker habitat in the Potamus analysis area.

Northern Three-toed Woodpecker Habitat	Reference (1939)		Existing (2004)		Difference from Refer [1]	
	Acres	Percent [2]	Acres	Percent [2]	Acres	Percent
Primary Reproductive	0	0%	0	0%	0	0%
Secondary Reproductive	0	0%	0	0%	0	0%
Total Reproductive	*0*	*0%*	*0*	*0%*	*0*	*0%*
Forage Habitat	3,154	100%	2,807	100%	(347)	-11%
TOTAL HABITAT	**3,154**	**100%**	**2,807**	**100%**	**(347)**	**-11%**

[1] Numbers with a negative value occur in parentheses ( ) or with a minus sign (-). [2] Percent of total habitat on National Forest land.

The distribution of available three-toed woodpecker habitat for the reference condition is displayed on Map 8-14. Habitat occurs in the upper section of the north analysis area (Potamus). Overall, habitat occurs as isolated, small to moderate size blocks. Foraging habitat generally occurs near the moist and cold plant associations (mid to high elevations) in the area. Map 8-15 shows the current distribution of available habitat for the northern three-toed woodpecker. Habitat on the current map is scattered across the analysis area, and occurs as small to moderate size blocks. Foraging habitat appears to occur in moist and/or dry sites. Generally forage habitat does not occur where it occurred in the reference condition.

Pine Marten

The historic density and distribution of the marten population in the Potamus watershed is unknown. Based on the assessment of available habitat for 1939, this species could have occurred in the Potamus watershed. However, because of the small amount of available habitat and particularly limited reproductive habitat, the density of marten could have been low. Based on the distribution of available habitat, the marten was poorly distributed across the analysis area.

The 2003 Terrestrial Wildlife Inventory (TWI) did not detect marten on any of the 55 plots in the analysis area. In addition to the general survey in the analysis area, carbon-sooted track plates were placed on 8 plots within or adjacent to potential marten habitat. None of the 8 plots detected the presence of marten. In addition, snow track surveys conducted along the Western Route (FR 53) from 1992 through 1995, did not detect the occurrence of marten along the route. Since 1990, the marten has been observed infrequently across the Forest and even less frequently within the Potamus watershed (NRIS –Fauna). Observations of marten have generally occurred in dense, moist, mature conifer stands with abundant dead downwood.

Preferred habitat for the marten consists of high elevation (> 4000') stands of dense conifer and downwood often associated with streams (Forest Service 1990 and Forest Service 1994). This habitat occurs primarily in the most northern portion of the watershed. A relatively small to moderate amount of potential habitat occurs in the watershed.

Table 8-15 compares available marten habitat in the reference condition (1939) with the current condition (1997) in the analysis area. Overall, the total habitat available for marten has decreased 33 percent in the analysis area. The decrease in habitat occurred in foraging habitat (-40%). When compared to the reference condition, the amount of secondary reproductive habitat has increased 720 acres (576%) in the area. Primary reproductive habitat did not occur in the reference or current condition of the analysis area. Some of the decrease in forage habitat could be attributed to forage habitat growing into secondary reproductive habitat. However, most of the reduction is most likely due to the reduction in lodgepole pine habitat in a late and old structural condition across the analysis area (Table 8-1 and 8-2)

Table 8-15. Reference and current conditions for pine marten habitat availability on National Forest land in the NF John Day/Potamus watershed.

Pine Marten Habitat	Reference (1939)		Current (1997)		Difference from Refer [1]	
	Acres	Percent [2]	Acres	Percent [2]	Acres	Percent
Primary Reproductive	0	0%	0	0%	0	0%
Secondary Reproductive	125	1%	845	11%	720	576%
Total Reproductive	*125*	*1%*	*845*	*11%*	*720*	*576%*
Forage Habitat	11,163	99%	6,703	89%	(4,460)	-40%
TOTAL HABITAT	**11,288**	**100%**	**7,548**	**100%**	**(3,740)**	**-33%**

[1] Numbers with a negative value occur in parentheses ( ) or with a minus sign (-). [2] Percent of total habitat on National Forest land.

The distribution of available marten habitat, for the reference condition, is displayed on Map 8-16. Habitat occurs mostly in the upper section of the north analysis area (Potamus). Overall, habitat is connected with large to moderate size blocks. Reproductive habitat occurs as one small patch in the center of north sections of the analysis area. The secondary reproductive patch is connected to foraging habitat. Primary reproductive habitat does not occur in the analysis area. Map 8-17 shows the current distribution of available habitat for the marten. Habitat on the current map is widely scattered across the analysis area, and occurs as small to moderate isolated blocks. Reproductive habitat is scattered and occurs as small to moderate size patches on the landscape. Foraging habitat appears to occur in more in moist and/or dry sites. Generally forage habitat does not occur where it occurred in the reference condition.

Primary Cavity Excavators (PCE)

Primary cavity excavators (PCE) include bird species that create holes for nesting or roosting in live, dead, or decaying trees. They also provide secondary cavity users such as owls; bluebirds, and flying squirrels habitat for denning, roosting and/or nesting. Primary cavity excavators with the potential to occur on the Umatilla National Forest are listed in Table 8-16 along with their preferred habitat type

Table 8-16. Primary cavity excavators and their habitats in the NF John Day/Potamus watershed.

Common Name	Habitat Community [1, 2]	Nest Tree Size[2]
Lewis' woodpecker	Ponderosa pine, riparian cottonwood, oak woodlandand burned stands.	13"-43" dbh.
Red-naped sapsucker	Riparian cottonwood, aspen, conifer forest. Mid – high elevations.	11" dbh, Avg.
Williamson's sapsucker	Mid – high elevation, mature or old conifer forests (ponderosa pine, fir, lodgepole pine, etc. with large dead trees present.	27" dbh. Avg.
Downy woodpecker	Riparian cottonwood, willow, aspen, mixed-deciduous, and mixed-conifer.	8" dbh. Min.
Hairy woodpecker	Mixed-conifer, ponderosa pine, and adjacent deciduous, stands.	17" dbh. Avg.
White-headed woodpecker	Open ponderosa pine or mixed conifer, dominated by ponderosa pine.	26" dbh. Avg.
Three-toed woodpecker	Coniferous, mixed conifer-deciduous forests. Prefer burned tracts and montane spruce or aspen.	12" dbh. Min.
Black-backed woodpecker	Coniferous forests especially burn over stands.	12" dbh. Min
Northern flicker	All forest types with older open forest and edges adjacent to open country.	22" dbh. Avg.
Pileated woodpecker	Mature coniferous, deciduous, and mixed forests.	20" dbh. Min.
Black-capped chickadee	Mixed woodland, deciduous and coniferous forests.	4" dbh. Min.
Mountain chickadee	Open canopy, ponderosa pine, lodgepole pine, and other conifer forests.	4" dbh. Min.
Chestnut-backed chickadee	Prefers low elevation, mesic coniferous forest of pine.	4" dbh. Min.
Red-breasted nuthatch	Coniferous forests with mid to late seral stages..	12" dbh.

Common Name	Habitat Community [1, 2]	Nest Tree Size[2]
		Min.
White-breasted nuthatch	Mature ponderosa pine and mixed-conifer forests. Oak woodlands	12" dbh. Min.
Pygmy nuthatch	Mature to old ponderosa pine or mixed conifer with ponderosa pine dominant.	12" dbh. Min.

[1] Johnson and O'Neil 2001. [2] Marshall 2003, DeGraaf 1991, Ehrlich 1988, and Thomas 1979.

In general, primary cavity excavator habitat consists of dead standing (snags) or dying trees in various size classes. Habitat can occur in a variety of vegetative communities with various structural conditions (Thomas 1979). In general, existing and potential habitat can be found throughout the watershed, except for non-forest areas and forest stands in the process of regeneration (stand initiation and stem exclusion). Essentially, primary cavity excavator habitat was evaluated in the previous Deadwood section of this document.

Threatened, Endangered, Proposed, Candidate and Sensitive Species

Federally "listed" species includes those identified as endangered, threatened, proposed, candidate species by the Fish & Wildlife Service (1999 and 2004). "Sensitive" species are those identified on the Regional Forester's (R6) Sensitive Animal List (Forest Service 2004) that meet National Forest Management Act (NFMA) obligation and requirements. Sensitive species addressed o the Umatilla National Forest include those that have been documented (D) or suspected ((S) likely to occur, based on available habitat to support breeding pair/groups) and occurring within or adjacent to the Umatilla National Forest boundary. Federally listed and sensitive species with the potential to occur in the Potamus analysis area are found in Table 8-17. This determination is based on observation records, vegetative and wildlife species inventory and monitoring, published literature on the distribution and habitat utilization of wildlife species, and the experience and professional judgment of wildlife biologists on the Umatilla National Forest.

Table 8-17. The status of "federally" listed and sensitive species for consideration on National Forest land in the NF John Day/Potamus watershed.

Species	U.S. Fish & Wildlife Service (1999 & 2004)	Regional Foresters Sensitive Animals (2004)	Occurrence on the Umatilla National Forest[1]
Columbia spotted frog	Candidate	Sensitive	D
Painted turtle		Sensitive	S
Bald eagle	Threatened		D
Peregrine falcon		Sensitive	S
Upland sandpiper		Sensitive	S
Gray flycatcher		Sensitive	S
Spotted bat		Sensitive	S
Gray wolf	Threatened		D
California Wolverine		Sensitive	D

[1] D = Documented, reliable, recorded observation within the Umatilla National Forest boundary. S = Suspected, likely to occur based on habitat availability to support breeding pairs/groups within the Umatilla National Forest boundary.

Columbia Spotted Frog

The historic density and distribution of the spotted frog population in the Potamus watershed is not known. Because of their association with water and particularly wetland and riparian habitat, the frog most likely occurred historically in the watershed.

The Terrestrial Wildlife Inventory (TWI) in 2003 did not detected spotted frogs on any of the 55 plots in the analysis area. Since 1990, the frog has been observed occasionally across the Forest and within the Potamus watershed (NRIS –Fauna). Observations of spotted frogs have generally occurred in wet meadows in the spring and along stream riparian corridors associated with various upland vegetation types.

The spotted frog frequents waters and associated vegetated (grassy) shorelines of ponds, springs, marshes, and slow-flowing streams and appears to prefer waters with a bottom layer of dead and decaying vegetation (NatureServe Explore 2004 and Csuti et al. 1997). They typically occur between 150 and 8,000 feet in elevation (Corkran and Thomas 1996). They breed in very shallow water, often a flooded meadow (wet meadow), beside a pond or stream or water pooled on top of flattened, dead vegetation at the edge of a pond, in early or mid spring (Corkran and Thomas 1996). They lay their eggs on the bottom, usually on low aquatic vegetation. Hatchlings are often stranded in the water on top of the egg mass at first; then they swim in rain or snowmelt to deeper water (Corkran and Thomas 1996). Tadpoles live in the warmest parts of ponds (Corkran and Thomas 1996). Froglets and adults live in well-vegetated ponds, marshes or slow, weedy streams that meander through meadows (Corkran and Thomas 1996). Springs maybe used as over-wintering sites for local populations of spotted frogs (NatureServe Explore 2004). Suitable habitat for the spotted frog can be found in the analysis area along the numerous streams and remaining wet meadows or seeps. The limiting factor for spotted frog habitat in the area could be insufficient aquatic vegetation for cover and foraging.

Painted turtle

The historic density and distribution of the painted turtle population in the Potamus watershed is not known. Because of their association with water and particularly pond and lake habitat, the turtle most likely occurred infrequently in the analysis area. Historically, the analysis area contained few or no lakes and ponds.

The Terrestrial Wildlife Inventory (TWI) in 2003 did not detected painted turtles on any of the 55 plots in the analysis area. Since 2000, the turtle has not been observed on the Forest or within the Potamus watershed (NRIS –Fauna).

Preferred habitat for the painted turtle includes lakes, ponds, marshes, or low gradient, slows moving streams with a muddy or sandy substrate and aquatic vegetation (NatureServe Explore 2004, St John 2002, Csuti et al. 1997, and Johnson 1995). Nests in soft soil in open area up to 500 feet from water (NatureServe Explore 2004, St. John 2002, and Csuti et al. 1997). The analysis area contains Penland Lake, a large private lake adjacent to National Forest lands and numerous stock and wildlife ponds scattered across the landscape. Most of the stock ponds tend to dry up by mid to late summer but are generally full by spring. Streams in the area are generally moderate to high gradient with a very rocky, cobble substrate, making them unsuitable for painted turtles.

Bald Eagle

The historic population density and distribution of bald eagles in the analysis area is unknown. Because of their association with large bodies of water and rivers, the bald eagle most likely occurred at least occasionally in the watershed along the North Fork of the John Day River.

The Terrestrial Wildlife Inventory (TWI) in 2003 did not detect bald eagles or nesting sites on any of the 55 plots in the analysis area. Since 1990, wintering bald eagles has been observed across the Forest (NRIS –Fauna). The Forest has one bald eagle nest site near Bologna Basin, about 20 air miles southwest of the watershed (Dry Creek, Isaacs and Anthony 2004). Observations of bald eagles have generally occurred during the winter, feeding on carrion at various upland sites or roosting along river corridors.

Nest sites are typically near a large body of water (rivers, lakes, etc.) that supports an adequate food supply (NatureServe Explorer 2004 and FWS 1986). In the Pacific Northwest recovery area, preferred nesting habitat for bald eagles is predominately an uneven-aged, mature coniferous (ponderosa pine, Douglas-fir) stands or large black cottonwood trees along a riparian corridor (NatureServe Explorer 2004 and FWS 1986). Eagles usually nest in mature conifers with gnarled limbs that provide ideal platforms for nests. The nest tree is characteristically one of the largest in the stand and usually provides an unobstructed view of a body of water (FWS 1986). In Oregon, the majority of nests are within 0.5 miles of the shoreline (Anthony and Isaacs 1989). The size and shape of a defended breeding territory varies widely (1.6 to 13 square miles) depending upon the terrain, vegetation, food availability, and population density of an area (FWS 1986). Potential bald eagle nesting habitat in the watershed remains along the North Fork John Day river corridor.

Wintering eagles tend to perch on dominant trees that provide a good view of the surrounding area and close to a food source such as carrion, fish, etc. (NatureServe Explorer 2004 and FWS 1986). A communal roost generally hosts several eagles each evening at the same site during the winter months. Communal night roosts are generally near a rich food source (high concentrations of waterfowl or fish) and in forested, uneven-aged stands with a remnant old growth component (Anthony et al. 1982). Communal winter roosts tend to be isolated from disturbance and offer more protection from the weather than diurnal roosts (NatureServe Explorer 2004 and FWS 1986). The best wintering habitat in the watershed occurs along the North Fork John Day River. However, the entire watershed remains available for bald eagles foraging for carrion in the uplands of the watershed.

Peregrine Falcon

The historic population density and distribution of peregrine falcon in the analysis area is unknown. Because of their association with large grassland for foraging and rocky cliffs for nesting, the peregrine falcon most likely occurred at least occasionally along the cliffs and drainage of the North Fork John Day River.

The Terrestrial Wildlife Inventory (TWI) in 2003 did not detect peregrine falcons or nesting sites on any of the 55 plots in the analysis area. Aerial surveys of potential nest sites were conducted along the North Fork John Day River each year from 1991 through 1994, and again in 1997, peregrine falcon eyries were not observed. These surveys and additional ground surveys (up to and including year 2001) have failed to detect any peregrine falcons in the watershed. Since 1990, peregrine falcons have been observed foraging across the Forest during the fall migration ((non-breeding season) NRIS –Fauna).

Suitable habitat for the peregrine falcon includes; various open habitats from grassland to forested in association with suitable nesting cliffs (NatureServe Explore 2004, Marshall et al 2003). The falcon often nests on ledges or holes on the face of rocky cliffs or crags. Ideal locations include undisturbed areas with a wide view, near water, and close to plentiful prey. Foraging habitats of woodlands, open grasslands, and bodies of water are generally associated with the nesting territory (FEIS 1998 and NatureServe Explorer 2004). Falcons are known to forage over large areas, often 10 to 15 miles from the eyrie. Cliffs, providing potential nesting habitat does occur in the watershed along the lower Potamus drainage, as well as area east and west of the drainage. Potential foraging habitat occurs in the watershed primarily between the southern edge of the analysis area and the North Fork John Day River.

Upland sandpiper

The historic population density and distribution of upland sandpipers in the analysis area is not known. Because of their association with large grasslands and meadows for nesting and foraging, the sandpiper most likely occurred infrequently or in relatively low numbers in the analysis area. Historically, the analysis area did contain some large grasslands and wet meadow habitat.

The Terrestrial Wildlife Inventory (TWI) in 2003 did not detect upland sandpipers on any of the 55 plots in the analysis area. Since 1990, the sandpiper has not been observed on the Umatilla National Forest and within the Potamus watershed (NRIS –Fauna). However, upland sandpipers have been observed on private land around Ukiah and Albee Meadows, these areas are about 10-15 miles east of the watershed.

Upland sandpiper habitat is primarily restricted to open tracts of grassland habitat with water or intermittent creeks nearby. This includes large meadows and grasslands (1,000-30,000 ac), usually surrounded with trees (lodgepole pine and some ponderosa pine), or in the middle of sagebrush communities and generally at elevations from 3,400 – 5,000 feet (Csuti et al. 1997, NatureServe Explorer 2004, and Marshall et al 2003). Taller grassy areas are preferred for nesting and brood cover (NatureServe Explorer 2004). Foraging occurs in open meadows for invertebrates (Csuti et al. 1997, Marshall et al 2003, and NatureServe Explorer 2004). Relatively large grasslands occur across the mid section of the watershed, however; these sites are somewhat dry and scattered with ponderosa pine.

Gray flycatcher

The historic population density and distribution of gray flycatcher in the analysis area is not known. Because of their association with woodland and shrubland communities, and to lesser extent ponderosa pine-shrub communities, the gray flycatcher most likely occurred at low to moderate levels in the analysis area. However, the flycatcher may have occurred more frequently across the mid section of the watershed where historical shrub communities were more prevalent.

The Terrestrial Wildlife Inventory (TWI) in 2003 did not detect gray flycatchers on any of the 55 plots in the analysis area. Since 2000, the gray flycatcher has not been observed on the Umatilla National Forest and National Forest land in the NF John Day/Potamus watershed (NRIS – Fauna).

The flycatcher prefers woodland and shrubland habitats including juniper woodland, tall sagebrush, bitterbrush, and mountain mahogany vegetative communities (Csuti et al. 1997, Marshall et al 2003, and NatureServe Explorer 2004). The bird also occupies open ponderosa pine and lodgepole stands with an understory of sagebrush or bitterbrush (Csuti et al. 1997 and Marshall et al 2003). Generally found below 6,000 feet in elevation (Csuti et al. 1997 and Marshall et al 2003). Habitat for the gray flycatcher, within analysis area, includes ponderosa pine with a shrubby understory.

Gray Wolf

The historic population density and distribution of gray wolf in the watershed is unknown. A general observation noted in Bailey (1936) follows, “In 1854 Suckley reported them (wolves) very numerous in Oregon and Washington from the Cascades to the summit of the Rocky Mountains, and especially in the Blue Mountains, country.” Basically, the wolf was extirpated from the region by the early 1900’s. Because they are habitat generalist, and associated with big game populations, the wolf most likely occurred historically in the Potamus watershed.

The Terrestrial Wildlife Inventory (TWI) in 2003 did not detect gray wolves on any of the 55 plots in the analysis area. In 1999, a collared wolf from the experimental, non-essential Idaho population traveled to the Blue Mountains and stayed until she was captured and returned to Idaho (Cody 1999). A second gray wolf was found dead on Interstate 84 near Baker City in 2000. Another wolf was killed in October 2000, north of Ukiah. Since 2000, the wolf has been infrequently observed on the Umatilla National Forest (NRIS –Fauna).

Habitat preference for the gray wolf is more prey dependent than cover dependent. The wolf is more of a habitat generalist inhabiting a variety of plant communities, typically containing a mix of forested and open areas with a variety of topographic features (NatureServe Explorer 2004, Ballard and Gipson 2000, Verts and Carraway 1998, and Witmer et al 1998). Wolves are strongly territorial, defending an area of 75-150 square miles. Territory size and location is strongly related to prey abundance. Wolves prey mainly on large ungulates, such as deer and elk and to a lesser extent on small mammals. The gray wolf does prefer areas with few roads, generally avoiding areas with an open road density greater than one mile per square mile (NatureServe Explorer 2004, Ballard and Gipson 2000, and Witmer et al 1998). Natal dens typically occur as underground burrows, but can also be caves, or other types of shelter. Rendezvous sites are generally open areas (FEIS 1998 and NatureServe Explorer 2004). Habitat in the analysis area could be limited because of the high density of open roads, generally greater than 2 miles per square mile (Table 8-12).

California Wolverine

The historic population density and distribution of wolverine in the analysis area is not known. Based on the assessment of available habitat for 1939, the wolverine was probably never common in the analysis area, owing to the species large territory size (Banci 1994) and the limited amount of natal denning habitat in the area. The historic presence of wolverine in the watershed mostly occurred while foraging.

The 2003 Terrestrial Wildlife Inventory (TWI) did not detect wolverine on any of the 55 plots in the analysis area. In addition, Snow tracking surveys conducted across the District, since 1991, for wolverine, fisher, American marten and lynx has resulted in one suspected set of wolverine tracks (2/18/94) on the "Kelly Route" near the 2105 road on Ellis Creek. The potential observation was most likely a transient or dispersing wolverine. Since 1990, the wolverine has been observed infrequently across the Forest and within the Potamus watershed (NRIS –Fauna).

The wolverine prefers high elevation, conifer forest types, with a sufficient food source, and limited exposure to human interference (Forest Service 1994, Wolverine Foundations (TWF) 2004). Natal denning habitat includes open rocky slopes (talus or boulders) surrounded or adjacent to high elevation forested habitat that maintains a snow depth greater than 3 feet into March and April (Forest Service 1994, TWF 2004). The wolverine is an opportunistic scavenger, with large mammal carrion the primary food source year-round. While foraging, they generally avoid large open areas and tend to stay within forested habitat at the mid and high elevations (>4,000’) and typically travel 18-24 miles to forage/hunt (Forest Service 1994, TWF

2004). The analysis area does not contain high elevation forest types or open rocky slopes for natal denning habitat. Potential habitat for the wolverine occurs about 25 miles southeast of the analysis area near the Vinegar Hill area, the southern portion of the NF John Day District.

Table 8-18 compares available wolverine habitat in the reference condition (1939) with the current condition (1997) in the analysis area. Overall, foraging habitat available for wolverine has increased 4 percent in the analysis area. However, primary foraging habitat decreased by 56% when compared to the reference condition. When compared to the reference condition, the amount of secondary foraging habitat increased by 7,544 acres (18%) in the area. The decreases in primary forage habitat most likely lead to the increase in secondary forage habitat. The change in forage habitat was the result of vegetative changes in subalpine fir/Engelmann spruce, and lodgepole pine in the analysis area between the reference and current condition (Table 8-1 and 8-2). Reproductive habitat, natal denning habitat, does not occur in the analysis area.

Table 8-18. Reference and existing conditions for wolverine habitat in the Potamus analysis area.

California Wolverine Foraging Habitat	Reference (1939)		Current (1997)		Difference from Refer [1]	
	Acres	Percent [2]	Acres	Percent [2]	Acres	Percent
Primary Foraging	9,629	18%	4,225	8%	(5,404)	-56%
Secondary Foraging	42,712	82%	50,256	92%	7,544	18%
TOTAL HABITAT	**52,341**	**100%**	**54,481**	**100%**	**2,140**	**4%**

[1] Numbers with a negative value occur in parentheses ( ) or with a minus sign (-). [2] Percent of total habitat on National Forest land.

The distribution of available wolverine habitat, for the reference condition, is displayed on Map 8-19. Habitat occurs mostly in the north analysis area (Potamus). Overall, habitat is connected with large blocks in both the north and south analysis area. Primary foraging habitat occurs in the most northern portion of the analysis area. The habitat occurs as one large connected block on the landscape. Map 8-20 shows the current distribution of available habitat for the wolverine. Essentially, current foraging habitat covers the same areas identified as forage in the reference condition. Primary foraging habitat in the current condition occurs as small, fragmented patches in the north portion of the analysis area.

Other Species of "Interest or Concern"

General

Other species of "interest" or "concern" generally exclude species previously listed as endangered, threatened, proposed, candidate species (FWS 1999 and 2004), or sensitive species (Forest Service 2004). Generally species of interest or concern come from state threatened, endangered, and sensitive species lists (ONHIC 2004). Oregon State listed and sensitive species with the potential to occur in the Potamus analysis area are found in Table 8-19. Occurrence determinations are based on observation records, vegetative and wildlife species inventory and monitoring, published literature on the distribution and habitat utilization of wildlife species, and the experience and professional judgment of wildlife biologists on the Umatilla National Forest.

Some of the species on Table 8-19 have been previously addressed in this document. A few selected species are addressed in this section because of their particular interest to the general public.

Table 8-19. Species of interest or concern on National Forest land in the NF John Day/Potamus watershed.

Species	Natural Heritage Ranks [1]	Oregon State Status (ONHIC 2004)	Occurrence on the Umatilla National Forest[2]
Tailed frog	S2	Sensitive-vulnerable	S
Western toad	S3	Sensitive-vulnerable	D
Northern Goshawk	S3	Sensitive-critical	D
Flammulated owl	S3	Sensitive-critical	D
Great Gray owl	S3	Sensitive-vulnerable	D
White-headed woodpecker	S2/S3	Sensitive-critical	D
Lewis' woodpecker	S2/S3	Sensitive-critical	D
Black-backed woodpecker	S3	Sensitive-critical	D
Olive-sided flycatcher	S3	Sensitive-vulnerable	D
Pine grosbeak	S2	N/A	D
Fringed myotis	S2	Sensitive-vulnerable	S
Townsend's big-eared bat	S2	Sensitive-vulnerable	S
Pallid bat	S2	Sensitive-vulnerable	S

[1] ONHIC 2004, S = State ranking. 1= Critically imperiled because of extreme rarity or especially vulnerable to extinction or extirpation (< 5 occurrences), 2 = Imperiled because of rarity or other factors that make if vulnerable to extinction or extirpation (6-20 occurrences) and 3 = Rare, uncommon or threatened, but not immediately imperiled (21-100 occurrences). [2] D = Documented, reliable, recorded observation within the Umatilla National Forest boundary. S = Suspected, likely to occur based on habitat availability to support breeding pairs/groups within the Umatilla National Forest boundary.

<u>Northern Goshawk</u>

The historic density and distribution of the northern goshawk population in the Potamus watershed is not known. Based on the assessment of available habitat for 1939, this species could have occurred in the Potamus watershed. However, because of the small amount of available reproductive habitat, the density of northern goshawk could have been low to moderate. Based on the distribution of available habitat, the northern goshawk was moderately distributed across the analysis area.

In 2003 a Terrestrial Wildlife Inventory (TWI) was conducted across the Potamus analysis area. The inventory did not detect goshawk on any of the 55 plots in the analysis area. In addition to the Terrestrial Wildlife Inventory, there are occasional goshawk observations across the Forest and on the Heppner and NF John Day Districts (NRIS –Fauna). A portion of the observations includes goshawk survey conducted for projects in adjacent watersheds. Since 1990 northern goshawks have been observed occasionally across the Forest in habitats similar to those found in the Potamus analysis area.

Preferred habitat for the goshawk consists of coniferous forests with a variety of structural stages for nesting and foraging (FEIS 1998 and NatureServe Explorer 2004). Nesting sites typically consist of a dense cluster of large trees, surrounded by a similar forest type with a more open overstory. The understory is relatively open and the nest site is generally within one-quarter mile of a stream or other water source. The best foraging habitat occurs in a mosaic of structural stages scattered across the landscape (FEIS 1998 and NatureServe Explorer 2004). Potential goshawk habitat occurs throughout the mid and upper elevations of the Potamus analysis area.

Table 8-20. Reference and current (1997) conditions for northern goshawk habitat availability on National Forest land in the NF John Day/Potamus watershed.

Northern Goshawk Habitat	Reference (1939)		Current (1997)		Difference from Refer [1]	
	Acres	Percent [2]	Acres	Percent [2]	Acres	Percent
Primary Reproductive	6,187	10%	4,612	6%	(1,575)	-25%
Secondary Reproductive	7	0%	20	0%	13	186%
Total Reproductive	*6,194*	*10%*	*4,632*	*6%*	*(1,562)*	*-25%*
Forage Habitat	55,543	90%	70,194	94%	14,651	26%
TOTAL HABITAT	**61,737**	**100%**	**74,826**	**100%**	**13,089**	**21%**

[1] Numbers with a negative value occur in parentheses ( ) or with a minus sign (-). [2] Percent of total habitat on National Forest land.

Table 8-20 compares available northern goshawk habitat in the reference condition (1939) with the current condition (1997) in the analysis area. Overall, the total habitat available for the goshawk has increased 21 percent in the analysis area when compared to 1939. However, primary reproductive habitat has decreased 25 percent when compared to the reference condition. This decrease in primary reproductive habitat is generally associated with the decrease in old forest habitat that occurred in the analysis area during the same period. Secondary reproductive habitat has essentially remained unchanged. The increase in habitat is primarily associated with the 26 percent increase in forage habitat in the analysis area. The foraging habitat increase is generally associated with the expansion of grand fir in dryer forest sites of the analysis area.

The distribution of available northern goshawk habitat for the reference condition is displayed on Map 8-21. Habitat is wide spread across the analysis areas, interconnected with large to moderate size blocks. Primary reproductive habitat occurs as small to moderate sized patches scattered across the area. Map 8-22 shows the current distribution of available habitat for the northern goshawk. In general the current distribution of habitat is much like the reference condition, wide spread and interconnected. Primary reproductive habitat is scattered and occurs as small to moderate size patches on the landscape. Secondary reproductive habitat is essentially not present in the reference and current condition.

White-headed woodpecker

The historic population density and distribution of the white-headed woodpecker in the watershed is unknown. The white-headed woodpecker was most common in extensive stands of late and old ponderosa pine. Based on the assessment of vegetative habitat and structural conditions for 1939, the species could have occurred in the Potamus analysis area, although not in large numbers because of the limited amount of capable habitat in the watershed.

The current population of white-headed woodpeckers in the Potamus analysis area is unknown. In Washington and Oregon, even in favorable habitat, it is not as common as several other woodpecker species, however, the breeding range includes northeast Oregon (Marshall 1997). Sightings of the white-headed woodpeckers in the watershed have been documented (Fauna 2004). Based on the current assessment of vegetative conditions, the species could occur in the Potamus analysis area, although not in large numbers. The species is still limited by the small amount of potential habitat in the analysis area.

California Bighorn Sheep

The historic distribution and density of bighorn sheep in the watershed is unknown. Generally, sheep were native to most of the mountain and canyon country in northeast Oregon and southeast Washington (Bailey 1936) including the Blue Mountains and John Day River basin. Bailey (1936) reported skull fragment with horn cores, picked up on the Wenaha River, and noted 50 sheep occurred in the Wallowa National Forest in 1933. Bighorn sheep were gone from the region by 1945.

California bighorn sheep were reintroduced to the Potamus drainage in February 2003 near the confluence of Potamus Creek and the NF John Day. The initial transplant of 21 sheep included 18 ewes and 3 rams. The sheep immediately took up residence in the vicinity of Potamus Point. During the first year one sheep was lost, presumably to a mountain lion. By July of 2004 the herd had grown to 35 sheep, including 3 rams, 23 ewes and 9 lambs (Pers Com Jim Van Winkle, and Steve Cherry). The herd remains healthy and continues to grow.

Preferred habitat for bighorn sheep consists of rugged, open to semi-open areas of coniferous grassland or grass/shrub plant communities that affords high visual contact with their surroundings (ODFW 2003). The sites should include occasional to frequent expanses of cliffrock, rimrock, and rocky outcroppings, this is especially important for lambing and escape from predators (ODFW 2003). Typically, sheep avoid forested areas, but it is not unusual to find them seeking thermal cover from conifers, juniper and mountain mahogany when available. Grasses make up the staple forage species, complemented seasonally with forbs and shrubs. Water is an essential requirement for bighorn sheep and in some cases may limit their distribution (ODFW 2003). Winter range generally consists of low elevation grasses and shrubs. The overall intent of bighorn sheep management is to keep habitat and populations as remote and undeveloped as possible (ODFW 2003). Habitat in the watershed occurs primarily occurs along the rim of the North Fork John Day river.

Neotropical migratory birds (NTMB)

Neotropical migratory birds are those that breed in the U.S. and winter south of the border in Central and South America. Continental and local declines in population trends for migratory and resident landbirds have developed into an international concern. Causes for the declines include habitat degradation in winter and summer ranges and the continued use of toxic pesticides in Latin America (Sharp 1992). As a result of these declines, numerous lists were developed to identify birds of “concern” over the last 10 years.” Currently, the most referenced list is The Birds of Conservation Concern 2002 (FWS 2002). This list takes into consideration other nationally recognized assessments, including Partners in Flight, North American Waterfowl Conservation Plan, and the United States Shore Conservation Plan. Birds identified as a “conservation concern” are listed for each Bird Conservation Region (BCR) in North America. The Potamus watershed is in the Northern Rockies BCR (#10). Species identified in the Northern Rockies BCR with the potential to occur on National Forest land in NF John Day/Potamus watershed occur in Table 8-21. Species identified in the Birds of Conservation Concern 2002 (FWS 2002) are addressed in the various conservation plans either directly as a “focal species” or indirectly as “priority habitat.”

Table 8-21. Bird of conservation concern (2002) with the potential to occur on National Forest land in the NF John Day/Potamus watershed.

Species	General Habitat	Occurrence on the Umatilla National Forest
Peregrine Falcon	Cliff rock near Grassland/Woodland	S
Prairie Falcon	Cliff rock near Grassland/Woodland	D
Upland Sandpiper	Grassland/Montane Meadow	S
Flammulated Owl	Coniferous Forest	D
Lewis' woodpecker	Riparian Woodland	D
Williamson's Sapsucker	Coniferous Forest	D
Red-naped Sapsucker	Aspen	D
White-headed woodpecker	Ponderosa Pine	D
Pygmy Nuthatch	Ponderosa Pine	D

In the late 1990's, Partners in Flight (PIF) led an effort to complete a series of Bird Conservation Plans for the entire continental United States to address declining population trends in migratory landbirds. The primary goal of Partners in Flight Landbird Conservation Planning is to ensure long-term maintenance of healthy populations of native landbirds. Partners in Flight Conservation Planning effort provided the framework to develop and implement landbird conservation strategies by recommending conservation actions at the provincial level to help prevent the need for future listings. These plans include priority setting, establishment of objectives, necessary conservation actions, and evaluation criteria necessary for bird conservation in the western hemisphere.

The Partners in Flight Bird Conservation Plan is used to address the requirements contained in Executive Order (EO) 13186 (January 10, 2001), *Responsibilities of Federal Agencies to Protect Migratory Birds*. Under Section 3(E)(6), through the National Environmental Policy Act, the Executive Order requires that agencies evaluate the effects of proposed actions on migratory birds, especially species of concern. Partners in Flight Conservation Planning allows the analysis of effects of proposed projects on neotropical migratory birds through the use of guidelines for priority habitats and bird species of concern for each planning unit. The conservation strategy identifies "priority" habitats and "focal" species for each planning unit in the nation. "Focal" species are used as indicators to describe the conservation objectives, and measures project effects in different "priority" habitats for the avian communities found in the planning unit. The Umatilla National Forest occurs in the Northern Rocky Mountain Landbird Conservation Planning Region, which includes the Blue Mountains sub-region and the Blue Mountains sub-province. Conservation planning for the Blue Mountains, Ochoco Mountains, and Wallowa Mountains sub-provinces is addressed in the *Conservation Strategy for Landbirds* in the Northern Rocky Mountains of Eastern Oregon and Washington (Altman 2000), hereafter referred in this section as the Strategy.

The Strategy discusses the migratory and landbird species of concern for the Northern Rocky Mountain Region and the Blue Mountain sub province. "Focal" species were selected and used to represent species of concern and priority habitats identified in the Strategy. Priority habitats, habitat features, and focal species identified in the Strategy (Altman 2000) with the potential to occur on National Forest land in NF John Day/Potamus watershed occur in Table 8-22.

Table 8-22. Priority Habitat Features and Associated Landbird Species for Conservation in the Northern Rocky Mountain Landbird Conservation Region of Oregon and Washington (Altman 2000)

Habitat Type	Habitat Feature/Conservation Focus	Focal Species
Dry Forest	Large patches of old forest with large trees and snags	White-headed woodpecker
	Old forest with interspersion of grassy openings and dense thickets	Flammulated owl
	Open understory with regenerating pines	Chipping sparrow
	Large patches of old forest with large trees and snags	White-headed woodpecker
Mesic Mixed Conifer	Large snags	Vaux's swift
	Overstory canopy closure	Townsend's warbler
	Structurally diverse; multi-layered	Varied thrush
	Dense shrub layer in forest openings or understory	MacGillivray's warbler
	Edges and openings created by wildfire	Olive-sided flycatcher
Riparian Woodland	Large snags	Lewis' woodpecker
	Canopy foliage and structure	Red-eyed vireo
	Understory foliage and structure	Veery
Riparian Shrub	Willow/alder shrub patches	Willow flycatcher
Subalpine Forest	Subalpine Forest	Hermit thrush
Montane Meadow	Wet/dry meadows	Upland sandpiper
Steppe Shrublands	Steppe shrublands	Vesper sparrow
Aspen	Large aspen and snags with young structural stages	Red-naped woodpecker

While many of the habitat types and features identified in Table 8-22 occur in the watershed, the total amount of habitat and patch size is less than the potential for those habitats to occur in the watershed. In general, habitats with large overstory trees and a shrub understory are currently limiting across the landscape. In addition, riparian habitat with large trees and/or a dense shrub layer occurred more commonly during historic conditions in the watershed then the current condition.

Findings/Results

As a result of this assessment the following key findings were identified relative to issues and concerns for the terrestrial wildlife resource. Findings occur on National Forest land in the NF John Day/Potamus watershed unless indicated otherwise.

<u>Move the landscape toward a more historic composition and structure of forested and non-forested areas.</u>

- The ponderosa pine cover type (not mixed) occupies less area and occurs in smaller patches then the reference condition.
- Shrubland and grasslands, including meadows occupy less area and occurs in much smaller patches then the reference condition.
- Structural stages are currently over represented in the mid seral group. The structural stage patch size is currently smaller than the reference condition.

Restore and maintain wetland and riparian habitats

- Aspen and wetland habitats occupy less area and occur in much smaller patches then historic conditions.

Maintaining or enhance late and old structure (LOS) in the watershed, including old growth habitat.

- The late and old forest structural stage occupies less area and occurs in smaller patches then the reference condition.
- In the dry upland forest type, old forest single stratum is below the historic range of variability.
- In the cold, moist, and dry upland forest types, old forest multi-strata is below the historic range of variability.

Maintaining deadwood habitat (snags and downwood) at moderate to high levels in the watershed.

- Snag densities currently exceed Forest Plan standards and guidelines.
- In the moist upland forest type 33% (6,000 acres) of the area contains zero snags greater than or equal to 10 inches in diameter at breast height.
- In the dry upland forest type 29% (14,300 acres) of the area have zero snags in the 0.1-4 snags per acre in the greater than or equal to 10-inch group.
- Downwood densities in the moist and cold upland forest types are below Forest Plan standards and guidelines.

Restore and maintain the large snag (>21”) component throughout the watershed.

- In the moist upland forest type, 36% (6,500 acres) of the area has zero snags greater than 20 inches diameter at breast height.
- In the dry upland forest type, 25% (12,300 acres) of the area has zero snags in the 0.1-4 snags per acre in the greater than 20 inch group.

Maintain or improve cover and forage for big game (elk) winter range.

- Total cover exceeds Forest Plan standards and guidelines for all elk management areas (C3, C4, E1, and E2).
- Satisfactory cover is below Forest Plan standards in the Bone Point (C3) winter range.
- HEI is below Forest Plan standards in the Monument (C3) winter range, Bone Point (C3) winter range, Desolation (C3) winter range and the C4 (Potamus) management area in the watershed.

Maintain and enhance habitats for MIS species that have the potential to occur in the area.

- Pileated woodpecker reproductive habitat occupies less area and occurs in smaller patches then the reference condition.
- Northern three-toed woodpecker reproductive habitat does not occur in the area.
- Primary reproductive habitat for the pine marten does not occur in the area.

Maintain and enhance habitats for TES species that have the potential to occur in the area.

- In general, habitats for TES species occupy less area and occur in smaller patches then the reference condition.
- Natal denning habitat for the California wolverine occurs outside the watershed.

Maintain and enhance habitats for species of interest or concern in the area.

- In general, habitats species of interest or concern occupy less area and occur in smaller patches then the reference condition.
- Primary reproductive habitat for northern goshawk occupies less area than the reference condition. Natal denning habitat for the California wolverine occurs outside the watershed.
- Habitat for the white-headed woodpecker occupies less area and in smaller patches than historic conditions.

Maintain and enhance California bighorn sheep in the Potamus drainage.

- Successful California bighorn sheep reintroduction in the Potamus drainage.
- Habitat quality appears to be suitable for the California bighorn sheep population in the watershed.

Develop and maintain habitat for Neo tropical migratory birds in the area.

- In general, habitats for neo tropical migratory birds occupy less area and occur in smaller patches then the reference condition.
- Understory shrubs may be a limiting habitat component for most landbirds in the watershed.

Recommendations

In response to the findings and results identified in the previous section the following recommendation apply.

Habitat Improvement

- Develop and maintain large patches of ponderosa on dry upland forest sites.

- Maintain and restore grassland and shrublands across the area. Look for opportunities to restore shrubs in the understory of dry and moist sites.
- Look for opportunities to maintain and restore wetland and aspen stand across the landscape.
- Develop and maintain lodgepole pine and subalpine fir stand for the northern three toed woodpecker.
- Seek opportunities to expand or create large patches of late and old structure in both the Multi and single story types. Maintain connectivity between late and old structure and old growth patches.
- Maintain dedicated (C1) and managed (C2) old growth stands in the area.
- In the moist upland forest type, snag greater than 10 inches, restore snag densities in the 0.1-24 snags per acres groups (Table 8-1). For snag greater than 20 inches, restore snag densities in the 0.1-4 snags per acre group (Table 8-2).
- In the dry upland forest type, snag greater than 10 inches, restore snag densities in the 0.1-4 snags per acres groups (Table 8-3). For snag greater than 20 inches, restore snag densities in the 0.1-4 snags per acre group (Table 8-4).
- Restore and maintain downwood densities in the moist and cold forest types.
- Improve and maintain HEI by reducing road density, maintaining “desired” levels of satisfactory cover and maintain the distribution of cover-forage.
- Utilize prescribed fire to increase the quality and quantity of winter range for elk (big game) and California bighorn sheep.
- Look for opportunities to create water developments (ponds/guzzlers) for big game and upland birds.
- Continue to monitor California bighorn sheep population in the Potamus drainage.

Inventory and Monitoring

- Verify dedicated (C1) and managed (C2) old growth stands when they occur within or adjacent to a project area.
- Inventory affected areas for TE and S species prior to project development.
- Monitor pileated woodpecker, northern three –toed woodpecker and pine marten in dedicated (C1) and managed (C2) old growth stands, when they occur in the project area.
- Inventory affected areas for northern goshawk nest sites and other raptor nests.
- Inventory and monitor deadwood density and distribution in the project area and affected area.
- Continue to inventory aspen stands in the watershed. Update the Forest “aspen” GIS layer.

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Status [1]	Frequency [2]	Common Name Taxon	Status			Habitat Association Reference Guide [6]															
			FWS [3]	FS [4]	OR [5]	Meadow (Opening)	Grassland	Sagebrush	Shrub	Juniper	Ponderosa Pine	Aspen	Mixed Confier	Grand fir	Lodgepole	Subalpine fir	Riparian	Water	Marsh	Cliffs, Tallus	Caves
R	C	**long-toed salamander** *Ambystoma macrodactylum*				X	X			X							X	X			
R	U	**tiger salamader** *Ambystoma tigrinum*				X	X		X		X						X	X			
R	U	**inland tailed frog** *Ascaphus montanus*			SV								X	X	X	X	X	X			
R	C	**western toad** *Bufo boreas*			SV	X			X	X	X	X	X	X	X	X	X	X			
R	C	**Pacific treefrog** *Pseudacris regilla*				X	X	X	X	X	X	X	X	X	X	X	X	X	X		
R	U	**Columbia spotted frog** *Rana luteiventus*	C	SOR	SU	X	X										X	X	X		
I	R	**bull frog** *Bufo catesbeiana*															X	X	X		
R	R	**northern painted turtle** *Chrysemys picta*		SOR	SC													X	X		
I	R	**slider** *Trachemys scripta*															X	X	X		
R	C	**western fence lizard** *Sceloporus occidentalis*				X				X	X		X							X	
R	C	**western skink** *Eumeces skiltonianus*						X	X	X	X	X	X							X	
R	C	**rubber boa** *Charina bottae*						X	X	X	X		X	X			X				
R	C	**racer** *Coluber constrictor*				X		X	X	X	X									X	
		striped whipsnake																			

			Status			Habitat Association Reference Guide [6]															
Status [1]	*Frequency [2]*	*Common Name* *Taxon*	*FWS [3]*	*FS [4]*	*OR [5]*	Meadow (Opening)	Grassland	Sagebrush	Shrub	Juniper	Ponderosa Pine	Aspen	Mixed Confier	Grand fir	Lodgepole	Subalpine fir	Riparian	Water	Marsh	Cliffs, Tallus	Caves
R	R	**striped whipsnake** *Masticophis taeniatus*		SWA				X	X	X	X									X	
R	U	**gopher snake** *Pituophis melanoleucus*				X	X	X	X	X	X										
R	U	**common garter snake** *Thamnophis sirtalis*				X											X	X	X		
R	U	**western terrestrial garter snake** *Thamnophis elegans*				X	X		X	X	X						X	X			
R	R	**night snake** *Hypsiglena torquata*					X	X	X	X	X									X	
R	U	**western rattlesnake** *Crotalus viridis*					X	X	X	X	X						X	X		X	
S	U	**wood duck** *Aix sponsa*															X	X	X		
S	U	**mallard** *Anas platyrhynchos*															X	X	X		
M	U	**blue-winged teal** *Anas discors*																X	X		
S	R	**cinnamon teal** *Anas cyanoptera*																X	X		
W	R	**green-winged teal** *Anas crecca*																X	X		
R	U	**common merganser** *Mergus merganser*															X	X	X		
I	U	**chukar** *Alectoris chukar*					X	X	X								X				
		ruffed grouse																			

			Status			Habitat Association Reference Guide [6]															
***Status* [1]**	***Frequency* [2]**	*Common Name* / *Taxon*	***FWS* [3]**	***FS* [4]**	***OR* [5]**	**Meadow (Opening)**	**Grassland**	**Sagebrush**	**Shrub**	**Juniper**	**Ponderosa Pine**	**Aspen**	**Mixed Confier**	**Grand fir**	**Lodgepole**	**Subalpine fir**	**Riparian**	**Water**	**Marsh**	**Cliffs, Tallus**	**Caves**
R	C	**ruffed grouse** *Bonasa umbellus*							X		X	X	X				X				
R	C	**blue grouse** *Dendragapus obscurus*							X		X	X	X				X				
I	C	**turkey** *Meleagris gallopavo*							X		X	X	X				X				
R	U	**mountain quail** *Oreortys pictus*			SU				X		X						X				
R	U	**California quail** *Callipepla californica*							X	X	X		X				X				
S	U	**turkey vulture** *Cathartes aura*				X	X			X	X										
S	U	**osprey** *Pandion haliaetus*									X		X				X	X	X		
SW	R	**bald eagle** *Haliaeetus leucocephalus*	T		LT						X		X				X	X			
R	C	**northern harrier** *Circus cyaneus*				X	X		X										X		
R	U	**sharp-shinned hawk** *Accipiter striatus*											X	X	X	X					
R	U	**Cooper's hawk** *Accipiter cooperii*									X		X	X			X				
R	U	**northern goshawk** *Accipiter gentilis*			SC						X	X	X	X	X						
R	C	**red-tailed hawk** *Buteo jamaicensis*								X	X	X	X	X			X		X		
R	U	**golden eagle** *Aquila chrysaetos*									X		X							X	

			Status			Habitat Association Reference Guide [6]															
Status [1]	*Frequency [2]*	*Common Name* / *Taxon*	*FWS [3]*	*FS [4]*	*OR [5]*	**Meadow (Opening)**	**Grassland**	**Sagebrush**	**Shrub**	**Juniper**	**Ponderosa Pine**	**Aspen**	**Mixed Confier**	**Grand fir**	**Lodgepole**	**Subalpine fir**	**Riparian**	**Water**	**Marsh**	**Cliffs, Tallus**	**Caves**
R	C	**American kestrel** *Falco sparverius*						X	X	X	X	X	X							X	
S	U	**American peregrine falcon** *Falco peregrinus*		S	LE			X	X	X	X		X							X	
R	U	**prairie falcon** *Falco mexicanus*				X	X	X												X	
S	U	**Sora** *Porzana carolina*				X												X	X		
S	U	**American coot** *Fulica americana*																X	X		
S	U	**killdeer** *Charadrius vociferus*				X	X											X	X		
S	U	**spotted sandpiper** *Actitis macularia*				X							X	X			X	X	X		
S	R	**upland sandpiper** *Bartramia longicauda*		S	SC	X	X				X						X				
S	U	**Common (Wilson's) snipe** *Gallinago gallinago (delicata)*				X												X	X		
S	C	**mourning dove** *Zenaida macroura*					X	X	X	X								X			
M	U	**flammulated owl** *Otus flammeolus*			SC						X		X								
R	U	**western screech owl** *Megascops kennicottii*								X	X		X				X				
R	C	**great horned owl** *Bubo virginianus*								X	X	X	X	X	X	X	X				
R	U	**northern pygmy owl** *Glaucidium gnoma*								X	X	X	X	X							

Status [1]	Frequency [2]	Common Name / Taxon	Status			Habitat Association Reference Guide [6]															
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R	U	**great gray owl** *Strix nebulosa*		SWA	SV	X							X	X	X						
R	U	**northern saw-whet owl** *Aegolius acadicus*									X		X	X			X				
S	U	**common nighthawk** *Chordeiles minor*				X	X	X										X		X	
S	C	**common poorwill** *Phalaenoptilus nuttallii*					X	X	X	X	X									X	
S	C	**Vaux's swift** *Chaetura vauxi*											X	X							
S	U	**calliope hummingbird** *Stellula calliope*				X					X		X	X	X		X				
S	C	**rufous hummingbird** *Selasphorus rufus*											X	X	X	X	X				
R	C	**belted kingfisher** *Ceryle alcyon*															X	X			
S	U	**Lewis' woodpecker** *Melanerpes lewis*			SC	X			X	X	X						X				
S	C	**Williamson's sapsucker** *Sphyrapicus thyroideus*									X	X	X								
S	U	**red-naped sapsucker** *Sphyrapicus nuchalis*									X	X					X				
R	C	**downy woodpecker** *Picoides pubescens*										X					X				
R	C	**hairy woodpecker** *Picoides villosus*									X		X								
R	R	**white-headed woodpecker** *Picoides albolarvatus*			SC						X		X								

Status [1]	Frequency [2]	*Common Name* / *Taxon*	Status			Habitat Association Reference Guide [6]															
			FWS [3]	*FS* [4]	*OR* [5]	Meadow (Opening)	Grassland	Sagebrush	Shrub	Juniper	Ponderosa Pine	Aspen	Mixed Confier	Grand fir	Lodgepole	Subalpine fir	Riparian	Water	Marsh	Cliffs, Tallus	Caves
R	U	**American three-toed woodpecker** *Picoides dorsalis*			SC								X	X	X	X					
R	U	**black-backed woodpecker** *Picoides arcticus*			SC						X		X	X	X						
R	C	**northern flicker** *Colaptes auratus*				X				X	X	X	X								
R	C	**pileated woodpecker** *Dryocopus pileatus*											X	X			X				
S	C	**olive-sided flycatcher** *Contopus cooperi*			SV	X					X		X				X	X	X		
S	U	**western wood-pewee** *Contopus sordidulus*				X					X		X	X	X		X				
S	U	**willow flycatcher** *Empidonax traillii*			SU				X	X		X	X	X			X				
S	C	**Hammond's flycatcher** *Empidonax hammondii*										X	X	X							
S	U	**gray flycatcher** *Empidonax wrightii*		S				X	X	X	X										
S	U	**dusky flycatcher** *Empidonax oberholseri*				X				X	X	X	X		X		X				
S	U	**Pacific-slope (Western) flycatcher** *Empidonax difficilis*									X	X			X	X	X				
M	U	**Say's phoebe** *Sayornis saya*					X	X	X											X	
S	C	**western kingbird** *Tyrannus verticalis*								X							X				
S	C	**Cassin's vireo** *Vireo cassinii*									X		X	X			X				

			Status			Habitat Association Reference Guide [6]															
Status [1]	*Frequency [2]*	*Common Name* *Taxon*	*FWS [3]*	*FS [4]*	*OR [5]*	**Meadow (Opening)**	**Grassland**	**Sagebrush**	**Shrub**	**Juniper**	**Ponderosa Pine**	**Aspen**	**Mixed Confier**	**Grand fir**	**Lodgepole**	**Subalpine fir**	**Riparian**	**Water**	**Marsh**	**Cliffs, Tallus**	**Caves**
S	U	**blue-headed vireo** *Vireo solitarius*									X		X	X	X		X				
S	C	**warbling vireo** *Vireo gilvus*										X					X				
S	U	**red-eyed vireo** *Vireo olivaceus*															X				
R	C	**gray jay** *Perisoreus canadensis*											X	X	X	X					
R	C	**Steller's jay** *Cyanocitta stelleri*									X		X	X			X				
R	C	**Clark's nutcracker** *Nucifraga columbiana*														X					
R	C	**black-billed magpie** *Pica hudsonia*				X		X	X	X							X				
R	C	**common raven** *Corvus corax*				X		X		X	X		X	X	X	X	X		X		
S	U	**horned lark** *Eremophila alpestris*					X	X													
S	U	**tree swallow** *Tachycineta bicolor*											X	X			X	X			
S	U	**violet-green swallow** *Tachycineta thalassina*				X							X	X						X	
S	U	**northern rough-winged swallow** *Stelgidopteryx serripennis*															X	X			
S	U	**cliff swallow** *Petrochelidon pyrrhonota*				X	X										X			X	
S	U	**barn swallow** *Hirundo rustica*				X	X										X			X	

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R	C	**black-capped chickadee** *Poecile atricapillus*								X		X					X				
R	C	**mountain chickadee** *Poecile gambeli*								X	X	X	X	X	X	X	X				
R	U	**chestnut-backed chickadee** *Poecile I364rufescens*											X	X	X						
R	C	**red-breasted nuthatch** *Sitta canadensis*											X	X	X						
R	U	**white-breasted nuthatch** *Sitta carolinensis*									X		X								
R	C	**pygmy nuthatch** *Sitta pygmaea*									X		X								
R	C	**brown creeper** *Certhia americana*									X		X	X			X				
S	U	**rock wren** *Salpinctes obsoletus*							X											X	
S	U	**canyon wren** *Catherpes mexicanus*																		X	
S	U	**house wren** *Troglodytes aedon*									X		X	X	X	X	X				
R	U	**winter wren** *Troglodytes troglodytes*											X	X	X	X					
R	C	**American dipper** *Cinclus mexicanus*											X	X			X			X	
R	C	**golden-crowned kinglet** *Regulus satrapa*									X		X	X	X						
R	C	**ruby-crowned kinglet** *Regulus calendula*											X	X	X	X					

Status [1]	Frequency [2]	Common Name / Taxon	Status			Habitat Association Reference Guide [6]															
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S	C	**western bluebird** *Sialia mexicana*				X	X			X	X	X	X								
S	C	**mountain bluebird** *Sialia currucoides*				X		X	X	X	X	X	X		X						
R	C	**Townsend's solitaire** *Myadestes townsendi*				X					X		X	X	X	X					
S	C	**veery** *Catharus fuscescens*							X				X	X	X	X	X				
S	C	**Swainson's thrush** *Catharus ustulatus*							X				X	X		X					
S	C	**hermit thrush** *Catharus guttatus*							X	X		X	X	X	X	X					
R	C	**American robin** *Turdus migratorius*						X	X	X	X	X	X	X	X	X	X				
R	U	**varied thrush** *Ixoreus naevius*							X				X	X							
I	U	**European starling** *Sturnus vularis*								X	X	X	X	X	X		X				
S	C	**cedar waxwing** *Bombycilla cedrorum*							X	X	X						X				
S	C	**orange-crowned warbler** *Vermivora celata*							X			X					X				
S	U	**Nashville warbler** *Vermivora ruficapilla*							X		X		X								
S	C	**yellow warbler** *Dendroica petechia*							X			X					X				
S	C	**yellow-rumped warbler** *Dendroica coronata*										X		X	X	X					

			Status			Habitat Association Reference Guide [6]															
Status [1]	*Frequency [2]*	*Common Name* / *Taxon*	*FWS [3]*	*FS [4]*	*OR [5]*	Meadow (Opening)	Grassland	Sagebrush	Shrub	Juniper	Ponderosa Pine	Aspen	Mixed Confier	Grand fir	Lodgepole	Subalpine fir	Riparian	Water	Marsh	Cliffs, Tallus	Caves
S	U	**black-throated gray warbler** *Dendroica nigrescens*							X	X	X		X				X				
S	C	**Townsend's warbler** *Dendroica townsendi*											X	X							
M	R	**American redstart** *Setophaga ruticilla*							X		X				X		X				
M	U	**northern waterthrush** *Seiurus noveboracensis*							X		X				X	X	X				
S	U	**MacGillivray's warbler** *Oporornis tolmiei*							X								X				
S	U	**common yellow throat** *Geothlypis trichas*							X								X		X		
S	C	**Wilson's warbler** *Wilsonia pusilla*							X			X	X	X							
S	C	**western tanager** *Piranga ludoviciana*									X		X	X							
S	U	**green-tailed towhee** *Pipilo chlorurus*		SWA					X	X	X						X				
S	U	**spotted towhee** *Pipilo maculatus*							X	X							X				
S	C	**chipping sparrow** *Spizella passerina*							X	X	X		X								
S	U	**vesper sparrow** *Pooecetes gramineus*				X	X	X		X											
S	U	**savannah sparrow** *Passerculus sandwichensis*				X	X														
R	C	**song sparrow** *Melospiza melodia*							X								X		X		

Status [1]	Frequency [2]	Common Name / *Taxon*	Status			Habitat Association Reference Guide [6]															
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S	U	**Lincoln's sparrow** *Melospiza lincolnii*				X										X	X				
S	C	**white-crowned sparrow** *Zonotrichia leucophrys*				X			X			X				X	X				
R	C	**dark-eyed junco** *Junco hyemalis*				X				X	X		X	X	X	X					
S	C	**black-headed grosbeak** *Pheucticus melanocephalus*									X		X				X				
S	U	**lazuli bunting** *Passerina amoena*							X								X				
S	C	**western meadowlark** *Sturnella neglecta*					X	X	X												
S	U	**Brewer's blackbird** *Euphagus cyanocephalus*					X		X										X		
S	C	**brown-headed cowbird** *Molothrus ater*					X		X	X							X				
S	U	**Bullock's oriole** *Icterus bullockii*								X	X		X				X				
M	U	**gray-crowned rosy-finch** *Leucosticte tephrocotis*														X				X	
S	R	**pine grosbeak** *Pinicola enucleator*													X	X					
M	R	**purple finch** *Carpodacus purpureus*									X		X				X				
R	C	**Cassin's finch** *Carpodacus cassinii*								X	X	X	X	X	X	X					
S	C	**house finch** *Carpodacus mexicanus*					X	X	X	X	X	X									

Status [1]	Frequency [2]	Common Name Taxon	Status: FWS [3]	Status: FS [4]	Status: OR [5]	Habitat Association Reference Guide [6]: Meadow (Opening)	Grassland	Sagebrush	Shrub	Juniper	Ponderosa Pine	Aspen	Mixed Confier	Grand fir	Lodgepole	Subalpine fir	Riparian	Water	Marsh	Cliffs, Tallus	Caves
R	U	**red crossbill** *Loxia curvirostra*									X		X	X	X	X					
W	U	**white-winged crossbill** *Loxia leucoptera*											X	X	X	X					
R	C	**pine siskin** *Carduelis pinus*									X	X	X	X	X	X					
S	U	**evening grosbeak** *Coccothraustes vespertinus*											X	X	X	X					
R	C	**house sparrow** *Passer domesticus*							X												
R	U	**montane (Dusky) shrew** *Sorex monticolus*							X				X	X							
R	C	**vagrant shrew** *Sorex vagrans*				X	X		X								X				
R	C	**coast mole** *Scapanus orarius*				X		X			X	X	X	X	X	X	X				
M	U	**California myotis** *Myotis californicus*						X	X	X	X		X	X			X			X	X
R	U	**long-eared myotis** *Myotis evotis*			SU	X			X		X		X	X							
R	C	**little brown bat** *Myotis lucifugus*				X	X		X		X		X	X			X	X			
R	U	**fringed myotis** *Myotis thysanodes*			SV								X	X			X				X
R	U	**long-legged myotis** *Myotis volans*			SU						X		X	X			X			X	X
		hoary bat																			

			Status			Habitat Association Reference Guide [6]															
Status [1]	*Frequency [2]*	*Common Name* / *Taxon*	*FWS [3]*	*FS [4]*	*OR [5]*	**Meadow (Opening)**	**Grassland**	**Sagebrush**	**Shrub**	**Juniper**	**Ponderosa Pine**	**Aspen**	**Mixed Confier**	**Grand fir**	**Lodgepole**	**Subalpine fir**	**Riparian**	**Water**	**Marsh**	**Cliffs, Tallus**	**Caves**
R	U	**hoary bat** *Lasiurus cinereus*										X			X	X	X				
R	R	**silver-haired bat** *Lasionycteris noctivangans*			SU					X	X	X	X	X							
R	U	**big brown bat** *Eptesicus fuscus*									X		X	X			X			X	
R	R	**Townsend's big-eared bat** *Corynorhinus townsendii*		SWA	SC					X	X		X								X
R	C	**mountain cottontail** *Sylvilagus nuttalli*						X	X	X	X	X	X							X	
R	U	**snowshoe hare** *Lepus americanus*				X							X	X	X	X					
R	C	**yellow-pine chipmunk** *Tamias amoenus*							X	X	X		X								
R	U	**least chipmunk** *Eutamias minumus*						X	X		X										
R	U	**Belding's ground squirrel** *Spermophilus beldingi*				X		X	X	X	X										
R	C	**Columbian ground squirrel** *Spermophilus columbianus*				X					X		X	X	X	X					
R	C	**golden mantled ground squirrel** *Spermophilus lateralis*				X		X	X		X		X							X	
R	C	**red squirrel** *Tamiasciurus hudsonicus*									X		X	X	X	X					
R	C	**northern flying squirrel** *Glaucomys sabrinus*									X		X	X	X	X					
R	C	**northern pocket gopher** *Thomomys talpoides*					X		X	X	X	X	X	X	X	X					

			Status			Habitat Association Reference Guide [6]															
Status [1]	***Frequency [2]***	*Common Name* / *Taxon*	***FWS [3]***	***FS [4]***	***OR [5]***	**Meadow (Opening)**	**Grassland**	**Sagebrush**	**Shrub**	**Juniper**	**Ponderosa Pine**	**Aspen**	**Mixed Confier**	**Grand fir**	**Lodgepole**	**Subalpine fir**	**Riparian**	**Water**	**Marsh**	**Cliffs, Tallus**	**Caves**
R	U	**beaver** *Castor canadensis*										X					X	X			
R	U	**canyon mouse** *Peromyscus crinitus*																		X	
R	C	**deer mouse** *Peromyscus maniculatus*				X	X	X	X	X	X	X	X	X	X	X					
R	C	**bushy-tailed woodrat** *Neotoma cinerea*						X	X	X	X	X	X	X	X	X					
R	C	**southern red-backed vole** *Clethrionomys gapperi*											X	X	X	X					
R	U	**Heather vole** *Phenacomys intermedius*				X							X	X	X		X				
R	U	**long-tailed vole** *Microtus longicaudus*				X			X		X		X	X	X	X	X		X		
R	U	**water vole** *Microtus richardsoni*													X	X	X				
R	C	**porcupine** *Erethizon dorsatum*							X	X	X	X	X	X							
R	C	**coyote** *Canis latrans*				X	X	X	X	X	X	X	X	X	X	X					
R	R	**gray wolf** *Canis lupus*	T		LE	X	X		X	X	X		X	X			X			X	
R	C	**black bear** *Ursus americanus*							X				X	X			X				
R	C	**raccoon** *Procyon lotor*															X	X	X		
R	U	**marten** *Martes americana*			SV								X	X	X	X	X				

Status [1]	Frequency [2]	Common Name Taxon	Status: FWS [3]	Status: FS [4]	Status: OR [5]	Habitat Association Reference Guide [6]: Meadow (Opening)	Grassland	Sagebrush	Shrub	Juniper	Ponderosa Pine	Aspen	Mixed Confier	Grand fir	Lodgepole	Subalpine fir	Riparian	Water	Marsh	Cliffs, Tallus	Caves
R	C	**ermine** *Mustela erminea*											X	X	X	X	X	X			
R	C	**long-tailed weasel** *Mustela frenata*				X	X	X	X	X	X	X	X	X	X	X	X	X			
R	R	**mink** *Mustela vison*															X	X	X		
R	R	**wolverine** *Gulo gulo*		S	LT										X	X				X	
R	U	**western spotted skunk** *Spilogale gracilis*							X	X	X		X				X			X	
R	U	**mountain lion** *Puma concolor*									X		X	X	X	X				X	X
R	C	**bobcat** *Lynx rufus*						X	X	X	X		X	X	X	X				X	
R	C	**elk (wapiti)** *Cervus elephus*				X			X		X	X	X	X			X				
R	C	**mule deer** *Odocoileus hemionus*					X	X	X	X	X	X	X	X							
R	U	**white-tailed deer** *Odocoileus virginianus*				X			X		X	X	X								
R	U	**California bighorn sheep** *Ovis canadensis californiana*				X	X	X												X	

[1] Status - the extent or time of use by an individual on the Forest. R = resident yearlong, individuals present throughout the year, with only small seasonal shifts in activity. Individuals breed on the Forest. W = winter resident, present on the forest in winter, migrates out of the area during summer. S = summer resident, present in the summer and migrates out of the area during the winter. The individual potentially breeds on the Forest. M = migrant, individuals pass through the area, only pausing to feed or rest. Typically breeding does not occur on the Forest. I = introduced, residents (year-long) that are not native to the area.

Status [1]	Frequency [2]	Common Name Taxon	Status			Habitat Association Reference Guide [6]															
			FWS [3]	FS [4]	OR [5]	Meadow (Opening)	Grassland	Sagebrush	Shrub	Juniper	Ponderosa Pine	Aspen	Mixed Confier	Grand fir	Lodgepole	Subalpine fir	Riparian	Water	Marsh	Cliffs, Tallus	Caves

[2] Frequency - The occurrence of a species is based on the amount of preferred habitat in the area and individual observations during the appropriate season. A = abundant, occurs throughout the area (>50%) and observations of the species are high or very frequent. C = common, observations are high (or very frequent) in less than 50% of the area, or observations are moderate to frequent throughout the area (>50%). U = uncommon, observations are moderate (or frequent) in less than 50% of the area or observations are low to infrequent throughout the area (>50%). R = rare, observations are low to few in less than 50% of the area.

[3] US Fish and Wildlife Service (FWS) listing (FR 5/2004), E = Endangered, T = Threatened, C = Candidate, and P = Proposed

[4] US Forest Service (FS) Regional Foresters Sensitive Animals (August 2004), S = Sensitive, SOR - Sensitive in Oregon only, SWA = Sensitive in Washington only.

[5] Oregon (OR) state status, LE = state listed endangered, LT = state listed threatened, SC= sensitive species "critical", SV = sensitive "vulnerable", SP = "peripheral or naturally rare and SU = undetermined status.

[6] Habitat association are initially based on Thomas el al 1997 (Appendix 6). Habitat association were updated from Corkran and Thomas 1996, St. John 2002, Marshall et al 2003, and Verts and Carraway 1998. X - preferred habitat association for the species based on the previously cited references.

Appendix B

Considerations for sustaining late/old forest structural stages at the landscape scale.

Management Direction for LOS

In the Land and Resource Management Plan (Umatilla National Forest 1990), old growth tree habitat is managed through dedicated forested units, managed lodgepole stands, riparian areas, and unroaded areas distributed throughout the Forest. The dedicated old growth units are in mixed conifer and ponderosa pine types that have been identified and mapped as Management Area C1. Lodgepole pine habitat units are identified and managed according to the specifications listed in Management Area C2. In addition, the Forest Plan protects existing old growth/mature habitat in Management Areas A1, A2, A7, A8, C3A, C7, C8, D2, F2, and F4 (roadless, riparian, and other suitable areas outside wilderness). The old growth/mature habitat on the Forest is managed for those species with a strong affinity for that habitat condition (i.e. pileated woodpecker, marten, three-toed woodpecker, etc.). The size of old growth stands varies by management indicator species (MIS): pileated woodpecker, 300 acres; pine marten, 160 acres; and northern three-toed woodpecker, 75 acres. In addition, the distribution of stands differs for dedicated and managed stands, but average spacing is generally every 5 miles across the Forest and units did not need to meet old growth/mature conditions at the time of selection. Forest-wide standards and guidelines for old growth units include the following criteria: maintain habitat within suitable and/or capable conditions for the MIS, maintain the distribution of units throughout the Forest, and maintain sufficient amounts for (other) wildlife species. Essential to the management of old growth is field verification and tracking of units, stands, and surrounding areas.

The Regional Forester's Forest Plan Amendment #2 (Forest Service 1995) also provides direction for managing late and old structure. The direction, referred to as the "Eastside Screens," requires the Forest to analysis the Historical Range of Variability (HRV) at the watershed scale. This analysis characterizes the difference in percent composition of the structural stages between HRV and current conditions for each biophysical environment. The HRV condition determines potential treatment areas.

When LOS stages fall below HRV for a particular biophysical group within a watershed, then there should be not net loss of LOS from that group. Timber harvest can occur within LOS stages that are within or above HRV in a manner to maintain or enhance LOS for the biophysical group. Harvest activities are allowed outside of LOS, with the intent to maintain and/or enhance LOS components in stands, provided the follow standards are met:

- Maintain all remnant late and old seral and structural live trees >21" dbh currently within the stand.
- Manipulate vegetative structure in a manner to move it toward a condition to meet HRV.
- Maintain "open park-like" stands conditions, where they occurred historically.
- In order to maintain connectivity and reduce fragmentation of LOS stand the following standards will be followed.

- Maintain or enhance the current level of connectivity between LOS stands and between Forest Plan “old growth” management areas, by maintaining stands between them to serve the purpose of connectivity.
- LOS stands and designated “old growth” stands need to be connected with each other inside the watershed and outside the watershed, in a contiguous network pattern by at least 2 different directions.
- Connectivity corridor-stands are those where medium diameter or larger trees are common, and canopy closures are within the top one-third of site potential. Stand widths should be at least 400 feet wide at their narrowest point. The length of the connectivity corridor depends on the distance between LOS/”old growth” stands.

The Eastside Screens (Regional Forester’s Amendment #2) provides additional standards and guidance for managing LOS stages for other HRV scenarios.

Current LOS Situation

A variety of wildlife species on the Forest appear to demonstrate a high level of use and dependence on mature and old growth tree habitat. Past harvest activities have removed much of the suitable old growth tree habitat once found on the Forest. Based on historic records and current habitat assessments, the size and arrangement of late/old forest has declined greatly since the early 1900’s. Historic late/old forests typically occurred in large patches, contained a large amount of interior habitat, connected to similar habitats, and generally occupied more than 50% of the forested area. Current late/old forests typically occur in small patches, contain little interior habitat, are widely scattered, loosely connect to similar habitats, and generally occupy less than 10% of the forested area. In generally, LOS stands are currently not uniformly or evenly distributed across the landscape.

The management of old growth habitat for wildlife species and other values continues to be an issue of controversy. Various internal and external interests are divided on the amount of old growth habitat to retain on the Forest. The majority of individuals have expressed concern about reduced quantities and quality of old growth/mature tree habitat across the Forest. Based on this concern and the current condition of old forest stands, one of the driving objective of forest management is to restore the quantity of late/old forest conditions at the landscape scale and across the Forest.

Proposed LOS Strategy

The overall goal is to manage for a late and old forest condition well within the Historic Range of Variability (HRV) of the watershed. The following objectives would lead to the restoration of the Late and/or Old Structural component in the watershed.

- Maintain existing LOS units/stands.
- Expand the LOS component in the watershed.
- Increase the patch size of LOS stands.
- Utilize existing LOS direction to implement the strategy.

Implementation

The purpose of this strategy is to increase the amount of late and old structure in the watershed as soon as possible and to restore this component firmly within the HRV. In order to have a significant and lasting affect on the watershed, the structural composition needs to be enough (acreage) to make a difference in the watershed and provide interior habitat for viable populations. By restoring and maintaining the HRV a mid levels, a reasonable stockpile of LOS would be available to buffer the erosion of LOS stages in the watershed due to natural disturbance (insect, disease, fire, etc.), harvest, and normal stand dynamics. Once LOS stands have developed, structural diversity in the watershed would resemble a more "desirable" condition for wildlife species associated with late and old structure. With a more balanced structural composition, the watershed would be more receptive to an array of cultural treatments, increasing management opportunities throughout the watershed. Targeting a moderate level of restoration also provides a firm foundation for the re-establishment of old growth habitat in the watershed and across the Forest. Maintaining the LOS component at a moderate level puts the District in a better position to manage the LOS component, once "desired" levels are established (at some point in time). In addition, maintaining a moderate level of LOS stage hedges the likelihood of continually increasing the amount of LOS to meet the needs of species dependant on that structural condition. Managing LOS at lower level essentially maintains the status quo in the watershed limiting management's flexibility, and potentially impeding the recovery of ecosystem processes and function.

Table B-1 identifies the amount of LOS to restore on National Forest land in the NF John Day/Potamus watershed. The percentage value in the Restoration Objective in the table is simply a rounded value derived from the mean of the two extreme values of the historic range. The HRV mid-point value is the restoration objective for maintaining LOS stages at the moderate level. The acre value for the Restoration Objective is historic range mid point (percent) times the total acres in the potential vegetations group. Theses estimated acres target the amount of LOS to restore and maintain in the watershed for each potential vegetation group.

Table B-1. Restoration objectives for LOS stages in the Potamus watershed.

Potential Vegetation Group		Old Forest Multi Strata			Old Forest Single Stratum			
		Historic Range	Current	Restoration Objective	Historic	Current	Restoration Objective	NFS Acres (Total)
Cold	*Percent*	*10-40%*	*1%*	*25%*	*0-5%*	*4%*	*3%*	11,328
	Acres	1,100-4,500	100	2,800	0-600	500	300	
Moist	*Percent*	*10-30%*	*2%*	*20%*	*0-5%*	*8%*	*3%*	10,678
	Acres	1,100-3,200	200	2,100	0-500	900	300	
Dry	*Percent*	*5-20%*	*3%*	*12%*	*15-55%*	*2%*	*40%*	56,329
	Acres	2,800-11,300	200	6,800	8,400-31,000	1,100	22,500	
Total Acres		---	500	11,700	---	2,500	23,100	---

Implementing objectives would be address anytime a project proposal develops in the watershed. At that time, stands will be selected/identified, in order to fully attain, the restoration objective for the watershed (Table B-1). Efforts would then focus on maintaining the existing LOS condition and/or moving stands toward an LOS condition as soon as possible.

Initially, all existing old forest patches or stands (old forest single strata or old forest multi stratum) are maintained and protected from disturbances such as timber harvest to serve as a corner stone for future late and old structural development. These existing stands/patches can be used as stepping-stones to increase the quantity and improve the quality of LOS in the watershed. Forest Plan old growth units (C1 or C2) can be included if their existing condition is near or at late or old forest condition.

To expand the LOS component in the watershed identify "new" stands or building off existing stands to meet the restoration objective identified in Table B-1. Mid-to late-seral patches (understory reinitiation and young forest multi strata stands), in close proximity to existing old forest patches can be selected as potential replacements stands. The mid-to late-seral patches should be examined on the ground to determine which old forest attributes they currently have, and to determine if cultural activities (thinning, etc.) could promote missing attributes more quickly than would occur through "normal" stand dynamics. The distribution of desired future patch should be identified and determined if young-seral stands (stand initiation and stem exclusion), located on a desirable spacing could be cultured (thinned, etc.) to produce old forest attributes more quickly than would occur by less aggressive treatments. When identifying candidates for future old forest multi strata, stands should be selected that have the highest potential to survive to the old forest stage – namely areas on north facing aspects and at high elevations, particularly if they occur within valley bottoms and drainage headwalls. The predicted location of semi-stable environmental setting could be modeled using criteria described by Camp and others (1997).

In order to maximize interior habitat and mimic historic patch sizes large LOS patches/stands need to be developed. The intent is to create old forest patches/stands at least 300 acres in size, with their length not be more than 1.5 times their width. Where feasible, the focus should be on increasing the LOS component adjacent to existing LOS stands in order to obtain a larger patch size.

Apply the existing standards and guidelines in the Forest Plan and "Eastside Screens" to implement this strategy and manage LOS and old growth stands identified or selected in the watershed. LOS stands and old growth habitat needs to be connected with each other inside the watershed as well as to like stands in adjacent watersheds in a continuous network pattern by <u>at least</u> 2 different directions. Connective habitat consists of stands where medium (>10" DBH) or large (>20" DBH) diameter trees are common, and canopy closure is within the top 1/3 of the site potential. Connective stands should be at least 400 feet wide at their narrowest point, but a more desirable width of 800 to 1,200 feet is preferred.

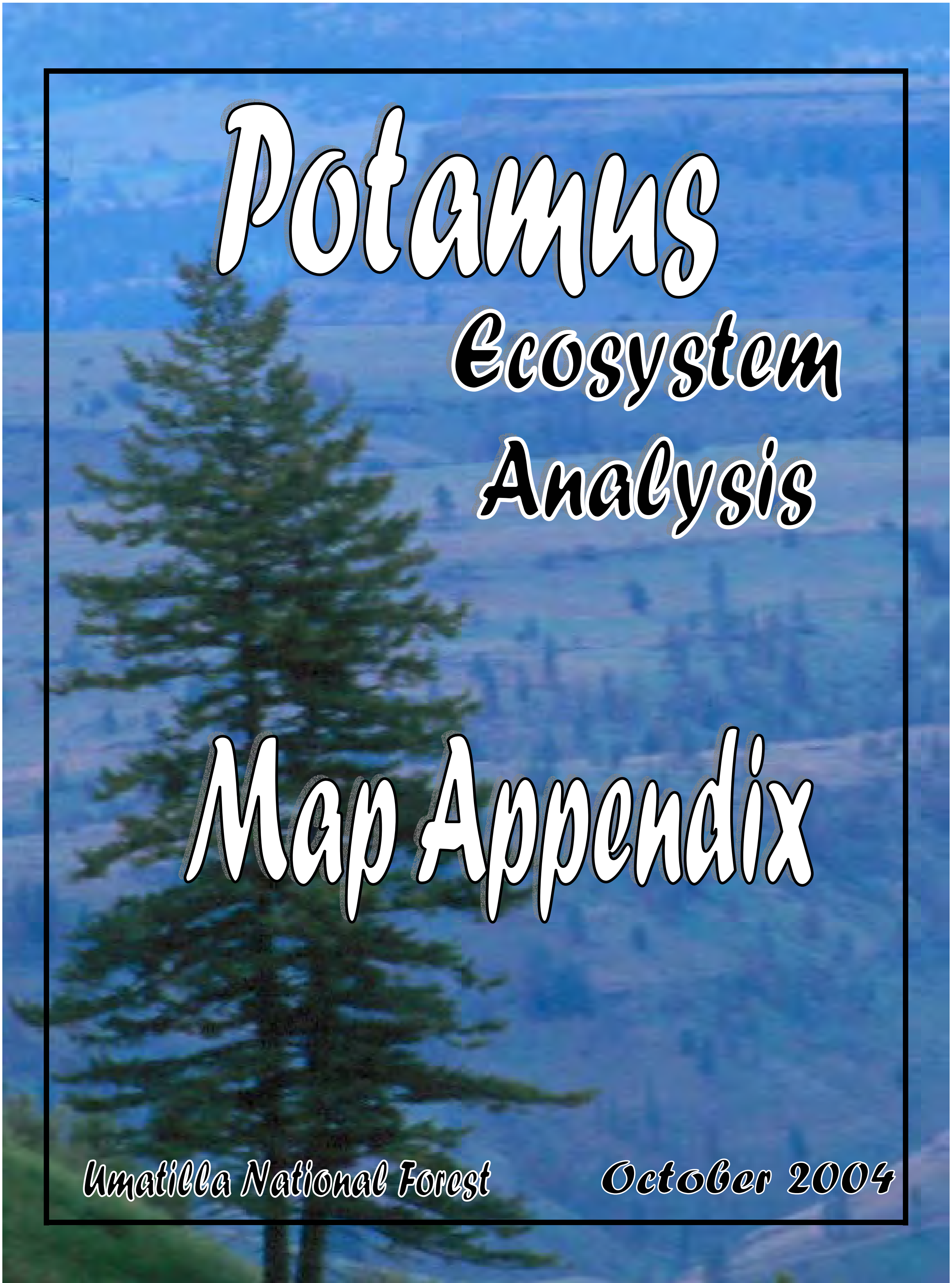
Monitoring

All stands identified as LOS stands or targeted for LOS development will be verified by ground-truthing to determine current and potential condition. Current LOS stands and stands selected for development to a LOS condition will be identified in the stand database as such. The stand condition will be updated and tracked periodically in the database. Stands should be reviewed after cultural treatments and 3-5 years after treatments to evaluate the effects of treatment on the stand. A map showing existing and potential LOS stages and habitat connectivity in the watershed will be developed and maintained over time. The map should be available as needed and particularly during the project development phase. Map 8-7 with the current database can be used as baseline data to start the implementation and monitoring phase of this strategy.

Potamus

Ecosystem Analysis

Map Appendix



Umatilla National Forest

October 2004

SOILS & GEOLOGY

SUBSECTIONS

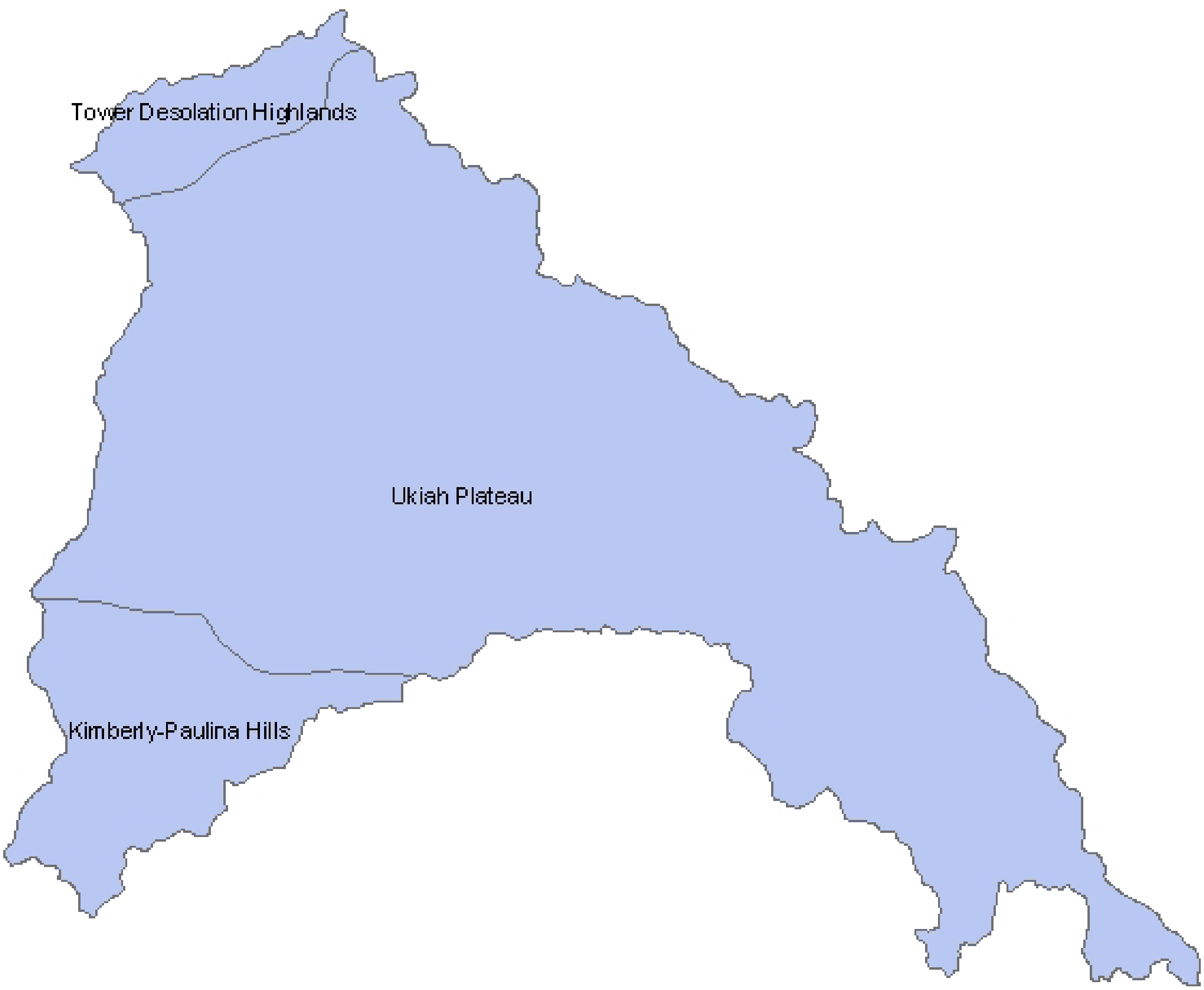


Figure 2-1. Subsection map

LAND TYPE ASSOCIATIONS

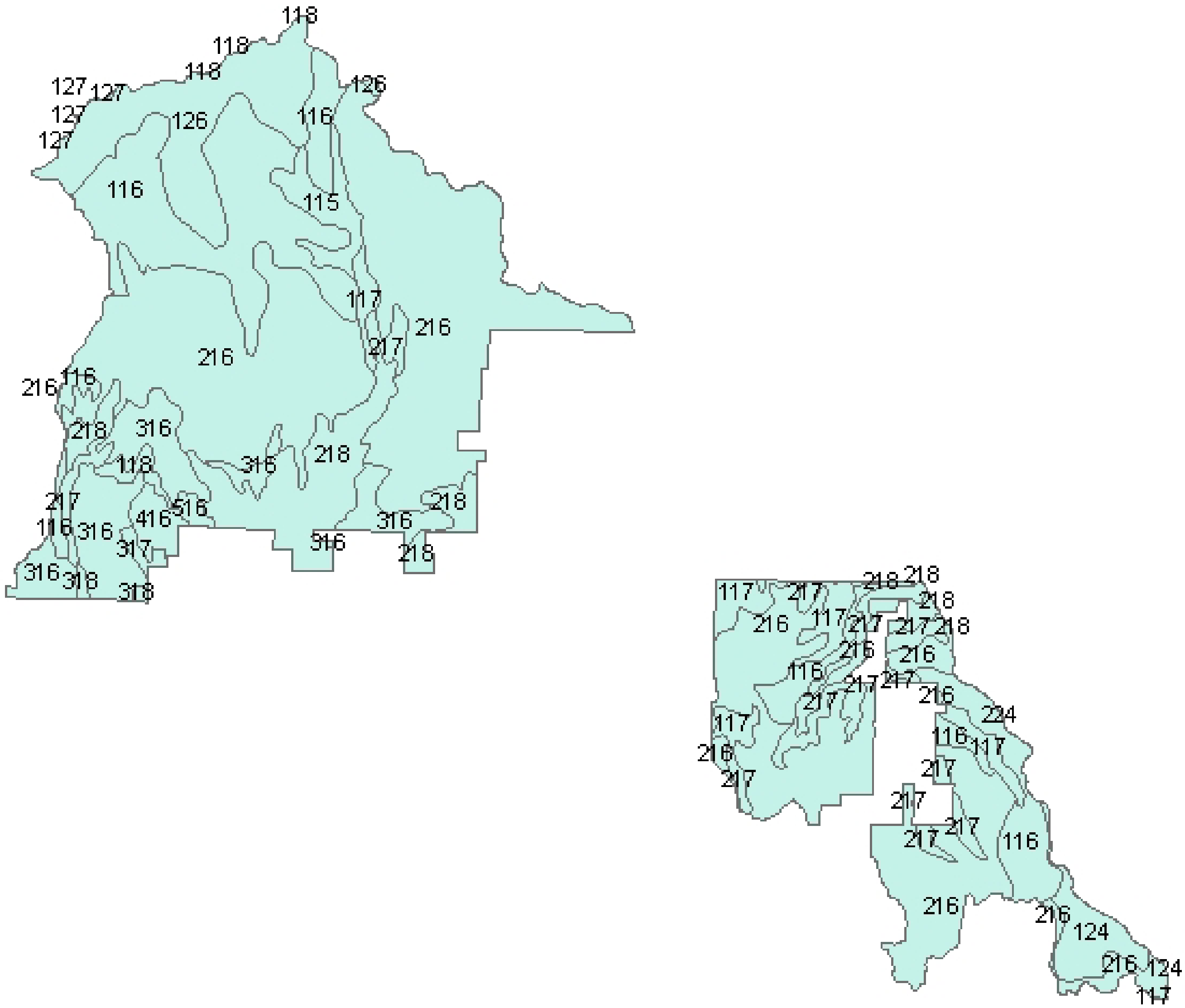


Figure 2-2. Land-type Associations

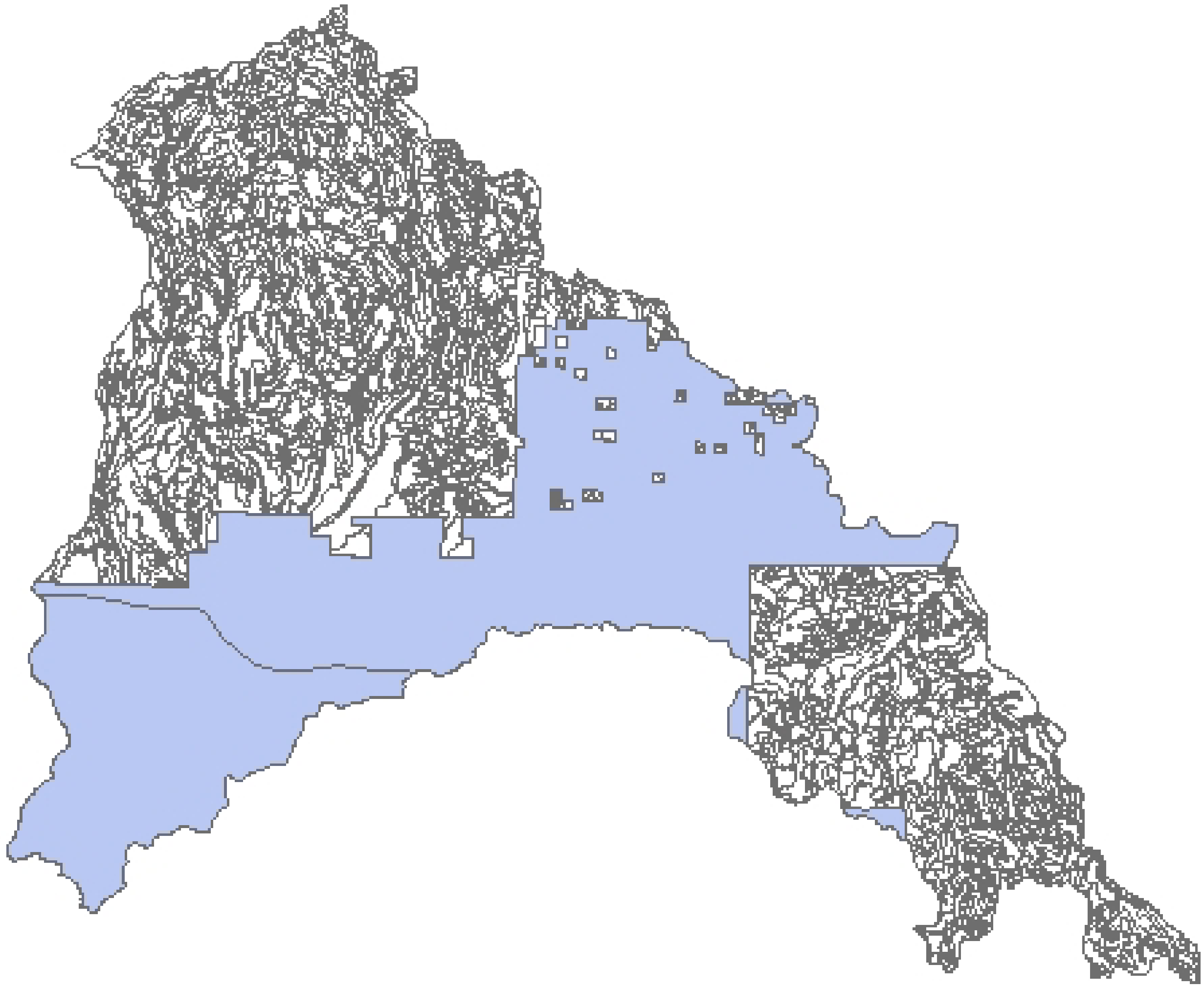


Figure 2-3. Soil Resource Inventory

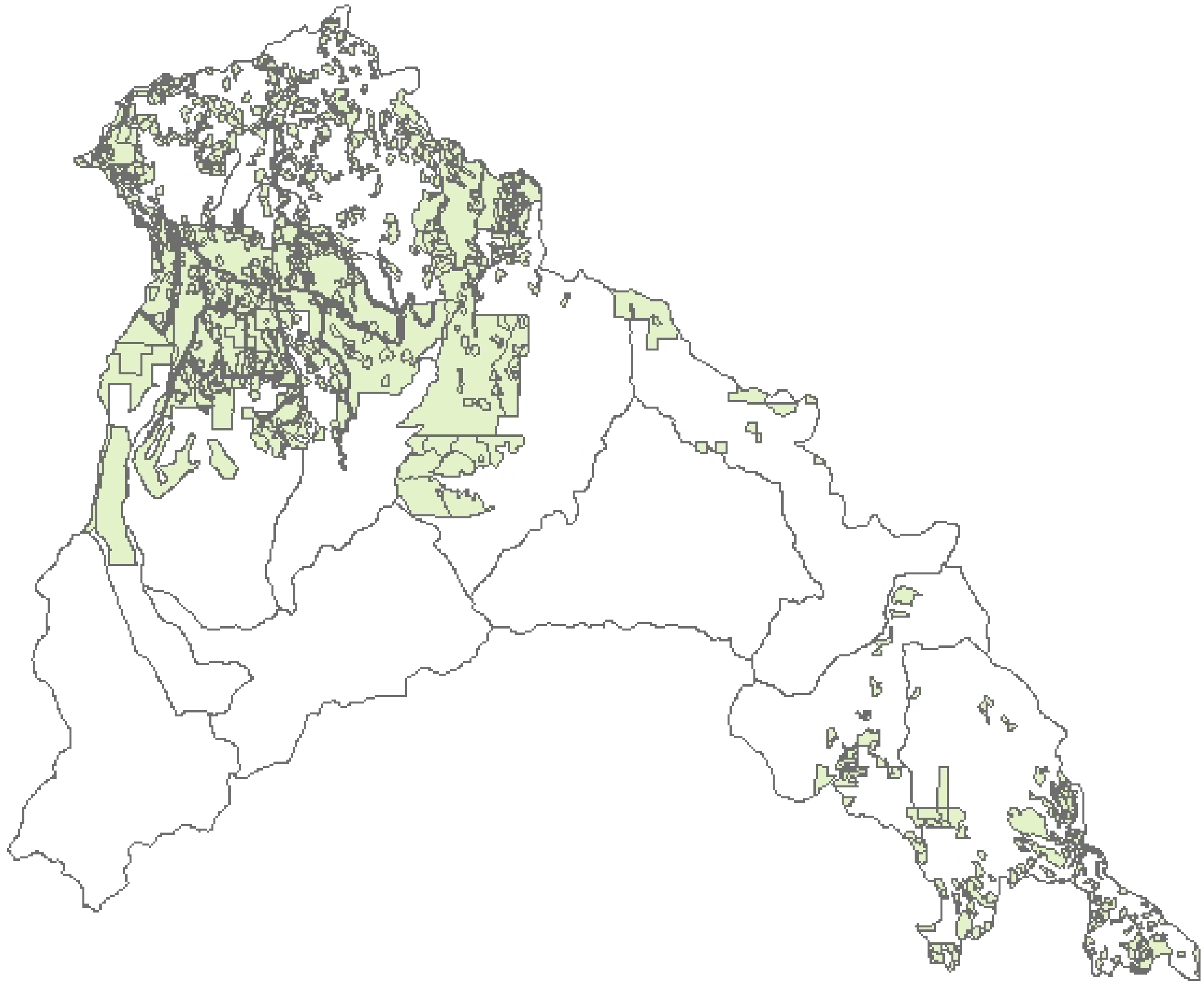


Figure 2-4. Harvest unit

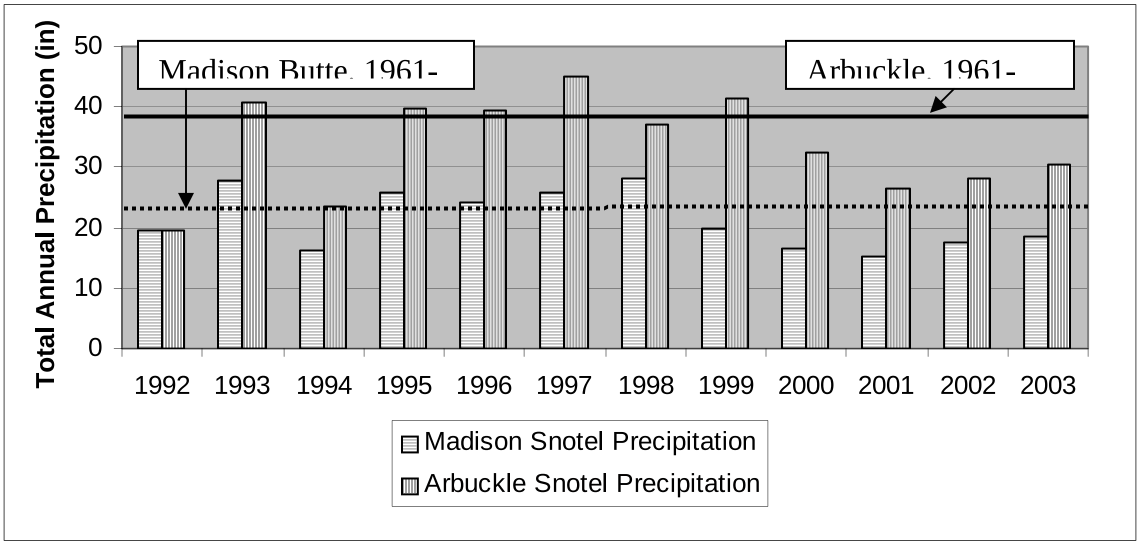


Figure 3-1. Madison Butte and Arbuckle SNOTEL Sites, Annual Precipitation and 30-Year Averages, 1961-1991.

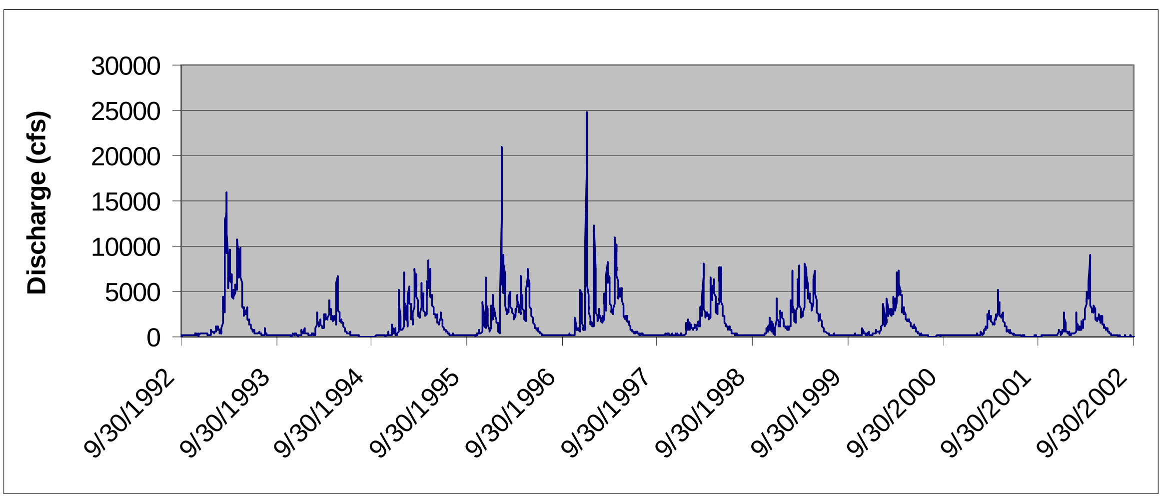


Figure 3-2. Decadal Hydrograph at NFJD Monument Gage.

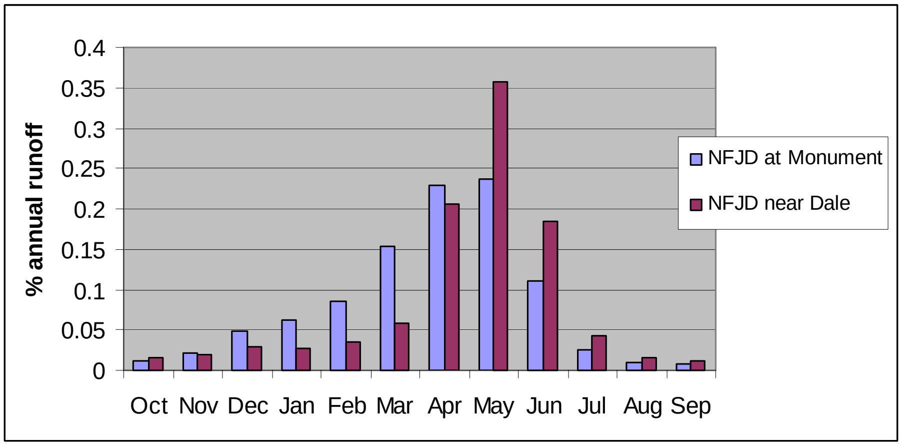


Figure 3-3. Percent annual runoff at NFJD River Gages.

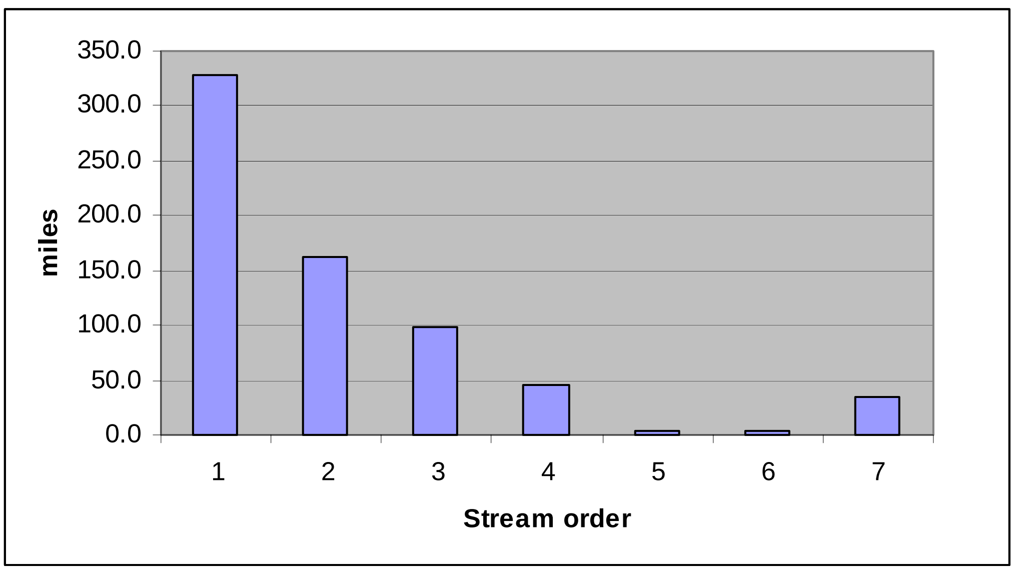


Figure 3-4. Miles of stream by Strahler stream order.

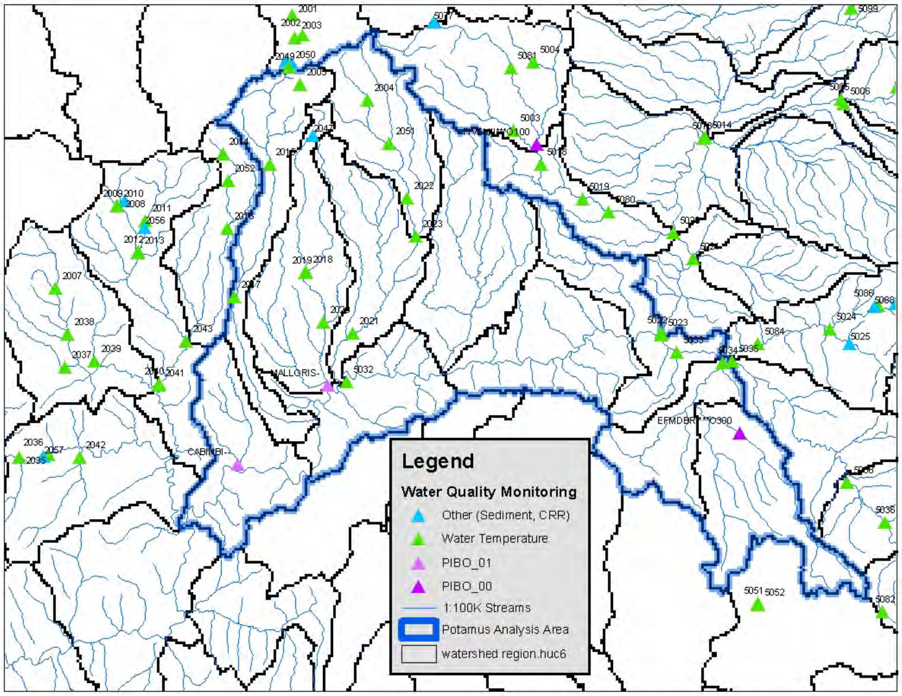


Figure 3-5. Water Quality and Aquatic Monitoring Locations

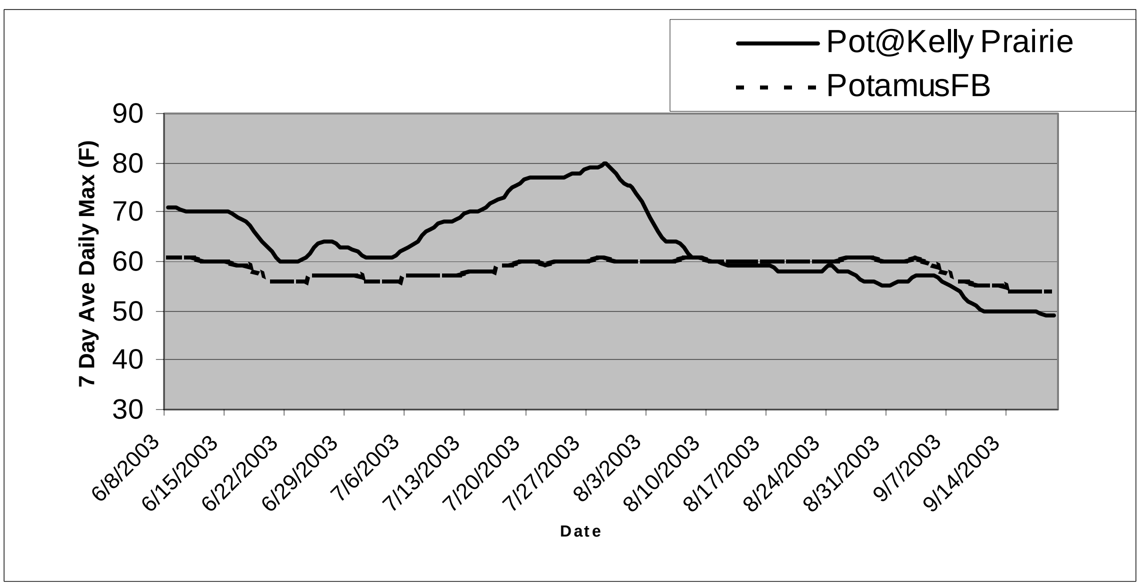


Figure 3-6. Water Temperatures on Potamus Creek.

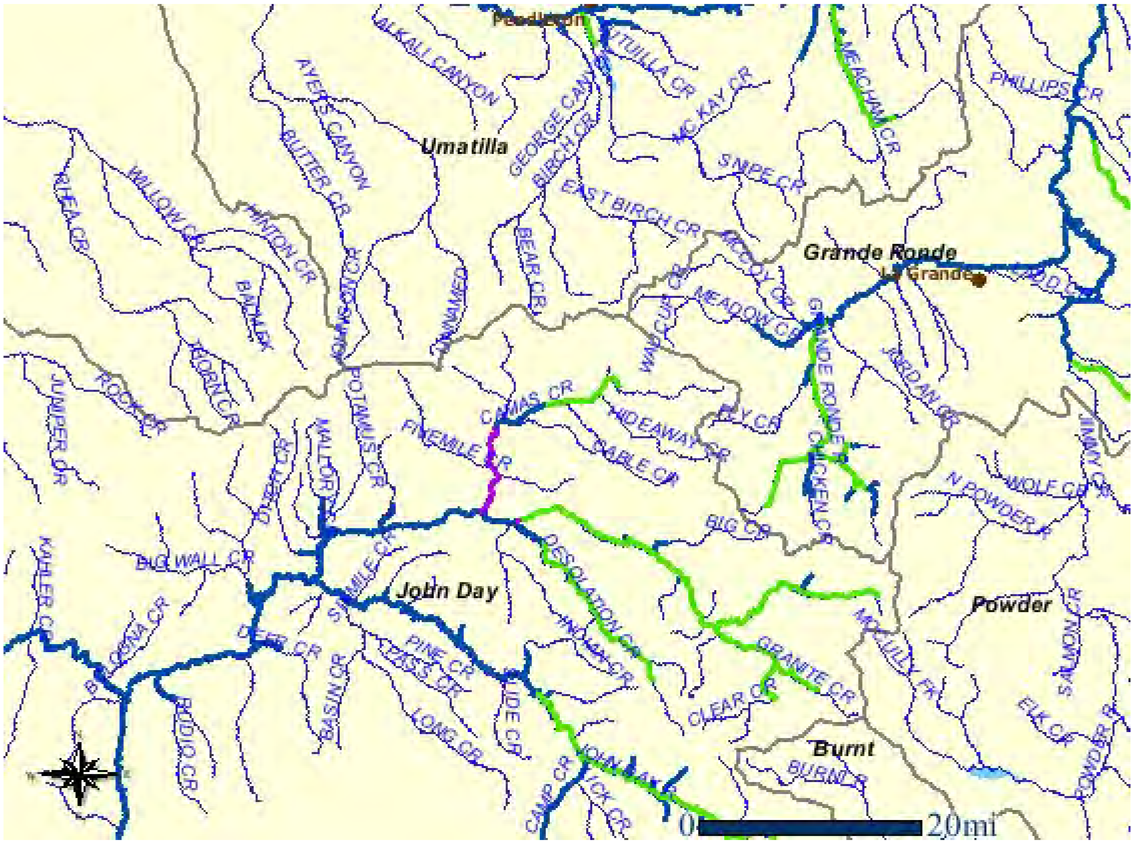
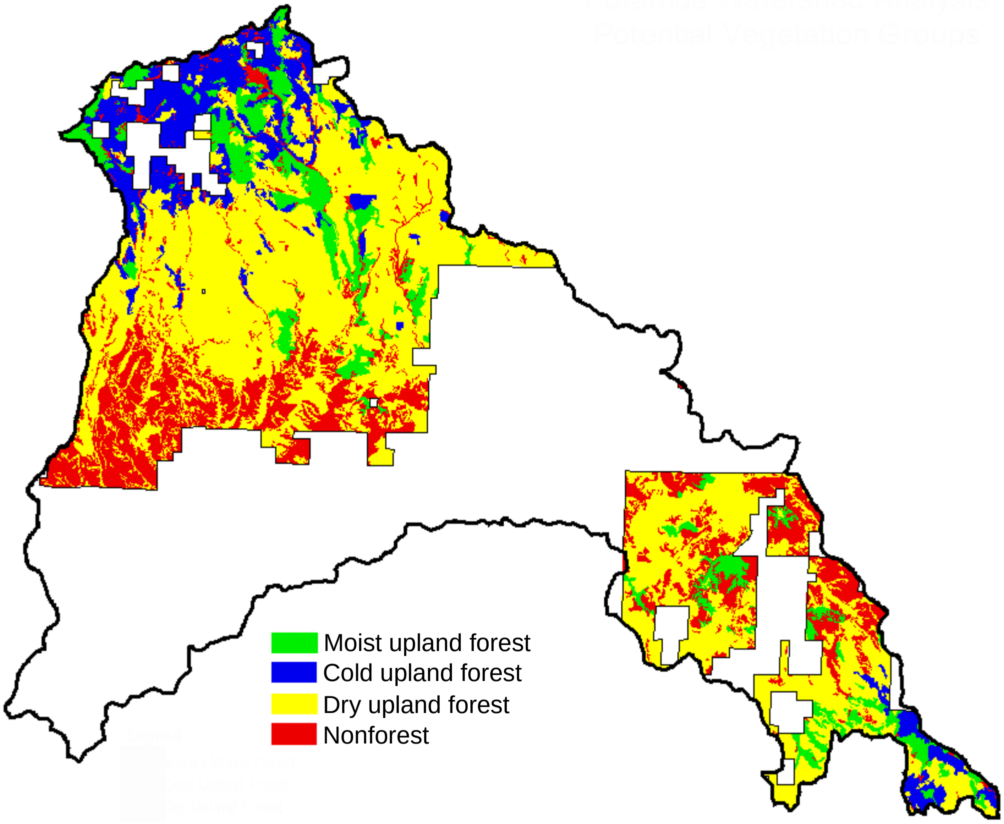
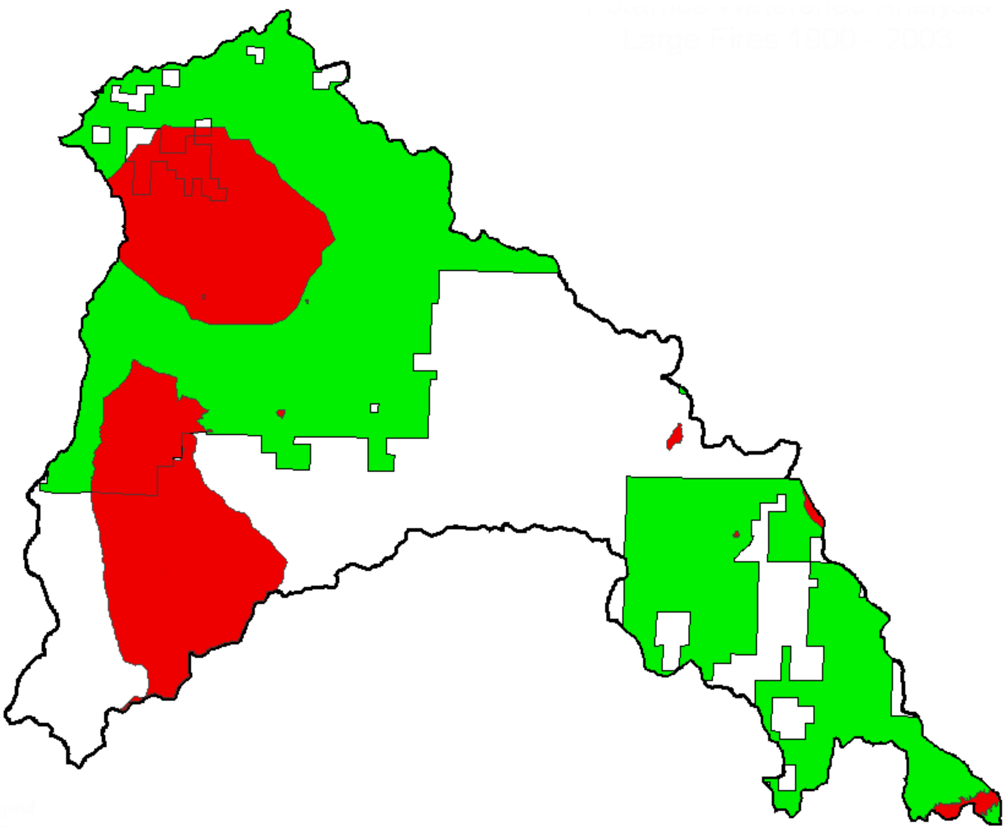


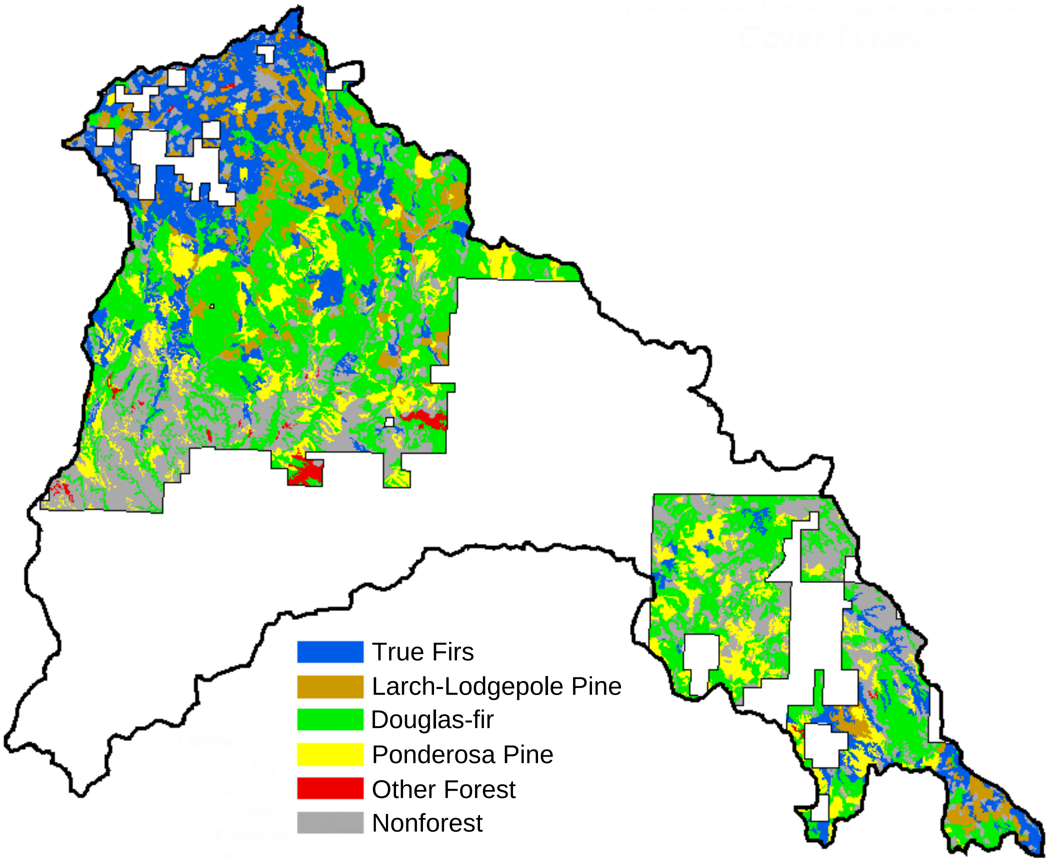
Figure 4-1. Chinook Distribution and habitat use in the Potamus Watershed and surrounding area.

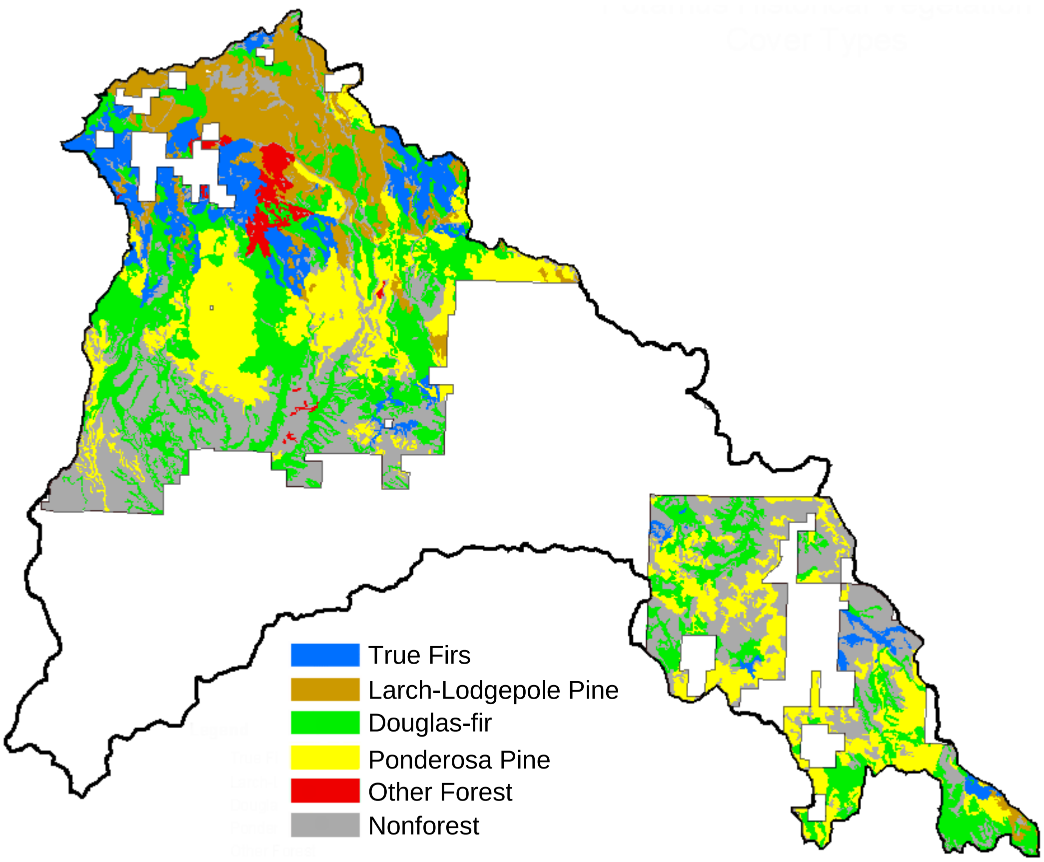


Map 5-1. Upland forest potential vegetation groups of the Potamus analysis area.



Map 5-2. Large wildfires (red color) occurring in the Potamus analysis area (green color).





Map 5-3. Existing (upper) and historical (lower) cover types of the Potamus analysis area.

Map 5-4. Existing and historical forest density classes of the Potamus analysis area.

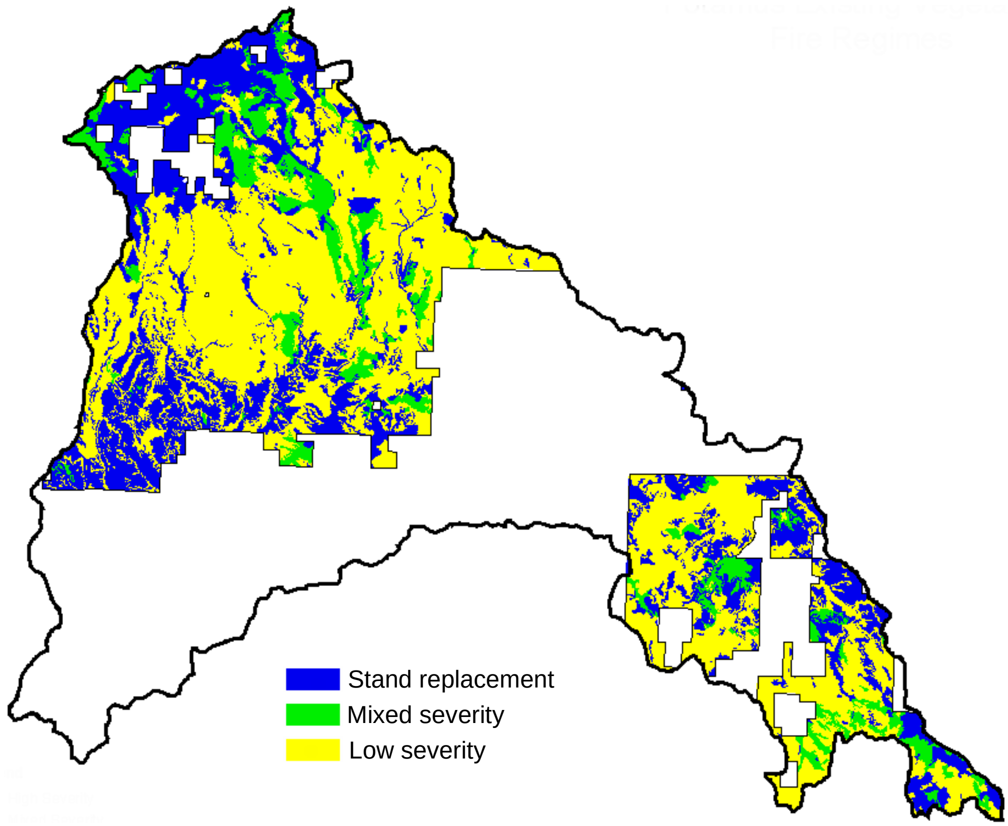
Map 5-5. Existing and historical forest size classes of the Potamus analysis area.

Map 5-6. Existing and historical forest structural classes of the Potamus analysis area.

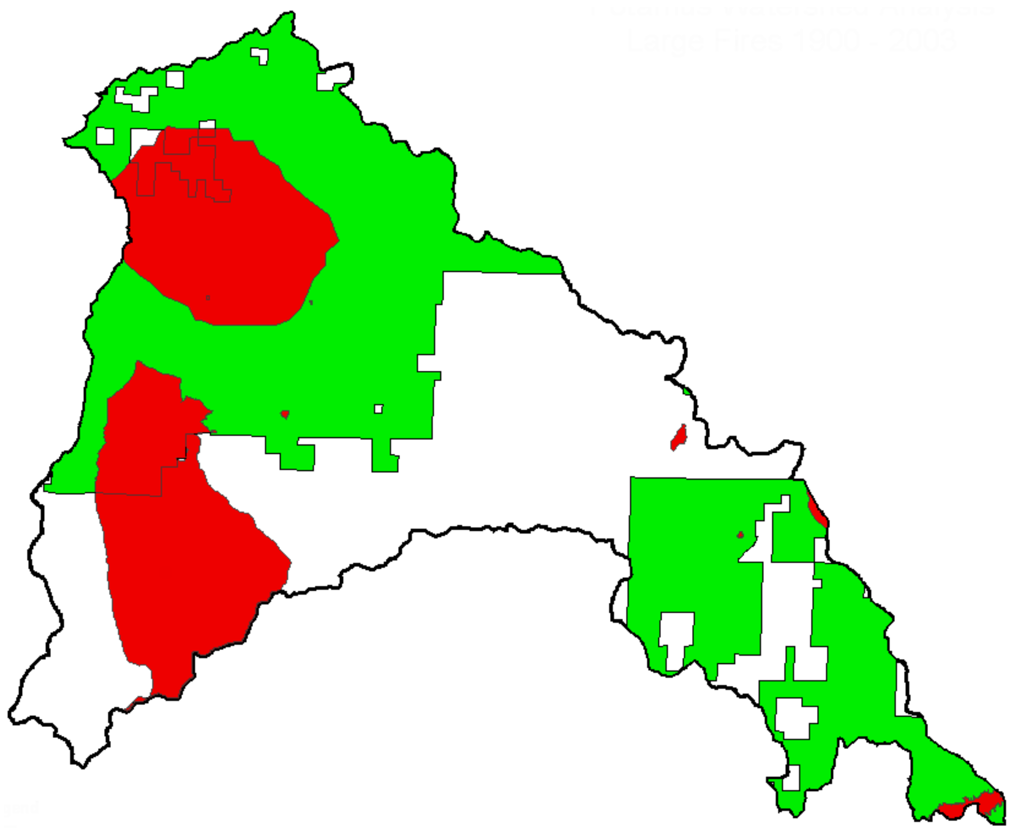
Map 5-7. Existing and historical forest canopy layering of the Potamus analysis area.

Map 5-8. Existing susceptibility ratings for bark beetles in ponderosa pine, defoliators, Douglas-fir beetle, and fir engraver.

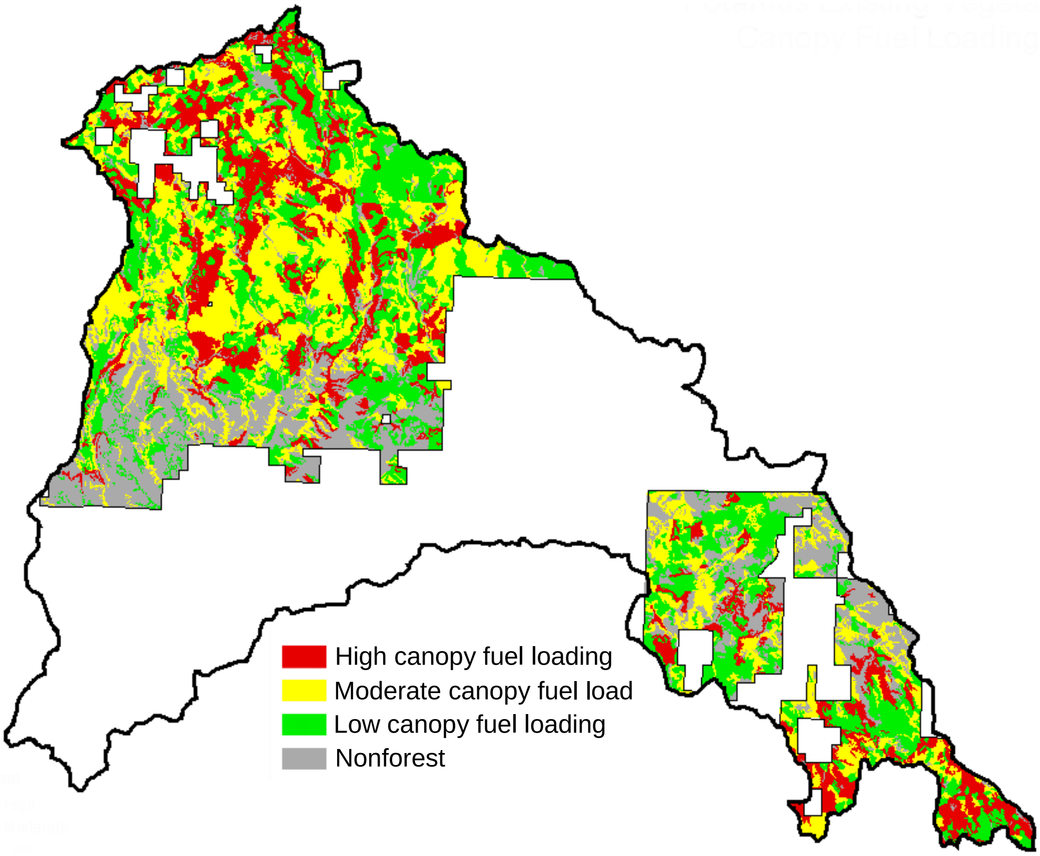
Map 5-9. Historical susceptibility ratings for bark beetles in ponderosa pine, defoliators, Douglas-fir beetle, and fir engraver.

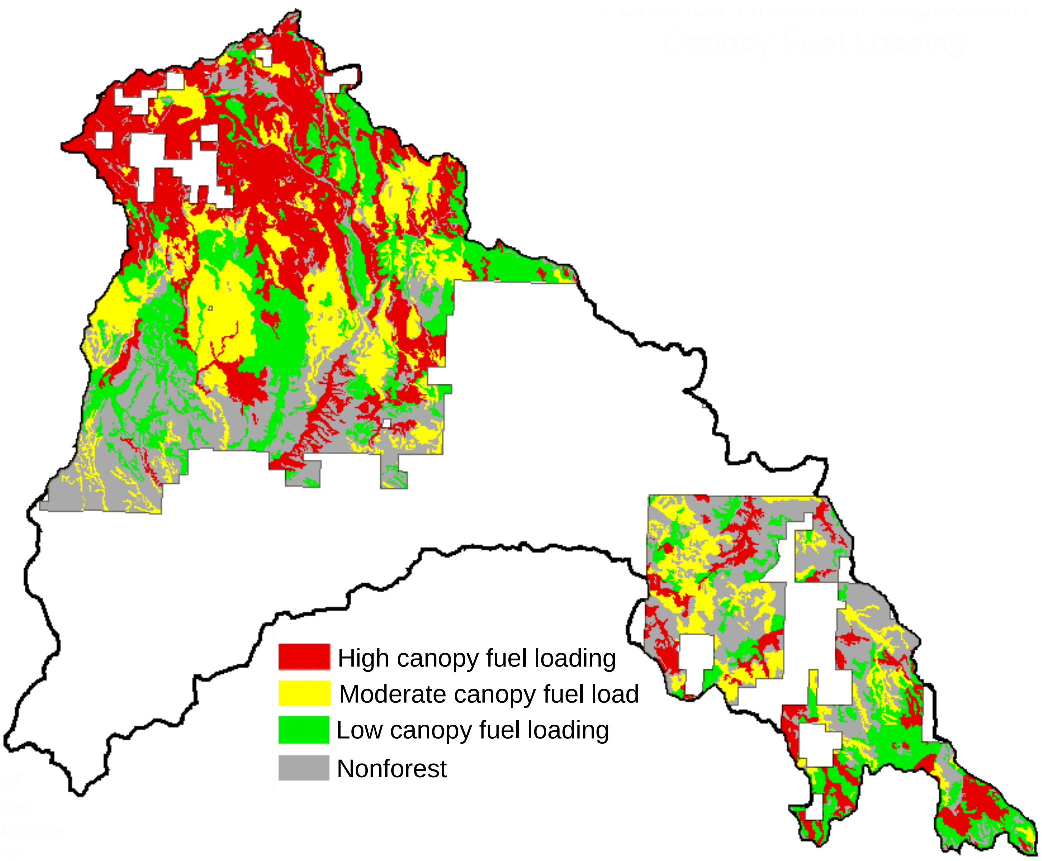


Map 6-1. Historical fire regimes of the Potamus analysis area.

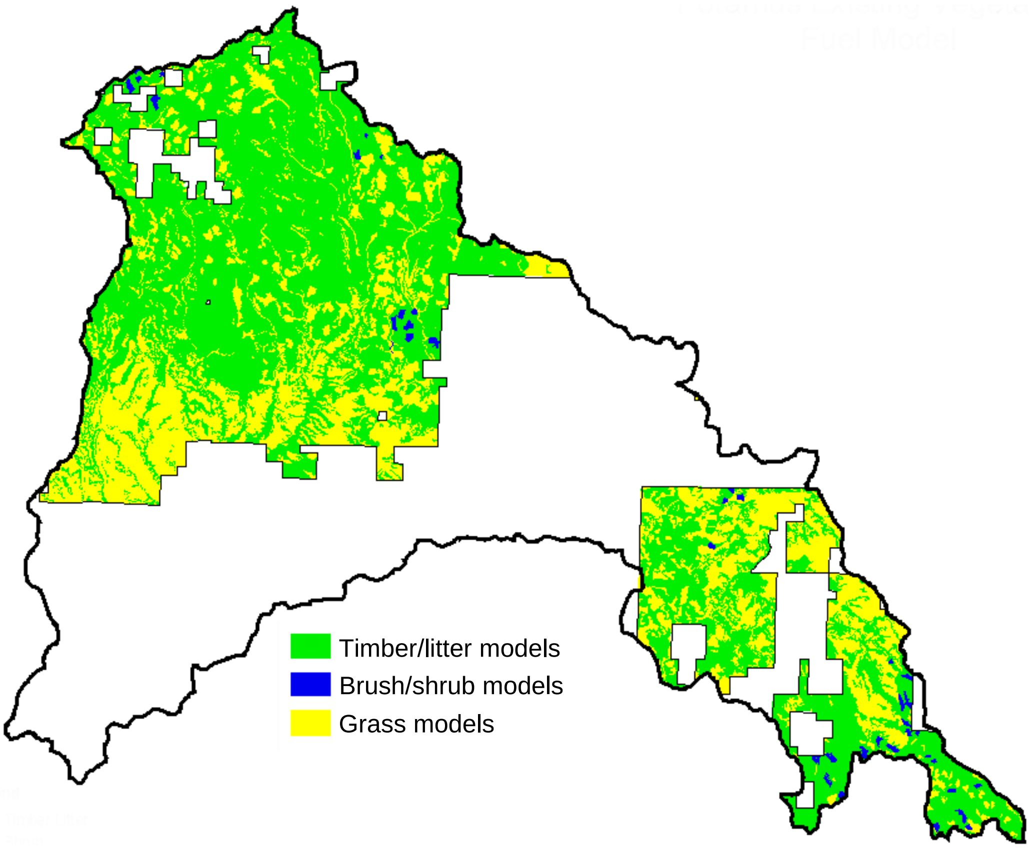


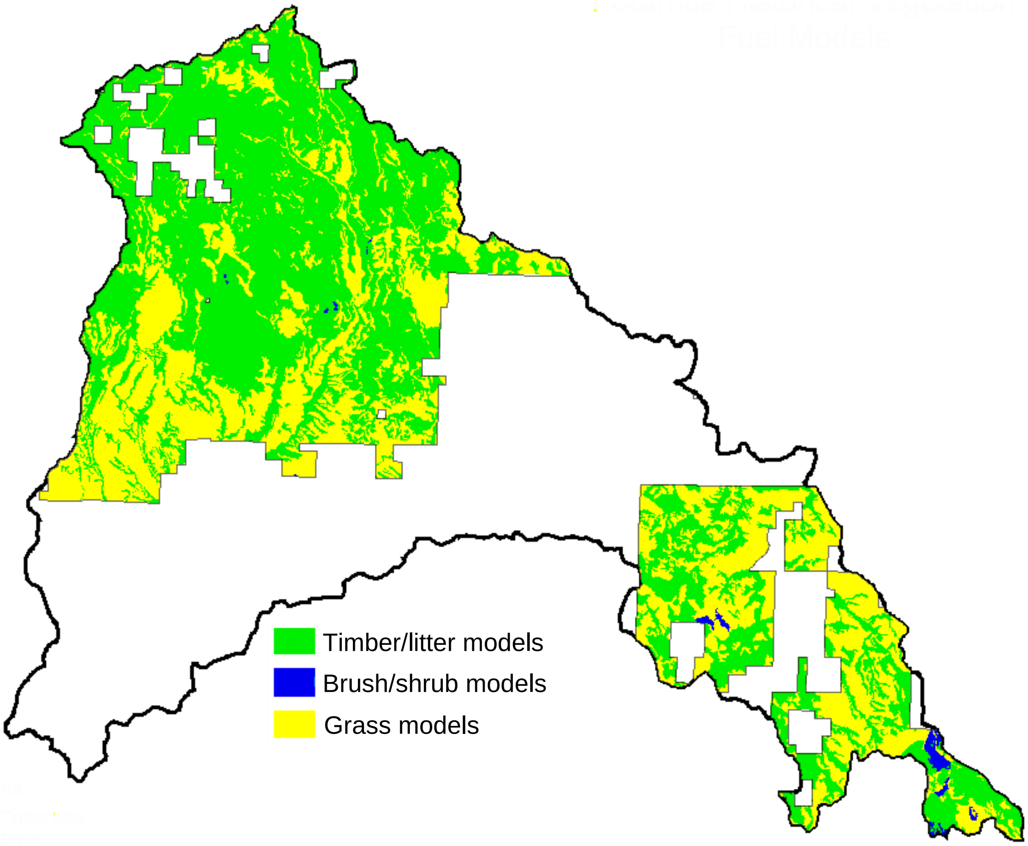
Map 6-2. Large wildfires (red color) occurring within the Potamus analysis area (green).


High canopy fuel loading
Moderate canopy fuel load
Low canopy fuel loading
Nonforest

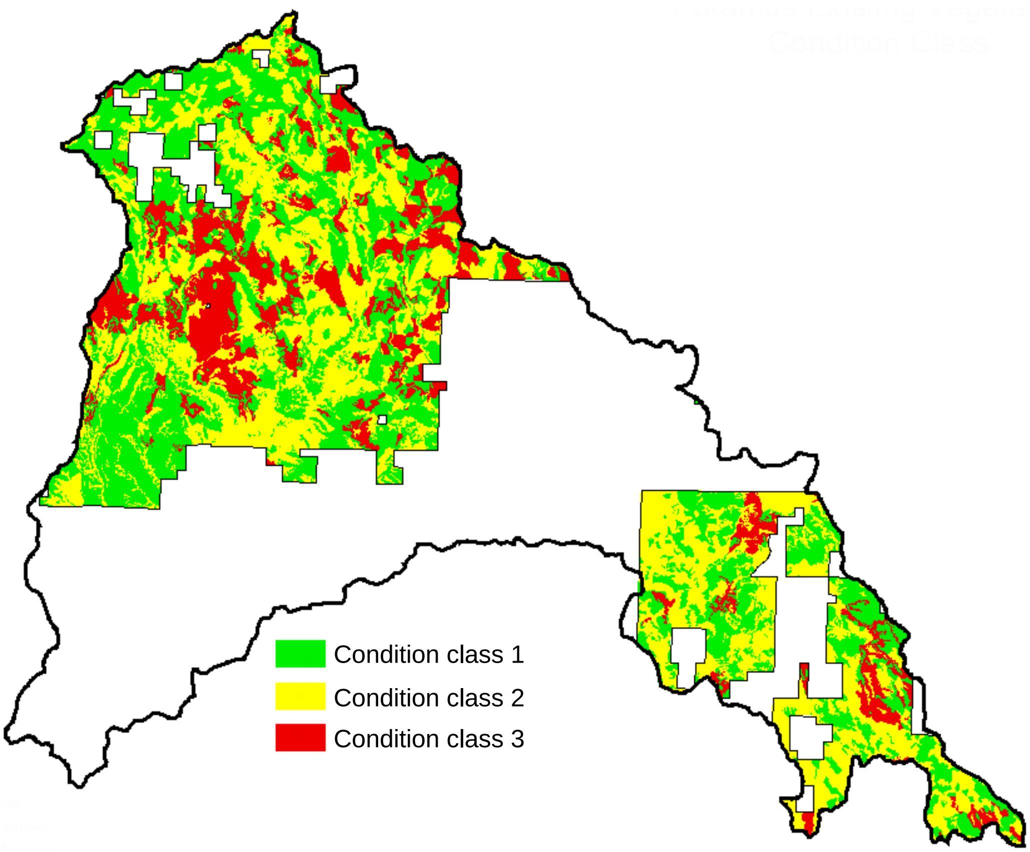

High canopy fuel loading
Moderate canopy fuel load
Low canopy fuel loading
Nonforest

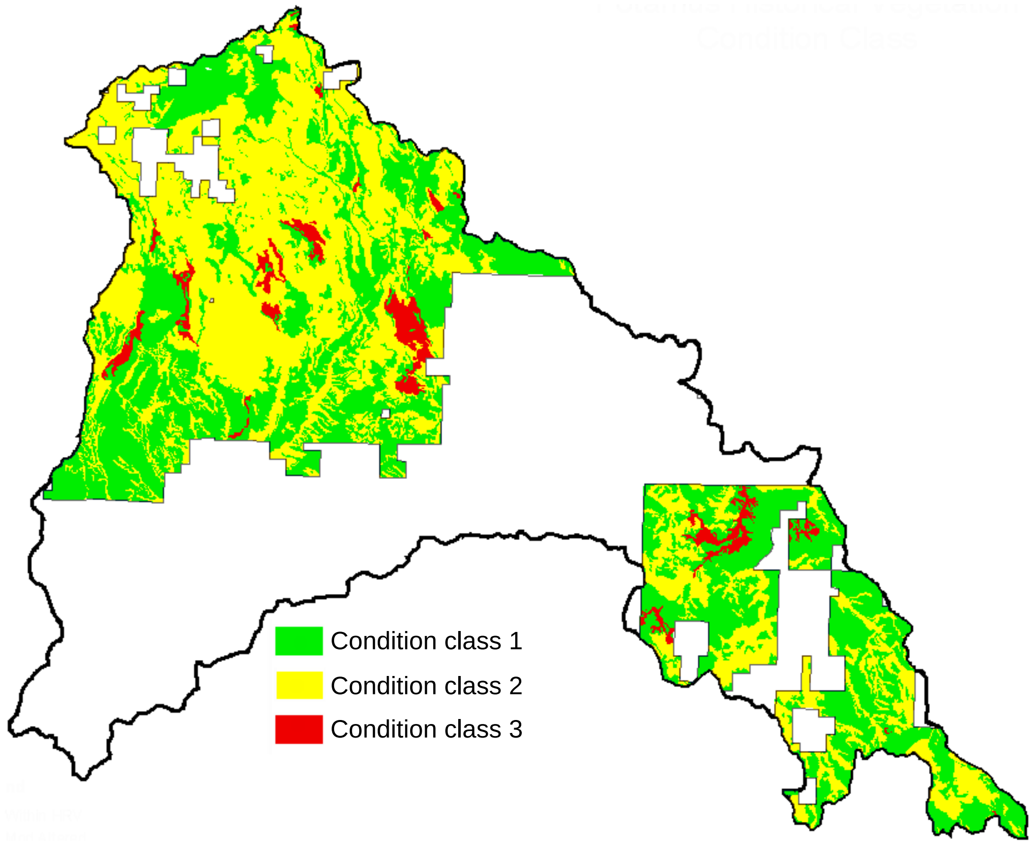
Map 6-3. Existing (upper) and historical (lower) canopy fuel loading for the Potamus analysis area.



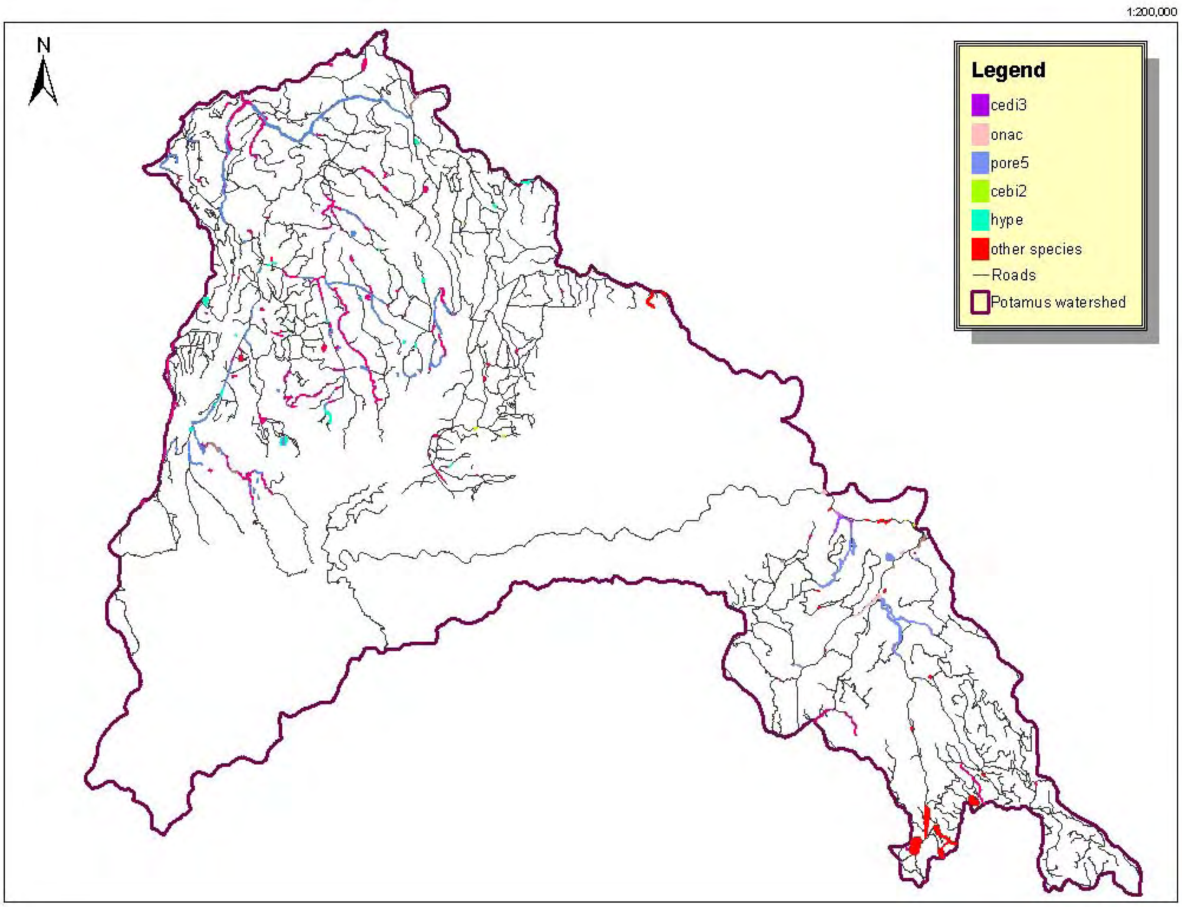


Map 6-4. Existing (upper) and historical (lower) fuel models for the Potamus analysis area.

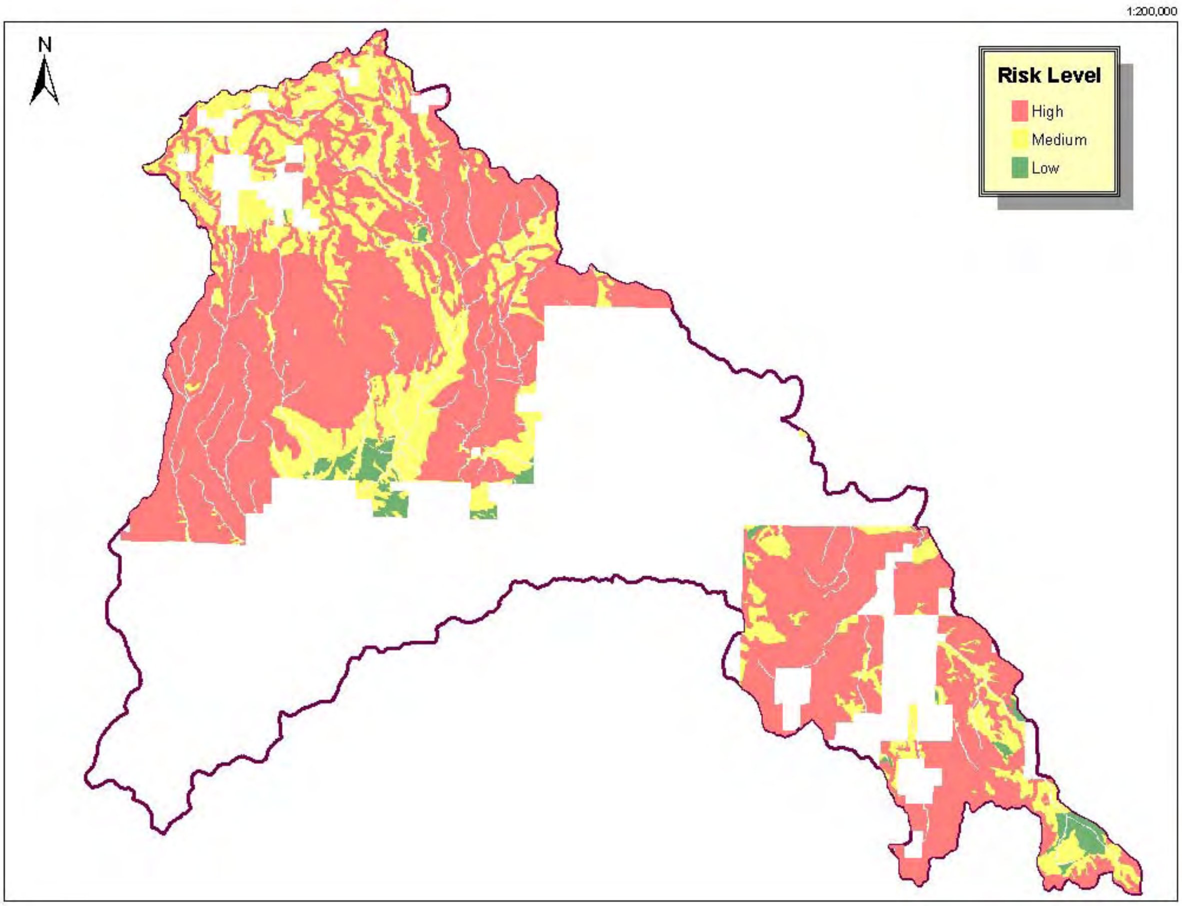




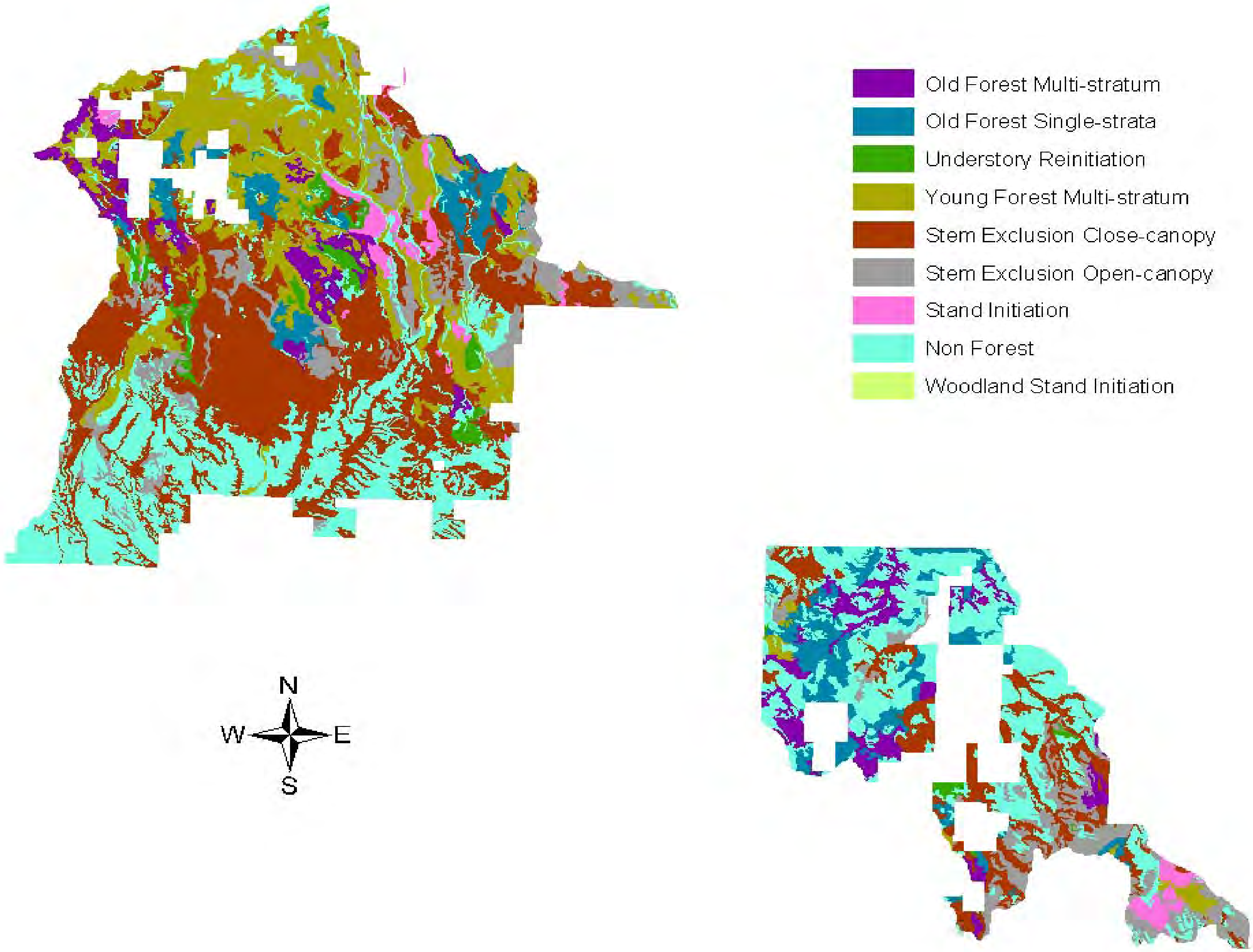
Map 6-5. Existing (upper) and historical (lower) fire regime condition classes for the Potamus analysis area.



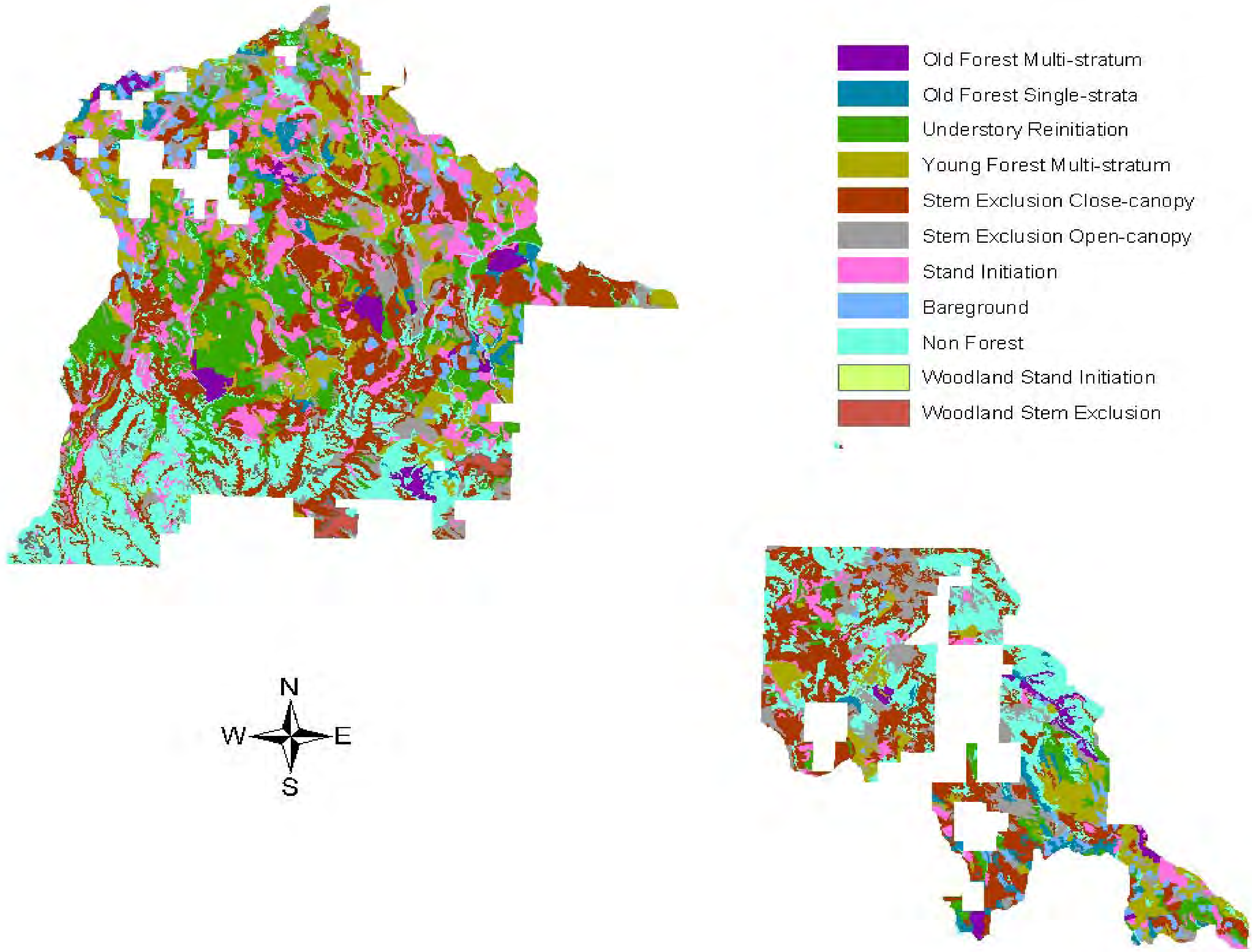
Map 7-10. Inventoried Noxious Weed Sites in the Potamus Watershed



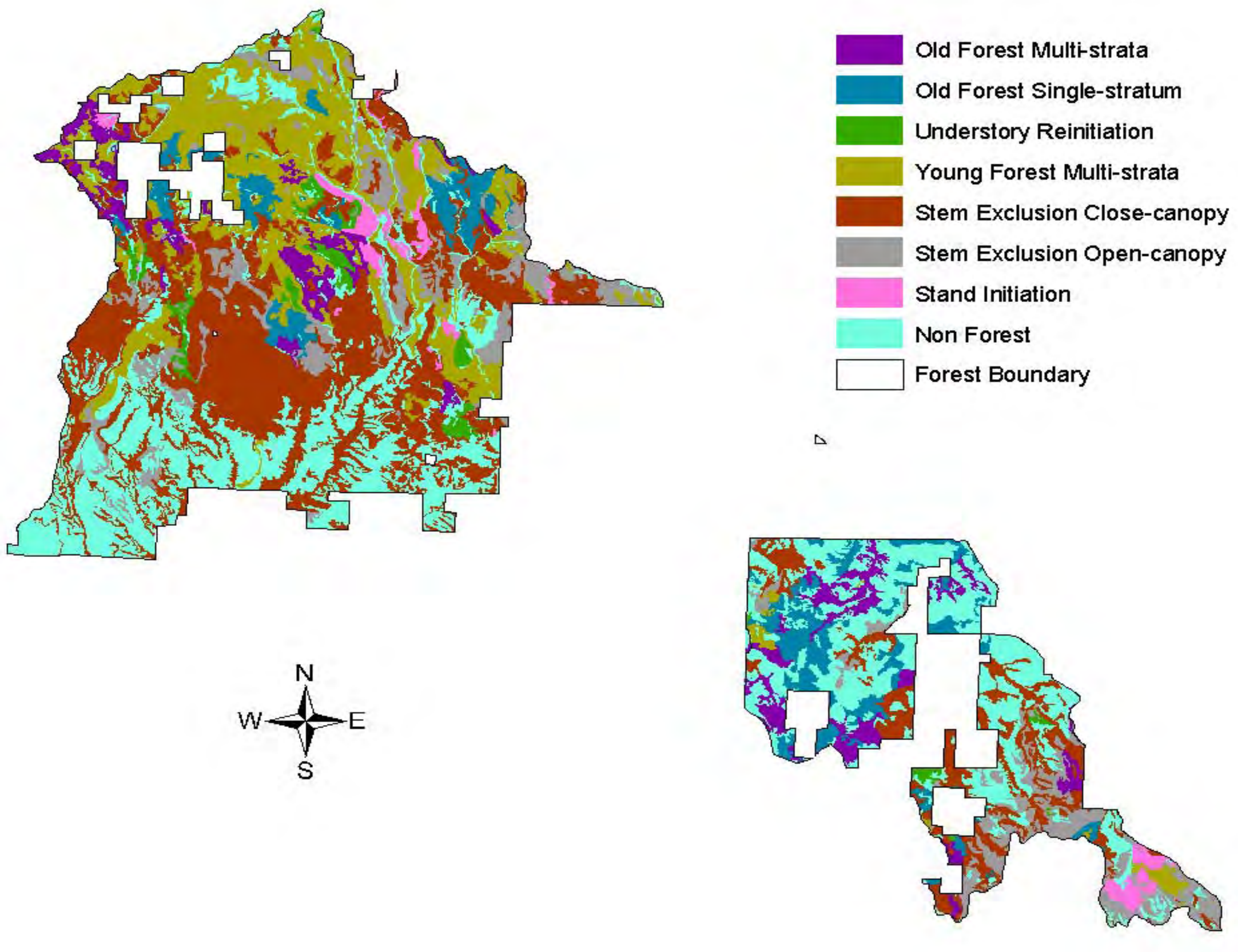
Map 7-11. Noxious weed susceptibility and risk rating for the Potamus watershed.



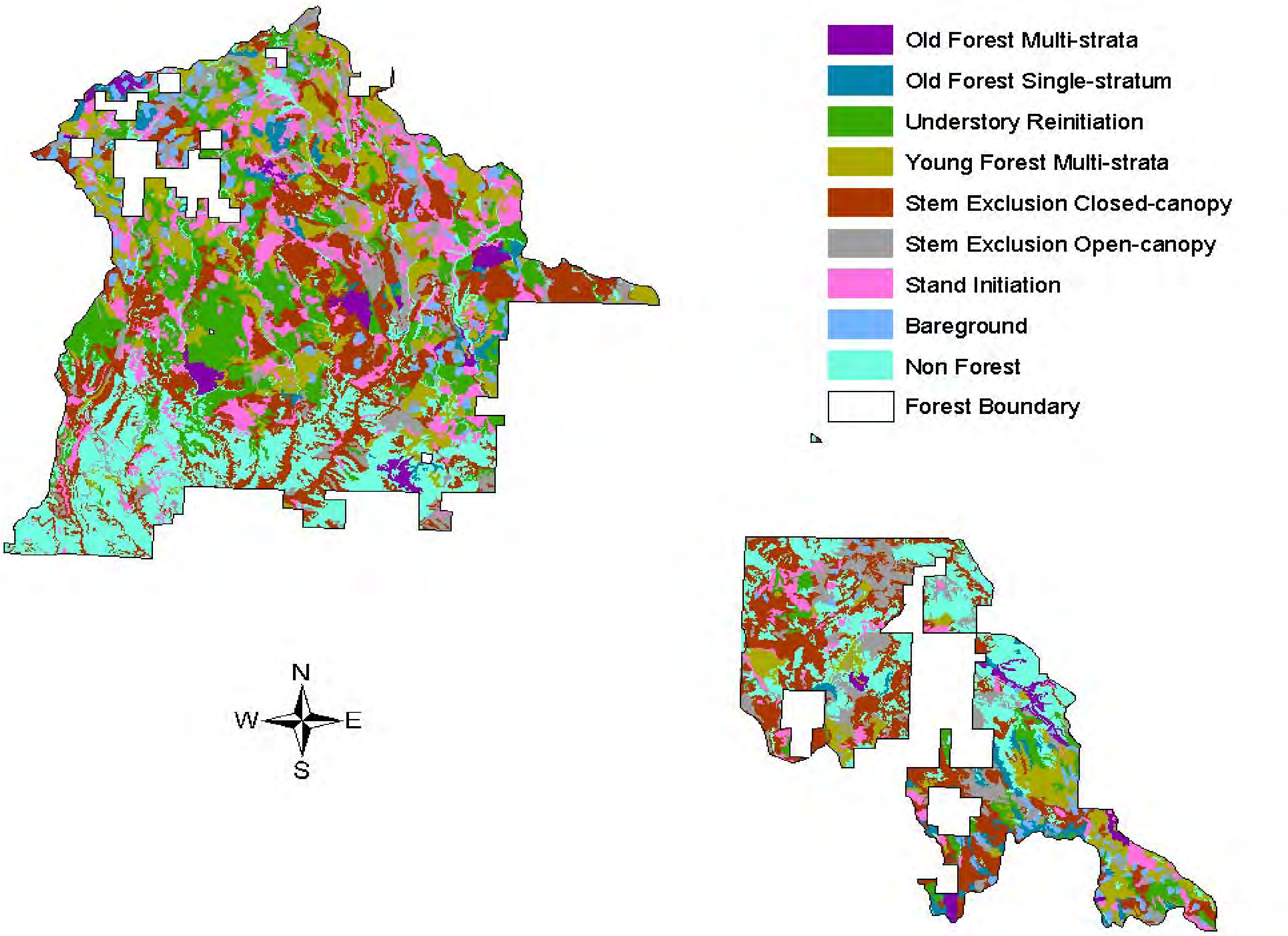
Map 8-1. Reference (1939) habitats in the Potamus analysis area.



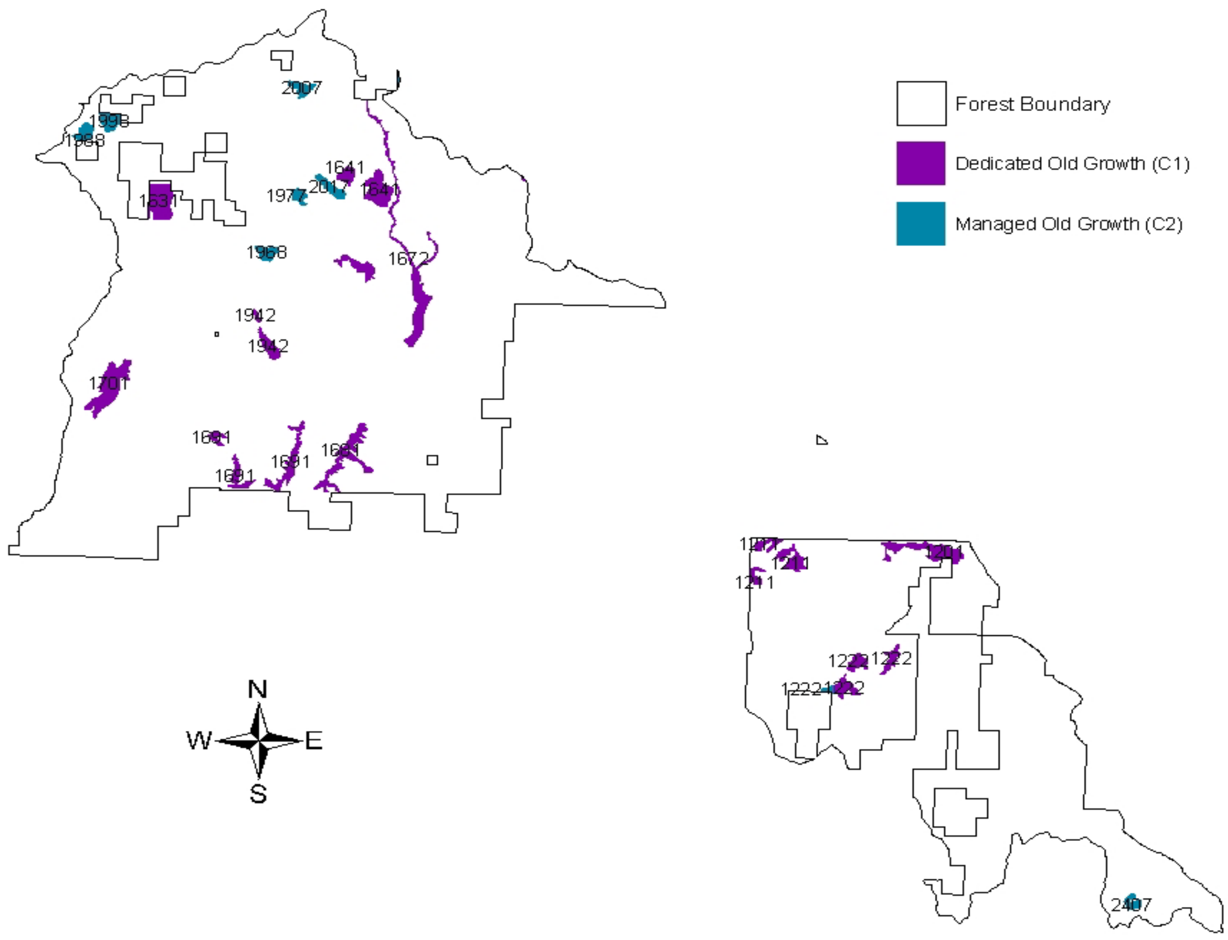
Map 8-2. Current (2004) habitats in the Potamus analysis area.



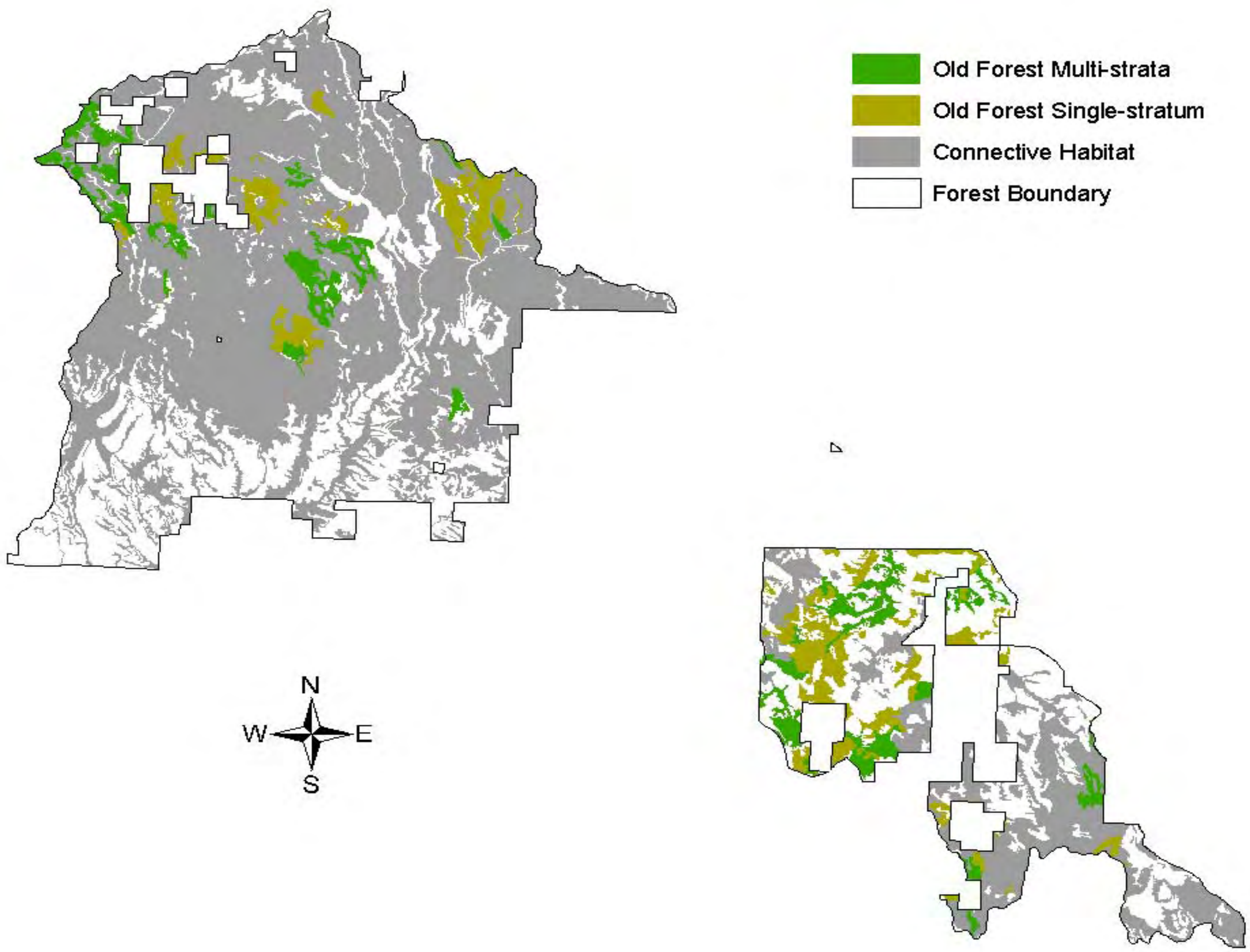
Map 8-3. Reference (1939) structural condition in the Potamus analysis area.



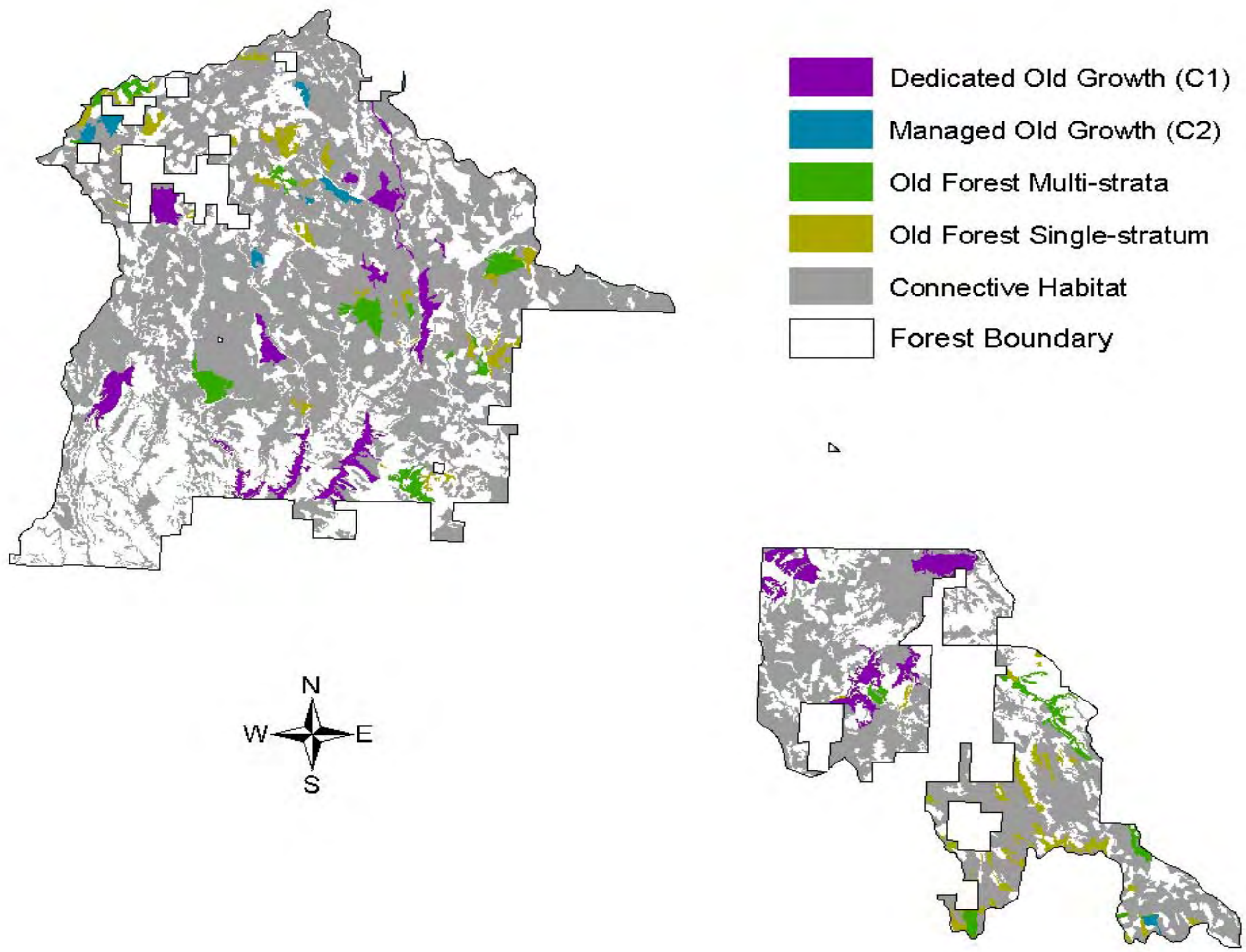
Map 8-4. Current (2004) structural condition in the Potamus analysis area.



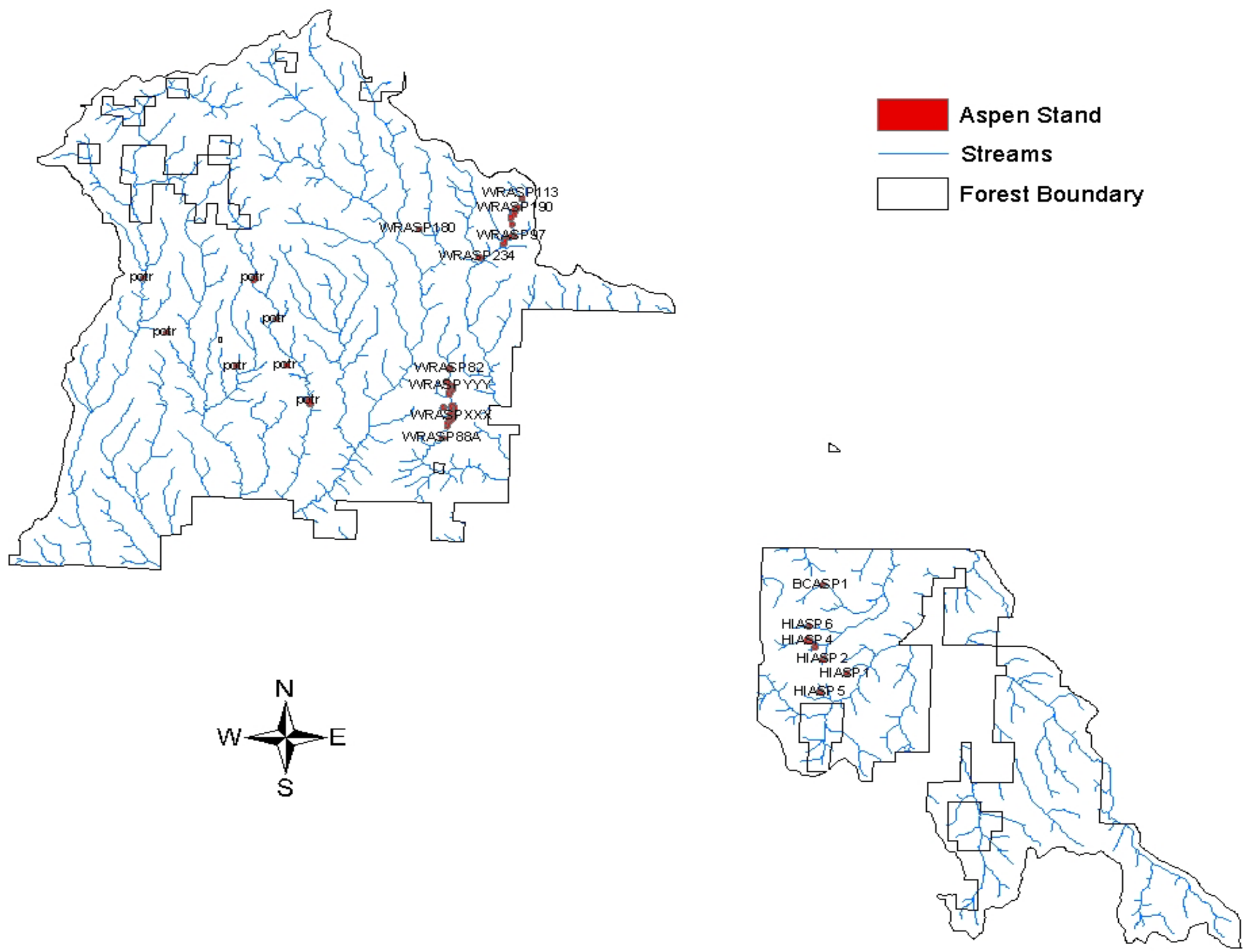
Map 8-5. Forest Plan dedicated (C1) and managed (C2) old growth areas in the analysis area.



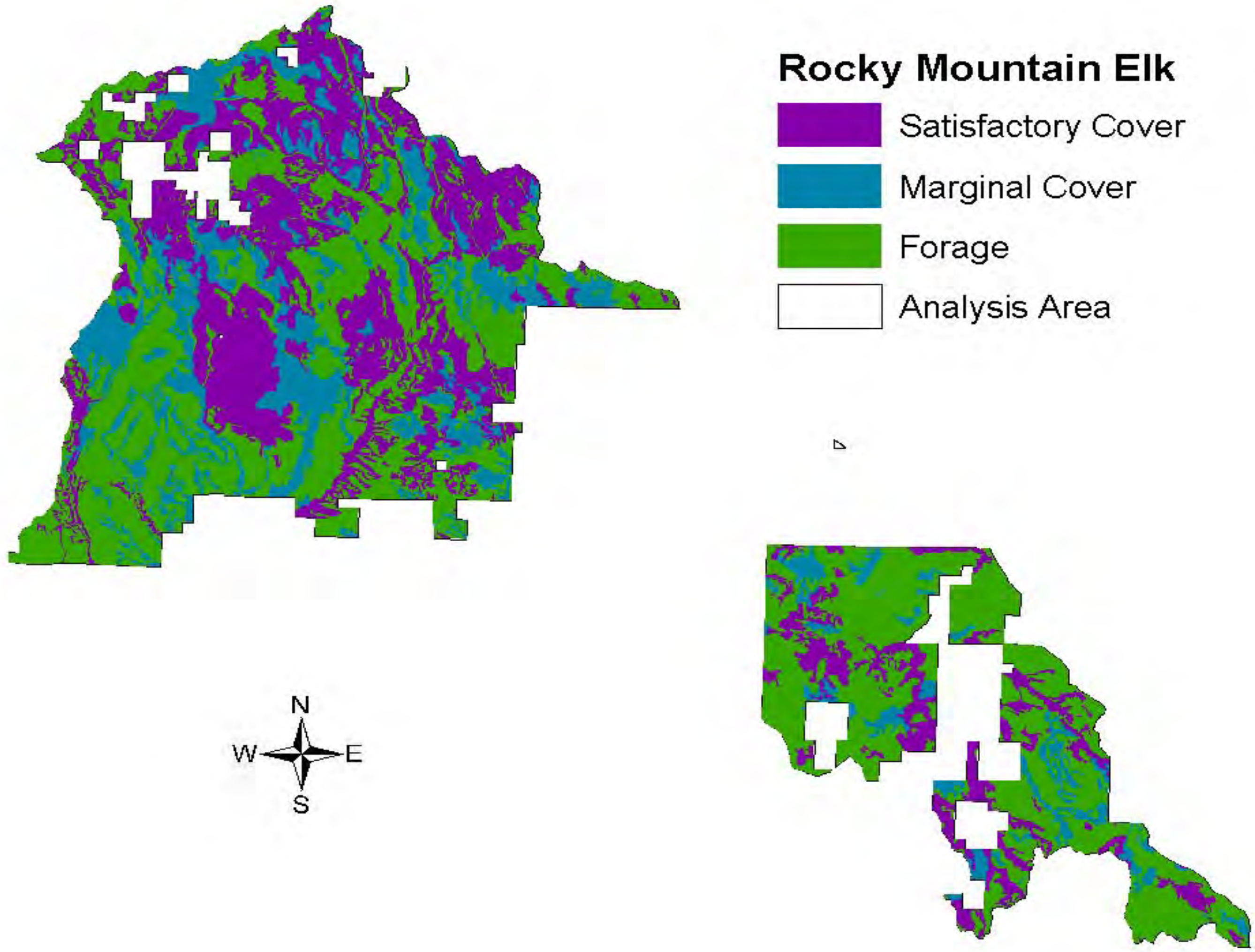
Map 8-6. Reference (1939) old forest habitats with connectivity in the Potamus analysis area.



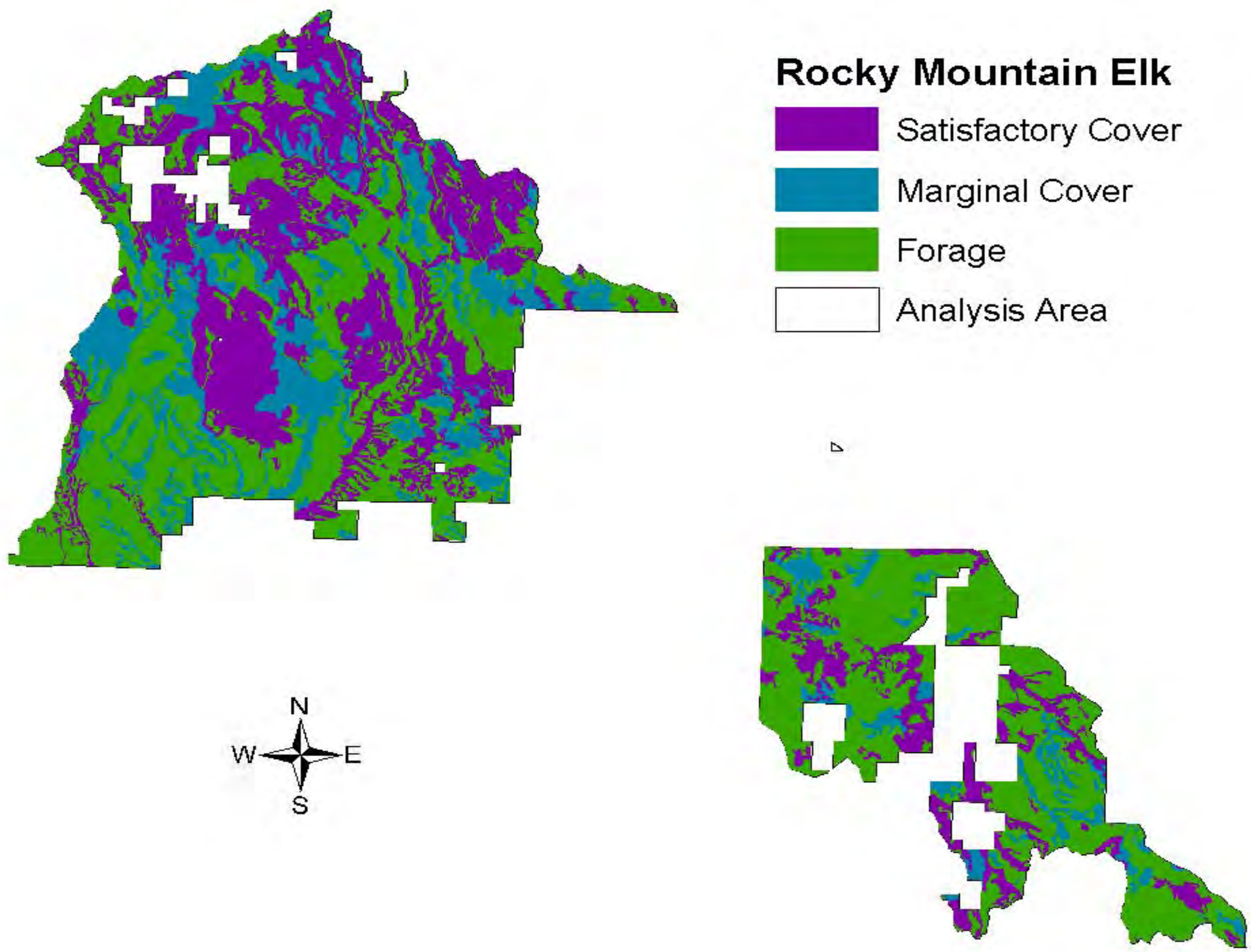
Map 8-7. Current (2004) old forest habitats with connectivity in the Potamus analysis area.



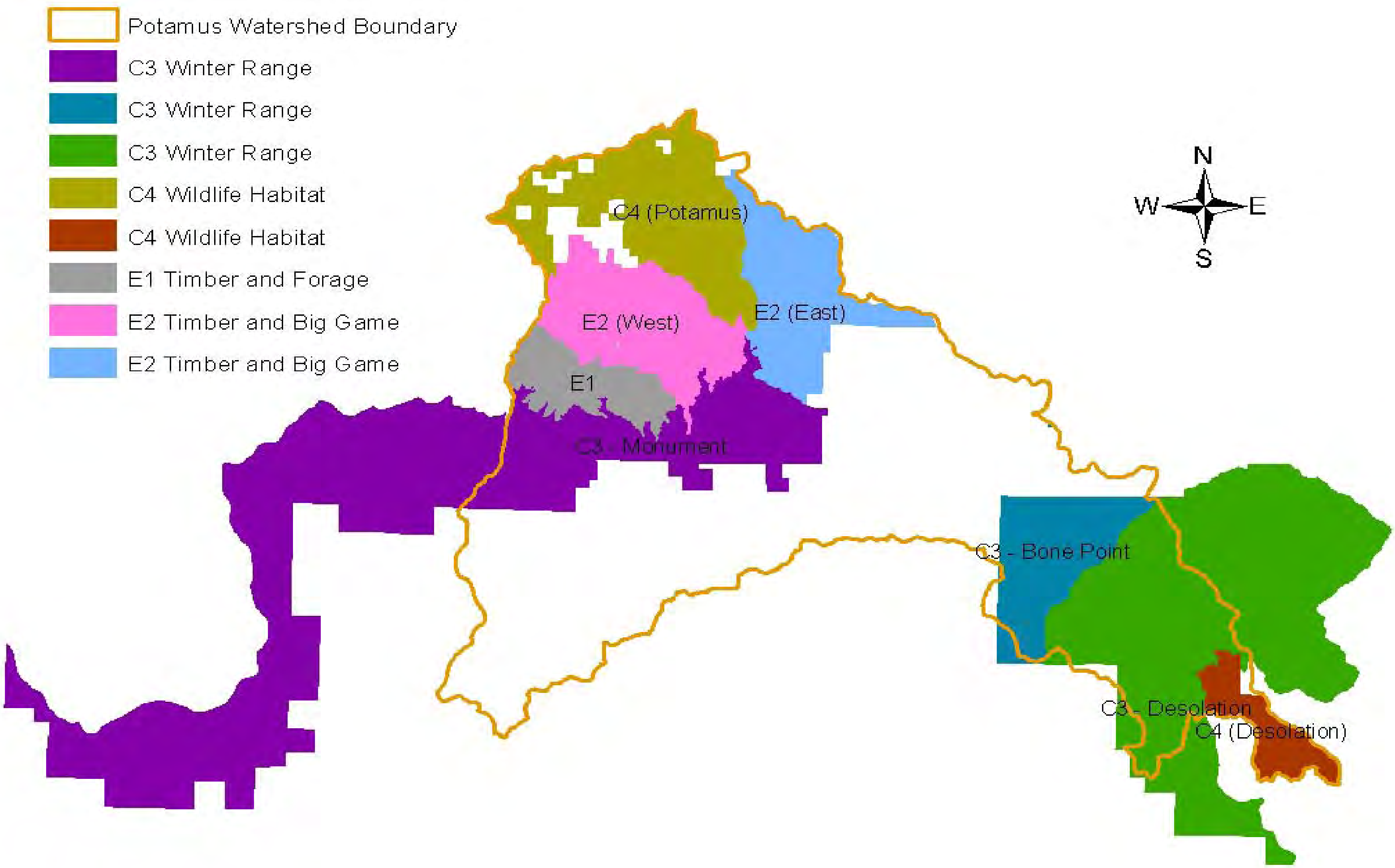
Map 8-8. Aspen stands in the Potamus analysis area.



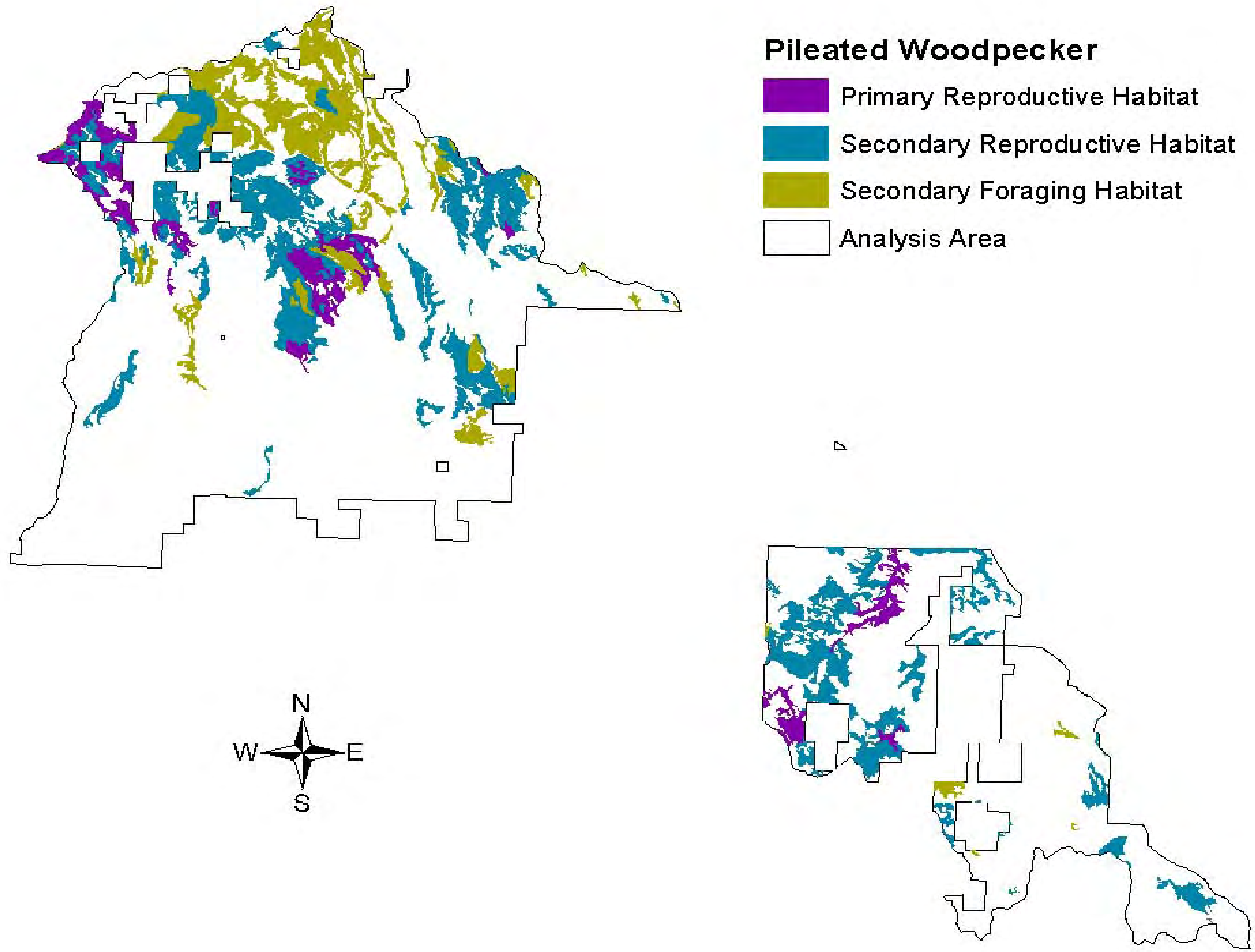
Map 8-9. Reference (1939) Rocky Mountain Elk habitat availability in the Potamus analysis area.



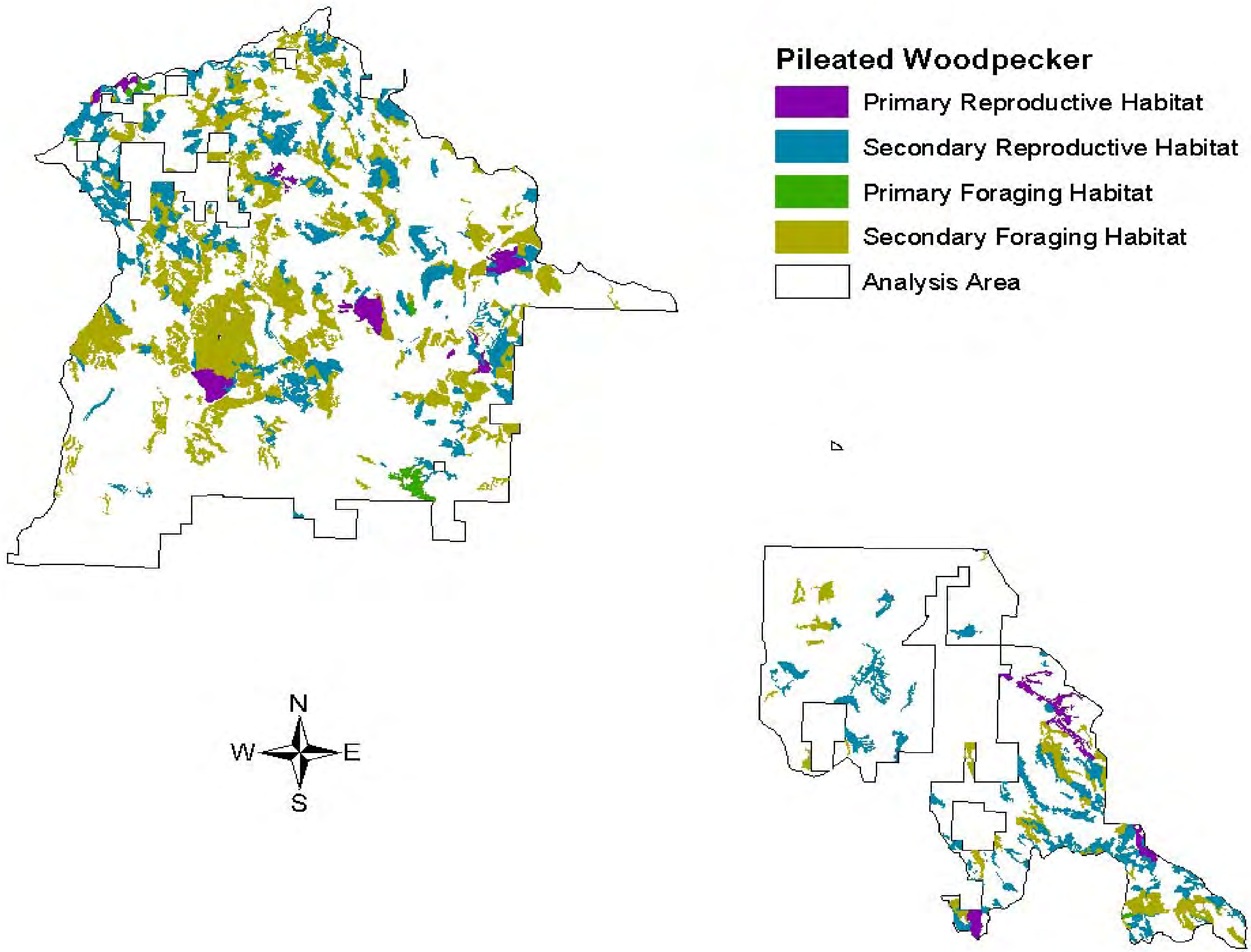
Map 8-10. Current (2004) Rocky Mountain Elk habitat availability in the Potamus analysis area.



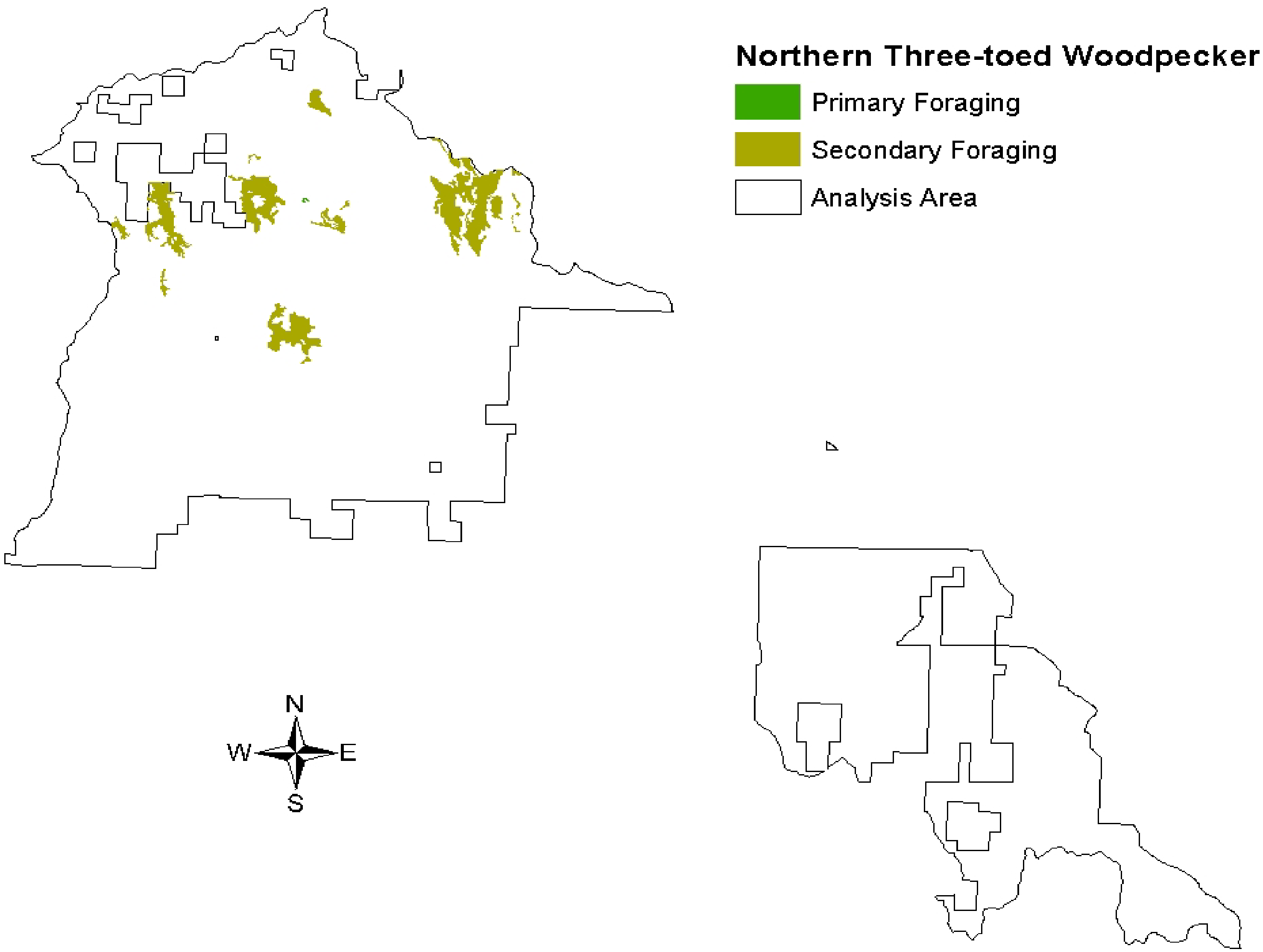
Map 8-11. Elk habitat effectiveness (HEI) analysis areas in the Potamus watershed.



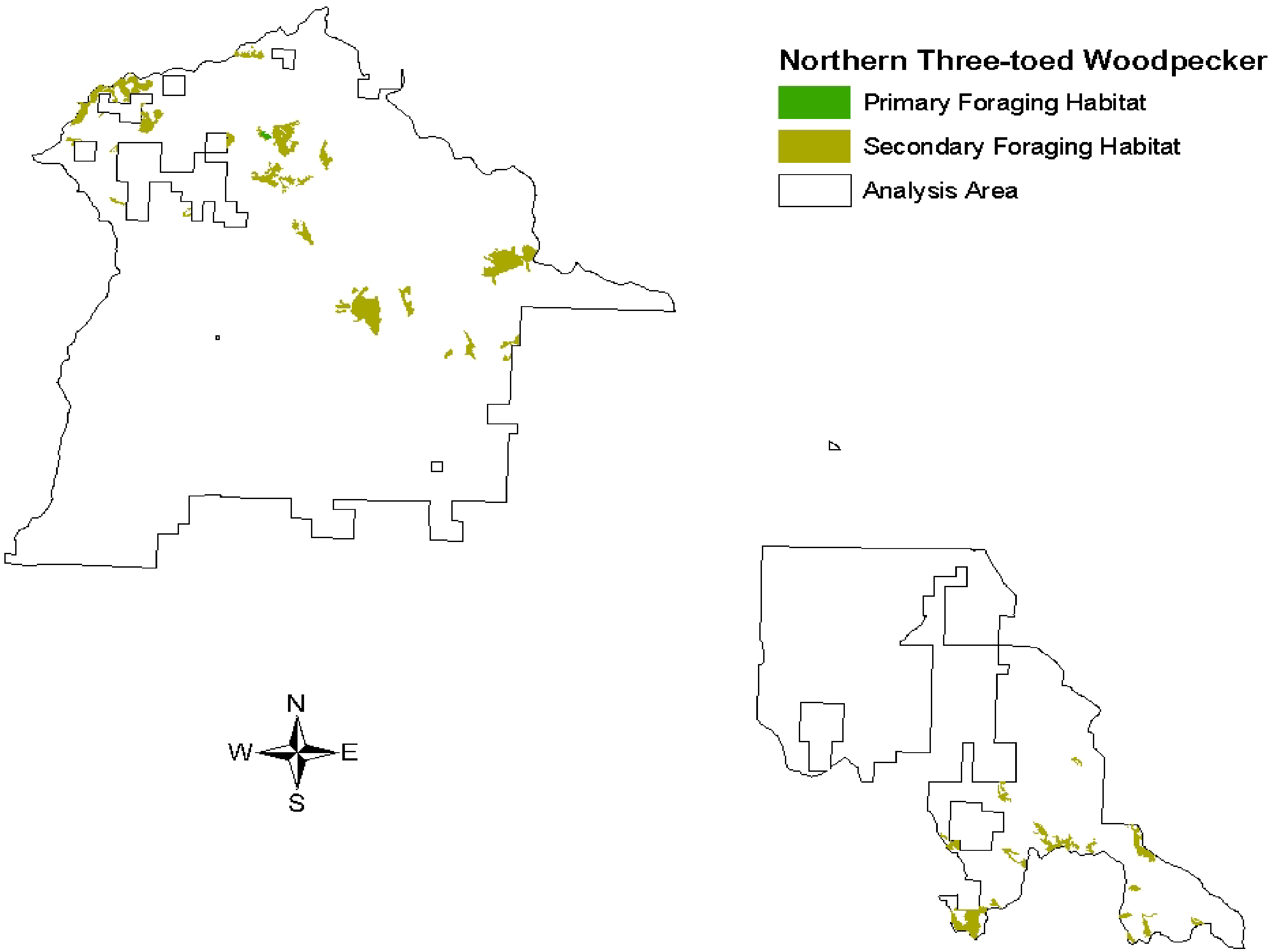
Map 8-12. Reference (1939) Pileated woodpecker habitat availability in the Potamus analysis area.



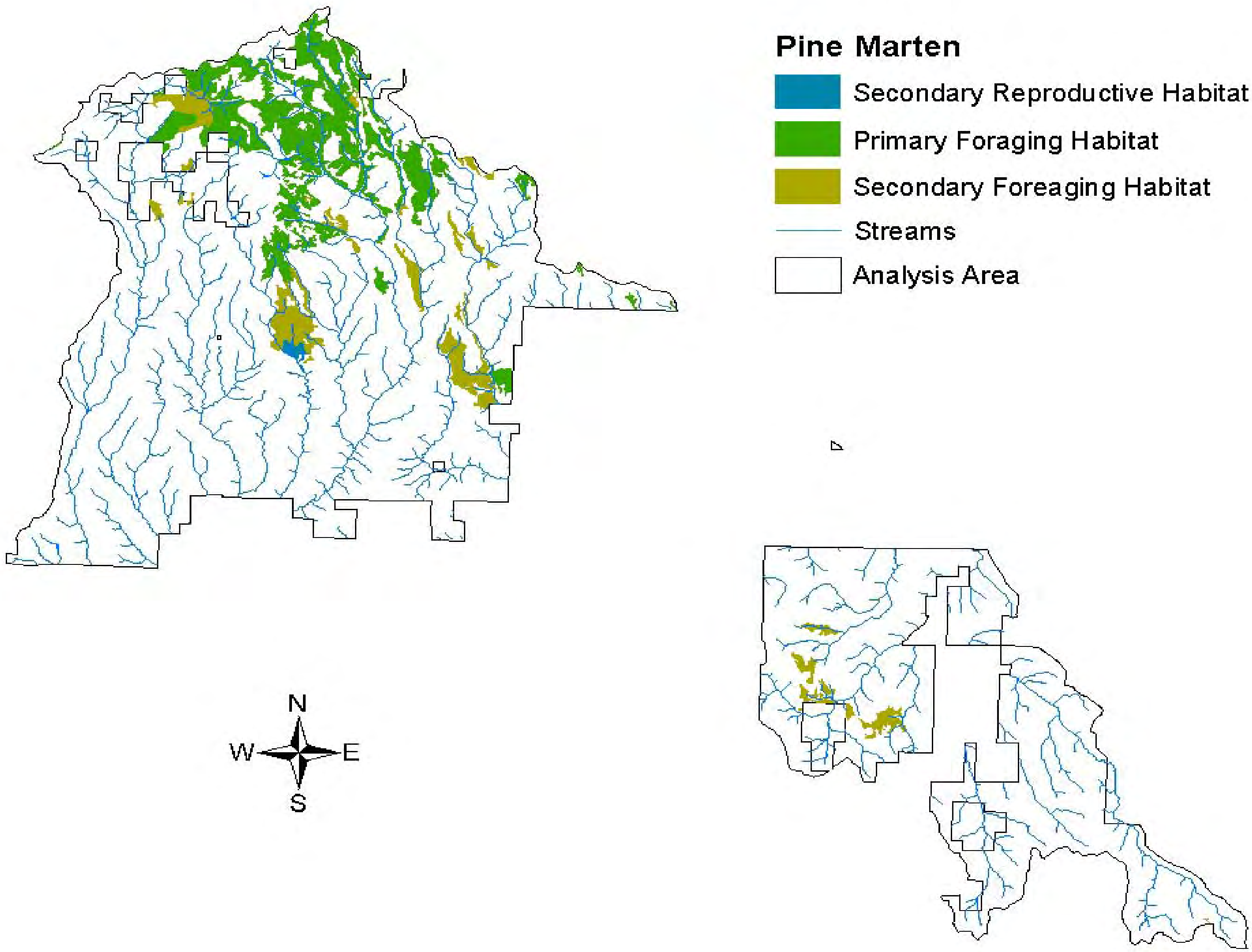
Map 8-13. Current (2004) Pileated woodpecker habitat availability in the Potamus analysis area.



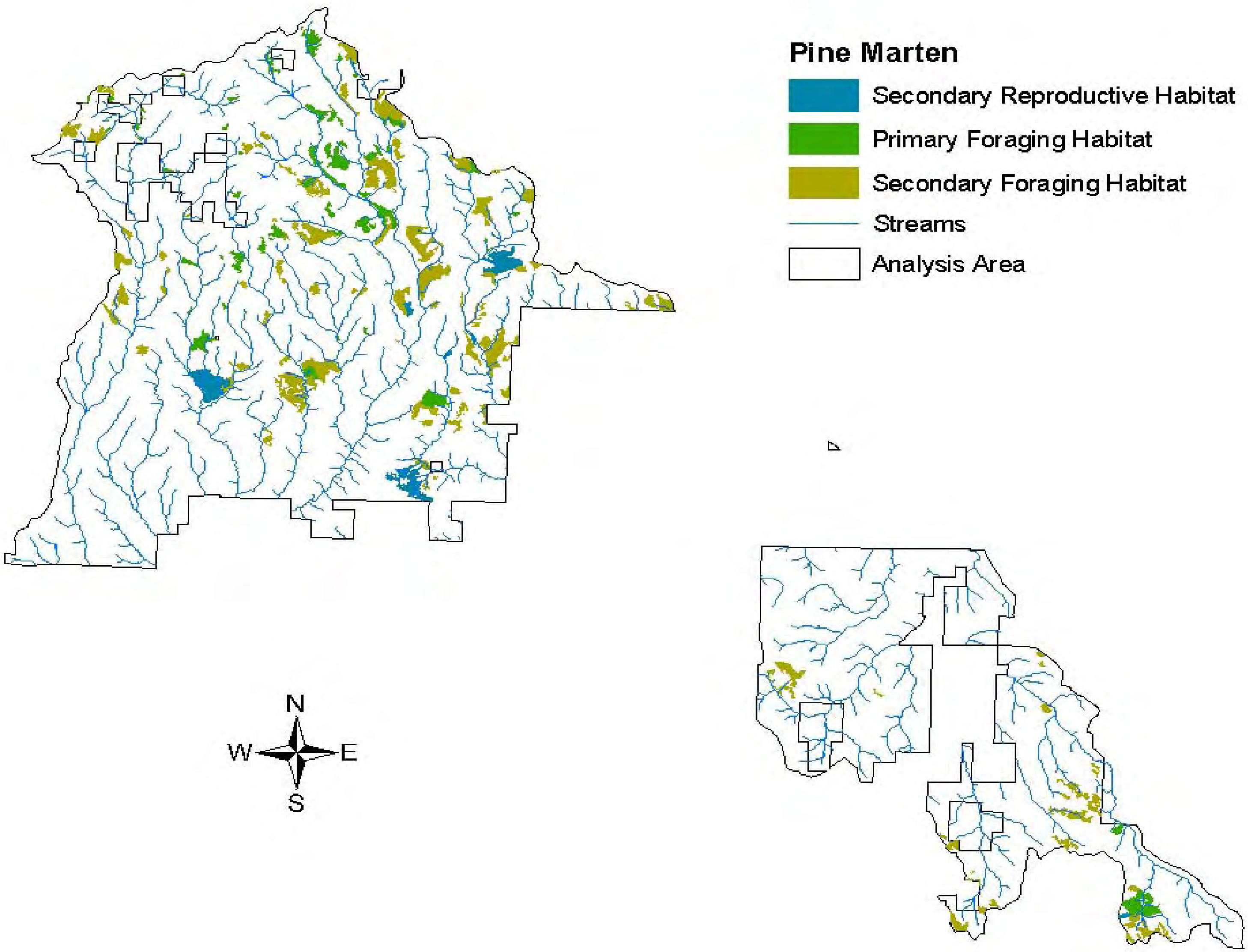
Map 8-14. Reference (1939) Northern three-toed woodpecker habitat availability in the Potamus analysis area.



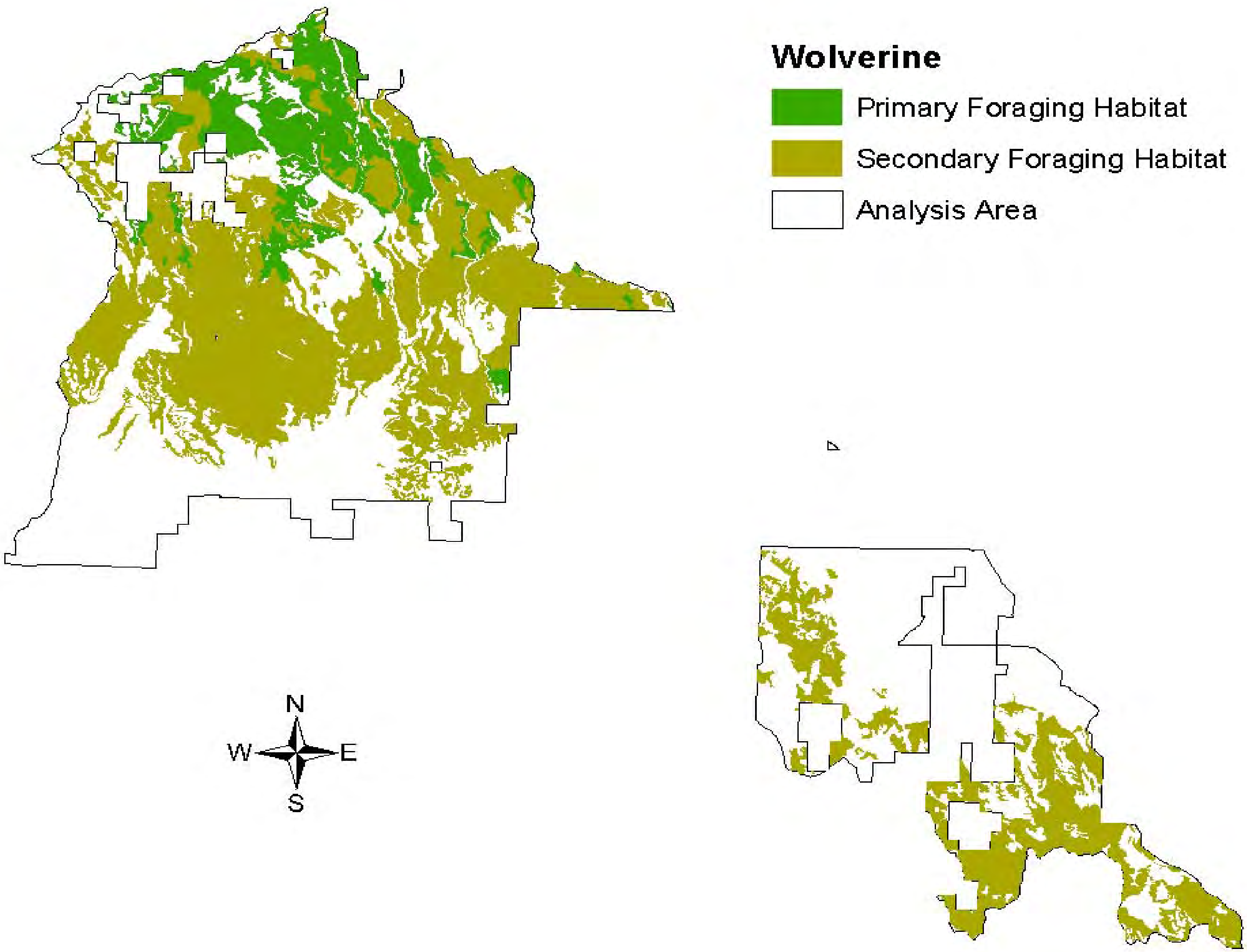
Map 8-15. Current (2004) Northern three-toed woodpecker habitat availability in the Potamus analysis area.



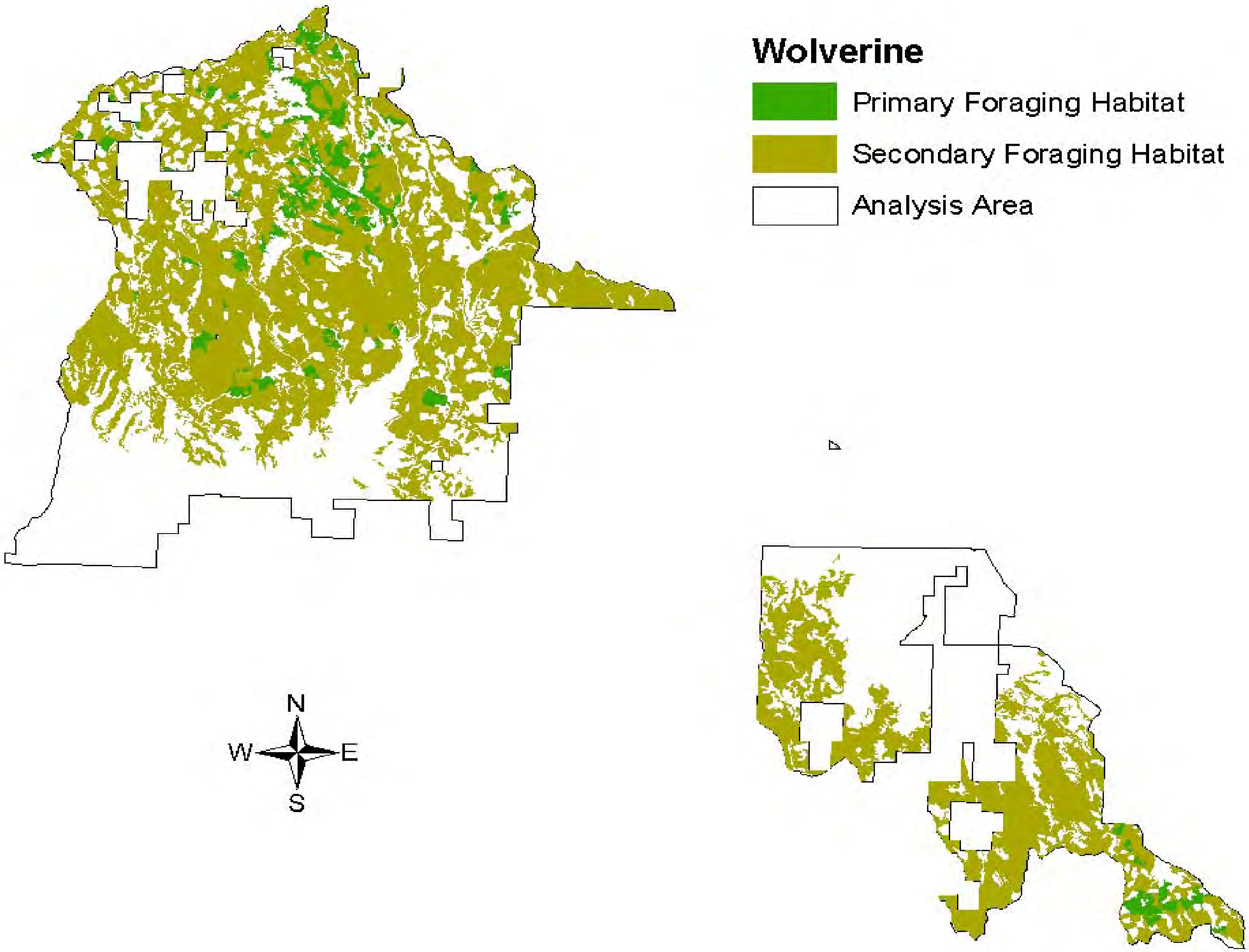
Map 8-16. Reference (1939) Pine marten habitat availability in the Potamus analysis area.



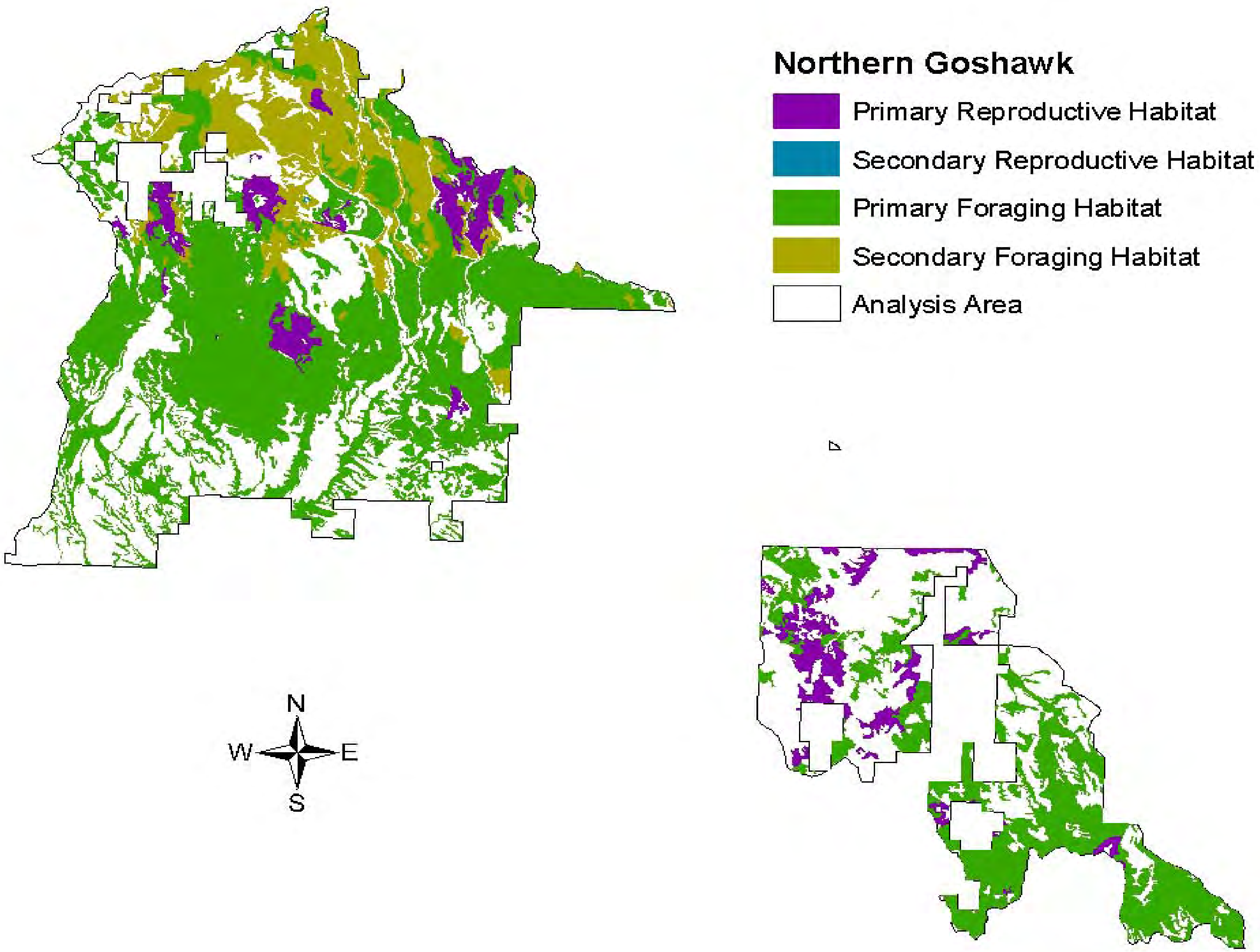
Map 8-17. Current (2004) Pine marten habitat availability in the Potamus analysis area.



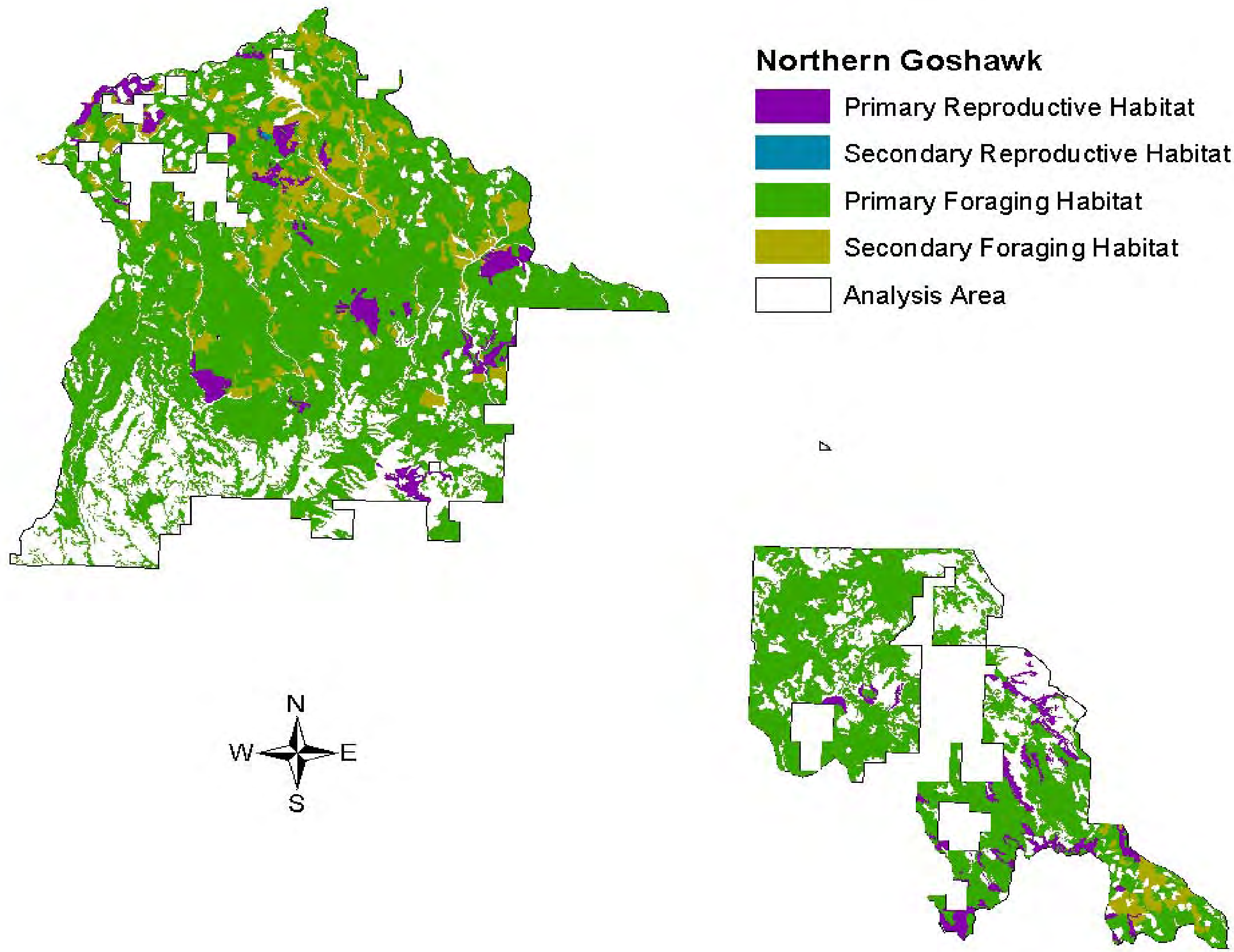
Map 8-18. Reference (1939) Wolverine foraging habitat availability in the Potamus analysis area.



Map 8-19. Current (2004) Wolverine foraging habitat availability in the Potamus analysis area.



Map 8-20. Reference (1939) Northern goshawk habitat availability in the Potamus analysis area.



Map 8-21. Current (2004) Northern goshawk habitat availability in the Potamus analysis area.