Phillips-Gordon Ecosystem Analysis

Umatilla National Forest
Walla Walla Ranger District

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Editor's Note

A wide variety of GIS layers and analysis methods were used to develop the materials presented in this report. One artifact of the analysis process is that acreage totals and subtotals derived from intersecting various GIS layers can create acreage values that differ slightly among various resource disciplines. Recurring edits and updates to GIS layers also change acreages over time and make consistent reporting of these values difficult. Minor differences in the acreage total and subtotals appear among the chapters in this document. These differences are not significant in the overall context of this report.

INTRODUCTION

Document Purpose

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

This document presents the results of the Phillips-Gordon Ecosystem Analysis. The purpose of the analysis was to collect, analyze, and synthesize existing information about the watersheds encompassing Phillips and Gordon creeks in order 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.

Document Organization

This document contains four chapters. Chapter I characterizes watershed features and highlights special features that may occur within specific subwatersheds. Chapter II identifies issues and key questions, especially in relation to management. Chapter III summarizes current and reference conditions including detailed discussions of current conditions of major resources, based on analysis of quantitative and qualitative data, and professional experience as well. Reference conditions are taken from old maps, historical society information, early Forest Service records, old journals and oral histories. Chapter IV is a synthesis and interpretation of the changes in resource conditions over the last century, and the probable causes of those changes. Results of the various analyses are integrated to arrive at a more holistic view of the consequences of both human-caused and natural disturbances. The chapter concludes with recommendations for management, both at the subwatershed and watershed level.

In order to provide color maps and photos and retain the efficiency of black and white reproduction for the text portion of the document, a separate color map/photo appendix was created. Color figures and photos are referenced to the map appendix in the text.

Summary of Findings

The following summary of findings pertains primarily to the Umatilla National Forest portion of the two watersheds. Data for non-Forest Service lands for vegetation, hydrology, and fisheries were scarce and prevented quantitative analyses of these areas. Since over 60 percent of the analysis area is non-Forest Service, a significant portion of the watersheds could not be analyzed in detail. However, qualitative assessments of private land conditions were included in the analyses when particular resources had strong interdependence among the different land ownerships.

Significant findings in this analysis include the following:

High levels of forest damage occurred in the Phillips-Gordon analysis area during the late 1980s and the early 1990s.

About 15,000 acres of forest land have high densities, making them more susceptible to mortality from Douglas-fir tussock moth, Douglas-fir beetle, and western spruce budworm. A number of silvicultural practices are identified that could be used to rectify the stocking problems.

Average road densities for the Forest Service portion of the Phillips-Gordon analysis area are relatively high (>3.5 mile per square mile). Many of the roads are situated in valley bottoms and have direct adverse impacts of hydrology and aquatic habitat. Existing road obliteration and upgrading schedule at the District are addressing the most severe problem areas.

Due to steep terrain and silty soils, over half the area has erosion hazard ratings of severe or very severe. Although significant progress has been made to lower road density via road obliteration, the combined effects of high road density and erosion hazard makes additional road obliteration/restoration a high priority.

Extensive livestock grazing on the erosion-prone soils in the analysis area has probably contributed to the degradation of aquatic habitat, although data are lacking to quantify these effects.

Federally-listed endangered Snake River steelhead trout spawn and rear throughout the analysis area. Low and dry flows are the major aquatic factor limiting populations. Floodplain, riparian and upland vegetation restoration is needed to reduce the frequency and severity of dry flow conditions.

Pedro Creek contains important steelhead habitat, and provides 10 percent of the flow to East Phillips Creek, which is one of the most important fisheries resource in the project area. These streams have high pool frequency and abundant large woody debris.

The area of forests with medium and large trees has declined from 25 percent in 1936 to 3 percent in 1999. Divergent inventory methods between the two data could account for some, but not all of this difference. Wildfires and timber harvest has reduced the number of large trees in the analysis area. Similarly, the area classified as old forest has declined from 78 percent to 25 percent over this time period. In contrast to size classes, the species composition has remained relatively stable over the past 75 years.

Three plant species in the analysis area are listed as R6 sensitive species.

Noxious weed problems are prevalent. Available data indicates that there are 77 knapweed and 18 tansy ragwort infestations. Focal points for the expansion of these populations coincide with the more heavily used transportation routes. Only 39 of the 98 inventoried noxious weed sites can be treated under the Forest's 1995 Noxious Weed EA.

Total habitat for Management Indicator wildlife species has declined.

Forested areas are at a significantly higher risk of experiencing stand-replacing wildfires as compared to historical conditions.

SITE CHARACTERIZATION

(Editors note: In order to include color maps, photos, and selected color figures with the Phillips-Gordon ecosystem analysis, we created a map appendix to accompany the text document. Color figures are referenced to the Map Appendix).

Characterization is the first step in a six-step process for Ecosystem Analysis at the Watershed Scale (Regional Ecosystem Office 1995). The purpose of Characterization is to identify the dominant physical, biological, and human processes or features of the watershed that affect ecosystem functions and conditions. Relationships between ecosystem elements and those occurring in the river basin or province are identified. The land management objectives and regulatory constraints that influence resource management in the watershed are also discussed.

Location and Setting

The analysis area lies within the Upper Grande Ronde (UGR) Watershed (the main stem and all its tributaries upstream of Rondowa), which is one of three subdivisions of the Upper Grande Ronde Subbasin (Figure 1-1, Map Appendix). The analysis area includes two small HUC-5 watersheds, Phillips/Willow Creek (# 84) and Gordon Creek (#07). Eleven subwatersheds are recognized in this analysis, two in the Gordon Creek drainage and nine in Phillips/Willow Creek drainage (Figure 1-2, Map Appendix; Table 1-1).

Occupying adjacent drainages, these two watersheds are direct tributaries of the Grande Ronde, comprising approximately 112,612 acres (176 mi.^{2}) of the UGR drainage area. Phillips Creek and Gordon Creek enter the river near the town of Elgin, Union County, Oregon. Willow Creek enters the Grande Ronde River near the town of Summerville, Union County, Oregon. There are several other minor creeks in the two watersheds, including Dry creek, Coon Creek, Mill Creek, Spring Creek, and Smith Creek. The Grande Ronde River is a tributary of the Snake River. The confluence of the Snake and Grande Ronde Rivers is approximately 493 miles upstream from the mouth of the Columbia River.

There are three permanent communities within the analysis area, the towns of Elgin (population 1,715), Imbler (population 310), and Summerville (population 150). Private lands around all three towns support a number of families on farms, orchards, and ranches.

Privately-owned lands comprise about 63 percent of the total area, mostly at lower elevations in the southeastern portion of the analysis area (Figure 1-3, Map Appendix). Elevations in the analysis area range from approximately from 2670 ft. at the confluence of Phillips Creek and the mainstem Grande Ronde River at Elgin to around 5000 feet at High Ridge.

Table 1-1. Acres by subwatershed for the Phillips-Gordon analysis area

Watershed	Subwatershed (SWS)	National Forest Acres	Other Acres	Total Acres	% of Analysis Area
Gordon/Cabin	07A Cabin Ck.	5,083	10,797	15,880	14.2
	07B Gordon Ck.	4,214	14,612	18,826	16.7
Phillips/Willow	84A Lower Phillips Ck.	0	2,928	2,928	2.6
	84B Little Phillips Ck.	6,718	577	7,295	6.5
	84C Middle Phillips Ck.	3,437	2,731	6,168	5.5
	84D East Phillips Ck.	4,219	0	4,219	3.7
	84E Upper Phillips Ck.	4,215	0	4,215	3.7
	84F Lower Willow Ck.	0	15,297	15,297	13.6
	84G SF Willow Ck.	2,720	9,353	12,073	10.7
	84H Upper Willow Ck.	3,809	7,399	11,208	9.9
	84I Dry Creek	7,233	7,270	14,503	12.9
Total		41,648	70,964	112,612	100

Geology, Soils, Topography and Erosion

The Phillips and Gordon Creek watersheds lie on uplands on the eastern edge of the large basalt and andesite uplift block that drains eastward directly into the Grande Ronde River. The drainage pattern is predominantly northwest to southeast. The headwaters originate on the relatively gentle slope of the main plateau (Tollgate plateau) and adjacent headwalls that comprises much of the Walla Walla district of the Umatilla National Forest.

The watershed is situated in the Minam-Tollgate Plateau subsection of the Blue Mountain section of the Middle Rocky Mountain Steppe Ecoregion. This subsection consists of dissected, basalt plateau uplands with cool and usually moist soils with a volcanic ash mantle from Mount Mazama. The ash mantle is relatively undisturbed in places, on gentle ridges and plateaus and north slopes with forest canopy. The steep canyon portions of Phillips-Gordon have little volcanic ash mantle remaining and are shallow and dry in the summer and fall. Footslope and canyon bottom positions often have deep re-deposited ash mixed with loess and mixed colluvium and alluvium from other sources (Lammers 1997). Shallow soils dominate the National Forest portion of the analysis area (> 50 % of the area). Deep and very deep soils (those over 40 inches in total depth) are the next most common (37% of the area, Table 1-3).

The marine-influenced climate is conducive to a moist, productive coniferous forest where soil depths are suitable. This subsection is differentiated from other intermediate-elevation, forested subsections due to the marine air influence and summer convections storms that provide more cool, humid air and relatively greater precipitation. This moisture and greater water holding capacity of the volcanic ash mantled soils provide moist soil conditions throughout the growing season in most years (Lammers 1997).

Due to the Tollgate Plateau's proximity to the Columbia Basin Plateau, there is also considerable loess soil, generally in the same places where deeper ash deposits remain or have been transported. Loess soil has an increased water-holding capacity (though not as great as ash soils) with similar coarse-fragment free textures (as ash) and high nutrients. This translates into high productivity where loess is present (Johnson and Simon 1987).

These drainages are representative of the northern Blue Mountains- moderately dissected wide uplifted plateau dominated by fluvial erosion and landslide processes. Landslide activity appears to be rather static in recent decades with occurrences mostly relegated to steep chutes in canyon headwalls and is subdominant as an erosion process compared to water and wind erosion.

The analysis area is comprised primarily of basalt flows of the Columbia River Basalt group, especially the Wanapum and Saddle Mountain subgroups (Figure 1-4, Map Appendix; Table 1-2). Phillips Creek marks the transition zone between the Powder River Volcanic field (younger andesite) to the south and the Wanapum and Saddle Mountain basalts to the north (Mark Ferns, personal communication). Stream deposit interbeds in the Phillips Creek area include some chert-bearing granitic sands that most likely washed in from the Elkhorn Mountains to the south.

The last volcanic eruptions in the area likely happened between 2 and 4 million years ago when a number of small shield volcanoes erupted near the mouth of Phillips Creek. Jones Butte, which juts out of the flat just north of Elgin, is about 2 million years old and is perhaps the youngest volcano in northeast Oregon (Ferns, personal communication).

Topography of the Phillips and Gordon watersheds is characterized by moderately to very steep slopes, with over half of the area having slopes greater than 30 percent (Table 1-4). The Phillips-Gordon watershed area is generally quite stable and does not have any active landslides of consequence. There are the typical (for these basalt canyons) headwall rockslide areas in many of the side drainages. No areas are identified in the Umatilla National Forest Soil Resource Inventory as active landslides or of historically unstable condition. There are areas of geologic landslide mapped on the geologic map in the Gordon Creek drainage adjacent to Forest Service ownership.

The dominant erosion process in the Phillips-Gordon analysis area is surface erosion (sheet and gully) with mass wasting occurring but as more infrequent and localized events. Upland erosion rates vary by soil type, slope, aspect, cover, and land use, among other factors. Natural upland erosion rates are generally highest on steep slopes with shallow soils on south-facing slopes in low to mid-elevation areas where rain and rain-on-snow are dominate. Accelerated erosion occurs in response to climatic conditions and often occurs in association with roads, logged areas, past heavily grazed areas, and recreation sites. The following conditions produce the highest rates of erosion: heavy rain on saturated ground or on frozen soils, along with accumulation of a snowpack and rapid warming. These conditions occurred in the analysis area in the winters of 1995-97 and resulted in areas sheet and rill erosion on moderate gradient, non-forested slopes; and a few small shallow landslides in steep headwalls and open slopes. Debris flows in small side valley tributaries also were associated with these events.

While timber harvest by itself generally has relatively minor effects on erosion rates (Helvey and Fowler 1979), associated roads often rapidly accelerate natural rates of erosion. In the Phillips-Gordon watersheds, land uses are generally concentrated on ridgetops and in valley bottoms, with the exception of livestock grazing. Grazing on private lands occurs in the lower portion of the analysis area, adjacent to streams, and accelerates bank erosion. Overall, channel erosion can be an important sediment source. Erosion rates vary by stream type and channel condition; infrequent high magnitude storms accelerate channel erosion and sedimentation, particularly in main valley streams where sediment is stored in floodplain and channel deposits.

Table 1-2. Geologic types in the Phillips-Gordon analysis area.

Geologic type	Description	Acres	% of Total
Qal	Alluvial Deposits	1,326	1
Qf	Basaltic Alluvial Fan Debris	14,265	13
Qls	Landslide & Debris Flow	4,488	4
Qs	Pleistocene Lacustrine and Fluvial	8,549	8
Tc	Columbia River Basalt	153	<1
Tcg	Grande Ronde Basalt	61,037	54
Tcs	Saddle Mtn. Basalt	12,302	11
Tcw	Wanapum Basalt	9,953	8
Tvm	Mafic Breccia and Scoria	284	<1
	TOTAL	112,612	100

Source: State of Oregon Geology Map

Table 1-3. Acres of soils by soil depth class for Forest Service land in the Phillips-Gordon analysis area.

Soil Depth Class	Range (inches)	Acres	Percent
Shallow	0-19	21240	51
Mod. Deep	20-39	4997	12
Deep, Very Deep	40+	15409	37

Table 1-4. Acres by slope class for Forest Service land in the Phillips-Gordon analysis area.

Slope Class	Acres	Percent of Analysis Area (FS lands only)
0-15 %	5,831	14
16-29	12,077	29
30-44	13,744	33
45+	9,996	24

Watershed Hydrology

Climate

This area is part of the Blue Mountains that intercept marine weather systems that move east through the Columbia River Gorge and is referred to as the Maritime-Influenced Zone. The precipitation is intensified as air masses rise up the slopes of the northern Blues, producing rain and snow to these mountains in all but the driest summer months. The maritime area receives more precipitation than anywhere else in the Blues except the high Wallowas and Elkhorns.

The Phillips and Gordon watersheds have a mixed maritime-continental climate with seasonal extremes of temperature and precipitation. At higher elevations, average monthly mean temperatures are generally five to ten degrees cooler than at lower elevations (Figure 1-5). For High Ridge (elevation 4980 feet), August is the warmest month and December is the coldest. For Elgin (elevation 2716 feet), August is also the warmest, but January is generally the coldest.

Most precipitation comes as winter rain or snow between November and May. Average monthly precipitation at Elgin ranges from 0.7 inches in August to 3.3 inches in January, and average monthly precipitation at High Ridge ranges from 0.7 inches in August to 7.5 inches in November (Figure 1-6). Annual precipitation increases with elevation from less than 15 inches near Summerville to over 45 inches at the headwaters of Phillips Creek (Figure 1-7, Map Appendix).

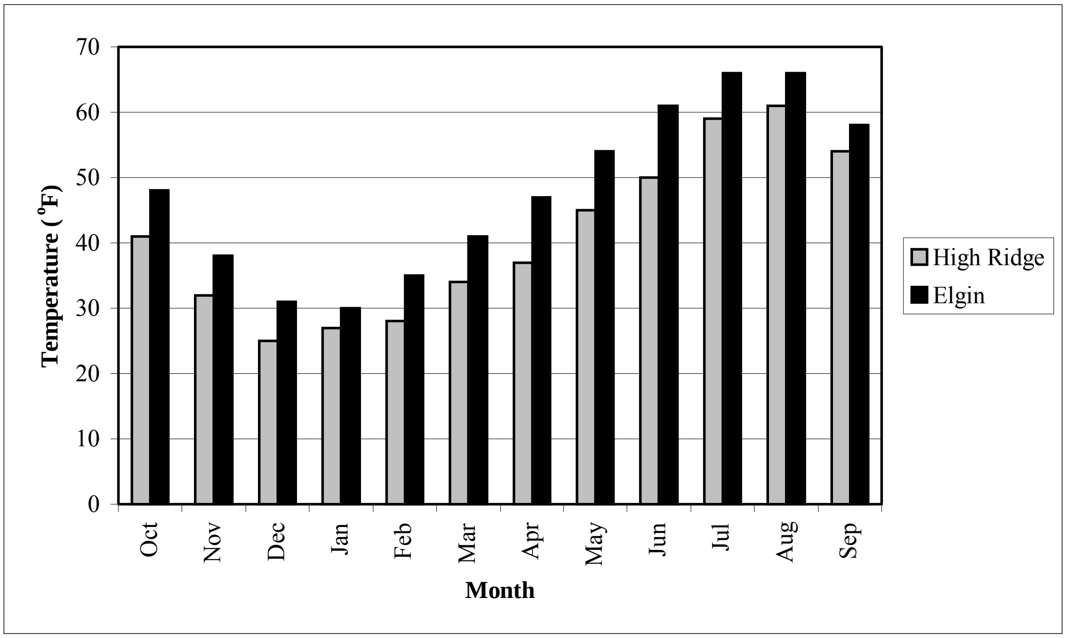

Figure 1-5. Average monthly mean temperatures, High Ridge (1990-1999) and Elgin (1970-1998).

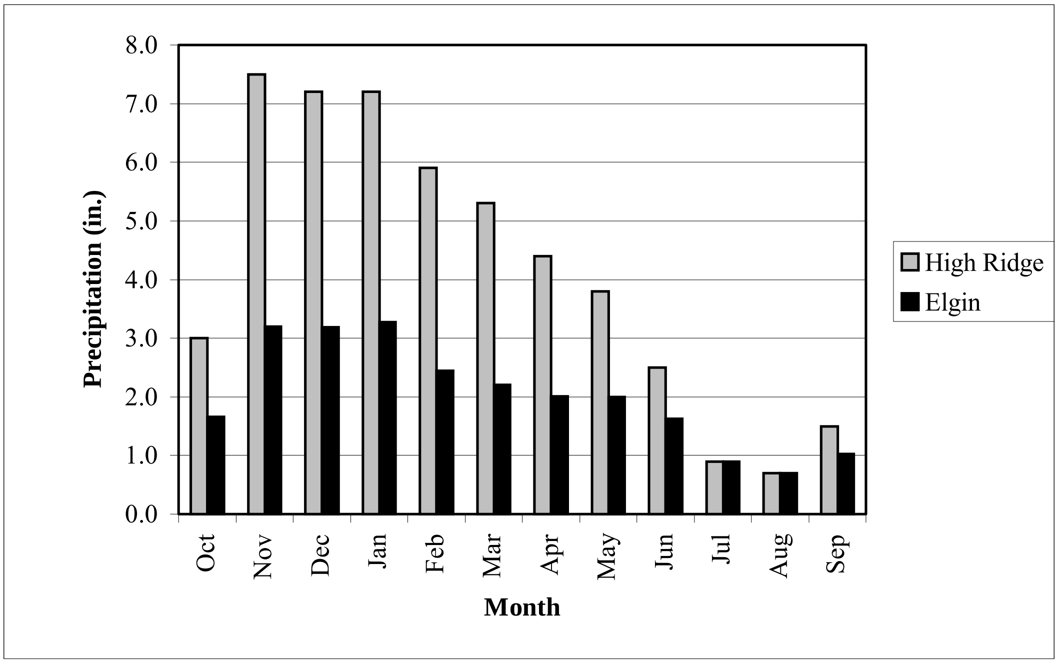

Figure 1-6. Average monthly precipitation, High Ridge (1979-1999) and Elgin (1970-1998).

Water Flows

No published streamflow records are available for the Phillips-Gordon analysis area. Nearby gages include Grande Ronde near Elgin, Lookingglass Creek, and Indian Creek. These data can be used to calculate the average unit discharge (average discharge divided by the drainage area = cfsm^2), which is useful calculation to compare water yield from drainage areas of various sizes. The streamflow gage at Grande Ronde near Elgin has a low cfsm^2 value probably because it is affected by upstream withdrawals for irrigation (Table 1-5). Indian Creek and Lookingglass Creek are more representative of conditions on Phillips Creek compared to the Grand Ronde data, although there remain significant differences among these drainages in their water flow characteristics. Most significantly, Phillips Creek is dry at the lower elevations in the summer, while Lookingglass is not. Also, it is generally observed that water flows from Phillips Creek are more “flashy” than Lookingglass Creek.

Average monthly discharge was estimated using a percent drainage area calculation based on the Grande Ronde at Rondowa gage, downstream of the analysis area. This calculation shows that Phillips Creek follows the seasonal pattern of winter snow accumulation, spring runoff peak, and fall baseflows (Figure 1-8). The average monthly discharge estimate does not take into account stream channel morphology and possible subsurface flow.

Table 1-5. Average unit discharge for gauged streams near the Phillips-Gordon analysis area.

Reference Stream Gage	Period of Record	Elevation	Drainage Area (mi^2)	Cfsm^2
Grande Ronde near Elgin	1955-1981	2,660	1,250	.53
Indian Creek	1938-1950	3,800	22	1.89
Lookingglass Creek	1982-1999	2,530	78.3	1.78
		Average (Indian and Lookingglass)		1.84

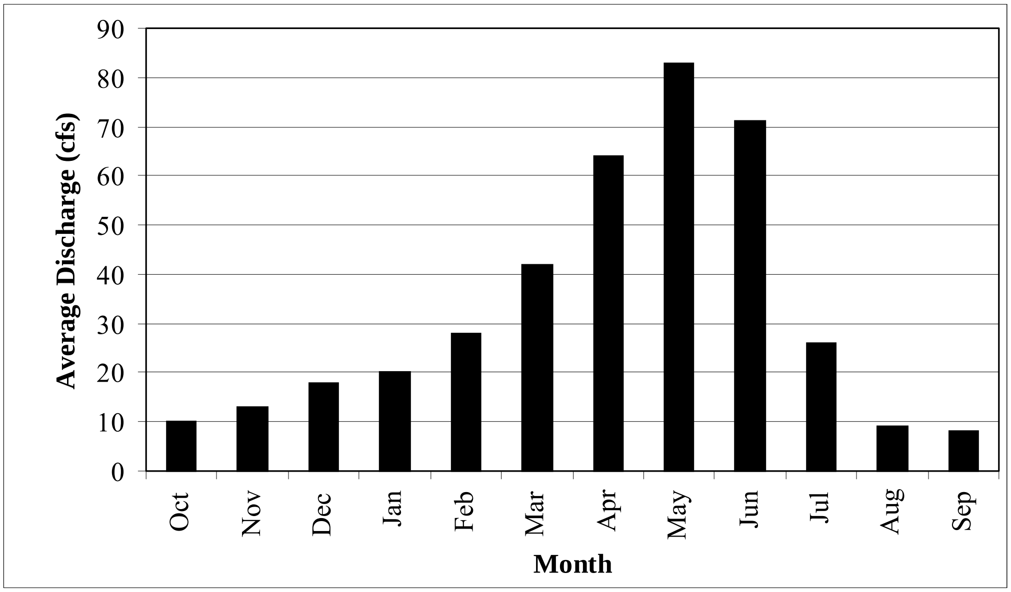

Figure 1-8. Estimated average monthly discharge for Phillips Creek at mouth.

Discharge was estimated for selected exceedance probabilities (Table 1-6) using regional regression equations (Harris and Hubbard 1983). The exceedance probability of 0.5 (Q 0.5) or the 2-year recurrence interval flow is slightly higher than the 1.5-year recurrence interval used to estimate bankfull flow. Bankfull flow is considered the channel maintenance flow, or the flow that transports the bulk of available sediment over time (Wolman and Miller 1960, and Dunne and Leopold 1978).

Table 1-6. Estimated discharges for selected exceedance probabilities/recurrence intervals.

Estimated Discharge	Cabin Creek 07A	Gordon Creek 07B	Phillips Creek 84A, B, C, D, E	Willow Creek 84F, G, H	Dry Creek 84I
Q 0.5 (2 year)	300	337	475	382	282
Q.02 (50 year)	768	847	1183	1231	727
Q.01 (100 year)	857	943	1322	1423	812

Stream Network and Riparian Areas

Streams in the Phillips-Gordon analysis area flow from the Blue Mountains in a southeasterly direction, to the Grande Ronde River (Figure 1-9, Map Appendix). There are approximately 565 miles of stream, classified as follows:

Class 1—streams that directly support anadromous fishery or public supply watershed:

Class 2—support resident fish or important tributaries to a public supply watershed;
Class 3—perennial streams that do not support fish or contribute to a public water supply; and
Class 4—intermittent, seasonal streams

Compared to National Forest averages, the Phillips-Gordon analysis area supports more miles of anadromous fish bearing streams, about the same miles of resident fish bearing streams, and has fewer miles of intermittent streams (Table 1-7). Exact data on stream classes and type of fishery are not available, and thus the data presented here are estimates.

The streams in the Phillips-Gordon analysis area are classified using the previous stream classification system. The most common classification system now uses the PACFISH stream categories, described below.

Category 1—fish bearing streams;
Category 2—permanently flowing non-fish bearing streams;
Category 3—ponds, lakes, reservoirs, and wetlands greater than 1 acre; and
Category 4—seasonally flowing or intermittent streams, wetlands less than 1 acre, landslides, and landslide prone areas

The previously used stream classification system can be used to approximate how streams in the Phillips-Gordon analysis area would be classified using the PACFISH category system. Class 1 and 2 combined approximates Category 1, Class 3 approximates Category 2, and Class 4 approximates Category 4. Category 3 is not represented by the previous classification system.

Table 1-7. Miles of stream by stream class, compared to forest averages, Phillips-Gordon.

		Category 1 [a]		Category 2	Category 4	Totals
Subwatershed	SWS#	*Class 1*	*Class 2*	*Class 3*	*Class 4*	
Cabin	07A	4.7	5.8	29.6	47.2	87.3
Gordon	07B	8.8	0.7	29.4	55.8	94.7
Lower Phillips Cr.	84A	Private Land, Data Not Available				
Little Phillips Cr.	84B	2	5.3	11.1	27.2	47.6
Middle Phillips Cr.	84C	2	1	13.0	34.9	50.9
East Phillips Cr.	84D	3	0.03	9.0	17.5	29.5
Upper Phillips Cr.	84E	3	0.8	10.3	22.1	39.2
Lower Willow Cr.	84F	Private Land, Data Not Available				
South Fork Willow Cr.	84G	21.0		15.6	16.9	53.5
Upper Willow Cr.	84H	37.9		17.2	16.6	71.7
Dry Cr.	84I	12.5	1.2	26.5	61.8	102.0
Watershed Totals		84.9	18.8	161.7	300.0	565.4
Percent		15.0	3.3	28.6	53.1	100
Forest Average (%)		11.0	4.0	24.0	61.0	100

[a] Miles were estimated for 84b,c,d,e from maps.

Water Quality

Beneficial uses of the of the Phillips-Gordon analysis area and the associated water quality standards as defined by the State of Oregon for the Grande Ronde Basin are shown in Table 8. Very little water quality monitoring has taken place in the Phillips-Gordon analysis area. An automatic sampler was in place on East Fork Phillips Creek from 1986 to 1991, collecting late spring and summer daily composite samples. Water samples were analyzed for total suspended solids, turbidity, conductivity, and total dissolved solids. Sediment loads can only be estimated because streamflow was not measured. Summer water temperatures were monitored on East Fork Phillips Creek for 1986 and 1988. The water quality data were input into STORET, the national water data bank maintained by the Environmental Protection Agency.

None of the streams in the Phillips-Gordon analysis area are listed on Oregon's 303(d) list as water quality limited. However, since monitoring data is not available for many of the streams, it is possible that some of the streams exceed state water quality standards. The Grande Ronde Water Quality Management Plan lists the Willow and Phillips watersheds as high priority for restoration.

Table 1-8. Beneficial uses and associated water quality parameters for Grande Ronde River Basin

Beneficial Use	Associated Water Quality Parameter
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
Anadromous Fish Passage	Biological Criteria, Dissolved Oxygen, Flow Modification, Habitat Modification, pH, Sedimentation, Temperature, Total Dissolved Gas, Toxics, Turbidity
Salmonid Fish Rearing	Dissolved Oxygen, Flow Modification, Habitat Modification, Sedimentation, Temperature
Salmonid Fish Spawning	Same as Salmonid Fish Rearing
Resident Fish and Aquatic Life	Same as Anadromous Fish Passage
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

Water Rights and Uses

In the Phillips-Gordon watershed, there are 16 water rights on the National Forest filed with the Oregon Water Resources Department (OWRD). All of these water rights are spring or pond developments designated for livestock or wildlife use. An additional three water sources (culvert outlets or ponds) have been identified by the Forest for road maintenance and fire protection needs.

Fish and Aquatic Habitat

Many of the aquatic species influenced by watershed condition of the Phillips-Gordon analysis area are highly mobile or migratory. Therefore, a characterization of the analysis area, relative to aquatic animals, must include descriptions of species, their life histories and distribution, from the Grande Ronde Basin or Columbia River Basin perspective.

The Grande Ronde River Basin has experienced a decline in aquatic species diversity in recent years. Native anadromous fish species have suffered local extirpation and others have been listed under the Endangered Species Act as Threatened or Endangered. The ICBEMP DEIS identified the Blue Mountains as an area especially important to the genetic integrity of anadromous salmonids. Aquatic strongholds were identified in the Grande Ronde Basin that were considered key elements for rebuilding and maintaining functioning aquatic ecosystems. The Integrated Scientific Assessment of ICBEMP noted that a key element of rebuilding would be connecting habitat patches with corridors or dispersal habitat and eliminating barriers to ensure that all parts of the regional population interact by allowing individuals to move between patches. Aquatic strongholds are found in areas of low road density and are typically high elevation such as wilderness and unroaded areas on the National Forest. While no aquatic strongholds were identified within the analysis area itself, strongholds were designated below (wilderness) and above (Grande Ronde River). Thus, conditions within the Phillips-Gordon area will affect the goal of rebuilding and maintaining aquatic ecosystems in the Grande Ronde watershed.

Four stocks of three fish species in the Grande Ronde Basin are listed as Threatened under the Endangered Species Act, namely spring/summer and fall chinook salmon *(Oncorhynchus tshawytscha)*, Snake River steelhead trout *(Oncorhynchus mykiss)*, and Columbia River bull trout (*Salvelinus confluentus).*

Snake River steelhead trout spawn and rear throughout the Phillips-Gordon analysis area. Eggs are in the gravel from one to two months, depending on water temperature with fry emergence from May to June. Juvenile steelhead typically rear in their natal streams for up to 2 years before beginning their downstream migration to the ocean with high spring flows in March through May. Adult Snake River steelhead trout typically leave the ocean as 3- to 6- year olds and begin their upriver migration in June of each year passing Bonneville by July. The steelhead trout spawning in the Grande Ronde subbasin enter the Grande Ronde in two distinct migrations, one peak in September and the other in March and April. Adults arriving in September hold in the Grande Ronde through the winter. Spawning activity is from March through May with the peak spawning activity occurring throughout the subbasin in late April and May. All four tributary streams support populations of rearing juvenile Snake River steelhead trout.

Both migratory and resident bull trout are known to occupy the Grande Ronde subbasin. However, resident bull trout are restricted to headwater streams and are not found in the Phillips-Gordon analysis area. Migratory bull trout are known to use the Grande Ronde River adjacent to the analysis area as a migration corridor and possibly as winter habitat from November through May for adult foraging. There is no record of bull trout inhabiting either the Phillips or Gordon drainages.

Non-migratory redband trout inhabit North Fork Cabin Creek from the Forest boundary at river mile 3.0 to approximately mile 4.0. All occupied fish habitat in South Fork Cabin Creek is below the National Forest boundary at river mile 8.0. The typical steelhead and redband trout habitat in the analysis area are shallow pools, 3 to 4 feet wide and less than one foot deep, in areas where stream banks are well vegetated with brush providing good fish hiding cover.

Riparian Management Constraints

Approximately 1500 acres of the Phillips-Gordon drainage are designated C5 riparian management area. Regional requirements for PACFISH (USDA Forest Service 1995) management strategies, and the presence of sensitive aquatic species impose limitations on the activities in the Phillips-Gordon watersheds.

Upland Forest Vegetation

Upland forest vegetation in the Phillips-Gordon analysis area is characterized by great diversity. What at a distance appears to be a band of coniferous forest occurring above a grassland zone is actually a mosaic of diverse vegetation zones with poorly defined borders. Herbaceous communities and stands of deciduous trees are scattered throughout the coniferous forest, and the species of dominant conifer changes from one site to another. These vegetative conditions can be thought of as the product of two important ecosystem processes, plant succession (as controlled by potential vegetation) and disturbance. Potential vegetation (PV) is a concept, which implies that over the course of time and in the absence of future disturbance, similar plant communities will develop on similar sites.

Potential vegetation information offers insights into vegetation-site relationships and can be helpful in projecting the type of vegetation expected under a particular set of ecological factors (Powell 2000). It has an important influence on ecosystem processes and is the “engine” that powers vegetation change. It controls the speed at which shade-tolerant species get established beneath shade-intolerant trees, the rate at which forests produce and accumulate biomass, and the impact that fire, insects, pathogens, and other disturbance agents have on forest composition and structure.

Potential vegetation is primarily influenced by temperature and moisture. Significant changes in these factors will cause a change in potential vegetation. The Phillips-Gordon analysis area, due to diverse landforms and topography, supports a variety of temperature and moisture regimes that vary somewhat predictably with changes in elevation, aspect, and slope exposure (Powell 2000). The potential vegetation associated with a particular set of temperature and moisture conditions is called a plant association. A plant association is named for the dominant plant species in its vegetation layers, for example the grand fir/twinflower plant association is dominated by grand fir in the overstory (tree) layer, and by twinflower in the undergrowth layer. In the analysis area, 32 forested plant associations have been identified (Johnson and Clausnitzer 1992, Johnson and Simon 1987).

Sites that can support similar plant associations are grouped together as a plant association group (PAG). Similarly, closely related plant association groups are aggregated into a potential vegetation group (PVG). The end result is a hierarchy ranging from plant associations at the lowest level to PVGs at the highest level (Table 1-9). Selected characteristics of the PVGs are summarized in Table 1-10. Location and distribution of upland-forest PAGs and PVGs are shown in Figures 1-10 and 1-11, Map Appendix, respectively.

Table 1-9. Potential vegetation hierarchy for upland forests of the Phillips-Gordon analysis area. Acres reflect National Forest lands.

PVG	PAG	Abbreviation	Common name of vegetation type	Area
Cold Upland Forest	Cold Dry	ABGR/VASC	Grand Fir/Grouse Huckleberry	100
		ABLA2/CAGE	Subalpine Fir/Elk Sedge	33
		ABLA2/POPU	Subalpine Fir/Polemonium pct	163
		ABLA2/VASC	Subalpine Fir/Grouse Huckleberry	440
		ABLA2/VASC/POPU	Subalpine Fir/Grouse Huckleberry/Polemonium	8
Moist Upland Forest	Cool Wet	ABGR/TABR/CLUN	Grand Fir/Pacific Yew/Queen's Cup Beadlily	823
		ABGR/TABR/LIBO2	Grand Fir/Pacific Yew-Twinflower	459
		ABLA2/STAM	Subalpine Fir/Twisted Stalk pct	90
	Cool Very Moist	ABGR/TRCA3	Grand Fir/False Bugbane	51
	Cool Moist	ABGR/CLUN	Grand Fir/Queen's Cup Beadlily	4,505
		ABGR/LIBO2	Grand Fir/Twinflower	2,480
		ABGR/VAME	Grand Fir/Big Huckleberry	6,536
		ABLA2/CLUN	Subalpine Fir/Queen's Cup Beadlily	1,378
		ABLA2/LIBO2	Subalpine Fir/Twinflower	91
		ABLA2/TRCA3	Subalpine Fir/False Bugbane	131
		ABLA2/VAME	Subalpine Fir/Big Huckleberry	1,360
		PICO(ABGR)/VAME	Lodgepole Pine (Grand Fir)/Big Huckleberry pct	240
	Warm Very Moist	ABGR/ACGL	Grand Fir/Rocky Mountain Maple	2,071
	Warm Moist	ABGR/ACGL-PHMA	Grand Fir/Rocky Mountain Maple-Ninebark pct	112
		ABGR/BRVU	Grand Fir/Columbia Brome	595
		PSME/ACGL-PHMA	Douglas-fir/Rocky Mountain Maple-Ninebark	17
		PSME/HODI	Douglas-fir/Oceanspray	1,437
Dry Upland Forest	Warm Dry	ABGR/CAGE	Grand Fir/Elk Sedge	259
		ABGR/CARU	Grand Fir/Pinegrass	262
		ABGR/SPBE	Grand Fir/Birchleaf Spirea	729
		GRASS/TREE MOSAIC	Grass/Tree Mosaic pct	4,288
		PIPO/CAGE	Ponderosa Pine/Elk Sedge	135
		PIPO/CARU	Ponderosa Pine/Pinegrass	581
		PIPO/SPBE	Ponderosa Pine/Birchleaf Spirea pct	33
		PIPO/SYAL	Ponderosa Pine/Common Snowberry	163
		PSME/CAGE	Douglas-fir/Elk Sedge	790
		PSME/CARU	Douglas-fir/Pinegrass	1,028
		PSME/PHMA	Douglas-fir/Ninebark	709
		PSME/SPBE	Douglas-fir/Birchleaf Spirea	4
		PSME/SYAL	Douglas-fir/Common Snowberry	333
		PSME/SYOR	Douglas-fir/Mountain Snowberry	148
		PSME/VAME	Douglas-fir/Big Huckleberry	229
	Hot Dry	PIPO/AGSP	Ponderosa Pine/Bluebunch Wheatgrass	210
		JUOC community types	Western Juniper plant community types	88

Table 1-10. Selected characteristics of potential vegetation groups (PVGs) for upland forests. Acres reflect National Forest lands.

PVG	Area (Acres)	Disturbances	Fire Regime	Patch Size	Elevation (Feet)	Slope (Percent)	Dominant Aspects
Dry Upland Forest	9,990	Fire Insects Harvest	Understory	1-2,000	4,228 (3,355-5,778)	35 (4-63)	Southeast Southwest East
Moist Upland Forest	22,376	Diseases Harvest Fire Insects	Mixed Severity	1-10,000	4,515 (3,218-5,773)	29 (2-62)	East Northeast West Southeast
Cold Upland Forest	721	Wind Insects Fire Diseases	Stand Replacement	1-1,000	5,003 (4,006-5,697)	21 (2-57)	East Northeast Southeast

Understory and Herbaceous Vegetation

More than 680 species of understory plants are found in the Phillips-Gordon analysis area, including approximately 73 species of grasses, 497 forbs and 69 shrubs. Culturally significant food plants, as well as medicinal plants and other plants that qualify as “Special Forest Products" (non-timber plants and products with commercial exploitation potential) are present in the analysis area. The extent of use of these plants is undocumented. As in many other watersheds on the Forest, noxious weeds are of increasing concern in this analysis area. Because alien plant species may be introduced to an area in so many ways (including vehicles, livestock, wind, or water) control is extremely difficult, particularly in light of current limitations on control methods.

Disturbance Factors

In the Phillips and Gordon watersheds disturbance processes have been the dominant ecosystem process affecting vegetative conditions. Important disturbance agents within the analysis area have been bark beetles, defoliating insects, livestock grazing, parasites and pathogens, timber harvest, wildfires, and windstorms. Three of these; fire, defoliating insects, and timber harvest; have been particularly important and are discussed in detail. The discussion on timber harvest can be found under the Human Activities and Uses section of this chapter.

Fire

Fire has been long been a pervasive disturbance process in the Blue Mountains. Historical records and fire-scarred trees suggest that fire burned at frequent intervals in the forest and grasslands of this area. The frequency and intensity of wildfires that have resulted in today’s landscape reflect the interaction of fire regimes, lightning frequency, forest stand condition, and human manipulation.

Agee (1990) developed Fire Severity Regimes for the Blue Mountains based on potential vegetation. Three regimes occur within the Phillips-Gordon analysis area.

Dry Forests. Low intensity-short return interval fires dominate dry forests. Fire sustains early seral species, such as ponderosa pine, and thins a large proportion of the seedlings and saplings that become established between fires. The result is that a majority of this forest type should be open, single storied stands. Based on the potential vegetation analysis, about 30 percent of the upland forested area is classified as dry forests.

Moist Forests. Fire regimes are complex in these forests and are often referred to as a mixed fire regime, indicating that fires often burn with a combination of low to moderate intensity surface fire and patches of high intensity fire. The patches of high intensity, stand replacing fire occur when changes in surface fuels, stand density, and/or topography come together to increase fire intensity. Because of the variation in these factors, patch sizes resulting from this type of fire regime are likely to be highly variable. Based on the potential vegetation analysis, about 68 percent of the upland forested area is classified as moist forests.

Cold Forests. The cold forest fire regime is characterized as high intensity-low frequency. Tree species in these forests show little resistance to fire, but in the case of lodgepole pine can quickly reclaim a site after a fire. The late seral species of these forests, such as subalpine fir and Engelmann spruce, are very susceptible to crowning and/or torching, which produces fires that spread rapidly via spotting or crowning runs. Based on the potential vegetation analysis, about 2 percent of the upland forested area is classified as cold forests.

Like most areas in the Blue Mountains, fire suppression has strongly influenced the structure and composition of the forest vegetation within the analysis area. Most significantly, early seral species such as ponderosa pine, lodgepole pine, and western larch have been replaced by late seral and climax species like Douglas-fir and grand fir. In addition, forest structure has changed from predominately low density, single story to high density, multi-story. Forests have also colonized grasslands, resulting in an overall decline in herbage production. There has been a substantial loss of hardwood tree species, particularly in riparian areas, resulting in a loss of forest tree diversity.

Defoliating Insects

Defoliating insects, primarily western spruce budworm and Douglas-fir tussock moth, have also played a major role in shaping the current forest vegetation. Both of these insects are native components of coniferous ecosystems and have been active in the Phillips-Gordon analysis area for as long as a food supply has been available. Occasionally, after weather and other environmental conditions become ideal for their growth and survival, populations explode in what is called an outbreak (epidemic). Substantial, wide-ranging insect outbreaks have been common in the Blue Mountains in recent years. There have been two spruce budworm and one tussock moth outbreaks in the last 50 years.

Terrestrial Vertebrates

Habitat

Habitats in the Phillips-Gordon watersheds range from forests of true firs interspersed with grassy scablands at the upper elevations, through dense stands of mixed conifers at mid-elevations to open pine stands with only intermittent steams in the lower portions of the drainages. Management practices (timber harvest, grazing, fire exclusion, etc.) over the past 100 years, along with natural disturbances, have contributed to changes in forest structure and composition. Resultant changes in habitat quality and quantity include reductions in habitat patch size, distribution and connectivity. Remaining late/old forest structure is limited in extent and highly fragmented.

Approximately 13 percent of the Phillips-Gordon watershed is included in management areas having specific emphasis on habitats for terrestrial wildlife, including Management Areas C1-Dedicated Old Growth (1,023 ac.), C3-Big Game Winter Range (1,161 ac.), C4-Wildlife Habitat (11,577 ac.), and C5-Riparian (1,542 ac.).

Species

A wide variety of terrestrial wildlife species occurs in the Phillips-Gordon analysis area. Approximately 233 species of terrestrial vertebrates have the potential to occur within the drainage, including 6 amphibians, 8 reptiles, 161 birds, and 58 mammals (Boula 2000). Over 50 percent of the bird species that nest within the drainage are Neo-tropical Migrants (species that winter in Central or South America). Several species of raptors, including the goshawk and great gray owl, occur in the drainage. Forest carnivores, including cougar, black bear, bobcat, coyote and marten are known to occur. Wolverines are likely to occur but at very low numbers. Lynx may be rare visitors at the very highest elevations.

Management Indicator Species

All Forest Management Indicator Species (MIS) (pileated woodpecker, pine marten, northern three-toed woodpecker, Rocky Mountain elk, and primary cavity excavators) have been observed in the Phillips and Gordon watersheds.

Threatened, Endangered, and Sensitive Species

Two threatened species, the bald eagle and lynx, have the potential to occur in the Phillips-Gordon area. Bald eagles are uncommon winter visitors along streams. Observations of lynx have been recorded. The Region 6, Regional Forester's Sensitive Species includes several species that are known or have the potential to occur in the Phillips-Gordon area (Table 1-11).

Table 1-11. Threatened, Endangered and Sensitive Species with potential to occur in the Phillips-Gordon analysis area.

Species	U.S. Fish and Wildlife Service	R-6 Regional Forester's Sensitive	State Status (Oregon)
Western toad			Sensitive-Vulnerable
Columbia spotted frog	Candidate		Sensitive-Undetermined
Tailed frog			Sensitive-Vulnerable
Bald eagle	Threatened	Sensitive	Threatened
Peregrine falcon		Sensitive	Endangered
White-headed woodpecker			Sensitive-Critical
Three-toed woodpecker			Sensitive-Critical
Black-backed woodpecker			Sensitive-Critical
Long-eared myotis			Sensitive-Undetermined
Fringed myotis			Sensitive-Vulnerable
Long-legged myotis			Sensitive-Vulnerable
Western small-footed myotis			Sensitive-Undetermined
Silver-haired bat			Sensitive-Undetermined
Townsend's big-eared bat		Sensitive	Sensitive-Critical
American marten			Sensitive-Vulnerable
Canada lynx	Threatened		
Wolverine		Sensitive	Threatened

Human Activities and Uses

Native American Affiliated Sites

Describing the activities of prehistoric Native Americans within the watersheds is difficult, as non-perishable materials such as stone or bone are the only remaining indications of presence or use within the area. In general, Native American adaptations in the Blue Mountains consisted of a seasonal mix of nomadism and sedentism. During the winter, camps were established along major rivers at lower elevations, and groups subsisted primarily upon dried provisions and local game and fish. As the higher elevations became snow free in the spring, tribal members ranged higher through their territories to exploit seasonally available resources. Horses were first acquired by the Columbia basin tribes in the early 1700s, and soon became an integral part of the nomadic lifeway of the Blue Mountain peoples (Hug 1961). Temporary campsites were generally established near food or water sources, and along traditional trails. Lithic scatter found at the higher elevations and along ridgetops in the Phillips-Gordon area are consistent with this pattern.

Euro-American Affiliated Sites

A review of the Euro-American sites suggests a pattern of land use similar to other areas of Euro-American activity in the region. Euro-Americans arrived on the heels of the Lewis and Clark expedition, primarily to trap beaver and other fur-bearers. By the 1830s, much of the Blue

Mountains had been trapped out. Permanent settlement by whites in the Elgin area displaced a former Native American encampment called Lochow Lochow (Hug 1961). As more and more people settled in the Grande Ronde Valley and the area between Pendleton and Walla Walla, the U.S. Government sought to establish treaties with the resident tribes. The Phillips and Gordon watersheds are located within lands ceded to the United States by the Cayuse, Umatilla and Walla Walla tribes. The Euro-American colonization of the area continued through the 1860s and 70s. Phillips and Gordon creeks are named after early homesteaders that arrived around 1865.

Of particular importance to the history of the watershed are several historic toll roads. The Woodward Road (earlier called the Tollgate trail) was established over the route of an Indian trail that connected the Milton-Freewater and Elgin areas. The trail was used extensively by Cayuse Indians and later by Hudson Bay trappers. Captain John C. Fremont and his company crossed the trail in 1843, the first to do so with a wheeled vehicle. Thirteen years later (1856) American soldiers would use the trail on their way to La Grande to engage in military actions associated with the Yakima Indian War.

The discovery of gold near Baker City had direct effects in the Phillips-Gordon area, as residents of Walla Walla and the Grande Ronde and Powder River valleys further developed the trail for pack use for support to the gold fields. Samuel Lincton made further improvements and connected the resulting wagon road to his own road near the summit of (what is now) Lincton Mountain, becoming the first real wagon “road” between the Grande Ronde and Walla Walla valleys. In 1873, the residents of Summerville and Weston began efforts to link their towns via the Lincton Mountain Road. A road was built across Phillips Creek and up to the head of Gordon Creek, where it tied in with the Lincton Mountain road. The Summerville Weston Wagon Road became known as the Woodward road, and served as a toll road until 1925, when it was turned over to Union and Umatilla counties. The current State Highway 204 route was completed in 1935 (Union County Historical Society notes, n.d.).

Summerville was established in the 1860’s along an old Umatilla Indian trail that came down Finley and Willow Creeks. It was a boom town in the early years, but location of a railroad through La Grande instead of through Summerville resulted in population declines. Fires destroyed most of the original town buildings. A sawmill was established in Summerville as early as 1864 and another one established on Gordon Creek in 1881. Around 1908 there were 17 sawmills hauling logs to Elgin (Elgin Leader newspaper, April 16, 1908). The town of Elgin was established at the site of an Indian encampment and fish trap on Phillips Creek. Imbler was established in 1890 as a rail station for agricultural products and lumber. With the advent of exploration and settlement by Euro-Americans, activities and land uses changed dramatically. The land and it’s resources have been affected by trapping, the development of roads and railroads, agriculture (including livestock grazing, crops and irrigation), development of permanent communities, manipulation of rivers and streams via dams, drainage and diversions, establishment of the National Forest, fire suppression, silviculture and timber harvest, and the management of fish and wildlife populations for harvest and recreation.

Current Land Uses and Activities

Federal Trust Responsibilities to Indian Tribes

In 1855, two treaties that affect this area of the Umatilla National Forest were signed between the United States Government and several Indian tribes. The treaty with the Walla Walla, Cayuse, and Umatilla tribes, and bands of Indians in Washington and Oregon Territories (today referred to as the Confederated Tribes of the Umatilla Indian Reservation) was signed on June 9, 1855. The treaty with the Nez Perce tribe was signed on June 11, 1855. In each of these treaties, the tribes ceded certain traditional lands to the U.S. Government. The Phillips and Gordon watersheds are within the area of interest of the Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce Tribe (Interior Columbia Basin Ecosystem Management Project, Eastside Draft Environmental Impact Statement).

Treaties and executive orders after 1971 obligate the United States and its agencies to certain trust responsibilities. This responsibility has been generally referred to as the federal trust responsibility. In addition to obligations in treaties and statutes, the Forest Service has an obligation to consult with Federally recognized Indian Tribes on a Government-to-Government basis throughout Forest planning process.

Indian Tribes having rights to fish, hunt, gather, graze livestock or trap on National Forest Lands also have the implied right to have associated resources (habitat) protected from degradation. The Forest views this ecosystem analysis as the beginning of the consultation process at the technical level with local tribal governments. The identification of treaty rights, treaty protected resources and other tribal concerns is the first step. This information will be used when developing specific projects. When consultation with tribes indicates a concern or conflict with the proposed action and that conflict is related to treaty rights or other rights or interests, those issues will be addressed in the site specific NEPA analysis. Depending on the character of the issues, they may be addressed in several different ways. An issue may be used to develop alternatives to the proposal, to develop mitigation measures or could be used by the decision maker in selecting among the alternatives. In all cases, tribal governments will be involved throughout the planning process.

Forest Plan Management Areas and Land Uses

A variety of uses and values characterize the Phillips-Gordon analysis area, as evidenced by the number of Forest Plan Management Strategies assigned to the area (Table 1-12, Figure 1-12). A brief description of each Area designation and its management goals follows:

A3, Viewshed 1: Manage the area seen from a primary travel route, use area or water body, where forest visitors have a major concern for the scenic qualities, as a natural appearing landscape.

A4, Viewshed 2: Manage the area seen from a primary travel route, use area or water body, where forest visitors have a major concern for the scenic qualities, as a natural appearing to slightly altered landscape.

A5, Roaded Natural: Provide dispersed recreation opportunities in an area characterized by a predominantly natural to near natural appearing environment with moderate evidences of the sights and sounds of man. Such evidences usually harmonize with the natural environment.

A9, Special Interest Area: Manage, preserve and interpret areas of significant cultural, historical, geological, botanical, or other special characteristics for educational, scientific and public enjoyment purposes.

C1, Dedicated Old Growth: Provide and protect sufficient suitable habitat for wildlife species dependent upon mature and/or overmature forest stands, and promote a diversity of vegetative conditions for such species.

C3, Big Game Winter Range: Manage big game winter range to provide high levels of potential habitat effectiveness and high quality forage for big game species.

C4, Wildlife Habitat: Manage forest lands to provide high levels of potential habitat effectiveness for big game and other wildlife species with emphasis on size and distribution of habitat components (forage and cover for elk, and snags and dead and down materials for all cavity users). Unique wildlife habitats and key use areas will be retained or protected.

C5, Riparian Fish and Wildlife: Maintain or enhance water quality, and produce a high level of potential habitat capability for all species of fish and wildlife within the designated riparian habitat areas while providing for a high level of habitat effectiveness for big game.

E2, Timber and Big Game: Manage forest lands to emphasize production of wood fiber (timber), encourage forage production, and maintain a moderate level of big game and other wildlife habitat.

F3, High Ridge Evaluation Area: Provide an administrative study area to evaluate the effects of timber harvesting activities on water quality and streamflow regimes.

Table 1-12. Forest Plan Management Areas in the Phillips-Gordon analysis area.

Management Area	Description	Total Acres	Percent of Umatilla NF Lands
A3	Viewshed 1	2,438	7
A4	Viewshed 2	1,044	3
A5	Roaded Natural	3,873	11
A9	Administrative	2	<1
C1	Old Growth	1,022	3
C3	Big Game winter Range	1,161	3
C4	Wildlife Habitat	11,577	32
C5	Riparian	1,504	4
E2	Timber and Big Game	13,715	38
F3	High Ridge Evaluation Area	20	<1

The majority of the area is allocated to the E2 Timber and Big Game, and C4 Wildlife Habitat management areas. The North Mount Emily Roadless Area comprises 4,634 acres of the analysis area and is situated in the southwest corner of the analysis area in SWS 84H and 84I.

The Forest Plan has been modified by two Regional amendments: PACFISH and the Eastside Screens. PACFISH direction increases the width of riparian buffers and limits harvest activities in the designated areas. Buffer size is dependent on stream class. Modifications to default buffer widths may be proposed as part of Ecosystem Analyses. The Eastside Screens were intended to preserve some old forest habitat by prohibiting harvest of trees greater than 21 inches DBH in subwatersheds where large trees were deficit relative to historic levels. Both amendments are expected to be replaced with the implementation of the Interior Columbia Basin Ecosystem Management Project.

Timber Harvest

The extent of harvesting since the arrival of EuroAmericans in the mid-1800 is not well recorded. Harvest practices within the last 30 years have been widespread, ranging from thinnings to clearcuts, and area salvages, and total around 27,000 acres. Area salvage contracts make it difficult to estimate exact treatment acreages. Approximately 30 percent of the area is currently allocated primarily to the production of timber. The extent of harvesting on private lands is unknown.

Recreation

The analysis area is located in a relatively remote yet roaded portion of the Walla Walla Ranger District. A variety of dispersed recreation activities such as snowmobiling, horseback riding, hiking, mountain biking, motorcycle/all terrain vehicle trail riding, hunting, fishing, and camping occur in this area. There are no developed campgrounds. During the fall, dispersed campsites are heavily used by deer and elk hunters. Winter activities are dominated by snow-oriented sports, primarily Nordic skiing and snowmobiling.

Transportation/Travel Routes

Road densities within the drainage exceed 4 miles per square mile in some portions of the Analysis Area. Many roads are located within riparian corridors. Forest Road 31 runs along the ridgetop, which separates the Grande Ronde and Umatilla drainages.

Rangeland Forage Resources

The bulk of forage for cattle, elk, and deer within the analysis area is found in forested settings. The forage resources within these drainages contain approximately 63,162 acres of suitable forage located primarily on upland forests, with some riparian areas, and few open grass/scabland and wet meadows. The watersheds contain only one Umatilla National Forest grazing allotment (Figure 1-13, Map Appendix) administered by the North Fork John Day Ranger District: the North End sheep allotment. Portions of all six allotment pastures are within the watersheds and are shown in Table 1-13.

Table 1-13. North End Allotment Acres in the Phillip and Gordon Watersheds.

Pasture	Acres Within Allotment	Acres Within Watershed	Suitable Acres Within Watershed
English Springs	14,045	774	697
Jarboe	23,705	22,904	16,732
Phillips Creek	27,283	11,481	8,583
Middle Ridge	21,279	11,753	8,566
Swamp Creek	26,873	23,855	18,468
Spout Springs	18,811	17,786	10,116
Total	131,996	88,553	63,162

ISSUES AND KEY QUESTIONS

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. While answers to key questions are not always stated as such, and are not contained in a single section, all questions are addressed at some point in 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 Walla Walla Ranger District and Forest staff. 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 forest sustainability, understory and non-Forest and botanical resources, and terrestrial vertebrate biodiversity. 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.

Issue I. Hydrology, Aquatic Habitat and Fisheries

The streams of the Phillips and Gordon watersheds are a source area for downstream water supplies, and contribute to flows in the Grande Ronde River. Recognized beneficial uses of water that occur in the Phillips and Gordon watersheds are: public and private domestic water supply, livestock watering, anadromous fish passage, salmonid fish rearing and spawning, resident fish and aquatic life, water contact recreation, and aesthetic quality.

Water quality standards established by the State of Oregon are intended to delineate thresholds of beneficial use support. Some standards are numeric, such as water temperature (64° F general, 55° F Chinook salmon spawning, and 50° F bull trout). Other standards are descriptive, such as “deleterious amounts” for sediment. Standards that apply to the Phillips and Gordon watersheds include temperature, sediment, habitat, and flow.

While water resource issues are not new in this area, recognition of those issues and controversy over how to manage water resources is increasing. Specific issues identified for this analysis are described below.

Degraded condition of in-stream habitats for anadromous and resident fish

Low summer flows, high water temperatures, changes in channel structure, high sediment loads, insufficient pools, and shortages of in-stream wood are indicators of reduced habitat quality. Such conditions are evident in the mid and lower elevations of the analysis area, where some formerly perennial creeks are now dry completely by mid-summer. Limited stream temperature data suggest that several streams in the Phillips-Gordon analysis area probably exceed state temperature standards. None of the streams are designated as water quality limited [303(d)] streams at this time.

Past and present management of riparian and upslope lands (both public and private) can contribute to degraded terrestrial riparian and aquatic habitat quality and quantity.

Riparian vegetation and stream bank stability along some streams have been seriously degraded by past land use practices. Management of upslope vegetative communities can also have impacts on the downslope riparian community. Resource uses including timber harvest and livestock grazing in riparian areas, livestock water developments, roads (development, use and maintenance), and ATV use have adversely affected riparian and aquatic habitat.

Current status of at-risk resident and anadromous fish

Two life history types of salmonid fish, resident redband trout and anadromous steelhead trout, use this portion of the Grande Ronde River system. Other non-salmonid fish are also present. Redband trout, and Snake River summer steelhead are listed as Sensitive Species by the Regional Forester. Both are also listed as ICBEMP Key Salmonid Species. Snake River steelhead were listed as Threatened under the ESA in October, 1997. The adjacent Grande Ronde River is a migration stream and possible winter habitat for ESA-listed bull trout and Chinook salmon.

Tribal fishing and cultural uses

Status of the steelhead run is also an issue because of the species' cultural and nutritional importance to the tribes. When fish populations become very low, need and desire for consumptive uses may conflict with regulations restricting take in order to protect the population for future use.

Key Questions:

- *What are the principle physical characteristics of the Phillips and Gordon watersheds, and how are they related to erosion processes, stream conditions, and water quality?*
- *Are dry stream channels (intermittent flow) during summer, low flow conditions natural, or an indication of changed hydrologic conditions?*
- *How are past and current land uses influencing erosion, sediment, channel morphology, and water quality?*
- *What is the quality of the aquatic habitat in the Phillips and Gordon watersheds, and how does it affect the status of the native salmonid species in the watershed?*
- *How have aquatic habitat conditions and fish populations in the Phillips and Gordon watersheds changed over time? What are the reasons for the changes?*
- *What management actions can be taken to mitigate or reverse any adverse cumulative effects that have occurred, and improve aquatic conditions?*
- *What additional information is needed in order to most effectively manage fish habitat in the Phillips and Gordon watersheds?*

Upland Forest Sustainability

Elements and processes within forest ecosystems are naturally dynamic, and the composition and structures of plant communities change over time. Changes generally occur within a range of conditions reflecting the tolerances of the dominant vegetative community. When a forested community moves substantially beyond that "historical range of variability", it may be simply the results of ongoing succession, a natural process, or an indication that the system has been moved outside its range of tolerance by natural events or human intervention.

In the case of the Phillips and Gordon watersheds, changes in overstory species composition and tree density have occurred, resulting in increased tree mortality and vulnerability to stand-replacement fires.

Key Questions:

- *How do current forest conditions compare to those that existed historically?*
- *How have disturbance processes shaped existing forest conditions, and what role might we expect them to play in the future?*
- *Are current forest conditions considered to be ecologically sustainable over the long term?*
- *If current forest conditions are considered to be unsustainable, what management actions could be used to create more sustainable conditions?*

Understory and Non-Forest Botanical Resources

The issue of vegetation sustainability pertains to understory plants and deciduous trees as well as to forest overstory vegetation (conifers). Most concerns stem from the unintended impacts of past and on-going land management. For example, the invasion of noxious weeds, as well as introduced grasses, threatens the sustainability of some native understory species. The increasing awareness of and demand for native plants for medicinal purposes has the potential of greatly impacting plants with medicinal properties, and could threaten their sustainability. Sensitive plant populations are potentially vulnerable to further reduction in numbers or viability due in part to decades of grazing by domestic livestock. As in forested ecosystems, the exclusion of fire for many decades may be resulting in changes in non-forest plant communities.

Key Questions:

Floristic Biodiversity

- *What vascular plant species presently occur in the Phillips-Gordon Creek analysis area? How does this compare with historic plant community composition?*
- *What is the floristic richness of the Phillips-Gordon analysis area in comparison with the rest of the Walla Walla Ranger District, and within the Umatilla National Forest?*
- *What is the ratio of native to introduced species in the analysis area? Is this ratio an accurate indicator of historic variability in Floristic Biodiversity?*
- *How have disturbance processes shaped existing floristic conditions, and what role might we expect them to play in the future?*

Sensitive Species

- *What are the occurrences of historically-listed or presently-listed sensitive plant species within the Phillips-Gordon 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?*

Noxious Weeds

- *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?*

Culturally and Economically Significant Plants

- *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/restoration projects within the watershed?*

Terrestrial Vertebrate Biodiversity

Wildlife issues in the Phillips and Gordon watersheds center on the availability, distribution, and condition of important habitat types, effects of management and natural disturbances on those habitats, and the resulting status of wildlife populations. In particular, District wildlife staff identified a scarcity of big game winter range as a concern. Other specific concerns include reductions in the availability of riparian and old forest habitats, and diminished snag resources. Riparian habitats on some private lands no longer provide viable habitat for songbirds or small mammals.

Key Questions:

Habitat Quantity and Quality

- *How have important habitat types, including late/old coniferous forest, riparian hardwood forest (aspen, birch and cottonwood), wet meadows and shrublands changed since historical times in terms of patch size, distribution, and connectivity, and what are the causes of the changes?*
- *How might habitat conditions and patterns be restored to be more “ecologically sustainable”, keeping in mind the community of terrestrial vertebrates that currently occupies the watershed?*

Terrestrial Vertebrate Populations

- *What terrestrial vertebrate species occur in the watershed?*
- *How has habitat for Management Indicator Species changed over time within the Phillips and Gordon watersheds, and what are the causes?*
- *What is the status of Management Indicator Species/Sensitive/Listed Species and other species of local concern within the watershed?*
- *How does wildlife community composition relate to habitat composition and availability?*
- *Are there species at risk of “local extirpation”? If so, can risks be lessened through management?*

CURRENT AND REFERENCE CONDITIONS FOR SOILS AND GEOLOGY

Erosion Processes

The dominant erosion process in the Phillips-Gordon analysis area is surface erosion (sheet and gully) with mass wasting occurring as infrequent and localized events. Upland erosion rates vary by soil type, slope, aspect, cover, and land use, among other factors. Natural upland erosion rates are generally highest on steep slopes with shallow soils on south-facing slopes in low to mid-elevation areas where rain and rain-on-snow are dominant. Accelerated erosion occurs in response to climatic conditions and often occurs in association with roads, logged areas, past heavily grazed areas, and recreation sites. Highest rates of erosion are produced by heavy rain on saturated ground or on frozen soils, along with accumulation of a snowpack and rapid warming. These conditions occurred in the winter of 1995-97 in the analysis area and resulted in areas of sheet and rill erosion on moderate gradient, non-forested slopes as well as localized shallow landslides in steep headwalls and open slopes, and debris flows in small side valley tributaries.

In the Phillips-Gordon watersheds, land uses are generally concentrated on ridgetops and in valley bottoms, with the exception of livestock grazing. Grazing on private lands occurs in the lower portion of the analysis area, directly adjacent to streams, accelerating bank erosion. Overall, channel erosion can be an important sediment source. Erosion rates vary by stream type and channel condition. Infrequent, high magnitude storms accelerate channel erosion and sedimentation, particularly in main valley streams where sediment is stored in floodplain and channel deposits. Over half of the area is rated as having severe or very severe erosion hazard, indicative of the steep terrain and silty soil textures (Table 2-1).

Effects of Timber Harvest and Roads

While timber harvest by itself generally has relatively minor effects on erosion rates (Helvey and Fowler 1979), associated roads often rapidly accelerate natural rates of erosion. Table 2-2 shows Forest Service timber sale acres within the analysis area, grouped by subwatershed. Most sale activity has been concentrated in the Dry Creek subwatershed. Areas with multiple sales and repeated activity in the same units are most likely to have soils that have been adversely impacted in terms of productivity and stability.

Roads

Upper, Middle, and Little Phillips, and Gordon Creek subwatersheds had total road densities on Forest Service ownership greater than 4 miles per square miles prior to recent road obliteration work. Open road densities are currently much lower, although the average total road density for the Forest Service portion of the analysis area remains relatively high at 3.5 miles per square mile. Considerable road obliteration and/or decommissioning work has occurred in the Phillips Creek drainage over the last few years. Stabilization work on the remaining roads has helped to reduce road-related sedimentation problems. High *total* road densities are an indication of the need to further examine the road network and assess the ATM plan for concurrence.

Table 2-1. Erosion hazard ratings for the soils in the analysis area as interpreted from the

Umatilla National Forest Soil Resource Inventory.

Hazard Category	Acres	Percent
Low	0	0
Moderate	17,443	48
Severe	12,167	33
Very Severe	6,781	19
Total	36,391	100

Table 2-2. Historical timber harvest activity in the Phillips-Gordon watersheds on Umatilla National Forest Land

Subwatershed	Acres of Harvest Activity
Dry Creek 84I	7,070
Cabin Creek 07A	4,771
Little Phillips 84B	4,710
East Phillips 84D	3,558
Upper Phillips 84E	3,333
Middle Phillips 84C	2,389
Gordon Creek 07B	1,443
Willow 84H	<1

CURRENT AND REFERENCE CONDITIONS FOR HYDROLOGY

Current Conditions

To assess the effects of land use on watershed conditions, each watershed in the analysis area was evaluated in terms of its hydrologic response to disturbance. Hydrologic response was determined from the combination of very steep slopes (> 45%), shallow soils (0-20 inches), warm/hot aspect (>90^o, <270^o), and stream density (Table 3-1). Subwatersheds with high proportions of steep slopes, shallow soils, warm/hot aspects, and high stream densities are most hydrologically responsive. These include subwatersheds 07A, 84D, and 84H (Table 3-1). Only information from Umatilla National Forest lands was used for this evaluation and thus these values do not represent the entire subwatershed conditions.

Current levels of timber harvest and roads are also indicators of watershed and stream conditions. High levels of harvest and roads or moderate levels in hydrologically responsive areas increase the likelihood of accelerated erosion, change in peak flows, channel adjustments, and adverse impacts to water quality and aquatic habitat. Roads alter surface hydrology through several mechanisms including interception of subsurface runoff, concentrating surface runoff, and extending channel networks which increases watershed efficiency. Roads also reduce infiltration, reduce vegetative cover in streamside areas, and accelerate erosion and sedimentation into streams (Megahan 1983).

Road densities in the Phillips-Gordon subwatersheds range from 0.3 mi/mi^2 in Upper Willow Creek to 6.2 mi/mi^2 in Upper Phillips Creek (Table 3-2). These densities reflect only roads within the Umatilla National Forest. All subwatersheds except Upper Willow Creek have road densities higher than 2.0 mi/mi^2, identified as a road density level of concern in the National Marine Fisheries Service (NMFS) Biological Opinion on the Umatilla National Forest Land and Resource Management Plan (NMFS 1995).

Table 3-1. Subwatershed characteristics as related to hydrology for portions within the Umatilla National Forest

Code	Subwatershed Name	Steep Slopes (%)	Shallow Soils (%)	Warm/Hot Aspect (%)	Stream Density (mi/mi^2)
07A	Cabin Creek	14	45	76	3.5
07B	Gordon Creek	20	18	73	3.2
84A	Lower Phillips Creek	private ownership, no information available			
84B	Little Phillips Creek	10	25	44	4.0
84C	Middle Phillips Creek	13	34	64	5.6
84D	East Phillips Creek	31	36	63	4.2
84E	Upper Phillips Creek	18	46	69	5.5
84F	Lower Willow Creek	private ownership, no information available			
84G	S.F. Willow Creek	private and Wallowa-Whitman National Forest, no information available			
84H	Upper Willow Creek	78	47	35	7.3
84I	Dry Creek	24	29	51	4.5

Another critical factor in the interaction between roads and streams is the slope position of the roads. Many of the Phillips-Gordon subwatersheds have valley bottom roads, including Road 32 along Dry Creek, Road 3738 along Phillips Creek, Road 204 along Little Phillips Creek, and Road 3727 along Gordon Creek. Valley bottom roads have the most direct effect on streams and riparian areas, including accelerated erosion, loss of streamside shade, and increased number of road stream crossings. Mid slope roads intercept subsurface runoff, extend channel networks, and accelerate erosion. Ridgetop roads can influence watershed hydrology by channeling flow into small headwater swales, accelerating channel development. Because roads increase the efficiency of watershed runoff, the timing of streamflow is affected. Generally, roads reduce the amount of time for runoff to reach the stream system, causing peak flows to occur earlier than with non-roaded watershed conditions.

Percent Equivalent Clearcut Acres measures the extent of harvested openings and is used as an indirect measure of hydrological effects such as increases in water yields and peak flows from harvesting. The procedure to determine percent ECA (Ager and Clifton 1995) accounts for both harvest method and vegetative recovery rates for the Blue Mountains (Ager and Clifton 1995). The NMFS Biological Opinion (NMFS, 1995) specified an ECA of 15 percent as a level of concern. Subwatershed 07A, Cabin Creek, has an ECA of 18.5 percent. All other subwatersheds in the analysis area are below the 15 percent level of concern (Table 3-2).

Table 3-2. Equivalent clearcut acres and road density by subwatershed (SWS) for Umatilla National Forest lands

Code	SWS Name	Acres (Umatilla NF)	SWS Square Miles	% ECA (UNF)	Road Miles (UNF)	Road Density (mi/mi^2)
07A	Cabin Creek	5,083	7.9	18.5	22.4	2.8
07B	Gordon Creek	4,214	6.6	0.7	29.1	4.4
84A	Lower Phillips Creek	private, no information available				
84B	Little Phillips Creek	6,718	10.5	2.8	35.0	3.3
84C	Middle Phillips Creek	3,437	5.4	5.0	24.0	4.4
84D	East Phillips Creek	4,219	6.6	9.9	25.5	3.9
84E	Upper Phillips Creek	4,215	6.6	7.8	41.0	6.2
84F	Lower Willow Creek	Private, no information available				
84G	S.F. Willow Creek	private and Wallowa Whitman NF, no information available				
84H	Upper Willow Creek	2,911	4.5	0	1.2	0.3
84I	Dry Creek	7,233	11.3	4.1	38.1	3.4

Very little water quality monitoring data has been collected for the Phillips and Gordon watersheds. An automated sampler collecting daily water samples for analysis of sediment parameters (total suspended solids (TSS), turbidity, total dissolved solids, and conductivity) was operated on East Phillips Creek from 1986 to 1991. These data are stored in STORET, the EPA national water quality database. The sampler was mostly running during the end of snowmelt through summer/fall low flows. These results do not take into account any winter or early spring storm events and may under-represent actual suspended sediment loads. Winter and spring storm events often contribute significant amounts of sediment to stream systems. Yearly suspended sediment loads were estimated using the TSS values sampled with the automated sampler and an estimated average daily discharge of 12.1 cfs (Figure 3-1). The average daily discharge was determined by multiplying drainage area by an average cfsm^2 value of 1.84 for the analysis area (Table 3-3). Estimated yearly loads range from 5.6 tons/mi^2/year in 1986 to 16.6 tons/mi^2/year in 1989. Harris and Clifton (1999) found high spatial and temporal variability in sediment loads for three sediment sampling sites on the Umatilla River, with ranges from 14 to 197 tons/mi^2/year at one site.

The Umatilla National Forest monitored daily stream temperatures on East Phillips Creek in 1986 and 1988. Several locations in the Phillips-Gordon analysis area were monitored by Oregon Department of Forestry in 1993. All streams show a 7-day maximum below the state standard of 64 degrees F (Table 3-3). Stream survey information indicates elevated single point stream temperature measurements on several stream reaches in the analysis area.

The Phillips and Gordon watersheds are included in the North End livestock allotment. This area has been grazed since the late 1800's, and the Forest Service began issuing permits in 1920. Effects from grazing include upland soil compaction and displacement, physical damage to streambanks from trampling, loss or reduction in vegetation by herbivory, and increases in nutrients and bacteria from animal wastes. Stream surveys completed by the Walla Walla District on Dry Creek in 1992 indicate evidence of intensive sheep grazing (eg. bank sloughing, flattened grass, browsed shrubs, and wool found on branches) as reported by Hines (1993).

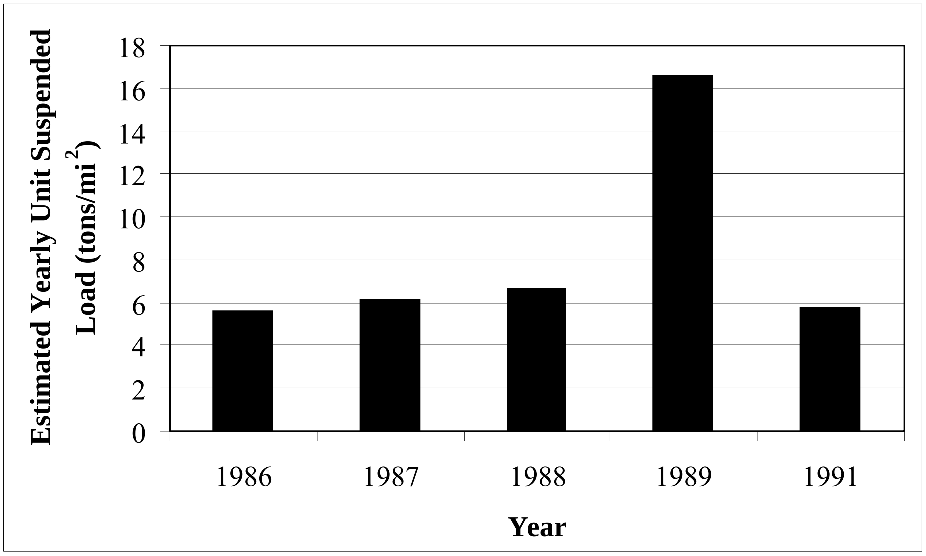

Figure 3-1. Estimated Yearly Suspended Sediment Load (Tons/mi^2) for East Phillips Creek.

Table 3-3. Annual 7-Day Moving Average of the Daily Maximum Stream Temperatures.

		7 Day Maximum (°F)		
Stream	Agency	*1986*	*1988*	*1993*
East Phillips Cr. at mouth	USFS	56	63	-
East Phillips Cr. Above Pedro	ODF	Na	Na -	57
Upper East Phillips Cr.	ODF	Na	Na -	54
Pedro Cr. At mouth	ODF	Na	Na -	56
Upper Phillips Cr.	ODF	Na	Na -	55

Phillips Cr.	ODF	Na	Na -	55

Reference Conditions

Reference conditions provide a measure of watershed potential. Unfortunately, few records of past conditions are available for comparison, and thus reference conditions can only be described in general terms.

Historical changes in the Middle and Upper Grande Ronde River Subbasins that have had either direct or indirect effects on the system's hydrological regime are summarized below (Gildemeister 1999):

- 1820's – 1830's: International fur trade removed most of the beaver from the area.
- 1860's – 1950's: Intensive logging of streamside areas, streams cleared and used for splash dams
- 1870's – 1990's: Ditching and channeling reduced the number of stream miles in the Grande Ronde Valley.
- 1880's to early 1900's: Intensive grazing of cattle and sheep. Grazing was reduced on National Forest land (Wallowa Whitman and Umatilla) by 78 percent by 1990.
- 1940's – 1970's: Loss of wetlands and wet meadows and removal of riparian vegetation altered stream systems. Over 1,500 miles of logging roads constructed on National Forest land in the Upper Grande Ronde (Wallowa Whitman and Umatilla National Forests).

Of particular significance is the loss of beavers in this area. Beavers played an important role in stream system development prior to the introduction of the fur trade. Early journal entries indicate beaver were plentiful in 1812 (Gildemeister, 1999). Historic information suggests beaver's role in controlling stream flows, water quality, and sediment movement ended by the 1850s or 1860s, as the species was systematically extirpated. Wet meadows previously ponded by beaver dams dried up as the beavers were removed. Stream surveys in the late 1950's indicate few remaining beaver dams (Thompson and Haas, 1960). Also of significance is the intensive grazing that began in the 1880's in the Upper Grande Ronde watershed. Native American horses probably intensively grazed the valleys previous to the 1880's (Gildemeister, 1999).

The effects of these changes on the hydrology of the analysis area are many, and according to Gildemeister (1999) include some of the following:

- Decrease in river channel length from cutting off meandering loops, straightening channels, and digging ditches.
- Loss of riparian shade from vegetation removal leading to higher stream temperatures.
- Loss of connection of floodplain to the river, contributing to less connection of shallow groundwater to river, less storage of shallow groundwater in floodplain, resulting in warmer stream temperatures.
- Near elimination of beaver, resulting in river modifications from the loss of beaver dams and vegetation manipulation.
- Loss of wet meadow, wetland, meadow grassland, and riparian forest types, leading to simplified river structure.
- Loss of "sponge" action of the Grande Ronde Valley to hold spring floodwater. Floodwater is transported quickly through the system.

Some anecdotal information is available from stream surveys in the late 1950's. These indicated that Willow Creek was dry in late summer from a few miles above the mouth to Findley Creek. Water in the lower portion of Willow Creek was contributed from Spring Creek. Many diversion ditches were noted along Spring Creek and lower Willow Creek. Stream surveys also indicated that Phillips Creek was an intermittent stream, going dry in late summer as far up as Little Phillips Creek. Two diversions and several log/debris jams were noted on Phillips Creek. The stream was considered generally well shaded along the banks except in the lower mile where a logging road was located along the creek. On Cabin and Gordon creeks, several beaver dams and small diversions were noted. Recommendations were made in the stream survey summary report to remove the beaver dams and log/debris jams to promote fish passage (Thompson and Haas 1960).

CURRENT AND REFERENCE CONDITIONS FOR FISH AND AQUATIC HABITAT

Overview

The Grande Ronde River is a tributary of the Snake River located in northeastern Oregon and southeastern Washington. The confluence of the Snake and Grande Ronde Rivers is approximately 493 miles upstream from the mouth of the Columbia River. Tributaries draining the analysis area enter the Grande Ronde from the west between river miles 87.5 and 106 near the towns of Imbler and Elgin, Oregon.

The Phillips and Gordon Creeks watershed analysis area contain four Grande Ronde River tributaries that have been divided into 11 subwatersheds totaling 112,612 acres. The analysis area is bounded on the north by the Lookingglass Creek watershed and on the west by the Umatilla River watershed. Their headwaters area located on the Walla Walla Ranger District of the Umatilla National Forest in the Blue Mountains of northeastern Oregon. The four primary tributaries of the Grande Ronde draining the analysis area are from north to south, beginning at Grande Ronde River Mile 87.5, Cabin Creek, Gordon Creek, Phillips Creek, and Willow Creek. Willow Creek enters the Grande Ronde approximately 6 miles above Elgin, Oregon.

Extinct and Endangered Fish Populations

The anadromous fish of the Grande Ronde Basin have been the center of attention for many decades due to declining populations. Native resident fish and introduced exotics are also of concern. This discussion of aquatic species of the Phillips and Gordon Creeks subwatersheds will include Endangered Species Act (ESA) listed aquatic species, Regional Forester listed sensitive species and species of concern.

Populations of sockeye (*Oncorhynchus nerka),* and early fall chinook salmon *(Oncorhynchus tshawytscha)* once found in the Grande Ronde basin are now extinct. A few coho salmon, *(Oncorhynchus kisutch),* were found below the analysis area in the Grande Ronde and Wallowa Rivers (Smith 1975) but are now extinct. Sockeye salmon historically migrated up the Grande Ronde and Wallowa Rivers on their return to Wallowa Lake to spawn. Over fishing and irrigation development in the early 1900's lead to their extinction. High water temperatures and low stream flows in the lower Grande Ronde during the late summer/early fall adult migration period prevent reestablishment of sockeye at Wallowa Lake (James 1984).

Three fish species in the Grande Ronde Basin are listed as Threatened under the Endangered Species Act, spring/summer chinook salmon *(Oncorhynchus tshawytscha)*, Snake River steelhead trout *(Oncorhynchus mykiss)*, and Columbia River bull trout (*Salvelinus confluentus).*

Most adult spring/summer chinook salmon of the Grande Ronde drainage enter the Columbia River in April and May of each year (Moore 1990). By June or July the fish are holding in the Upper Grande Ronde near spawning habitat. Spawning usually occurs in August and September. Eggs incubate in the gravel through the winter and fry emerge from the gravel between March and May. Spring/summer chinook juveniles typically rear in the waters of the Grande Ronde basin for one year before migrating to the ocean as smolts in March through May. Adult spring/summer chinook salmon return to spawn at ages 3 to 6 years with 4 year olds being the predominate age class. Chinook salmon juveniles are known to rear in small streams where spawning does not take place but the tributaries of the analysis area do not provide habitat for rearing Chinook salmon.

Adult Snake River steelhead trout typically leave the ocean as three to six year olds and begin their upriver migration in June of each year passing Bonneville by July. The steelhead trout spawning in the Grande Ronde subbasin enter the Grande Ronde in two distinct migrations, one peak in September and the other in March and April. Adults arriving in September hold in the Grande Ronde through the winter. Spawning activity is from March through May with the peak spawning activity occurring throughout the subbasin in late April and May. Eggs are in the gravel from 1 to 2 months, depending on water temperature with fry emergence from May to June. Juvenile steelhead typically rear in their natal streams for up to 2 years before beginning their downstream migration to the ocean with high spring flows in March through May. Snake River steelhead trout spawn and rear throughout the Phillips-Gordon analysis area.

Aquatic Habitat Conditions

The Phillips-Gordon analysis area is drained by four small tributaries of the Grande Ronde River; Cabin Creek, Gordon Creek, Phillips Creek, and Willow Creek. All four streams support populations of rearing juvenile Snake River steelhead trout (Figure 4-1, Map Appendix). National Forest land is found in the headwaters of each tributary with private land lower in the subwatershed. The analysis area is approximately 64 percent private land.

Cabin Creek, subwatershed 07A has an estimated 9.7 miles of Snake River steelhead trout spawning and rearing habitat, all of which is found on private land. North Fork Cabin Creek has resident redband trout habitat from the Forest boundary at river mile 3.0 to approximately 4.0. All occupied fish habitat in South Fork Cabin Creek is below the National Forest boundary. Oregon State Game Commission records from a June 1971 physical and biological stream survey describe evidence of steelhead spawning with good spawning and rearing habitat present. The occupied steelhead habitat averaged 10 to 15 feet wide with 10 percent pool habitat with the deepest pools 2 to 3 feet deep. The survey continued past the National Forest boundary documenting the extent of steelhead habitat and resident redband trout habitat.

Gordon Creek subwatershed 07B has an estimated 9.5 miles of Snake River steelhead spawning and rearing habitat. The National Forest boundary is at river mile 8.0. Records from the Oregon State Game Commission physical and biological stream survey completed in August 1969 describe a small stream with an intact riparian plant community and evidence of human impacts. During these low flow conditions the stream was approximately 5 feet wide and less than 1foot deep, 97 percent riffle with very shallow pools with an average depth of 15 inches. Beaver activity was noted in many sections of stream. A road paralleled the stream with several stream crossings from River Mile 1 to 8. Many small water diversions were noted as well as impacts from logging activity. Recorded hand held water temperatures were very warm, 76°F to 79°F in the late afternoon. Snake River steelhead habitat extends one mile above the Forest boundary. The occupied steelhead and redband trout habitat on the Forest is typically 3 to 4 feet wide and less than one foot deep with few pools all of which were shallow. Stream banks were well vegetated with brush providing good fish hiding cover.

Phillips Creek subwatersheds 84A, 84C, and 84E have an estimated 14.1 miles of Snake River steelhead spawning and rearing habitat. Little Phillips Creek, subwatershed 84B has an estimated 7.8 miles of Snake River steelhead trout spawning and rearing habitat and subwatershed 84B containing East Phillips and Pedro Creeks has an estimated 5.6 miles of Snake River steelhead trout spawning and rearing habitat. Stream inventory of Phillips Creek began at the confluence with Little Phillips Creek and continued upstream to the Forest boundary for 2.8. Dry channel during low flow conditions is one of the most limiting factors for fish production. From its headwaters to the junction with East Phillips, the 4.1-mile reach of Phillips Creek is 61 percent dry channel during summer low flow. The 3.9- mile reach between East Phillips Creek and the Forest boundary is 31 percent dry channel. Dry channel is rare below the Forest boundary. Marginal steelhead trout habitat is found in Phillips Creek in current condition. Fish habitat improvement opportunity would be long-term floodplain and upland vegetation recovery to improve summer low flow fish habitat, and wood placement where woody debris is deficit.

East Phillips Creek is very important fish habitat under current conditions. Rainbow/steelhead trout are found throughout the entire 6.2-mile length of this small spring fed tributary. The East Phillips floodplain has an abundance of pool habitat and large woody debris creating high quality fish habitat. A road that formerly ran along the creek was recently obliterated, further enhancing habitat quality. East Phillips Creek also provides over half the flow of Phillips Creek at their confluence.

Pedro Creek is a tributary of East Phillips Creek and provides an estimated 10 percent of East Phillips Creek flow at their confluence. Rainbow/steelhead were found throughout the 2.7-mile survey. Average stream channel gradient was 8.8 percent, which is relatively steep for fish habitat. However, the abundant large wood has helped create many small pools providing valuable fish habitat. Pedro Creek, though small in size is an important fisheries resource.

Little Phillips Creek runs parallel to Oregon Highway 204. The highway occupies most of the floodplain forcing the creek to the toe of either slope at the edges of the narrow “V” shaped valley floor. Two tunnels were constructed for the stream in sections where the highway occupies the entire floodplain. The highway is also plowed and sanded during the winter with plowed snow and sand frequently finding its way to the creek. Little Phillips has a low abundance of pool habitat and large woody debris. The creek is occupied by rainbow/steelhead trout throughout its entire length at low density due to poor habitat quality. There is little opportunity for aquatic habitat restoration on Little Phillips Creek since the floodplain has been dedicated to Oregon Highway 204.

Dry Creek is primarily a dry channel during summer low flow conditions. The floodplain has been constricted by road construction and impacted by past timber harvest. Streambank instability is a greater problem in Dry Creek then other streams in the analysis area. Canopy cover is an average 20 percent which is low and large woody debris is scarce. Rainbow/steelhead are found in the few pools that provide summer survival habitat. Dry Creek does flow during late winter and spring each year and historically was steelhead trout habitat. Under current conditions Dry Creek is marginal steelhead trout habitat for approximately one mile above the Forest boundary.

Analysis of Stream Inventory Data

Stream inventory using the USDA Forest Service Region 6 stream inventory methods (version 7.5, 1994, and version 2.0, 2000) were used to conduct a “Level II” stream inventory on Phillips Creek and its tributaries during summer low flow in 1994 and Dry Creek in 1992 and 2000. The Level II inventory is used to generate baseline information that is valuable in identifying factors limiting the productive capabilities of habitats and help in setting habitat objectives. The inventory was not completed on the majority of habitat below the Forest boundary. Inventories were not completed on Gordon, Cabin, or Willow Creeks. Oregon Game Commission inventories from the 1960's was used to characterize those stream habitats.

Pool Frequency

Pool frequency is a common measure of salmonid fish habitat quality. The PACFISH pool frequency objective for these streams is a range of 96 to 84 pools per mile. Only Pedro Creek and East Phillips Creek meet the PACFISH objective (Figure 4-2). These two streams have the most intact and least developed floodplains with occupied fish habitat on the National Forest portion of the assessment area. Phillips Creek has a highly modified floodplain. Forest Service Road 3738 parallels Phillips Creek for the entire length of the survey area with five road crossings. Pool forming structures were installed in reaches 2 and 3 of Phillips Creek to provide summer survival habitat for juvenile steelhead trout and resident redband trout. The low pool frequency of the 4 reaches of Little Phillips Creek is a result of stream channelization to accommodate State Highway 204. Reach 1 of Dry Creek is a dry channel during summer low flow. Reach 2 is an intermittent stream with isolated pools. Even with perennial flow, Dry Creek would still have a low pool frequency.

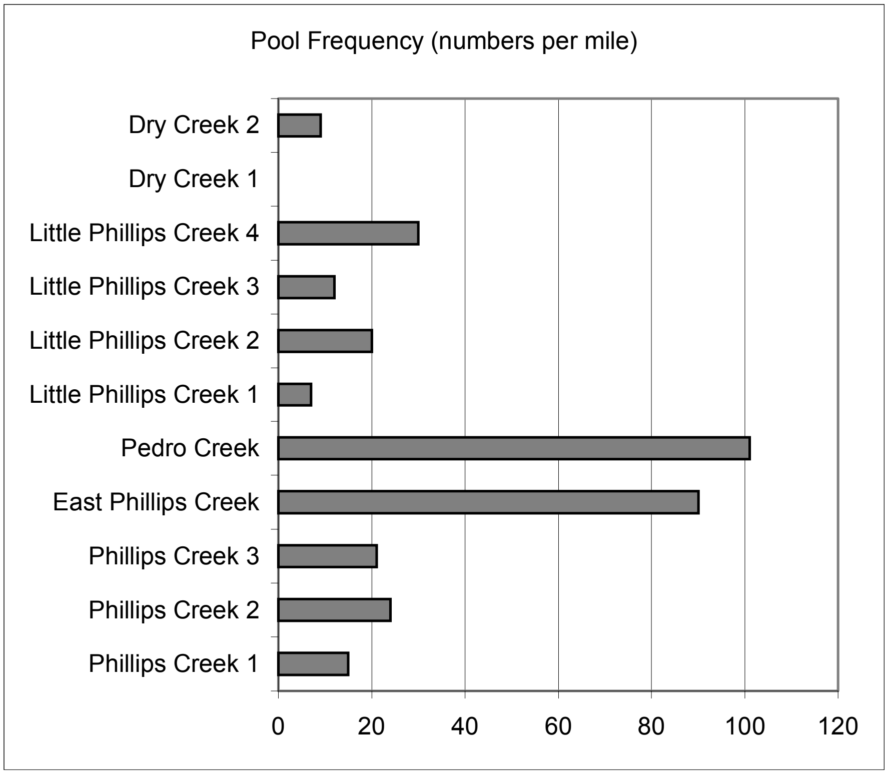

Figure 4-2. Pool Frequency for selected streams and reaches in the Phillips-Gordon analysis area.

Large Wood Frequency

The PACFISH large woody debris objective for streams east of the Cascades in Oregon is a minimum of 20 pieces of large wood per mile greater than 12 inches in diameter and over 35 feet in length. Pedro Creek and East Phillips, which have the least modified floodplains, also have the greatest amount of large wood found in the stream channel (Figure 4-3). Phillips Creek reaches 2 and 3 have over 20 pieces of large wood per mile. The pool forming structures have added large wood to the stream helping to meet the objective. Little Phillips Creek is far below the objective of 20 pieces of wood per mile with little opportunity to improve fish habitat complexity with the stream located adjacent to Highway 204. Dry Creek also has very low levels of large wood. Pedro Creek and East Phillips Creeks give examples of large wood levels when access to the floodplain for wood removal is difficult. The low levels of large wood in the streams of the analysis area are probably due to a long history of easy access for firewood cutters and past floodplain logging. Current condition clearly shows low amounts of in-channel large woody debris throughout the analysis area. In particular, Reach 1 of Phillips Creek, which was recently acquired by the Umatilla NF as part of a land exchange, is an area that has been heavily logged and has extremely low amounts of woody debris.

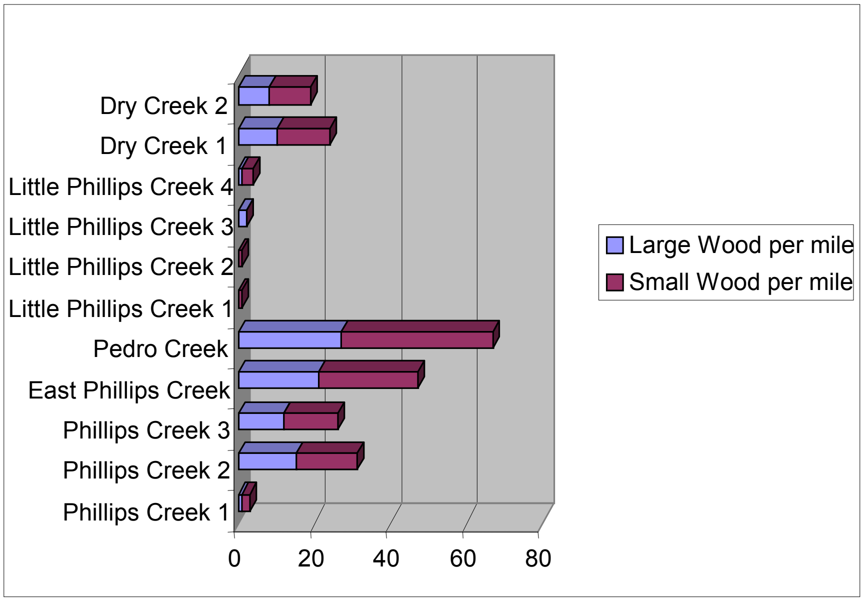

Figure 4-3. Large wood frequency for selected streams and reaches in the Phillips-Gordon analysis area.

Water Temperature

There is very little water temperature data collected from the analysis area. Handheld water temperatures taken during stream inventory during summer low flow conditions show a range of temperatures from 76˚F to 54˚F. High summer water temperatures are known to be a limiting factor for salmonid fish in the analysis area. Current condition can be considered warmer than the management objective of 64˚F during summer low flow conditions. Any management activity that will increase stream surface shade and stream flow would help decrease water temperatures.

Stream Channel Roughness

Embeddedness and dominant substrate are measures of stream channel roughness that can be useful in characterizing the current condition of juvenile fish hiding cover and stream channel conditions for aquatic insect production. Average cobble embeddedness is a measure of proportion of rock buried in the stream bottom. A high amount of fine sediment in transport will typically bury cobble. The cobble embeddedness measured in the analysis area ranged from 18 percent embedded to 39 percent embedded. This is typical of streams that are not dominated by fine sediment transport. Small fish and insects can easily find hiding places between the cobble of the streambed. Cobble and gravel was reported as the dominate and subdominate substrate type for all but one surveyed stream reach. Reach one of Little Phillips Creek had sand reported as the subdominate substrate type probably due to sand used on Highway 204 for tire traction during the winter. The current condition for streams in the analysis area is a low amount of fine sediment in transport with the exception of Highway sand entering Little Phillips Creek.

Fish Passage Barriers

Twenty-four culvert sites were surveyed in August and September 2000 to assess fish passage capabilities. Five sites were open bottom arches or sunken pipes with natural stream bottom that allow fish passage at all flows. One culvert had been removed as part of road obliteration. The highest priority for fish passage improvement would be one culvert on Pedro Creek Road 3734-060, and one culvert in the headwaters of Phillips Creek Road 3738. Two culverts on Little Phillips Creek and two culverts on Dry Creek are partial migration barriers for salmonids but are a moderate priority due to poor upstream fish habitat quality. The culvert at Pedro Creek and Road 3734-070 is considered moderate priority due to limited upstream fish habitat. The culvert at Phillips Creek and Road 3738-060 has log step pools to improve fish passage. Fish passage could be improved during spring flows with a structure that does not restrict bankfull flows. This site is also moderate priority for fish passage improvement.

CURRENT AND REFERENCE CONDITIONS FOR UPLAND FOREST VEGETATION

Overview

This section describes the current upland forest vegetation in the Phillips and Gordon watersheds and compares it to reference conditions. The comparison of current and reference conditions assesses changes in upland forest vegetation by analyzing the following forest ecosystem elements: cover types, size classes, structural class, canopy layers, and density classes. Reference conditions were based on data from several historical sources. Unless otherwise noted, acreage figures and percentages referred to in this section are exclusive of non-National Forest System lands.

Comparison of 1936, 1958, and Current Forest Vegetation

Comparisons were made between current vegetation and conditions as reported in 1936 and 1958 for the above mentioned forest ecosystem elements. Current vegetation conditions were derived from the Umatilla National Forest existing vegetation (EVG) database (Umatilla National Forest, GIS Data Dictionary, 1999). This database contains both photo interpreted and field-recorded stand exam information. The former were based on interpretation of aerial photography acquired in 1987 and 1988. The latter data from stand exams were collected between 1986-1998. Thus the data represents a composite view within the decade. It is heretofore referred to as the "current" vegetation. The 1936 and 1958 data were obtained from mapping completed by the Pacific Northwest Forest and Range Experiment Station in 1958 and 1936 (Powell 1999). The 1958 type maps were somewhat more detailed than the 1936 mapping. Direct comparison of these maps and current vegetation was made difficult by differences in the classification methodology and the coarser level of detail for the historical maps. Additionally, the historic maps account for all the National Forest System land within the analysis area, including approximately 5,300 acres administered by the Wallowa-Whitman National Forest. Current vegetation conditions include only Umatilla National Forest acreage. For these reasons, comparisons are made with some level of uncertainty.

Non-Forest Land Area

About 9 percent of the analysis area currently supports nonforest vegetation, compared to 4 percent in 1936 and 11 percent in 1958. Most of the current nonforest vegetation is grassland. Dry meadows and bunchgrass communities (dominated by fescues and bluebunch wheatgrass) are common grassland types. Shrublands comprise a relatively small proportion of the nonforest vegetation, although a diverse mix of shrub types is present. Often, the nonforest vegetation occurs in a matrix of forest and grassland referred to as a grass-tree mosaic (GTM). In general, GTM consists of forested stringers alternating with nonforest communities (grasslands and shrublands). This condition, characterized by "stringers" of trees in draws alternating with nonforest communities on the exposed slopes, is perpetuated through edaphic or physiographic conditions (such as shallow soils of steep, southerly exposures) and fire.

Forest Cover Types

Tree species occur in either pure or mixed stands called forest cover types. Cover types are classified using existing tree composition and are based on a predominance of stocking. They are named for the dominant or plurality species.

Current Condition

Table 5-1 summarizes the area of existing forest cover types for the Phillips-Gordon analysis area. The predominant forest cover type is grand fir (43 percent of upland forests in the analysis area have grand fir as the plurality or majority species), followed by Douglas-fir (21 percent) and ponderosa pine (14 percent), and western larch (5 percent). Forests with a plurality or majority of subalpine fir, lodgepole pine or Englemann spruce are uncommon, each of them occupies 2 percent or less of the analysis area. Existing forest cover types are illustrated in Figure 5-1, Map Appendix.

Table 5-1. Existing forest cover types of the Phillips-Gordon analysis area.

Code	Forest Cover Type Description	Acres	Percent
CA	Forest with subalpine fir as the majority species	306	<1
Camix	Mixed forest with subalpine fir as the plurality species	631	2
CD	Forest with Douglas-fir as the majority species	3,078	8
Cdmix	Mixed forest with Douglas-fir as the plurality species	4,739	13
CE	Forest with Engelmann spruce as the majority species	702	2
Cemix	Mixed forest with Engelmann spruce as the plurality species	689	2
CL	Forest with lodgepole pine as the majority species	218	<1
Clmix	Mixed forest with lodgepole pine as the plurality species	174	<1
CP	Forest with ponderosa pine as the majority species	2,050	6
Cpmix	Mixed forest with ponderosa pine as the plurality species	2,952	8
CT	Forest with western larch as the majority species	615	2
Ctmix	Mixed forest with western larch as the plurality species	1,246	3
CW	Forest with grand fir as the majority species	10,126	28
Cwmix	Mixed forest with grand fir as the plurality species	5,562	15
Other	Non-forested cover types (grass and shrub); administrative sites	3,315	9

Reference Condition

Vegetation conditions as they existed in 1900 (Gannett 1902) are summarized in Table 5-2. It is not possible to make direct comparisons between the 1900 and later maps because of differences in their resolution and due to widely divergent map legends. Another factor is that historical forest type maps often contain inherent biases related to the commercial value of certain species. The 1900 map (Figure 5-2, Map Appendix) shows that 60 percent of the Phillips-Gordon analysis area consisted of moderate density forest. Low and high density forest comprised 10 and 12 percent of the area, respectively. Burnt, timber less, and woodland types comprised 18 percent of the area.

Table 5-2. Vegetation conditions in the Phillips-Gordon analysis area as of 1900, all ownerships.

Map Attribute	Inferred Vegetation Conditions	Area (Acres)	Percent
Timber less	Nonforest areas dominated by grasses or shrubs	16,314	14%
Woodland	Widely scattered ponderosa pine (savannah forest)	1,018	1%
0–5 MBF/Acre	Low-density forest of pure or mixed composition	11,394	10%
5–10 MBF/Acre	Moderate-density forest of pure or mixed composition	67,765	60%
10–25 MBF/Acre	High-density forest of pure or mixed composition	13,277	12%
Burnt	Areas burned by wildfire	2,844	3%

Additional historical forest cover type data is available for 1936 and 1958. The 1936 map (Figure 5-3, Map Appendix) shows that the predominant forest cover type in 1936 was grand fir (40 percent of the forested portion of the analysis area), followed by ponderosa pine (25 percent) and a mixed composition (22 percent). In 1958, the predominant forest type was grand fir (39 percent of the classified forested area), followed by ponderosa pine (19 percent), Douglas-fir (17 percent), and western larch (5 percent). Table 5-3 shows the 1936 and 1958 historical cover types as compared to the current conditions.

Table 5-3. Changes over time in vegetative cover types and percent cover type for National Forest lands in the analysis area (Powell 2000).

Code	Dominant Vegetation	1999		1958		1936	
		Acres	%*	Acres	%*	Acres	%*
CA	Subalpine fir	937	3	849	2	550	1
CD	Douglas-fir	7,817	21	6,907	17	482	1
CE	Englemann spruce	1,391	4	485	1	--	--
CL	Lodgepole pine	392	1	966	2	784	2
CP	Ponderosa pine	5,002	14	7,366	19	9,876	25
CT	Western larch	1,861	5	2,375	6	1,448	4
CW	Grand fir	15,688	43	15,289	39	16,076	40
MIX	Mixed conifer	--	--	--	--	9,082	22
NF	Non-forest	3,315	9	4,488	11	1,480	4
BU	Burned area	--	--	--	--	73	<1
	Unclassified	--	--	1,320	3	185	<1
	Total Forested Land	36,403		40,045		40,036	

* = percent of TOTAL land

Comparison

Forest composition has been relatively stable in the analysis area over the last 65 years (Table 5-3). The predominant forest cover type has been grand fir; comprising between 39 and 43 percent of the area during that time span. In 1936 and 1958, ponderosa pine was the second most common cover type, comprising 25 and 19 percent of the analysis area, respectively. At the present time, only 14 percent of the analysis area has a plurality or majority of ponderosa pine. Douglas-fir cover types comprised 17 percent of the analysis area in 1958 and 21 percent currently.

Recent bioregional assessments have concluded that dry-forest areas have vegetation conditions that are out-of-balance when compared with the historical (presettlement) situation (Caraher and others 1992, Hessburg and others 1999, Lehmkuhl and others 1994, Quigley and Arbelbide 1997). Further analysis of forest cover types corroborates that finding and suggests that too many dry-forest sites in the analysis area currently support grand fir or Douglas-fir forest. In the presettlement era, it is believed that dry forests would have supported 72-90 percent ponderosa pine, 8-14 percent Douglas-fir, and 1-5 percent grand fir (Morgan and Parsons 2000). Currently, dry-forest sites support 22 percent ponderosa pine, 49 percent Douglas-fir, and 24 percent grand fir.

Forest Size Classes

The diameter (size) distribution of trees is a key element in the structure and biological diversity of a forest stand. Historically, forest size classes were defined using economically important criteria that emphasized wood product or utilization standards (small sawtimber, large sawtimber, etc.). Size class definitions recently evolved to incorporate a biological approach based on tree size or physiological maturity. The Phillips-Gordon analysis used size class definitions that reflect tree size (note that size class was based on tree diameter rather than tree height).

Current Condition

Table 5-4 summarizes the existing forest size classes for the Phillips and Gordon watersheds. It shows that the predominant overstory size class is a mixture of small and medium trees (42 percent of the forested portion of the analysis area), followed by small trees ranging from 9 to 15 inches in diameter (15 percent), small trees ranging from 15 to 21 inches in diameter (12 percent), and poles and small trees mixed (12 percent). Forest overstories dominated by medium or large trees (those with diameters of 21 inches or more), or seedlings and saplings (trees less than 5 inches in diameter) are uncommon; each of those size classes occupies 2 percent or less of the forested portion of the Phillips-Gordon analysis area. Forest size classes are shown in Figure 5-4, Map Appendix.

Reference Condition

Table 5-4 summarizes the historical forest size classes for the Phillips and Gordon watersheds. It shows that the predominant overstory size class in 1936 was a mixture of small and medium trees ranging from 9 to 32 inches in diameter (52 percent of the classified portion of the analysis area), followed by medium trees ranging from 21 to 32 inches in diameter; 25 percent) and then a mix of saplings and poles ranging from 1 to 9 inches in diameter (14 percent). In 1958, the predominant size class was a mix of medium and large trees ranging from 21 to 48 inches in diameter (55 percent of the classified area), followed by small trees ranging from 15 to 21 inches in diameter (25 percent).

Table 5-4. Existing and historical forest size classes of the Phillips-Gordon analysis area.

Code	Size Class Description	1999		1958		1936	
		Acres	%	Acres	%	Acres	%
1	Seedlings, < 1 inch in diameter	254	<1	--	--	--	--
2	Seedlings and saplings mixed	323	1	93	<1	396	1
3	Saplings, 1 to 4.9 inches in diameter	679	2	--	--	--	--
4	Saplings and poles mixed	275	<1	--	--	5,709	14
5	Poles, 5 to 8.9 inches in diameter	574	2	--	--	--	--
6	Poles and small trees mixed	4,181	12	1,959	5	388	1
6.5	Small trees, 9 to 14.9 inches in diameter	4,980	15	--	--	--	--
7	Small trees, 9 to 20.9 inches in diameter	3,278	10	--	--	--	--
7.5	Small trees, 15 to 20.9 inches in diameter	3,884	12	10,049	25	301	1
8	Small and medium trees mixed	13,715	42	--	--	21,007	52
9	Medium trees, 21 to 31.9 inches in diameter	762	2	--	--	9,947	25
10	Medium and large trees mixed	120	<1	22,137	55	--	--
12	Large and giant trees mixed	62	<1	--	--	--	--
--	Unclassified and non-forest cover types	--		5,807	15	2,288	6
	Total Forested Land	33,087		40,045		40,036	

Sources/Notes: Summarized from the ExistPG, 1936veg, and 1958veg databases (Powell 2000). Acreage figures include NFS lands only. Forest size classes are based on the predominant situation and are seldom pure – the pole size class (5) has a predominance of pole-sized trees (50% or more) but may also contain minor amounts of other size classes. For multi-layered stands, this information pertains to the overstory layer only.

Comparison

As was the case with forest cover types, the group of intermediate and overstory size classes has been relatively stable over the last 65 years (Tables 5-4). The overall mix of small (9 inches or greater) to large trees in 1999 was 82 percent, as compared to 80 percent in 1958 and 78 percent in 1936. However, there has been a shift toward fewer large trees. The small to medium size classes (codes 1 to 8) were 53 percent of the total in 1936, increasing to 79 percent in 1999. Conversely, the medium and large tree classes (codes 9 to 12) decreased from 25 percent in 1936 to only 3 percent in 1999. This trend is in part the result of forest disturbance processes, including fire (and the associated fire suppression) and timber harvest.

Another implication of the trend in size classes is that there is less area dominated by very small trees now than there was historically. In 1936, forests dominated by seedlings, saplings, or poles comprised about 16 percent of the classified portion of the analysis area; currently, only 4 percent of the Phillips-Gordon analysis area supports those same size classes.

This reduction in the small size classes is probably due to a variety of factors, including differences in resolution between the historical and current data sources (the historical map was compiled using ground reconnaissance; the current map is a product of stand exams and photo-interpretation data); plant succession (immature forest in 1936 is now mature forest 65 years later); and disturbance processes (the 1936 map may have depicted young, regenerating forests resulting from wildfires or early timber harvests).

Forest Structural Classes

As a forest matures, it experiences successive and predictable changes in its structure. It may begin as a young, single-layer forest, but does not stay in that stage forever and eventually occupies other stages as part of a normal maturation (successional) process. In recent classification systems, structural entities have been referred to as "classes" rather than "stages" because it is not always appropriate to assume a sequential progression from one entity to another (O'Hara and others 1996).

One of the first efforts to classify forest development in the Interior Northwest was Thomas's (1979) system for forest stands in the Blue Mountains of northeastern Oregon and southeastern Washington. His stages characterized the sequential development of stands following clearcutting and, barring additional disturbance, involved a six-step progression: seedlings and saplings, saplings and poles, poles, small sawtimber, large sawtimber, and old growth.

Since publication of Thomas's classification, other structural approaches have been developed. Recently, a series of four process-based development stages was published by Oliver and Larson (1996). Although Oliver and Larson's classification works well for the geographical area in which it was developed (coniferous forests located west of the Cascade Mountains in Oregon and Washington), certain forest conditions in the Interior Northwest do not fit their four-stage approach. Consequently, their system was expanded to seven classes to include a wider spectrum of structural variation (O'Hara and others 1996). The Phillips-Gordon analysis used the 7-class system described in O'Hara and others.

Current Conditions

Table 5-5 summarizes the area of forest structural classes for the Phillips and Gordon watersheds. They show that the predominant structural stage is stem exclusion open canopy (25 percent of the analysis area), followed by young forest multi strata (23 percent), old forest multi strata (18 percent), and stand initiation (13 percent). Old forest single stratum, understory reinitiation, and stem exclusion closed canopy are relatively uncommon structural classes, each of them occupies less than 10 percent of the analysis area. Figure 5-5, Map Appendix, shows current forest structural classes in the Phillips-Gordon analysis area.

Table 5-5. Existing and historical forest structural classes of the Phillips-Gordon analysis area.

Code	Forest Structural Class Description	1999		1958		1936	
		Acres	%	Acres	%	Acres	%
OFMS	Old Forest Multi Strata	5,898	18	17,754	44	21,623	54
OFSS	Old Forest Single Stratum	2,657	8	5,584	14	9,465	24
SECC	Stem Exclusion Closed Canopy	1,334	4	1,726	4	5,140	13
SEOC	Stem Exclusion Open Canopy	8,264	25	233	1	562	1
SI	Stand Initiation	4,378	13	93	<1	864	2
UR	Understory Reinitiation	2,893	9	5,870	15	416	1
YFMS	Young Forest Multi Strata	7,663	23	2,978	7	301	1
NF	Non-forest Cover Types	--	--	4,488	11	1,480	3
Unknown	Unclassified	--	--	1,320	3	185	<1
	Total	33,087		40,046		40,036	

Forest Structural classes are described in Powell 2000.

Reference Conditions

Table 5-5 also summarizes the historical forest structural classes for the Phillips and Gordon watersheds. It shows that the predominant structural class in 1936 was old forest multi strata (54 percent of the classified, forested area), followed by old forest single stratum (24 percent) and stem exclusion closed canopy (13 percent). The other four structural classes were uncommon, each of them occupied two percent or less of the forested portion of the analysis area. In 1958, the predominant structural class was old forest multi strata (46 percent of the classified, forested area), followed by understory reinitiation (15 percent) and old forest single stratum (14 percent). Figure 5-6, Map Appendix, shows forest structural classes for the Phillips and Gordon watersheds as of 1936.

Comparison

A comparison of historical and current structural classes shows that the analysis area was dominated by old forest classes in 1936, with very little of any other class except stem exclusion (Table 5-5). By 1958, old forest was still predominant although other classes were better represented than in 1936, as evidenced by increases in understory reinitiation and young forest multi strata. Regenerating forest (stand initiation, 13 percent) is more prevalent now than it was historically.

The implications of this trend in structural classes is that old forest structures are less common now than they were historically; that regenerating forest (stand initiation) is more prevalent now than it was historically; and that mid-seral structural classes (understory reinitiation, stem exclusion, and young forest multi strata) are more abundant now than they were historically.

To understand the implications of current conditions, it is often helpful to put them in an historical context. A technique was recently developed to help put current conditions in their historical context, the historical range of variability (HRV). A key premise of HRV is that native species are adapted to, and have evolved with, the prevailing disturbance regime of an area. For that reason, ecosystem elements occurring within their historical range are believed to represent resilient and healthy situations (Morgan and others 1994, Swanson and others 1994). Managers often consider HRV to be an indicator of ecological sustainability.

Although HRV can be applied to a wide variety of ecosystem elements, it was decided to apply it to structural classes. Structural classes are inclusive, that is any particular point on a forest's developmental pathway can be assigned to a structural class. They are also universal. Every forest eventually passes through a series of structural classes, although not every stand occupies every class or spends an equal amount of time in any particular class. For those reasons, inclusiveness and universality, structural classes provide a valuable framework for comparing current and reference conditions.

An HRV analysis was completed for the Phillips-Gordon analysis area. It was based on two primary factors, forest structural classes and potential vegetation (as represented by PAGs). Results of the HRV analysis are provided in Table 5-6. It summarizes the current percentage of each structural class, by plant association group. The historical ranges for each of the structural classes are also shown.

The HRV results show that the young forest multi strata and stem exclusion closed canopy structural classes are below their historical ranges for three plant association groups (PAGs), and that the old forest single stratum and stem exclusion open canopy structural classes are above their historical ranges for five or four PAGs, respectively. Note that HRV was not interpreted for the cool very moist or hot dry PAGs due to their limited acreage within the analysis area.

Table 5-6. Historical range of variability (HRV) analysis for forest structural classes.

		Forest Structural Classes							
PAG		SI	SEOC	SECC	UR	YFMS	OFMS	OFSS	NFS Acres
CW	H%	1-10	0-5	1-10	5-25	20-50	30-60	0-5	1,372
	C%	6	3	1	7	47	28	8	
CVM	H%	1-10	0-5	5-20	5-25	20-60	20-40	0-5	51*
	C%	0	100	0	0	0	0	0	
CD	H%	1-20	0-5	5-20	5-25	10-40	10-40	0-5	721
	C%	11	25	3	1	14	19	29	
CM	H%	1-10	0-5	5-25	5-25	40-60	10-30	0-5	16,722
	C%	12	17	2	11	34	15	9	
WVM	H%	1-15	0-5	5-20	5-20	20-50	20-40	0-5	2,070
	C%	5	0	0	17	8	44	26	
WM	H%	1-15	0-5	5-20	5-20	20-50	10-30	0-5	2,160
	C%	21	26	0	4	12	26	12	
WD	H%	5-15	5-20	1-10	1-10	5-25	5-20	15-55	9,692
	C%	17	46	10	5	8	14	0	
HD	H%	5-15	5-20	0-5	0-5	5-10	5-15	20-70	298*
	C%	18	47	34	0	0	0	0	

Sources/Notes: Summarized from the ExistPG database (Powell 2000). Upland forest plant association groups (PAG) are described in Powell (1998). Historical percentages (H%) were derived from Hall (1993), Johnson (1993), and USDA Forest Service (1995a), as summarized in Blackwood (1998). Current percentages (C%) were based on NFS lands (Umatilla NF only). Structural class codes are described in Powell 2000. Gray cells show instances where the current percentage (C%) is above the historical percentage (H%) for a structural class. Black cells show instances where the current percentage is below the historical percentage. Since an HRV analysis is somewhat imprecise, deviations (whether above or below the H% range) were only noted when the current percentage differed from the historical range by 2 percent or more.

* Note that deviations from the historical range (either above or below) were not shown for the cool very moist and hot dry PAGs due to their limited area within the Phillips-Gordon analysis area.

Forest Canopy Layers

The vertical arrangement of tree canopy has an important influence on resource issues and values. For example, multi-layered stands with “old-growth” characteristics (e.g., a predominance of grand fir trees, high canopy closure, and an absence of logging evidence) are highly valued by pileated woodpeckers in the Blue Mountains (Bull and Holthausen 1993). Open, single-layered structures may have limited value for water quality, but high desirability for water yields (O’Hara and Oliver 1992).

Current Conditions

Table 5-7 summarizes the existing forest canopy layers for the Phillips and Gordon watersheds. They show that the predominant situation is a highly-complex layer structure (three or more layers; 50 percent of the forested portion of the analysis area), followed by a two-layer stand structure (41 percent of the forested area) and single-layer forest (9 percent).

Table 5-7. Existing and historical forest canopy layers of forest stands in the Phillips-Gordon analysis area.

Code	Forest Canopy Layer Description	1999		1936	
		Acres	%	Acres	%
1	Live canopy (crown) cover of trees occurs in l layer (stratum)	3,168	9	5,050	13
2	Live canopy cover of trees occurs in 2 layers or strata	13,557	41	474	1
3	Live canopy cover of trees occurs in 3 or more layers or strata	16,362	50	--	--
Unknown	Unclassified and non-forest cover types	--	--	34,512	86

Acreages include NFS lands only. No data available for 1958.

Reference Conditions

Table 5-7 summarizes the historical forest canopy layers for the Phillips-Gordon analysis area. It shows that the predominant situation in 1936 was an even-aged, single-layer condition (91 percent of the classified area), followed by an uneven-aged, multi-layer situation (9 percent). Note that most of the watershed area in 1936 was unclassified for this analysis indicator. Unfortunately the 1958 forest type map did not provide any information for the canopy layer analysis indicator.

Comparison

A comparison of current and reference conditions with respect to forest canopy layers (Table 5-7) shows that the analysis area was dominated historically by single-layer forest, whereas the modern forest tends to have two or more layers. This comparison is very misleading, however, because a very high proportion of the Phillips and Gordon watersheds (86 percent) was not rated for this analysis indicator in 1936, and the 1958 forest type map did not provide canopy layer information.

Further analysis of forest canopy layers shows that 85 percent of dry-forest sites in the analysis area currently have a multi-layered structure. This situation is inconsistent with the historical situation because it is believed that dry forests had a very high percentage of single-layer structure in the presettlement era, with perhaps as much as 70 percent of the ponderosa pine forest occurring as that structure (see OFSS historical range for the “hot dry” plant association group in Table 5-5).

Forest Density

Approximately half of the National Forest lands within the Phillips-Gordon analysis area has been examined using stand examinations. Stand exams provide quantified data suitable for characterizing stand density (trees per acre or basal area per acre) but they do not provide estimates of canopy (crown) cover. The other half of the analysis area was characterized using photo-interpretation surveys that provide canopy cover information but no estimates of basal area or trees per acre.

Current Condition

Table 5-8 summarizes the existing forest density classes for the Phillips and Gordon watersheds. It shows that the predominant situation is high-density forest (37 percent of the forested portion of the analysis area), followed by low density (35 percent of the forested area) and moderate density (28 percent of the forested area). Figure 5-7, Map Appendix, shows forest density classes in the Phillips-Gordon analysis area.

Table 5-8. Existing and historical forest density classes of the Phillips-Gordon analysis area.

		1999		1958		1936	
Code	Forest Density Class Description	Acres	%	Acres	%	Acres	%
Low	Live canopy cover, 10-40%	11,648	35	1,578	4	973	3
Moderate	Live canopy cover, 41-70%	9,189	28	2,756	7	445	1
High	Live canopy cover, > 70%	12,249	37	12,177	30	4,844	12
Unknown	Unclassified and non-forest	--	--	23,535	59	33,775	84
	Total	33,086		40,046		40,037	

Reference Condition

Table 5-8 summarizes the historical forest density classes for the Phillips and Gordon watersheds. It shows that the predominant situation in 1936 was high-density forest (77 percent of the classified portion of the analysis area), followed by low density (16 percent of the classified area) and moderate density (7 percent). In 1958, the predominant density class was high (74 percent of the classified area), followed by moderate (17 percent) and low (10 percent).

Comparison

A comparison of current and reference conditions (Table 5-8) indicates that the percentage of high-density forest may have declined substantially over the last 65 years. However, such a comparison is misleading because a very high proportion of the analysis area was not rated for this analysis indicator in both 1936 (84 percent) and 1958 (59 percent). If it is assumed that much of the non-rated portion of the analysis area consisted of an open forest (low-density) condition, then the current proportion of high-density forest (37 percent) would be as great as, if not greater than, it was historically.

Recently-developed stocking guidelines (Cochran and others 1994, Powell 1999) were used to analyze existing forest density levels to infer whether they are ecologically sustainable. By using the stocking guidelines in conjunction with potential vegetation (plant association groups), it was possible to determine the acres that would be considered overstocked (Table 5-9). Overstocked forests have density levels in the "self thinning" zone where trees aggressively compete with each other for moisture, sunlight, and nutrients. Forests in the self-thinning zone experience mortality as crowded trees die from competition or from insects or diseases that attack trees under stress (Powell 1999).

Table 5-9. Forest density analysis for the Phillips-Gordon analysis area.

	Area (NFS Acres) by Canopy Cover					Total	Over-
PAG	10-29%	30-45%	46-65%	66-80%	>80%	Acres	Stocked
CW	0	98	455	230	**589**	1,372	589
CVM	0	0	51	0	**0**	51	0
CD	171	129	147	**116**	**157**	720	273
CM	2,054	2,706	3,765	**2,860**	**5,336**	16,721	8,196
WVM	38	65	104	**250**	**1,614**	2,071	1,864
WM	676	301	430	**325**	**428**	2,160	753
WD	5,149	1,445	**1,434**	**1,360**	**304**	9,692	3,098
HD	196	**10**	**56**	**36**	**0**	298	102
Total	8,284	4,754	6,442	5,177	8,428	33,085	14,875

Sources/Notes: A forest density analysis was based on five categories of canopy cover and the upland-forest PAGs. The black cells indicate the National Forest System acreage that is presently overstocked if the objective is to maintain healthy forests with a component of early-seral species.

Timber Harvest. Some level of timber harvest has occurred since the Blue Mountains were settled by Euro-American emigrants. The first commercial logging in the pine region of eastern Oregon and Washington began around 1890 (Weidman 1936), although limited harvesting occurred during the preceding 25 years to meet the needs of miners and early settlers. Some of the first roads reaching into the Blue Mountains were wagon roads for hauling wood and rails out to farms and ranches.

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 those necessities (Robbins 1997, Tucker 1940).

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 fabricate shipping boxes for apples and other agricultural products (Bolsinger and Berger 1975, Gedney 1963, Robbins 1997).

Timber harvest has had a widespread impact on vegetation conditions in the analysis area. Harvest levels increased sharply beginning in the 1950s, and continued at high levels for most of a 40-year period. In the early 1990s, as concerns over water quality, fisheries, wildlife habitat and other resources began to surface, harvest levels on the National Forest lands in eastern Oregon and eastern Washington declined by 72 percent (O'Laughlin and others 1998). That trend is clearly reflected in the timber harvest history for the Umatilla National Forest (Figure 5-8)

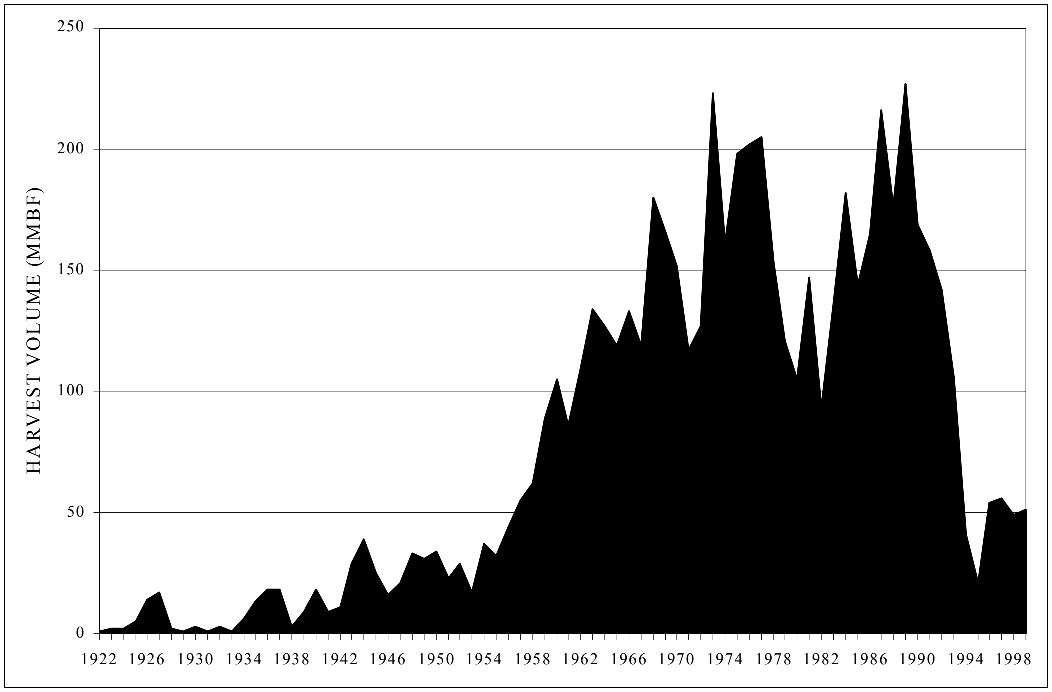

Figure 5-8. Timber harvest history for the Umatilla National Forest, 1922-1999

Assessment of Forest Sustainability

A protocol was recently established for evaluating forest sustainability at a national or international scale, including a set of criteria and indicators (Montreal Process 1995). In an effort to develop an assessment protocol that could be used at smaller scales, a landscape-level methodology was recently developed (Amaranthus 1997). It was based on four criteria originally proposed in 1994 (Kolb and others 1994). The four criteria, and an assessment of how the Phillips-Gordon analysis area rates with respect to each of them, are provided below.

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

Over most of the Phillips and Gordon watersheds, 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 forests of the Phillips-Gordon analysis area are probably in a sustainable condition when evaluated using this criterion.

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

A significant threat of stand-replacing disturbance exists within the Phillips and Gordon watersheds that could dramatically alter plant and animal structure and composition. This threat is a direct result of an altered disturbance regime 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 two to five fire cycles, contributing to unnaturally high fuel accumulations. Under the recent fire regime (suppression), the influence of fire as an ecological process has been markedly reduced, resulting in more homogenous landscape patterns with fewer vegetation types (particularly early-seral stages), larger patches at lower patch densities, and less total edge than would have been produced by the historical fire regime. Outbreaks of defoliators and other landscape-scale insects, and propagation of active or independent crown fire, can be expected in response to this increased level of homogeneity. Based on this second criterion, forests of the Phillips-Gordon analysis area are probably not in a sustainable condition.

A functional equilibrium between supply and demand of essential resources.

Forty-five percent of the Phillips-Gordon analysis area has tree density levels that threaten future sustainability of upland forests. Nutrient cycling and the availability of water and growing space is undoubtedly impaired on these overstocked sites. In addition, these dense stands represent high susceptibility to crown fire. The primary factor controlling crown fire behavior is crown bulk density (the volume of tree crowns or canopy available for fire consumption), and crown bulk density is directly dependent upon species composition and stand density. Dense stands are not only more likely to initiate crown fire behavior, but also to sustain an active (running) crown fire once it begins. Based on this criterion, forests of the Phillips-Gordon analysis area may be sustainable, but only marginally.

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

The Phillips and Gordon watersheds support a relatively well-balanced distribution of seral stages and stand structures (as indicated by the historical range of variability analysis for forest structural classes). Historical forest management practices, however, have resulted in substantial changes in the spatial pattern of vegetation diversity and complexity, particularly on dry-forest sites where over-crowded, multi-strata forests were a rare phenomenon before the onset of anthropogenic fire suppression. These changes have resulted in forests at risk 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 significant (“catastrophic”) change goes up dramatically. Based on this fourth criterion, forests of the Phillips-Gordon analysis area are marginally sustainable right now but if recent trends in forest density and fire suppression continue unabated into the future, it is likely that forest sustainability will not be maintained over the long term.

CURRENT AND REFERENCE CONDITIONS FOR FOREST DISTURBANCE AGENTS

Fire Regimes and Risks

There are 13 Fire Behavior fuel models, grouped into four major categories: grass, shrub, timber, and slash (Anderson 1982). Each model yields flame length and rate-of-spread information for the purpose of fire behavior prediction and fire planning. The models described in this section exist in the project area and are displayed by acreage and percentage of occurrence for the analysis area (Table 6-1).

The fuel model and representative stand descriptions are intended to help clarify current ground fuel situations with the visual aid of the landscape fuel model maps of the analysis area (Figure 6-1, Map Appendix). The fuel model maps display the dominant model identified in the stands; it is important to note that every stand has secondary models with variable occurrence percentages.

Fuel Model 1: Fire carries through fine herbaceous fuels that are cured or nearly cured. Very little shrubs or timber present. Grassland, savanna, and stubble are commonly modeled.

Fuel Model 2: Fuel is primarily fine herbaceous fuels, curing or dead. Litter and stem wood from open shrub or timber overstory contribute. Open shrublands or pine stands are most commonly modeled.

Fuel Model 5: Fuels consist mostly of litter cast by shrubs and forbs in the understory. Green stands of deciduous shrubs are most commonly modeled.

Fuel Model 8: Closed canopy stands of short-needle conifers or hardwoods that have leafed out support fire in the compact litter layer. This layer is mainly needles, leaves, and occasionally twigs (as little undergrowth is present). Representative conifer types are white pine, lodgepole pine, spruce, fir, and larch.

Fuel Model 9: Describes fires that run through surface litter faster than model 8 and have longer flame heights. Both long-needle conifer stands and hardwood stands are typical. Closed stands of long-needled pine like ponderosa pine are usually modeled.

Fuel Model 10: Fire burns in the surface and ground fuels with greater fire intensity than other timber litter models. Dead-down fuels include greater quantities of 3-inch or larger limbwood resulting from overmaturity or natural events that create a large load of dead material on the forest floor. Crowning out, spotting, and torching of individual trees are more frequent, leading to potential control difficulties. Any forest type may be considered if heavy down material is present. Examples are insect or disease ridden stands, windthrown stands, overmature situations with dead fall, and aged light thinning or partial-cut slash.

Table 6-1. Acres by fuel model, Phillips-Gordon analysis area.

Fuel Model	Acres	Percent
1	3,312	9%
2	7,497	21%
5	2,705	7%
8	15,595	43%
9	802	2%
10	5,775	16%

Current Condition Class

Current condition is defined in terms of departure from historic fire regime. It equates to the number of missed fire returns with respect to the historical interval and severity. The combination of the fire frequency and severity were used to create the Historical Fire Regime Map (Figure 6-2, Map Appendix).

Three condition classes were developed (Hardy 1996) to categorize the existing condition with respect to each of the five fire regimes. The risk of loss due to fire increases for each respectively higher condition class.

Each condition class is described through the use of five ecosystem attributes: 1) disturbance regime; 2) effects of disturbance agents; 3) potential production of smoke emissions; 4) hydrologic function; and 5) vegetative composition, structure and resilience.

Table 6-2. Condition classes of the Phillips-Gordon analysis area.

Condition Class	Acres	Percent
I	11,957	33%
II	18,187	50%
III	6,260	17%

Condition Class 1 (Figure 6-3, Map Appendix)
Disturbance Regime – the historical regime is largely intact and functioning naturally.

Disturbance Agents – The effects of insects and disease as well as severity potentials are within historical ranges, but are increasing with the length of the fire return interval.

Smoke Production – Smoke production is relatively frequent, but low in volume and short in duration.

Hydrological Function – The hydrological functions are within normal historical ranges.

Composition, Structure, Resilience – Vegetative composition and structure are resilient to disturbance from wind, insects, disease, or fire and are not predisposed to high risk of loss.

Condition Class 2 (Figure 6-4, Map Appendix)
Disturbance Regime – There has been moderate alteration to the historical disturbance regime. The effects of one or more missed fire intervals is clearly evident.

Disturbance Agents – The effect of insects and as well as fire severity potentials has increased the threat to key components of the system.

Smoke Production – Smoke production has increased in volume and duration and has increased the potential for adverse health effects and degradation of visibility values.

Hydrological Function – Hydrological functions, including riparian zones, show signs of adverse departures from historical conditions.

Composition, Structure, Resilience – Vegetation has shifted toward conditions that are less resilient and more prone to loss from wind, insects, disease, and fire.

Condition Class 3 (Figure 6-5 Map Appendix)

Disturbance Regime – The disturbance regime has been significantly altered and historical disturbance has been precluded.

Disturbance Agents – The effects of insects, disease, or fire may result in significant or complete loss of key ecosystem components.

Smoke Production – Episodic smoke production is possible, resulting in high volumes and long durations. This has the potential to pose significant threats to human health and social values.

Hydrological Function – Hydrological functions may be significantly altered, with dramatic increases in sedimentation potential and decreases in streamflows.

Composition, Structure, Resilience – Significant alteration of vegetative composition and structure predispose the ecosystem to disturbance well outside the range of historical variability. There is a potential to change the system to an unmeasured condition.

Defoliating Insects

Reference Conditions

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. The Phillips-Gordon analysis area has experienced two budworm outbreaks during the last 50 years. Early in the first outbreak (1944-1958), most of the budworm-host type in the analysis area was defoliated to some degree. In response to the defoliation and its resultant tree damage (top-killing and mortality), all of the Phillips-Gordon analysis area was sprayed in either 1950 or 1952 to reduce budworm populations to non-damaging levels (Dolph 1980). DDT, a chemical insecticide applied in a fuel oil diluent, was applied during those spray projects.

Table 6-3. Area (acres) of insect caused forest damage in the Phillips-Gordon analysis areas, 1980-1999.

Year	Mixed-Conifer Beetles	Pine Beetles	Western Spruce Budworm	Other	Total	Percent of Area
1980	267	789	—	—	1,057	2.6
1981	224	49	—	—	273	0.7
1982	98	—	31	—	129	0.3
1983	48	96	—	—	145	0.4
1984	120	—	—	—	120	0.3
1985	38	—	4,397	—	4,435	11.1
1986	—	—	33,664	—	33,664	84.1
1987	—	—	39,498	—	39,498	98.6
1988	4,500	—	19,219	—	23,720	59.2
1989	2,916	47	8,395	—	11,358	28.4
1990	2,280	9	16,708	—	18,996	47.4
1991	156	—	34,093	—	34,249	85.5
1992	91	—	34,996	51	35,139	87.7
1993	32	1	—	—	33	0.1
1994	167	—	—	33	200	0.5
1995	253	—	—	13	265	0.7
1996	10	—	—	—	10	0.0
1997	637	22	—	—	659	1.6
1998	5	5	—	—	10	0.0
1999	107	—	—	100	207	0.5

After the earlier outbreak collapsed in 1958, western spruce budworm remained at endemic levels until 1980, when another outbreak began in mixed-conifer stands near Cove, Oregon. The 1980-1992 outbreak moved from south to north in the Blue Mountains; the Phillips and Gordon watersheds did not experience substantial defoliation until 1986, although it then continued until 1992 (Table 6-3). Portions of the 1980s budworm outbreak were treated with a bacterial insecticide called B.t. *(Bacillus thuringiensis)* in 1988 and 1992 (Figure 6-6, Map Appendix). As was the case for the 1950s DDT treatments, application of B.t. during the recent outbreak successfully reduced budworm populations in the short term, but had little long-term impact on the outbreak itself or on host-tree damage (Powell 1994, Torgersen and others 1995).

Douglas-fir tussock moth defoliates true firs and Douglas-firs from the top down, killing trees outright or setting them up for future attack by bark beetles such as Douglas-fir beetle or fir engraver. Like budworm, Douglas-fir tussock moth is a native component of coniferous ecosystems and it has been active in the Phillips-Gordon analysis area for as long as a food supply has been available there. The last major tussock moth outbreak occurred between 1972 and 1974, when mixed-conifer stands throughout the analysis area were defoliated. This 1970s outbreak in the Interior Northwest was the largest and most severe one ever recorded (Brookes and Campbell 1978). In 1974, stands north of Mount Emily and west of Summerville (adjacent to the southwest corner of the analysis area) were treated with DDT to minimize defoliation-related damage, although tussock moth outbreaks have a short lifespan and tend to collapse on their own after about 3 years. One small area of private land in the Gordon Creek drainage (subwatershed 7B) was also treated with DDT (Graham and others 1975).

Historically, budworm and tussock moth outbreaks were smaller in extent than the most recent outbreaks because the insect food base (particularly mixed-conifer stands dominated by grand fir and Douglas-fir) was less in the past. (Hessburg and others 1994, 1999).

Current Conditions

Table 6-4 shows that high risk (susceptibility) is present for western spruce budworm and that the analysis area has moderate to high risk for Douglas-fir tussock moth and Douglas-fir beetle infestation. Spruce beetle has low to moderate risk. All other insect or disease agents (Douglas-fir dwarf mistletoe, mountain pine beetle in lodgepole pine, mountain pine beetle in ponderosa pine, mixed conifer root diseases, and white pine blister rust) were rated low for the Phillips-Gordon analysis area.

It is interesting that Douglas-fir tussock moth susceptibility was rated as moderate to high. Each spring, pheromone traps are placed in mixed-conifer stands throughout the Umatilla National Forest as an early-warning system for Douglas-fir tussock moth. Beginning in 1998, this early-warning system indicated that the northern Blue Mountains were facing an imminent outbreak. An outbreak actually began in the spring of 2000 and 39,392 acres on the Pine, Pomeroy, and Walla Walla Ranger Districts were sprayed with TM-BioControl, a natural virus affecting tussock moth only, during June and July of 2000 to minimize tussock-moth damage in specific areas of concern (old-growth stands, bull-trout habitat, etc.). It is anticipated that tussock moth defoliation will continue for several more years before subsiding.

Table 6-4. Insect and disease risk ratings for the Phillips-Gordon analysis area.

Insect or Disease	Risk Rating	Cabin-Gordon	Phillips-Willow
Douglas-fir Beetle	Low	65%	47%
	Moderate	14%	24%
	High	21%	29%
Douglas-fir Dwarf Mistletoe	Low	96%	96%
	Moderate	0%	4%
	High	4%	0%
Mountain Pine Beetle (Lodgepole Pine)	Low	93%	100%
	Moderate	4%	0%
	High	3%	0%
Mountain Pine Beetle (Ponderosa Pine)	Low	93%	99%
	Moderate	0%	0%
	High	7%	1%
Mixed Conifer Root Diseases	Low	89%	93%
	Moderate	0%	0%
	High	11%	7%
Spruce Beetle	Low	61%	78%
	Moderate	32%	22%
	High	7%	0%

Insect or Disease	Risk Rating	Cabin-Gordon	Phillips-Willow
Western Spruce Budworm	Low	32%	7%
	Moderate	7%	0%
	High	61%	93%
Douglas-fir Tussock Moth	Low	39%	16%
	Moderate	39%	51%
	High	22%	33%
White Pine Blister Rust	Low	100%	100%
	Moderate	0%	0%
	High	0%	0%

Sources/Notes: Calculations based on Current Vegetation Survey inventory plots located within the Phillips/Gordon analysis area (Ager 2000).

CURRENT AND REFERENCE CONDITIONS FOR NON-CONIFEROUS BOTANICAL RESOURCES

Overview

Species encounter lists compiled as part of the sensitive plant surveys conducted within the Phillips-Gordon analysis area indicates that 698 plant taxa inhabit the area. This represents 63 percent of the plant taxa currently found on the Walla Walla Ranger District, 66 percent of all plant taxa currently identified on Umatilla National Forest lands, and approximately 16 percent of Oregon's flora. Historical data are insufficient to compare current and past floristic diversity of the Phillip-Gordon analysis area. However, like elsewhere, the colonization by introduced species makes it likely that the analysis area likely supports more plant taxa today than it did in pre-settlement times. Floristic composition is 87 percent native and 13 percent non-native to North America. Introduced taxa come from all corners of the globe and appeared with the new-world settlement.

Table 7-1. Numbers of species by life form and origin (native or introduced)

Life-form	Taxa	Native	Introduced
Forbs	497	435	62
Grasses	73	46	27
Grass-likes	43	43	0
Shrubs	69	68	1
Trees	16	16	0
Total	698	608	90

The 698 taxa present within the Phillip-Gordon watersheds were assigned a habitat affinity value for each of the ecological settings they inhabit. Habitat affinity values were obtained from sensitive plant surveys dating back to 1982. Ecological settings in this analysis represent an aggregation of similar plant association groups. Five life form categories (Table 7-1) were used to aggregate taxa within ecological settings: 1) Forbs, herbaceous plants, usually broad-leaved; 2) grasses; 3) grass-likes, sedges, rushes; 4) shrubs, and; 5) trees. The following eight ecological settings were used in this analysis: 1) ponderosa pine forest; 2) warm dry forest; 3) cool moist forest; 4) lodgepole pine forest; 5) cold dry forest; 6) steppe (grass-steppe and shrub-steppe); 7) riparian (riverine and lacustrine); and 8) meadow.

Numeric assignments of 0, 1, 2, or 3 were made for each species occurrence in each of the eight ecological settings. Numeric assignments were based on species affinity lists recorded during sensitive plant surveys. Using this method, taxa receiving a value of 3 in a given ecological setting exhibit a high affinity for that setting. Taxa with a value 3 are always to be found in that setting. A value of 2 indicates a moderate affinity for that setting and implies that the taxa are usually to be found. A value of 1 indicates a low affinity for that setting and implies that the taxa may be found. A value of 0 indicates that the habitats occurring within the ecological setting are unsuitable for particular plant taxa.

The floristic biodiversity database also generates affinity, amplitude, and abundance values for each taxon encountered within the analysis area. Affinity values represent not only relative abundance but signify which ecological setting(s) a species occupies. Amplitude is the sum of ecological settings occupied by any given taxa. It provides a measure of an individual's ecological distribution. A value of 1 signifies narrow amplitude, the taxa occurring in just 1 of 8 settings. A value of 8 indicates wide amplitude, and occurs in all 8 settings. Abundance is simply the sum of each species individual abundance (1, 2, or 3) for each of the 8 ecological settings. Values range from a low abundance of 1 to a high abundance of 16.

Due to the manner in which field data has been collected, it was necessary to aggregate sub-watersheds for analyzing floristic diversity. Unsurveyed portions of the Phillips-Gordon watersheds and varying methods of data collection prohibited comparisons between sub-watersheds. Approximately 75 percent of the analysis area has been surveyed for sensitive plant species. The majority of unsurveyed areas lie within a narrow, twisting segment of steep canyon country between the Grande Ronde River and the Umatilla's forested uplands.

Floristic Diversity

Table 7-2 characterizes the floristic composition and distribution of the Phillips-Gordon analysis area. The table's focus is on the eight ecological settings, and five life form categories to provide a broad-scale botanical representation of the analysis area. Within each of the 8 ecological settings, ratios of native to introduced and total taxa are represented. Distributions of native and introduced taxa by life form indicate trends in floristic composition.

Introduced grasses in the eight ecological settings average 47 percent of all grass taxa. Introduced forbs account for 17 percent of all forb taxa. With one exception, the shrub *Artemisia vulgaris*, 99 percent of the introduced or non-native taxa are from within these two life forms.

A notable feature of the floristic composition and distribution of the Phillips-Gordon watersheds are the number of taxa that exhibit habitat affinities in all eight of the Ecological Settings used in this analysis. Forty-one taxa occur in all 8 Ecological Settings. Native taxa account for 49 percent, non-native taxa account for 51 percent. Abundance values average 13 for the native component and 11 for the non-native. The aggressive physiology evident in the majority of non-native taxa provides a competitive advantage over native taxa. The non-native component consists of seven noxious and/or "weedy" taxa, recognized as such in both Oregon and/or Washington. Thirteen taxa are "legacy" or "old school" conservation/restoration cultivars, intentionally broadcast to provide soil stabilization and forage enhancement. Common practice for over a century, these species have seen extensive distribution throughout the entire Umatilla National Forest, and on adjacent lands. In the present, these species represent a significant ecological dilemma. While 20 out of 608 native taxa occur in all eight settings, 21 out of 90 non-native taxa occur, and with abundance values nearly as great. This is an indication of the true potential non-natives can exhibit within an ecosystem. These "legacy" species include legumes *Medicago lupulina* (Black Medic), *Trifolium hybridum* (Alsike Clover), *T. pratense* (Red Clover), *T. repens* (White Clover), and grasses, *Agropyron intermedium* (Pubescent Wheatgrass), *Agrostis alba* (Redtop), *Alopecurus pratensis* (Meadow Foxtail), *Arrhenatherum elatius* (Tall Oatgrass), *Bromus inermis* (Smooth Brome), *Dactylus glomerata* (Orchard Grass), *Phleum* *pratense* (Common Timothy), *Poa compressa* (Canada Bluegrass), and *Poa pratensis* (Kentucky Bluegrass).

Table 7-2. Broad scale floristic composition and distribution in the Phillips-Gordon analysis area by Ecological Settings

	Forbs		Grasses		Grass-likes		Shrubs		Trees	
Life-Form	Native	Introd.	Native	Introd	Native	Introd	Native	Introd	Native	Introd
Ecological Setting										
Ponderosa Pine 256/61 ∑ = 317	190	39	21	22	9	0	28	0	8	0
Warm, Dry 274/65 ∑ = 339	204	43	21	22	9	0	30	0	10	0
Cool, Moist 250/52 ∑ =302	177	38	13	14	8	0	40	0	11	0
Lodgepole Pine 182/46 ∑ =228	119	32	16	14	6	0	32	0	9	0
Cold, Dry 237/44 ∑ =281	169	31	18	13	8	0	32	0	10	0
Steppe 328/79 ∑ =407	246	54	32	24	19	0	26	1	5	0
Riparian 392/61 ∑ =453	262	41	22	20	39	0	52	0	16	0
Meadow 186/43 ∑ =229	113	28	19	15	29	0	17	0	7	0

Ratio of Native/Introduced Taxa. Sum of (∑) Taxa Within Ecological Settings

Non-native species appear to continue expanding into all plant associations. Non-native (excluding listed as noxious) species can be expected to persist, increasing in both composition and distribution throughout the Forest. Factors promoting these increases are; 1) current existing distribution, and density throughout the Forest, both vegetative and seed, 2) competitive and establishment advantages over native taxa, 3) depleted forested and non-forested ecological conditions, often below recovery thresholds, 4) loss of localized native seed sources, 5) pre-existing populations and continued use on adjacent lands.

Table 7-3 compares floristic similarities between the eight ecological settings used in this analysis. Selecting 1 of 8 ecological settings within the matrix along the x and y-axis allows floristic comparisons of ecological settings. The x and y intersection indicates the coefficient of similarity unique to that combination. The coefficient of similarity is the combination of taxa in common and the percent of floristic similarity shared between two ecological settings. Number of taxa within each ecological setting is represented in the shaded diagonal row.

Floristic similarity is highest (81%) between the ponderosa pine (PP) setting (317 taxa), and the warm dry (WD) setting (339 taxa), with 294 taxa in common. The riparian/riverine (RV) setting has the greatest diversity with 453 taxa total, 65 percent of the flora in the watershed. As expected, the greatest dissimilarity is between the forested settings and the meadow (MDW) setting with floristic similarity 25 percent or less. The second greatest dissimilarity is between the cooler, moister sites of the cool moist (CM), lodge-pole pine (LLP), and cold dry (CD) ecological settings and that of the warmer, dryer steppe (ST) setting.

Table 7-3. Floristic similarities across ecological settings, Phillips-Gordon analysis area

Ecological Setting	PP	WD	CM	LPP	CD	ST	RV	MDW	Coefficient of Similarity	% of Analysis Area Flora
PP	317	294	185	181	189	229	209	100	Taxa in Common	45%
		81%	43%	50%	46%	46%	37%	22%	% Floristic Similarity	
WD		339	221	195	209	215	237	110	Taxa in Common	49%
			53%	52%	51%	40%	43%	24%	% Floristic Similarity	
CM			302	188	215	126	255	106	Taxa in Common	43%
				55%	58%	22%	51%	25%	% Floristic Similarity	
LPP				228	197	135	181	88	Taxa in Common	33%
					63%	27%	36%	24%	% Floristic Similarity	
CD					281	154	215	95	Taxa in Common	40%
						29%	41%	23%	% Floristic Similarity	
ST						407	188	124	Taxa in Common	58%
							28%	24%	% Floristic Similarity	
RV							453	188	Taxa in Common	65%
								38%	% Floristic Similarity	
MDW								229	Number of Taxa per Ecological Setting	33%

(PP)-Ponderosa Pine Ecological Setting, (WD)-Warm, Dry Ecological Setting, (CM)-Cool, Moist Ecological Setting, (LPP)-Lodge-Pole Pine Ecological Setting, (CD)-Cold, Dry Ecological Setting, (ST)-Steppe Ecological Setting, both grass and shrub steppe, (RV)-Riparian Ecological Setting, both riverine and lacustrine, (MDW)-Meadow Ecological Setting

Due in part to the disruption of the Blue Mountains historic fire regime, plant communities have been greatly altered. Fire, historically a major defining force within the ecosystem, is today conspicuously absent. A floristic "migration" is in evidence as the thresh hold of maximum historical range of variability is approached and in instances surpassed. A landscape level ecological restructuring of floristic composition and distribution is subtly occurring. The absence of a naturally occurring fire regime, the introduction of non-native species, increased herbivory and resource based management practices are creating new and largely undefined ecological complexes. The outcome of these floristic shifts is unclear.

As current ecological conditions within the Phillips-Gordon watersheds further diverge from historic levels, assessing and prioritizing species at risk becomes a crucial tool in future land management decisions. Preventing the listing of additional species is key. Physical factors such as temperature, moisture, and fire regime combine with biological factors such as herbivory, competitive ability, and shade tolerance, to create unique ecological profiles, a "portrait" of each species. Each species has a range of habitat(s) in can successfully occupy.

Taxa at risk are taxa with narrow, and specific physical and biological requirements. They are considered to have narrow ecological amplitude and frequently occupy only one ecological setting. These taxa are most susceptible to loss of viability, population decline and have higher potential for extirpation. Loss of native plant species, fragmentation of plant communities, and the potential for partial loss of ecosystem function are all possible without careful long-term planning.

In this analysis, 125 native taxa were determined to be at risk (Table 7-4). Non-native taxa were not considered in this analysis. Analysis criteria examined taxa with low amplitude, those occurring in only one ecological setting, (affinity value of 1), and low abundance (1, 2, or 3). Occurrences of culturally significant and historically sensitive species are identified in Table 8-4 as well. Five taxa meet the analysis criteria for taxa at high risk, (affinity of 1, abundance of 1), 7 for moderate risk, (affinity of 1, abundance of 2) and 111 for low risk (affinity of 1, abundance of 3).

Five taxa occurring in the high and moderate risk categories are former Region 6 sensitive plant species. Although delisted, they remain uncommon. The majority of low risk taxa generally occur on multiple districts. Although well distributed and relatively abundant, these 111 taxa have been documented in only one ecological setting and are therefore considered at risk. All taxa at risk are especially sensitive to noxious weeds and invasive introduced species, over utilization by native and domestic ungulates, fire periodicity well outside the range of historic variability, natural resource extraction, and agronomics. The Steppe (shrub and grass) ecological setting supported the largest number of taxa at risk with 71 taxa or 57 percent. The riparian ecological setting supported 43 taxa or 34 percent of all taxa at risk. These two settings support 91 percent of all taxa at risk within the Phillips-Gordon watersheds. A list of species that that could be developed as part of the Forest's restoration strategy has been developed and can be used to select species to diversify and increase native species suitable for restoration purposes (Riley 2000).

Analysis of species encounter lists compiled as part of sensitive plant surveys in the Phillips-Gordon watersheds indicate that 20 plant species with either current Region 6 sensitive status or historic status occur within or immediately adjacent to the analysis area (Table 7-5). Of these 20 species, only 3 are presently listed as sensitive. Three species of *Botrychium* occur, *B. lanceolatum*, (lance-leaf grapefern) *B. minganense*, (Mingan grapefern) and *B. pinnatum* (pinnate grapefern*),* are currently listed as sensitive within the analysis area.

As part of the analysis process, the potential for finding additional R6 sensitive plant species within the analysis area was examined (Table 7-6). Species are ranked based on: 1) habitat requirement parameters, 2) proximity to known occurrences of sensitive plants, and 3) the potential of unsurveyed habitats to support sensitive plant species. The location column represents current documented populations.

Table 7-4. At-Risk native species defined as having low ecological amplitude (value = 1) and low abundance (value ≤ 3)[3]

Risk Assessment	Life Form	Scientific Name	Common Name	PIPO	Warm, Dry	Cool, Moist	PICO	Cold, Dry	Steppe	Riparian	Meadow
High	G-L	Juncus brachyphyllus	Short-leaved Rush	0	0	0	0	0	0	**1**	0
High	G-L	Juncus confusus	Colorado Rush	0	0	0	0	0	**1**	0	0
High	S	Ribes oxyacanthoides cognatum[1]	Umatilla Gooseberry	0	0	0	0	0	0	**1**	0
High	S	Symphoricarpos mollis hesperius	Creeping snowberry	0	0	**1**	0	0	0	0	0
High	S	Viburnum edule[2]	High-Bush Cranberry	0	0	0	0	0	0	1	0
Moderate	F	Antennaria corymbosa	Meadow Pussytoes	0	0	0	0	0	2	0	0
Moderate	F	Astragalus whitneyi sonneanus[1]	Balloon Pod Milkvetch	0	0	0	0	0	2	0	0
Moderate	F	Chaenactis douglasii glandulosa[1]	Hoary Chaenactis	0	0	0	0	0	2	0	0
Moderate	F	Cirsium brevifolium[1]	Palouse Thistle	0	0	0	0	0	2	0	0
Moderate	F	Gnaphalium viscosum	Green Cudweed	0	2	0	0	0	0	0	0
Moderate	F	Trifolium longipes reflexum	Longstalk Clover	0	0	0	0	0	0	2	0
Moderate	S	Ribes hudsonianum[1], [2]	Stinking Currant	0	0	0	0	0	0	2	0

[1] Historically Sensitive Species, Delisted [2] Culturally Significant Species. [3] At-Risk Native Species defined as having Low Ecological Amplitude (value = 1) and Low Abundance (value ≤ 3)

Table 7-5. Presently listed and historically listed sensitive plant species in the Phillips-Gordon and adjacent watersheds.

Scientific Name	Common Name	Status	Life Form	Location
Allium madidum	Blue Mountain swamp onion	HSO	F	H; N; P; W
Astragalus whitneyi sonneanus	Balloon pod milkvetch	HSW	F	H; N; P; W
Bolandra oregana	Oregon bolandra	HSO; PSW	F	P; W
Botrychium lanceolatum	Lance-leaf grapefern	PSO; HSW	F	N; W
Botrychium minganense	Mingan grapefern	PSO; HSW	F	N; W
Botrychium pinnatum	Pinnate grapefern	PSO; HSW	F	N; W
Calypso bulbosa	Calypso orchid	HSO	F	H; N; P;W
Chaenactis douglasii glandulosa	Hoary chaenactis	HSW	F	H; N; P; W
Cirsium brevifolium	Palouse thistle	HSW	F	W; P
Cirsium utahense	Utah thistle	HSW	F	H; N; P; W
Corallorhiza trifida	Yellow coral root	HSO	F	H; N; P; W
Cypripedium montanum	Mountain lady slipper	HSO	F	H; N; P; W
Delphinium depauperatum	Slim larkspur/dwarf larkspur	HSW	F	H; N; P; W
Dryopteris filix-mas	Male fern	HSO; HSW	F	P; W
Lupinus polyphyllus burkei	Burke's lupine	HSO	F	H; N; P; W
Lupinus sabinii	Sabin's lupine	HSO; PSW	F	W
Pedicularis bracteosa pachyrhiza	Bracted lousewort	HSO	F	H; N; P; W
Penstemon pennellianus	Penn ell’s penstemon	HSO; HSW	F	N; P; W
Ribes hudsonianum	Stinking currant	HSO	S	H; N; P; W
Ribes oxyacanthoides cognatum	Umatilla gooseberry	HSO; PSW	S	H; N; P; W

Table 7-6. Additional sensitive plant species with high likelihood of growing within the Phillips-Grodon watersheds.

Scientific Name	Common Name	Potential	Life Form	Location
Allium dictuon	Blue Mountain onion	Moderate	F	P
Botrychium ascendens	Upward lobed moonwort	Moderate	F	W-W NF
Botrychium campestre	Iowa moonwort	Moderate	F	W-W NF
Botrychium crenulatum	Crenulated grape-fern	Moderate	F	W-W NF
Botrychium hesperium	Western moonwort	High	F	W-W NF
*Botrychium lineare**	Slender moonwort	Low	F	W-W NF
Botrychium paradoxum	Two-spiked moonwort	Moderate	F	N; W
Botrychium pedunculosum	Stalked moonwort	Moderate	F	W-W NF
Calochortus marcocarpus maculosus	Nez Perce Mariposa Lily	High	F	P
Calochortus nitidus	Broad-fruit mariposa	Low	F	W-W NF
Cypripedium fasciculatum	Clustered lady slipper	High	F	P
Carex backii	Back’s sedge	Mod	G-L	H; P; W
Carex crawfordii	Crawford’s Sedge	Low	G-L	N
Carex hystericina	Porcupine sedge	Low	G-L	P
Carex interior	Inland sedge	Low	G-L	N
Dryopteris filix-mas	Male fern	High	F	P; W
Erigeron disparipilus	Snake river daisy	Moderate	F	P; W
Leptodactylon pungens hazeliae	Prickly phlox	High	S	P
Lycopodium complanatum	Ground cedar	Moderate	F	W-W NF
Mimulus clivicola	Bank monkey-flower	Low	F	W-W NF
Phacelia minutissima	Least phacelia	Low	F	W-W NF
Phlox multiflora	Many flowered phlox	Moderate	F	W-W NF

Scientific Name	Common Name	Potential	Life Form	Location
*Silene spaldingii***	Spalding's silene	Very-Low	F	P
*Spiranthes diluvialis****	Ute ladies'-tresses	Very-Low	F	Okanogan NF
Suksdorfia violacea	Violet Suksdorfia	Moderate	F	W-W NF
Trifolium douglasii	Douglas clover	Low	F	P; N

PSO=Presently Sensitive Oregon; HSO=Historically Sensitive Oregon; PSW=Presently Sensitive Washington; HSW=Historically Sensitive Washington
H=Heppner District; N=North Fork John Day District; P=Pomeroy District; W=Walla-Walla District
F=Forb; G-L=Grass-like; S=Shrub
W-W NF=Wallowa Whitman National Forest
*Currently under review, USFW, for federal listing, **Federal Candidate Species; ***Federally Listed as Threatened

Ecological affinity, amplitude and abundance values for both currently listed sensitive and historically listed sensitive species are displayed in Table 7-7. Affinity values indicate that the riparian/riverine, meadow complex, cool moist and lodge pole pine ecological setting currently support populations of all three current sensitive species. With an amplitude, and abundance value of four, all three *Botrychium* species are at present, secure. This information further defines the ecological conditions that support taxa listed as sensitive as well as the mechanism by which sensitive species are removed or down-graded from both Regional and Federal sensitive plant lists. It also identifies those taxa with low abundance, and amplitude values that may ultimately need the protection that Regional or Federal listing provides. As Table 7-7 illustrates many former sensitive taxa are now considered abundant with broad amplitudes. However, several taxa are still limited in abundance and amplitude, and warrant special consideration to prevent re-listing. Because of the documented affinities for multiple ecological settings and/or forest-wide distribution and relatively high abundance, it is unlikely that proposed management activities will cause upward listing of current sensitive taxa or place formally listed taxa back into sensitive status.

Table 7-7. Ecological affinity, amplitude, and abundance of current and historically listed sensitive plant species within the Phillips-Gordon and adjacent watersheds.

			Species Affinity by Ecological Setting										
Scientific Name	**Common Name**	**Sensitive Status**	**Ponderosa Pine**	**Warm, Dry**	**Cool, Moist**	**Lodge Pole Pine**	**Cold, Dry**	**Grass/Shrub Steppe**	**Riparian/ Riverine**	**Meadow Complex**	**Amplitude**	**Abundance**	**Life Form**
Allium madidum	Blue Mountain Onion	HSO	0	0	0	0	0	1	2	1	3	4	F
Astragalus whitneyi sonneanus	Balloon Pod Milkvetch	HSW	0	0	0	0	0	2	0	0	1	2	F
Bolandra oregana	Oregon Bolandra	HSO; PSW	0	0	0	0	0	1	1	0	2	2	F
Botrychium lanceolatum	Lance-leaf Grapefern	**PSO**; PSW	0	0	1	1	0	0	1	1	4	4	F
Botrychium minganense	Mingan Grapefern	**PSO**; HSW	0	0	1	1	0	0	1	1	4	4	F
Botrychium pinnatum	Pinnate Grapefern	**PSO**; PSW	0	0	1	1	0	0	1	1	4	4	F
Calypso bulbosa	Calypso Orchid	HSO	0	1	2	0	1	0	1	0	4	5	F
Chaenactis douglasii glandulosa	Hoary Chaenactis	HSW	0	0	0	0	0	2	0	0	1	2	F
Cirsium brevifolium	Palouse Thistle	HSW	0	0	0	0	0	2	0	0	1	2	F
Cirsium utahense	Utah Thistle	HSW	2	2	0	0	1	2	0	0	4	7	F
Corallorhiza trifida	Yellow Coral Root	HSO	0	2	2	0	0	0	1	0	3	5	F
Cypripedium montanum	Mountain Lady Slipper	HSO	1	2	2	1	1	0	1	0	6	8	F
Delphinium depauperatum	Slim or Dwarf Larkspur	HSW	1	2	1	0	1	1	2	0	6	8	F
Dryopteris filix-mas	Male Fern	HSO	0	0	1	0	0	0	2	0	2	3	F
Lupinus polyphyllus burkei	Burke's Lupine	HSO	0	0	2	2	2	0	2	0	4	8	F
Lupinus sabinii	Sabin's Lupine	HSO; PSW	1	2	0	0	0	2	2	0	4	8	F
Pedicularis bracteosa pachyrhiza	Bracted Lousewort	HSO	0	1	2	2	1	0	2	0	5	8	F
Penstemon pennellianus	Pennell's Penstemon	HSO; HSW	1	0	0	0	1	2	0	0	3	4	F
Ranunculus populago	Mountain Buttercup	PSW	0	0	0	0	0	0	2	1	2	3	F
Ribes hudsonianum	Stinking Currant	HSO	0	0	0	0	0	0	2	0	1	2	S
Ribes oxyacanthoides cognatum	Umatilla Gooseberry	HSO; PSW	0	0	0	0	0	0	1	0	1	1	S

CURRENT AND REFERENCE CONDITIONS FOR NOXIOUS WEEDS

Overview

This report examines the current status of noxious weed infestations in the Phillips-Gordon analysis area. Priority species and treatment areas are identified, and past and ongoing noxious weed control efforts are summarized. 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 (1999) GIS coverage (fsfiles\ref\library\gis\uma\nw99).

Methods for Assessment

A Forest-wide noxious weed risk assessment was conducted in Spring 2000 to evaluate risk/susceptibility of noxious weed invasion and spread, and to determine priority areas for prevention and control efforts. The risk model was developed by the Wallowa-Whitman National Forest (Erickson 2000) 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 current (1999) noxious weed inventories, transportation layers, grazing allotments, existing vegetation, and potential vegetation groups. The Forest-wide noxious weed risk coverage is located in */fsfiles/gis/noxweeds/nwrisk.*

Current Conditions

Ninety-eight noxious weed sites representing a total of 1,730 acres have been inventoried in the analysis area (Table 7-8, Figure 7-1, Map Appendix). The average size of an infestation is 18 acres, with individual sites ranging from 0.05 to 294 acres. Eight weed species are present, including diffuse and spotted knapweed, Canada and bull thistle, houndstongue, Klamathweed (St. John's wort), tansy ragwort, and flannel mullein. Of greatest concern are the 77 knapweed and 18 tansy ragwort infestations. The other weed species are generally considered to be too common and widespread for effective treatment given current funding and personnel levels. Focal points for the expansion and spread of noxious weeds, particularly spotted and diffuse knapweed, coincide with heavily used transportation corridors such as Oregon State Highway 204, and Forest Roads 3738 (Phillips Creek), 3727-020 (Andie's Ridge), 3727-050, 3725-090, and 3725-100.

Less than half of the currently inventoried sites (n=39, Table 1) 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. Sites not covered in the 1995 EA (yellow polygons, Figure 1, Map Appendix) will require additional analysis and new NEPA decisions before any treatments other than hand-pulling can be implemented.

Prior to 1995, weed control efforts on the Forest and in the analysis area were limited to manual treatments (hand-pulling). Nearly all of the weed sites have been manually treated at least once, with many of the sites receiving 3-5 treatments over the last 8 years since records have been maintained. Chemical control methods were initiated in 1995, and have focused primarily on the diffuse knapweed sites. The majority of the sites have been treated at least twice, with some receiving up to 4-5 applications. Repeated chemical treatments have been highly effective, and many of the weed populations are now contained. Most chemical control work in the analysis area has been accomplished by Union and Umatilla Counties under cooperative agreements between the Forest Service and local Weed Control Districts.

Risk Assessment

Of the 34,815 acres classified for noxious weed risk in the analysis area, approximately 64 percent (21,779 acres) are in the high risk category (Table 7-9). The primary factors contributing to the high overall risk rating are the large amount of suitable habitat for noxious weeds (warm to hot, dry forest with canopy closure of less than 40%) and the relatively large number of existing noxious weed sites (high seed availability). With the exception of subwatershed 84H (Upper Willow Ck.) in the southern portion of the analysis area, the acres at high risk of noxious weed invasion and spread occur fairly uniformly throughout the analysis area (Table 7-9, Figure 7-2, Map Appendix).

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 educational 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 Departments of Agriculture, and other landowners and federal agencies.

Table 7-8. Summary of noxious weed sites (1999 inventory) occurring in the Phillips-Gordon analysis area.

Common Name	Scientific Name	Alpha Code	Total		NEPA Cleared	
			# sites	#acres	# sites	#acres
Diffuse knapweed	*Centaurea diffusa*	CEDI	71	1229	38	777
Spotted knapweed	*Centaurea maculosa*	CEMA	6	791	3	514
Canada thistle	*Cirsium arvense*	CIAR	26	1099	15	596
Bull thistle	*Cirsium vulgare*	CIVU	27	937	16	612
Common houndstongue	*Cynoglossum officinale*	CYOF	10	888	15	596
Klamathweed	*Hypericum perforatum*	HYPE	19	716	14	426
Tansy ragwort	*Senecio jacobaea*	SEJA	18	159	16	151
Flannel mullein	*Verbescum thapsus*	VETH	6	818	2	498
		Total	98	1730	39	778

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 7-9. Acres by noxious weed risk rating for subwatersheds in the Phillips-Gordon analysis area.

Subwatershed	Acres		
	Low	Medium	High
07A		1,270	3,635
07B		1,058	3,003
84B		2,645	2,638
84C		453	2,780
84D		1,629	2,405
84E		715	3,245
84H	1,331	1,112	101
84I		2,823	3,972
Total	1,331	11,705	21,779
Overall Risk Rating: HIGH			

CURRENT AND REFERENCE CONDITIONS FOR TERRESTRIAL VERTEBRATES

Overview

The Phillips-Gordon analysis area provides a mosaic of forested and grassland habitats that support a wide variety of terrestrial vertebrates. Forest habitats range from subalpine fir and Englemann spruce at the highest elevations, to forested stringers of Douglas fir, ponderosa pine, and western larch in the draws and canyon bottoms. North-facing slopes generally support colder, more mesic forest habitats, while south-facing slopes are either grass-covered or support more widely spaced, mixed coniferous forests. In addition to the coniferous forest, other habitats include ridgetop scablands, hardwood-shrub riparian stringers, small meadows, open grassland and agricultural lands.

Most wildlife species that currently occur or have the potential to occur in the watersheds also occurred historically. Some species that naturally occurred at low numbers may have been locally extirpated or now persist at just a few locations. Generalist species such as elk, robins, and raccoons have probably increased.

A total of approximately 173 terrestrial vertebrate species have the potential to occur in the area. This includes 106 birds, 54 mammals, 8 reptiles, and 5 amphibians. Five Forest Plan Management Indicator Species, 2 Federally threatened species, 2 Regional Forester's sensitive species, 15 species listed as sensitive by the State of Oregon, and numerous species of local interest or concern.

Habitat Composition

A previous section of this report described the changes in vegetation between 1936 and present (1999). The data are re-examined in this section in the context of wildlife habitat. Table 8-1 illustrates changes that have occurred in forested habitats over that period. Based on the comparison of estimates of historic and current vegetation, changes in composition of vegetative communities are evident over a 60-year period. These include increases in the Englemann spruce, Douglas-fir, and mixed conifer habitat types, and decreases in the subalpine fir, lodgepole and ponderosa pine, western larch, and grand fir habitat types. The data suggest that the non-forest type, including grasslands and shrubs, has almost tripled in acreage over the last 60 years. Shrub-dominated communities are scarce in most subwatersheds, although shrubs associated with forested stands are common throughout both drainages.

Table 8-1. Vegetative communities occurring in the Phillips-Gordon analysis area for 1936 and 1999*.

Vegetation Type	1936	1999	Trend
Non Forest(Grass/Shrub)	1553	3,315	*UP*
Subalpine fir	550	306	*DOWN*
Douglas-fir	482	3,078	*UP*
Englemann spruce	0	702	*UP*
Lodgepole pine	784	218	*DOWN*
Ponderosa pine	9,876	2,050	*DOWN*
Western Larch	1,448	615	*DOWN*
Grand fir	16,076	10,126	*DOWN*
Mixed Conifer	9,082	16,557	*UP*
Unclassified			

* Umatilla National Forest acres only

Forest Structural Stages and Late/Old Forest Habitat

Of particular concern across the Blue Mountains is the decline in acreage and quality of old forest habitat. Many wildlife species demonstrate a high level of use and dependence on mature and old growth tree habitat. Past harvest and other disturbances has removed much of the suitable old growth tree habitat once found on the Forest. Remaining stands are not well distributed across the landscape.

Historic and Current Conditions

Comparisons of old forest availability between 1936 and 1999 indicate that gross acres of late/old forest habitat have declined substantially across the Phillips-Gordon analysis area, although the severity of decline here is not as great as in some other watersheds across the Forest.

In general, old forest stands in 1936 occurred in large polygons, contained a large amount of interior habitat, were well-connected to like polygons, and occupied more than 50 percent of the two drainages combined (Table 8-2, Figure 8-1, Map Appendix). At present, old forest occurs in small polygons, often supporting no interior habitat. Polygons are widely scattered and rarely connected to other areas of old forest (Table 8-2, Figure 8-2, Map Appendix). While some degree of fragmentation is a natural feature of forests in the Blue Mountains (resulting from fire, insects and/or disease, etc.), today's highly fragmented old forest stands are largely a function of human manipulation; through harvest, roading, and/or the altered plant communities that result from fire exclusion. Currently, old forest stands occupy approximately 8,555 acres, or approximately 26 percent of the forested area within the analysis area (Tables 8-2 and 8-3; Figure 8-2, Map Appendix).

Table 8-2. Changes in old forest polygon size, 1936-1999, Phillips-Gordon analysis area.

	Single Stratum			Multiple Strata		
	1936	1999	Trend	1936	1999	Trend
Total Acres	8,089	2,467	Down	12,461	5,546	Down
Largest Polygon	1,003	124	Down	1,579	340	Down
Mean Polygon Size	111	29	Down	168	35	Down

For wildlife species associated with old forest habitats, current conditions could mean larger home ranges (and thus higher energy expenditures), increased vulnerability to predation, and potentially more difficulty in locating mates. Ultimately, such conditions can result in reduced or low population viability among less-adaptable old forest species. The higher historic levels of late and old structures (LOS) probably supported larger populations of associated species than are present today.

Old forest types that have declined since 1936 include single story ponderosa pine, multi-story grand fir, and "mixed" old forest (Figure 8-1, Map Appendix). There have been minor increases in multi-story Douglas-fir, Englemann spruce and single story grand fir old forests (less than 200 acres in each). These changes can be attributed to harvesting and natural events such as insects, disease, drought, wind-throw, wildfire. Mapping errors and differences in mapping standards may also be responsible for some of the changes observed in the data.

Table 8-3. Available old forest habitat by subwatershed, for 1936 and 1999.*

SWS	Old Forest Structural Stage					
	Multi Stratum			Single Strata		
	1936 Acres	1999 Acres	Trend	1936 Acres	1999 Acres	Trend
07A	3,776	897	Down	1,757	498	Down
07B	1,024	850	Down	512	93	Down
84B	1,117	720	Down	792	335	Down
84C	287	205	Down	1,014	0	Down
84D	383	383	No change	614	497	Down
84E	170	406	Up	590	271	Down
84H	4,462	756	Down	761	457	Down
84I	1,119	1,680	Up	1,694	507	Down
Total Old forest	12,338	5,897	Down	7,734	2,658	Down

* Percent of forested vegetation on NF lands within the subwatershed.

Table 8-4. Changes in acres of old forest habitat, by cover type, between 1936 and 1999.

Old Forest Type	1936 Acres	1999 Acres	Trend
Ponderosa pine single stratum	8090	0	Down
Ponderosa pine multi-strata	0	0	No change
Grand fir single stratum	0	1221	Up
Grand fir multi-strata	7969	3284	Down
Douglas-fir single stratum	0	0	No change
Douglas-fir multi-strata	296	485	Up
Western larch single stratum	0	0	No change
Western larch multi-strata	0	0	No change
Subalpine fir single stratum	0	0	No change
Subalpine fir multi-strata	420	0	Down
Englemann spruce single stratum	0	137	Up
Englemann spruce multi-strata	0	51	Up
"Mix"	3,776	0	Down
TOTAL	20,551	5,178	Down

Management Direction for Old Forest Habitat

The goal of C1 old growth management, as stated in the Umatilla Forest Plan, is to "provide and protect sufficient suitable habitat for wildlife species dependent upon mature and/or overmature forest stands, and to promote a diversity of vegetative conditions for such species." Desired Future Conditions for old growth areas, as described in the Forest Plan, includes areas characterized by "stands of naturally appearing overmature trees", with multiple tree canopies in two or more age classes, and an abundance of standing and down dead wood. Stands having these characteristics are recognized as contributing to forest biodiversity and aesthetic values. Forest Plan direction further specifies that only those management activities that enhance or perpetuate old growth forest habitat conditions be allowed (Umatilla Forest Plan, pg. 5-144). Old Growth Tree habitat is to be managed through dedicated forested units, managed lodgepole stands, riparian areas, and unroaded areas distributed throughout the Forest. Dedicated old Growth units are located in mixed conifer and ponderosa pine types that are mapped as Management Area C1. Lodgepole pine habitat units managed according to the specifications listed in Management Area C2 (there are no C2 units in the analysis area). Forest Plan language indicates protection of existing old growth/mature habitat in Management Areas A1, A2, A7, A8, C3A, C7, C8, D2, F2, and F4 (none of these MAS occur within the analysis area). The size of old growth stands varies by Management Indicator Species:

pileated woodpecker:	300 acres
American (pine) marten:	160 acres
northern three-toed woodpecker:	75 acres

Average spacing for C1 units is every 5 miles across the Forest. At the time of selection, management units did not need to meet old growth/mature conditions; consequently C1 units in Phillips-Gordon are a mosaic of old and young forests. Forest-wide standards for old growth include maintaining habitat within suitable and/or capable conditions for the MIS, maintaining the distribution of units throughout the Forest, and maintaining sufficient amounts for (other) wildlife species. Field verification and tracking of old growth units are required in the Forest Monitoring Plan, but are rarely completed.

The C1 MAS in the Phillips-Gordon area currently includes 1,022 acres, of which 317 acres (31%) are classified as either OFMS or OFSS (Table 8-5; Figures 8-5, 6, 7, Map Appendix). The percentage of old forest within the C1 areas is only slightly higher than that of the total forested acres (26%). C1 areas are located in only three of the nine National Forest subwatersheds, despite the fact that old forest habitat is available in all subwatersheds (Figure 8-5, Map Appendix).

Table 8-5. Current Status of Designated Old Growth (C1) Areas, Watershed.

C1 Area #	Target Species[1]	Total Acres	Acres by Structural Stage								Percentage of Old Forest
			OFMS	OFSS	YEMS	UR	SECC	SEOC	SI	NF	
2552	PWP	366	31	0	170	0	0	81	0	84	8.4%
0801	PWP/AM	355	35	45	11	21	85	41	39	78	22.5%
0795	PWP/AM	301	179	27	32	5	9	44	5	0	68.4%
Network Totals		1,022	245	72	213	26	94	166	44	162	31%

[1] AM=American marten, PWP=pileated woodpecker

In 1993, the Regional Forester's Forest Plan Amendment #8 and the subsequent Amendment #11, in 1995 provided additional direction for management of late and old forest structure (LOS). The changes were based on new information, monitoring results, and public opinion for changes in the location and design of timber sales on the National Forests east of the Cascade Range. These standards and guidelines, know as the "Eastside Screens," use "Historical Range of Variability" (HRV) analysis as the basis for determining the management intensity for each biophysical environment. In general, interim wildlife standards prohibit the harvest of LOS stands when the amount of LOS in the watershed falls below the HRV for that biophysical environment. The overall intent is to maintain or enhance the LOS component in stands as much as possible with emphasis on enhancing LOS by manipulating younger forest stands. Additional direction includes, maintaining connectivity and reducing fragmentation of LOS stands. The intent of these standards is to allow the free movement, interaction of adults, the dispersal of young, and reduce the amount of "edge" in LOS stands. Connective habitat is not intended to be suitable breeding habitat but should allow free movement between suitable breeding areas. LOS stands must be connected at least two different ways and the connection should be as short as possible.

Dead Standing (snags) and Down Wood (logs)

Historical information for dead wood (standing and down) habitats in the Phillips and Gordon watersheds is not available. In general, snags and down logs were probably common in mixed conifer and true fir stands across both watersheds and in recently burned areas, but less common in fire-regulated pine communities. Densities fluctuated with the frequency of natural mortality and the frequency and intensity of large and small-scale disturbances, such as fires, insect and disease, ice storms, and drought.

Analysis of current snag and down wood resources is based on current vegetation survey (CVS) inventories from 1993-1995. The CVS inventory is a permanent plot grid system at 3.4 mile and 1.7 mile intervals that samples vegetative conditions across the National Forest.

A variety of vegetative information including plant association, live trees pre acre, dead trees per acre, diameters and heights for each species, and down wood volume is collected at each plot.

Ninety-five forested points/subplots were used to analyze the dead standing tree (DST) and “green” replacement tree (GRT) component for the watershed (Table 8-7). Dead standing trees were tallied for each 2” diameter increment, then divided by the total number of plots sampled to arrive at an average DST density for each diameter class. Sample plots were stratified by potential vegetation groups (PVG) in the watershed. Age classes were summed to arrive at size class groups for comparison with Forest Plan standards and guides.

Table 8-6. Dead tree (snags) density, in the Phillips-Gordon analysis area.

LMRP, Umatilla NF Guidelines		Phillips-Gordon Analysis Area	
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 Forest	1.9 snags/ac. >10" dbh 4.3 snags/ac. >12" dbh 3.5 snags/ac. >20" dbh 8.7 snags/ac. Total
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 Forest	4.1 snags/ac. >10" dbh 6.9 snags/ac. >12" dbh 3.5 snags/ac. >20" dbh 14.5 snags/ac. Total
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 Forest	2.7 snags/ac. >10" dbh 4.6 snags/ac. >12" dbh 7.3 snags/ac. Total
Subalpine Zone	1.21 snags/ac. >10" dbh 0.59 snags/ac. >12" dbh 1.8 snags/ac. Total		

Table 8-7. “Green” Replacement Tree density, in the Phillips-Gordon Analysis Area.

LMRP, Umatilla NF Guidelines		Phillips-Gordon Analysis Area	
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 Forest	14.8 trees/ac. >10" dbh 21.2 trees/ac. >12" dbh 9.8 trees/ac. >20" dbh 45.8 trees/ac. Total
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 Forest	9.4 trees/ac. >10" dbh 35.6 trees/ac. >12" dbh 16.5 trees/ac. >20" dbh 61.5 trees/ac. Total
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 Forest	12.0 trees/ac. >10" dbh 36.7 trees/ac. >12" dbh 48.7 trees/ac. Total
Subalpine Zone	13.9 trees/ac. >10" dbh 5.3 trees/ac. >12" dbh 19.2 trees/ac. Total		

Dead standing trees were recorded in all size class from 2” to 50” DBH. Density of total DSTs ranged from 7.3 to 49 snags per acre.

In the Dry Forest PVG, DST occurred in all size classes from 2” to the >20” category. Densities ranged from 1.9 to 7.3 SPA. For size classes less than 30” DBH, the average density for DST was greater than or equal to 0.1 TPA.

The Moist Forest PVG had DST in all size classes. Densities for this PVG ranged from 3.5 to 6.9 TPA. Size classes less than 30” DBH had an average DST density greater than or equal to 0.3 TPA.

In the Cold Forest group, all size classes from 2” to 30” and 36” DBH contained DST. Densities ranged from 0.8 to 280 TPA. For size classes less than 30” DBH, the average density for DST were greater than or equal to 0.2 TPA.

Standards and guidelines for dead standing and down wood have evolved over the years as new information became available. Current Forest Plan direction for snag management is based on the Regional Forester’s Forest Plan Amendment #2 (6/95) and Interim Snag Guidance for Salvage Operation (4/93). CVS snag densities were tallied for the watershed to compare average densities in the watershed with the Forest Plan standards and guidelines. As noted by the results on Table 8-6, *overall* snag densities appear to meet or exceed Forest Plan standards. However, as specified in the Forest Plan (4-57), snag densities are to be maintained “… for each logical harvest size unit (or no larger than 40-acre units).” Thus, while overall snag and replacement tree densities may appear to be above standards and guidelines across the watershed, densities may still be below standards in localized areas or “logical harvest units”.

Riparian Habitats

Historical information for riparian habitats in the analysis area is limited to anecdotal information. Wetland habitats were probably always limited in both size and distribution across the Blue Mountains, including the analysis area. However, wet meadows, springs and seeps were probably larger prior to the impacts of unrestricted grazing in the late 1800s. Riparian broadleaf communities of cottonwood, alder, willow and water birch occurred along many stream corridors in the watershed.

The database for existing condition vegetation used in this analysis did not include hardwood or riparian species. These communities are, however, still present. Black cottonwood and willows are present along streams in the middle and lower elevations. Aspen is very rare, in some cases persisting only as individual trees. There are many springs in the watershed, which support small (< 1 ac.) patches of riparian vegetation.

"Special/Unique" Habitats

While rocky outcrops and talus slopes themselves have changed very little over the analysis period, access to and the availability of cover (conifers, shrubs, etc.) around important habitats have changed. Cover adjacent to these sites affords a degree of security for movement between areas and provides screening from an increasing human presence (i.e. roads, developments, etc.) that could have an impact on species such as marten, wolverine, and lynx.

Roads and Trails

Roads affect terrestrial wildlife and their habitats in a variety of ways. Direct mortality from collision with vehicles or hunting are certainly the most obvious, but other effects can be much more subtle and difficult to quantify. High road densities and their related disturbance may cause individuals or local populations to leave an area entirely. Roads create access for an increasing number of humans intent on hunting, gathering, recreation, timber harvest etc. These uses can increase wildlife displacement, vulnerability to mortality, habitat fragmentation and the spread of noxious weeds.

Total road densities in the Phillips-Gordon drainage vary widely from one subwatershed to another, but in general are high compared to other areas of the District. Total and open road densities are reported in the hydrology section of this report.

Trails in the watershed are open to Off Road Vehicles (OHVs), as well as mountain bikes, hikers and horses. Depending on the amount and season of use, trails may be either sources of disturbance, or corridors for local wildlife.

Assessment of Current and Reference Conditions for Individual Species and Their Habitats

Overview

Most species that were either known or suspected to occur historically are still present within the Phillips-Gordon drainage, with some notable exceptions. Grizzly bear and wolves were native to this area of northeastern Oregon, and survived in the Blue Mountains until the 1930s. Other species have almost certainly declined in numbers (i.e. bald eagles, some neo-tropical birds), while others have become established or increased in number (starlings, cowbirds, and other species that thrive in early forest structural stages).

Lacking either historic or current estimates of population sizes for individual species, only an indirect assessment of the health of terrestrial wildlife communities was possible. The results and discussion that follow were based on a compilation of several disparate forms of available data, the intent being to display the more obvious changes in habitat quantity and quality over the last 60 years. Results of this analysis should not be viewed as having any statistical significance. Table 8-9 lists the evaluation criteria used to formulate Paradox queries for this analysis. Relative changes in habitat availability for individual species, based on queries illustrated in Table 8-8, are summarized in Tables 8-10 and 8-13 and Figures 8-7 through 8-23, Map Appendix.

Table 8-8. Selected species and habitat indicators used to model current and historic habitat availability in the Phillips-Gordon watershed.

Species	Habitat	Cover Type	Structural Stage	Canopy Cover	Other Habitat Features
Pileated Woodpecker (MIS)	R1	PIEN, ABGR, Mix, PSME, HC	OFMS		Large snags
	R2	PIEN, ABGR, Mix, PSME, LAOC, PIPO, HC	YFMS, OFSS, OFMS		
	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 (MIS)	R1	ABLA2, PICO	OFMS		Elev. >= 4,500 ft.
	R2	PIEN, Mix			
	F1	ABLA2, PIEN, PICO	OFMS, OFSS		
	F2	ABGR, Mix, PSME			
American Marten (MIS)	R1	ABLA2, PIEN, PICO	OFMS	>= 40%	Elev. >= 4,000 ft.
	R2	Mix, PSME			
	F1	ABLA2, PIEN, PICO	YFMS, OFMS		
	F2	Mix, PSME	YFMS, OFSS, OFMS		
Primary Cavity Excavators (MIS)	Primary	ABLA2, PIEN, PICO, ABGR, Mix, PSME, LAOC, PIPO, HC	OFSS, OFMS		
	Secondary		YFMS, UR		
Rocky Mountain Elk (MIS)	SC	ABLA2, PIEN, PICO, ABGR, Mix, PSME	SECC, YFMS, UR, OFMS	>= 70%	Canopy Layers: 2 or 3
	MC	ABLA2, PIEN, PICO, ABGR, Mix, PSME, LAOC, PIPO		>= 40%, <70%	Canopy Layers: > 1
	F1	ABLA2, PIEN, PICO, ABGR, Mix, PSME, LAOC, PIPO, HC, NF, BU	SI, NF		
	F2	ABLA2, PIEN, PICO, ABGR, Mix, PSME, LAOC, PIPO, HC, BU	SEOC, UR, OFSS		
Canada Lynx (TES)	Potential	Cold Very Moist, Cold Moist, Cold Dry, Cool Very Moist, Cool, Moist, and ABLA2/STAM	N/A	N/A	Elev. >= 4,500 ft. (North Umatilla) >=5,000 ft. (South Umatilla)
	Unsuitable	All (w/n potential)	SI	N/A	
			SEOC	<50%	
	Denning	All (w/n potential)	OFMS, OFSS	>49%	
	Foraging	All (w/n potential)	Various	N/A	
Wolverine (TES)	Natal Denning	NF, Rock, Talus	N/A	N/A	Aspects: N, NE, NW, & E Elev. >= 5,000 ft.
	F1	ABLA2, PIEN, PICO, PSME	SEOC, SECC, YFMS, UR, OFSS, OFMS		Elev. >= 4,000 ft.
	F2	ABGR, Mix, LACO, PIPO, HC			
Northern Goshawk (Local Concern)	R1	ABGR, Mix, PSME, LACO, PIPO	OFSS, OFMS	>= 40%	
	R2	ABLA2, PIEN, PICO			
	F1	ABGR, Mix, PSME, LACO, PIPO 000	SI, SEOC, SECC, YFMS, UR, OFSS, OFMS		
	F2	ABLA2, PIEN, PICO			

SC= Satisfactory Cover, MC= Marginal Cover, F1= Primary Foraging Habitat, F2= Secondary Foraging Habitat, R1= Primary Reproductive Habitat, R2= Secondary Reproductive Habitat, NF= NonForest HC= Cottonwood, BU=

Management Indicator Species (MIS)

The Forest Management Indicator Species that have the potential to occur in the Phillips-Gordon watershed are listed in Table 8-9 along with their representative habitat type. The habitat requirements of these species are presumed to represent those of a larger group of wildlife species. Habitat conditions for MIS, as well as all other wildlife species on the Forest, is to be managed to maintain viable populations (36 CFR 219.19).

Table 8-9. Management indicator species expected to occur in Phillips-Gordon watershed.

Species	Habitat Types
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.
Rocky Mountain elk	General forest habitat and winter ranges.

In general, “total” habitat availability for most MIS has declined since 1936 (Table 8-10). Sharp declines in primary habitat are especially apparent. Changes from primary to secondary habitat further verify loss and deterioration of habitat. Reduction in acreage, loss of old forest, and loss of distinct habitat types all contribute to these changes (Table 8-8). A discussion of historic and current habitat conditions for each MIS follows.

Pileated Woodpecker

Historic population densities and distribution of pileated woodpeckers are unknown. Based on the assessment of available habitat, this species would have occurred historically in the Phillips and Gordon watersheds in sufficient numbers to maintain a population over time.

Current population status and distribution of pileated woodpecker in the Phillips-Gordon analysis area are also unknown. Formal inventories have not been conducted for this species within the analysis area.

Preferred habitat for the pileated woodpecker consists of large blocks of grand fir and mixed conifer stands in late and old structural stages with large diameter snags and down wood.

In 1936, primary reproductive habitat was available in large blocks, at mid and high elevations, and was generally well connected with similar habitat (Figure 8-7, Map Appendix). Nesting habitat was widely dispersed across the northwestern half of the landscape.

Currently, suitable habitat is limited to the mid- and upper elevations of the Phillips-Gordon analysis area. The southern portions of the analysis area, which was converted to agriculture decades ago, does not provide habitat for pileated woodpeckers. Primary reproductive habitat is now limited to small, largely non-functional patches at higher elevations, and is largely absent from the northwestern portions of the area where it was most abundant in 1936.

The trend in “total” habitat for the pileated woodpecker since 1936 is negative. While upwards of 80 percent of National Forest lands within the watershed provided some level of suitable habitat in 1936, only about 20 percent of the area is useable today (Table 8-10; Figure 8-8, Map Appendix).

Overall, habitat quality for the pileated woodpecker in the analysis area is considered very poor because of sharp declines in the quantity and quality old forest, small patch size, and the disjunctive distribution of the remaining primary reproductive habitat. The declines in primary reproductive habitat parallel declines in late and old structure since 1936.

Table 8-10. Management Indicator Species in the Phillips-Gordon analysis area and available primary habitat for 1936 and 1999.

SPECIES/GROUP	1936		1999		Trend
	Reproduction	Foraging	Reproduction	Foraging	
Pileated Woodpecker	10,462	12,460	3,662	495	Down
American Marten	420	420	148	724	Mixed
Northern Three-Toed Woodpecker	420	4,677	63	268	Down
Primary Cavity-Excavators	20,549	NA	8,013	NA	Down

Northern Three-toed Woodpecker

Historic population densities and distribution of the northern three-toed woodpecker are unknown. Based on the habitat availability assessment, it is assumed this species could have occurred historically in the Phillips and Gordon watersheds, although not in great numbers.

Current population status and distribution of the three-toed woodpecker in the Phillips-Gordon watersheds are also unknown (Figure 8-10, Map Appendix). No formal inventories have been conducted for this species within the analysis area.

Preferred habitat for the three-toed woodpecker consists of mature and old lodgepole pine stands with abundant snags and down wood, at elevations above 4500 feet. In 1936, primary reproductive habitat was restricted to forests at the ridgeline of Mt. Emily, mostly in SWS 84 H. Primary and secondary foraging habitat occurred along the northern and western boundaries of the analysis area (Figure 8-9, Map Appendix). A study of three-toed woodpecker habitat in the Deschutes National Forest (Goggans et al. 1988) found a mean home range size of 411 acres. Thus it appears that reproductive habitat for three-toed woodpeckers within the analysis area were quite limited in extent even in 1936 (Table 8-10).

Based on the mean home range size described by Goggans et al., there is probably little if any functional reproductive habitat left in the analysis area for three-toed woodpeckers. Overall habitat quality is considered very poor**,** due to limited habitat potential and declines in habitat quantity and quality. It is unlikely that three-toed woodpeckers currently occur in the analysis area, except as occasional foragers.

American Marten (pine marten)

Historic population densities and distribution of pine marten are unknown. Based on the assessment of available habitat, this species probably occurred historically in the Phillips and

Gordon watersheds, but not in great numbers. Current population status and distribution of the pine marten in the Phillips-Gordon analysis area are also unknown.

Preferred habitat for the marten consists of high elevation (> 4000') stands of dense conifer and down wood often associated with streams. In 1936, primary reproductive and foraging habitat were very limited, with a total of only about 420 acres scattered across the upper slopes of Mt. Emily, mostly in the Dry Creek drainage (SWS 84H, Figure 8-11, Map Appendix).

By 1999, less than 150 acres of primary reproductive habitat was available within the analysis area, along the far northern boundary (Table 8-10; Figure 8-12, Map Appendix). Suitable habitat within the analysis area is contiguous with a limited amount of suitable habitat in adjacent watersheds, but it is unlikely that any reproducing population of marten persists in the Phillips-Gordon analysis area.

Overall, the habitat quality for the pine marten in the Phillips and Gordon watersheds is considered poor, due to small patch size and poor distribution of the remaining habitat. Comparing the C1 and 1999 marten habitat map indicates that C1 area 0795, designated as suitable habitat for both marten and pileated woodpecker, does not currently provide adequate reproductive habitat for either species.

Primary Cavity Excavators (PCE)

Included in the PCE group are 16 bird species capable of carving out cavities in dead standing trees, although some species are capable of creating cavities in green trees. These species are important to the landscape because they provide cavities for dozens of secondary cavity nesters and users (Thomas et al. 1979). Table 8-11 lists primary cavity excavators in the Phillips-Gordon analysis area.

Table 8-11. Primary cavity users of the Phillips-Gordon analysis area.

common flicker	pileated woodpecker	Lewis' woodpecker
yellow-bellied sapsucker	Williamson's sapsucker	hairy woodpecker
downy woodpecker	red-breasted nuthatch	black-backed woodpecker
three-toed woodpecker	white-headed woodpecker	mountain chickadee
chestnut-backed chickadee	black-capped chickadee	pygmy nuthatch
white-breasted nuthatch		

Historic population densities and distribution of primary cavity excavators are unknown. Based on the assessment of available habitat, these species are assumed to have occurred historically in the Phillips and Gordon watersheds in sufficient numbers to maintain their population over time.

Current population status and distribution of primary cavity excavators in the Phillips-Gordon watersheds are also unknown. No formal inventories have been conducted for this group of species.

Habitat for primary cavity excavators includes conifers stands having dead trees in various size and decay classes. Primary habitat has the potential to provide snag greater than 16" dbh, while secondary habitat can provide snags greater than 8" dbh but less than 16" dbh. Potential habitat can be found throughout the Phillips-Gordon analysis area, except for non-forest areas and regenerating forest stands (stand initiation, and stem exclusion).

In 1936, primary habitat for excavator species was found in very large blocks, distributed throughout the National Forest portion of the analysis area (Figure 8-13, Map Appendix). Moreover, habitats in the Phillips drainage were well connected to other very large blocks of suitable habitat in the adjacent Umatilla drainage, just to the north.

By 1999, primary habitat had declined by more than 50 percent, concurrent with changes in the availability of old forest habitats. Secondary habitat has increased, but mostly at the expense of primary habitat (Figure 8-14, Map Appendix).

Overall quality of habitat for the primary cavity excavators is considered fair, mostly as a result of high snag densities and relatively good dispersal of habitat across the landscape (many of these species have small territory sizes and are thus able to persist in areas of fragmented old forests). While the current level of snags and old forest may still provide adequate habitat for primary cavity excavators in the short term, the low proportion of existing and future old forest structure suggests that large diameter snags could be limiting in the long term.

Rocky Mountain Elk

Preferred habitat for elk consists of a mixture of forest and non-forest habitat types and a variety of forest structures to provide forage and cover for summer or winter usage (Table 8-8). The Phillips-Gordon analysis area contains both summer and winter habitats (Figures 8-15 through 8-18, Map Appendix). Summer range (forest habitat) occurs in the upper end of the drainage at higher elevations. Winter range (grassland/grass tree mosaic habitat) occurs in the southern portion of the watershed and at lower elevations. Approximately half of the analysis area consists of low elevation winter range, mostly on private lands

The overall trend in habitat availability on National Forest lands within the analysis area is positive (Table 8-12). Virtually all National Forest lands within the analysis area provide either cover or forage for elk. Winter range occurs primarily in the lower elevations and valley bottoms in the southern half of the analysis area. Gross acres of forage habitat have more than doubled since 1936.

Table 8-12. Changes in habitat availability for Rocky Mountain Elk, 1936-1999.

Rocky Mountain Elk	1936	1999	Trend
Satisfactory Cover	15,887	16,010	*UP (minor)*
Marginal Cover	17,317	14,318	*DOWN*
Primary Forage	2,125	7,691	*UP*
Secondary Forage	9,142	13,813	*UP*

Elk Populations

Following decades of unregulated hunting by newcomers traveling the Oregon Trail (Langston 1994), elk numbers in the Blue Mountains had crashed by the late 1800s. In response to the declines, the Oregon State Game Commission closed the region to elk hunting and began a re-introduction program in the early 1900s. Most elk populations found in the Blue Mountains today are the descendents of those transplants. Elk numbers peaked in the Blue Mountains during the 1970s.

The Phillips-Gordon analysis area is located entirely within the Mount Emily hunt unit. In general, ungulate populations (deer and elk) have remained stable over the last few years. Management objectives (MOs) for populations in the Mt. Emily unit (established in 1989) are 5,700 elk, and 1,950 mule deer. As of 1998, elk numbers for the unit were estimated at 6,000, slightly above the management objective. The cow/calf ratio, however, was low, estimated at only 27 calves/100 cows (T. Wertz, ODFW, pers. Comm. Dec. 2000).

While robust herds are good news for hunters, conflicts with agricultural interests are on-going. Even with good winter and summer range in the analysis area, some elk forage on private lands adjacent to NFS lands. Utilization off-Forest occurs mostly in the spring when forage is limited or at lower elevations where "green-up" occurs first, and late summer when agricultural fields provide scarce green forage. While searching for food, it is not unusual for elk to move outside of their "normal range": this herd seems to have acquired a taste for rye grass, wheat, and orchard crops on nearby agricultural lands. Damage complaints have resulted in special hunts in the Pumpkin Ridge area. Management actions to improve winter range implemented by the Forest Service, ODFW, and the CTUIR during the early 1990s were intended to hold more elk on public lands and reduce impacts to agriculture lands. Recent fires (summer of 2000) in the adjacent Umatilla and Meacham drainages may result in additional on-Forest forage resources for the next few years. While improved range condition may result in some success at reducing impacts, some elk will continue to seek green lush forage wherever it occurs, regardless of human ownership boundaries.

Roads open to motorized vehicles are a particular issue with elk habitat, especially winter range. Open roads reduce the effectiveness of adjacent big game habitat for up to one-quarter mile on either side. Seasonal road closures occur on a sizable portion of the winter range in the analysis area, and serve to mitigate adverse habitat effects. There are localized areas with particularly high road densities in the analysis area.

Threatened, Endangered and Sensitive (TES) Species, and Species of Local Concern

Federally listed threatened, endangered and Regional Forester's sensitive species with the potential for occurrence in the Phillips-Gordon watersheds include two threatened, one candidate, and two sensitive species. In addition, numerous State endangered, threatened, and sensitive species have the potential to occur in the watersheds. Table 8-13 lists those species that could occur within the analysis area. Habitat analyses were conducted for wolverine and lynx.

Table 8-13. Threatened, endangered and sensitive species with the potential to occur in the Phillips-Gordon analysis area.

Species	U.S. Fish and Wildlife Service	R-6 Regional Forester's Sensitive	State Status (Oregon)
Bald eagle	Threatened		Threatened
Black-backed woodpecker			Sensitive-Critical
Columbia spotted frog	Candidate		Sensitive-Undetermined
Fringed myotis			Sensitive-Vulnerable
Long-eared myotis			Sensitive-Undetermined
Long-legged myotis			Sensitive-Vulnerable

Species	U.S. Fish and Wildlife Service	R-6 Regional Forester's Sensitive	State Status (Oregon)
Lynx	Threatened		
Marten			Sensitive-Vulnerable
Silver-haired bat			Sensitive-Undetermined
Tailed frog			Sensitive-Vulnerable
Townsend's big-eared bat		Sensitive	Sensitive-Critical
Three-toed woodpecker			Sensitive-Critical
Western small-footed myotis			Sensitive-Undetermined
Western toad			Sensitive-Vulnerable
White-headed woodpecker			Sensitive-Critical
Wolverine		Sensitive	Threatened

Canada Lynx

Historic population densities and distribution of lynx are unknown. Based on the assessment of available habitat, this species probably occurred historically in the Phillips and Gordon watersheds to a limited extent. Current population status and distribution of the lynx in the Phillips-Gordon analysis area are also unknown. Formal inventories have not been conducted for this species. However, miscellaneous sighting have occurred near the north end of the analysis area in the last 10 years.

Preferred habitat for the lynx consists of high elevation (> 4500') stands of cold and cool forest types with a mosaic of structural stages for foraging and denning. This habitat can currently be found only along the northern and eastern boundaries of the Phillips-Gordon watersheds (Figure 8-19, Map Appendix).

The 1936 and 1958 vegetative databases did not provide potential habitat coverage for those years; therefore, the trend in historic available habitat cannot be analyzed.

California Wolverine

Historic population densities and distribution of wolverine in 1936 are unknown. The wolverine was probably never common in the analysis area due to the lack of natal denning habitat (Banci 1994). Current population status and distribution of wolverine in the Phillips-Gordon analysis area are also unknown. Winter snow track surveys were conducted in 1991 and 1992 for wolverine, fisher, American marten and lynx across the District and just northeast of the analysis area. Verifiable sightings or tracks have yet to be documented; however, miscellaneous sighting have occurred on the District just north of the analysis area within the last 10 years.

The wolverine prefers high elevation conifer forest types with a sufficient food source and limited exposure to human interference (USDA 1994). 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 spring (March-April (USDA 1994)). 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 mid to high elevations (>3,000') and typically travel 18-24 miles to forage/hunt (USDA 1994).

In 1936, one or two small areas of potential reproductive habitat may have been present in the Cabin Creek subwatershed. Primary foraging habitat occurred in blocks, scattered across the mid section of the analysis area (Figure 8-20, Map Appendix). Secondary habitat was much more widespread and well connected over most of the area.

In 1999, wolverine primary foraging habitat was highly fragmented, occurring in very small patches (Figure 8-21, Map Appendix). Secondary foraging habitat in 1999 was similar in distribution and connectivity to 1936 secondary habitat.

Overall, the current habitat quality for wolverine in the Phillips-Gordon analysis area is considered poor to marginal because of the lack of natal denning habitat and the limited amount of primary habitat in the analysis area.

Bald Eagle

Historic population density and distribution of bald eagles in the analysis area are unknown. It is assumed that both wintering and nesting eagles occurred in the area at one time, particularly along the lower portions of Phillips, Gordon, Willow, and Dry creeks. Current population density and distribution of bald eagles in the Phillips and Gordon watersheds are unknown, and there are no known nest sites within the analysis area.

Wintering bald eagles are occasionally observed in the Elgin and Summerville areas and along the Grande Ronde River between Imbler and Elgin. Wintering eagles perch on dominant trees that provide a good view of the surrounding area and are close to a food source (carrion, fish, etc., USDI 1986). Communal night roosts are generally located in uneven-aged stands with a remnant old growth component, near a rich food source (high concentrations of waterfowl or fish). Communal winter roosts tend to be isolated from disturbance and offer more protection from the weather than diurnal roosts (USDI 1986).

Overall, the quality of both wintering and nesting habitat for bald eagles in the analysis area is considered poor due to deficiencies in both habitat structure and prey availability.

Table 8-14. Habitat trends for wolverine, lynx and goshawk in the Phillips-Gordon analysis area.

Species	1936 acres	1999 acres	Trend
Wolverine			
Natal Denning	15	15	No change
Primary Foraging	5,947	6,601	Up
Secondary Foraging	18,952	18,641	No Change
Lynx			
Potential/ Foraging	No Information	15,268	NA
Denning	No Information	2,142	NA
Goshawk			
Primary Reproduction	20,130	8,376	Down
Secondary Reproduction	4,195	2,837	Down
Primary Foraging	25,515	30,367	Up
Secondary Foraging	419	2,327	Up

Northern Goshawk

Preferred habitat for the goshawk consists of coniferous forests with variety of structural stages for nesting and foraging. Nesting sites consist of large trees surrounded by a dense overstory canopy with a relatively open understory. Nest groves are generally situated within one-quarter mile of a stream or other water source. Optimal foraging habitat occurs as a mosaic of structural stages scattered across the landscape.

In 1936, primary reproductive habitat was available in large blocks, at mid and high elevations, and was well connected with similar habitat in adjacent watersheds. Approximately 80 percent of the analysis area supplied potential high quality nesting habitat (Figure 8-22, Map Appendix; Table 8-14).

In 1999, primary reproductive habitat was highly fragmented, occurring in small, scattered patches, primarily along riparian corridors (Figure 8-23, Map Appendix; Table 8-14). Foraging habitat was still widely available.

Habitat quality for northern goshawks in the analysis area is considered poor**,** as a result of the pronounced reduction in both gross acres and patch size of available reproductive habitat.

Columbia Spotted Frog

Historic populations and distribution of spotted frog in the analysis area are unknown. However, it is assumed that the frogs occurred in the analysis area and in most of the wetland habitat across the area. Current population densities and distribution of spotted frogs is unknown. Spotted frogs have been observed at a few locations along the Umatilla River and just outside the analysis area (K. Kronner, pers. comm. 1998). Due to their small size, riparian habitats within the analysis area are not easily mapped, and thus no spatial analysis was conducted for spotted frogs.

Preferred habitat for the Columbia spotted frog consists of marsh and permanent ponds, and slow streams, usually with abundant aquatic vegetation. Flooded or wet meadows near a pond or stream can provide breeding habitat. Suitable habitat for the spotted frog can be found in the analysis area along the numerous streams and a few wet meadows or seeps. The limiting factor for spotted frogs in the area could be insufficient aquatic vegetation for cover and foraging. Also, habitat associated with ponds and wet meadows are somewhat limited during the late summer months.

Neotropical Migratory Birds (NTMB)

Neotropical migrant birds include species which nest in North America and migrate to Central and South America for the winter. Over the past two decades, declines in many NTMB species have been noted, including many songbirds that nest in the Blue Mountains. Causes for the declines include habitat degradation in winter and summer habitats and the continued use of toxic pesticides in Latin America (Sharp 1992).

Neotropical migrants account for a significant portion of the avian biological diversity in the Phillips and Gordon watersheds. Of the 106 species of birds known or suspected to occur in this analysis area, 76 (50%) are NTMBs. These species occupy a variety of habitats: 31 are closely associated with riparian habitats, and 31 species are associated with old growth. Only 18 of the NTMB species were strongly associated with stand initiation or stem exclusion.

The MAPS (Monitoring Avian Productivity and Survivorship) program, a cooperative effort between public and private organizations, was initiated in 1992 to provide trend data for diurnal land birds, including NTMBs. Two MAPS stations with significant data are located near the analysis area; one at Buck Mountain, the other at Coyote Ridge. Data highlight for 1992 through 1995 seasons include:

- 30 different species were identified at Coyote Ridge and 32 at Buck Mountain.
- the overall species composition of the breeding community is relatively stable.
- species richness is highest in meadows and habitats having a high degree of edge.
- the total abundance of songbirds remained relatively stable for the time period.
- song bird productivity appears to be declining from 1992 levels.

In 1994, the Oregon and Washington Chapters of Partners In Flight (PIF) analyzed the status of NTMB in Oregon and Washington. That report (Andelman and Stock 1994) identified breeding NTMB in Oregon, habitat relations, and NTMB population trends. The analysis primarily relied on breeding bird surveys conducted across the state between 1968 and 1994. In addition, the Interior Columbia Basin Ecosystem Management Project (ICBEMP) assessed NTMB in the basin (Saab and Terrell. 1997). The ICBEMP assessment took the Oregon and Washington PIF assessment a step further and assessed NTMB under various management themes. Table 8-15 contains NTMB breeding in the Phillips-Gordon analysis area and identified in Andelman and Stock (1994, Table 6) as species with significant declining trends, and in Saab and Terrel (1997 Table 4) as species of high concern to management.

Table 8-15. Neotropical migratory birds of "concern" in the Phillips-Gordon analysis area.

Species	"Primary" Habitat for Breeding	"Significant Declining Trends" (Andelman and Stock 1994)	"High Concern to Management" (Saab and Rich. 1997)
American kestrel	Coniferous forest, Grassland,	X	
Band-tailed pigeon	Riparian,	X	
Mourning dove	Coniferous forest, Riparian	X	
Vaux's swift	Coniferous forest, Riparian	X	
Rufous hummingbird	Coniferous forest, Riparian	X	
Belted kingfisher	Riparian	X	
Williamson's sapsucker	Coniferous forest, Riparian	X	
Lewis' woodpecker	Coniferous forest, Riparian		X
Olive-sided flycatcher	Coniferous forest	X	X
Willow flycatcher	Riparian		X
Western wood-pewee	Coniferous forest, Riparian	X	
Violet-green swallow	Coniferous forest, Riparian	X	
Barn swallow	Riparian	X	
Swainson's thrush	Coniferous forest, Riparian	X	
Varied thrush	Coniferous forest	X	
Orange-crowned warbler	Riparian	X	
Wilson's warbler	Riparian	X	
Hermit warbler	Coniferous forest		
Western tanager	Coniferous forest, Riparian	X	
Chipping sparrow	Coniferous forest	X	
White-crowned sparrow	Riparian	X	
Dark-eyed junco	Coniferous forest, Riparian	X	
Western meadow lark	Grassland	X	X
American goldfinch	Riparian	X	
Pine siskin	Coniferous forest		X

Most of these species are dependant on coniferous forests and riparian habitats. While these habitats occur in the analysis area, current habitat trends, including homoginization of forest types, decreased old forest availability, simplification and reduction of riparian habitat, and the increasing fragmentation of many habitat types can have cumulative, negative impacts on Neotropical migrants.

Other Species of "Interest/Concern"

Historic information for birds, small mammals, reptiles and amphibians is almost totally anecdotal. As noted in the Ochoco NF Viable Ecosystems Management Guide (Ochoco NF 1994), higher water tables, more extensive riparian vegetation and aspen groves, and more beaver activity no doubt provided more suitable habitat for amphibians, waterbirds, songbirds, and riparian-associated small mammals such as shrews and mink than do current conditions.

Black bear and cougar may actually be more common today than in the early 1900s, as a result of recovering deer herd densities and restrictions on hunting of predators. Coyotes are common throughout the Blue Mountains. Bobcats are trapped and occasionally observed in the analysis area, but population numbers and distribution are unknown.

Evidence of past and/or present beaver activity is present within the drainage, although the Phillips and Gordon drainages almost certainly lost the bulk of their beaver populations during the fur-trading era of the late 18th and early 19th centuries.

Blue and ruffed grouse persist in the analysis area, although no information on current population status or distribution is available. Re-introduction of the sharp-tailed grouse was undertaken at Zumwalt Prairie on the adjacent Wallowa-Whitman National Forest in the early 1990s. Chukar, Hungarian partridge, and wild turkey were introduced by ODFW and are occasionally observed in the Phillips-Gordon watershed (K. Blakely, ODFW, pers. comm., March 2000).

Historic population densities and distribution of the white-headed woodpecker are unknown. The white-headed woodpecker was probably never a "common" species, except perhaps in areas of extensive stands of mature ponderosa pine. However, based on assessment of historic habitat conditions, both species are assumed to have occurred in the Phillips and Gordon watersheds in sufficient numbers to maintain a population over time. The current population of white-headed woodpeckers in the Phillips-Gordon analysis area is unknown. Sightings of the white-headed woodpeckers are uncommon.

SYNTHESIS AND DISCUSSION OF RESTORATION RECOMMENDATIONS

Overview

The recommendations in this chapter are designed to address departures from historic or sustainable conditions identified through the watershed analysis. The overall goal of the recommendations is ecosystem restoration at the watershed scale. Restoration means the reestablishment of the structures, processes, and functions of an ecosystem. A stream is an example of a structure. Water discharge is an example of a process. Functions are the many roles that elements play within the ecosystem. For example, woody debris functions to provide habitat diversity in streams (USDA Forest Service, 1995). Ecosystem restoration needs to integrate individual actions across the landscape and consider interactions among resources. As an example, fuels recommendations are considered in terms of their potential effects on fish habitat. Sometimes, conflicting objectives are difficult to resolve.

A crucial part of ecosystem analysis is the integration of the results into a prioritized scheme of management opportunities and recommendations. Integration of information, concerns and priorities for the Phillips-Gordon Ecosystem Analysis evolved through a series of team-interactive work sessions where team members shared information about subwatershed attributes from their individual analyses. Participation by Walla Walla Ranger District specialists facilitated the integration process. The exchange of information between team members and experienced local managers helped identify and resolve problems related to the implementation of the report's findings.

Two definitions are critical to understanding the following recommendations; *Conservation* and *Action*. *Conservation* was defined by the Analysis Team as "Any restorative actions that do not result in reduction of current levels of suitability or function, when applied to ecosystem components or processes currently impaired or at risk". Conservation concerns arise from the need to conserve high quality elements within one or more parts of some subwatersheds. These same subwatersheds may also have other portions with one or more high priority management opportunities. These apparently contradictory actions for a particular subwatershed must be viewed in terms of long-term goals for ecosystem sustainability. *Action* was defined as activities that might increase the short-term risk of ecosystem function, but likely result in a long-term enhancement of ecosystem function.

Each member contributed to construction of a matrix of important attributes within each issue, rating their level of concern (L, M, H, i.e., low, moderate, high) for conditions in each subwatershed. Using these, the team compiled a list of concerns (both positive and negative attributes) and management recommendations for each subwatershed. Next, attributes in each matrix were pared down to those considered to be "key attributes". These attributes were then used to rank subwatersheds for ***action* or *conservation*, by issue**. Refinement continued, with a tally of the number of times a subwatershed was listed in the action or conservation priorities. This process resulted in a final overall priority placement of each subwatershed. Finally, a list of projects for each of the highest priority subwatersheds was generated from the sets of recommendations developed for each subwatershed.

Priority Subwatersheds

Subwatersheds with high priority for restoration and/or conservation were further considered by constructing new tables and re-listing some key attributes. Those subwatersheds of concern for bull trout were automatically designated highest priority. The subwatersheds listed in Table 10-1 were selected by the team as the highest in overall priority for field validation of attributes analyzed and for subsequent planning of projects. It should be noted that the acreage figures are estimates and will change after field validation of relevant data.

Table 10-1. Subwatershed management priorities by resource attribute.

Resource Category	Conserve (High Priority)	Project Action Priority		
		Low	Medium	High
Hydrologic Functions & Processes				
Quantity Changes				
Quality Changes				
Channel and Riparian Areas Changed				
Fish Habitat				
Pool Habitat Quality	84C	84I	84D, 84E	84C
Water Temperature	84C, 84D, 84E	84I	7A, 7B, 84F, 4G, 84H	84A, 84B, 4C, 84D, 84E
Substrate Quality			84C	
Fish Cover/Complexity		84I	84C	
Forest Vegetation Sustainability				
Site/Soil Productivity				
Maintenance/Restoration of early seral species		84D, 84H	7A, 84B, 84C	7B, 84E, 84I,
Stand Density		84C, 84E	84B, 84D, 84H	7A, 7B, 84I
Fire Hazard Reduction				
Noxious Weeds or New Invaders				
Botanical Biodiversity				
Floristic Surveys			07B, 84B, 84D 84H	
Monitor existing Sensitive taxa			84B, 84D	
Riparian Enhancement				84C, 84E
Noxious Weed Abatement				84C, 84E, 84I
Noxious Weed Surveys		All		
Vertebrate Biodiversity				
Terrestrial Species Diversity Terrestrial Habitat Diversity				
Late Old Forest Structure				

Integrated Recommendations

"Recommendations" is the final step in the "Ecosystem Analysis at the Watershed Scale" process (REO 1995). Recommendations are designed to respond to issues, concerns and findings identified during the five previous ecosystem analysis steps. Issues and concerns, and treatments that could be used in response to them, are summarized below.

Upland Forest Vegetation

High levels of forest damage occurred in the Phillips-Gordon analysis area during the late 1980s and the early 1990s. Upland forest silvicultural practices that could be used to respond to this issue are:

- Salvage of dead trees;
- Planting.

Forty-five percent of the analysis area has forest density levels that threaten future sustainability of upland forests in the analysis area. Upland forest silvicultural practices that could be used to respond to this issue are:

- Noncommercial thinning;
- Commercial thinning.

Substantial reductions in the area of early-seral species (particularly the ponderosa pine forest cover type) have occurred in the Phillips and Gordon watersheds between 1936 and the present. Upland forest silvicultural practices that could be used to respond to this issue are:

- Improvement cutting in stands where the early-seral species still exist;
- Forest regeneration in appropriate stands where early-seral species no longer exist.

Several analysis indicators show that dry forest sites currently have conditions that are inconsistent with ecosystem sustainability and resilience (see "forest cover types" and "forest canopy layers" discussions in the synthesis and interpretation section). Upland forest silvicultural practices that could be used to respond to this issue are:

- Understory removals;
- Pruning;
- Prescribed fire.

Treatment recommendations did not explicitly consider project feasibility (logging operability, etc.), so they basically represent management opportunities. Nine treatment opportunities were identified in this process, namely salvage of dead trees, planting, thinning, and improvement cutting. Table 10-2 summarizes the acres by subwatershed, for four of the silvicultural treatment (thinnings, improvement cuttings, regeneration cuttings, and understory removals). Maps showing the acres identified in this analysis can be found in Figure 10-1, Map Appendix. A total of 23,401 acres in the Phillips-Gordon analysis area apparently qualify for one or more of the silvicultural treatment opportunities described in this section; 2,180 of those acres have a high treatment priority, 6,995 acres have a moderate priority, and 14,226 acres have a low priority

Table 10-2. Area (acres) of treatment opportunities by subwatershed (SWS).

SWS	Thinning	Improvement Cut PP	Improvement Cut WL	Regeneration DF	Regeneration GF	Understory Removal
7A	2,133	545	363	326	240	1,038
7B	2,030	69	144	370	531	801
Total	4,163	614	507	696	771	1,839
84B	2,089	344	144	750	25	706
84C	1,206	671	—	248	153	949
84D	1,593	74	23	415	365	417
84E	936	379	23	1,242	562	1,640
84H	1,216	216	197	421	148	792
84I	3,673	655	353	1,095	342	2,105
Total	10,713	2,339	740	4,171	1,595	6,609
Grand Total	14,876	2,953	1,247	4,867	2,366	8,448

Salvage treatments are permitted in all Forest Plan management areas within the analysis area. Planting evaluations should include consideration of establishing western larch and ponderosa pine where they are early-seral species. Western white pine should also be considered for sites in the moist-forest potential vegetation group. If forest sustainability is an objective, then planting should attempt to establish a future stand with at least 60 percent of the composition being early-seral species. This recommendation is particularly appropriate for areas with high risk of future spruce budworm or tussock moth defoliation.

Thinning from below can create an open, single-storied stand structure that is amenable to reintroduction of low-intensity surface fires and offers an opportunity to remove late-seral, pest-susceptible trees and thereby favor early-seral species (Powell 1994). The residual trees left by a thinning often exhibit an increase in vigor, allowing them to produce more resin and defensive chemicals for warding off insect and disease attacks (Safranyik and others 1998). Over the long run, thinning can be a very effective way to deal with defoliating insects such as western spruce budworm. Research from Montana found that thinning improved budworm resistance by increasing stand vigor, increasing budworm larval mortality during their dispersal period, and by reducing the budworm-host species in mixed-conifer forests. Thinning provided short-term protection for treated stands, and would presumably contribute to long-term resistance once landscape-sized areas were treated (Carlson and Wulf 1989, Carlson and others 1985, Powell 1999). The plant association groups with apparent overstocking should be field examined to determine if the high densities actually exist and, if so, then they should be evaluated to determine their suitability for a thinning treatment. Figure 10-2 shows the location and distribution of upland-forest sites that would apparently qualify for the thinning treatment opportunity.

Improvement cutting was considered as one silvicultural alternative for addressing the "reduction in early-seral species" issue. In that context, improvement cutting would be used in mixed-species stands that still have a viable component of early-seral trees (either ponderosa pine or western larch in this instance). An improvement cutting scenario responds to several consequences associated with fire suppression and historical partial-cutting timber removals. After frequent surface fires were suppressed, and following removal of mature ponderosa pines and larches during partial-cutting entries, the ultimate result was multi-layered, mixed-species forest dominated by late-seral trees (Powell 1994, Sloan 1998). An improvement cutting would remove many (but not all) of the late-seral trees, thereby providing additional growing space for residual ponderosa pines and western larches. It is expected that the response to this treatment would include improved vigor and longevity for residual trees. Figure 10-3 shows the location and distribution of upland-forest sites that would apparently qualify for the improvement cutting treatment opportunity.

Regeneration cutting was considered as one silvicultural alternative for addressing the "reduction in early-seral species" and "inconsistent composition on dry-forest sites" issues. In that context, regeneration cutting would be used in situations where the desired species do not exist currently, or they exist in numbers too low to qualify as a viable seed source. A regeneration cutting scenario was designed to respond primarily to ecologically inconsistent species composition on dry-forest sites. After frequent surface fires were suppressed over the last 90 years, late-seral, fire-sensitive species (Douglas-fir and grand fir) were able to get established on dry-forest sites that historically supported fire-tolerant species such as ponderosa pine (see "fire" discussion in Site Characterization of this report). If ponderosa pine is no longer present on these dry-forest areas, or is present in very low numbers only, then a regeneration treatment (shelterwood or seed-tree method) in conjunction with tree planting would be an effective way to reestablish it. Figure 10-4 (Map Appendix) shows the location and distribution of upland-forest sites that would apparently qualify for the forest regeneration treatment opportunity.

Understory removal is used in multi-storied stands, typically those with an overstory of early-seral trees and an understory of shade-tolerant species. The objective is to remove a high proportion of the understory trees and thereby improve overstory vigor by reducing inter-tree competition. When the overstory trees are mature ponderosa pines or western larches, this treatment is effective at ensuring their continued survival (Arno and others 1995). Understory removals are implemented in at least two ways: on an area basis, or around individual trees. In the first method, understory trees are removed on areas having a relatively uniform stand composition and structure. Area-wide understory removals can be especially useful before initiating a prescribed fire program. In areas lacking uniform conditions, the understory is removed from around individual overstory trees with the objective of prolonging their survival by decreasing inter-tree competition and increasing tree vigor. *An understory removal would be particularly appropriate as a treatment to remove Douglas-firs and grand firs that have invaded on warm dry sites.* Figure 9-3 (Map Appendix) shows the location and distribution of upland-forest sites that would apparently qualify for the understory removal treatment opportunity.

Pruning can also play a role in achieving natural resource objectives. In areas where budworm-host trees will continue to be a stand component, pruning could be used to remove the lower crown portion of host trees, thereby providing less food for survival and growth of budworm larvae. After pruning trees that are large enough to have developed a 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 turning into a crown fire. Pruning must be carefully coordinated with the onset of an underburning program – if trees were pruned too soon, epicormic branching or "water" sprouts could occur on the stem and increase a tree's risk of torching in an underburn (Bryan and Lanner 1981, Oliver and Larson 1996). Mechanical pruning would produce a stand that can be underburned much more quickly than waiting for natural pruning. It is recommended that pruning be considered as a future treatment for young stands on the hot dry and warm dry plant association groups. Pruning may not be needed until at least 30 years after plantations have been established, when it could then be coordinated with prescribed burning treatments as a way to lower the risk of pole-sized trees being killed by a fire (torching).

Enhancement of Minor Forest Species

For the Phillips and Gordon watersheds, quaking aspen, black cottonwood, and western white pine are three limited components of particular concern. Evidence suggests that aspen was historically more abundant in the Blue Mountains than it is now. Fire exclusion and herbivory over the last 90 years has undoubtedly reduced its distribution. Relict aspen clones are scattered throughout the Phillips-Gordon analysis area. Aspen is a good example of an ecosystem element that is 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 many other species. In winter when foliage is no longer present, elk feed on its smooth white bark. After dying, aspen may be used by almost as many species as when alive. Dead trees are prized by woodpeckers, flickers and many other species that use cavities (DeByle 1985). Aspen is a clonal species that primarily regenerates by producing suckers from its root system (Schier and others 1985). Unfortunately, the suckers are highly palatable to elk, deer, and domestic livestock. In order to allow the suckers to persist and eventually grow above the browse height of large ungulates, aspen clones are often fenced to prevent grazing damage. Some of the clones have been fenced but others have not. Any remaining unprotected clones should be fenced as soon as possible.

Fire exclusion and herbivory over the last 90 years has also reduced the distribution of black cottonwood (Case and Kauffman 1997, Peterson and others 1996). Black cottonwood should be restored on appropriate sites in both the upper portion of the dry forest PVG and in the moist forest PVG. Ecologically, black cottonwood is not considered an appropriate revegetation species for the cold forest PVG.

Western white pine, a mid-seral tree species, is sometimes found on cool moist, cool wet, and warm moist sites in the upper montane and lower subalpine vegetation zones (Powell 1998). The species has a relatively wide distribution as a minor species in mixed-conifer forests, although it seldom comprises a plurality of the basal area in any individual stand. Due to changes caused by fire exclusion, bark-beetle outbreaks, white pine blister rust *(Cronartium ribicola)* and other factors, it is believed that white pine in the Blue Mountains was more abundant historically than at present. Over the last 15 years, western white pine has increasingly been used in reforestation plantings because it survives well and has rapid juvenile growth. Rust-resistant sources of white pine should continue to be planted on moist-forest sites where it is ecologically well adapted. In the near future, some of the historical plantations containing white pine will need to be thinned. As there are currently no specific stocking rates for white pine (Powell 1999), Douglas-fir stocking levels should also be used for white pine, as was recommended by Seidel and Cochran (1981).

Wildfire Risk and Fuel Management

Restoration of the Natural Landscape

Humans have effected the “natural fire” cycles in the Blue Mountains since their arrival in the area millenniums ago. This has resulted in a variety of changing ecologies where climate, soil, vegetation and human fire practices are the major variables. Long-term human interaction within the ecosystems has contributed to current fire regimes and will continue to do so. Thus, managing to restore potential natural vegetation within an ecosystem will, in many cases, involve human intervention. Decades of fire exclusion have left many acres of dry forest settings with heavy loads of live and dead fuels. Wildland fire in these forests can be expected to convert them into grass and shrublands, perhaps for long periods of time. Restoration of these stands will often require continued fire suppression, under thinning, fuel removal, and prescribed fire.

To maintain, preserve, and protect the natural resources in the watersheds and restore the resilience to the ecosystems, the following is recommended:

- Reduce the biomass, focusing on those areas that are in condition class II and III through thinning, mechanical fuel removal, and selective use of prescribed fire.
- Maintain the current state of those areas that fall into condition class I with landscape prescribed fire.

Prescribed Fire

Managers should strongly consider using prescribed fire on dry-forest sites. Once ponderosa pines or western larches are 10 to 12 feet tall, a prescribed burn could be completed, leaving most of the 6- to 8-foot trees undamaged (Wright 1978). From that point on, surface fires could be used on a regular cycle, usually at intervals of 10 to 20 years.

Fall burns are desirable from an ecological perspective because they replicate the natural fire regime and result in fewer losses of overmature pines to fire damage or to western pine beetle attack (Swezy and Agee 1991). 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 a likely vector of black stain root disease in ponderosa pine, was most abundant following fall fires. Spider abundance was reduced temporarily following either spring or fall burning; spider diversity was significantly higher for fall fires as compared to spring burns (Niwa and others 2000).

Periodic burning can also be used to increase the nutrient capital of a site by rejuvenating snowbrush ceanothus, lupines, peavines, vetch, buffaloberry, and other nitrogen-fixing plants. Numerous studies have documented the slow decomposition rates associated with woody material in the interior West (Harvey and others 1994). This means that forests of the Interior Northwest may have depended more on nitrogen-fixing plants and low-intensity fires to recycle soil nutrients than on microbial decomposition of woody debris (Powell 2000).

Providing adequate levels of site nutrition is important for maintaining tree resistance to insects and diseases (Mandzak and Moore 1994). In central Oregon, for example, Reaves and others (1984, 1990) found that ash leachates (chemical substances produced when water percolates through the ash remaining after a fire) from prescribed burns in ponderosa pine forests had a direct negative effect on the growth of *Armillaria ostoyae*, cause of Armillaria root disease. Much of the Armillaria suppression was due to a fungus called *Trichoderma*, which was strongly antagonistic to *Armillaria ostoyae* in burned soils.

Fire may not be beneficial on all upland-forest sites; on moist areas, burns could favor dominance by bracken fern, western coneflower, and other allelopathic plants that inhibit conifer regeneration (Ferguson 1991, Ferguson and Boyd 1988).

On poor to moderate forest sites (generally dry areas with coarse or shallow soils and thin forest floors), broadcast burning can be detrimental from a nutritional standpoint. The short-term benefits of prescribed fire may be achieved at a cost of high soil pH, nitrogen and sulfur deficiencies, and other nutritional problems later in a forest's life (Brockley and others 1992). In central Oregon, prescribed fire was observed to cause a net decrease in nitrogen mineralization rates and a decline in long-term site productivity (Cochran and Hopkins 1991, Monleon and others 1997). Nutrient cycling is considered by some to be the most important ecosystem "service" provided by forest biomes (Costanza and others 1997).

A carefully planned prescribed fire program is recommended for use on dry-forest plant association groups (warm dry and hot dry) after multi-layer stands have received an understory removal or thinning treatment. Prescribed fire should also be considered as a future treatment for any plantations established on those same PAGs. Prescribed fire will probably not be feasible for at least 30 years after plantations have been established, but it could then be coordinated with thinning and pruning treatments designed to create stand structures with low risk of crown fire or other undesirable fire behavior (Agee 1996, Scott 1998).

Soils Impacts

Many of the unneeded roads in this analysis area have already been obliterated. Analysis should continue on the remaining system roads for drainage improvement opportunities and further assessment of remaining non-system or closed system roads. This area has high potential for being one of the first of the watersheds on the Forest where soil-water restoration issues have been largely addressed. Future and on-going assessments and treatments for upland site rehabilitation should concentrate on areas that have had higher activities in the past. The most feasible and, therefore, high priority sites for treatment of site/soil impacts are those with gentle terrain that have experienced timber harvest and road construction activities. These sites would include log landings and unused or closed roads. The latter can be identified from the transportation management system in GIS. Many of these restoration activities will require vegetation disturbance, and thus must consider the trade-off between loss of existing vegetation and long-term rehabilitation of the site.

Hydrological Improvements

Hydrological function in the analysis area could be improved with road system upgrades that could improve water quality. Road/stream interactions play an important role in degraded stream conditions. Much road obliteration has already taken place in the Phillips-Gordon watersheds. Future road obliteration should focus on streamside roads and on subwatersheds with high road densities, such as Gordon Creek and Middle and Upper Phillips Creek subwatersheds. Open roads determined necessary for travel and access should be upgraded to reduce potential sediment delivery to streams. Upgrades would consist of outsloping, the installation of waterbars, storm hardening road surfaces, the installation of rolling dips over existing culverts, and designing filter strips along roadways to catch excess sediment. Road/stream crossings should be upgraded to reduce the possibility of severe erosion during high flow events when water overtops the road or re-routes around the culverts into roadside ditches. Continue on-going restoration projects, including proposed road obliterations in the Pedro-Colt planning area.

Enhancement of Riparian Vegetation

Restoring riparian vegetation is an important step in restoring healthy stream channels. Riparian shade should be increased with plantings and streamside grazing exclusion to preserve cooler water temperatures. Riparian revegetation would also act as a streambank stabilizer, reducing erosion into streams. Native stocks should be used whenever possible for riparian revegetation. Riparian restoration emphasis should be placed on perennial or fish bearing streams with streamside roads or other disturbances. Emphasis should also be placed on land exchange areas where streamside logging has taken place. Riparian hardwoods should be planted where pine plantations extend into riparian zones.

Best Management Practices

Best Management Practices (BMPs) should be applied for all land-disturbing activities, including administrative actions, operations, and mitigation for short-term disturbances. All management plans should include site-specific BMPs for water quality protection. BMPs include retaining riparian buffers, silt fences for erosion control, proper location of skid trails for logging, and timing of in-stream management activities. Projects should be periodically monitored to assure applicable BMPs are properly used and are effective in reducing potential impacts to water quality.

Fisheries Restoration

Some specific fisheries recommendations are as follows. Consider the introduction of large woody debris to Dry Creek reach 1 and 2 and Phillips Creek reaches 1, 2, and 3. These stream reaches have low abundance of large wood and poor to moderate fish habitat quality and low abundance of pools. The addition of large wood could improve spring and winter fish habitat in the short-term and contribute to long-term floodplain recovery.

Fish passage restoration projects should be considered a high priority at Pedro Creek and Road 3734-060. This culvert restricts juvenile fish passage at low flow to approximately 1 mile of habitat above this site. Pedro Creek is a small stream that could provide important resident trout habitat and summer and winter anadromous rearing habitat. The same is true for Phillips Creek and Road 3738, T.2N., R.38E., Sec. 8: Resident trout and possibly adult steelhead trout upstream passage at high flows is blocked by this partial migration barrier. Juvenile fish passage is blocked at low flows. Approximately three-quarters of a mile of habitat is available above this site. Moderate priority projects are at Little Phillips Cr. and Road 3734 where juvenile fish passage is restricted at summer low flow conditions to approximately 3 miles of poor to moderate quality fish habitat.

Fisheries restoration projects should include an assessment of the effectiveness of pool-forming structures on Phillips Creek to determine maintenance needs.

Noxious Weeds Control

Due to high habitat potential and seed availability, noxious weeds will likely continue to be a persistent problem in the Phillips-Gordon Creek watershed. 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 priority for the various noxious weed species occurring in the analysis areas are displayed in Table 10-3. “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. The three new invader species present in the analysis area (diffuse knapweed, spotted knapweed and tansy ragwort) have also been designated as priority noxious weeds by both Oregon and Washington State Departments of Agriculture (“B” or “T” statutory status).

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 tansy ragwort and diffuse/spotted knapweed. Some of the sites in greatest need of treatment occur within NFS road right-of-ways outside the Forest boundary, notably those along the southeast portion of the Phillips Creek road (Rd. 3738). These and other infestations lacking NEPA clearance could be addressed in a new District or Forest Noxious Weed EA or possibly incorporated into NEPA documents dealing with other projects in the vicinity (e.g., road rehabilitation, prescribed fire, vegetation management projects). Integrating diverse projects into umbrella NEPA documents may be an effective approach for decreasing the lag time between weed introduction and control.

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.

Table 10-3. Status and treatment priority for noxious weeds species occurring in the Phillips-Gordon analysis area.

Common Name	Management Status	Statutory Status		Spread Potential	Treatment Priority
		OR[1]	WA[2]		
Diffuse knapweed	New Invader/ Established	"B"	"B"	Very High	Very High
Spotted knapweed	New Invader	"T"	"B"	Very High	Very High
Canada thistle	Established	"B"	"C"	Moderate	Low
Bull thistle	Established	"B"	-	High	Low
Houndstongue	Established	"B"	"C"	High	High
Klamathweed	Established	"B"	"C"	Very High	Low
Tansy ragwort	New Invader	"T"	"B"	Very High	Very High
Flannel Mullein	Established	-	-	Low	Low

[1] Oregon Department of Agriculture Noxious Weed Rating System: B = Noxious weed of economic importance which is regionally abundant, but may have limited distribution in some counties; biological control is the preferred approach; T = Priority noxious weed designated as a target species for statewide management plan.

[2] Washington State Noxious Weed Categories: B = Non-native species limited to portions of WA; designated for control in regions where not yet widespread; C = Non-native species which may be widespread in WA; long-term suppression and control are a local option.

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 educational 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 Departments of Agriculture, and other landowners and federal agencies.

Terrestrial Vertebrates

Conservation of Late/Old Forest Structure

Past harvest activities have removed much of the suitable old growth tree habitat in the Phillips-Gordon analysis area. 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 percent of the forested area. Current late/old forest stands within the analysis area generally occur in small patches, contain little interior habitat, are widely scattered patches, seldom connect to similar habitats, and occupy approximately 26 percent of the forested area.

The goal for old forest management, Forest-wide, is to maintain existing habitat and restore habitat in watersheds where it is deficit. Management objectives to achieve this goal include:

- Maintenance of existing LOS units/stands.
- Expansion of the LOS component in the watershed.
- Increase in patch size of individual LOS stands.
- Utilization of existing LOS direction to implement the strategy.

The purpose of the strategy outlined in Table 10-4 is to increase the amount of late and old structure as soon as possible in order to restore a fully functional old forest component within the watershed. The question "how much is enough?" then arises. The HRV concept was used to derive a "desired condition" for LOS by Old Forest type and Plant Association Group (PAG). Table 10-5 displays the results of these calculations. The middle point of the HRV, identified for each PAG, is simply a rounded value derived from the mean of the two extreme values of the historic range for each structural classe. The HRV mid-point value represents a moderate level of LOS attainment, and while this number serves as a convenient target level, it should not be considered as the "maximum" amount of needed old forest. Additional acres beyond the target will make the network more flexible and more resilient to loss from disturbance such as insects, disease or windthrow. Whenever a restoration objective target translates to less than 150 acres on the ground for any PAG, look for opportunities to connect stands with similar Potential Vegetation Groups (PVG, i.e. Cold Forest, Moist Forest, Dry Forest, etc.) in order to reduce the number of fragmented stands, increase interior habitat, and to approximate historic patch size.

Table 10-4. Initial LOS restoration objectives, by plant association group, in the Phillips-Gordon analysis area.

		Old Forest Single Strata			Old Forest Multi Stratum		
PAG	Total PAG Acres	Historic Range of Variability	HRV Mid-point	Restoration Objective (Acres)	Historic Range of Variability	HRV Mid-point	Restoration Objective (Acres)
Cold, Dry	7,210	0-5 %	3%	22	10-40 %	25%	180
Cool, Wet	1,372	0-5 %	3%	41	30-60 %	45%	617
Cool, Very Moist	51	0-5 %	3%	2	20-40 %	30%	15
Cool, Moist	16,722	0-5 %	3%	502	10-30 %	20%	3344
Warm, Very Moist	2,070	0-5 %	3%	62	20-40 %	30%	621
Warm, Moist	2,160	0-5 %	3%	65	10-30 %	20%	432
Warm, Dry	9,692	15-55 %	35%	4361	5-20 %	13%	1,260
Hot, Dry	298	20-70 %	45%	134	5-15 %	10%	30
Subtotal	39,575			5,189			6,499
Total Restoration Objective							11,688

Implementation of this strategy begins with Ecosystem Analysis and continues through local project planning. As site-specific activities are being planned, existing old forest stands and opportunities for expansion can be reviewed and needed changes implemented. Efforts at this stage should focus on maintaining the existing LOS condition and/or moving stands toward an LOS condition as soon as possible.

At this time, it is recommended that all existing old forest patches or stands (old forest single strata or old forest multi stratum) be protected from anthropogenic disturbances so as to serve as a cornerstone for future networks. Existing stands/patches can then 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 fill this role if the existing condition is at or near the old forest stage.

The LOS component in the watershed can be expanded by identifying "new" stands and/or by building off existing stands to meet the restoration objective identified in Table 10-4. Mid-to late-seral patches (understory reinitiation and young forest multi strata stands) in close proximity to existing old forest patches should be selected as potential replacements. 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 via passive management. The distribution of desired future patches (stand initiation and stem exclusion) should be identified and evaluated to determine if those stands are located on a desirable spacing, and which, if any, silvicultural activities might be used to accelerate their movement into the older age classes. 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, based on variables such as aspect, elevation, PVG, PAG, and past management activities. 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, LOS patches/stands must be much larger than indicated by current Forest direction. 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 in stands adjacent to current LOS patches in order to increase total patch size.

Existing standards and guidelines in the Forest Plan and "Eastside Screens" can be used to implement this strategy and manage LOS and old growth stands identified or selected in the watershed. LOS stands and old growth habitats need to be connected with each other inside the watershed as well as to like stands in adjacent watersheds in a continuous network pattern by at least two 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.

All stands identified as LOS stands or targeted for LOS development should 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 should be developed for the watershed showing existing and potential LOS stands as well as all possible habitat connectivity in the watershed. The map should be available as needed, particularly during the development phase of the project.

Implementation Strategy and Subwatershed Projects List

1. Within the priority subwatersheds, find areas of National Forest where actions would fit validated conditions using the following maps and information:

- forested areas with density problems
- all areas with slopes <30%
- areas with any timber sale history
- areas with slopes <30% that are uncut
- ECA
- stream reaches with bull trout concerns
- check insect and disease maps for pest potential effect on priority

2. Review the sizes and locations of areas, by subwatershed, where forest vegetation sustainability concerns can be addressed and conflicting objectives can be resolved.

3. Re-list the remaining candidates, grouping them first geographically (other logical groupings may be needed later) - Reconsider the late-old/riparian network map and address those needs to maintain usability - consult the ECA map.

4. Check for road access limitations and Forest Plan conflicts

5. Re-examine the lists of potential projects (see Step 3 below) in light of funding timelines and availability. Consider which areas offer the greater combined gain for effort expended through joint efforts. Consider other priority-setting criteria. Develop an overall timetable to plan/schedule what areas and actions will take place, including the project environmental assessments.

Relationship to the Blue Mountain Demonstration Area

As the entire area encompassed by this ecosystem analysis is within the Blue Mountains Demonstration Area (BMDA), it desirable for recommendations to be consistent with the BMDA Restoration Strategy. The BMDA Restoration Strategy provides a blue print for the future of the demonstration area, and is based on expectations provided by Oregon Governor Kitzhaber and Forest Service officials. According to the BMDA Charter, a high priority for conservation is associated with:

- *Areas dominated by old forests, native shrub lands or native grasslands;*
- *Stands dominated by large trees of resilient structure and composition;*
- *Areas providing high water quality or critical habitats for federally listed species;*
- *Rare ecosystems and those of high integrity;*
- *Unroaded areas; and*
- *Designated Research Natural Areas, Areas of Critical Environmental Concern, Wild and Scenic Rivers, and Wilderness Study Areas.*

A high priority for restoration is associated with:

- *Areas where there is potential to restore water quality impaired waters;*
- *Areas where existing roads provide access for restoration activities;*
- *Streams functioning at risk;*
- *Areas dominated by dry forests with conditions outside of historic range of variability;*
- *Areas where sagebrush/steppe is out of balance with the historical range of variability;*
- *Areas where roads have adverse effects;*
- *Areas where there are opportunities for economic or cultural benefits within ecological limits;*
- *Wildland/urban interfaces;*
- *Areas with noxious weed populations with an emphasis on new infestations;*
- *Areas where landowners are willing to participate;*
- *Areas where management would result in more stable, resilient watershed conditions;*
- *Areas providing habitat for species in decline (i.e. aspen groves); and*

- *Areas identified in species conservation plans as critical or important habitats where work will contribute to listed species recovery or where conditions are stable and disturbance risks are small.*

A low priority for restoration is associated with:

- *Cold forest settings*
- *Isolated parcels of land (unless unique)*
- *Areas where investments would have a low probability of success.*

Possible Revisions of Forest Plan, Forest Policy, or Procedures

Riparian Management Objective

PACFISH allows for modifications of riparian management objectives based on local geology, topography, climate, and potential vegetation. However, the lack of stream survey data for the Phillips-Gordon analysis area prevent assessment of whether PACFISH standards should be modified.

Fishing Access

The Umatilla National Forest Land and Resource Management Plan states on page 4-8, third paragraph, that "The opportunity to catch fish will have increased" based partly upon "better access from roads." Given the effects of roads upon stream channels and aquatic habitats, plans to construct more roads in or leading to riparian areas do not seem wise. At present and in the foreseeable future, it seems much more likely that best management practices will continue to include reducing the amount of roaded area on the Forest, especially in riparian areas. The Walla Walla Ranger District has already begun closing and obliterating some roads. It seems appropriate at this point to recommend deletion of the phrase "better access from roads" from page 4-8, paragraph three of the Forest Plan.

Fish Population Objectives

The Umatilla National Forest Land and Resource Management Plan states on page 4-7, paragraph 7, that "10 years from now, significant increases in production of both anadromous and resident fish will have occurred on the Forest. Anadromous fish increases will be the highest and most noticeable..." and on page 4-8, third paragraph, that the number of rainbow trout on the forest will have increased. This statement is problematic for two reasons: 1) Without baseline numbers for comparison, progress is not measurable, and 2) There are so many other, off-forest factors that figure into the anadromous fish population equation (dams, hatcheries, ocean fishing, Columbia River gillnet fishing, sport fishing), over which the Forest Service has no control, that population numbers are not really very useful as a measure of the Forest Service's progress. Most of the more accurate population census methods can be harmful to fish and would be inappropriate in streams with at-risk species. Redd counts are an apparent exception to this and should be used for those species and in those locations where feasible. More appropriate overall would be values for specific habitat parameters. Parameters such as pool frequency, wood frequency, water temperature, canopy cover, habitat complexity and others could be useful measurements of progress. The Forest Plan does indicate that improved instream habitat is also part of the desired future condition for fisheries, but does not quantify them. PACFISH quantifies some parameters and these are therefore now official goals of the Umatilla National Forest. Some of these could be refined to make them more specifically applicable to the Umatilla National Forest and to the watersheds under consideration, and some refinements have been suggested in this document.

Aquatic Management Indicator Species

Species selected as management indicator species ought to be especially sensitive to degradation of the environment. Rainbow trout/steelhead are specified as management indicator species for the Umatilla National Forest. They are probably the most hardy of the local salmonid species and as such are not effective indicators of degradation of the aquatic environment. Bull trout or some species of aquatic insects or amphibian would be much more useful in this capacity. Selection of a better management indicator species for aquatic environments should be based on consultation with biologists knowledgeable about streams and aquatic species common to the local area.

Terrestrial Management Indicator Species:

Similar concerns arise among terrestrial management indicator species. The pileated woodpecker was selected as representative of species requiring snags and down wood in mature and old mixed coniferous forest, while “primary cavity excavators”, from downy woodpeckers to flickers, were to represent the snag and down wood requirements of all other excavator species, as well as secondary cavity nesters. The white-headed woodpecker, having perhaps the most restrictive habitat requirements of all local excavator species (mature and old growth ponderosa pine), is poorly protected under this management scheme. Likewise, the flammulated owl, a secondary cavity nester associated with large pine snags, may not fare well under the current management scheme. Based on snag abundance analysis, many pine stands in the analysis area do not contain the minimum numbers of snags and logs required to support the Forest Plan management level of 40 percent. We recommend that the white-headed woodpecker be added to the list of terrestrial management indicator species, representing species with a preference for mature and old growth ponderosa pine, and that Forest Plan direction specify protection of all remaining suitable habitat for this species. Snag and down log requirements should be met or exceeded in all timber sale planning, and monitoring of these habitat components fully funded and implemented. It is recognized that few, if any, white-headed woodpeckers remain in this portion of the Blue Mountains. Therefore, should conflicts arise between management for white-headed woodpeckers and pileated woodpeckers, suitable pileated woodpecker habitat should not be sacrificed on the premise that white-headed woodpeckers might at some point in the future re-colonize this area.

Fire Management

The Forest Plan should be amended to provide direction for the use of prescribed natural fire to achieve management objectives in accordance with the Umatilla National Forest Land and

Resource Management Plan (FSM 5140.2). A Fire Use Management Plan should be prepared (Umatilla National Forest Fire Management Plan Chapter 41) and implemented through a Wildland Fire Implementation Plan (FSM 5143.2).

Fuels Management

In dry forest settings where the fire regime is represented by frequent, low intensity fires, each treatment shall be designed to achieve watersheds stand and fuel conditions such that, if impacted by a (head) fire under 90th percentile weather conditions, at least 70 percent of the basal area of overstory fire resistant trees within the watershed will survive. The definition of 90th-percentile weather conditions will be based on an analysis of fire season conditions, calculated for mid-afternoon, over a period of 10 to 20 years at the closest fire weather station. The prescription to implement the treatment will be developed based on fire behavior modeling and predicted fire effects. Effects will be predicted using techniques such as FOFEM (first order fire effects model), FARSITE and/or expert opinion.

Satisfactory or Marginal Elk Cover

A common and occasionally contentious issue is provision of elk thermal cover, particularly satisfactory elk cover. Satisfactory elk cover is defined as “a stand of coniferous trees at least 12 m (40 ft) tall and exceeding an average of 70 percent crown closure” (Thomas and others 1979). The concern about satisfactory elk cover centers on sustainability--are the stand densities required to attain 70 percent crown closure biologically feasible and ecologically sustainable? The answer to that question depends on stand composition. For ecological settings with the capability to support a wide range of species (CD, CM, and WD), the shade-tolerant, late-seral species can occur at sustainable densities that are high enough to provide satisfactory elk cover. However, the early-seral, shade-intolerant species cannot occur at densities high enough to provide satisfactory elk cover and still be considered sustainable over the long term (with one apparent exception western larch for the CM ecological setting). For the PP and LP ecological settings, it does not appear that satisfactory thermal cover is biologically feasible because the SDI values associated with 70 percent canopy cover meet or exceed the maximum SDI values for those settings. To preclude serious losses from insects, diseases, drought, and certain other disturbances, stand densities should be maintained at a stocking density below the upper management zone. Marginal elk cover is defined as a stand of trees 10 or more feet high with an average canopy cover of at least 40 percent (USDA Forest Service 1990). Data indicate that the basal areas and stand density indexes associated with 40 percent canopy cover are generally low, and would pose little or no risk from a forest sustainability standpoint. The guidelines for elk cover should be reviewed in light of more recent sustainability concepts for forest stand and more recent findings in cover requirements for elk.

Data Gaps and Information Needs

Vegetation

Future conditions were not considered. Most of this vegetation analysis focused on reference (historical) and current conditions. There was no explicit consideration of future conditions.

Unfortunately, the inter-agency Federal process developed for watershed analysis (REO 1995) does not require an assessment of future conditions. Perhaps future EAWS efforts would benefit from having the "third leg of the triangle" (i.e., future conditions) take its place alongside reference and current conditions. Analytical tools have recently been developed that would help evaluate future scenarios, such as the Vegetation Dynamics Development Tool (Beukema and Kurz 2000).

Additional information about limited vegetation components would have been helpful. Insufficient information was available about the condition and trend of limited vegetation components such as quaking aspen, black cottonwood, and western white pine in the Phillips-Gordon drainage. The Walla Walla District has information about these components but, in some instances, the information is not readily available or has not yet been synthesized or interpreted. It is recommended that the District continue its on-going efforts to develop a "species of special concern" GIS layer (and associated databases) to monitor the location and status of limited vegetation components.

Current field inventories may have improved analysis accuracy. Inventory information is used to prepare assessments of watersheds, landscapes, entire National Forests, and other mid- or broad-scale land areas. Dating back to the early 1990s, inventory budgets have been steadily declining, quickly resulting in reduced availability of stand examinations and other high-resolution data sources. It is recommended that the Walla Walla District continue to acquire updated field inventories whenever possible.

Hydrology

Data on private land harvest and roads are not available. As a result, ECA and road density values for subwatersheds with significant proportions of private lands may not be representative of actual values.

Livestock grazing, recreational uses, and private land uses are not quantified. This means there are limitations to our ability to fully evaluate the cumulative effects of land management on watershed function. A complete cumulative effects analysis would quantify these uses and assess impacts.

There are no current inventories of Class 3 or 4 streams. Integrated riparian and stream channel inventories are a vital component absent in current Forest management programs. The R-6 Stream Inventory protocol is geared towards aquatic habitats in Class 1 and 2 (fish-bearing) streams. In addition, information on streamside vegetation communities is needed to address management issues in these critical habitats. Crowe and Clausnitzer's (in review) wetlands classification should be used to identify existing plant communities and likely plant associations. Identification of watershed restoration needs could be a part of an integrated inventory, and are an essential part of field validation and implementation of the recommendations in this report.

Need to analyze existing hydro-meteorological data. There is a backlog of data and more should not be collected with out sufficient monitoring plans in place.

Stream temperature has only been monitored on a sporadic basis. Only a few locations have been used to collect stream temperature data. Inexpensive thermographs should be placed at several locations in the watershed to determine areas of concern. Easily accessible sites could include Dry Creek, Phillips Creek, Little Phillips Creek, and Gordon Creek near the Forest

Boundaries. If these locations typically are dry late summer, the thermographs should be located in nearby pools or upstream in perennially flowing water.

Stream classification databases should be updated and validated. Project-level planning should use field information to update and validate stream inventories.

ECAs, road densities, stream densities, and geomorphology characteristics are only available for Umatilla National Forest acres. Subwatersheds with significant proportions of private lands may not be well represented by calculated parameter values.

Coordinated Monitoring

Multiple ownerships in the Phillips-Gordon watershed provide opportunities for coordinated monitoring. Private landowners and the Grande Ronde Model Watershed are interested in coordinated monitoring and watershed restoration efforts.

Fire and Fuels Information

Estimates of fuels conditions are often made based on vegetation, prior activity, slope, elevation, aspect, etc. Using this approach to developing predictive models for fire behavior is imprecise at best. Good predictive models require accurate, field-verified fuels profiles, as well as information on stand structure, weather, and topography. When properly stored in GIS, this information can be used to develop models that result in more accurate fire growth predictions.

Lack of Population Information for Terrestrial Vertebrates

Baseline information on which to assess the population status of terrestrial wildlife were available only for elk and deer, with some very limited presence/absence information for the pileated woodpecker. Quantitative historical information on wildlife populations (again with the exception of deer and elk) is almost totally lacking. Without this information, it is extremely difficult to predict the future viability of local vertebrate populations. Estimates, predictions of future status, and management recommendations contained in this report are, therefore, based almost totally on analysis of habitat conditions only.

Future Conditions

Most of this vegetation analysis focused on historical and current conditions. There was no explicit description of future (desired) conditions, although they were considered indirectly when formulating management recommendations and opportunities. Future conditions were not considered due to time constraints imposed by the size, breadth, and scope of the 113,000-acre analysis area, and because explicit consideration of future conditions is not a requirement of the “ecosystem analysis at the watershed scale” process (Regional Ecosystem Office 1995).

Future ecosystem assessments would benefit from having the “third leg of the triangle” (e.g., future conditions) take its place alongside historical and current conditions. Allowing additional analysis time, or analyzing smaller areas in the same time as was available for this effort, might allow future conditions to be assessed using a successional model such as the Vegetation Dynamics Development Tool (Beukema and Kurz 2000).

Quality of the Historical Maps.

This upland-forest analysis made extensive use of historical maps. Those maps were generally unregistered, available on a variety of media, and produced at a scale of 1 inch equals 1 mile (1:63,360). The digitizing process required that the maps be registered as well as they could be, using section corners as control points and USGS 7½ minute quad maps (1:24,000) as references. All polygon boundaries on those maps must be assumed to be approximate, due to distortions in the media over time and the inexact nature of the registration process.

Accuracy of Structural Stage Determinations.

The structural stage determinations were based on generalized characteristics for each forest polygon (see tables 26-27 in appendix 1, Powell). Had stand exam information been available for all forested area, it could have significantly improved the determination of structural stages, particularly for old forest. Since stand exams were available for only 42 percent of the National Forest System lands in the analysis area, it was necessary to use some low-resolution data sources (photo interpretation) to derive forest structural stages. Without a structural stage assignment for every polygon, it would have been impossible to complete an HRV (historical range of variability) analysis.

Missing Portion of the 1936 Map.

The 1936 historical cover-type map was used for several analyses. However, its use was constrained slightly because coverage was unavailable for a small portion of the analysis area (primarily Union County in the east and south ends of the analysis area).

Reliability of Canopy Cover Equations. Several analyses relied upon canopy cover information, which was often used as a surrogate for vegetation or stand density. Since stand density guidelines do not include canopy cover directly, it was necessary to calculate that information using equations developed from an elk cover study (Dealy 1985). Although Dealy’s equations were derived from a large sample, their predictive accuracy (r^2 values) were not particularly high (ranging from .21 to .49), and it must be assumed that canopy cover calculations are estimates. In this analysis, it was necessary to apply canopy cover equations developed at the series level (CP, CW, etc., from Hall 1973) to individual tree species. Since some unknown portion of Dealy’s sample consisted of multiple-species stands, it must be assumed that use of his equations could be compromised to some degree when used for a single-species scenario.

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Upland Forest Vegetation Analysis: Phillips and Gordon Watersheds

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Loading a Ford Trimotor airplane with “goop” (DDT insecticide and a diesel oil carrier) during a western spruce budworm treatment project. This photograph was taken in June of 1951 at the Meacham, Oregon airstrip. Portions of the Phillips/Gordon analysis area were sprayed in both 1950 and 1952 to control spruce budworm population levels.

CONTENTS

INTRODUCTION

"Ecosystem analysis at the watershed scale" is a process 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).

Upland forests reflect the interaction of ecosystem elements called components, structures, and processes. Components are the organisms that make up an ecosystem (Manley and others 1995); they can include individual trees, aggregations of tree species called forest cover types, or combinations of cover types called life-forms (Veg Table 1).

Structures are the arrangement or distribution of ecosystem components (Manley and others 1995). They occur both horizontally (the spatial distribution of components across a landscape) and vertically (trees of varying height growing together in a multi-layered arrangement). Structures can consist of forest size classes, structural classes, or physiognomic groups (Veg Table 1).

Processes are the flow or cycling or energy, materials, and nutrients through space and time (Manley and others 1995). Forest processes include everything from photosynthesis and nutrient cycling to stand-replacing wildfires and insect outbreaks (Veg Table 1). In the Phillips and Gordon watersheds and in the Interior Northwest in general, disturbance processes have influenced vegetation conditions to a greater degree than other ecosystem processes (Clark and Sampson 1995; Oliver and Larson 1996).

Veg Table 1 demonstrates that ecological analysis is highly influenced by scale because ecosystem elements occur as hierarchies (Haynes and others 1996). Some elements are easily identified at one scale but not at another. That doesn't mean an element ceased to exist – it is just not apparent at the resolution of a different hierarchical level. For example, at the fine scale represented by the interior of a forest stand, individual trees can be 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 can no longer be discerned although life form differences (forest versus non-forest) are obvious.

Veg Table 1. Selected examples of upland-forest ecosystem elements.

	ECOSYSTEM SCALE (HIERARCHICAL LEVEL)		
ELEMENTS	**FINE**	**MID**	**BROAD**
Components	Individual Trees	Cover Types	Life Forms (forest/nonforest)
Structures	Tree Size Classes	Structural Classes	Physiognomic Groups
Processes	Photosynthesis; Nutrient Cycling	Disturbances	Weather; Climate

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

This report provides the results of an upland-forest vegetation analysis for the Phillips and Gordon watersheds. The following upland-forest ecosystem elements were analyzed: potential vegetation, cover types, size classes, structural classes, density classes, canopy layers, and disturbance processes. A variety of information sources were used for the analysis; the most important ones are described in Veg Table 2. Appendix one describes databases supporting the upland forest analyses.

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

DATA SOURCE	DESCRIPTION OF DATA SOURCE
ADB (Activities Database).	ADB is a normalized, relational database system assembled and maintained by the Walla Walla Ranger District. Detailed information is stored about current and historical timber harvest, reforestation, site preparation, thinning, pruning, and other management activities.
Aerial Detection Surveys.	The Pacific Northwest Region of the Forest Service has been monitoring the impact of important forest insects since 1947, when the first aerial sketch map was prepared to provide information about a spruce budworm outbreak (Dolph 1980). Sketch maps have been completed annually since then; maps from 1980-1999 were used to characterize insect-caused damage for the Phillips/Gordon area.
CVS (Current Vegetation Survey).	CVS is an equal-interval grid system that sampled both forest and nonforest ecosystems. Each installation was a 5-point plot cluster occupying about 1 hectare (2.5 acres). Plots were installed every 1.7 miles (3.4 miles in Wilderness). Each 1.7-mile plot represents an area of 1,853 acres. 22 CVS plots were used to assess insect and disease risk for the analysis area.
EVG (Existing Vegetation).	EVG stores information about existing vegetation at the stand level. The original data was based on interpretation of aerial photography acquired in 1987 and 1988. For the Phillips/Gordon area, 49% of the polygons were characterized using photo-interpretation data from EVG.
GLO (Government Land Office) **Survey Notes.**	The GLO was formed in 1812 to survey the public domain. Their survey notes described vegetation and other features. Survey notes from the late 1850s to the early 1900s were used to assemble a database, and it was then used as a source of historical information for vegetation analyses.
Historical Forest-Type Maps.	Two historical forest-type maps were used for the analysis: one published in 1936 and another in 1958 (both were produced at a scale of 1 inch = 1 mile). The maps were published by the Pacific Northwest Forest and Range Experiment Station during a county-level forest survey program.
MSS (Managed Stand Survey).	MSS is a plot-based system that sampled young, managed stands with an average diameter of 3 inches or more – primarily plantations that had been thinned at least once. Each installation was a 5-point plot cluster covering about 1 acre. Thirteen MSS plots were installed in the Phillips/Gordon analysis area in 1990.
Potential Vegetation Map (PVEG).	Between May and November of 1998, a potential vegetation map was prepared by Karl Urban, Forest Botanist. The map contains over 20,000 polygons, each of which was assigned an Ecoclass code (plant association or community type). Management implications were also recorded for some of the polygons (potential for quaking aspen, white pine, etc.).
R6-TSE (Stand Exam).	Stand exams are designed to collect information at the stand level. Site, stand, and tree data are collected on temporary plots. For the Phillips/ Gordon analysis area, 51% of the polygons were characterized using stand examinations (including walk-through surveys).

Sources/Notes: See appendix 1 for more information about EVG, historical forest type maps, and stand exams.

ISSUES AND KEY QUESTIONS

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 being 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.

The upland-forest vegetation analysis was designed to respond to these key questions:

1. How do current forest conditions compare to those that existed historically?
2. Are current forest conditions considered to be ecologically sustainable over the long term?
3. If current forest conditions are considered to be unsustainable, how could they be changed in order to create a more sustainable situation?
4. How have disturbance processes shaped existing forest conditions, and what role might we expect them to play in the future?

The key questions were addressed during an analysis of the ecosystem elements. Specific analysis indicators were selected for each ecosystem element and are shown in Veg Table 3.

Veg Table 3. Key ecosystem elements and analysis indicators for upland-forest vegetation.

ELEMENTS	ANALYSIS INDICATORS	WHERE ANALYZED
Components and Structures	Forest Cover Types	Cur Con; Ref Con; Syn Int
	Forest Density Classes	Cur Con; Ref Con; Syn Int
	Forest Size Classes	Cur Con; Ref Con; Syn Int
	Forest Structural Classes	Cur Con; Ref Con; Syn Int
	Forest Canopy Layers	Cur Con; Ref Con; Syn Int
Processes	Potential Vegetation	Characterization
	Forest Disturbance Processes	Characterization
	Forest Insects (Impact)	Characterization
	Insect and Disease Risk	Synthesis and Interpretation

Sources/Notes: Analysis indicators were used to measure or interpret each of the ecosystem elements. The “where analyzed” column shows the “Ecosystem Analysis at the Watershed Scale” steps where the analysis indicator was used – “Cur Con” is current conditions; “Ref Con” is reference conditions; and “Syn Int” is synthesis and interpretation.

CHARACTERIZATION

Landscapes and the ecosystems that comprise them "age" through time. The series of changes that result in forest aging is called plant succession. Plant succession refers to temporal changes in both species abundance and vegetation structure following a disturbance event. Once initiated, plant succession follows a variety of pathways and occurs at varying rates of speed (Drury and Nesbit 1973, McCune and Allen 1985). The main factor affecting the speed and direction of plant succession is potential vegetation.

Upland forests in the analysis area can be thought of as the product of two important ecosystem processes: plant succession (as controlled by potential vegetation), and disturbance. Each of those processes is described individually in this section.

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 the two 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. Herbaceous communities and stands of deciduous trees are scattered throughout the coniferous forest, and the species of dominant conifer changes from one site to another. At the foot of the mountains, fingers of forest and ribbon-like shrub stands invade the grassland zone for varying distances but become progressively less common before eventually disappearing altogether.

The Blue Mountains province, then, is actually broken up into a myriad of small units, most of which are repeated in an intricate, changing pattern. Making sense of this landscape pattern is possible using a concept called potential vegetation (PV). Potential vegetation implies that over the course of time and in the absence of future disturbance, similar plant communities will develop on similar sites. Potential vegetation information offers insights into vegetation-site relationships and can be helpful in projecting the type of vegetation expected under a particular set of ecological factors (Powell 2000).

The genetic structure of a plant species allows it to be adapted to a specific range of environmental conditions, which is called its ecological amplitude (Daubenmire 1968). Ecological amplitude is controlled by many factors such as elevation, aspect, geology and soil type – together they create the underlying foundation, or a "geomorphic template," upon which the biological landscape is constructed. The biophysical components of a plant's environment interact to form a temperature and moisture regime.

Because of their diverse landforms and topography, mountainous areas support a variety of temperature and moisture regimes. Since potential vegetation is influenced primarily by temperature and moisture, any significant change in an area's temperature or moisture status will cause a change in potential vegetation. In the Phillips and Gordon watersheds and other mountainous areas, temperature and moisture varies somewhat predictably with changes in elevation, aspect, and slope exposure (Powell 2000).

The potential vegetation associated with a particular set of temperature and moisture conditions is called a plant association. A plant association is named for the dominant plant species in its vegetation layers – the grand fir/twinflower plant association is dominated by grand fir in the overstory (tree) layer, and by twinflower in the undergrowth layer. In the analysis area, 32 forested plant associations have been identified (Johnson and Clausnitzer 1992, Johnson and Simon 1987; see Veg Table 4).

Sites that can support similar plant associations are grouped together as a plant association group (PAG). Similarly, closely related plant association groups are aggregated into a potential vegetation group (PVG). The end result is a hierarchy ranging from plant associations at the lowest level to PVGs at the highest level (Veg Table 4). Veg Table 5 summarizes selected characteristics of the PVGs. Veg Figures 1 and 2 (see appendix 2) show the location and distribution of upland-forest PAGs and PVGs, respectively.

Veg Table 4. Potential vegetation hierarchy for upland forests of the Phillips/Gordon analysis area

PVG	PAG	ABBREVIATION	COMMON NAME OF VEGETATION TYPE	AREA
Cold Upland Forest	Cold Dry	ABGR/VASC	Grand Fir/Grouse Huckleberry	100
		ABLA2/CAGE	Subalpine Fir/Elk Sedge	33
		ABLA2/POPU	Subalpine Fir/Polemonium pct	163
		ABLA2/VASC	Subalpine Fir/Grouse Huckleberry	440
		ABLA2/VASC/POPU	Subalpine Fir/Grouse Huckleberry/Polemonium	8
Moist Upland Forest	Cool Wet	ABGR/TABR/CLUN	Grand Fir/Pacific Yew/Queen's Cup Beadlily	823
		ABGR/TABR/LIBO2	Grand Fir/Pacific Yew-Twinflower	459
		ABLA2/STAM	Subalpine Fir/Twisted Stalk pct	90
	Cool Very Moist	ABGR/TRCA3	Grand Fir/False Bugbane	51
	Cool Moist	ABGR/CLUN	Grand Fir/Queen's Cup Beadlily	4,505
		ABGR/LIBO2	Grand Fir/Twinflower	2,480
		ABGR/VAME	Grand Fir/Big Huckleberry	6,536
		ABLA2/CLUN	Subalpine Fir/Queen's Cup Beadlily	1,378
		ABLA2/LIBO2	Subalpine Fir/Twinflower	91
		ABLA2/TRCA3	Subalpine Fir/False Bugbane	131
		ABLA2/VAME	Subalpine Fir/Big Huckleberry	1,360
		PICO(ABGR)/VAME	Lodgepole Pine (Grand Fir)/Big Huckleberry pct	240
	Warm Very Moist	ABGR/ACGL	Grand Fir/Rocky Mountain Maple	2,071
	Warm Moist	ABGR/ACGL-PHMA	Grand Fir/Rocky Mountain Maple-Ninebark pct	112
		ABGR/BRVU	Grand Fir/Columbia Brome	595
		PSME/ACGL-PHMA	Douglas-fir/Rocky Mountain Maple-Ninebark	17
		PSME/HODI	Douglas-fir/Oceanspray	1,437
Dry Upland Forest	Warm Dry	ABGR/CAGE	Grand Fir/Elk Sedge	259
		ABGR/CARU	Grand Fir/Pinegrass	262
		ABGR/SPBE	Grand Fir/Birchleaf Spirea	729
		GRASS/TREE MOSAIC	Grass/Tree Mosaic pct	4,288
		PIPO/CAGE	Ponderosa Pine/Elk Sedge	135
		PIPO/CARU	Ponderosa Pine/Pinegrass	581
		PIPO/SPBE	Ponderosa Pine/Birchleaf Spirea pct	33
		PIPO/SYAL	Ponderosa Pine/Common Snowberry	163
		PSME/CAGE	Douglas-fir/Elk Sedge	790
		PSME/CARU	Douglas-fir/Pinegrass	1,028
		PSME/PHMA	Douglas-fir/Ninebark	709
		PSME/SPBE	Douglas-fir/Birchleaf Spirea	4
		PSME/SYAL	Douglas-fir/Common Snowberry	333
		PSME/SYOR	Douglas-fir/Mountain Snowberry	148
		PSME/VAME	Douglas-fir/Big Huckleberry	229
	Hot Dry	PIPO/AGSP	Ponderosa Pine/Bluebunch Wheatgrass	210
		JUOC community types	Western Juniper plant community types	88

Sources/Notes: Adapted from Powell (1998). "Pct" after a common name refers to a plant community type (a seral or successional plant community); all other vegetation types are plant associations described in Johnson and Clausnitzer (1992). "Grass/tree mosaic" refers to a juxtaposition of forest and grassland communities that typically occurs as forested stringers embedded in a nonforest matrix of grassland or shrubland. Area figures (acres) include National Forest System lands only.

Veg Table 5. Selected characteristics of potential vegetation groups (PVGs) for upland forests.

PVG	AREA (ACRES)	DISTURBANCES	FIRE REGIME	PATCH SIZE	ELEVATION (FEET)	SLOPE (PERCENT)	DOMINANT ASPECTS
Dry Upland Forest	9,990	Fire Insects Harvest	Understory	1-2,000	4,228 (3,355-5,778)	35 (4-63)	Southeast Southwest East
Moist Upland Forest	22,376	Diseases Harvest Fire Insects	Mixed Severity	1-10,000	4,515 (3,218-5,773)	29 (2-62)	East Northeast West Southeast
Cold Upland Forest	721	Wind Insects Fire Diseases	Stand Replacement	1-1,000	5,003 (4,006-5,697)	21 (2-57)	East Northeast Southeast

Sources/Notes: Areas, elevations, slope percents, and aspects were summarized from the "ExistPG" database (see appendix 1). Patch size (acres) was taken from Johnson (1993). Disturbances, which show the primary agents affecting upland-forest ecosystems, were based on the author's judgment. For elevations and slope gradients, values are portrayed in the following format: average (minimum-maximum). Fire regime ratings have the following interpretation (Smith 2000):

Understory: fires generally not lethal to dominant vegetation – approximately 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 – app. 80% or more is consumed/killed.

Some late-seral (successional) vegetation types persist on the landscape and have been referred to as plant community types in vegetation classifications. Forested plant community types have one or more dominant 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 analysis area, seven forested plant community types have been identified (Johnson and Clausnitzer 1992, Johnson and Simon 1987; see Veg Table 4).

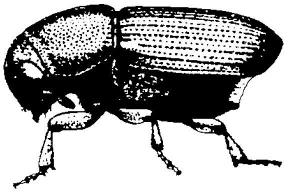
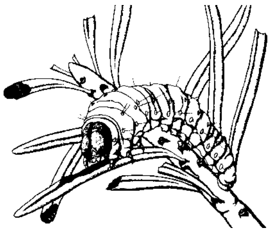
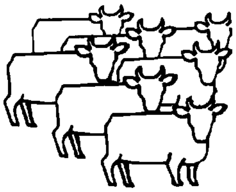
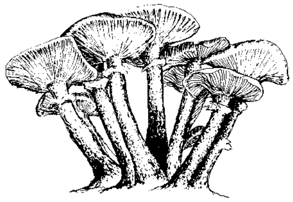
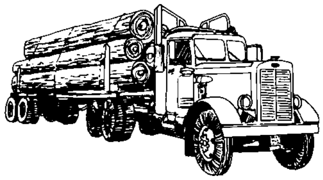
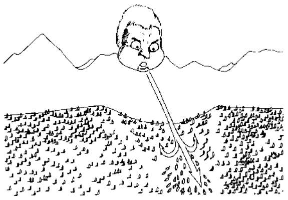
Why do we care about the potential vegetation (PV) of the Phillips/Gordon area? The main reason is that PV has an important influence on ecosystem processes. It is the "engine" that powers vegetation change – it controls the speed at which shade-tolerant species get established beneath shade-intolerant trees, the rate at which forests produce and accumulate biomass, and the impact that fire, insects, pathogens, and other disturbance agents have on forest composition and structure. The implications of those processes are predictable, at least to some extent, for a reason – they can be related to PV, and research has shown that sites with the same PV behave in a similar way (Cook 1996, Daubenmire 1961).

FOREST DISTURBANCE PROCESSES

Disturbance processes have a profound influence on the structure and composition of vegetation. Veg Table 6 describes seven disturbance agents that have influenced upland-forest vegetation in the Phillips/Gordon analysis area, although they are certainly not the only ones to have done so.

Much of the forested land within the analysis area was affected by various disturbance agents in the recent past. Information provided by the Pacific Northwest Region's annual aerial survey program was used to assess insect impacts (see Veg Table 2 for information about aerial detection surveys). Insect activity was recorded on a "sketch map;" sketch maps for a 20-year period (1980-1999) were used to summarize the areal extent of recent insect impact on upland-forest sites (Veg Table 7).

Veg Table 6. Important disturbance agents of the Phillips/Gordon analysis area.

	**Bark Beetles.** Douglas-fir beetle and fir engraver are the main bark beetles affecting mid-elevation mixed-conifer forests (see Veg Table 7). Mountain pine beetle has affected both ponderosa and lodgepole pines, with large outbreaks occurring in the mid 1940s (Buckhorn 1948) and in the 1970s (Carter 1976). Western pine beetle was very active in the late 1940s, particularly after ranchers began girdling ponderosa pine trees to clear land for grazing (Buckhorn 1947).
	**Defoliating Insects.** The analysis area experienced 2 spruce budworm outbreaks over the last 50 years: one in 1944–1958, and another from 1980–1992. In the first outbreak, the entire analysis area was defoliated to some degree by 1949; parts of it were sprayed with DDT in 1950 and 1952 (Dolph 1980). In the second outbreak, defoliation peaked by the late 1980s and B.t. was sprayed in 1988 and 1992 (Veg Figure 3). Douglas-fir tussock moth defoliated mixed-conifer forest in 1972-1974; one small area of private land in the Gordon Creek drainage (subwatershed 7B) was treated with DDT in June of 1974.
	**Grazing.** Historical cattle and sheep grazing in the analysis area had significant impacts on vegetative conditions, particularly along ridgetops used as sheep driveways or as bedding grounds (Galbraith and Anderson 1970, Irwin and others 1994, Tucker 1940). Immense bands of sheep grazed in the Blue Mountains in the late 1800s and the early 1900s, often causing enduring changes in plant composition and fine-fuel continuity (Coville 1898, Griffiths 1903, Humphrey 1943).
	**Parasites and Pathogens.** Root diseases tend to be localized, but can cause significant tree mortality in affected areas. Armillaria root disease is found throughout the mixed-conifer type; Annosus root disease is associated with partial-cut timber harvest areas, especially if fir stumps were created by the harvest. Dwarf mistletoes, a tree parasite, affect ponderosa pine, lodgepole pine, western larch, and Douglas-fir in the Phillips/Gordon analysis area.
	**Timber Harvest.** Timber harvest has been used to produce the wood commodities desired by a human society. Harvest in the Blue Mountains began in the 1880s but at a much reduced rate as compared to other pine forests in eastern Oregon (Weidman 1936). From the 1940s on, however, harvesting of ponderosa pine increased to meet the demand for post-war housing. The main timber harvest era occurred in the mid 1970s when at least 51 million board feet were harvested to salvage trees killed or damaged during a Douglas-fir tussock moth outbreak.
	**Wildfires.** A large fire occurred in the analysis area about 1850; it came "from the present Umatilla Indian Reservation, burned up the river Umatilla, then turned north along the heads of the Walla Wallas, and reached as far as the head of the Wenaha" (Kent 1904). When a forest-type map of Oregon was published in 1900, portions of 2 burnt areas were shown in the Phillips/Gordon area – one was 118 acres and the other 2,726 acres (Thompson and Johnson 1900).
	**Windstorms.** A major windstorm occurred on January 8, 1990. It affected subalpine fir/Engelmann spruce stands along Highway 204 and in the Tollgate/Spout Springs area. The infamous 1962 Columbus Day windstorm, which caused extensive damage throughout the Pacific Northwest, had little impact in the analysis area. Windstorms were frequently mentioned as a disturbance agent in historical accounts of the Blue Mountains (Smith and Weitknecht 1915).

Sources/Notes: Based on annual aerial detection surveys and on unpublished records available at the Walla Walla Ranger District and at the Umatilla National Forest Supervisor's Office.

Veg Table 7. Area (acres) of insect-caused forest damage in the Phillips/ Gordon analysis area, 1980-1999.

YEAR	MIXED-CONIFER BEETLES	PINE BEETLES	WESTERN SPRUCE BUDWORM	OTHER	TOTAL	PERCENT OF AREA
1980	267	789	—	—	1,057	2.6
1981	224	49	—	—	273	0.7
1982	98	—	31	—	129	0.3
1983	48	96	—	—	145	0.4
1984	120	—	—	—	120	0.3
1985	38	—	4,397	—	4,435	11.1
1986	—	—	33,664	—	33,664	84.1
1987	—	—	39,498	—	39,498	98.6
1988	4,500	—	19,219	—	23,720	59.2
1989	2,916	47	8,395	—	11,358	28.4
1990	2,280	9	16,708	—	18,996	47.4
1991	156	—	34,093	—	34,249	85.5
1992	91	—	34,996	51	35,139	87.7
1993	32	1	—	—	33	0.1
1994	167	—	—	33	200	0.5
1995	253	—	—	13	265	0.7
1996	10	—	—	—	10	0.0
1997	637	22	—	—	659	1.6
1998	5	5	—	—	10	0.0
1999	107	—	—	100	207	0.5

Sources/Notes: Areas (acres) were derived from aerial detection surveys (sketch maps) completed by the Pacific Northwest Region of the Forest Service (see Veg Table 2). Note that area figures in this table include National Forest System (NFS) lands only (including the Wallowa-Whitman NF). The "mixed-conifer beetles" category includes Douglas-fir beetle, fir engraver, spruce beetle, and western balsam bark beetle. "Pine beetles" includes mountain pine beetle in either lodgepole pine or ponderosa pine, *Ips* beetle in pine, and western pine beetle. "Other" includes larch casebearer, root disease, and sawfly. Some areas on the sketch maps 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 category columns because when insect activity is on-going in an area, the same acres may be included from one year to another (e.g., acreage values are not mutually exclusive from year to year). The "percent of area" values were calculated by dividing the "total" values by the NFS acres in the analysis area (40,046 acres for Phillips/Gordon).

Three disturbance processes have had an important influence on upland-forest conditions and will be discussed individually – defoliating insects, fire, and timber harvest.

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 (epidemic). Budworm outbreaks tend to be cyclic, with eruptive 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.

The Phillips/Gordon ecosystem analysis area has experienced two budworm outbreaks during the last 50 years. Early in the first outbreak (1944-1958), most of the budworm-host type in the analysis area was defoliated to some degree. In response to the defoliation and its resultant tree damage (top-killing and mortality), all of the Phillips/Gordon area was sprayed in either 1950 or 1952 to reduce budworm populations to non-damaging levels (Dolph 1980). DDT, a chemical insecticide applied in a fuel oil diluent, was applied during those spray projects.

DDT became a popular insecticide after it was used to control Douglas-fir tussock moth in northern Idaho and in the northern Blue Mountains west of Troy, Oregon in 1947 (Wickman and others 1973), and after it was applied experimentally to suppress spruce budworm populations on the Heppner Ranger District and adjacent Kinzua lands in 1948 (Eaton and others 1949). Although commonly used against defoliating insects, land managers eventually realized that DDT failed to provide long-term control because the underlying problem had not been addressed – a proliferation of insect-host type throughout the western United States (Carolin and Coulter 1971, Fellin 1983).

After the earlier outbreak collapsed in 1958, western spruce budworm remained at endemic levels until 1980, when another outbreak began in mixed-conifer stands near Cove, Oregon. The 1980-1992 outbreak moved from south to north in the Blue Mountains; the Phillips/Gordon watersheds did not experience substantial defoliation until 1986, although it then continued until 1992 (see Veg Table 7).

Portions of the 1980s budworm outbreak were treated with a bacterial insecticide called B.t. *(Bacillus thuringiensis)* in 1988 and 1992 (Veg Figure 3). As was the case for the 1950s DDT treatments, application of B.t. during the recent outbreak successfully reduced budworm populations in the short term, but had little long-term impact on the outbreak itself or on host-tree damage (Powell 1994, Torgersen and others 1995).

Douglas-fir tussock moth defoliates true firs and Douglas-firs from the top down, killing trees outright or setting them up for future attack by bark beetles such as Douglas-fir beetle or fir engraver. Like budworm, Douglas-fir tussock moth is a native component of coniferous ecosystems and it has been active in the Phillips/Gordon area for as long as a food supply has been available there. For example, a dendrochronology[1] analysis for the Drumhill Ridge area of the Walla Walla Ranger District indicates that Douglas-fir tussock moth may have defoliated mixed-conifer stands in that area between 1843 and 1845, 1852 and 1854, and in 1875 (Wickman and others 1994) (note that Drumhill Ridge adjoins the Phillips/Gordon analysis area at its southwest corner).

Historically, budworm and tussock moth outbreaks were smaller in extent than the most recent outbreaks because the insect food base (particularly mixed-conifer stands dominated by grand fir and Douglas-fir) was less continuous then (Hessburg and others 1994, 1999).

The last major tussock moth outbreak occurred between 1972 and 1974, when mixed-conifer stands throughout the analysis area were defoliated. This 1970s outbreak in the Interior Northwest was the largest and most severe one ever recorded (Brookes and Campbell 1978). In 1974, stands north of Mount Emily and west of Summerville (adjacent to the southwest corner of the analysis area) were treated with DDT to minimize defoliation-related damage, although tussock moth outbreaks have a short lifespan and tend to collapse on their own after about 3 years. One small area of private land in the Gordon Creek drainage (it occurs in subwatershed 7B) was also treated with DDT (Graham and others 1975).

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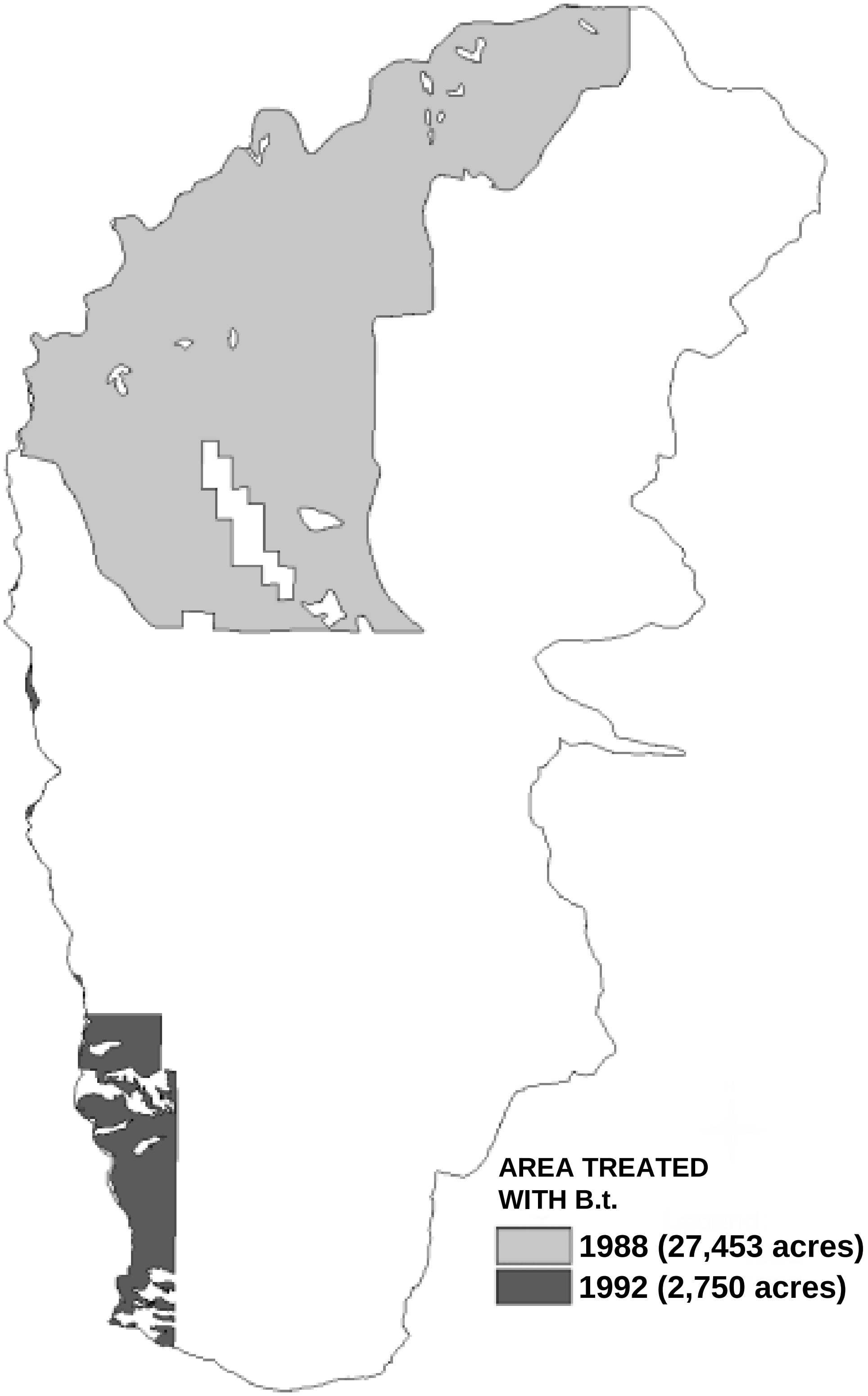
[1] Dendrochronology involves interpretation of tree cores to infer climate and fire cycles, insect outbreaks, etc.



Veg Figure 3. Areas treated with *Bacillus thuringiensis* (B.t.) in 1988 or 1992 to control western spruce budworm (treatment map provided by USDA Forest Service, Pacific Northwest Region, Forest Insect and Disease Group). By the mid 1980s, B.t. was the insecticide of choice because of its low risk to the environment and human health. Use of B.t. allowed land managers to maintain more of the pretreatment arthropod diversity than had been possible with carbaryl, acephate, mexacarbate or the other chemical insecticides in common usage at that time. Note that research found that application of insecticides during the 1980-1992 spruce budworm outbreak had little long-term impact on either budworm populations or host-tree damage (Powell 1994, Torgersen and others 1995).

Although application of DDT was an important response to tussock moth defoliation in the early 1970s, it was certainly not the only one – many salvage sales to harvest damaged and dead timber were also completed. The first tussock moth salvage sale on the Umatilla National Forest was sold on November 28, 1972; the last of forty sales was sold on September 3, 1974. In the Phillips/Gordon analysis area, at least 51.1 million board feet was harvested in five tussock-moth salvage sales: Dry (subwatershed 84I), Craig (84C), Middle (84B), Gordon (7B), and Balloon (7A).

One result of the 1970s outbreak was that the Forest Service instituted an early-warning system for Douglas-fir tussock moth. It utilizes pheromone traps to monitor tussock moth population levels (pheromones are biochemicals whose odor is used to attract insects – in this case, male tussock moths). The early-warning system was developed in the late 1970s, and then implemented throughout the western United States in 1980. Since tussock moth develops rapidly, the early-warning system was designed to predict population increases with enough lead time to implement a treatment program before serious damage to high-value areas could occur. It is interesting that the early-warning system indicates that the Blue Mountains are now heading into another tussock-moth outbreak (Ragenovich 2000).

Fire. Fire was an important ecosystem process on dry-forest sites in the Phillips/Gordon analysis area, and on some of the moist-forest ones as well. Within these environments, plants have been exposed to the long-term influence of fire. Some species such as ponderosa pine, western larch, snowbrush ceanothus, serviceberry, and bluebunch wheatgrass are considered to be "fire adapted." That is, over many centuries, they evolved strategies to help them maintain populations on sites where fires occurred frequently. Other vegetation such as Douglas-fir is not as well adapted to recurrent fire. Historically, frequent fires tended to reduce the abundance of young Douglas-firs because their thin bark and low-hanging branches made them vulnerable to fire damage (Veg Table 8).

Veg Table 8. Fire resistance characteristics for major conifer species of the Umatilla National Forest.

TREE SPECIES	Bark Thickness	Rooting Habit	Bark Resin (Old Bark)	Branching Habit	Stand Density	Foliage Flammability	Fire Resistance
Western Larch	Very thick	Deep	Very little	High and very open	Open	Low	Very high
Ponderosa Pine	Very thick	Deep	Abundant	Moderately high & open	Open	Medium	High
Douglas-fir	Very thick	Deep	Moderate	Moderately low & dense	Moderate to dense	High	High
Grand Fir	Thick	Shallow	Very little	Low and dense	Dense	High	Medium
Western White Pine	Medium	Medium	Abundant	High and dense	Dense	Medium	Medium
Lodgepole Pine	Very thin	Medium	Abundant	Moderately high & open	Dense	Medium	Low
Engelmann Spruce	Thin	Shallow	Moderate	Low and dense	Dense	Medium	Low
Subalpine Fir	Very thin	Shallow	Moderate	Very low and dense	Moderate to dense	High	Very low

Sources/Notes: Adapted from Powell (2000). Species rankings reflect the predominant situation for each trait. A species trait is not absolute – it can vary during the lifespan of an individual tree, and from one individual to another in a population. For example, grand fir's bark is thin when young, but thick when mature.

Many wildfires were ignited by lightning storms in mid or late summer (Plummer 1912) but a large number were apparently started by American Indians (Barrett 1980, Boyd 1999, Robbins 1997). Fire was used by American Indians to clear brush for improved hunting access, for entertainment, and for a variety of cultural activities. Oregon Indians used smoke to harvest pandora moths – after fire was run through an infested pine stand, the caterpillars would drop from the trees to the ground and were then gathered for food (Pyne 1982).[2]

Fire effects were often described in early journals. A recent book synthesizes journals and other writings from 19th century travelers on the Blue Mountains portion of the Oregon Trail (Evans 1991). When 66 journal accounts from that 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 thickets (Wickman and others 1994). Apparently in the Blue Mountains, the forest at low and mid elevations was comprised mostly of ponderosa pine, the pine forests were open and park-like with grass as the predominant undergrowth vegetation, and fire was a regular autumnal occurrence.

An historical account of wildfire in the northern Blue Mountains was provided by Washington Irving in a book entitled "The Adventures of Captain Bonneville, U.S.A." (Irving 1837).[3] Captain Bonneville and his party of trappers crossed the Blue Mountains when traveling between the Snake and Columbia Rivers in August of 1833. Irving vividly describes their encounter with forest fires:

> It was the season of setting fire to the prairies. As he advanced, he began to perceive great clouds of smoke at a distance, rising by degrees, and spreading over the whole face of the country. The atmosphere became dry and surcharged with murky vapor, parching to the skin, and irritating to the eyes. When traveling among the hills, they could scarcely discern objects at the distance of a few paces; indeed, the least exertion of the vision was painful. There was evidently some vast conflagration in the direction towards which they were proceeding; it was as yet at a great distance, and during the day they could only see the smoke rising in larger and denser volumes, and rolling forth in an immense canopy. At night, the skies were all glowing with the reflection of unseen fires; handing in an immense body of lurid light, high above the horizon.
>
> During four days that the party were ascending Gun Creek, the smoke continued to increase so rapidly that is was impossible to distinguish the face of the country and ascertain landmarks. Fortunately the travelers fell upon an Indian trail, which led them to the head waters of the Fourche de Glace, or Ice River, sometimes called the Grand Rond. Here they found all the plains and valleys wrapped in one vast conflagration; which swept over the long grass in billows of flame, shot up every bush and tree, rose in great columns from the groves, and sent up clouds of smoke that darkened the atmosphere. To avoid this sea of fire, the travelers had to pursue their course close along the foot of the mountains; but the irritation from the smoke continued to be tormenting.
>
> The country about the head waters of the Grand Rond spreads out into broad and level prairies, extremely fertile, and watered by mountain springs and rivulets. These prairies are resorted to by small bands of the Skynses,[4] to pasture their horses as well as to banquet upon the salmon which abound in the neighboring waters.

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[2] American Indians used most of the life stages of pandora moth for food – the Klamath and Modoc tribes dug up and used the pupae in a concoction called "bull quanch," whereas the Piutes gathered and dried the mature caterpillars and combined them with vegetable-type materials in a dish called "peage" (Patterson 1929).

[3] In 1832, Captain Bonneville arranged a 26-month leave from the U.S. Army and organized a 110-man expedition to trap beaver. In 1835, Washington Irving met him in Washington, D.C. when the Captain was trying to gain Army reinstatement after overstaying his leave. While awaiting reinstatement, Bonneville wrote up his experiences in the West. He later turned the manuscript over to Irving and suggested that he rewrite it, which resulted in "The Adventures of Captain Bonneville, U.S.A."

[4] Bonneville referred to the Cayuse as "Skyuses," a common practice of the time. His handwriting must have been difficult to read because Irving translated the word as "Skynses" (Evans 1990).

> The travelers continued, for many days, to experience great difficulties and discomforts from this wide conflagration, which seemed to embrace the whole wilderness. The sun was for a great part of the time obscured by the smoke, and the loftiest mountains were hidden from view. Blundering along in this region of mist and uncertainty they were frequently obliged to make long circuits, to avoid obstacles which they could not perceive until close upon them. The Indian trails were their safest guides, for though they sometimes appeared to lead them out of their direct course, they always conducted them to the passes.
>
> The flames, which swept rapidly over the light vegetation of the prairies, assumed a fiercer character, and took a stronger hold amidst the wooded glens and ravines of the mountains. Some of the deep gorges and defiles sent up sheets of flame, and clouds of lurid smoke, and sparks and cinders, that in the night made them resemble the craters of volcanoes. The groves and forests, too, which crowned the cliffs, shot up their towering columns of fire, and added to the furnace glow of the mountains. With these stupendous sights were combined the rushing blasts caused by the rarefied air, which roared and howled through the narrow glens, and whirled forth the smoke and flames in impetuous wreaths. Ever and anon, too, was heard the crash of falling trees, sometimes tumbling from crags and precipices, with tremendous sounds.
>
> In the daytime, the mountains were wrapped in smoke, so dense and blinding that the explorers, if by chance they separated, could only find each other by shouting. Often, too, they had to grope their way through the yet burning forests, in constant peril from the limbs and trunks of trees, which frequently fell across their path. At length they gave up the attempt to find a pass as hopeless, under actual circumstances, and made their way back to the camp to report their failure.[5]
>
> **The Adventures of Captain Bonneville, U.S.A. (Irving 1837).**

Large fires were common during Euro-American settlement of the Interior Northwest. Many fires were set by emigrants, either accidentally or intentionally. Miners often set fires to clear away brush and forest debris, thereby exposing rock outcrops for inspection by prospectors (Veblen and Lorenz 1991). Likewise, some early fires were started by livestock ranchers to remove brush and promote grass growth (Harley 1918). Whether of human or natural origin, large fires definitely occurred in the Phillips/Gordon analysis area during the presettlement era:

> Practically every portion of the reserve has suffered more or less from fire. The largest and most important of these was one which came from the present Umatilla Indian Reservation about fifty years ago, burned up the river Umatilla, into the reserve, then turned north along the west slope across the heads of the Walla Wallas, and reached as far as the head of the Wenaha. This burn has generally restocked finely, principally to tamarack and lodgepole pine.
>
> **The Proposed Wenaha Forest Reserve (Kent 1904).**

Even though emigrants caused some fires, they also contributed to conditions that limited fire intensity and spread. For instance, immense bands of sheep grazed in the Blue Mountains during the latter part of the nineteenth century (Coville 1898, Galbraith and Anderson 1970, Tucker 1940), consuming herbaceous vegetation that otherwise would have been available as fine fuel for a fire (Case and Kauffman 1997, Irwin and others 1994). Veg Figure 4 summarizes historical grazing trends for three classes of livestock (cattle and calves, sheep and lambs, horses and ponies). It pertains to Union County, Oregon, which comprises the majority of the analysis area.

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[5] After his scouting party returned unsuccessfully from their 20-day attempt to locate an "easy" pass, Bonneville's party crossed over the divide north of Mt. Emily (in the Phillips/Gordon analysis area) and went down the Umatilla River (Evans 1990).

Veg Figure 4. Number of grazing animals for Union County, Oregon (from Bureau of Census 1895, 1902, 1913, 1922, 1927, 1932, 1942, 1946, 1952, 1956, 1961).

After livestock removed most of the herbaceous vegetation from beneath forest stands, it was very difficult for fires to spread through them. That was particularly true for open stands of ponderosa pine because herbaceous vegetation was an important fuel component. When heavy livestock grazing coincided with effective suppression of low-intensity surface fires, the result was an increase in forest regeneration (Rummell 1951), as described in this account:

> And in open, overmature stands this [yellow pine] reproduction is even now so dense and large in many places as to practically prevent grazing. This advance reproduction has mostly come in during the last 25 or 30 years, and is due to the protection from fire which the forest has received partly by the Forest Service and partly by the unconscious efforts of the settlers and stockmen.
>
> **Yellow Pine Management Study in Oregon in 1916 (Weitknecht 1917).**

On dry-forest sites that historically supported open (park-like) ponderosa pine, suppression of the native disturbance regime – frequent surface fires (underburning) – had the unintended consequence of allowing grand firs and Douglas-firs to replace the pines. By the late 1970s, it was believed that at least 25 percent of the historical ponderosa pine type had been replaced with mixed-conifer forest (Barrett 1979); the reduction was apparently much greater than that for the southern Blue Mountains (Malheur National Forest), where ponderosa pine declined by more than half between 1936 and 1980 (Powell 1994).

If fire suppression caused major shifts in species composition, then why weren’t those changes recognized earlier? Actually, it turns out that many of them were recognized, but weren’t acted upon because of the prevailing attitudes of the time. As an example, the following questions and observations were made by a prominent fire researcher over fifty years ago.

> It is obvious that the present policy of attempting complete protection of ponderosa pine stands from fire raises several very important problems. How, for instance, will the composition of the reproduction be controlled? If ponderosa pine is desired on vast areas how, unless fire is employed, can other species such as white fir be prevented from monopolizing the ground? On the other hand, if it is de-

> cided to permit such species as white fir to come in under mature ponderosa pine, how much of the public's money are foresters justified in spending in trying to keep fire out? Even with unlimited funds, personnel, and equipment, can they give reasonable assurance that they can continue to keep such extremely hazardous stands from burning up? If they feel reasonably sure of this, can they then give assurance that the timber products of such stands will be more valuable than those that might otherwise be derived from ponderosa pine and will in addition justify the high protection costs?
>
> **Fire as an Ecological and Silvicultural Factor in the Ponderosa Pine Region (Weaver 1943).**

Timber Harvest. Some level of timber harvest has occurred ever since the Blue Mountains were settled by Euro-American emigrants. The first commercial logging in the Northwestern pine region of eastern Oregon and Washington began around 1890 (Weidman 1936), although limited harvesting occurred during the preceding 25 years to meet the needs of miners and early settlers. Some of the first roads reaching into the Blue Mountains were wagon roads for hauling wood and rails out to farms and ranches.

A local demand for construction timbers – trusses for mine tunnels and wooden viaducts to carry water – 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 person opened a sawmill to cut lumber for miners who were 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 those necessities (Robbins 1997, Tucker 1940). In the early days, lodgepole pine was harvested to provide an important heat source; the Meacham area, located southwest of the Phillips and Gordon watersheds, averaged more than 9,000 cords of wood a year (mostly fuelwood) between 1884 and 1924 (Tucker no date).[6]

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 fabricate shipping boxes for apples and other agricultural products (Bolsinger and Berger 1975, Gedney 1963, Robbins 1997).

Timber harvest has had a widespread but somewhat limited impact on vegetation conditions in the analysis area. For national forest lands located in eastern Oregon and eastern Washington, timber harvest levels declined by 72 percent between 1990 and 1995 (O'Laughlin and others 1998). That trend is clearly reflected in the timber harvest history for the Umatilla National Forest (Veg Figure 5); recent harvest levels on the Forest (and in the analysis area) are the lowest since the mid- to late-1950s.

Veg Table 9 summarizes tree density for all thirteen of the managed stand survey plots located in the Phillips/Gordon analysis area. It shows that reforestation following timber harvest has been successful when post-harvest tree density is used as a criterion to measure success – on average, the sampled plantations support 799 trees per acre.

Plantations with high tree densities will eventually need to be thinned to maintain tree vigor and to avoid future forest health problems. Delaying some of those thinnings until the stands are pole-sized could help address a deficiency of the stem exclusion closed canopy structural class in the analysis area (see Veg Table 27). For forest health and a variety of other reasons, early-seral tree species should be retained in the thinnings.

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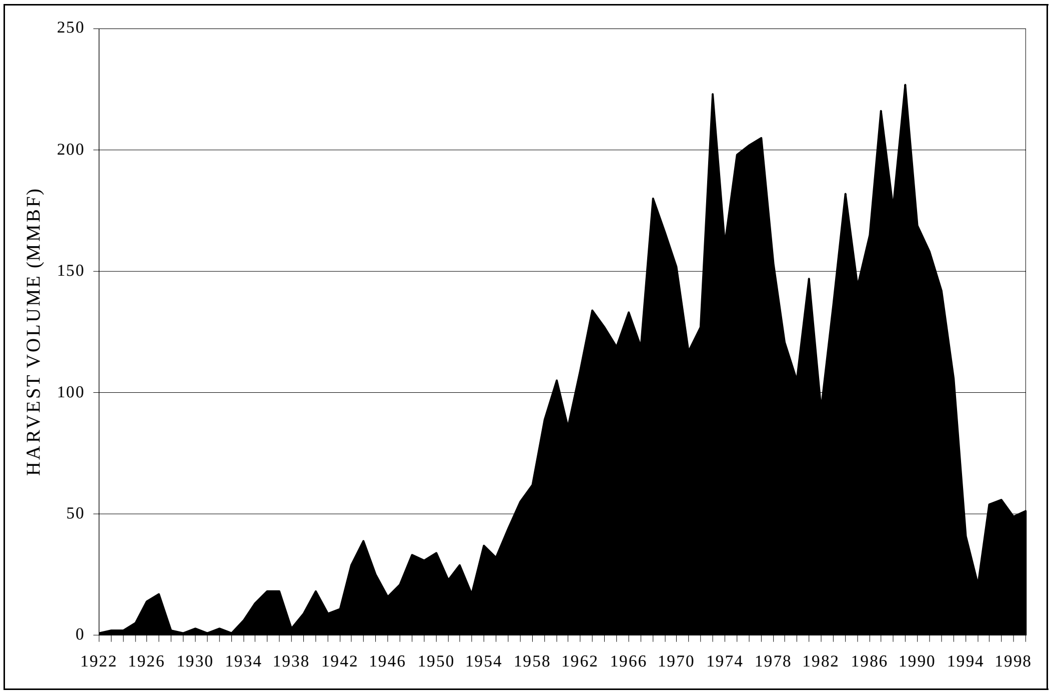
[6] Converted to board feet at 2 cords per thousand, 9000 cords was equivalent to an annual harvest level of 4½ million board feet.



Veg Figure 5. Timber harvest history for the Umatilla National Forest, 1922-1999. After 1993, harvest declined dramatically on the Umatilla NF, and that trend is also true for the analysis area.

Veg Table 9. Tree density (trees per acre) for managed stand survey plots located in the analysis area.

PLOT	PLANT ASS.	PAG	PP	LP	WL	DF	ES	GF	SF	PY	TOTAL
2753	GF/CLUN	CM	141	0	29	0	624	213	0	0	1,008
2761	GF/VAME	CM	153	0	0	16	4	36	0	0	209
2762	GF/VAME	CM	23	0	0	0	0	213	0	40	276
2763	GF/LIBO2	CM	0	0	967	44	665	201	0	0	1,877
2772	GF/SPBE	WD	139	0	0	120	0	28	0	0	287
2780	DF/CAGE	WD	108	0	0	68	0	4	0	0	180
2783	GF/LIBO2	CM	0	0	56	80	600	779	0	0	1,515
2787	GF/VAME	CM	0	0	269	87	532	665	0	0	1,553
2793	SF/VAME	CM	8	72	0	0	173	60	136	0	449
2822	GF/CLUN	CM	0	0	20	4	1,095	407	0	0	1,525
2834	GF/VAME	CM	77	0	11	8	44	181	0	0	321
2835	GF/VAME	CM	4	0	4	53	108	729	0	0	899
2836	DF/SYAL	WD	4	0	8	200	0	60	0	20	292
		Mean	51	6	105	52	296	275	10	5	799
Percent of Mean Total			6.4	0.7	13.1	6.5	37.1	34.4	1.3	0.6	

Sources/Notes: Based on 13 managed stand survey plots installed in the Phillips and Gordon watersheds in 1990 (see Veg Table 2 for more information about MSS plots). Plant associations are described in Veg Table 4 (note that GF refers to ABGR, DF refers to PSME, and SF refers to ABLA2). PAG refers to plant association group (CM refers to Cool Moist, WD refers to Warm Dry). Species are arranged by seral status (from early-seral at left to late-seral at right) and their codes are as follows: PP, ponderosa pine; LP, lodgepole pine; WL, western larch; DF, Douglas-fir; ES, Engelmann spruce; GF, grand fir; SF, subalpine fir; PY, Pacific yew.

CURRENT CONDITIONS

Forest Cover Types. The characterization section of this report described the potential vegetation of the Phillips/Gordon analysis area, e.g., the plant composition that would be expected to occur if disturbances were prevented from interrupting plant succession in the future. This section describes forest composition as it exists right now, regardless of whether it represents the potential vegetation or a transitory (seral) stage resulting from wildfire, timber harvest, windstorms, or another disturbance process.

Tree species occur in either pure or mixed stands called forest cover types. Cover types are classified using existing tree composition, so they reflect what a land manager finds on the ground and deals with on a daily basis. Forest cover types are based on a predominance of stocking[7] and 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, or other species.

Veg Tables 10 and 11 summarize the area of existing forest cover types for the Phillips/Gordon area. They show that the predominant forest cover type is grand fir (43% of upland forests in the analysis area have grand fir as the plurality or majority species), followed by Douglas-fir (21%), ponderosa pine (14%), and western larch (5%). Forests with a plurality or majority of subalpine fir, lodgepole pine or Engelmann spruce are uncommon because each of them occupies less than 5% of the analysis area. Veg Figure 6 (see appendix 2) shows forest cover types in the Phillips/Gordon area.

Veg Table 10 also shows that the analysis area has a relatively well balanced representation of pure and mixed forest (in actuality, even the pure stands contain tree species other than the primary one). Pure stands (cover types where one species is the majority) comprise 52% of the Phillips/Gordon forested area; mixed stands (types where no single species is the majority) comprise 48% of that area.

About 9% of the analysis area supports nonforest vegetation, most of which is grassland. Dry meadows and bunchgrass communities (dominated by fescues and bluebunch wheatgrass) are common grassland types. Shrublands comprise a relatively small proportion of the nonforest vegetation, although a diverse mix of shrub types are present. Often, the nonforest vegetation occurs as a juxtaposition of forest and grassland referred to as a grass-tree mosaic (GTM). In general, GTM consists of forested stringers alternating with nonforest communities (grasslands and shrublands).

Forest Density Classes. Half of the Phillips/Gordon analysis area has been examined using stand examinations. Stand exams provide quantified data suitable for characterizing stand density (trees per acre or basal area per acre) but they do not provide estimates of canopy (crown) cover. The other half of the analysis area was characterized using photo-interpretation surveys that provide canopy cover information but no estimates of basal area or trees per acre.

To provide a forest density measure that is compatible with both data sources, basal area values from stand exams were converted to their equivalent canopy cover using mathematical equations developed during an elk thermal cover study (Dealy 1985).

Veg Tables 12 and 13 summarize the area of existing forest density classes for the Phillips and Gordon watersheds. They show that the predominant situation is high-density forest (greater than 70% canopy cover; 37% of the forested portion of the analysis area), followed by low density (10-40% cover; 35% of the forested area) and moderate density (41-70% cover; 28% of forest). Veg Figure 7 (see appendix 2) shows forest density classes in the Phillips/Gordon area.

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[7] Forest cover types are based on species predominance using basal area. Types where one species comprises more than half of the basal area are named for the majority species; types where no individual species comprises more than half of the basal-area stocking are named for the plurality species along with a modifier (mix) to denote the lack of a majority species (Eyre 1980).

Veg Table 10. Existing forest cover types of the Phillips/Gordon analysis area.

CODE	FOREST COVER TYPE DESCRIPTION	ACRES	PERCENT
CA	Forest with subalpine fir as the majority species	306	<1
CAmix	Mixed forest with subalpine fir as the plurality species	631	2
CD	Forest with Douglas-fir as the majority species	3,078	8
CDmix	Mixed forest with Douglas-fir as the plurality species	4,739	13
CE	Forest with Engelmann spruce as the majority species	702	2
CEmix	Mixed forest with Engelmann spruce as the plurality species	689	2
CL	Forest with lodgepole pine as the majority species	218	<1
CLmix	Mixed forest with lodgepole pine as the plurality species	174	<1
CP	Forest with ponderosa pine as the majority species	2,050	6
CPmix	Mixed forest with ponderosa pine as the plurality species	2,952	8
CT	Forest with western larch as the majority species	615	2
CTmix	Mixed forest with western larch as the plurality species	1,246	3
CW	Forest with grand fir as the majority species	10,126	28
CWmix	Mixed forest with grand fir as the plurality species	5,562	15
Other	Non-forest cover types (grass and shrub); administrative sites	3,315	9

Sources/Notes: Summarized from the ExistPG database (see appendix 1). Acreage figures include National Forest System (NFS) lands only. Forest cover types where one tree species has a majority (comprising 50% or more of the stocking) are named for that species (Eyre 1980). For polygons where no single species predominates, the cover type is named for the plurality species followed by "mix" to designate a mixed-species composition.

Veg Table 11. Area (acres) of existing forest cover types by subwatershed (SWS).

SWS	Subalpine Fir	Douglas-fir	Engelmann Spruce	Lodgepole Pine	Ponderosa Pine	Western Larch	Grand Fir
7A	150	508	141	66	850	571	2,119
7B	223	501	239	121	135	198	2,465
Total	373	1,009	380	187	985	769	4,584
84B	393	1,234	277	117	866	280	1,896
84C	—	650	64	—	848	130	1,456
84D	130	889	411	64	249	65	1,875
84E	27	1,620	133	24	582	23	1,369
84H	8	421	40	—	216	197	1,387
84I	6	1,993	83	—	1,257	397	3,122
Total	564	6,807	1,008	205	4,018	1,092	11,105
Grand Total	937	7,816	1,388	392	5,003	1,861	15,689

Sources/Notes: Summarized from the ExistPG database (see appendix 1). Acreage figures include NFS lands only. Veg Table 10 describes the forest cover types used as column headings in this table. Note that majority and plurality types were summed for this table (e.g., CA + CAmix = Subalpine fir).

Veg Table 12. Existing forest density classes of the Phillips/Gordon analysis area.

CODE	FOREST DENSITY CLASS DESCRIPTION	ACRES	PERCENT
Low	Live canopy cover of trees is between 10 and 40 percent	11,648	35
Moderate	Live canopy cover of trees is between 41 and 70 percent	9,189	28
High	Live canopy cover of trees is greater than 70 percent	12,249	37

Sources/Notes: Summarized from the ExistPG database (see appendix 1). Acreages include NFS lands only.

Veg Table 13. Area (acres) of existing forest density classes by subwatershed (SWS).

SWS	LOW (10-40%)	MODERATE (41-70%)	HIGH (71-100%)
7A	1,447	1,359	1,599
7B	1,340	611	1,931
Total	2,787	1,970	3,530
84B	1,831	1,429	1,803
84C	945	1,287	917
84D	1,318	1,319	1,046
84E	1,972	1,051	755
84H	896	220	1,153
84I	1,899	1,913	3,045
Total	8,861	7,219	8,719
Grand Total	11,648	9,189	12,249

Sources/Notes: Summarized from the ExistPG database (see appendix 1). Acreage figures include NFS lands only. Veg Table 12 describes the forest density class codes used as column headings in this table.

Forest Size Classes. The diameter (size) distribution of trees is a key element in the structure of a forest stand and hence its biological diversity. Forest structure, for example, has an important influence on songbirds and other avian species. Since the relationship between tree diameter and height is well defined, and because there is a strong positive correlation between tree height and foliage complexity, forest size classes can serve as an effective proxy for foliage (canopy) complexity (Buongiorno and others 1994). Foliage complexity and other canopy attributes are often important when estimating the effect of vegetation conditions on wildlife species.

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

Veg Tables 14 and 15 summarize the area of existing forest size classes for the Phillips and Gordon watersheds. They show that the predominant overstory size class is a mixture of small and medium trees (42% of the forested portion of the analysis area), followed by small trees ranging from 9 to 15 inches in diameter (15%), small trees ranging from 15 to 21 inches in diameter (12%), and poles and small trees mixed (12%). Forest overstories dominated by medium or large trees (those with diameters of 21 inches or more), or seedlings and saplings (trees less than 5 inches in diameter) are uncommon; each of those size classes occupies two percent or less of the forested portion of the Phillips/Gordon area. Veg Figure 8 (see appendix 2) shows forest size classes in the Phillips/Gordon area.

Veg Table 14. Existing forest size classes of the Phillips/Gordon analysis area.

CODE	FOREST SIZE CLASS DESCRIPTION	ACRES	PERCENT
1	Seedlings; trees less than 1 inch in diameter	254	<1
2	Seedlings and saplings mixed	323	1
3	Saplings; trees from 1 to 4.9 inches in diameter	679	2
4	Saplings and poles mixed	275	<1
5	Poles; trees from 5 to 8.9 inches in diameter	574	2
6	Poles and small trees mixed	4,181	12
6.5	Small trees from 9 to 14.9 inches in diameter	4,980	15
7	Small trees from 9 to 20.9 inches in diameter	3,278	10
7.5	Small trees from 15 to 20.9 inches in diameter	3,884	12
8	Small trees and medium trees mixed	13,715	42
9	Medium trees from 21 to 31.9 inches in diameter	762	2
10	Medium and large trees mixed	120	<1
12	Large and giant trees mixed	62	<1

Sources/Notes: Summarized from the ExistPG database (see appendix 1). Acreage figures include NFS lands only. Forest size classes are based on the predominant situation and are seldom pure – the pole size class (5) has a predominance of pole-sized trees (50% or more) but may also contain minor amounts of other size classes. For multi-layered stands, this information pertains to the overstory layer only.

Veg Table 15. Area (acres) of existing forest size classes by subwatershed (SWS).

	FOREST SIZE CLASS CODE FOR OVERSTORY TREE LAYER												
SWS	**1**	**2**	**3**	**4**	**5**	**6**	**6.5**	**7**	**7.5**	**8**	**9**	**10**	**12**
7A	16	46	105	47	182	447	618	263	871	1,598	213	—	—
7B	—	56	142	16	22	788	854	337	626	934	108	—	—
Total	16	102	247	63	204	1,235	1,472	600	1,497	2,532	321	—	—
84B	19	63	96	—	183	744	946	544	680	1,703	38	48	—
84C	—	—	74	48	20	112	919	191	458	1,204	62	—	62
84D	95	64	128	11	66	499	436	804	489	916	138	37	—
84E	95	92	50	128	95	747	241	565	227	1,460	43	35	—
84H	—	—	—	7	—	37	22	—	60	2,081	64	—	—
84I	29	2	85	18	7	807	943	577	473	3,819	97	—	—
Total	238	221	433	212	371	2,946	3,507	2,681	2,387	11,183	442	120	62
Grand Total	254	323	680	275	575	4,181	4,979	3,281	3,884	13,715	763	120	62

Sources/Notes: Summarized from the ExistPG database (see appendix 1). Acreage figures include NFS lands only. Veg Table 14 describes the size class codes used as column headings in this table.

Forest Structural Classes. As a forest matures, it experiences successive and predictable changes in its structure. It may begin as a young, single-layer forest, but does not stay in that stage forever and eventually occupies other stages as part of a normal maturation (successional) process. In recent classification systems, structural entities have been referred to as “classes” rather than “stages” because it is not always appropriate to assume a sequential progression from one entity to another (O’Hara and others 1996).

One of the first efforts to classify forest development in the Interior Northwest was Thomas’s (1979) system for the Blue Mountains of Oregon and Washington. His stages characterized the sequential development of stands following clearcutting and, barring additional disturbance, involved a six-step progression: seedlings and saplings, saplings and poles, poles, small sawtimber, large sawtimber, and old growth.

Since publication of Thomas’s classification, other structural approaches have been developed. Recently, a series of four process-based development stages was published by Oliver and Larson (1996). Although Oliver and Larson’s (1996) classification works well for the geographical area in which it was developed (coniferous forests located west of the Cascade Mountains in Oregon and Washington), certain forest conditions in the Interior Northwest do not fit their four-stage approach. Consequently, their system was expanded to 7 classes to include a wider spectrum of structural variation; the Phillips/Gordon analysis used this 7-class system (O’Hara and others 1996).

Veg Tables 16 and 17 summarize the area of forest structural classes for the Phillips and Gordon watersheds. They show that the predominant structural stage is stem exclusion open canopy (25% of the analysis area), followed by young forest multi strata (23%), old forest multi strata (18%), and stand initiation (13%). Old forest single stratum, understory reinitiation, and stem exclusion closed canopy are relatively uncommon structural classes – each of them occupies less than 10 percent of the analysis area. Veg Figure 9 (appendix 2) shows forest structural classes in the Phillips/Gordon area.

Veg Table 16. Existing forest structural classes of the Phillips/Gordon analysis area.

CODE	FOREST STRUCTURAL CLASS DESCRIPTION	ACRES	PERCENT
OFMS	Old Forest Multi Strata structural class	5,898	18
OFSS	Old Forest Single Stratum structural class	2,657	8
SECC	Stem Exclusion Closed Canopy structural class	1,334	4
SEOC	Stem Exclusion Open Canopy structural class	8,264	25
SI	Stand Initiation structural class	4,378	13
UR	Understory Reinitiation structural class	2,893	9
YFMS	Young Forest Multi Strata structural class	7,663	23

Sources/Notes: Summarized from the ExistPG database (see appendix 1). Acreage figures include NFS lands only. Forest structural classes are described in Powell 2000 (see table 2, page 16).

Forest Canopy Layers. The vertical arrangement of tree canopy has an important influence on resource issues and values. For example, multi-layered stands with “old-growth” characteristics (e.g., a predominance of grand fir trees, high canopy closure, and an absence of logging evidence) are highly valued by pileated woodpeckers in the Blue Mountains (Bull and Holthausen 1993). Open, single-layered structures may have limited value for water quality, but high desirability for water yields (O’Hara and Oliver 1992).

Veg Tables 18 and 19 summarize the area of existing forest canopy layers for the Phillips and Gordon watersheds. They show that the predominant situation is a highly-complex layer structure (3 or more layers; 50% of the forested portion of the analysis area), followed by a two-layer stand structure (41% of the forested area) and single-layer forest (9%).

Veg Table 17. Area (acres) of existing forest structural classes by subwatershed (SWS).

FOREST STRUCTURAL CLASS CODE

SWS	SI	SEOC	SECC	UR	YFMS	OFMS	OFSS
7A	603	754	140	532	980	897	498
7B	687	712	93	612	835	850	93
Total	1,290	1,466	233	1,144	1,815	1,747	591
84B	768	1,385	22	671	1,162	720	335
84C	218	1,206	126	195	1,199	205	—
84D	872	810	305	381	435	383	497
84E	603	1,412	257	203	627	406	271
84H	50	727	9	82	189	756	457
84I	577	1,258	382	217	2,235	1,680	507
Total	3,088	6,798	1,101	1,749	5,847	4,150	2,067
Grand Total	4,378	8,264	1,334	2,893	7,662	5,897	2,658

Sources/Notes: Summarized from the ExistPG database (see appendix 1). Veg Table 16 describes the structural class codes used as column headings. Acreages include NFS lands only.

Veg Table 18. Existing forest canopy layers of the Phillips/Gordon analysis area.

CODE	FOREST CANOPY LAYER DESCRIPTION	ACRES	PERCENT
1	Live canopy (crown) cover of trees occurs in l layer (stratum)	3,168	9
2	Live canopy cover of trees occurs in 2 layers or strata	13,557	41
3	Live canopy cover of trees occurs in 3 or more layers or strata	16,362	50

Sources/Notes: Summarized from the ExistPG database (see appendix 1). Acreages include NFS lands only.

Veg Table 19. Area (acres) of existing forest canopy layers by subwatershed (SWS).

SWS	SINGLE LAYER	TWO LAYER	THREE LAYER
7A	177	1,982	2,245
7B	478	1,504	1,899
Total	655	3,486	4,144
84B	355	1,548	3,160
84C	20	799	2,331
84D	840	1,351	1,493
84E	679	1,922	1,177
84H	120	1,020	1,130
84I	500	3,430	2,927
Total	2,514	10,070	12,218
Grand Total	3,169	13,556	16,362

Sources/Notes: Summarized from the ExistPG database (see appendix 1). Acreages include NFS lands only. Veg Table 18 describes the canopy layer codes used as column headings.

REFERENCE CONDITIONS

Forest Cover Types. Historically, forest cover types were named for an economically important species such as ponderosa pine that might be present at a fairly low level of abundance, thus ignoring a more abundant but less valuable species. Therefore, the historical forest type maps used to characterize reference conditions may contain inherent biases related to the commercial value of certain species.

Veg Table 20 summarizes vegetation conditions as they existed in 1900 (Gannett 1902); however, it is not possible to make direct comparisons between the 1900 and later maps because of differences in their resolution and due to widely-divergent map legends. The 1900 map shows that 60% of the Phillips/Gordon analysis area consisted of moderate-density forest. Low- and high-density forest comprised 10% and 12% of the area, respectively. Burnt, timberless, and woodland types comprised 18% of the analysis area. Veg Figure 10 (see appendix 2) shows the geographical distribution of vegetation conditions in 1900.

Veg Table 20. Vegetation conditions in the Phillips/Gordon analysis area as of 1900.

MAP ATTRIBUTE	INFERRED VEGETATION CONDITIONS	AREA (ACRES)	PER-CENT
Timberless	Nonforest areas dominated by grasses or shrubs	16,314	14%
Woodland	Widely scattered ponderosa pine (savannah forest)	1,018	1%
0–5 MBF/Acre	Low-density forest of pure or mixed composition	11,394	10%
5–10 MBF/Acre	Moderate-density forest of pure or mixed composition	67,765	60%
10–25 MBF/Acre	High-density forest of pure or mixed composition	13,277	12%
Burnt	Areas burned by wildfire	2,844	3%

Sources/Notes: From a "Map of the state of Oregon showing the classification of lands and forests; prepared by Gilbert Thompson from information obtained by A.J. Johnson." The map (dated 1900) was included in the back pocket, as plate I, of a report by Gannett (1902). Inferred vegetation conditions were supplied by the author of this report, not by Gannett. Acreages include all land ownerships in the analysis area.

Veg Table 21 summarizes the area of historical forest cover types for the Phillips and Gordon watersheds. It shows that the predominant forest cover type in 1936 was grand fir (42% of the forested portion of the analysis area), followed by ponderosa pine (26%) and a mixed composition (24%). In 1958, the predominant forest type was grand fir (45% of the classified, forested area), followed by ponderosa pine (22%), Douglas-fir (20%), and western larch (7%). Veg Figure 11 (appendix 2) shows the geographical distribution of forest cover types in 1936.

Forest Density Classes. Veg Table 22 summarizes the area of historical forest density classes for the Phillips and Gordon watersheds. It shows that the predominant situation in 1936 was high-density forest (>70% canopy cover; 77% of the classified portion of the analysis area), followed by low density (10-40% cover; 16% of classified area) and moderate density (41-70% cover; 7%). In 1958, the predominant density class was high (74% of the classified area), followed by moderate (17%) and low (10%).

Forest Size Classes. Veg Table 23 summarizes the area of historical forest size classes for the Phillips and Gordon watersheds. It shows that the predominant overstory size class in 1936 was a mixture of small and medium trees ranging from 9 to 32 inches in diameter (56% of the classified portion of the analysis area), followed by medium trees (21 to 32 inches DBH; 26%) and then a mix of saplings and poles ranging from 1 to 9 inches in diameter (15%). In 1958, the predominant size class was a mix of medium and large trees ranging from 21 to 48 inches in diameter (65% of the classified area), followed by small trees ranging from 15 to 21 inches in diameter (29%).

Veg Table 21. Historical forest cover types of the Phillips/Gordon analysis area (acres).

CODE	FOREST COVER TYPE DESCRIPTION	1936	1958
BU	Burns at time of survey (no forest cover type provided)	73	—
CA	Forests with a predominance of subalpine fir trees	550	849
CD	Forests with a predominance of Douglas-fir trees	482	6,907
CE	Forests with a predominance of Engelmann spruce trees	—	485
CL	Forests with a predominance of lodgepole pine trees	784	966
CP	Forests with a predominance of ponderosa pine trees	9,876	7,366
CT	Forests with a predominance of western larch trees	1,448	2,375
CW	Forests with a predominance of grand fir trees	16,076	15,289
Mix	Mixed forests; less than 50% of one species	9,082	—
NF	Non-forest cover types	1,480	4,488
Unknown	Unclassified	185	1,320

Sources/Notes: Summarized from the 1936veg and 1958veg databases (see appendix 1). Acreages include NFS lands only (including those administered by the Wallowa-Whitman NF).

Veg Table 22. Historical forest density classes of the Phillips/Gordon analysis area (acres).

CODE	FOREST DENSITY CLASS DESCRIPTION	1936	1958
Low	Live canopy cover of trees is between 10 and 40 percent	973	1,578
Moderate	Live canopy cover of trees is between 41 and 70 percent	445	2,756
High	Live canopy cover of trees is greater than 70 percent	4,844	12,177
Unknown	Unclassified and non-forest cover types	33,775	23,535

Sources/Notes: Summarized from the 1936veg and 1958veg databases (see appendix 1). Acreages include NFS lands only (including those administered by the Wallowa-Whitman NF).

Veg Table 23. Historical forest size classes of the Phillips/Gordon analysis area (acres).

CODE	FOREST SIZE CLASS DESCRIPTION	1936	1958
2	Seedlings and saplings mixed	396	93
4	Saplings and poles mixed	5,709	—
6	Poles and small trees mixed	388	1,959
7.5	Small trees from 15 to 20.9 inches in diameter	301	10,049
8	Small trees and medium trees mixed	21,007	—
9	Medium trees from 21 to 31.9 inches in diameter	9,947	—
10	Medium and large trees mixed	—	22,137
Unknown	Unclassified and non-forest cover types	2,288	5,807

Sources/Notes: Summarized from the 1936veg and 1958veg databases (see appendix 1). Acreages include NFS lands only (including those administered by the Wallowa-Whitman NF). For multi-layered stands, this information pertains to the overstory layer only.

Forest Structural Classes. Veg Table 24 summarizes the area of historical forest structural classes for the Phillips and Gordon watersheds. It shows that the predominant structural class in 1936 was old forest multi strata (56% of the classified, forested area), followed by old forest single stratum (25%) and stem exclusion closed canopy (13%). The other four structural classes were uncommon – each of them occupied two percent or less of the forested portion of the analysis area. In 1958, the predominant structural class was old forest multi strata (52% of the classified, forested area), followed by understory reinitiation (17%) and old forest single stratum (16%). Veg Figure 12 (appendix 2) shows forest structural classes for the Phillips and Gordon watersheds as of 1936.

Veg Table 24. Historical forest structural classes of the Phillips/Gordon analysis area (acres).

CODE	FOREST STRUCTURAL CLASS DESCRIPTION	1936	1958
OFMS	Old Forest Multi Strata structural class	21,623	17,754
OFSS	Old Forest Single Stratum structural class	9,465	5,584
SECC	Stem Exclusion Closed Canopy structural class	5,140	1,726
SEOC	Stem Exclusion Open Canopy structural class	562	233
SI	Stand Initiation structural class	864	93
UR	Understory Reinitiation structural class	416	5,870
YFMS	Young Forest Multi Strata structural class	301	2,978
NF	Non-forest cover types	1,480	4,488
Unknown	Unclassified	185	1,320

Sources/Notes: Summarized from the 1936veg and 1958veg databases (see appendix 1). Acreages include NFS lands only (including those administered by the Wallowa-Whitman NF).

Forest Canopy Layers. Veg Table 25 summarizes the area of historical forest canopy layers for the Phillips/Gordon analysis area. It shows that the predominant situation in 1936 was an even-aged, single-layer condition (91% of the classified area), followed by an uneven-aged, multi-layer situation (9%). In 1936, note that most of the watershed area was unclassified for this analysis indicator. Unfortunately, the 1958 forest type map did not provide any information for the canopy layer analysis indicator.

Veg Table 25. Historical forest canopy layers of the Phillips/Gordon analysis area (acres).

CODE	FOREST CANOPY LAYER DESCRIPTION	1936	1958
EA	Live canopy cover of trees occurs in l layer (stratum)	5,050	No Data Available
UA	Live canopy cover of trees occurs in 2 or more layers or strata	474	
Unknown	Unclassified and non-forest cover types	34,512	

Sources/Notes: Summarized from the 1936veg database (see appendix 1). Acreages include NFS lands only (including those administered by the Wallowa-Whitman NF).

SYNTHESIS AND INTERPRETATION

Forest Cover Types. Forest composition has been relatively stable in the analysis area over the last 65 years (Veg Tables 10 and 21). The predominant forest cover type in 1936, 1958, and currently is grand fir; it comprised between 42 and 45 percent of the area during that time span. In 1936 and 1958, ponderosa pine was the second most common cover type, comprising 26 and 22 percent of the analysis area, respectively. At the present time, only 14% of the analysis area has a plurality or majority of ponderosa pine. Douglas-fir cover types comprised 20 percent of the analysis area in 1958 and 21 percent currently.

Recent bioregional assessments concluded that dry-forest areas have vegetation conditions that are out-of-balance when compared with the historical (presettlement) situation (Caraher and others 1992, Hessburg and others 1999, Lehmkuhl and others 1994, Quigley and Arbelbide 1997). Further analysis of forest cover types corroborates that finding and suggests that too many dry-forest sites in the analysis area currently support grand fir or Douglas-fir forest. In the presettlement era, it is believed that dry forests would have supported 72-90% ponderosa pine, 8-14% Douglas-fir, and 1-5% grand fir (Morgan and Parsons 2000). Currently, dry-forest sites support 22% ponderosa pine, 49% Douglas-fir, and 24% grand fir.

Forest Density Classes. A comparison of current and reference conditions (Veg Tables 12 and 22) indicates that the percentage of high-density forest may have declined substantially over the last 65 years. However, such a comparison is misleading because a very high proportion of the analysis area was not rated for this analysis indicator in both 1936 (84%) and 1958 (59%). If it is assumed that much of the non-rated portion of the analysis area consisted of an open forest (low-density) condition, then the current proportion of high-density forest (37%) would be as great as, if not greater than, it was historically.

Recently-developed stocking guidelines (Cochran and others 1994, Powell 1999) were used to analyze existing forest density levels to infer whether they are ecologically sustainable. By using the stocking guidelines in conjunction with potential vegetation (plant association groups), it was possible to determine the acres that would be considered overstocked. Overstocked forests have density levels in the "self thinning" zone where trees aggressively compete with each other for moisture, sunlight, and nutrients. Forests in the self-thinning zone experience mortality as crowded trees die from competition or from insects or diseases that attack trees under stress (Powell 1999).

A forest density analysis was used to help identify treatment opportunities; it was completed using the following process.

a. Since canopy cover was the only data item that could serve as a surrogate for forest density, equations were used to convert the stand density index information from Cochran and others (1994) into basal areas, and then from basal area into canopy cover (see Powell 1999 for the resultant canopy cover percentages).

b. Moist sites are capable of sustaining higher forest densities than dry sites, so potential vegetation (as represented by plant association groups) was used to stratify the watershed into classes with similar ecological capability to support forest density.

c. An analysis of forest density is species dependent, but it would be cumbersome to evaluate stocking for every tree species that could occur in each PAG. Since early-seral tree species are much more sensitive to dense, overcrowded conditions than late-seral species (Powell 2000, fig. 16), an early-seral species was selected to represent each PAG. Veg Table 26 shows the selected tree species.

d. It was then possible to directly compare total canopy cover from the ExistPG database and the recommended stocking levels expressed as canopy cover. The results of this comparison are summarized in Veg Table 27; it shows the acreage of each PAG that would be considered overstocked if the objective is to maintain density levels compatible with survival of the early-seral tree species.

Veg Table 26. Early-seral tree species and canopy cover values selected for the forest density analysis.

UPLAND FOREST PLANT ASSOCIATION GROUP	EARLY-SERAL SPECIES	LLMZ CANOPY COVER	ULMZ CANOPY COVER	SELECTED COVER VALUE
Cool Wet (CW)	ES	76	83	80
Cool Very Moist (CVM)	ES	77	85	80
Cold Dry (CD)	LP	59	66	65
Cool Moist (CM)	WL	64	71	65
Warm Very Moist (WVM)	WL	63	70	65
Warm Moist (WM)	WL	65	73	65
Warm Dry (WD)	PP	43	51	45
Hot Dry (HD)	PP	26	33	30

Sources/Notes: Plant association groups are described in Powell (1998) and in Veg Table 4. “Early-seral species” codes are: ES, Engelmann spruce; LP, lodgepole pine; WL, western larch; and PP, ponderosa pine. The “LLMZ Canopy Cover” and “ULMZ Canopy Cover” values are the mean canopy cover percentages associated with the lower limit of the management zone and the upper limit of the management zone stocking levels, respectively, for the early-seral species/PAG combination specified in the first two columns (ULMZ and LLMZ are defined in Powell 1999). The “Selected Cover Value” is the canopy cover percentage used for the density analysis.

Veg Table 27. Forest density analysis for the Phillips/Gordon analysis area.

PAG	AREA (NFS Acres) BY CANOPY COVER					TOTAL ACRES	OVER-STOCKED
	10-29%	30-45%	46-65%	66-80%	>80%		
CW	0	98	455	230	**589**	1,372	589
CVM	0	0	51	0	**0**	51	0
CD	171	129	147	**116**	**157**	720	273
CM	2,054	2,706	3,765	**2,860**	**5,336**	16,721	8,196
WVM	38	65	104	**250**	**1,614**	2,071	1,864
WM	676	301	430	**325**	**428**	2,160	753
WD	5,149	1,445	**1,434**	**1,360**	**304**	9,692	3,098
HD	196	**10**	**56**	**36**	**0**	298	102
Total	8,284	4,754	6,442	5,177	8,428	33,085	14,875

Sources/Notes: A forest density analysis was based on five categories of canopy cover and the upland-forest PAGs. The black cells indicate the National Forest System acreage that is presently overstocked if the objective is to maintain healthy forests with a component of early-seral species. Veg Table 26 provides PAG abbreviations and the early-seral species selected for each PAG.

Forest Size Classes. As was the case with forest cover types, overstory size classes have been relatively stable over the last 65 years (Veg Tables 14 and 23). A mix of small and medium trees (9 to 32 inches in diameter) was the predominant size class in both 1936 and currently, comprising 56% of the area in 1936 and 69% now. In 1958, it was much the same situation except that the range of tree sizes was larger – 94% of the forested area was comprised of trees ranging from 15 to 48 inches in diameter.

One of the implications of this trend in size classes is that there is less area dominated by very small trees now than there was historically. In 1936, forests dominated by seedlings, saplings, or poles comprised about 16% of the classified portion of the analysis area; currently, only 4% of the Phillips/Gordon area supports those same size classes.

This reduction in the small size classes is probably due to a variety of factors, including differences in resolution between the historical and current data sources (the historical map was compiled using ground reconnaissance; the current map is a product of stand exams and photo-interpretation data); plant succession (immature forest in 1936 is now mature forest 65 years later); and disturbance processes (the 1936 map may have depicted young, regenerating forests resulting from wildfires or early timber harvests).

Forest Structural Classes. A comparison of historical and current structural classes shows that the analysis area was dominated by old forest classes in 1936, with very little of any other class except stem exclusion (Veg Tables 16 and 24). By 1958, old forest was still predominant although other classes were better represented than in 1936, as evidenced by increases in understory reinitiation and young forest multi strata. Currently, stem exclusion is the predominant structural class (29%), followed by old forest (26%) and young forest multi strata (23%). Regenerating forest (stand initiation; 13%) is more prevalent now than it was historically.

The implications of this trend in structural classes is that old forest structures are less common now than they were historically; that regenerating forest (stand initiation) is more prevalent now than it was historically; and that mid-seral structural classes (understory reinitiation, stem exclusion, and young forest multi strata) are more abundant now than they were historically.

To understand the implications of current conditions, it is often helpful to put them in an historical context. A 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 represent sustainable conditions, at least to whatever extent Nature emphasized sustainability. A key premise of HRV is that native species are adapted to, and have evolved with, the prevailing disturbance regime of an area. For that reason, ecosystem elements occurring within their historical range are believed to represent resilient and healthy situations (Morgan and others 1994, Swanson and others 1994).

Although HRV can be applied to a wide variety of ecosystem elements, it was decided to use it with structural classes. Structural classes are inclusive – any particular point on a forest's developmental pathway can be assigned to a structural class. They are also universal – every forest eventually passes through a series of structural classes, although not every stand occupies every class or spends an equal amount of time in any particular class. For those reasons – inclusiveness and universality – structural classes provide a valuable framework for comparing current and reference conditions.

An HRV analysis was completed for the Phillips/Gordon analysis area. It was based on two primary factors – forest structural classes and potential vegetation (as represented by PAGs). Results of the HRV analysis are provided in Veg Table 28. It summarizes the current percentage of each structural class, by plant association group; the historical ranges for each of the structural classes are also shown.

Perusing the HRV results in Veg Table 28 shows that the young forest multi strata and stem exclusion closed canopy structural classes are below their historical ranges for three plant association groups (PAGs), and that the old forest single stratum and stem exclusion open canopy structural classes are above their historical ranges for five or four PAGs, respectively. Note that HRV was not interpreted for the cool very moist or hot dry PAGs due to their limited acreage within the analysis area.

Veg Table 28. Historical range of variability (HRV) analysis for forest structural classes.

		FOREST STRUCTURAL CLASSES							NFS
PAG		SI	SEOC	SECC	UR	YFMS	OFMS	OFSS	ACRES
CW	H%	1-10	0-5	1-10	5-25	20-50	30-60	0-5	1,372
	C%	6	3	1	7	47	28	**8**	
CVM	H%	1-10	0-5	5-20	5-25	20-60	20-40	0-5	51*
	C%	0	100	0	0	0	0	0	
CD	H%	1-20	0-5	5-20	5-25	10-40	10-40	0-5	721
	C%	11	**25**	3	**1**	14	19	**29**	
CM	H%	1-10	0-5	5-25	5-25	40-60	10-30	0-5	16,722
	C%	12	**17**	**2**	11	**34**	15	**9**	
WVM	H%	1-15	0-5	5-20	5-20	20-50	20-40	0-5	2,070
	C%	5	0	**0**	17	**8**	**44**	**26**	
WM	H%	1-15	0-5	5-20	5-20	20-50	10-30	0-5	2,160
	C%	**21**	**26**	**0**	4	**12**	26	**12**	
WD	H%	5-15	5-20	1-10	1-10	5-25	5-20	15-55	9,692
	C%	17	**46**	10	5	8	14	**0**	
HD	H%	5-15	5-20	0-5	0-5	5-10	5-15	20-70	298*
	C%	18	47	34	0	0	0	0	

Sources/Notes: Summarized from the ExistPG database (see appendix 1). Upland forest plant association groups (PAG) are described in Powell (1998) and in Veg Table 4. Historical percentages (H%) were derived from Hall (1993), Johnson (1993), and USDA Forest Service (1995a), as summarized in Blackwood (1998). Current percentages (C%) were based on NFS lands (Umatilla NF only). Structural class codes are described in appendix 1 and in Veg Table 16. Gray cells show instances where the current percentage (C%) is above the historical percentage (H%) for a structural class. Black cells show instances where the current percentage is below the historical percentage. Since an HRV analysis is somewhat imprecise, deviations (whether above or below the H% range) were only noted when the current percentage differed from the historical range by 2 percent or more.

* Note that deviations from the historical range (either above or below) were not shown for the cool very moist and hot dry PAGs due to their limited area within the Phillips/Gordon analysis area.

Forest Canopy Layers. A comparison of current and reference conditions with respect to forest canopy layers (Veg Tables 18 and 25) shows that the analysis area was dominated historically by single-layer forest, whereas the modern forest tends to have two or more layers. This comparison is very misleading, however, because a very high proportion of the Phillips and Gordon watersheds (86%) was not rated for this analysis indicator in 1936. Canopy layer information was not provided by the 1958 forest type map.

Further analysis of forest canopy layers shows that 85% of dry-forest sites in the analysis area currently have a multi-layered structure. This situation is inconsistent with the historical situation because it is believed that dry forests had a very high percentage of single-layer structure in the presettlement era, with perhaps as much as 70% of the ponderosa pine forest occurring as that structure (see OFSS historical range for the “hot dry” plant association group in Veg Table 28 above).

Forest Insects and Diseases (Risk). This upland-forest analysis is focused primarily on one issue: forest sustainability (see page 5). One factor influencing forest sustainability is tree damage or death caused by insects and diseases, many of which respond directly to forest composition, structure, or density (e.g., their host-type habitat). Forest inventory plots from the analysis area were used to characterize insect and disease risk; risk-rating results for nine important insects and diseases are provided in Veg Table 29.

Veg Table 29 shows that high risk (susceptibility) is present for western spruce budworm, and that the analysis area has moderate to high risk for Douglas-fir tussock moth and Douglas-fir beetle. Spruce beetle has low to moderate risk. All other insect or disease agents (Douglas-fir dwarf mistletoe, mountain pine beetle in lodgepole pine, mountain pine beetle in ponderosa pine, mixed conifer root diseases, and white pine blister rust) were rated low for the Phillips/Gordon analysis area.

It is interesting that Douglas-fir tussock moth susceptibility was rated as moderate to high. Each spring, pheromone traps are placed in mixed-conifer stands throughout the Umatilla National Forest as an early-warning system for Douglas-fir tussock moth. Beginning in 1998, this early-warning system indicated that the northern Blue Mountains were facing an imminent outbreak. An outbreak actually began in the spring of 2000 and 39,392 acres on the Pine, Pomeroy, and Walla Walla Ranger Districts were sprayed with TM-BioControl, a natural virus affecting tussock moth only, during June and July of 2000 to minimize tussock-moth damage in specific areas of concern (old-growth stands, bull-trout habitat, etc.). It is anticipated that tussock-moth defoliation will continue for several more years before subsiding.

Veg Table 29. Insect and disease risk ratings for the Phillips/Gordon analysis area.

INSECT OR DISEASE	RISK RATING	CABIN-GORDON	PHILLIPS-WILLOW
Douglas-fir Beetle	Low	65%	47%
	Moderate	14%	24%
	High	21%	29%
Douglas-fir Dwarf Mistletoe	Low	96%	96%
	Moderate	0%	4%
	High	4%	0%
Mountain Pine Beetle (Lodgepole Pine)	Low	93%	100%
	Moderate	4%	0%
	High	3%	0%
Mountain Pine Beetle (Ponderosa Pine)	Low	93%	99%
	Moderate	0%	0%
	High	7%	1%
Mixed Conifer Root Diseases	Low	89%	93%
	Moderate	0%	0%
	High	11%	7%
Spruce Beetle	Low	61%	78%
	Moderate	32%	22%
	High	7%	0%
Western Spruce Budworm	Low	32%	7%
	Moderate	7%	0%
	High	61%	93%
Douglas-fir Tussock Moth	Low	39%	16%
	Moderate	39%	51%
	High	22%	33%
White Pine Blister Rust	Low	100%	100%
	Moderate	0%	0%
	High	0%	0%

Sources/Notes: Calculations based on Current Vegetation Survey inventory plots located within the Phillips/Gordon analysis area (Ager 2000).

Assessment of Forest Sustainability. The health and sustainability of forest ecosystems is an issue, not just in the United States but around the World (Heissenbuttel and others No date). A protocol was recently established for evaluating forest sustainability at a national or international scale, including a set of criteria and indicators (Montreal Process 1995). In an effort to develop an assessment protocol that could be used at smaller scales, a landscape-level methodology was recently developed (Amaranthus 1997). It was based on four criteria originally proposed in 1994 (Kolb and others 1994). The four criteria, and an assessment of how the Phillips/Gordon watershed rates with respect to each of them, are provided below.

1. **The physical environment, biotic resources, and trophic networks to support productive forests**. Over most of the Phillips and Gordon watersheds, 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 forests of the Phillips/Gordon 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**.
   A significant threat of stand-replacing disturbance exists within the Phillips and Gordon watersheds that could dramatically alter plant and animal structure and composition. This threat is a direct result of an altered disturbance regime 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 two to five fire cycles, contributing to unnaturally-high fuel accumulations. Under the recent fire regime (suppression), the influence of fire as an ecological process has been markedly reduced – resulting in more homogenous landscape patterns with fewer vegetation types (particularly early-seral stages), larger patches at lower patch densities, and less total edge than would have been produced by the historical fire regime. Outbreaks of defoliators and other landscape-scale insects, and propagation of active or independent crown fire, can be expected in response to this increased level of homogeneity. Based on this second criterion, forests of the Phillips/Gordon analysis area are probably not in a sustainable condition.

3. **A functional equilibrium between supply and demand of essential resources**.
   Forty-five percent of the Phillips/Gordon analysis area has tree density levels that threaten future sustainability of upland forests. Nutrient cycling and the availability of water and growing space is undoubtedly impaired on these overstocked sites. In addition, these dense stands represent high susceptibility to crown fire. The primary factor controlling crown fire behavior is crown bulk density (the volume of tree crowns or canopy available for fire consumption), and crown bulk density is directly dependent upon species composition and stand density. Dense stands are not only more likely to initiate crown fire behavior, but also to sustain an active (running) crown fire once it begins. Based on this criterion, forests of the Phillips/Gordon analysis area may be sustainable, but only marginally.

4. **A diversity of seral stages and stand structures that provide habitat for any native species and all essential ecosystem processes**.
   The Phillips and Gordon watersheds support a relatively well-balanced distribution of seral stages and stand structures (as indicated by the historical range of variability analysis for forest structural classes). Historical forest management practices, however, have resulted in substantial changes in the spatial pattern of vegetation diversity and complexity, particularly on dry-forest sites where overcrowded, multi-strata forests were a rare phenomenon before the onset of anthropogenic fire suppression. These changes have resulted in forests at risk 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 significant (“catastrophic”) change goes up dramatically. Based on this fourth criterion, forests of the Phillips/Gordon analysis area are marginally sustainable right now but if recent trends in forest density and fire suppression continue unabated into the future, it is likely that forest sustainability will not be maintained over the long term.

RECOMMENDATIONS

The “recommendations” step is the final one in the “ecosystem analysis at the watershed scale” process (REO 1995). Recommendations are designed to respond to issues, concerns and findings identified during the five previous ecosystem analysis steps. Issues and concerns, and silvicultural practices that could be implemented in response to them, are summarized below.

1. High levels of forest damage occurred in the Phillips/Gordon analysis area during the late 1980s and the early 1990s (see Veg Table 7). Upland forest silvicultural practices that could be used to respond to this issue are:
   - Salvage of dead trees;
   - Planting.

2. Forty-five percent of the analysis area has forest density levels that threaten future sustainability of upland forests in the analysis area (see Veg Table 27). Upland forest silvicultural practices that could be used to respond to this issue are:
   - Thinning.

3. Substantial reductions in the area of early-seral species (particularly the ponderosa pine forest cover type) have occurred in the Phillips and Gordon watersheds between 1936 and now. Upland forest silvicultural practices that could be used to respond to this issue are:
   - Improvement cutting in stands where the early-seral species still exist;
   - Forest regeneration on dry-forest sites where early-seral species no longer exist.

4. Several analysis indicators show that dry forest sites currently have conditions that are inconsistent with ecosystem sustainability and resilience (see “forest cover types” and “forest canopy layers” discussions in the synthesis and interpretation section). Upland forest silvicultural practices that could be used to respond to this issue are:
   - Understory removal/thinning;
   - Pruning;
   - Prescribed fire.

Treatment recommendations did not explicitly consider project feasibility (logging operability, etc.), so they basically represent management opportunities. *It must be emphasized that these recommendations pertain to upland forest sites only (not to Riparian Habitat Conservation Areas).* Each of the nine treatment opportunities (silvicultural practices) listed above will be described individually.

Salvage of Dead Trees. Trees die when they cannot acquire or mobilize sufficient resources to heal injuries or otherwise sustain life (Waring 1987). In areas with a substantial number of dead trees, some of them may be salvaged. As is often the case with forest management activities, salvage logging can have both positive and negative effects. Some important benefits of salvage are to harvest and utilize wood fiber while it is still merchantable, to remove enough dead trees to promote regeneration of shade-intolerant, early-seral species, and to reduce fuel accumulations to the point where wildfire risk is acceptable and a prescribed burning program could be initiated (Powell 1994).

Any salvage removals should be done carefully. Enough dead trees should be left to provide adequate habitat for cavity-dependent birds. Retaining dead trees also provides habitat for ants and other invertebrates that prey on the larvae of defoliating insects. And standing dead trees eventually fall to the ground, where they contribute to nutrient cycling, long-term site productivity, and mycorrhizal habitat. In particular, more of the brown-rot species (pines, Douglas-fir, western larch) should be retained on-site than the white-rot species (true firs and Engelmann spruce) because their downed logs are most effective at providing long-term mycorrhizal habitat and soil moisture storage.

I recommend that salvage cutting be considered for areas with substantial amounts of forest damage; Veg Table 7 summarizes forest damage acreages by year. A salvage program should emphasize dry-forest areas because they have experienced the most pronounced changes in both species composition and forest structure over the last 90 years.

Salvage logging could also help generate revenue (K-V funds) to finance tree planting, noncommercial thinning, and other restoration treatments, but only if the dead trees are removed promptly while they still have economic value. Veg Table 30 shows the management areas in which the Umatilla National Forest Plan allows salvage cutting and associated tree planting to occur.

Veg Table 30. Management direction summary for the Phillips/Gordon analysis area.

MANAGEMENT AREA ALLOCATION	SALVAGE PERMITTED?	SUITABLE LANDS?	PLANT USING NFFV FUNDS?	PERCENT OF AREA
A3: Viewshed 1	Yes	Yes	Yes	7
A4: Viewshed 2	Yes	Yes	Yes	3
A5: Roaded Natural	Yes	Yes	Yes	11
A9: Special Interest Areas	Yes	No	No♦	<1
C1: Dedicated Old Growth	Yes*	No	No♦	3
C3: Big Game Winter Range	Yes	Yes	Yes	3
C4: Wildlife Habitat	Yes	Yes	Yes	32
C5: Riparian (Fish and Wildlife)	Yes	Yes	Yes	4
E2: Timber and Big Game	Yes	Yes	Yes	38
F3: High Ridge Evaluation Area	Yes	No	No♦	<1
PACFISH (Riparian Mgmt. Areas)	Yes	No	No♦	N.A.

Sources/Notes: Management area allocations are from the Umatilla NF Forest Plan (USDA Forest Service 1990). The “salvage permitted?” item shows whether salvage timber harvests are allowed by the management direction (standards and guidelines) for each land allocation; the “suitable lands?” item shows whether capable forested lands in the management area are designated as suitable (for timber production) by the Forest Plan; the “plant using NFFV funds” shows whether denuded or understocked lands could be planted using appropriated forest vegetation funds (NFFV); and the “percent of area” item shows the percentage of NFS lands in the analysis area allocated to the management emphasis. N.A. is not applicable.

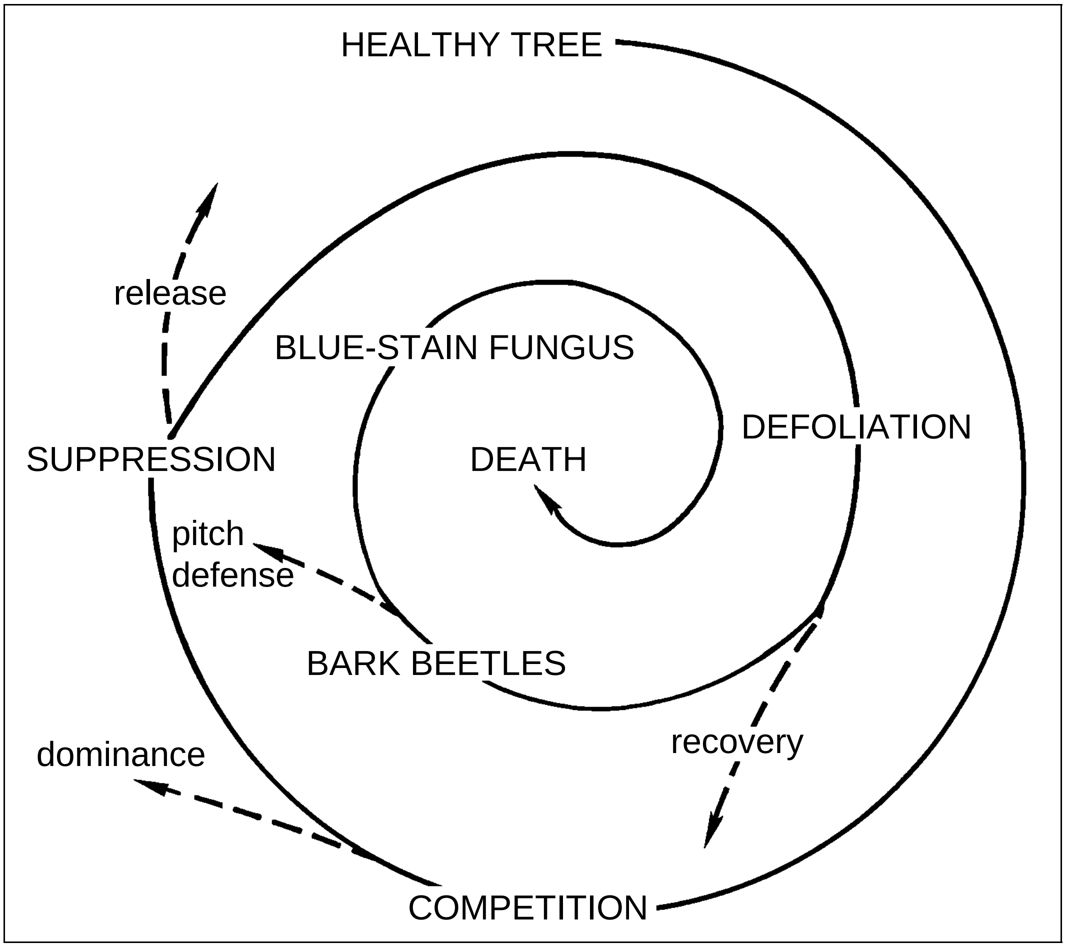
* Salvage harvest allowed only if an old-growth stand is killed by a catastrophic disturbance.

♦ Although appropriated NFFV funds cannot be used for planting because these lands are unsuitable, planting could occur if appropriated funds were provided by the benefiting resource (wildlife, fish, etc.) OR if a salvage harvest occurred and K–V funds were collected to finance the planting.

Planting. Planting is a powerful tool for influencing the future composition of a forest. In areas with substantial stand damage, planting can help reestablish a high proportion (60-70%) of early-seral, pest-resistant species. At lower elevations on warm dry sites, Douglas-fir or grand fir are the climax species and the choice of resistant species is limited, with ponderosa pine being the most obvious one. At higher elevations on cool moist sites, grand fir or subalpine fir are climax and the selection of non-host species is wider – lodgepole pine, western larch, ponderosa pine, western white pine, or quaking aspen could be used depending on the ecological conditions of the planting site.

If salvage treatments are completed in response to the stand damages described above, then the treated areas should be evaluated to determine their suitability for planting. Any reforestation evaluation should consider establishing western larch and ponderosa pine where they are the early-seral species; western white pine should also be considered for sites in the moist-forest potential vegetation group. If forest health is an objective, then planting should attempt to establish a future stand with at least two-thirds of the composition being early-seral species (Carlson and others 1983). This recommendation is particularly appropriate for areas with high risk of future spruce budworm or tussock moth defoliation.

Thinning. 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 insect and disease attacks, or otherwise sustain life (Veg Figure 13).



Veg Figure 13. Death spiral for a Douglas-fir tree in the Blue Mountains (adapted from Franklin and others 1987). In this example, a healthy tree is suppressed by larger trees. If not released from competition, the tree is predisposed to attack by defoliators. Once partially defoliated, the weakened tree is attractive to bark beetles such as Douglas-fir beetle (Wickman 1978), which carry blue-stain fungus. The fungus blocks water and sap movement in the tree and causes desiccation of the foliage. As a tree progresses along this spiral, the opportunities to use thinning or other silvicultural treatments to help it escape death become more limited.

An important silvicultural treatment is thinning, where some trees are removed so that those which remain receive additional sunlight, moisture and nutrients. The residual trees left by a thinning quickly increase their vigor, allowing them to produce more resin and defensive chemicals for warding off insect and disease attacks (Safranyik and others 1998).

Thinnings that anticipate density-related (competition-induced) mortality by removing trees from beneath the main canopy are called a low thinning or "thinning from below." Thinning from below can be advantageous because it creates an open, single-storied stand structure that is amenable to reintroduction of low-intensity surface fires. Low thinning also offers an opportunity to remove late-seral, pest-susceptible trees and thereby favor early-seral species (Powell 1994).

Over the long run, thinning and certain other silvicultural practices may be the most effective way to deal with defoliating insects such as western spruce budworm. Research from Montana found that thinning improved budworm resistance by increasing stand vigor, increasing budworm larval mortality during their dispersal period, and by reducing the budworm-host species in mixed-conifer forests. Thinning provided short-term protection for treated stands, and would presumably contribute to long-term resistance once landscape-sized areas were treated (Carlson and Wulf 1989, Carlson and others 1985, Powell 1999).

The plant association groups with apparent overstocking in Veg Table 27 should be field examined to determine if the high densities actually exist and, if so, then they should be evaluated to determine their suitability for a thinning treatment. Tables in Powell (1999) provide tree density recommendations by species and by plant association. They establish a "management zone" in which stand densities are presumed to be ecologically sustainable and relatively resistant to insect and disease problems.

Veg Figure 14 shows the location and distribution of upland-forest sites that would apparently qualify for the thinning treatment opportunity.

Improvement Cutting. 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[8] are removed from the upper canopy, often in conjunction with an understory thinning. In the Phillips/Gordon analysis area, improvement cutting was considered as one silvicultural alternative for addressing the "reduction in early-seral species" issue. In that context, improvement cutting would be used in mixed-species stands that still have a viable component of early-seral trees (either ponderosa pine or western larch in this instance).

An improvement cutting scenario responds to several consequences associated with fire suppression and historical partial-cutting timber removals. After frequent surface fires were suppressed, and following removal of mature ponderosa pines and larches during partial-cutting entries, the ultimate result was multi-layered, mixed-species forest dominated by late-seral trees (Powell 1994, Sloan 1998). An improvement cutting would remove many (but not all) of the late-seral trees, thereby providing additional growing space for residual ponderosa pines and western larches and improving their vigor and longevity.

Veg Figure 14 shows the location and distribution of upland-forest sites that would apparently qualify for the improvement cutting treatment opportunity.

Forest Regeneration. Regeneration cutting is defined as removal of trees to assist regeneration already present (existing seedlings and saplings) or to make 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.

In the Phillips/Gordon analysis area, regeneration cutting was considered as one silvicultural alternative for addressing the "reduction in early-seral species" and "inconsistent composition on dry-forest sites" issues. In that context, regeneration cutting would be used in situations where the desired species do not exist currently, or they exist in numbers too low to qualify as a viable seed source.

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[8] A determination of "desirable" or "undesirable" trees is based on the land management objectives of an area. Trees whose existing characteristics contribute to achieving the objectives of an area are desirable; undesirable trees lack such characteristics. This means that a change in objectives could result in a different determination of which trees are desirable or undesirable.

A regeneration cutting scenario was designed to respond primarily to ecologically inconsistent species composition on dry-forest sites. After frequent surface fires were suppressed over the last 90 years, late-seral, fire-sensitive species (Douglas-fir and grand fir) were able to get established on dry-forest sites that historically supported fire-tolerant species such as ponderosa pine (see "fire" discussion in the characterization section, page 13). If ponderosa pine is no longer present on these dry-forest areas, or is present in very low numbers only, then a regeneration treatment (shelterwood or seed-tree method) in conjunction with tree planting would be an effective way to reestablish it.

Veg Figure 14 shows the location and distribution of upland-forest sites that would apparently qualify for the forest regeneration treatment opportunity.

Understory Removal. This silvicultural practice is used in multi-storied stands, typically those with an overstory of early-seral trees and an understory of shade-tolerant species. The objective is to remove a high proportion of the understory trees and thereby improve overstory vigor by reducing inter-tree competition. When the overstory trees are mature ponderosa pines or western larches, this treatment is effective at ensuring their continued survival (Arno and others 1995).

Understory removals are implemented in at least two ways: on an area basis, or around individual trees. In the first method, understory trees are removed on areas having a relatively uniform stand composition and structure. Area-wide understory removals can be especially useful before initiating a prescribed fire program. In areas lacking uniform conditions, the understory is removed from around individual overstory trees with the objective of prolonging their survival by decreasing inter-tree competition and increasing tree vigor. *An understory removal would be particularly appropriate as a treatment to remove Douglas-firs and grand firs that have invaded on warm dry sites.*

Veg Figure 14 shows the location and distribution of upland-forest sites that would apparently qualify for the understory removal treatment opportunity.

Pruning. Pruning has traditionally been used to produce clear, knot-free wood for the lumber trade. But it can also play a role in achieving natural resource objectives. For example, the Phillips/Gordon watershed has experienced two intense outbreaks of spruce budworm over the last fifty years. In areas where budworm-host trees will continue to be a stand component, pruning could be used to remove the lower crown portion of host trees, thereby providing less food for survival and growth of budworm larvae.

After pruning trees that are large enough to have developed a 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 turning into a crown fire. Pruning must be carefully coordinated with the onset of an underburning program – if trees were pruned too soon, epicormic branching or "water" sprouts could occur on the stem and increase a tree's risk of torching in an underburn (Bryan and Lanner 1981, Oliver and Larson 1996).

Mechanical pruning would produce a stand that can be underburned much more quickly than waiting for natural pruning. For example, Veg Table 31 shows that ponderosa pine can self-prune quickly, but that dead branches often persist and that mechanical pruning would be advisable if a completely clean, branch-free bole is desired to minimize the risk of crown scorch or torching.

I recommend that pruning be considered as a future treatment for young stands on dry-forest sites. It may not be needed for at least 30 years, but it could then be coordinated with prescribed burning treatments as a way to lower the risk of pole-sized trees being killed by a fire (torching).

Veg Figure 14. Silvicultural treatment opportunities that could be used to respond to issues and concerns identified during the upland-forest analysis. Refer to the recommendations section of this report, pages 34-38, for detailed information about how the four silvicultural practices shown above could be implemented in the analysis area.

Veg Table 31. Natural 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 very quickly (2nd column) but dead branches are somewhat persistent, so that 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 would lift their crowns much more slowly than is shown above.

Prescribed Fire. After completing the understory removal, pruning or thinning treatments described in this section, managers should strongly consider using prescribed fire on dry-forest sites. Once ponderosa pines or western 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). From that point on, surface fires could be used on a regular cycle, usually at intervals of 10 to 20 years.

Fall burns are desirable from an ecological perspective because they replicate the natural fire regime and result in fewer losses of overmature pines to fire damage or to western pine beetle attack (Swezy and Agee 1991). 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 a likely vector of black stain root disease in ponderosa pine, was most abundant following fall fires. Spider abundance was reduced temporarily following either spring or fall burning; spider diversity was significantly higher for fall fires as compared to spring burns (Niwa and others 2000).

Periodic burning can also be used to increase the nutrient capital of a site by rejuvenating snowbrush ceanothus, lupines, peavines, vetch, buffaloberry, and other nitrogen-fixing plants. Numerous studies have documented the slow decomposition rates associated with woody material in the interior West (Harvey and others 1994). This means that forests of the Interior Northwest may have depended more on nitrogen-fixing plants and low-intensity fires to recycle soil nutrients than on microbial decomposition of woody debris (Powell 2000).

Providing adequate levels of site nutrition is important for maintaining tree resistance to insects and diseases (Mandzak and Moore 1994). In central Oregon, for example, Reaves and others (1984, 1990) found that ash leachates (chemical substances produced when water percolates through the ash remaining after a fire) from prescribed burns in ponderosa pine forests had a direct negative effect on the growth of *Armillaria ostoyae*, cause of Armillaria root disease. Much of the Armillaria suppression was due to a fungus called *Trichoderma*, which was strongly antagonistic to *Armillaria ostoyae* in burned soils.

Fire may not be beneficial on all upland-forest sites; on moist areas, burns could favor dominance by bracken fern, western coneflower, and other allelopathic plants that inhibit conifer regeneration (Ferguson 1991, Ferguson and Boyd 1988).

On poor to moderate forest sites (generally dry areas with coarse or shallow soils and thin forest floors), broadcast burning can be detrimental from a nutritional standpoint. The short-term benefits of prescribed fire may be achieved at a cost of high soil pH, nitrogen and sulfur deficiencies, and other nutritional problems later in a forest's life (Brockley and others 1992). In central Oregon, prescribed fire was observed to cause a net decrease in nitrogen mineralization rates and a decline in long-term site productivity (Cochran and Hopkins 1991, Monleon and others 1997). Nutrient cycling is considered by some to be the most important ecosystem "service" provided by forest biomes (Costanza and others 1997).

I recommend that prescribed fire be used on dry-forest plant association groups (warm dry and hot dry) after multi-layer stands have received an understory removal or thinning treatment, and that it be considered as a future treatment for any plantations established on those same PAGs.

Prescribed fire will probably not be feasible for at least 30 years after plantations have been established, but it could then be used as a thinning tool to help create and maintain stand structures with low risk of crown fire or other undesirable fire behavior (Agee 1996, Morris and Mowat 1958, Scott 1998). Prescribed fire can also be used to protect young stands from wildfire; research showed that controlled burning afforded almost complete protection to trees from a subsequent wildfire (Wagle and Eakle 1979).

Enhancement of Limited Vegetation Components. By its very nature, ecosystem analysis at the watershed scale (EAWS) encourages analysts to adopt a broad perspective that emphasizes looking beyond site-level conditions to focus on ecological processes at the landscape scale. One potential pitfall of a broad perspective, however, is the risk of overlooking limited vegetation components such as quaking aspen, western white pine, or black cottonwood – many of which have a restricted distribution and are indistinguishable at a landscape scale.

For the Phillips and Gordon watersheds, native hardwoods (deciduous tree species) and western white pine are limited vegetation components of particular concern.

Quaking aspen is a good example of an ecosystem element that is 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 many other species. And in winter, when foliage is no longer present, elk like to feed on its smooth white bark. After dying, aspen may be used by almost as many species as when alive – dead trees are prized by woodpeckers, flickers and many other species that use cavities (DeByle 1985). Although it may be difficult to prove (or quantify), it is very likely that aspen was historically more abundant in the Blue Mountains than it is now – fire suppression over the last 90 years has undoubtedly reduced its distribution.

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

Aspen clones apparently do not exist in the Phillips/Gordon analysis area (based on the Walla Walla District hardwood GIS layer). If clones are eventually discovered, I recommend that they be fenced as quickly as possible.

Black cottonwood has a wide geographical distribution but it 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). Its growth is enhanced by frequent depositions of nutrient-rich sediments, and the fine gravels or sand supplied by periodic flooding provide an ideal substrate for cottonwood regeneration. After humans intervened in riverine ecosystems by curtailing spring flooding or by grazing domestic livestock, black cottonwood declined or disappeared altogether (Case and Kauffman 1997, Peterson and others 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. It can also be propagated by sticking a branch cutting into moist soil and letting it form roots (Rose and others 1998). Although long-term trend data is unavailable for the Umatilla National Forest, black cottonwood is another species whose distribution is thought to be reduced from historical levels. Grazing by wildlife and livestock, and curtailment of frequent spring flooding, have combined with other factors to limit cottonwood regeneration.

I recommend that black cottonwood be planted on appropriate sites in both the upper portion of the dry forest PVG and in the moist forest PVG. Ecologically, black cottonwood is not considered an appropriate revegetation species for the cold forest PVG.

Western white pine, a mid-seral tree species, is sometimes found on cool moist, cool wet, and warm moist sites in the upper montane and lower subalpine vegetation zones (Powell 1998). It was characterized as having a restricted geographical distribution in the Blue Mountains (Haig and others 1941). In actuality, western white pine has a relatively wide distribution but 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 *(Cronartium ribicola)* and other factors, it is believed that 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 white pine continue to be planted on moist-forest sites where it is ecologically well adapted. 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, as was recommended by Seidel and Cochran (1981) (Powell 1999).

Recommendations Synthesis. Veg Table 32 summarizes the area (acres), by subwatershed, for four of the silvicultural treatment opportunities discussed in this section (thinning, improvement cutting, regeneration, and understory removal). It was prepared to summarize the silvicultural practices that could be used in each subwatershed, while also providing a treatment comparison between subwatersheds.

A total of 23,401 acres in the Phillips/Gordon analysis area (71% of the forested lands) apparently qualify for one or more of the silvicultural treatment opportunities described in this section; 2,180 of those acres (9%) have a high treatment priority, 6,995 acres have a medium priority (30%), and 14,226 acres have a low priority (61%) (Veg Figure 15; see appendix 2).

Data Gaps and Analysis Limitations. One product of the recommendations step in ecosystem analysis at the watershed scale is identification of data gaps and analysis limitations (REO 1995). The following gaps and limitations were identified during analysis of upland forest vegetation for the Phillips/Gordon watershed:

1. *Future conditions were not considered.* Most of this vegetation analysis focused on reference (historical) and current conditions. There was no explicit consideration of future conditions. Unfortunately, the inter-agency Federal process developed for watershed analysis (REO 1995) does not require an assessment of future conditions. Perhaps future EAWS efforts would benefit from having the “third leg of the triangle” (i.e., future conditions) take its place alongside reference and current conditions. Analytical tools have recently been developed that would help evaluate future scenarios, such as the Vegetation Dynamics Development Tool (Beukema and Kurz 2000).
2. *A detailed landscape analysis was not completed.* Time and other constraints did not provide an opportunity to analyze landscape characteristics (patch, matrix and corridor metrics). It is believed that a landscape characterization could have improved our understanding of broad-scale ecosystem processes and their effect on vegetation patterns.

Veg Table 32. Area (acres) of treatment opportunities by subwatershed (SWS).

SWS	Thinning	Improvement Cut		Regeneration		Understory Removal
		PP	WL	DF	GF	
7A	2,133	545	363	326	240	1,038
7B	2,030	69	144	370	531	801
Total	4,163	614	507	696	771	1,839
84B	2,089	344	144	750	25	706
84C	1,206	671	—	248	153	949
84D	1,593	74	23	415	365	417
84E	936	379	23	1,242	562	1,640
84H	1,216	216	197	421	148	792
84I	3,673	655	353	1,095	342	2,105
Total	10,713	2,339	740	4,171	1,595	6,609
Grand Total	14,876	2,953	1,247	4,867	2,366	8,448

Sources/Notes: Derived from an analysis of treatment opportunities that would respond to issues and concerns identified during the upland-forest analyses. Acreages include NFS lands only. Thinning would respond to the "high forest density" issue. Improvement cut would respond to the "reduction in early-seral species" issue – PP shows the acreage of mixed forest that still contains a ponderosa pine component (CPmix cover type); WL shows the acreage of mixed forest that still contains a western larch component (CTmix cover type). Regeneration would respond to both the "reduction in early-seral species" and "inconsistent structure on dry-forest sites" issues – DF shows the acreage of Douglas-fir cover types (CD and CDmix) on dry-forest sites that could be regenerated to ponderosa pine; GF shows the acreage of grand fir cover types (CW and CWmix) on dry-forest sites that could be regenerated to ponderosa pine. Understory removal would respond to the "inconsistent structure on dry-forest sites" issue by converting multi-layer structures (stands with 2 or more layers) to a single-layer structure.

Note: acreages are not mutually exclusive between the four primary treatment opportunity categories; the same polygons (and their acres) may be included in more than one category.

3. *More recent field inventories may have improved analysis accuracy*. Inventory information is used to prepare assessments of watersheds, landscapes, entire National Forests, and other mid- or broad-scale land areas. Dating back to the early 1990s, inventory budgets have been steadily declining, quickly resulting in reduced availability of stand examinations and other high-resolution data sources. Although 48% of the analysis area was characterized using stand examinations (excluding walk-through surveys), 62% of the exams were acquired before 1993. No attempt was made to update the older exams using the Forest Vegetation Simulator model, so they may not accurately represent forest characteristics as they exist right now. I recommend that the Walla Walla District continue to acquire updated stand examinations whenever possible.
4. *Additional information about limited vegetation components would have been helpful.* Insufficient information was available about the distribution, condition, and trend of limited vegetation components such as quaking aspen, black cottonwood, and western white pine. The Walla Walla Ranger District compiles and maintains a GIS layer about hardwood (non-coniferous) plant species such as quaking aspen, black cottonwood, water birch, and curl-leaf mountain-mahogany. The hardwood layer was consulted but it provided no occurrence information (other than a 0.04-acre water birch stand) for the Phillips/Gordon analysis area, even though impressive stands of black cottonwood are known to exist in these drainages (excellent stands along Phillips Creek, for example).

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APPENDIX 1: DESCRIPTION OF FOREST DATABASES

Vegetation data for the Phillips/Gordon analysis area was stored in four databases. This document serves as a data dictionary for those databases, as described below:

- A published map contained in the back pocket of a 1902 report (Gannett 1902) was used for a coarse characterization of vegetation conditions as they existed in 1900 (Thompson and Johnson 1900). The database name is: **1900veg**.
- Colored, thematic, cover-type maps published by the Pacific Northwest Forest Experiment Station (Sankela and Lynch 1936) were used to characterize upland-forest conditions as they existed in the early 1930s. These maps were produced by county. The database name is: **1936veg**.
- Thematic, county-level forest type maps published by the Pacific Northwest Forest and Range Experiment Station (Moravets 1958) were used to characterize upland-forest conditions as they existed in the early to mid 1950s. The database name is: **1958veg**.
- Intensive stand examinations, walk-through examinations, and interpretation of aerial photography were used as data sources to characterize existing (current) vegetation for upland forests. This information was acquired between 1986 and 1999. Stand exam information was extracted from EVG and FSVeg databases; photo-interpretation data came from EVG. The database name is: **ExistPG**.

The remainder of this appendix describes each database field and its corresponding codes. Some fields were used only in certain databases, and those situations are noted in the field descriptions.

Polygon Number (**Poly** is the database field name): Polygons were numbered consecutively using the Arc GIS software.

Polygon Area (Acres): Total acreage within the polygon boundary; calculated using the Arc GIS software. Acreage figures include National Forest System lands only (except for private-land polygons).

Data Source (Sour): Provides the data source for each record. [Note: this field was not used with the historical databases since all of their data was derived from a single source, e.g., a published map.]

Code	Description
SE	Stand examination
PI	Photo interpretation exam
WT	Walk through field exam

Subwatershed (SWS): Provides the predominant subwatershed for each polygon. Derived by overlaying the subwatershed layer with the existing vegetation polygon layer, and then using Arc's "identity" function to determine the subwatershed that occupies the majority of each polygon.

Elevation (Elev): Mean elevation of the polygon, in feet; calculated by the Arc GIS software after gridding the polygon into 30-meter square pixels. Value is an average of the pixels within a polygon.

Slope Percent (SlpPct): Mean slope percent of the polygon; calculated by the Arc GIS software after gridding the polygon into 30-meter square pixels. Value is an average of the pixels within a polygon.

Aspect (Asp1; Asp2): Mean aspect of the polygon; calculated by the Arc GIS software after gridding the polygon into 30-meter square pixels. Value is an average of the azimuth calculations, in degrees, for the pixels within a polygon. The azimuth value (Asp1) was converted to a compass direction (Asp2) using this relationship:

Code	Description
LE	Level (sites with no aspect; slope percents <5%)
NO	North (azimuths >338° and ≤23°)

Code	Description
NE	Northeast (azimuths >23° and ≤68°)
EA	East (azimuths >68° and ≤113°)
SE	Southeast (azimuths >113° and ≤158°)
SO	South (azimuths >158° and ≤203°)
SW	Southwest (azimuths >203° and ≤248°)
WE	West (azimuths >248° and ≤293°)
NW	Northwest (azimuths >293° and ≤338°)

Plant Association (Ecoclass): The predominant plant association was recorded for each polygon in the ExistPG database. When a polygon was characterized using a stand examination, the plant association from the stand exam was used; for polygons characterized using other data sources, a potential vegetation map was used to assign a plant association (see Veg Table 2). Plant associations were recorded using a 6-digit Ecoclass code (see Hall 1998). There are too many Ecoclass codes to list here. See Powell (1998), table 2, or Hall (1998) for a list that relates each Ecoclass code to the vegetation type it represents.

Plant Association Group (PAG): This derived field was based on data in the *plant association* field. Refer to Powell (1998) for a description about how plant associations were assigned to PAGs.

Code	Description
Cold Dry UF	Cold Dry Upland Forest PAG
Cool Moist UF	Cool Moist Upland Forest PAG
Cool Very Moist UF	Cool Very Moist Upland Forest PAG
Cool Wet UF	Cool Wet Upland Forest PAG
Hot Dry UF	Hot Dry Upland Forest PAG
Warm Dry UF	Warm Dry Upland Forest PAG
Warm Moist UF	Warm Moist Upland Forest PAG
Warm Very Moist UF	Warm Very Moist Upland Forest PAG
Nonforest	Nonforest vegetation types (no Ecoclass, PAG, PVG info available)

Potential Vegetation Group (PVG): This derived field was based on data in the *plant association group* field. Refer to Powell (1998) for a description about how the PAGs were assigned to PVGs.

Code	Description
Cold UF	Cold Upland Forest PVG
Dry UF	Dry Upland Forest PVG
Moist UF	Moist Upland Forest PVG
Nonforest	Nonforest vegetation types (no Ecoclass, PAG, PVG info available)

Structural Class (Struc): Structural classes were derived using database queries. The queries used combinations of the overstory cover *(OvCov)*, overstory size *(OvSiz)*, understory cover *(UnCov)*, and understory size *(UnSiz)* fields. Queries differed slightly by PVG. Veg Tables 33 and 34 (at the end of this appendix) show the structural class queries. See O'Hara and others (1996) and Powell (2000) for additional information about structural classes.

Code	Description
OFMS	Old Forest Multi Strata structural class
OFSS	Old Forest Single Stratum structural class
SECC	Stem Exclusion Closed Canopy structural class
SEOC	Stem Exclusion Open Canopy structural class
SI	Stand Initiation structural class
UR	Understory Reinitiation structural class
YFMS	Young Forest Multi Strata structural class
NF	Nonforest (no structural class determined for nonforest polygons)

Cover Types (CovTyp): These codes describe the predominant tree species composition for each polygon. Polygons were considered nonforest when the total canopy cover of trees was less than 10 percent; cover types were not determined for nonforest polygons. Types where one species comprises more than half of the stocking are named for the majority species; types where no one species comprises more than half of the stocking are named for the plurality species along with a modifier ("mix") to denote the lack of a majority species (Eyre 1980). Cover type codes are described below.

Code	**Description**
Admin	Administrative sites
BU	Burned area (used in 1936 only)
CA	Subalpine fir is the majority species
CAmix	Mixed forest; subalpine fir is plurality species
CC	Clearcut (used in 1958 only)
CD	Douglas-fir is the majority species
CDmix	Mixed forest; Douglas-fir is plurality species
CE	Engelmann spruce is the majority species
CEmix	Mixed forest; Engelmann spruce is plurality species
CL	Lodgepole pine is the majority species
CLmix	Mixed forest; lodgepole pine is plurality species
CP	Ponderosa pine is the majority species
CPmix	Mixed forest; ponderosa pine is plurality species
CT	Western larch (tamarack) is the majority species
CTmix	Mixed forest; western larch is plurality species
CW	Grand fir is the majority species
CWmix	Mixed forest; grand fir is plurality species
NF	Nonforest ("Grass" and "Shrub" were only codes used for nonforest polygons)

Total Canopy Cover (TotCov): Total canopy cover was recorded for all vegetation polygons. Total canopy cover refers to the percentage of the ground surface obscured by plant foliage.

Cover Class (CovCls): This derived field was based on data in the *TotCov* field. It was used for the forest density analysis. Each forested polygon in the ExistPG database was assigned to one of five cover classes, as described below:

Code	**Description**
10-29	Live canopy (crown) cover is between 10 and 29 percent
30-45	Live canopy cover is between 30 and 45 percent
46-65	Live canopy cover is between 46 and 65 percent
66-80	Live canopy cover is between 66 and 80 percent
>80	Live canopy cover is greater than 80 percent

Stocking Class (Stocking): For the ExistPG database, this field was derived using data in the *TotCov* field. For 1936veg and 1958veg, a stocking value was provided by the map code.

Code	**Description**
L	Low stocking (10-40 percent)
M	Moderate stocking (41-70 percent)
H	High stocking (71-100 percent)

Canopy Layers (NLay): The number of canopy layers was recorded for all forested polygons in the ExistPG database, as described below:

Code	**Description**
1	1 layer present
2	2 layers present

Code	Description
3	Three or more layers present

Overstory Cover (OvCov): For polygons with a forest cover type code, the canopy cover associated with the overstory layer was recorded in this field. When added to the understory cover value, the total should equal the canopy cover of the polygon as a whole (as coded in the *TotCov* field).

Overstory Size Class (OvSiz): For polygons with a forest cover type code, the predominant size class for the overstory layer was recorded using these codes:

Code	Description
1	Seedlings; trees less than 1 inch DBH
2	Seedlings and saplings mixed
3	Saplings; trees 1–4.9” DBH
4	Saplings and poles mixed
5	Poles; trees 5–8.9” DBH
6	Poles and small trees mixed
6.5	Small trees 9–14.9” DBH
7	Small trees 9–20.9” DBH
7.5	Small trees 15–20.9” DBH
8	Small trees and medium trees mixed
9	Medium trees 21–31.9” DBH
10	Medium and large trees mixed
11	Large trees 32–47.9” DBH
12	Large and giant trees mixed

Overstory Species (OvSp1, OvSp2): For polygons with a forest cover type code, one or more of the following tree species codes were recorded. Species are <u>not</u> shown in order of predominance in ExistPG.

Code	Description
ABGR	Grand fir
ABLA2	Subalpine fir
ACGL	Rocky Mountain Maple (tree size)
ALNUS	Alder (species not determined; tree size)
ALSI	Sitka Alder
LAOC	Western Larch
PICO	Lodgepole Pine
PIEN	Engelmann Spruce
PIMO	Western White Pine
PIPO	Ponderosa Pine
POTR2	Black Cottonwood
PSME	Rocky Mountain Douglas-fir
SALIX	Willow (tree size)
TABR	Pacific Yew (tree size)

Understory Cover (UnCov): For polygons with a forest cover type code and two or more canopy layers, the canopy cover associated with the understory layer was recorded in this field. When added to the overstory cover value, the result should equal the total cover of a polygon (as coded in the *TotCov* field).

Understory Size Class (UnSiz): For polygons with a forest cover type code and two or more canopy layers, the predominant size class for the understory layer was recorded in this field. Codes were the same as those described above for the overstory layer.

Understory Species (UnSp1, UnSp2): For polygons with a forest cover type code and two or more canopy layers, one or two tree species were recorded for the understory layer. Note: species are <u>not</u> shown in decreasing order of predominance in ExistPG.

Map Code (MapCode): This field was used in the 1900veg, 1936veg, and 1958veg databases. It provides the map attribute associated with each polygon. These map codes can be thought of as a concatenated string of individual characteristics, e.g., type, stand size, stocking, age, and other features were combined as an attribute "string" that was used to label a polygon. Lookup tables were used to decipher the map code and thereby "extract" individual data items (type, size, etc.) from the attribute string.

Harvest (Harvest): For both the 1936veg and 1958veg databases, it was possible to identify whether some of the polygons had been previously affected by timber harvest, as shown below:

Code	**Description**
Y	Timber harvest had occurred

Age (Age): For the 1936veg database only, it was possible to assign an age classification to some of the polygons, as shown below:

Code	**Description**
EA	Even-aged stand
UA	Uneven-aged stand

Purity (Purity): For the 1958veg database only, it was possible to assign a purity rating to some of the forested polygons, as shown below:

Code	**Description**
M	Mixed-species composition
P	Pure (single-species) composition

Treatment Opportunity (Thin, ImpCut, Regen, UndRem, Prior): For the ExistPG database only, it was possible to identify tentative treatment opportunities for some of the forested polygons. Treatment opportunities are designed to respond to issues and concerns identified during the upland-forest analysis. Thinning, improvement cutting, forest regeneration, and understory removal were included in the database. A priority field (**Prior**) was also included to identify polygons with the highest treatment priority.

Veg Table 33. Forest structural classes as related to canopy strata and tree size.

	SIZE CLASS OF UPPERMOST STRATUM		
NUMBER OF CANOPY LAYERS OR STRATA	SEEDLINGS/SAPLINGS (< 5" DBH)	POLES AND SMALL TREES (5 TO 20.9" DBH)	MEDIUM TREES (> 21" DBH)
1	Stand Initiation	Stem Exclusion	Old Forest Single Stratum
2	Not Applicable	Understory Reinitiation	Old Forest Multi Strata
3	Not Applicable	Young Forest Multi Strata	Old Forest Multi Strata

Sources/Notes: Adapted from Stage and others (1995). This generalized classification scheme was used when deriving forest structural classes for the 1936veg and 1958veg databases.

Veg Table 34. Methodology used to derive forest structural classes for the ExistPG database.

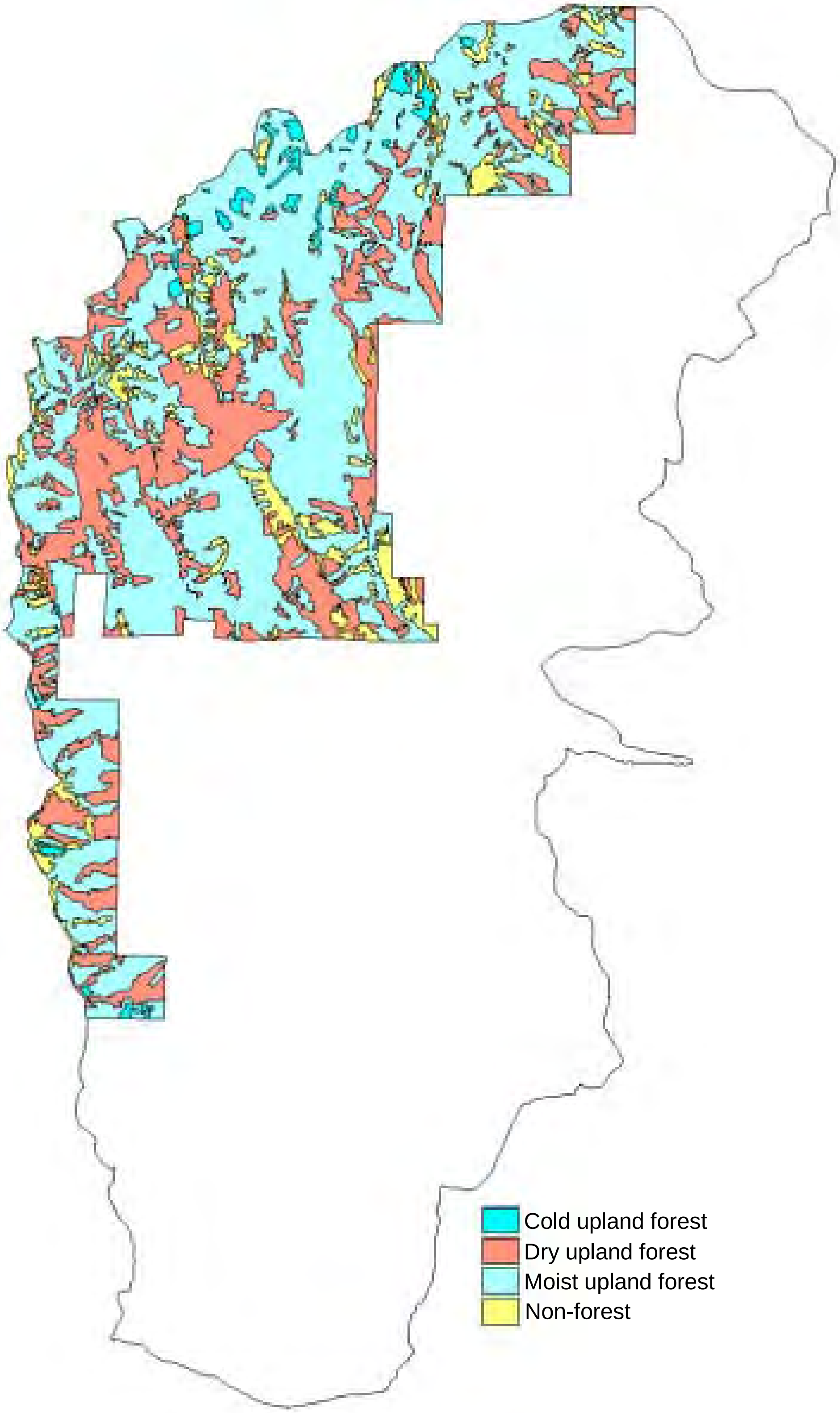
PVG	Order	OvSiz	OvCov	UnCov	UnSiz	Class	Remarks
COLD UPLAND FOREST	1	7.5-12	≥ 30	> 20		OFMS	Size class 7.5 included to account for LP and SF types
	2	7.5-12	≥ 30	≤ 20		OFSS	Size class 7.5 included to account for LP and SF types
	3	≥ 5	> 60	≥ 10		UR	
	4	≥ 5	>10, ≤ 60	≥ 10		YFMS	Differs from Hessburg; they used: OvCov ≥ 10%, ≤ 60
	5	≥ 5	> 70	< 10		SECC	
	6	≥ 5	>10, ≤ 70	< 10		SEOC	*Note*: > 10% OvCov was not used by Hessburg et al.
	7	< 5				SI	Overstory consists of seedlings and saplings
	8	≥ 5	≤ 10	<10		SI	Neither overstory nor understory has viable canopy cover
	9	[≥ 5]	[≤ 10]	≥ 10	< 5	SI	Nonviable overstory; understory is seedlings and saplings
	10	[≥ 5]	[≤ 10]	≥ 30	7.5-12	OFSS	Nonviable overstory; query based on understory data
	11	[≥ 5]	[≤ 10]	>70	≥ 5	SECC	Nonviable overstory; query based on understory data
	12	[≥ 5]	[≤ 10]	≤ 70	[≥ 5]	SEOC	Nonviable overstory; query based on understory data
MOIST UPLAND FOREST	1	8-12	≥ 30	> 20		OFMS	
	2	8-12	≥ 30	≤ 20		OFSS	
	3	≥ 5	> 60	≥ 10		UR	
	4	≥ 5	>10, ≤ 60	≥ 10		YFMS	Differs from Hessburg; they used: OvCov ≥ 10%, ≤ 60
	5	≥ 5	> 70	< 10		SECC	
	6	≥ 5	>10, ≤ 70	< 10		SEOC	*Note*: > 10% OvCov was not used by Hessburg et al.
	7	< 5				SI	Overstory consists of seedlings and saplings
	8	≥ 5	≤ 10	<10		SI	Neither overstory nor understory has viable canopy cover
	9	[≥ 5]	[≤ 10]	≥ 10	< 5	SI	Nonviable overstory; understory is seedlings and saplings
	10	[≥ 5]	[≤ 10]	≥ 30	8-12	OFSS	Nonviable overstory; query based on understory data
	11	[≥ 5]	[≤ 10]	>70	≥ 5	SECC	Nonviable overstory; query based on understory data
	12	[≥ 5]	[≤ 10]	≤ 70	[≥ 5]	SEOC	Nonviable overstory; query based on understory data

Veg Table 34. Methodology used to derive forest structural classes for the ExistPG database. [CONTINUED]

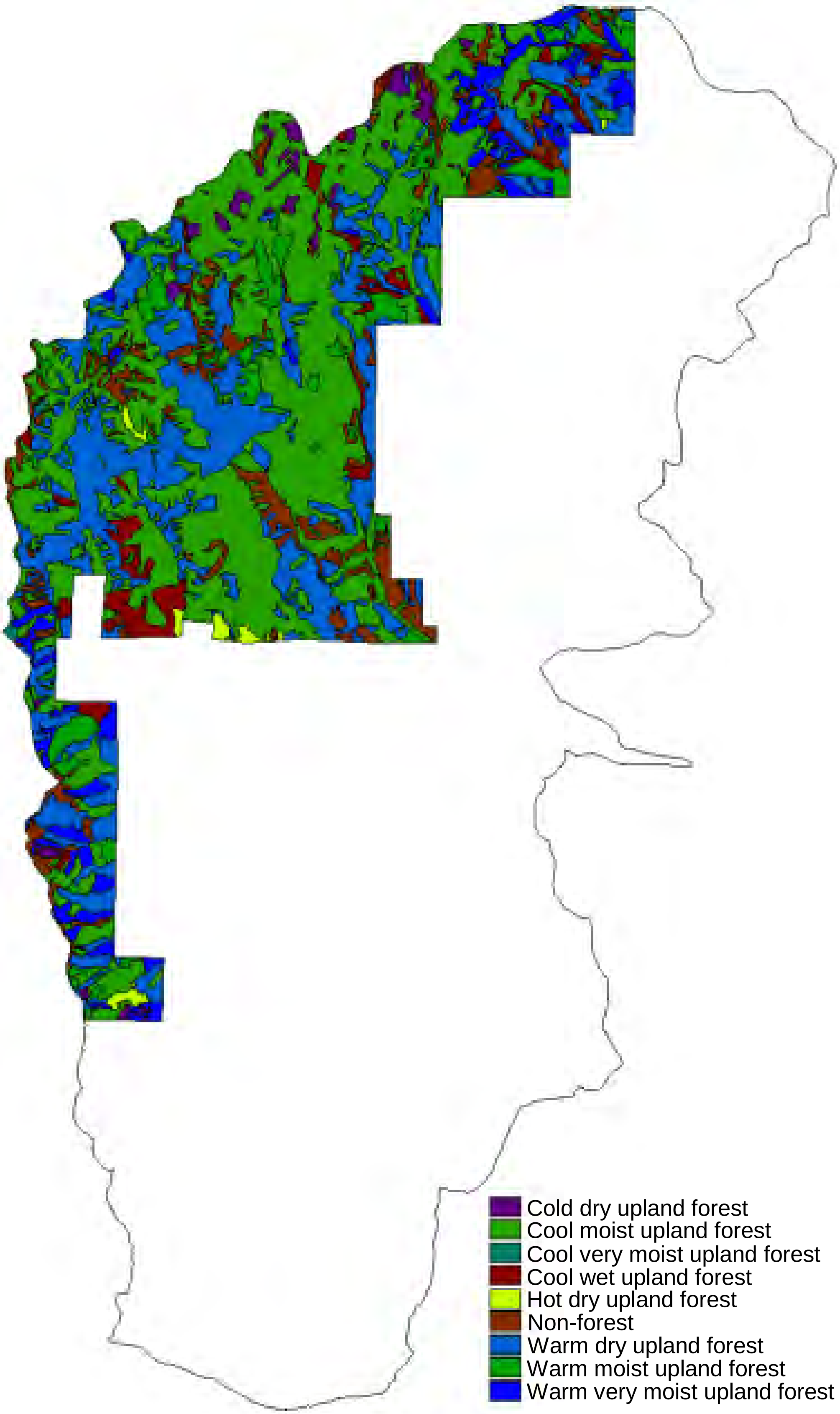
PVG	Order	OvSiz	OvCov	UnCov	UnSiz	Class	Remarks
DRY UPLAND FOREST	1	8-12	≥ 15	≥ 10		OFMS	*Note*: Except for SI, the Dry UF queries used ½ of the OvCov values used for the Cold and Moist UF queries
	2	8-12	≥ 15	< 10		OFSS	
	3	≥ 5	> 30	≥ 10		UR	
	4	≥ 5	>10, ≤ 30	≥ 10		YFMS	Differs from Hessburg; they used: OvCov ≥ 10%, ≤ 30
	5	≥ 5	> 35	< 10		SECC	
	6	≥ 5	>10, ≤ 35	< 10		SEOC	*Note*: > 10% OvCov was not used by Hessburg et al.
	7	< 5				SI	Overstory consists of seedlings and saplings
	8	≥ 5	≤ 10	<10		SI	Neither overstory nor understory has viable canopy cover
	9	[≥ 5]	[≤ 10]	≥ 10	< 5	SI	Nonviable overstory; understory is seedlings and saplings
	10	[≥ 5]	[≤ 10]	≥ 15	8-12	OFSS	Nonviable overstory; query based on understory data
	11	[≥ 5]	[≤ 10]	>35	≥ 5	SECC	Nonviable overstory; query based on understory data
	12	[≥ 5]	[≤ 10]	≤ 35	[≥ 5]	SEOC	Nonviable overstory; query based on understory data

Sources/Notes: Based on Hessburg and others (1999; page 47); deviations from their queries are noted in the remarks. Order is important for these calculations because if a polygon could meet more than one query option, a structural class should be assigned by the option with the lowest order number. Items in brackets are provided for information only; they are not necessary when using "blank, changeto" query statements.

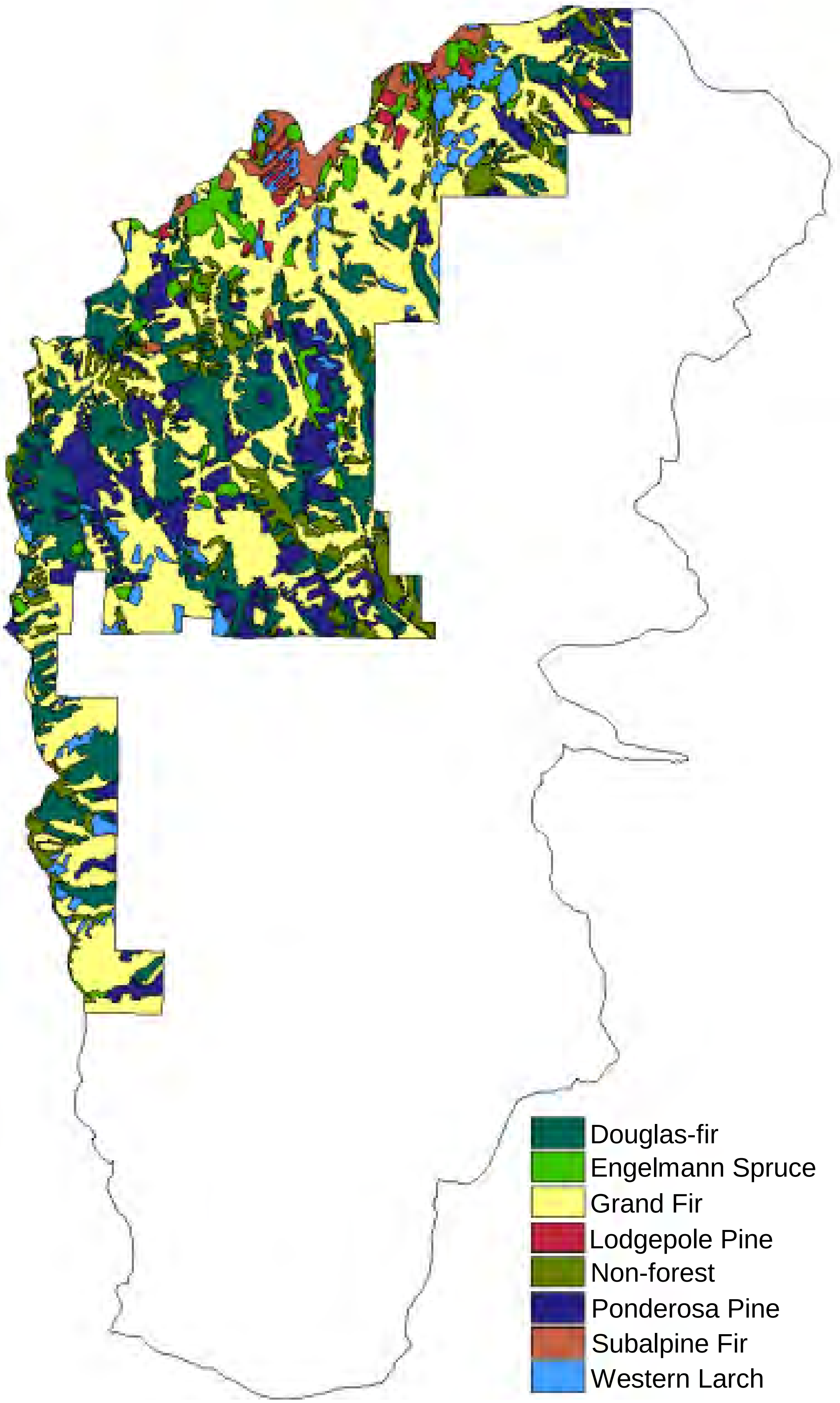
APPENDIX 2: COLOR MAPS



Veg Figure 1. Potential vegetation groups (PVGs) of the Phillips/Gordon analysis area. See Veg Table 4 (page 7) for additional information about the upland-forest plant association groups that were aggregated to form these potential vegetation groups.

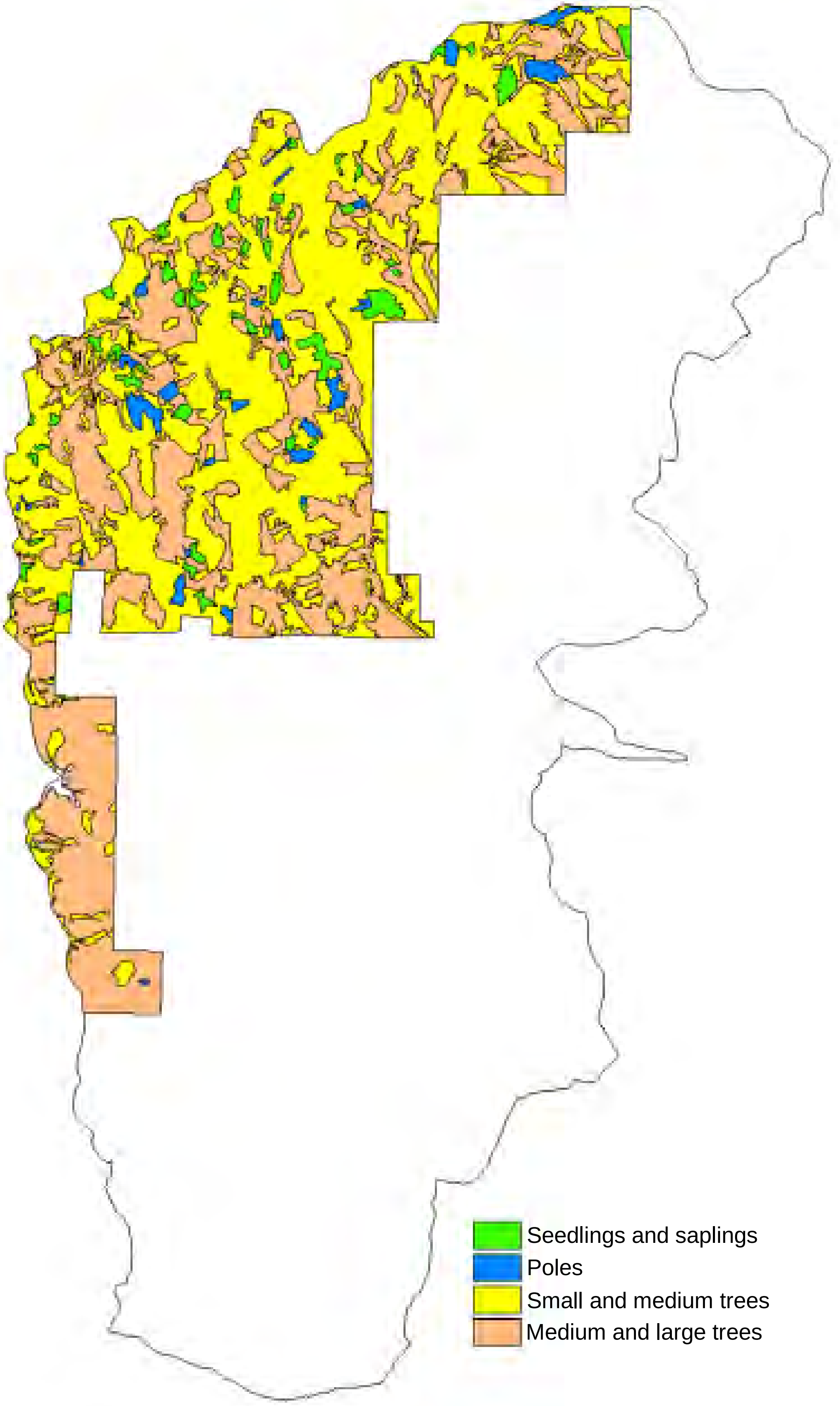


Veg Figure 2. Plant association groups (PAGs) of the Phillips/Gordon analysis area. Veg Table 4 (page 7) shows how plant associations were aggregated to form plant association groups.

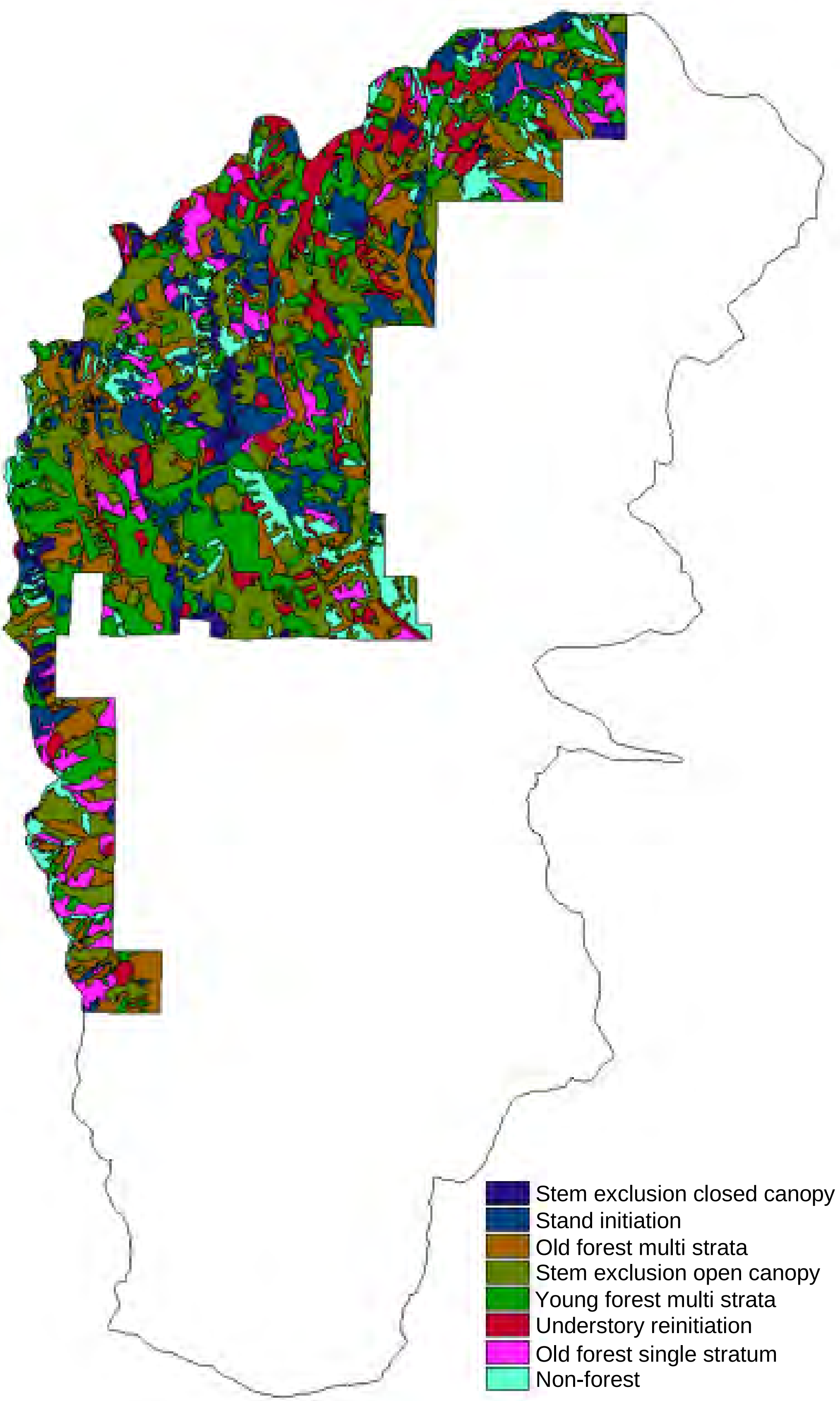


Veg Figure 6. Existing forest cover types of the Phillips/Gordon analysis area. Veg Table 10 (page 20) describes existing forest cover types in more detail.

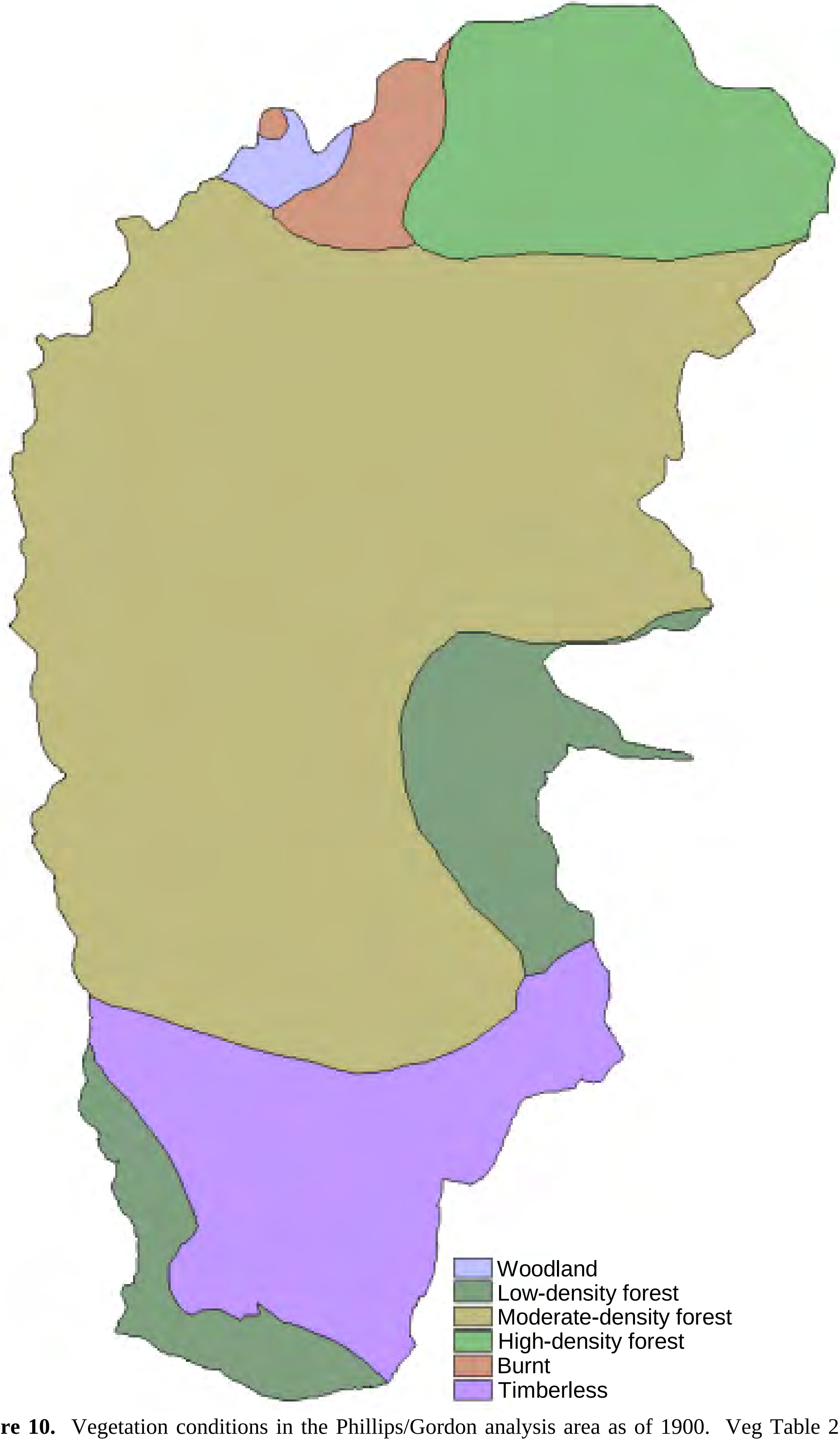
Veg Figure 7. Existing forest density classes of the Phillips/Gordon analysis area. Veg Table 12 (page 21) describes existing forest density classes in more detail.



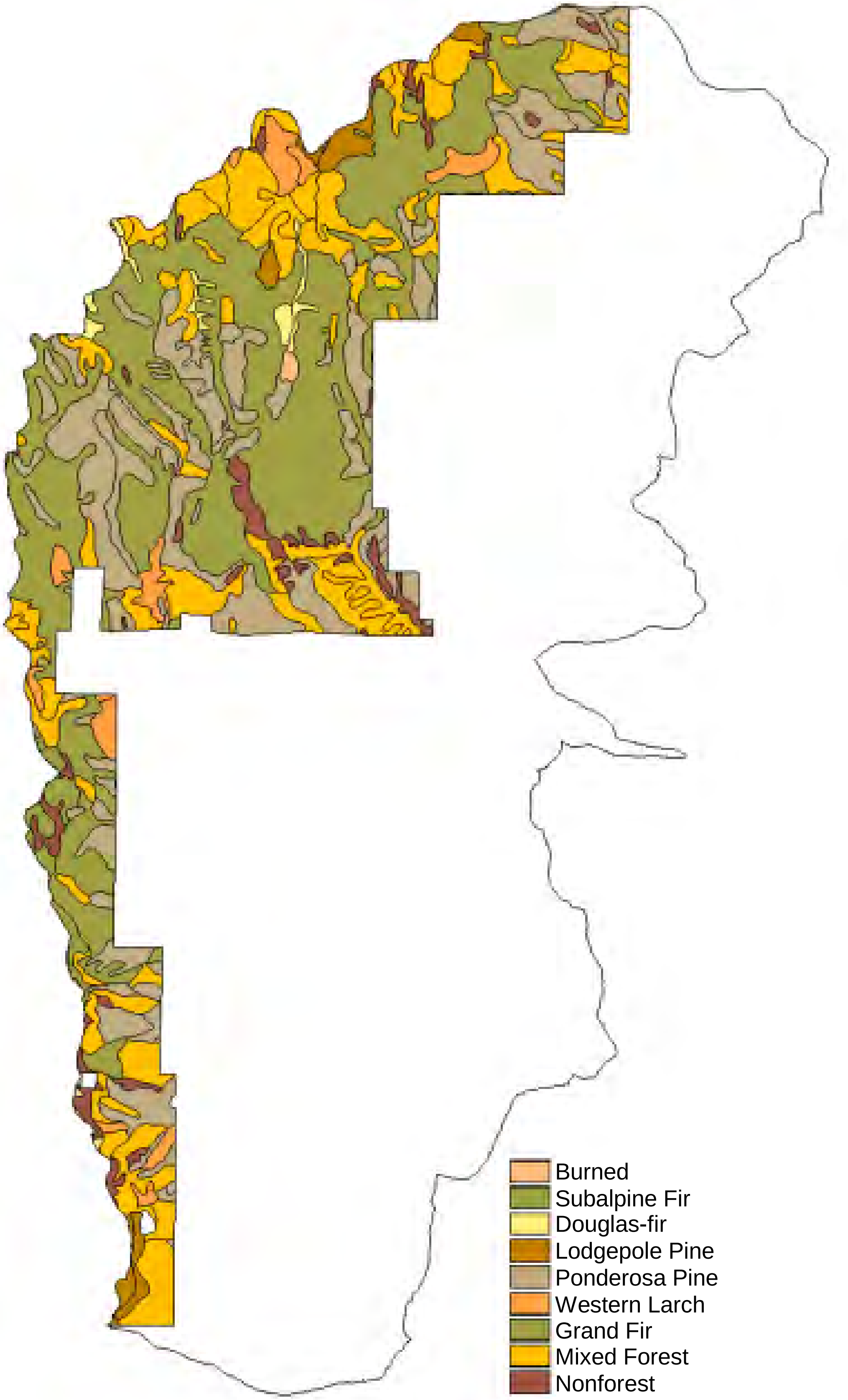
Veg Figure 8. Existing forest size classes of the Phillips/Gordon analysis area. Veg Table 14 (page 22) describes existing forest size classes in more detail.



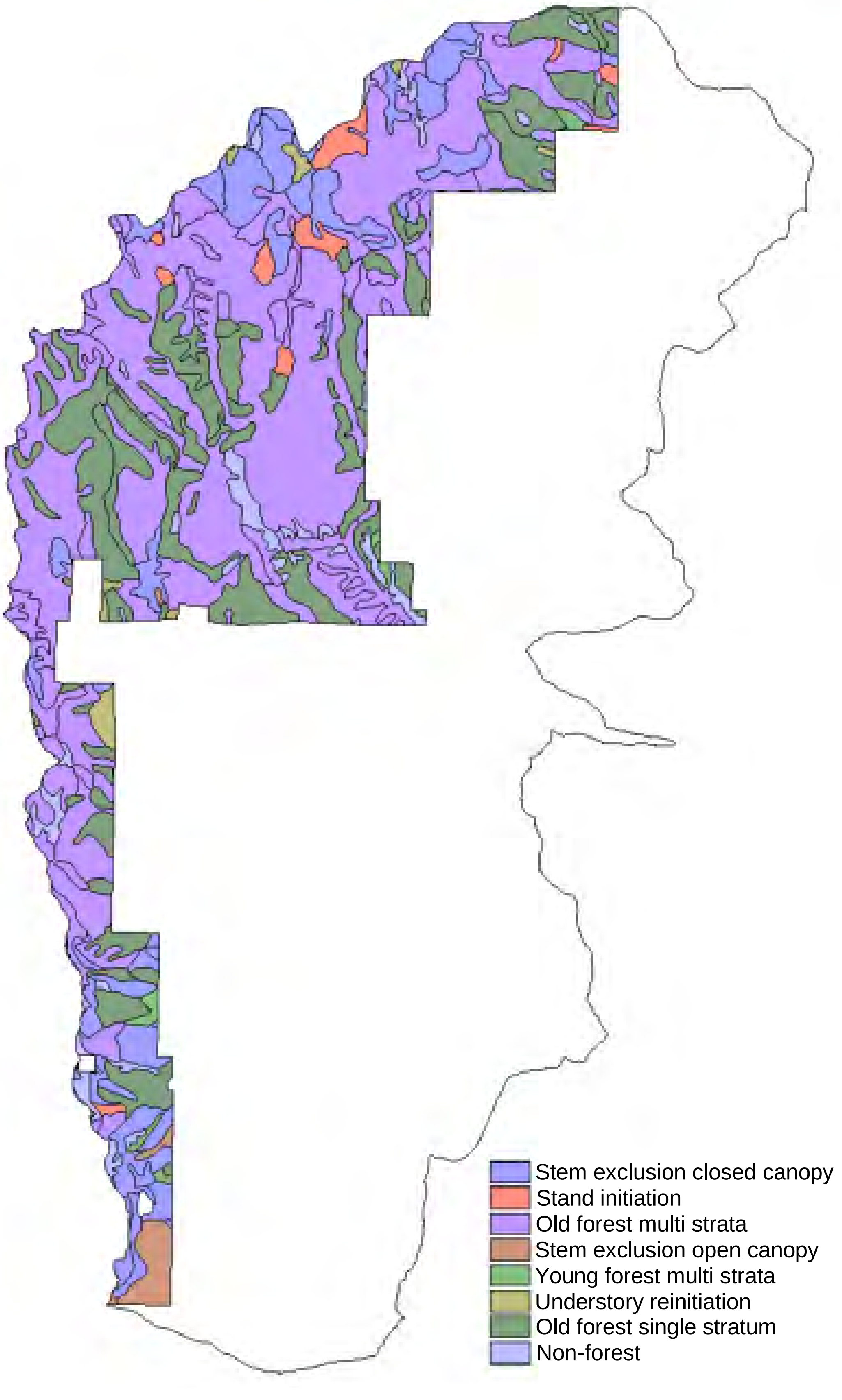
Veg Figure 9. Existing forest structural classes of the Phillips/Gordon analysis area. Veg Table 16 (page 23) describes existing structural classes in more detail.



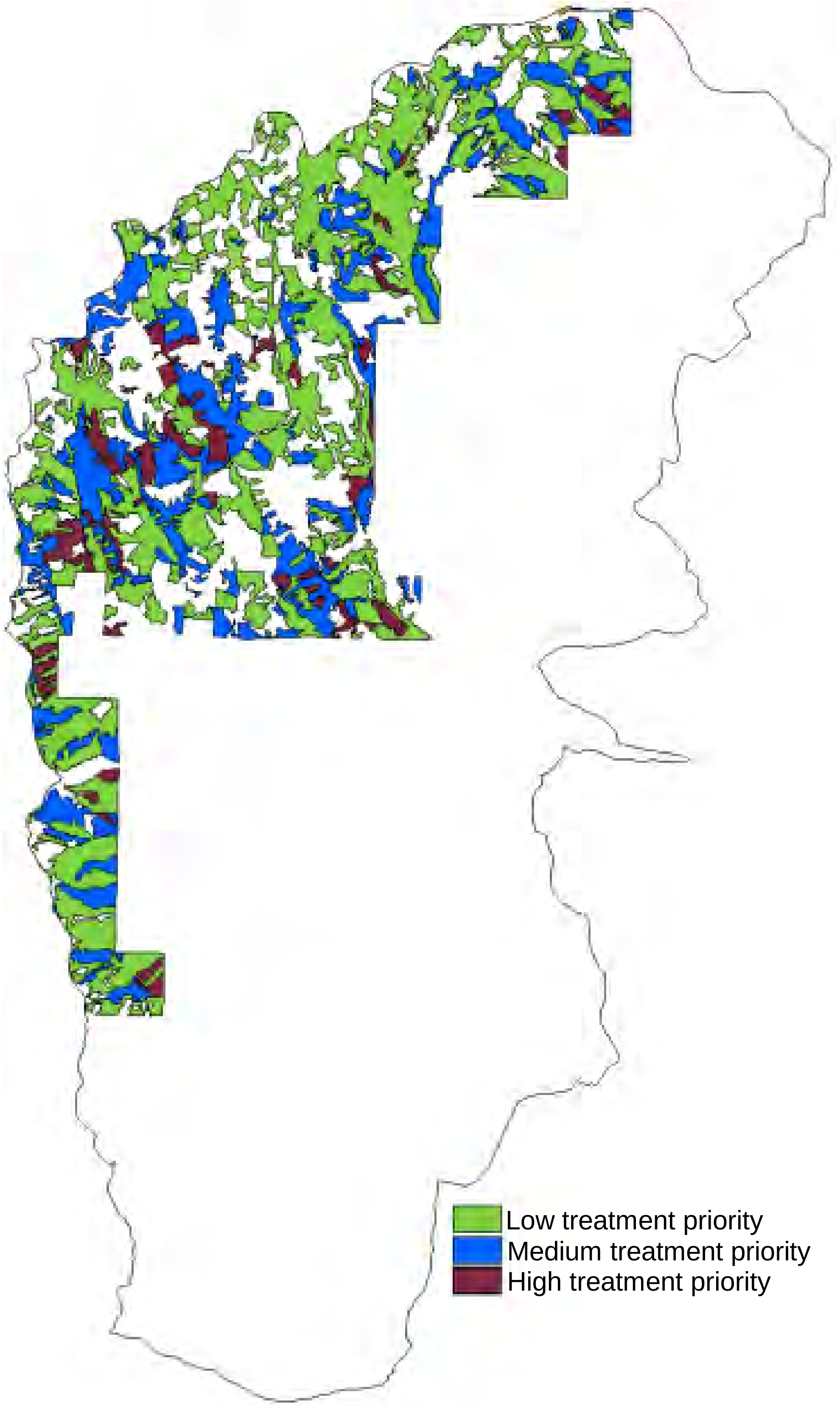
Veg Figure 10. Vegetation conditions in the Phillips/Gordon analysis area as of 1900. Veg Table 20 (page 25) describes the vegetation condition codes in more detail.



Veg Figure 11. Historical forest cover types of the Phillips/Gordon analysis area (1936). Veg Table 21 (page 26) describes historical forest cover types in more detail.



Veg Figure 12. Historical forest structural classes of the Phillips/Gordon analysis area (1936). Veg Table 24 (page 27) describes historical forest structural classes in more detail.



Veg Figure 15. Simplistic prioritization of the silvicultural treatment opportunities depicted in Veg Figure 14. Areas shown as high priority qualify for three of the four treatment opportunities; medium areas qualify for two of the opportunities; and low areas qualify for one treatment opportunity.

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Map Appendix

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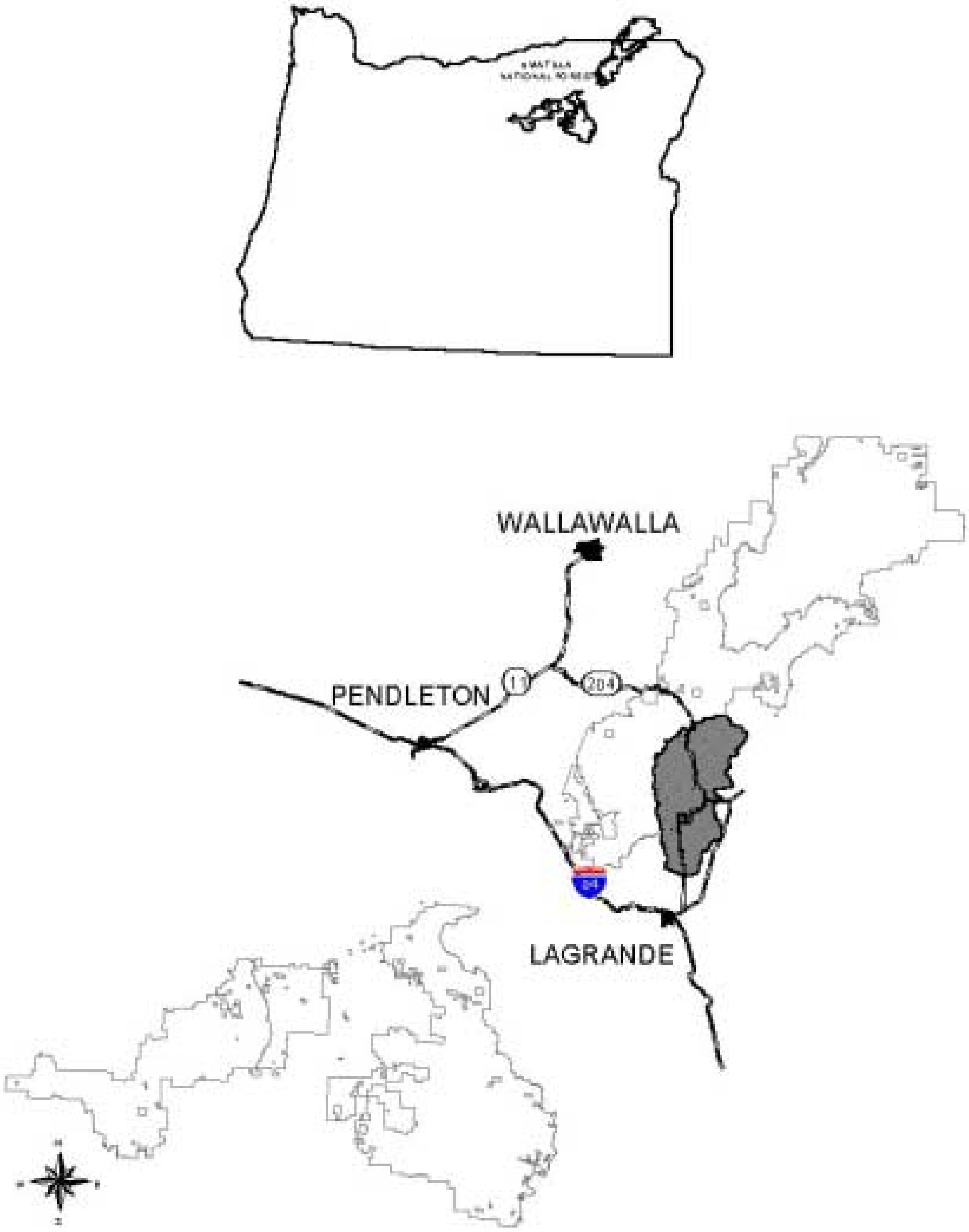


Figure 1-1. Vicinity map of the Phillips-Gordon analysis area.

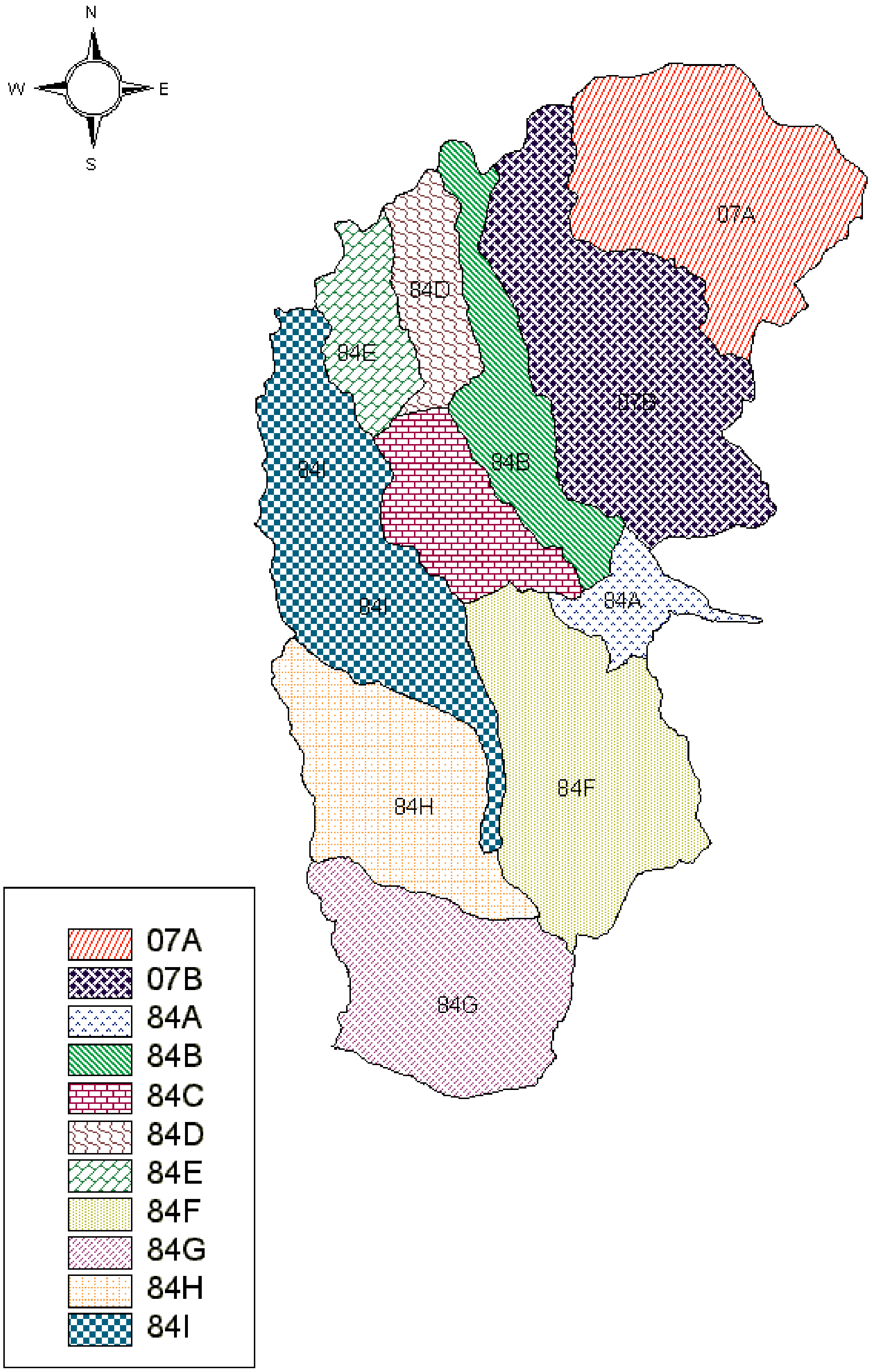


Figure 1-2. Subwatersheds of the Phillips-Gordon analysis area.

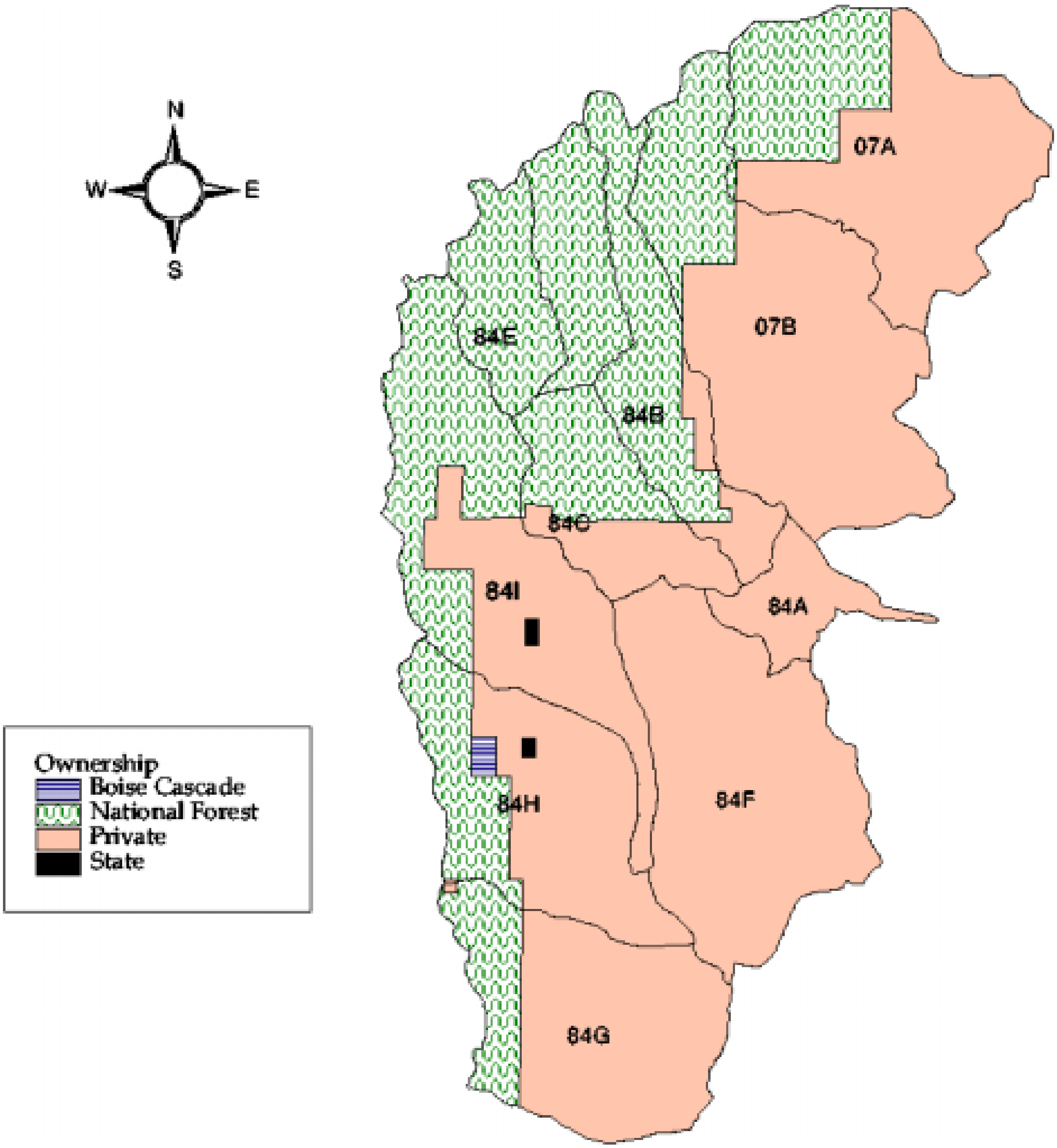


Figure 1-3. Land ownership in the Phillips-Gordon analysis area.

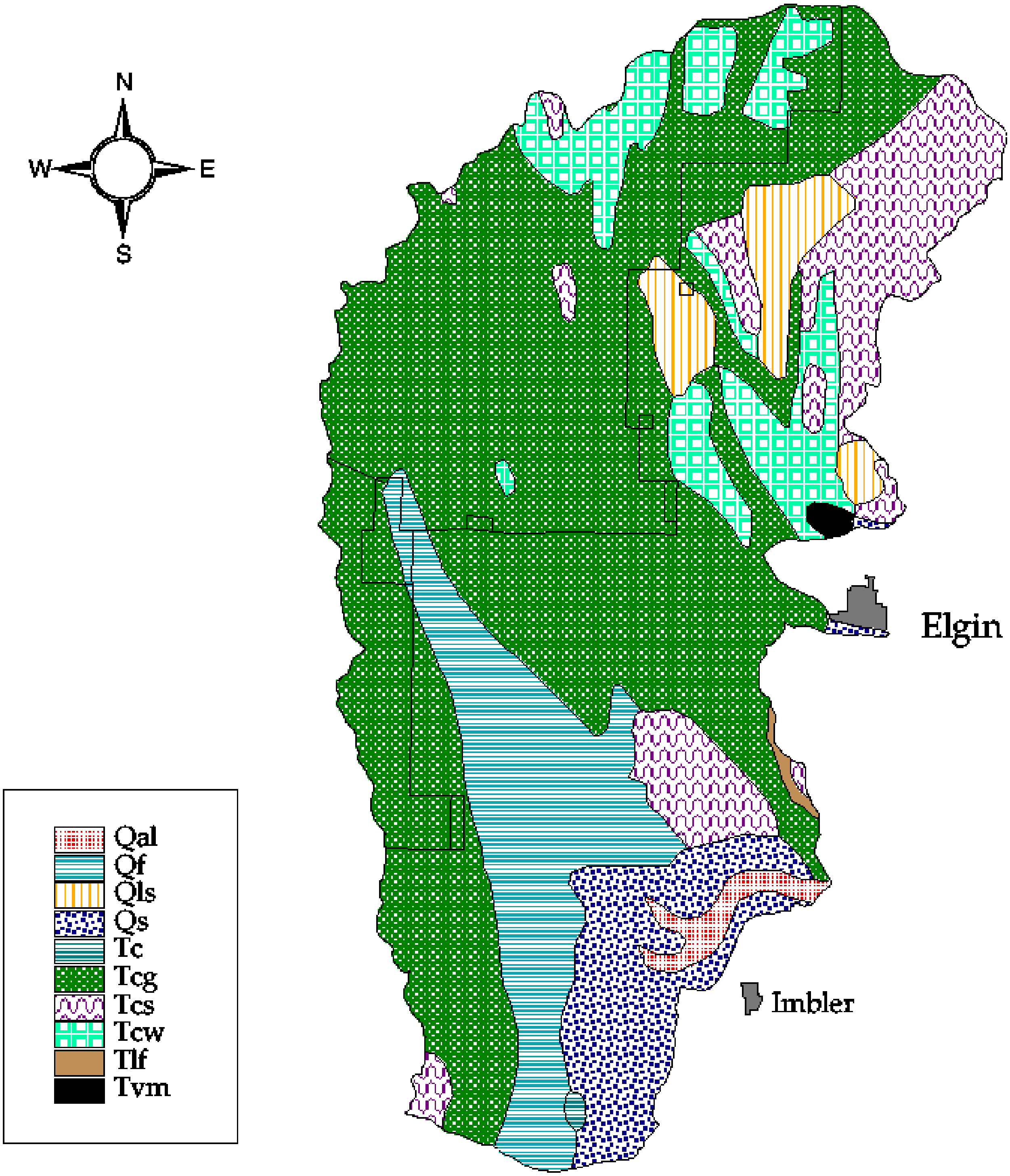


Figure 1-4. Geologic types in the Phillips-Gordon analysis area.

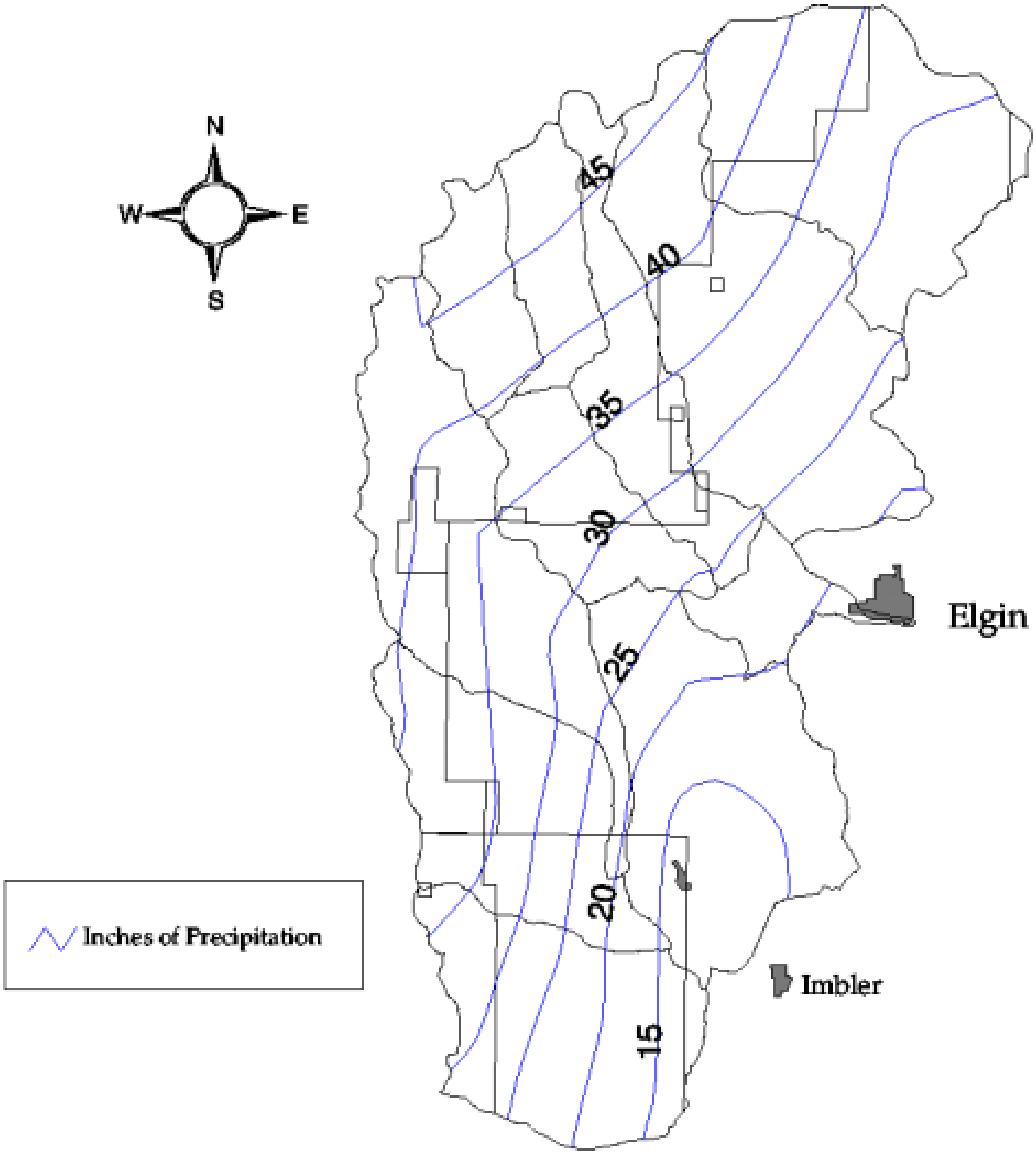


Figure 1-7. Annual precipitation rates in the Phillips-Gordon analysis area.

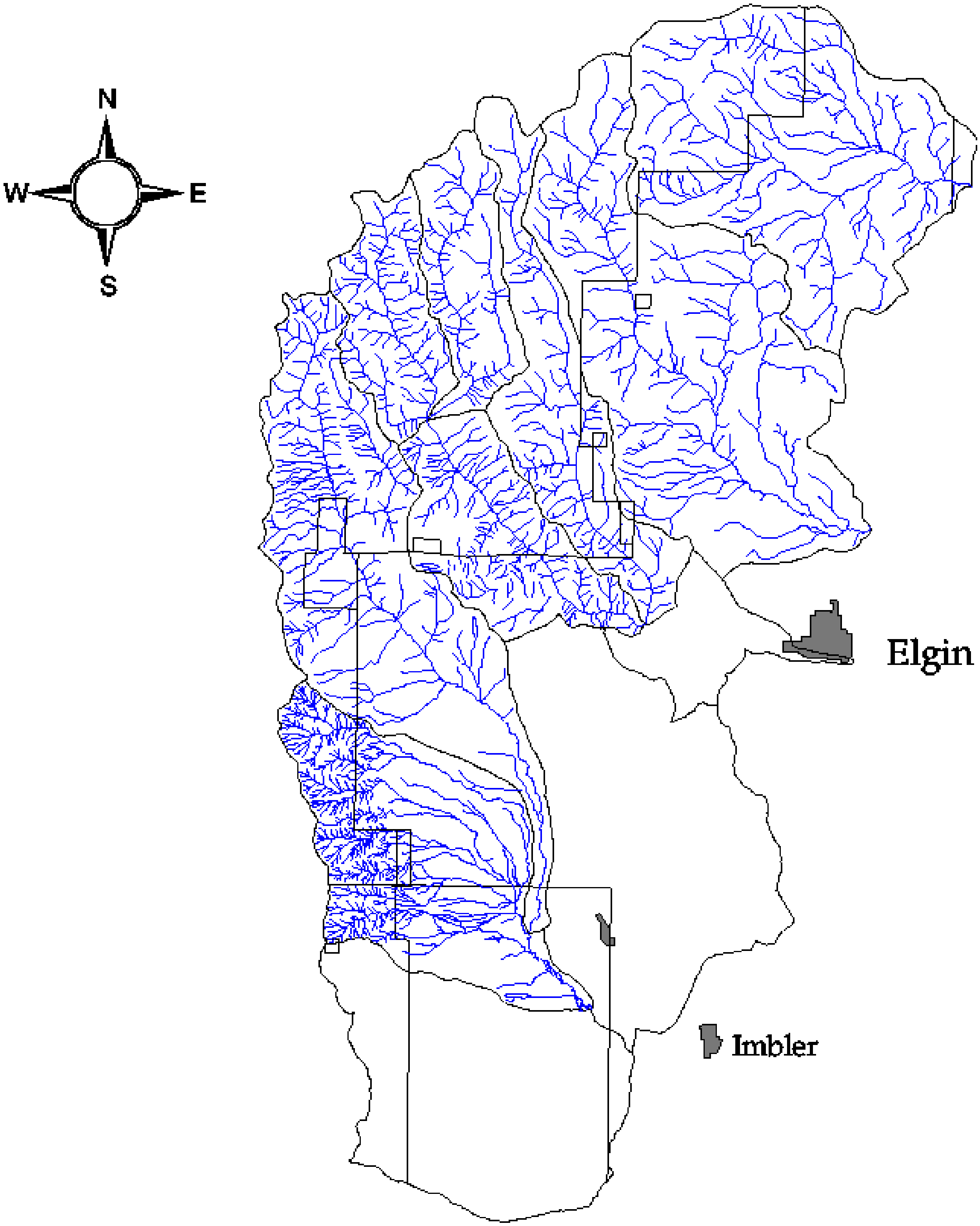


Figure 1-9. Streams of the Phillips-Gordon analysis area.

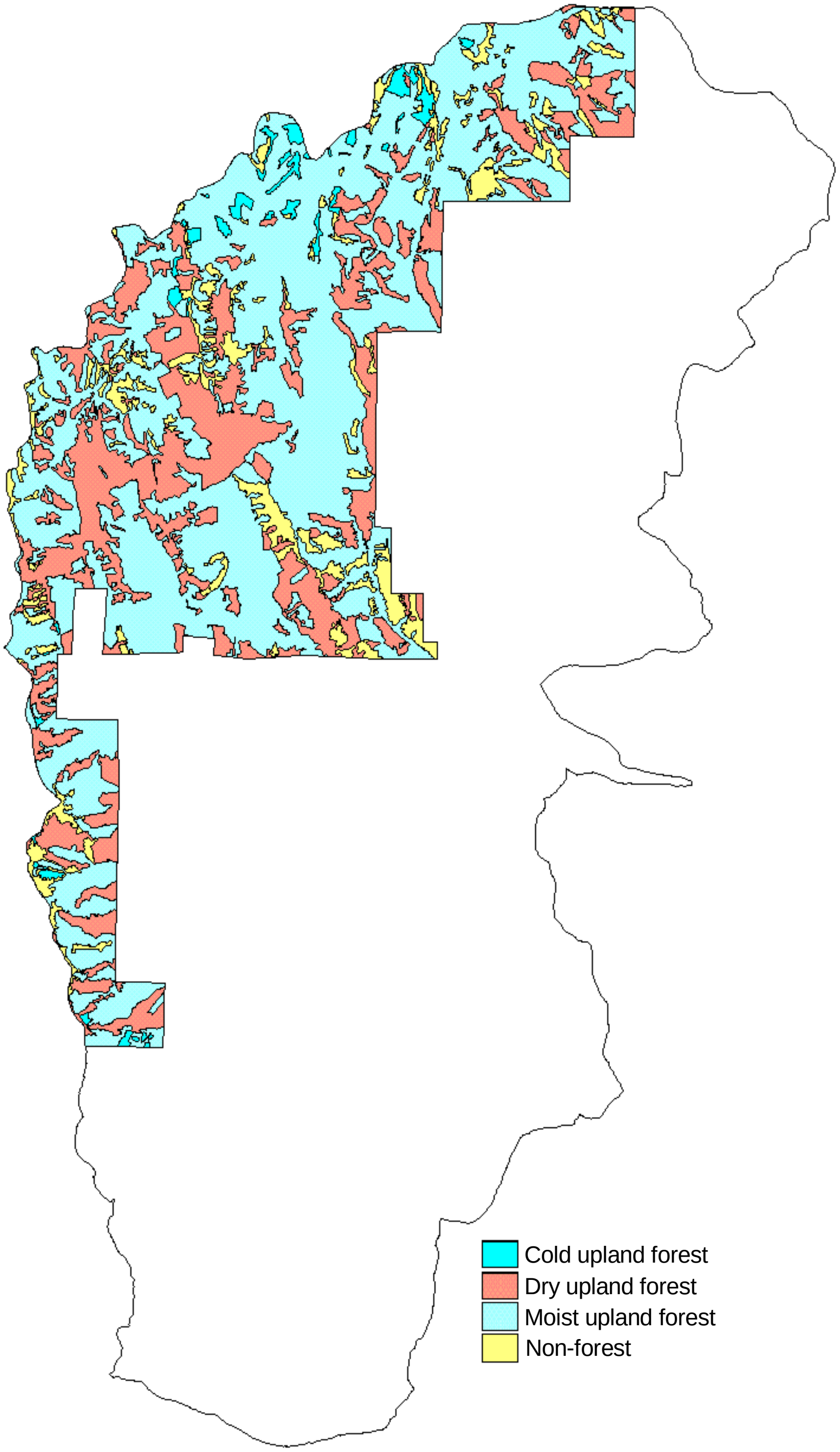


Figure 1-10. Potential vegetation types of the Phillips-Gordon analysis area

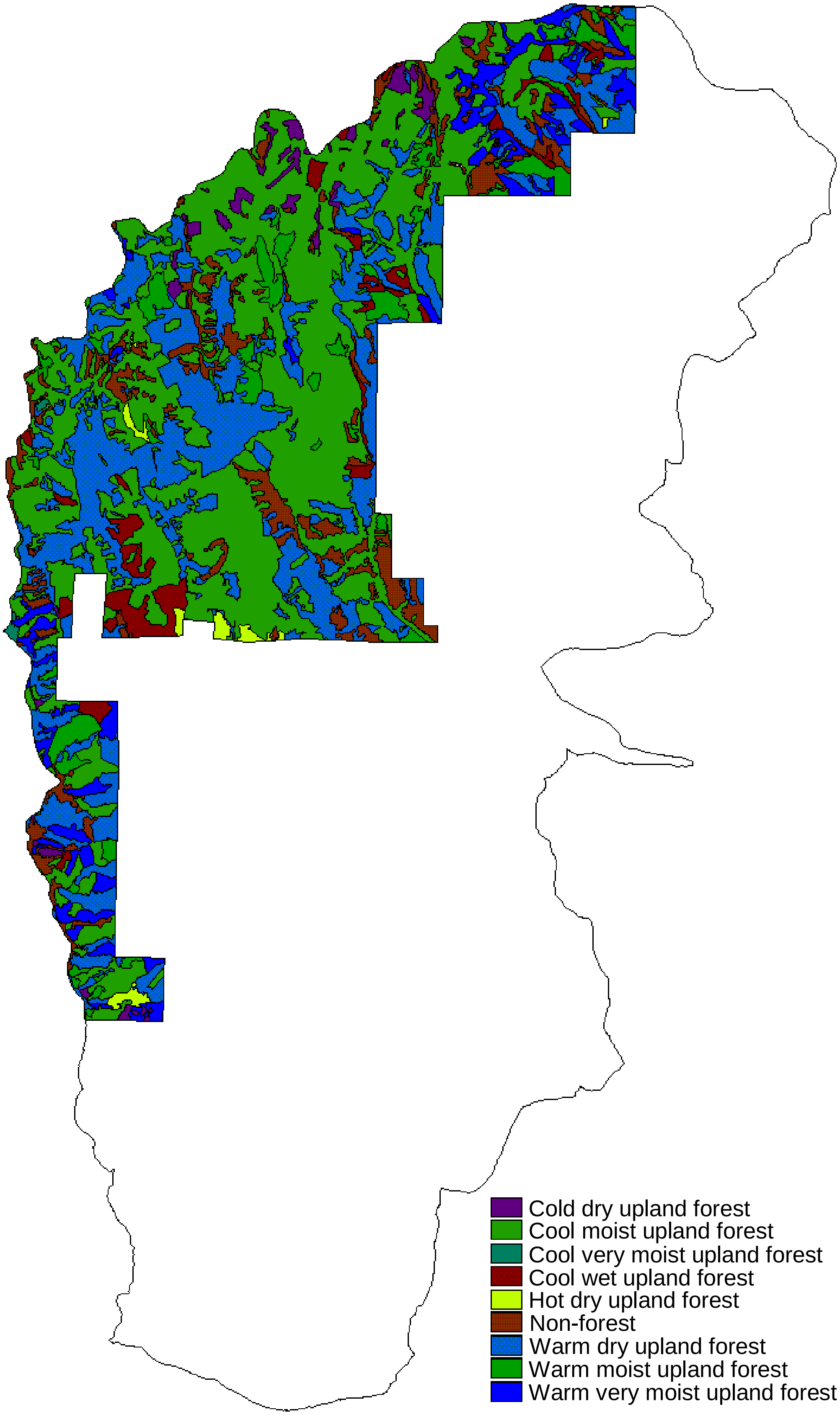


Figure 1-11. Plant association groups (PAGs) of the Phillips-Gordon analysis area.

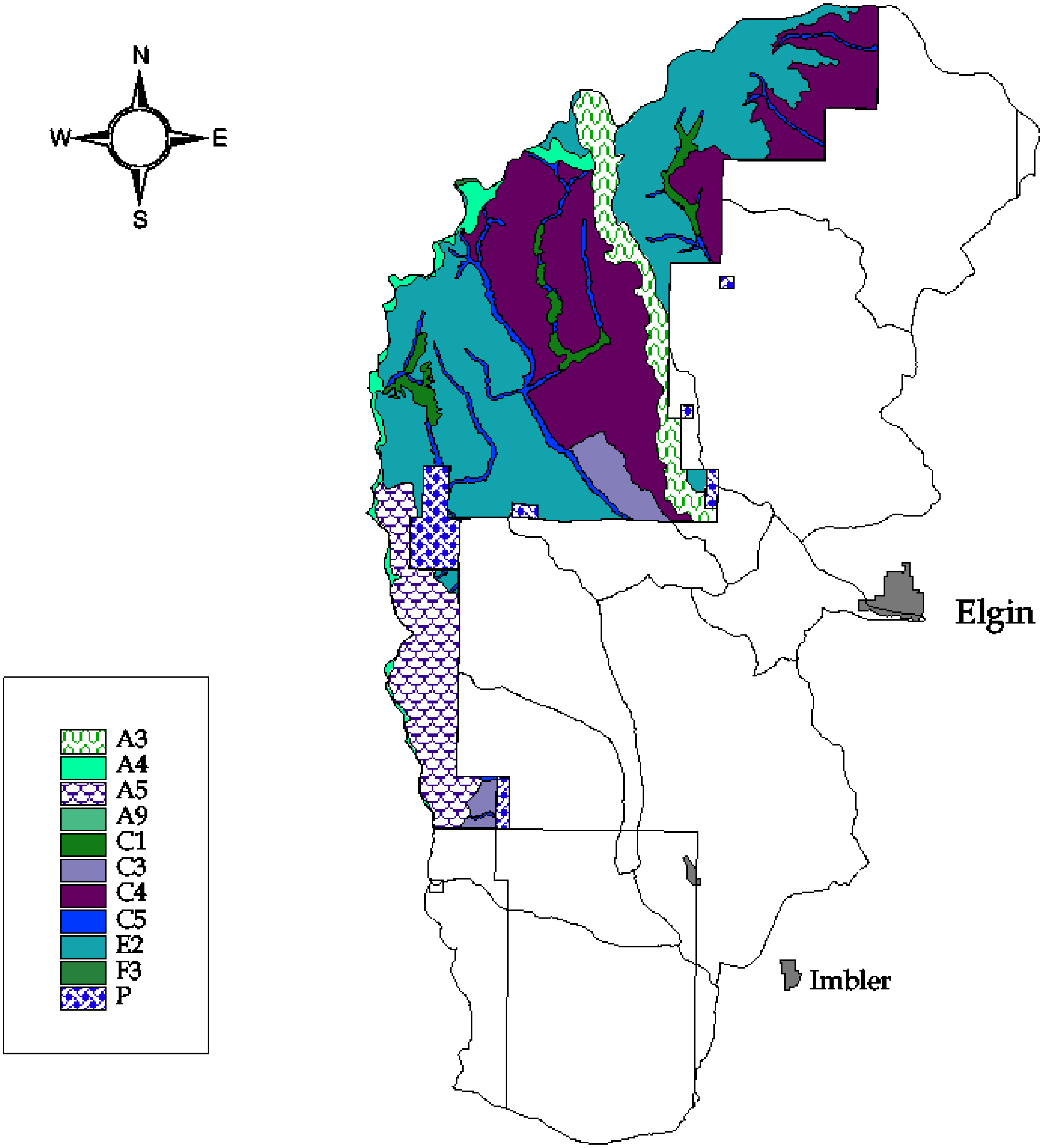
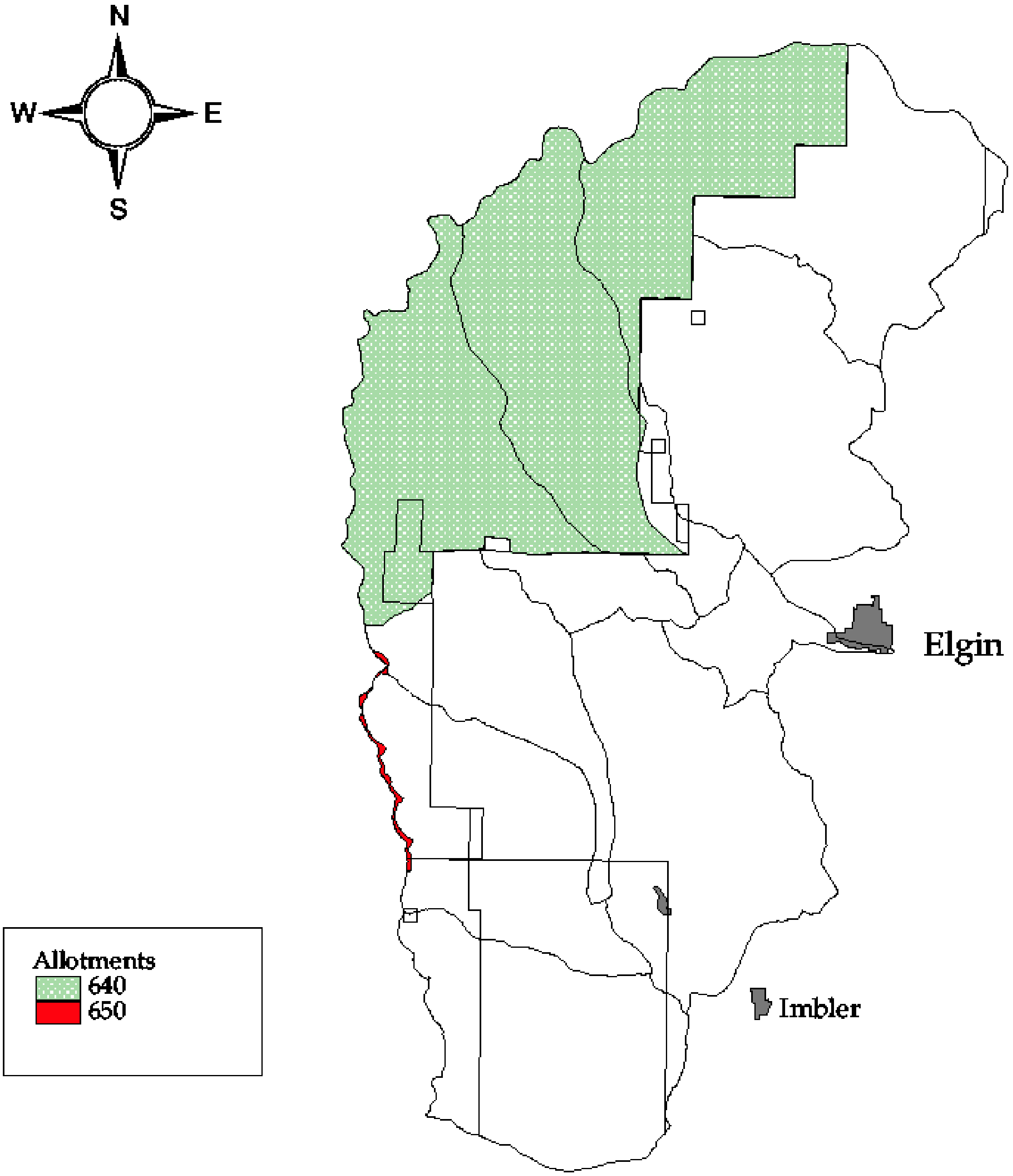


Figure 1-12. Forest Plan management areas in the Phillips-Gordon analysis area



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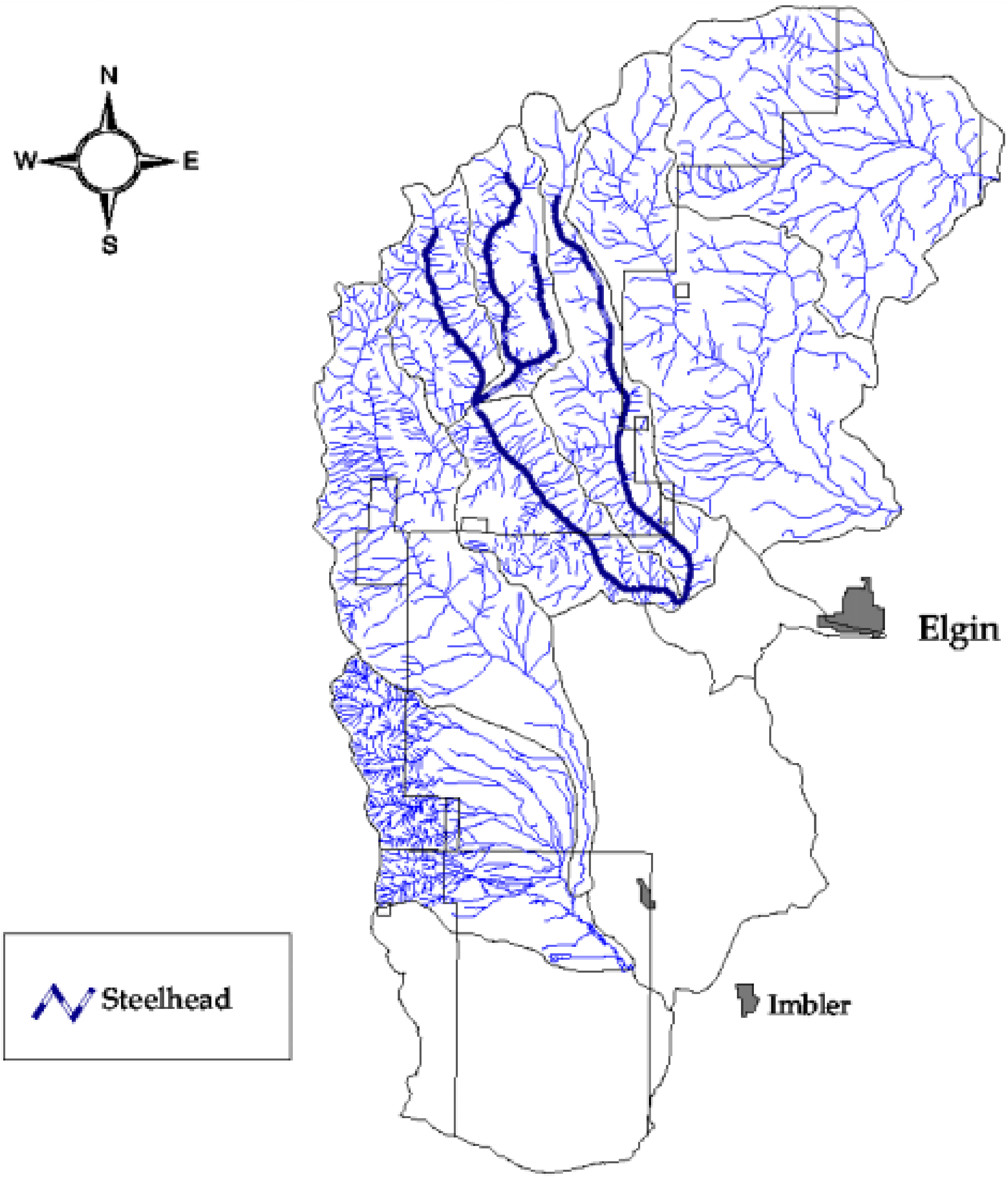


Figure 4-1.   Distribution of steelhead/rainbow/redband trout in the Phillips-Gordon analysis area.

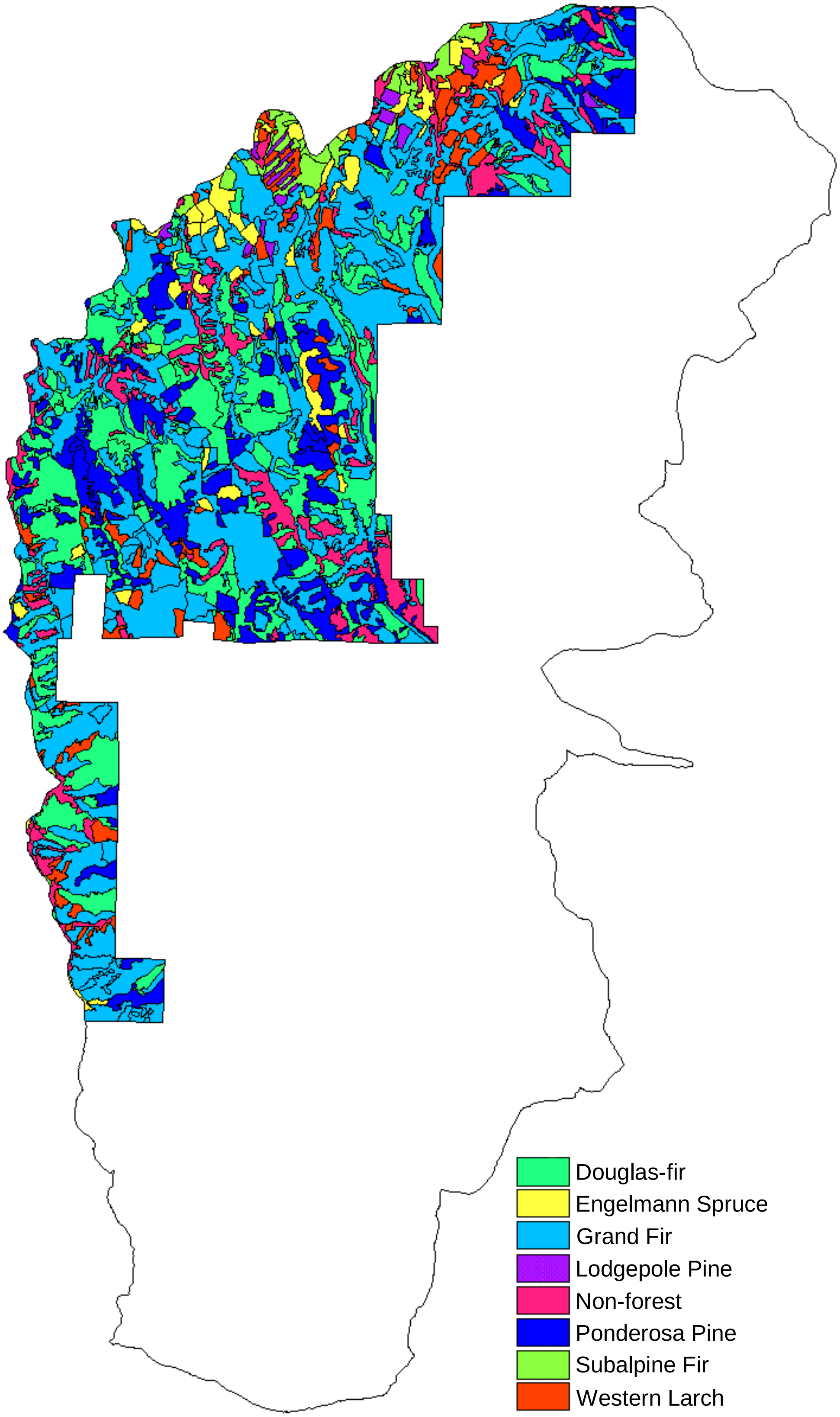
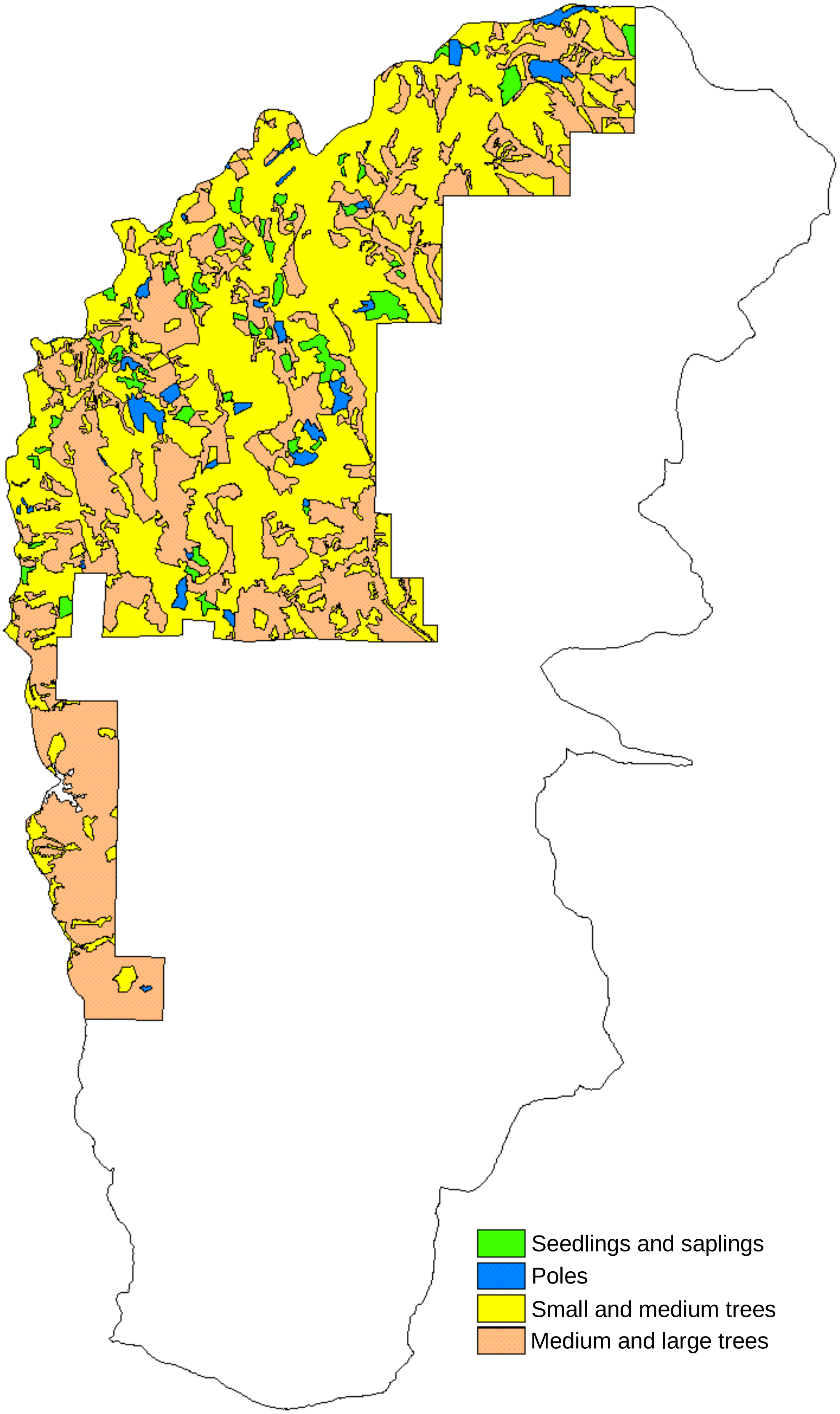


Figure 5-1. Existing forest cover types of the Phillips-Gordon analysis area

Figure 5-2. Vegetation conditions in the Phillips-Gordon analysis area as of 1900.

Figure 5-3. Historical forest cover types of the Phillips-Gordon analysis area (1936).



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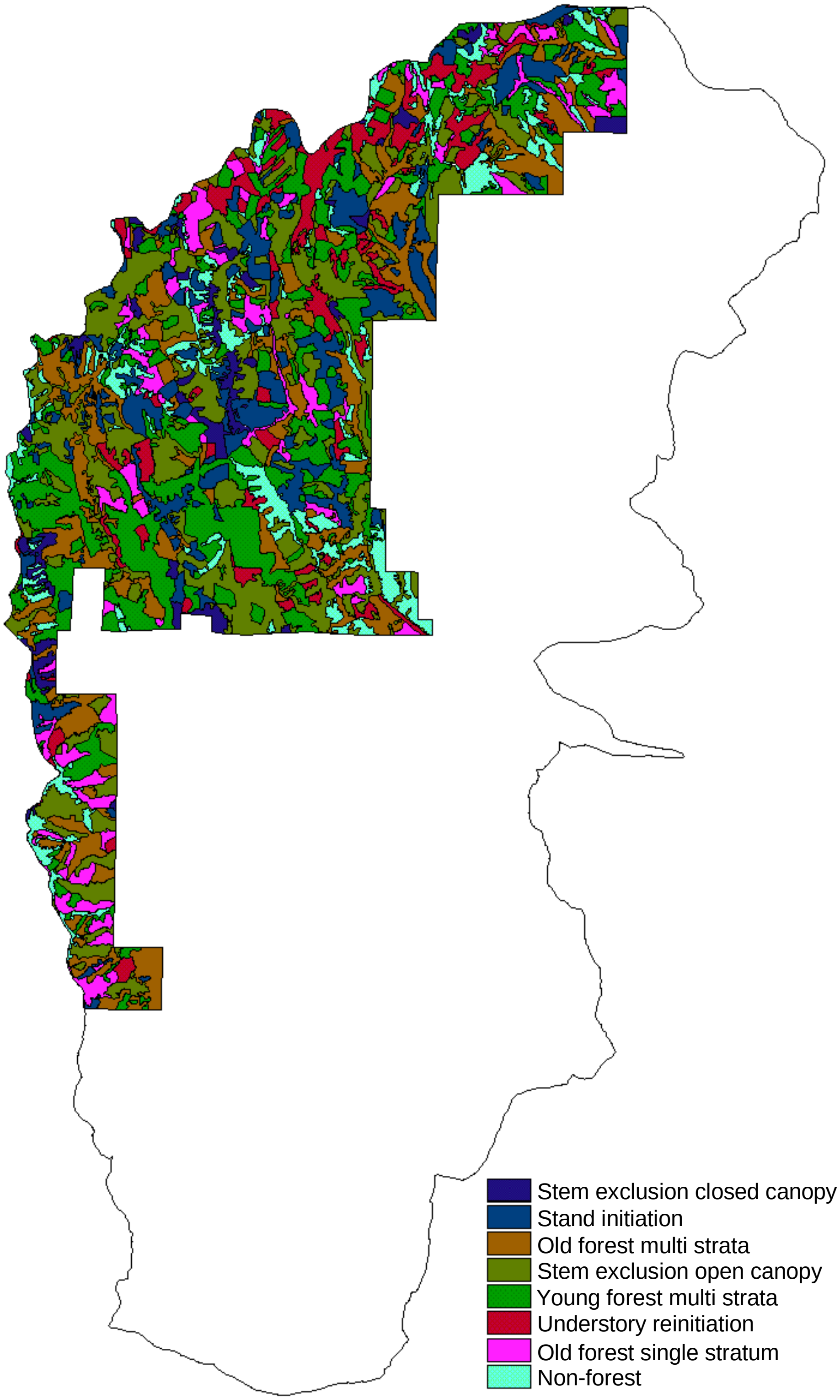

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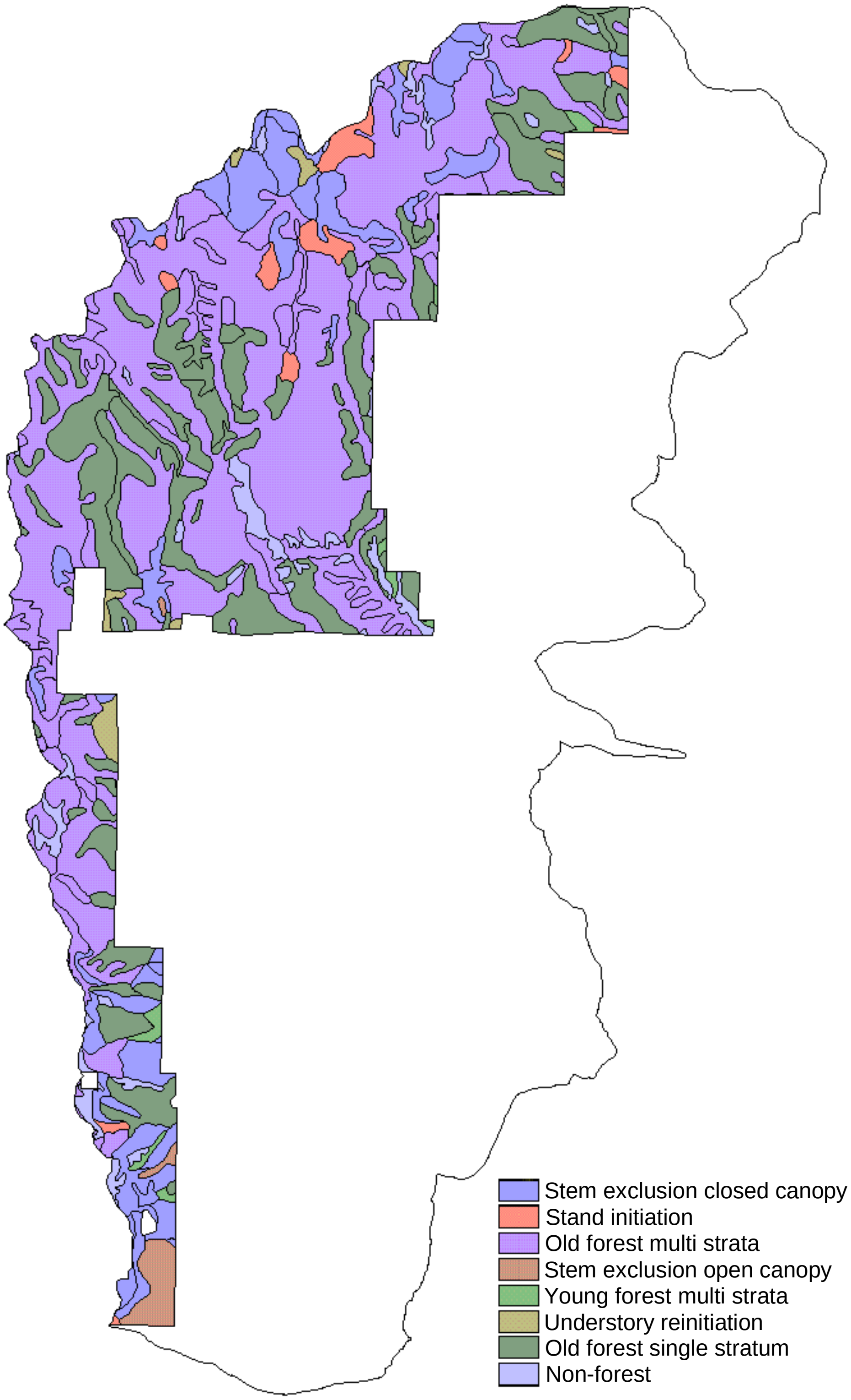

Figure 5-6. Historical forest structural classes of the Phillips-Gordon analysis area (1936).

Figure 5-7. Existing forest density classes.

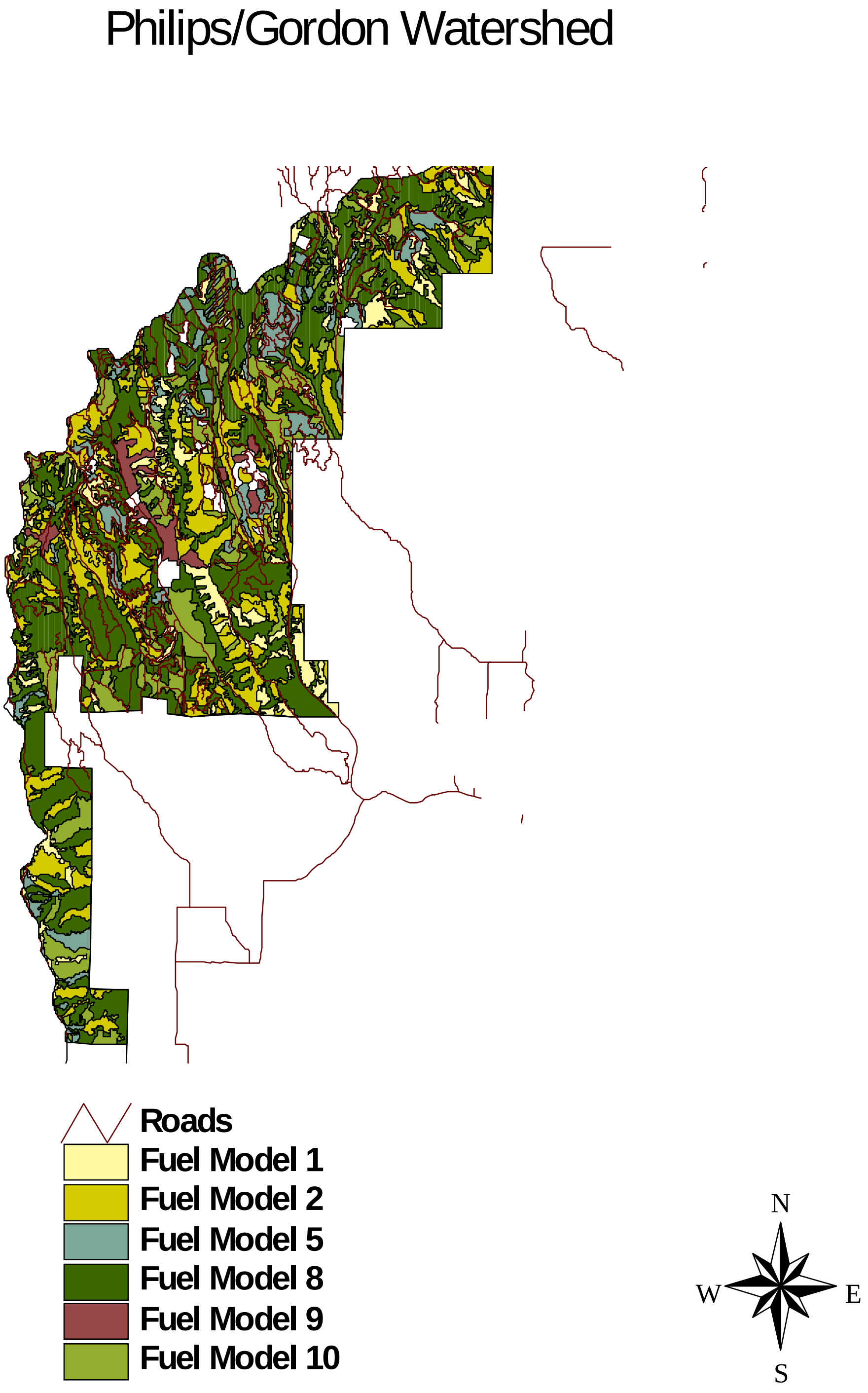

Figure 6-1. Fuel models of the Phillips-Gordon analysis area.

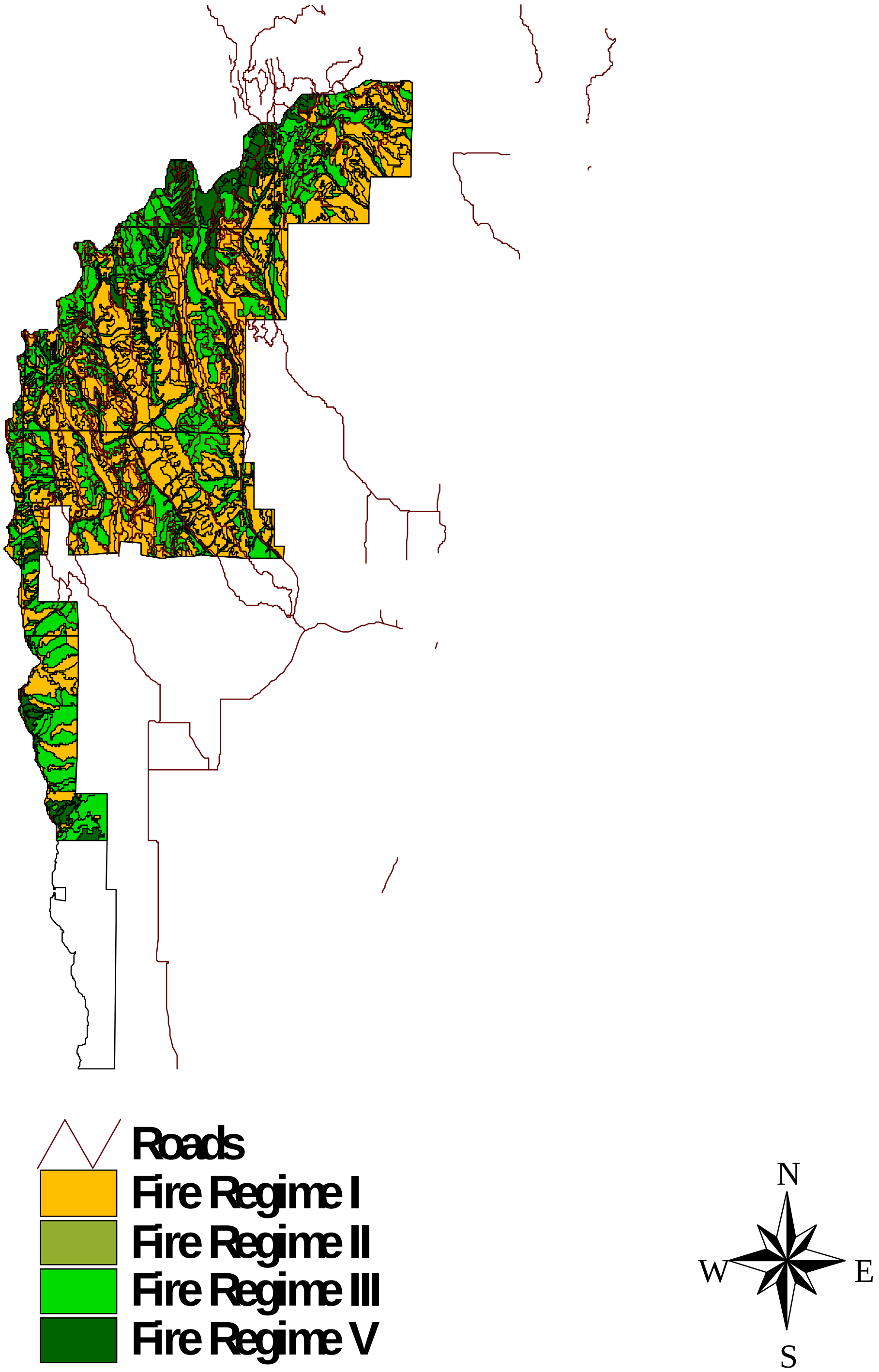

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Figure 6-3. Condition Class I

Figure 6-4. Condition Class 2

Figure 6-5. Condition Class 3.

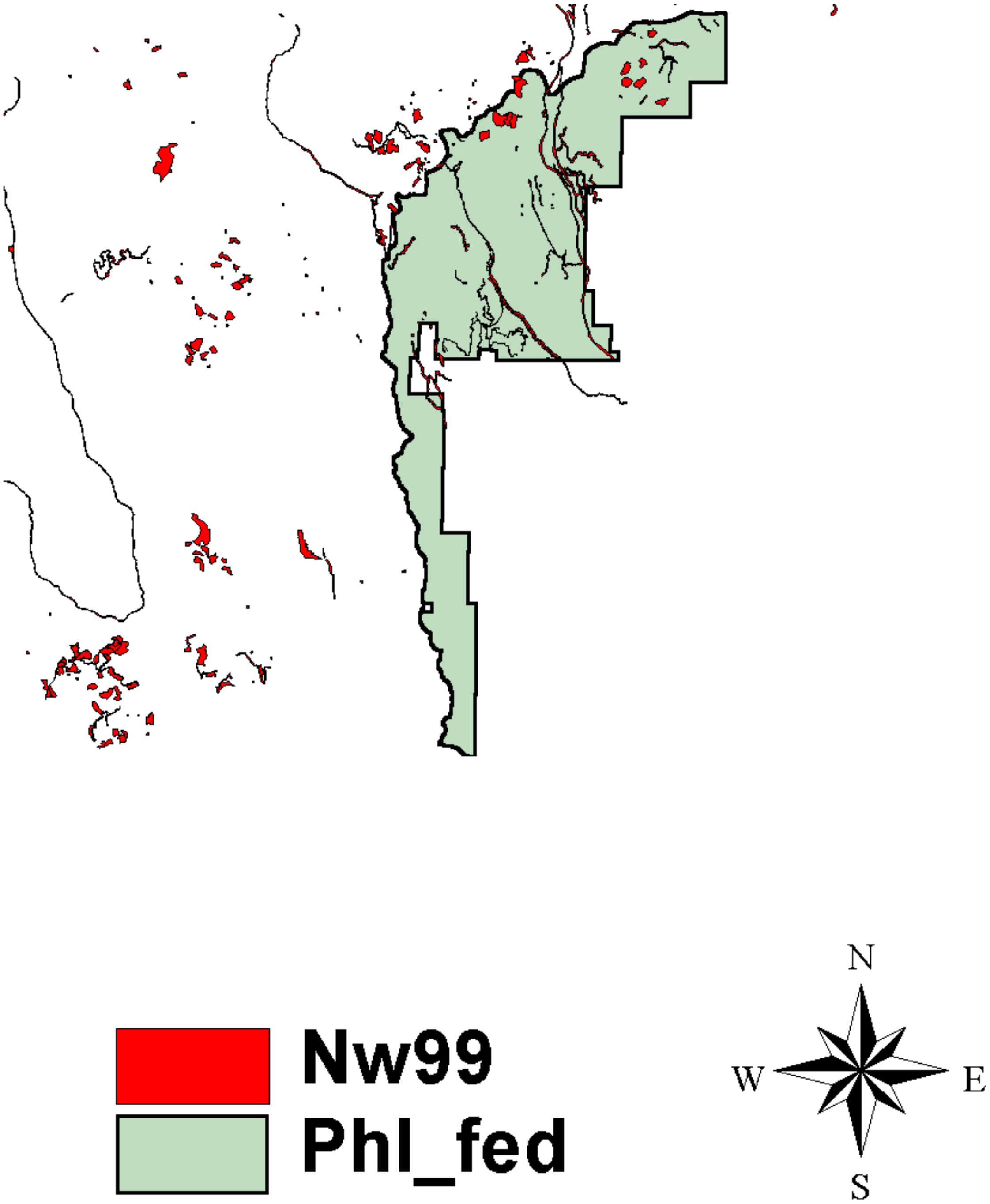

Figure 7-1. Inventoried noxious weed sites in the Phillips-Gordon watershed.

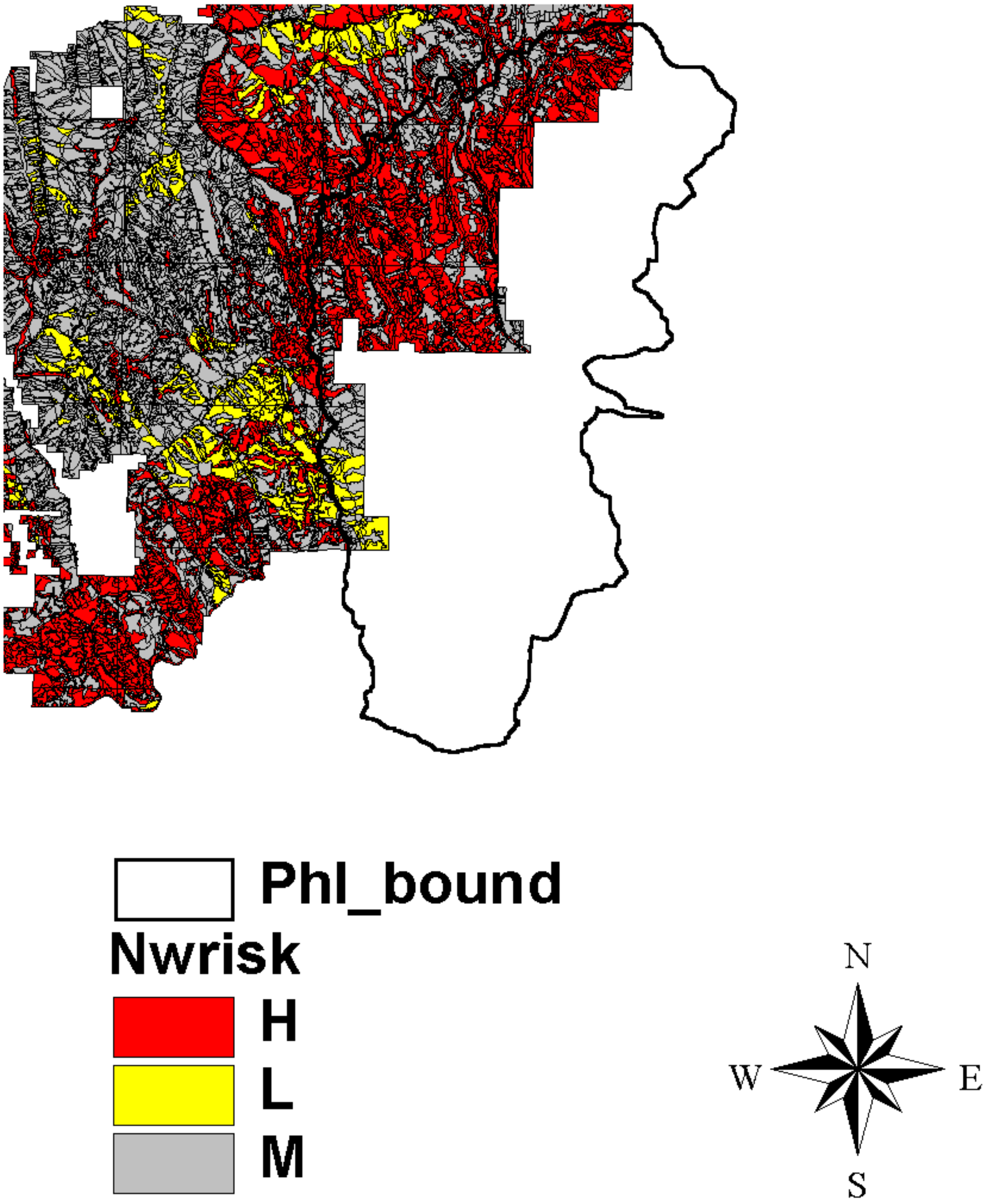

Figure 7-2. Results of noxious weed risk assessment in the Phillips-Gordon watershed.

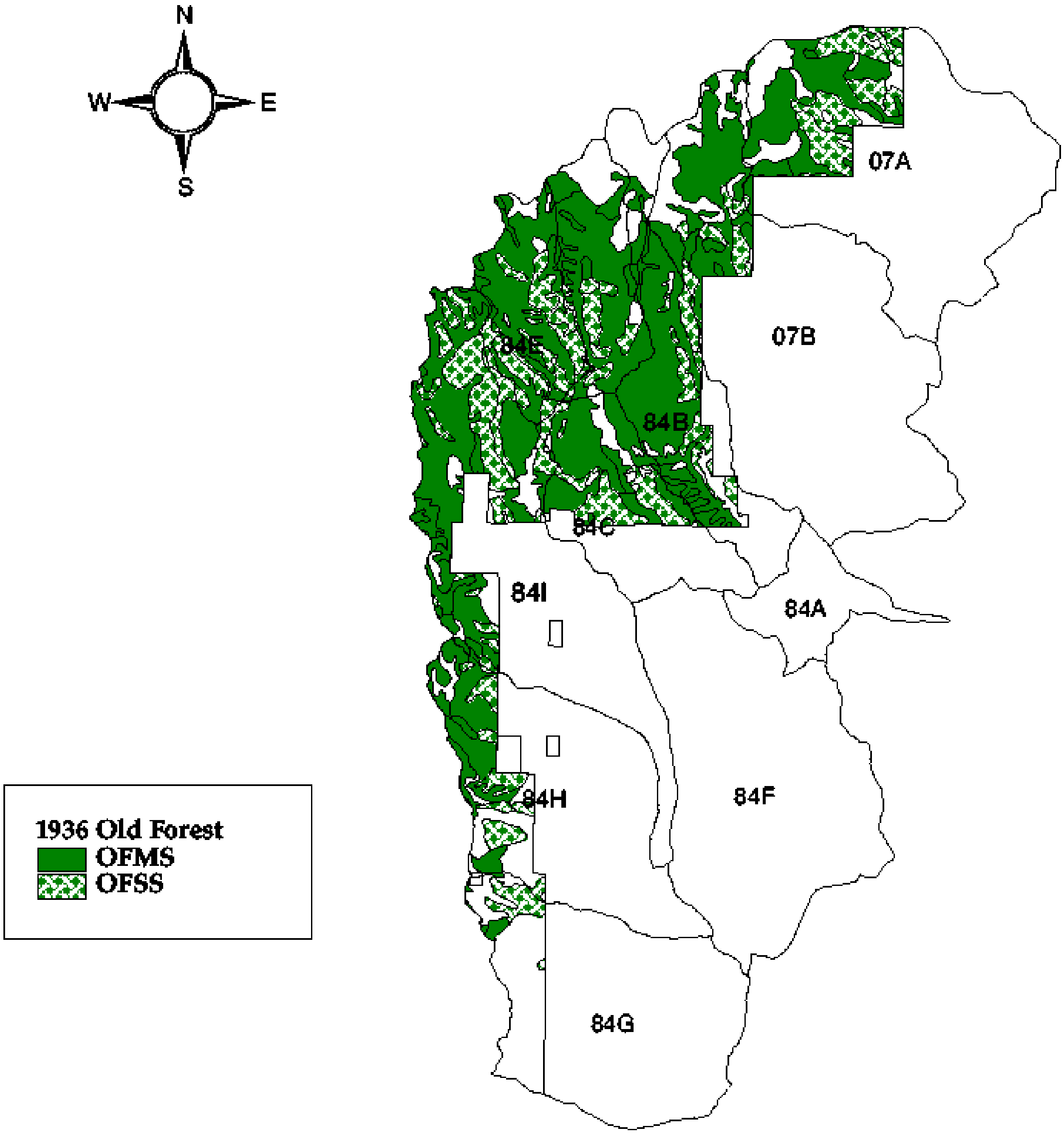

Figure 8-1. 1936 old forest

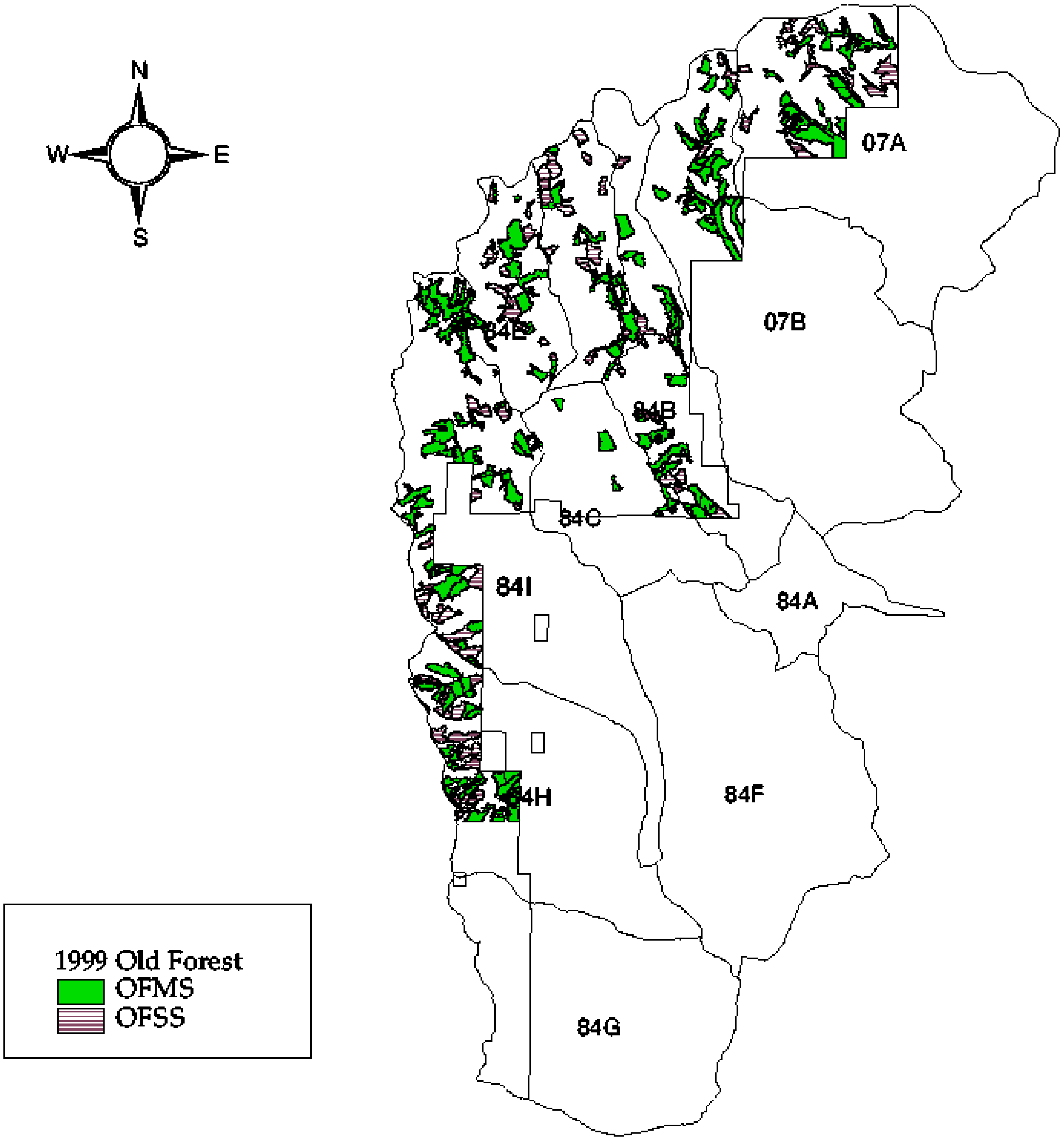

Figure 8-2. Current old forest

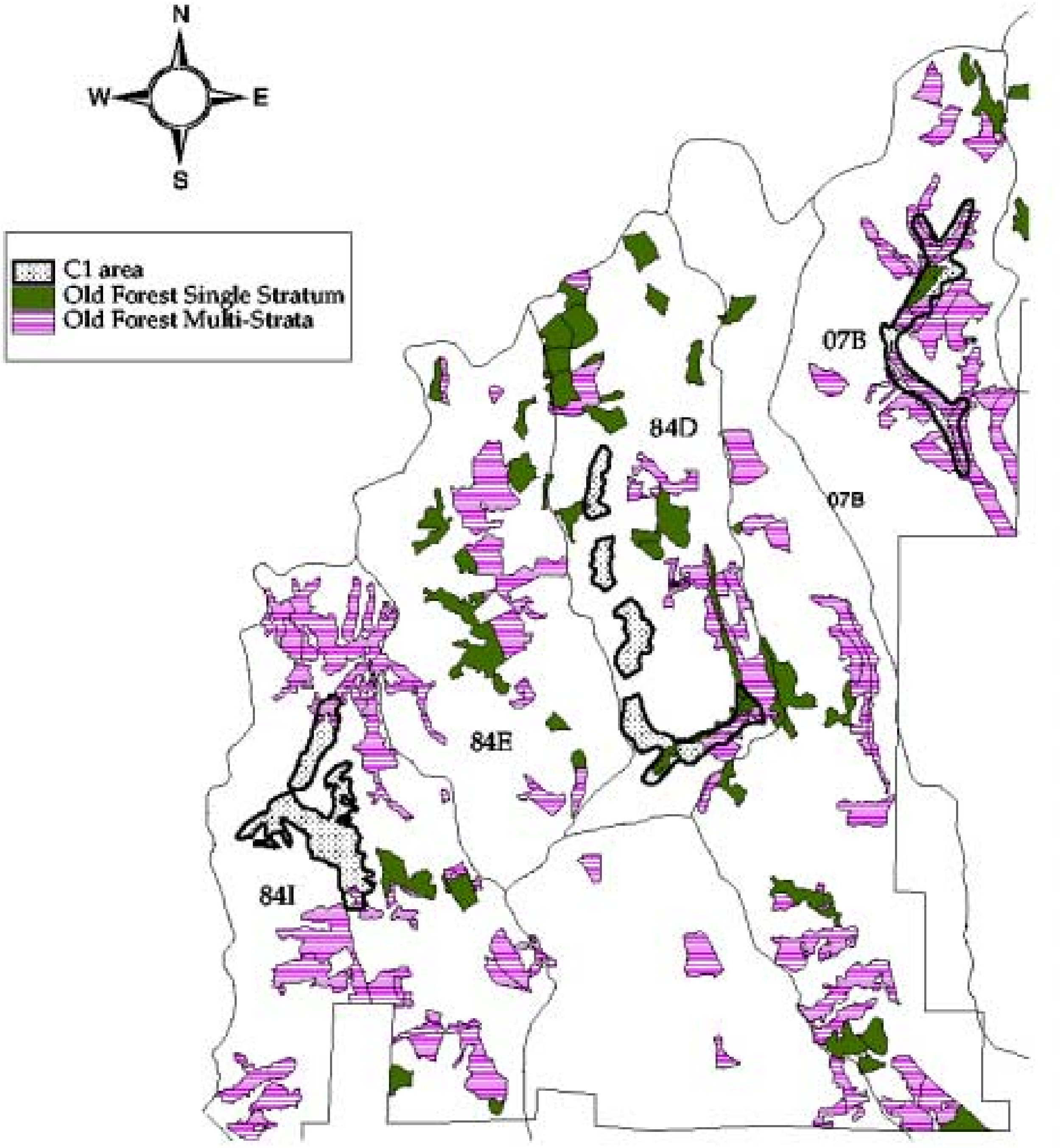

Figure 8-3. C1 network and existing old forest

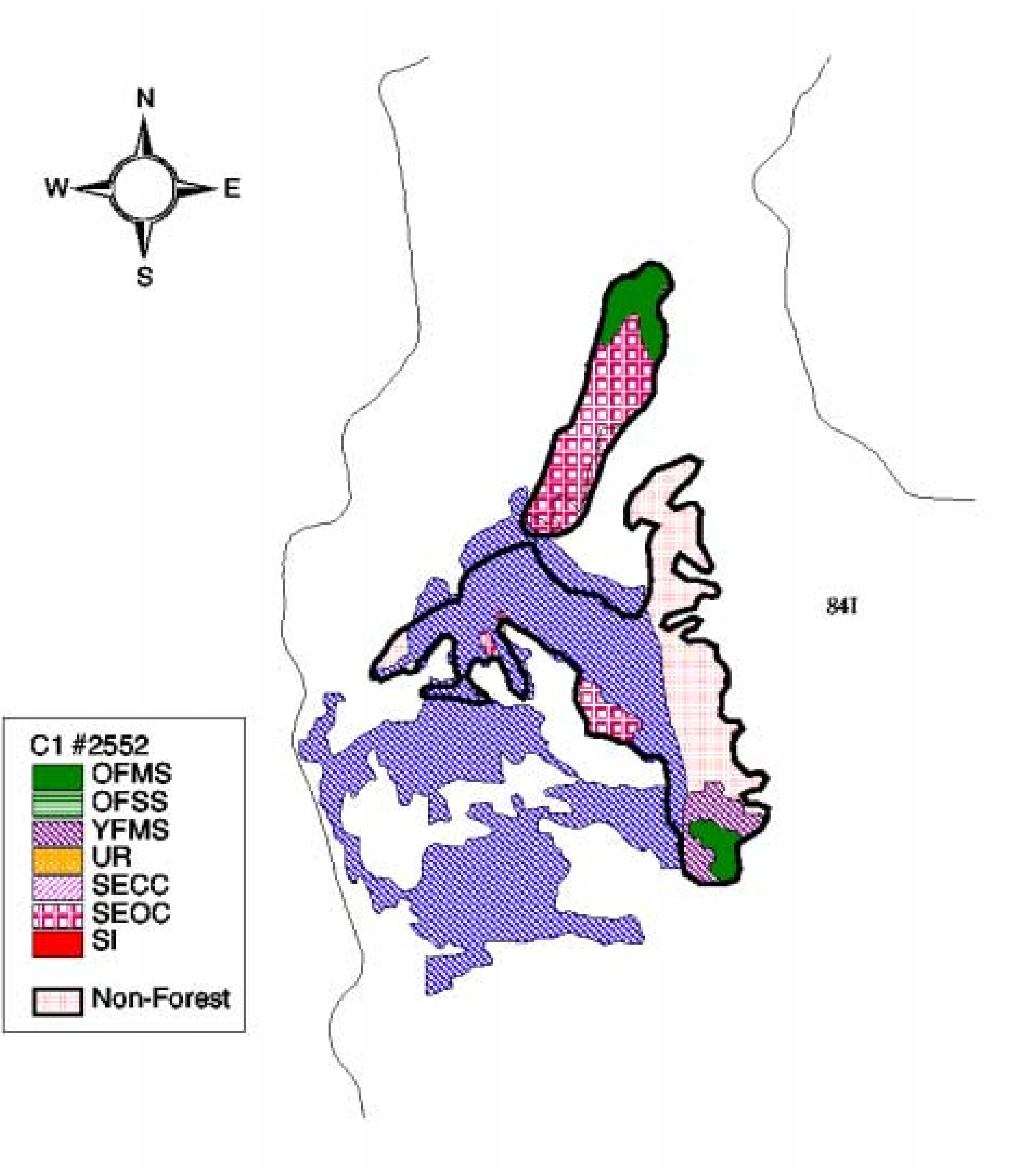

Figure 8-4. C1 area 2552

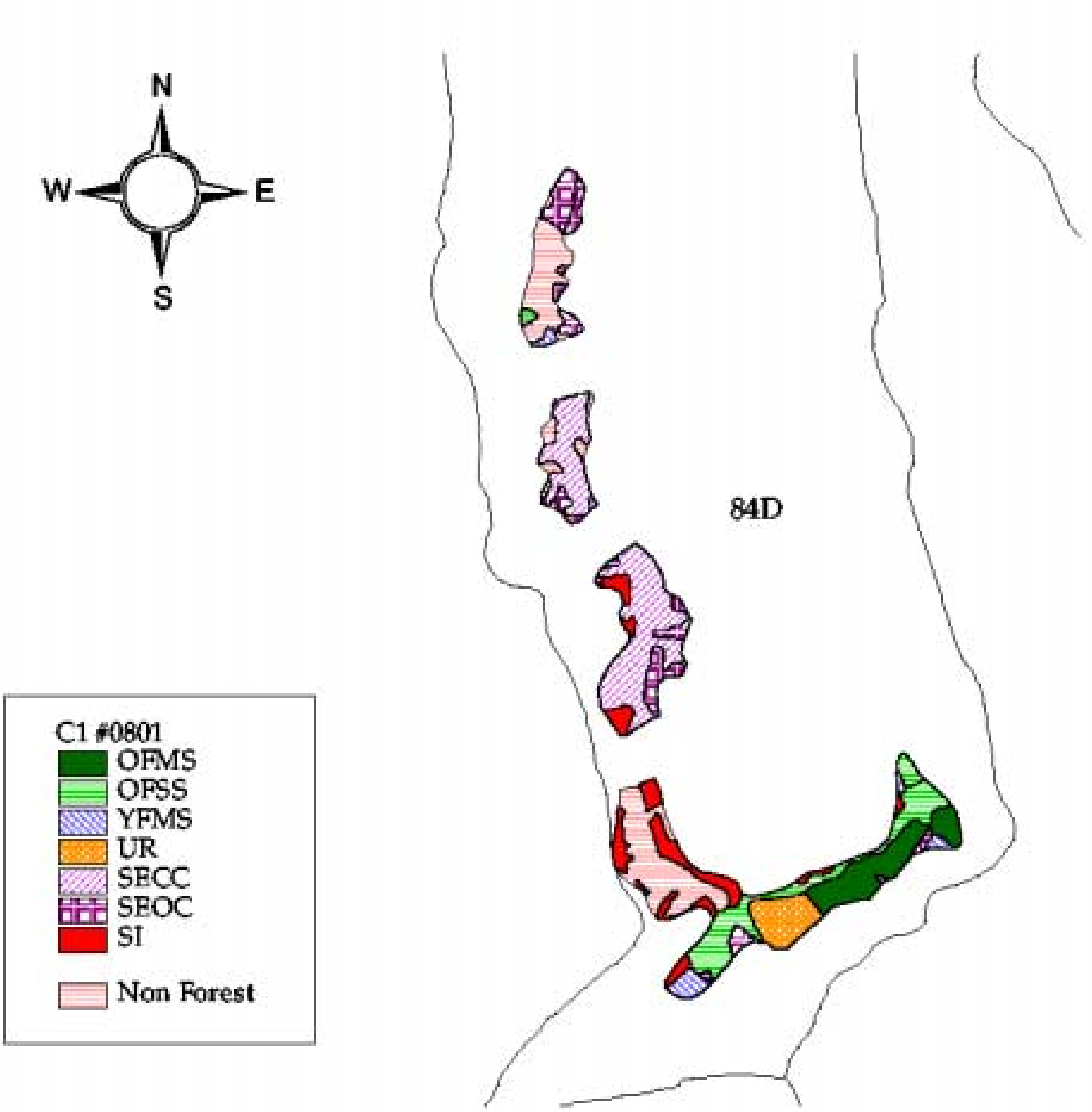

Figure 8-5. C1 area 0801

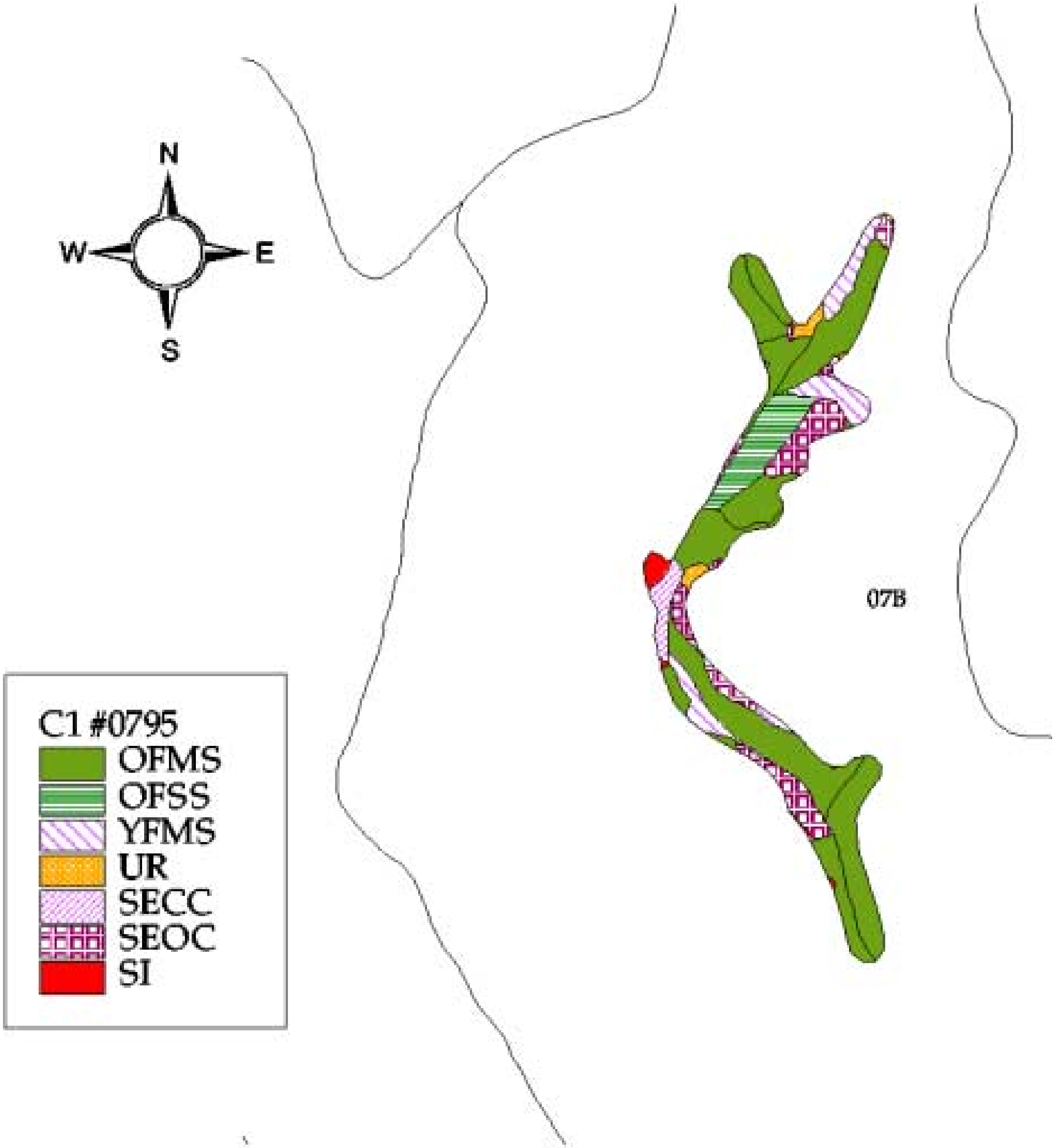

Figure 8-6. C1 area 0795

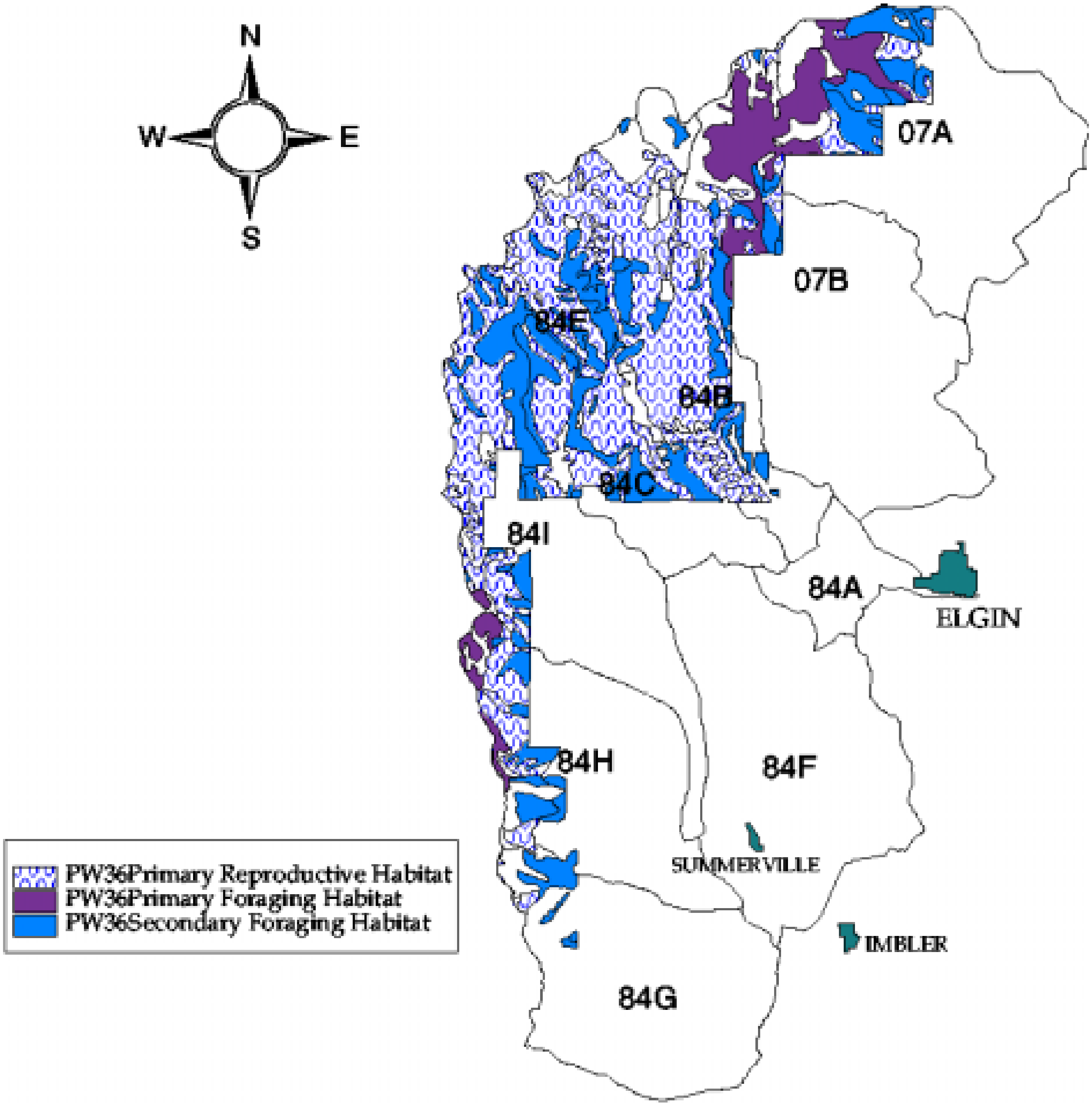

Figure 8-7. Pileated Woodpecker Habitat 1936

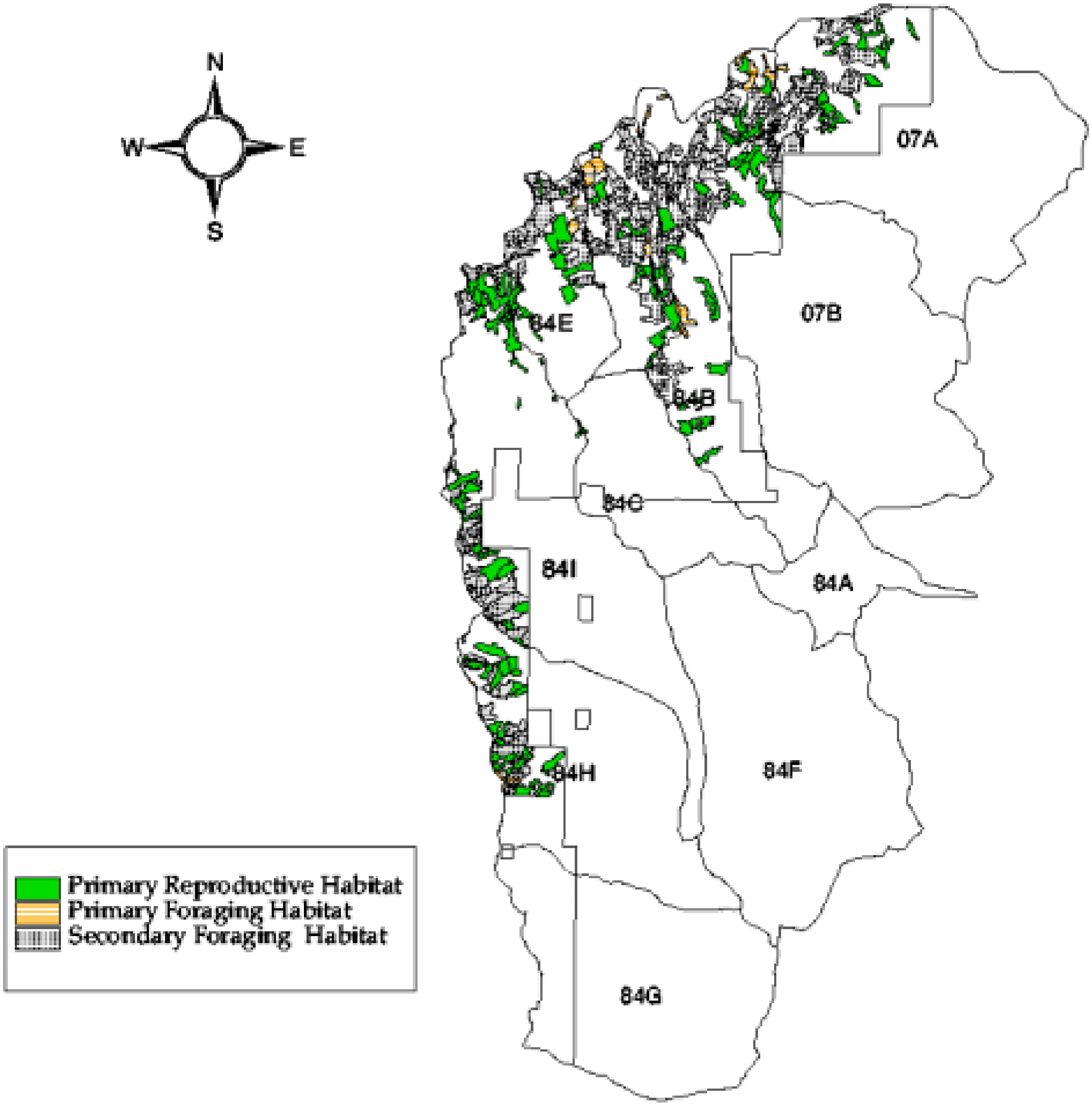

Figure 8-8. Pileated Woodpecker Habitat 1999

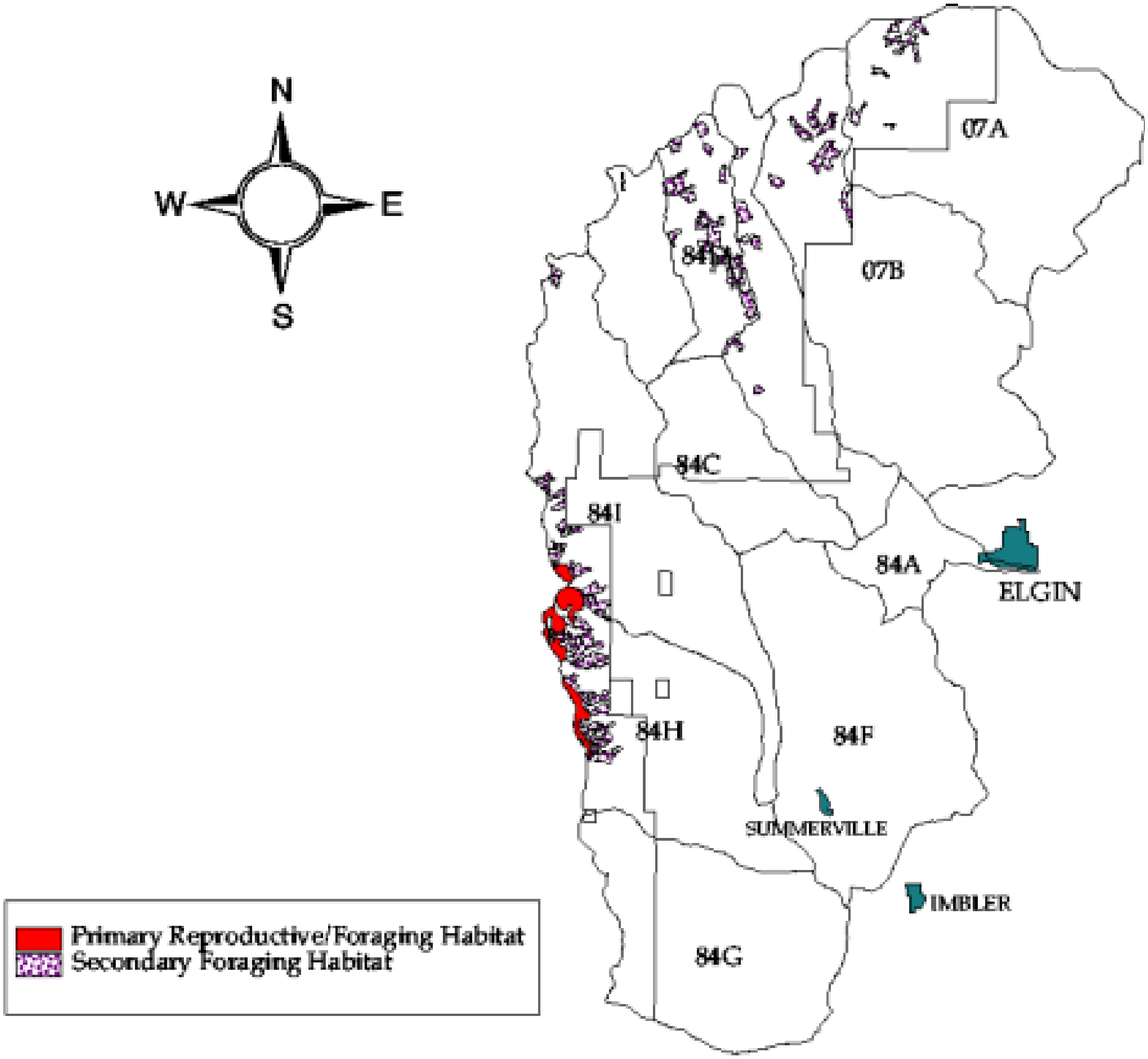

Figure 8-9. Northern Three-toed Woodpecker Habitat, 1936

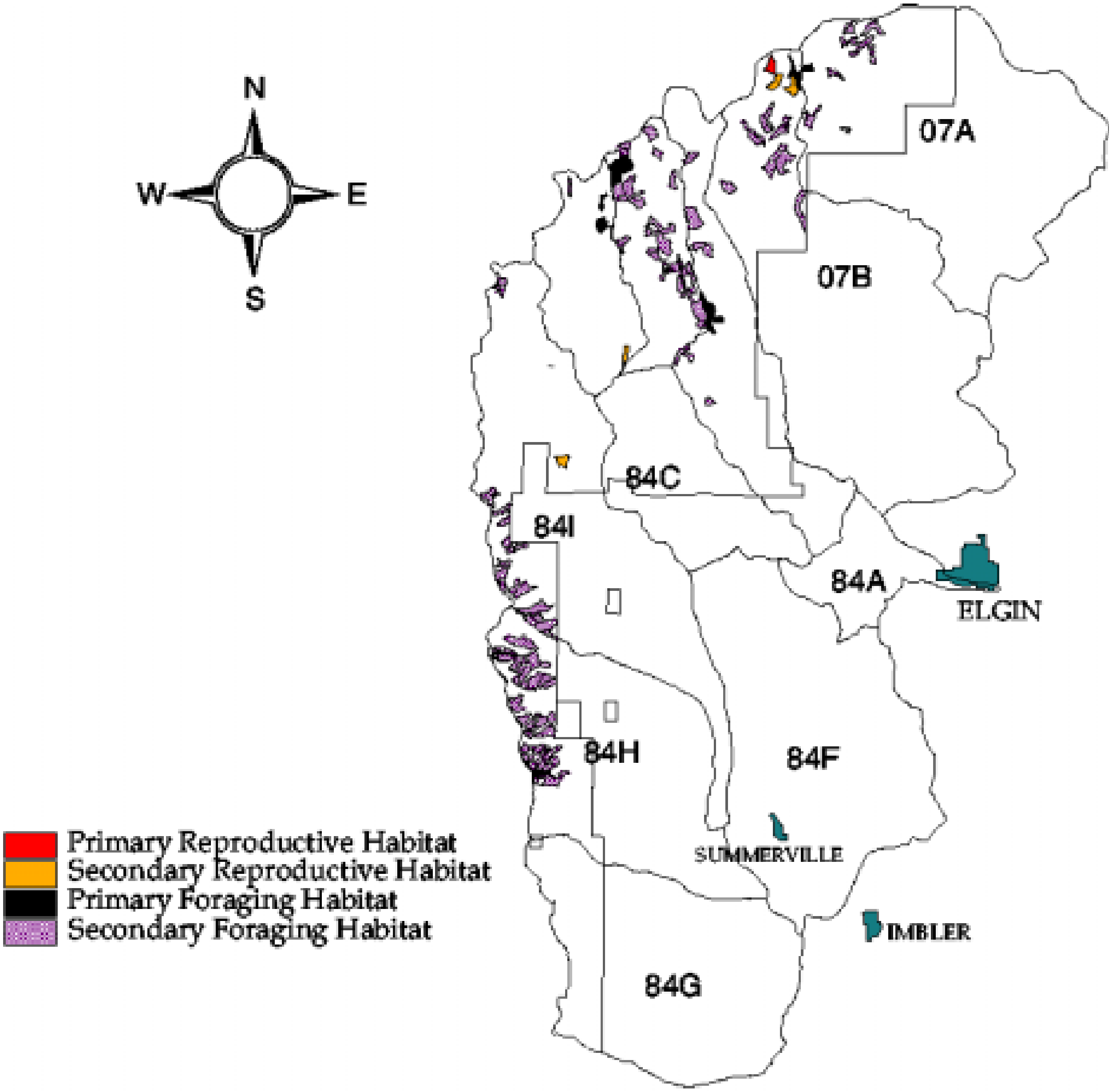

Figure 8-10. Northern Three-toed Woodpecker Habitat, 1999

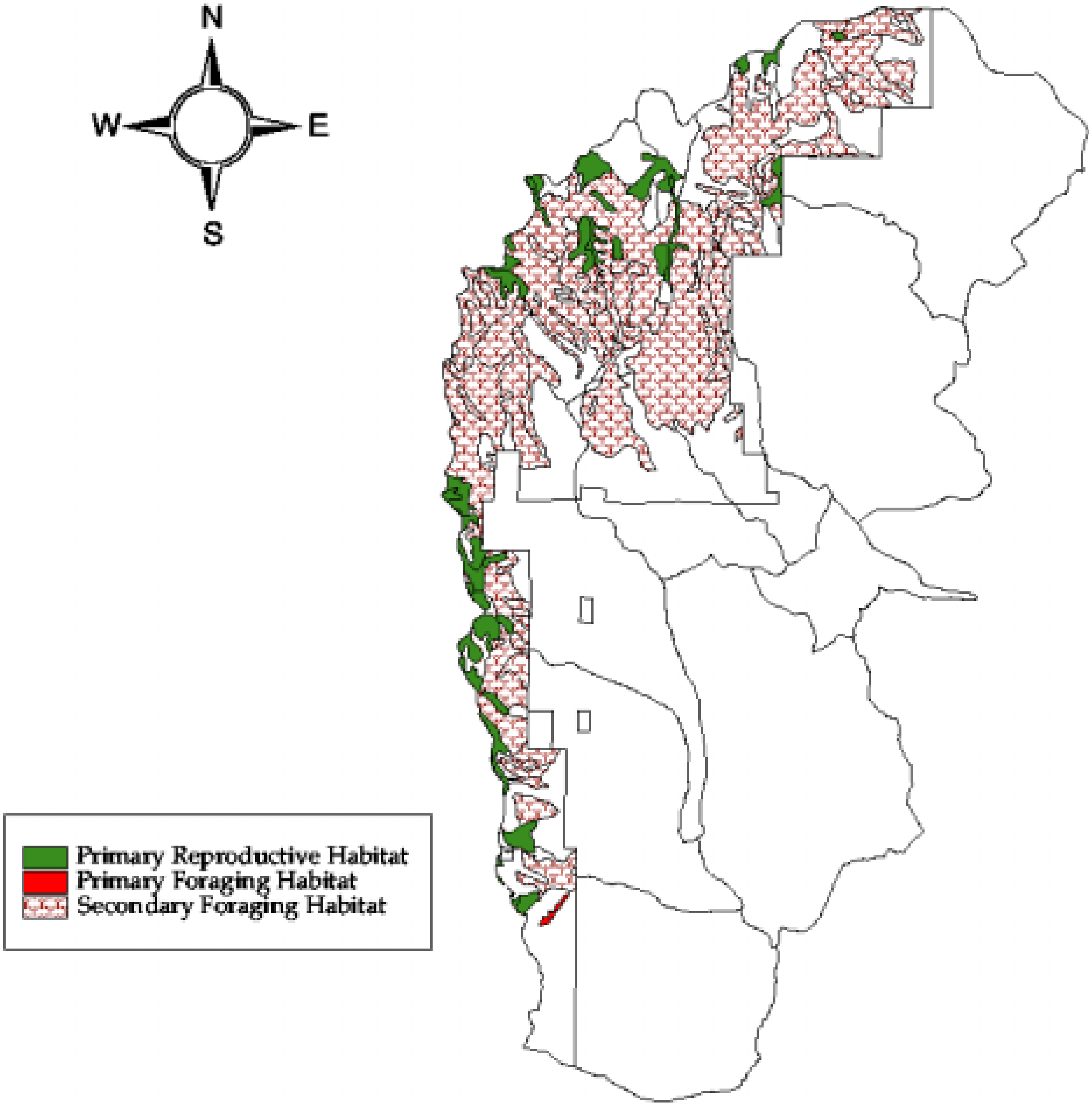

Figure 8-11. American Marten Habitat, 1936

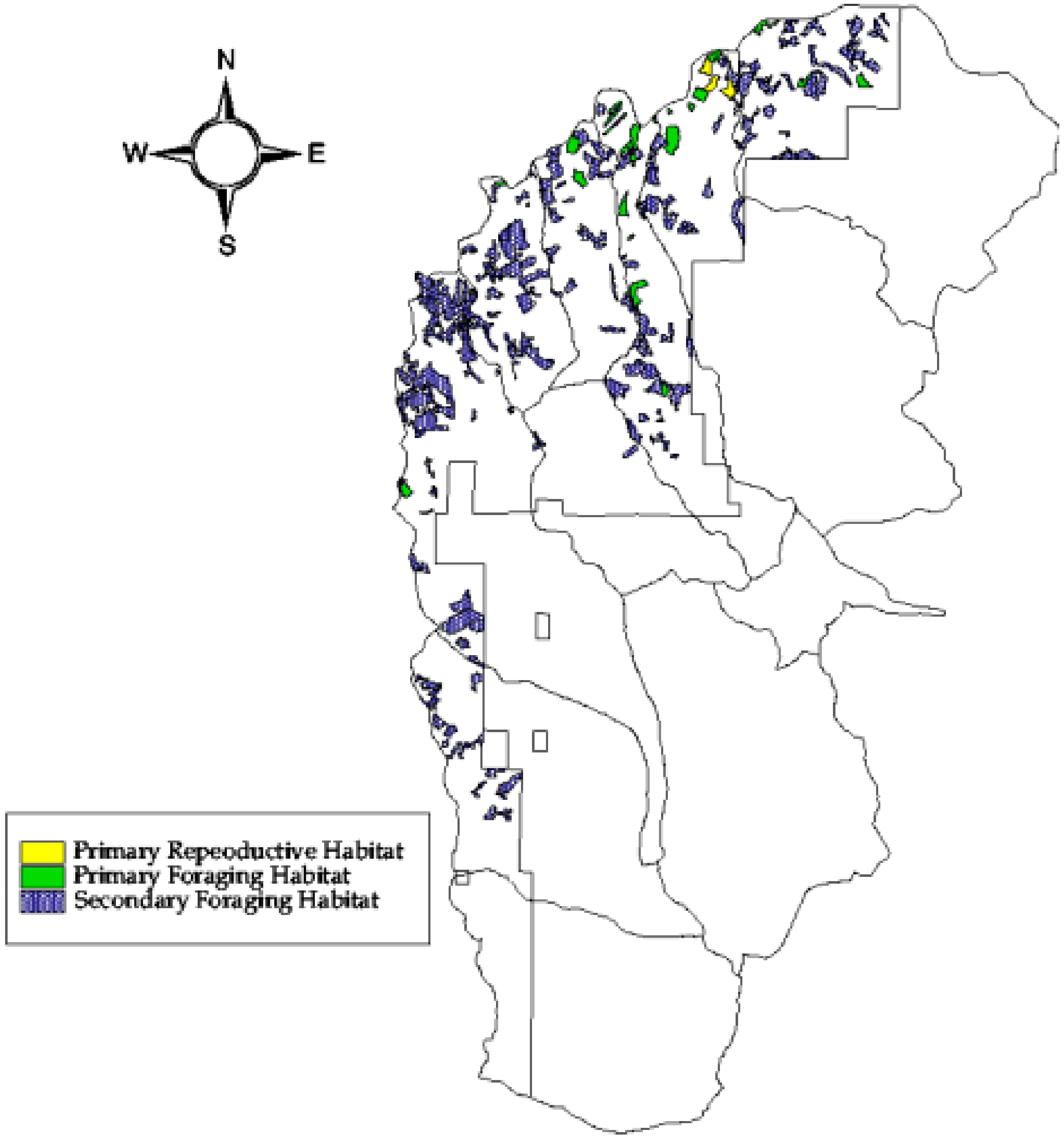

Figure 8-12. American Marten Habitat, 1999

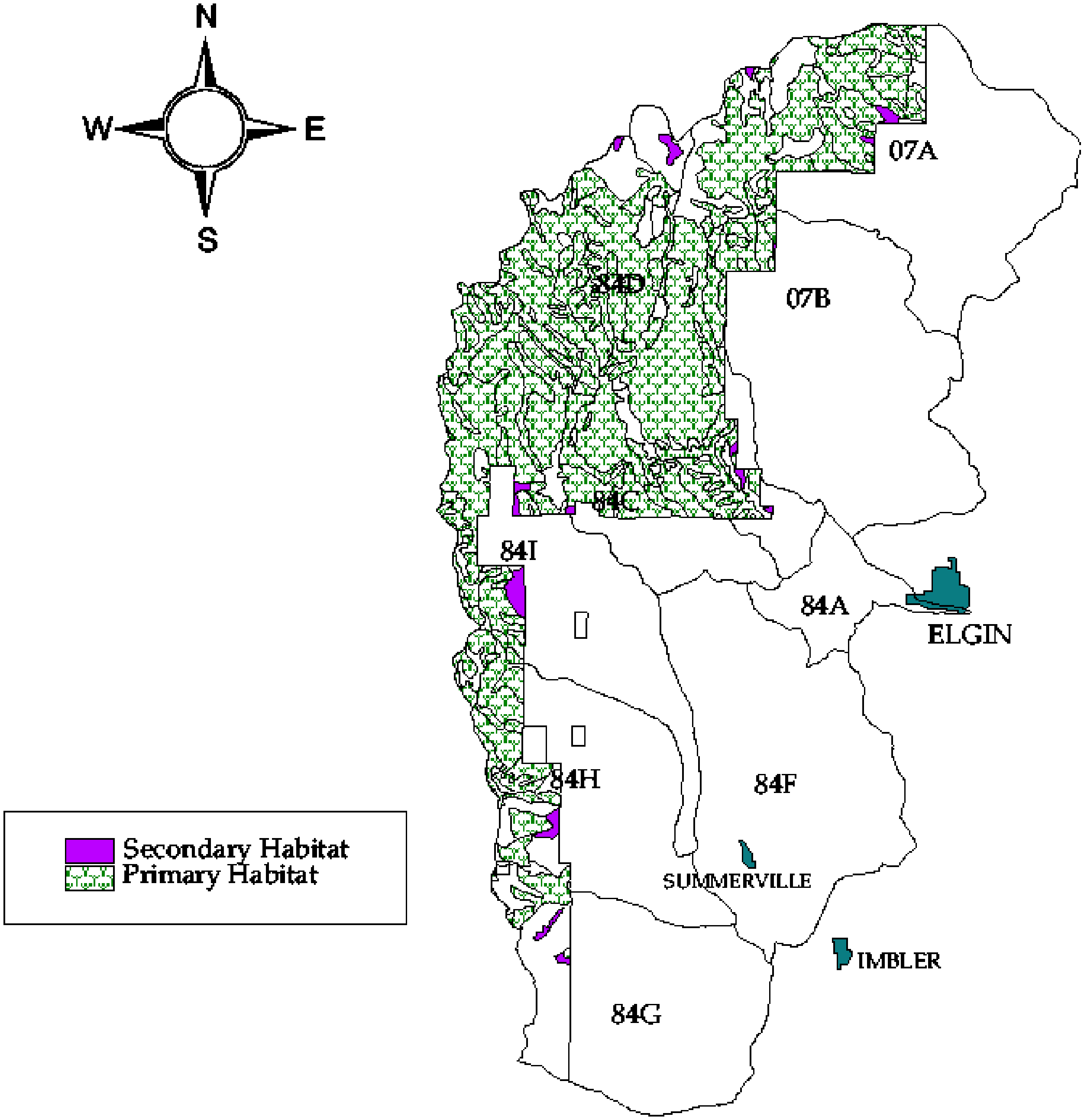

Figure 8-13. Primary Cavity Excavator Habitat, 1936

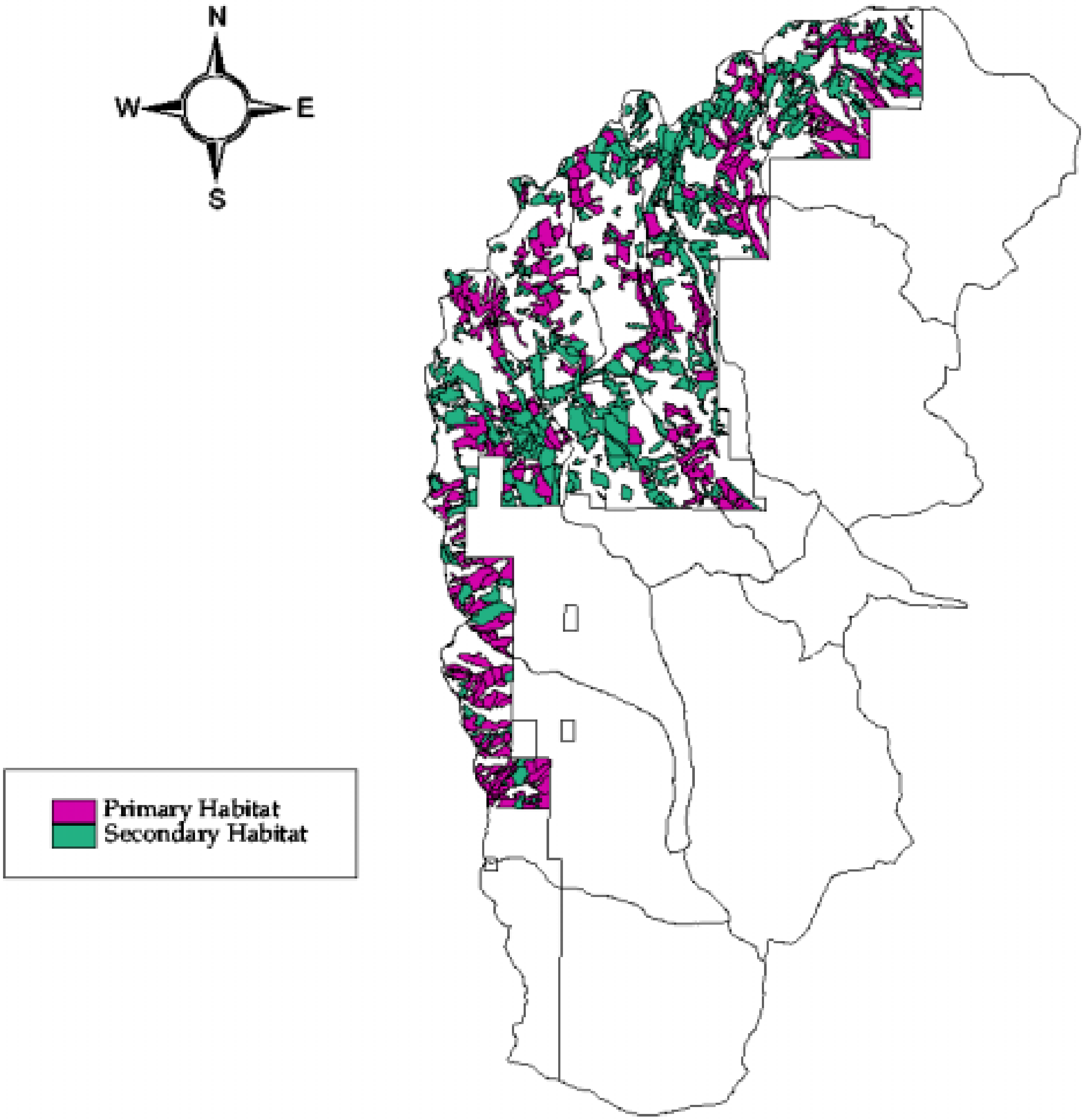

Figure 8-14. Primary Cavity Excavator Habitat, 1999

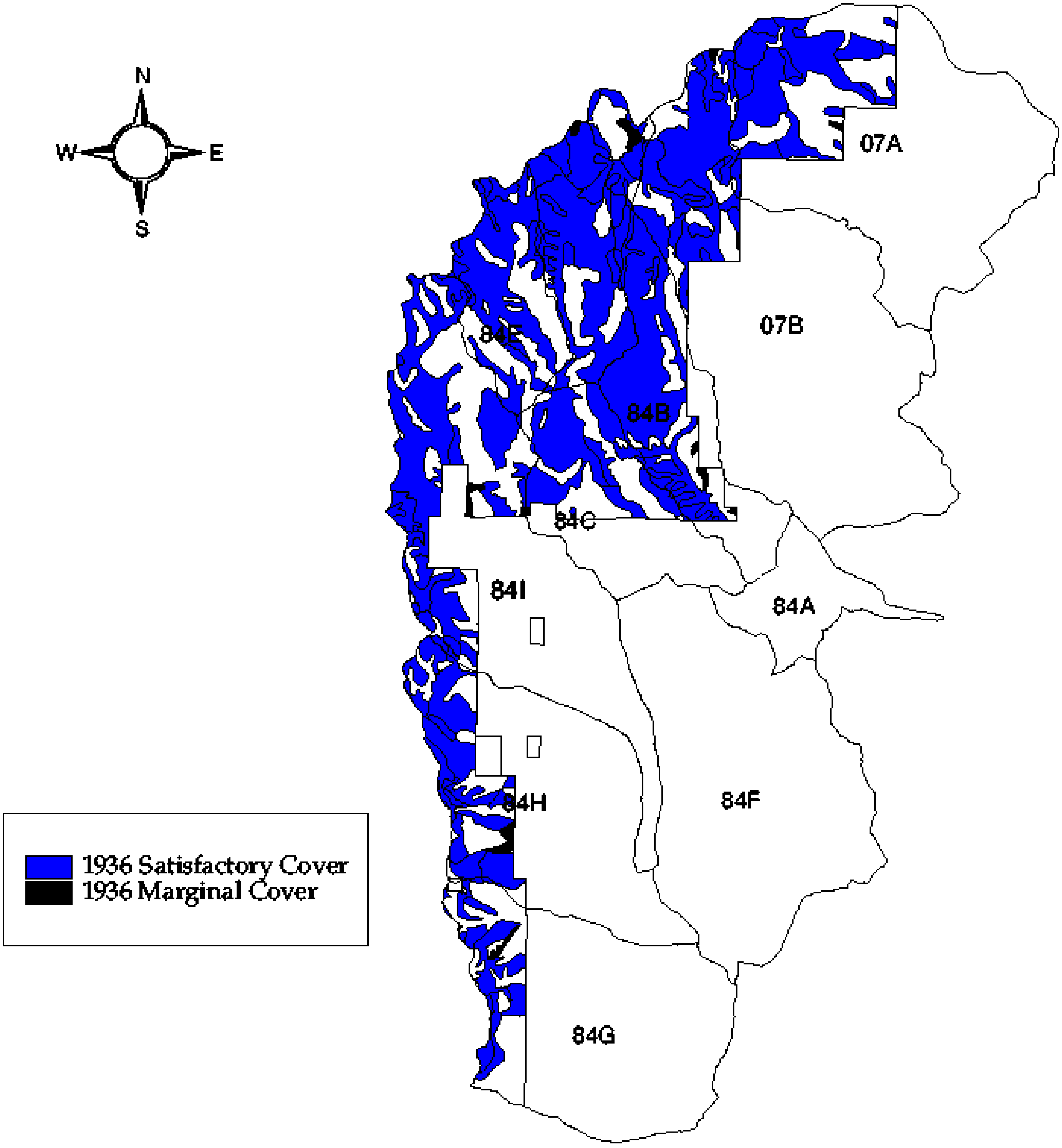

Figure 8-15. Elk Cover, 1936.

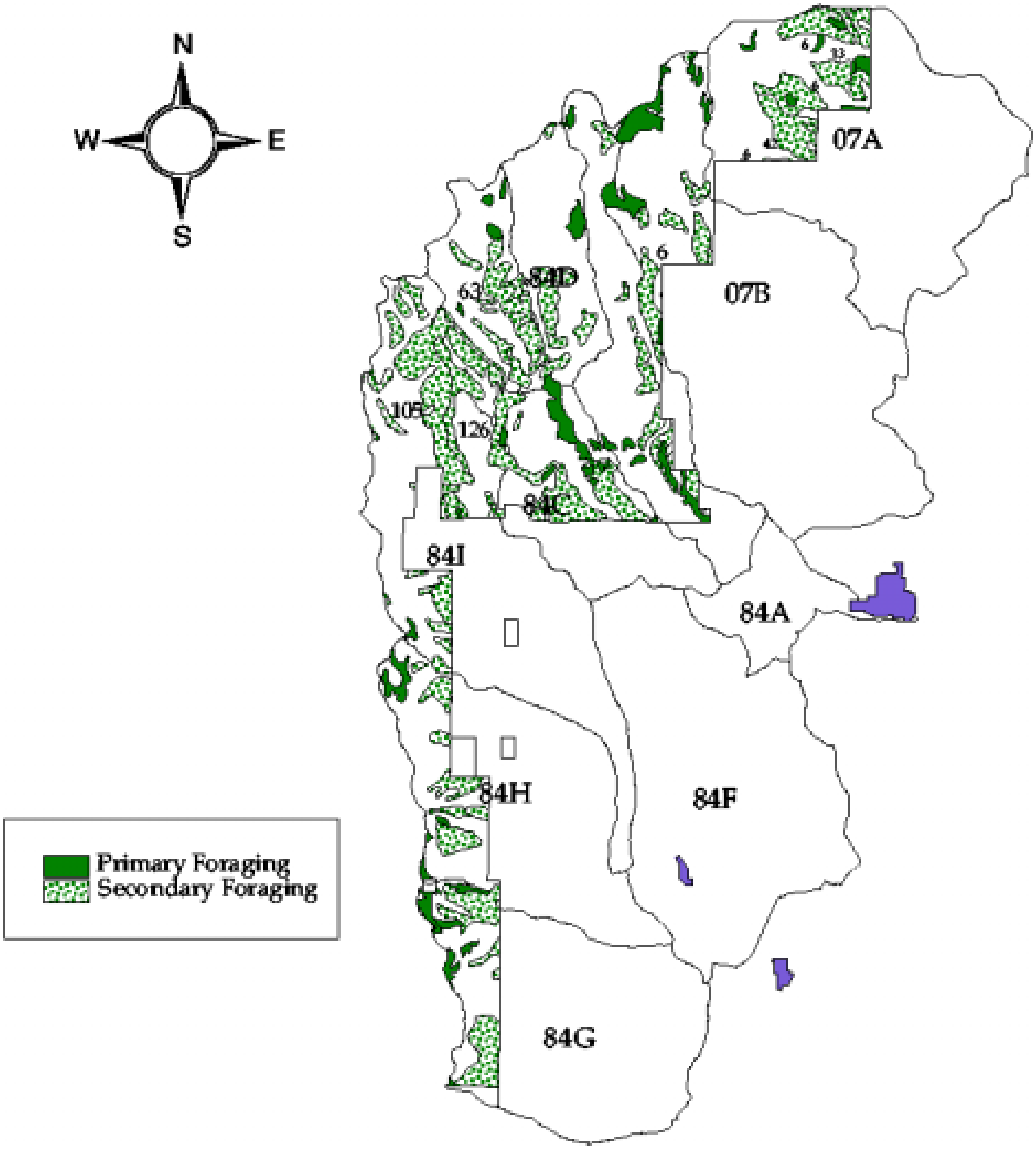

Figure 8-16. Elk Forage 1936.

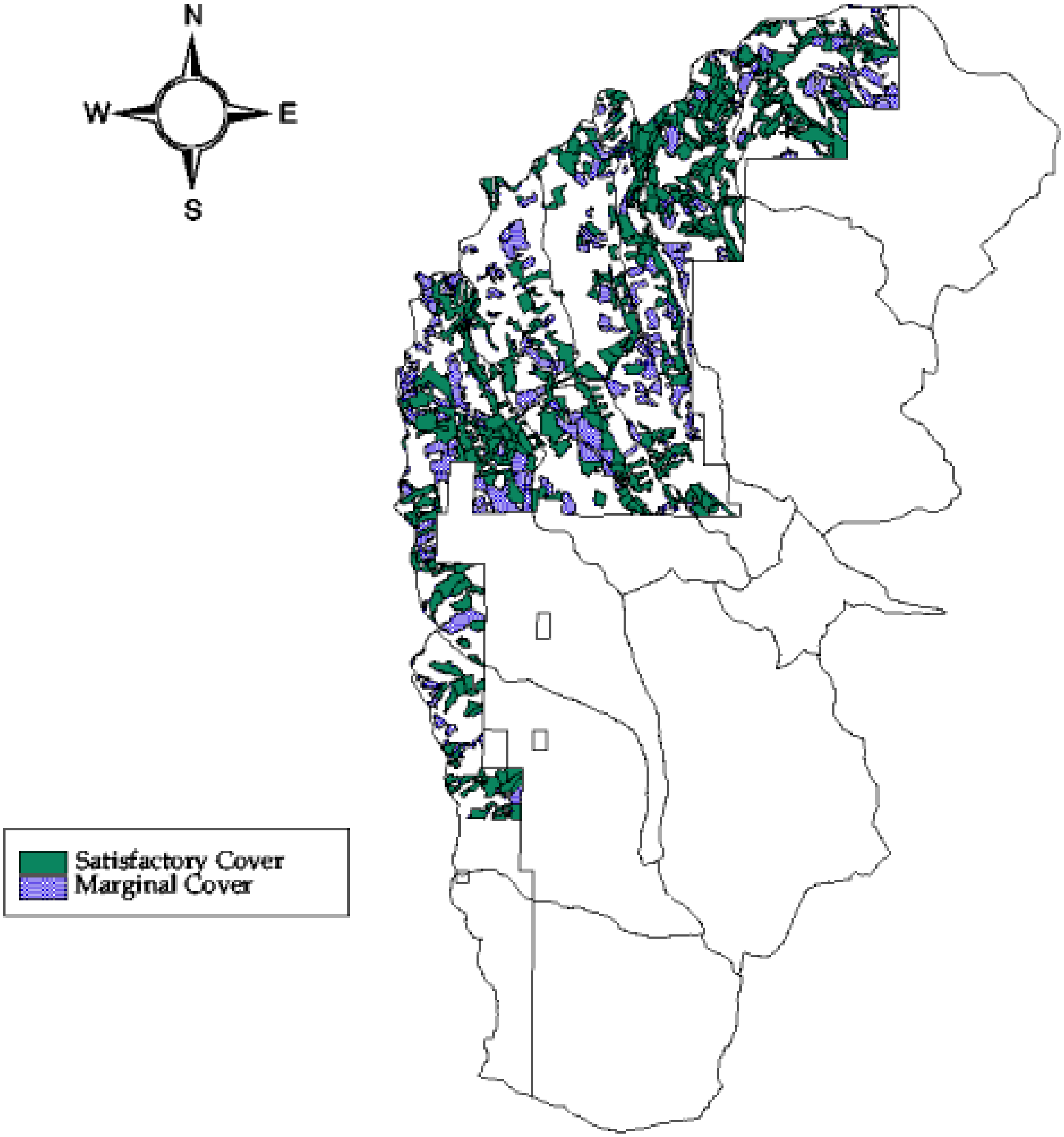

Figure 8-17. Elk Cover, 1999.

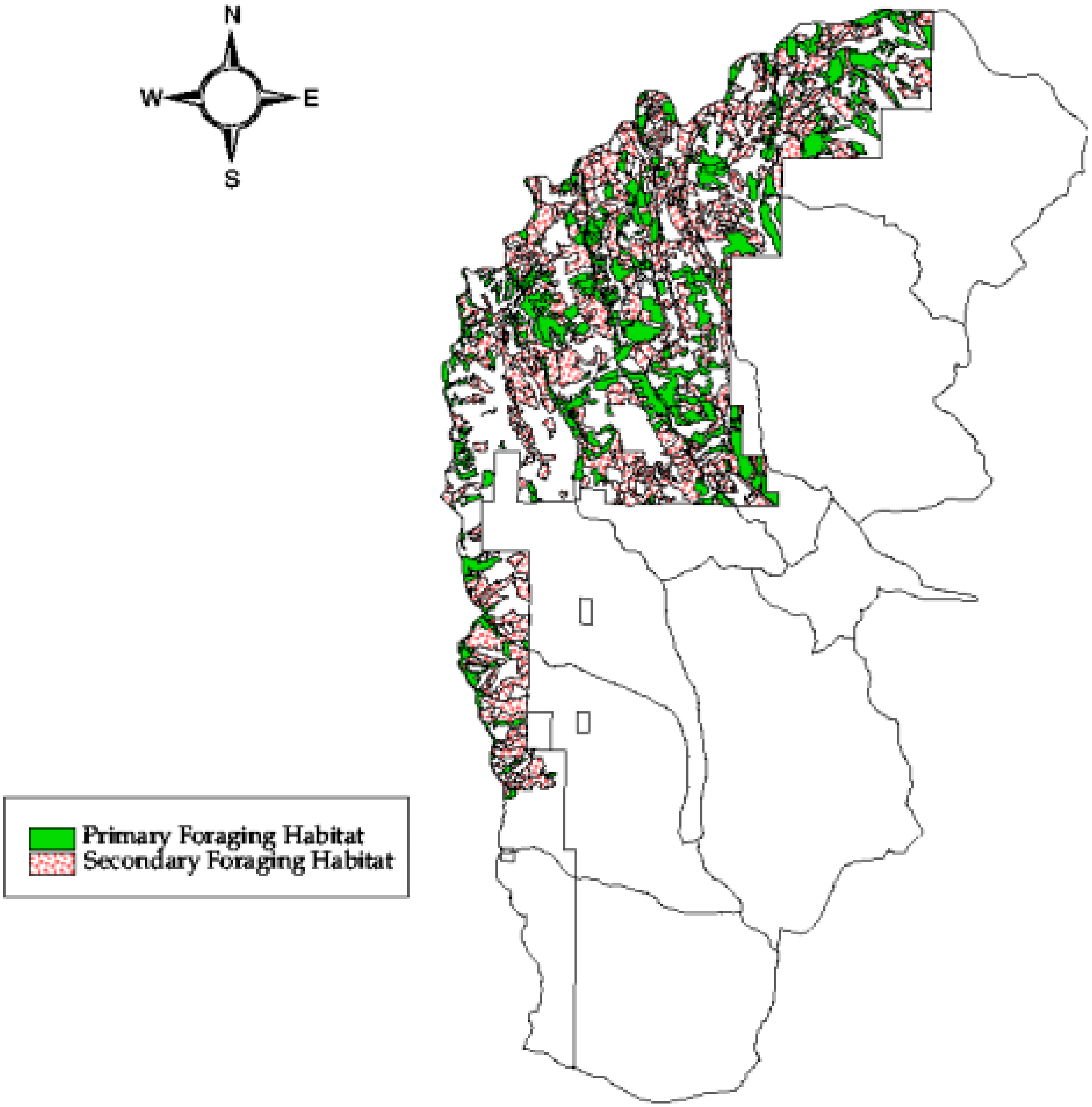

Figure 8-18. Elk Forage, 1999.

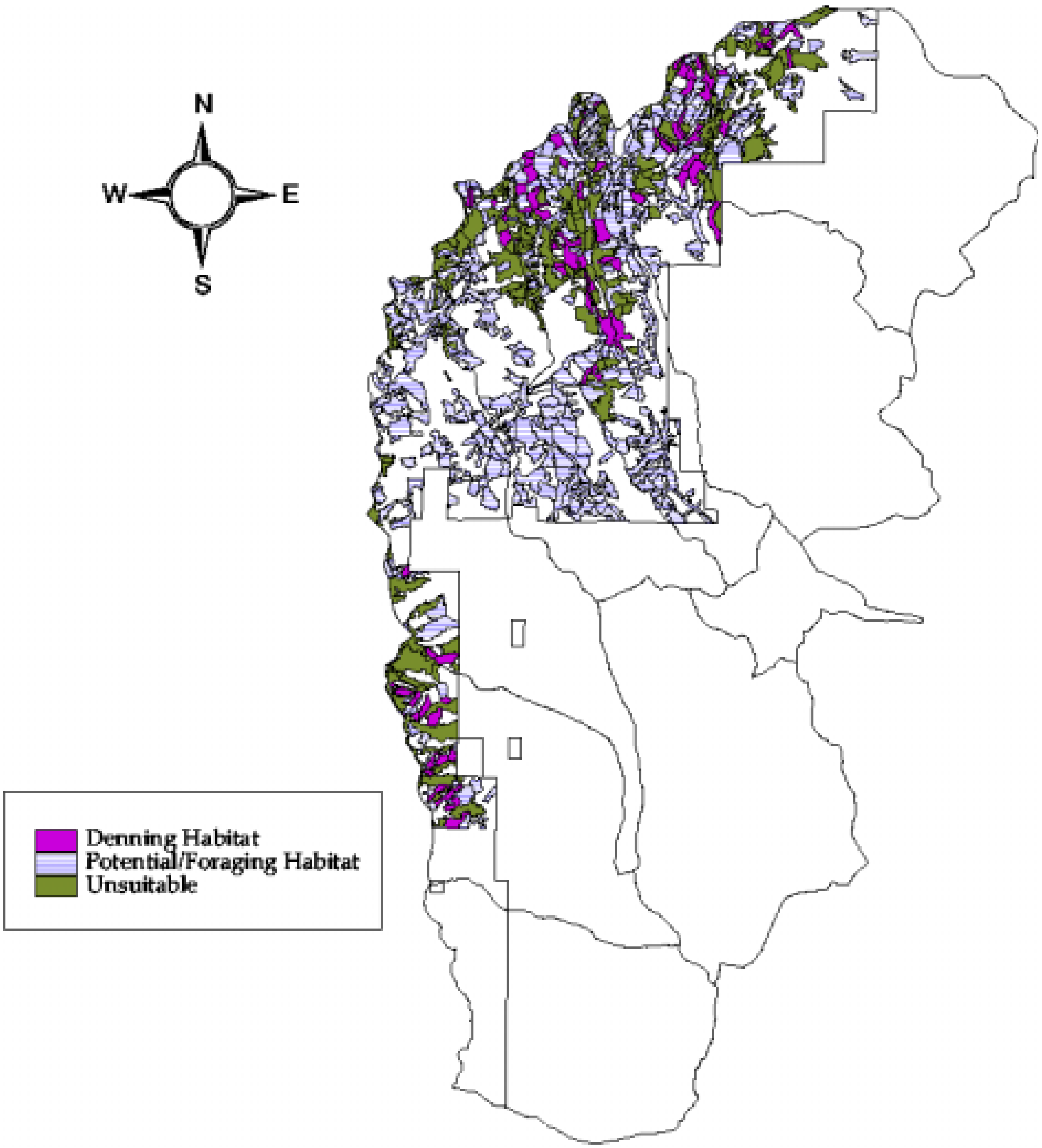

Figure 8-19. Lynx Habitat, 1999

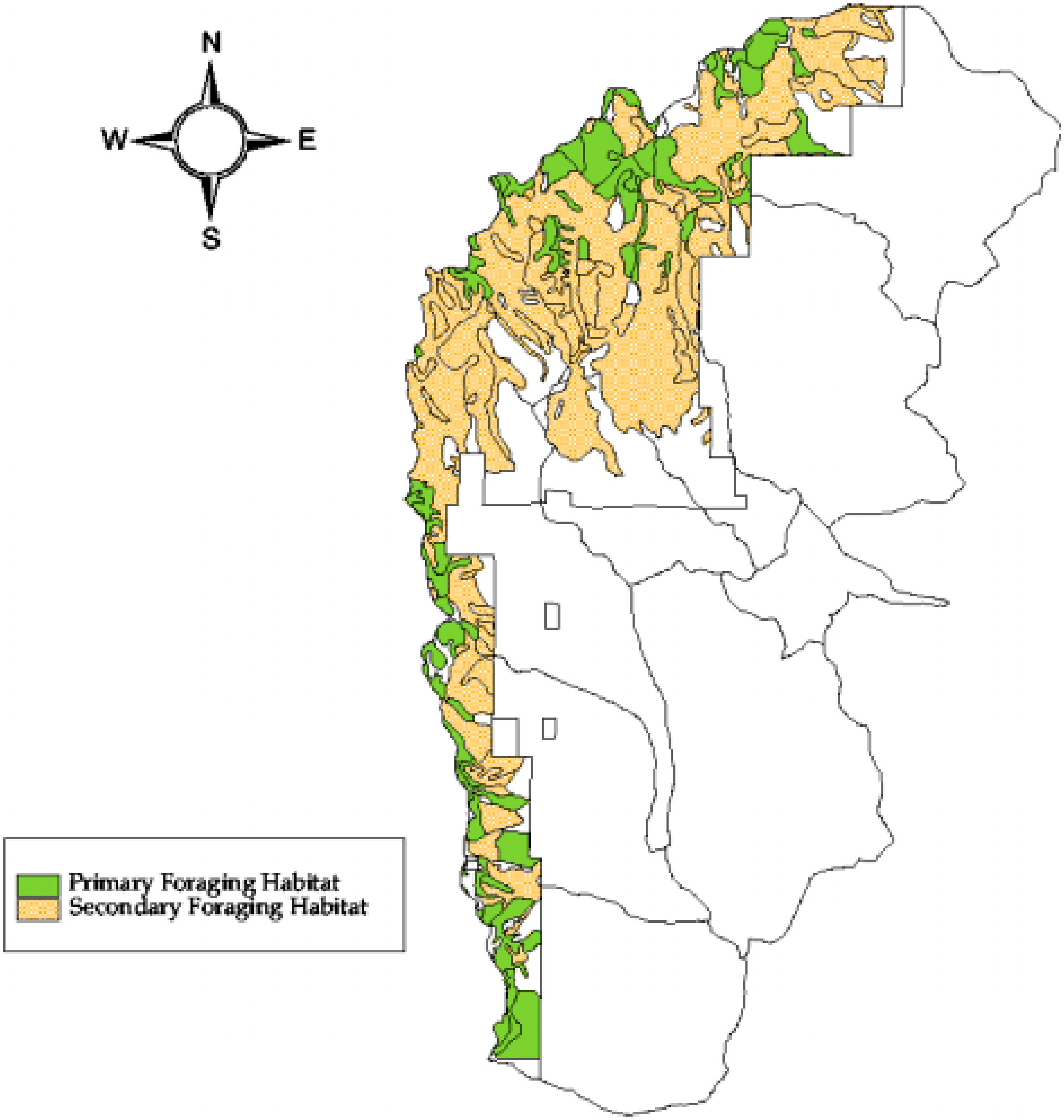

Figure 8-20. Wolverine Habitat, 1936

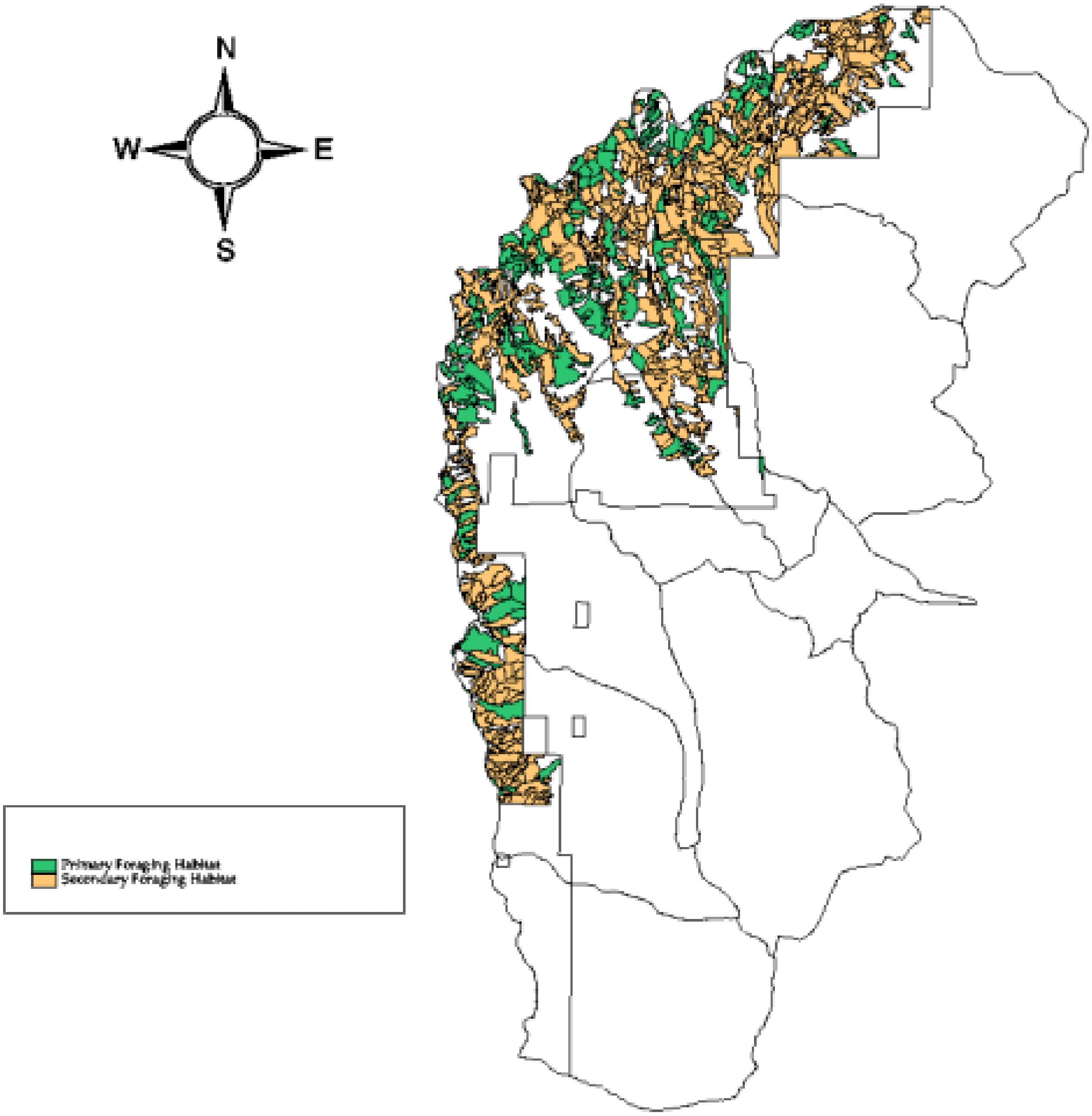

Figure 8-21. Wolverine Habitat, 1999

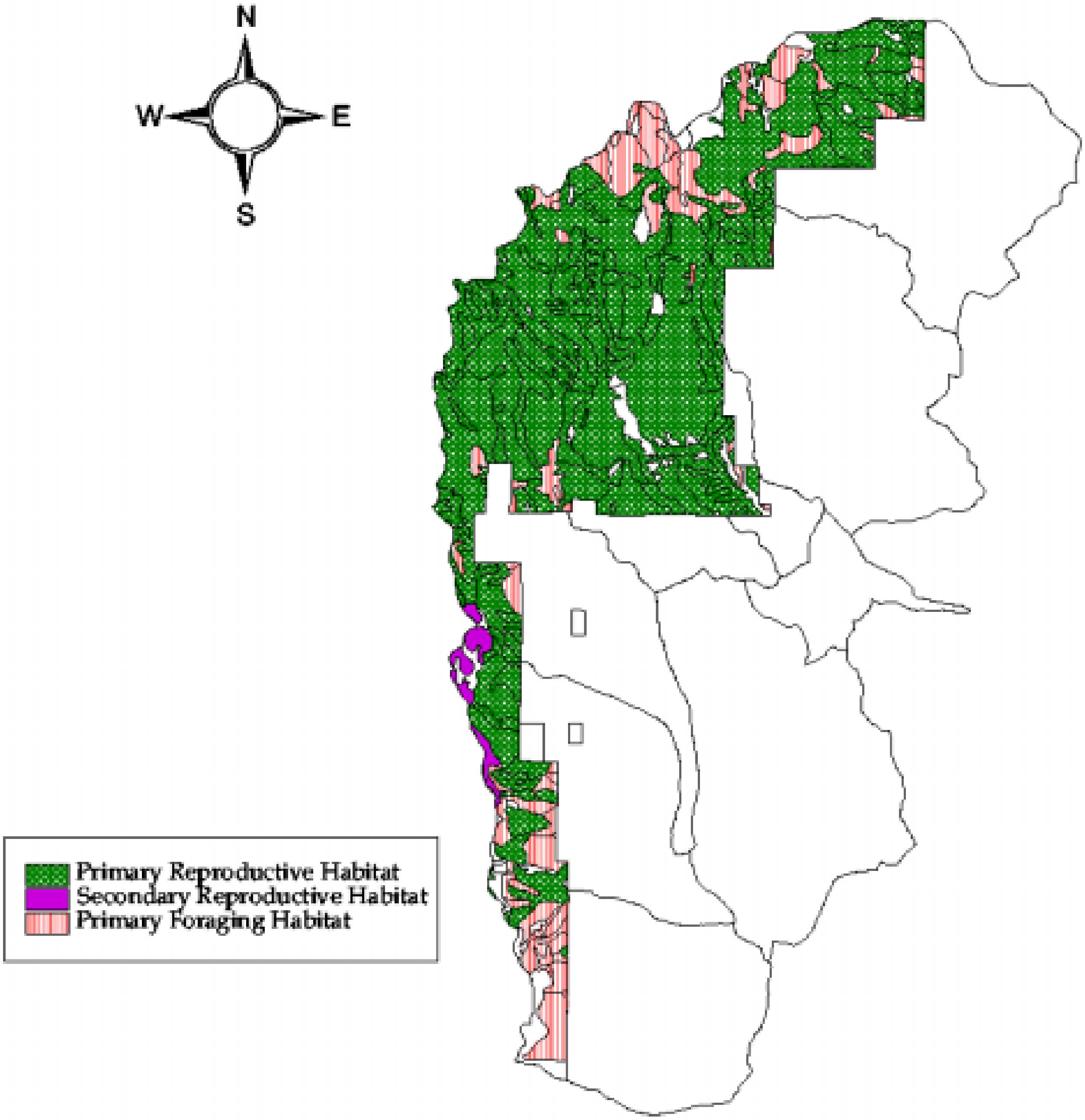

Figure 8-22. Goshawk Habitat, 1936

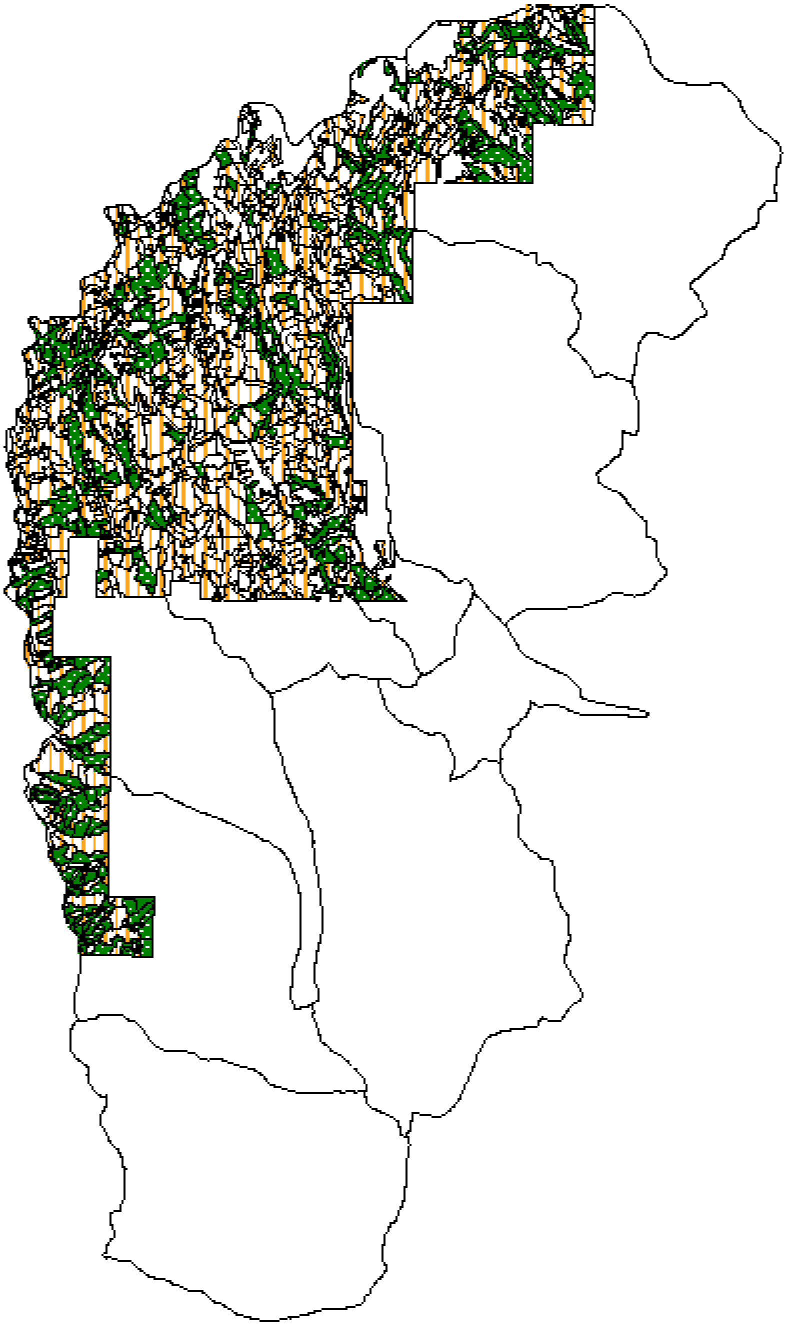

Figure 8-23. Goshawk Habitat, 1999

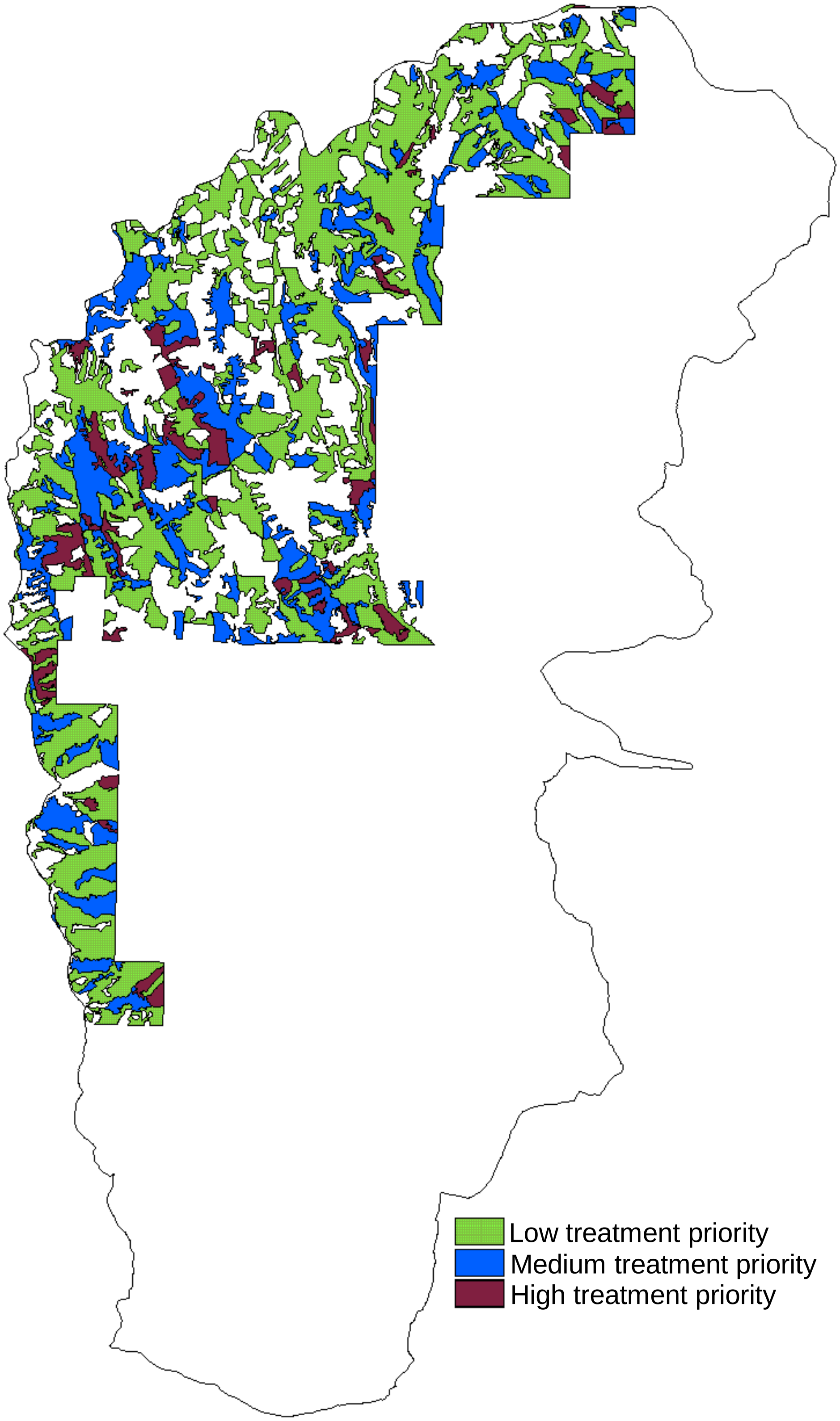

Figure 10-1. Prioritization of the silvicultural treatment opportunities