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(Excerpts from) CHAPTER 3 Landscape Dynamics of the Basin

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OVERVIEW OF METHODS

Characterization of Multi-scale Landscape Relationships

These methods are an overview of the key analyses that were conducted to assess landscape dynamics. For more detail we refer the readers to Hann and others (1997), Hessburg and others (1996a), Ottmar and others (1996), and Keane and others (1996b).

The broad-scale data for this assessment were coarse grained (low resolution), but continuous across the Basin. Conversely, the mid- and fine-scale data were finer grained (higher resolution), but were sampled from the Basin and therefore not continuous. Using a multi-scale approach improved our understanding of the relationships among fine-, mid-, and broad-scale vegetation attributes.

Plot data (fine-scale) obtained from various agencies were inconsistent in type, methods, and data quality control. Data were relatively consistent within, but not among administrative units. The most consistent statistical correlation of the plot data was found within the administrative unit that collected the data. Very few attributes demonstrated adequate consistency of values and interrelated logical relationships to provide confidence in the use of plot data as a whole. Consequently, we only used a very reduced data set that had consistent and standard methodology, and that had been corrected for errors in logical relationships.

Although mid-scale vegetation inventory map data were available from various sources, such as satellite remote sensing and forest, rangeland, and wildlife habitat inventories, they were as variable and inconsistent as the plot data. Legends were difficult to correlate among different maps; even though map legend attributes were labeled identically among maps, the attributes themselves were often different. Furthermore, most of the vegetation maps did not have corresponding potential vegetation maps of the same scale, and major problems with logical relationships existed for those that were of the same scale. Consequently, we were unable to use existing mid-scale vegetation-inventory maps and were forced to develop a new set of mid-scale data that was consistent and rectified with a potential vegetation layer (see Hessburg and others 1996a). The mid-scale data set was derived from a two-stage, stratified random sample of paired "current" and "recent historical" aerial photography covering 337 subwatersheds from 43 subbasins. The areal coverage of the subsample was equivalent to approximately 5 percent of the Basin. Many of the recent historical data (1930-1960s), particularly on rangelands, were derived from relatively recent aerial photography. Conversely, some of the current aerial photography (also primarily on rangeland-dominated subwatersheds) was relatively old (1980-1990s). Consequently, the recent historical and current photographic pairs spanned various temporal periods [see Hessburg and others (1996a) for further details of the mid-scale sampling design].

The mid- and fine-scale data that were strongly correlated with broad-scale data could be extrapolated across the entire extent of the Basin. We observed several attributes that were correlated among the three scales when stratified by geographic area: land ownership, management strategy, and groups of potential vegetation groups (PVGs). We divided the Basin into two geographic areas or management regions: the Eastside (EEIS) and the Upper Columbia River Basin (UCRB). Land ownership and management strategies were stratified into eight management classes (table 3.4). Because our analysis focused on BLM- and FS-administered lands, we further aggregated the non-BLM- and FS-administered lands into a single "Other" lands category (map 3.7).

Often, the relationships among the three different scales were complex and not immediately obvious. In order to correctly interpret the differences among scales, we often had to qualitatively or quantitatively develop a broad-scale correlate to assess trends of mid- and fine-scale conditions.

For example, although we could assess the broad-scale areal extent of fires, the mid- and fine-scale patterns of fuel types and fire behavior differed substantially. These differences were apparently due to the management history of an area — which was correlated with the management objectives of that area [for instance, managed as wilderness or roadless areas (wilderness-like), or managed primarily by human-influenced processes (non-wilderness or roaded areas)]. Consequently, mid- and fine-scale fire behavior attributes (that is, crown fire, fire severity, fire interval, and smoke) would not necessarily be the same for two areas having similar types of broad-scale fire and/or physiognomic vegetation conditions.

Biophysical Template

The PVGs (appendix 3-A) were used as indicators of broad-scale biophysical templates. We assessed the historical and current areal extent of each of the PVGs in relation to its general environment, land ownership pattern, composition of physiognomic types, and predominant disturbance regimes. Each of the PVGs was stratified at 1,200 meters mean sea level (MSL) to assess trends above and below that elevational breakpoint. In addition, we used a composite assessment to index the departure of the current PVG from its historical succession and disturbance regimes into three classes: low, moderate, and high.

Data for the assessment of PVGs were then derived from simulations of the historical and current periods using the Vegetation Dynamics Development Tool model (VDDT) (Beukema and Kurz 1995), the Columbia River Basin Succession Model (CRBSUM) (Keane and others 1996b), ecological vegetation and site plot data (Hann and others 1997), and historical vegetation mapping with comparison to current photo points (Losensky 1994, Losensky 1995). The dynamics of the historical physiognomic types were simulated using a single 100-year run of the

CRBSUM (Keane and others 1996b). We believed that a 100-year simulation of the historical dynamics captured the majority of the shifts in cover types and structural stages, and the associated succession and disturbance processes that would have occurred prior to Euro-American settlement and industrialization of the Basin. However, through sensitivity testing with the VDDT models we found that a 300-year period was generally required to produce consistent pattern repetitions (Hann and others 1997). Consequently, we conducted an additional CRBSUM historical simulation for 400 years.

Succession and Disturbance Processes

Vegetation structure and composition changed as a result of the interaction between disturbances and the subsequent successional responses that occurred. These processes changed the live and dead attributes of vegetation composition and structure, and the associated site conditions such as soil cover and soil organic matter.

We used the PVTs and the PVGs (appendix 3-A) to stratify the succession/disturbance regimes by biophysical environment. The PVTs were named for the dominant vegetation that could potentially grow on a site in the absence of disturbance, and were grouped into PVGs based on similar moisture and temperature gradients (Menakis and others 1996). Succession and disturbance processes were described and modeled for each PVT within the Basin (Beukema and Kurz 1995, Byler and others 1996, Hann and others 1997, Keane and others 1996b, Long and others 1996). A VDDT model (Beukema and Kurz 1995) was developed for each PVT to simulate cover type and structural stage changes that were attributable to the predominant disturbances of the historical, current, and future scenarios through time (Byler and others 1996, Keane and others 1996b, Long and others 1996). The VDDT models and Losensky's (1994) historical vegetation information suggested that year 0 of the historical simulation represented a generalized historical condition of cover type and structural stage dynamics. Modeling suggested that the PVTs in the Basin generally required 250 to 400 years to cycle and stabilize at a relatively constant composition of vegetation cover types and structural stages. These models were also used to assess trends of regional and landscape composition and structure.

Our evaluation included what we believed were the primary disturbance regimes. The evaluation took into account fire severity and fire interval (Morgan and others 1996), recent fire occurrence (Menakis and others 1996), roads (Menakis and others 1996), grazing (Burkhardt 1996), climate (Ferguson 1996a, 1996b, 1996c, 1996d), and human activities (Woods and Horstman 1996). In addition, we considered the paleoecological influences reported by Mehringer (1996). The simulations incorporated succession rates and disturbance effects in the modeling of regional and landscape composition and structure changes. Results of historical, current, and future modeling of different types of management were summarized by Keane and others (1996b) and Long and others (1996). Keane (1996) reported the results of modeling ecosystem processes. Response coefficients for modeling fire behavior and effects were adopted from Hardy and others (1996). Results of modeling the different effects of smoke from wildfire and prescribed fire were summarized by Holsapple and Snell (1996). Schoettle and others (1996) summarized the dynamics of air quality.

We developed a classification that separated succession/disturbance regimes into (1) regimes that generally maintained communities and (2) regimes that cycled communities through successional stages (table 3.6). Within these two classes, we provided for subdivisions based on the interval between disturbance, types of structures created by the disturbance, and the associated disturbance severity. Because the classification system was based upon succession and disturbance processes, it allowed us to readily predict succession and disturbance patterns without having detailed information on the causal disturbance agents (for example fire, drought, insect and disease infestation, stress, or wind). These regimes were developed from interpretations of plot data and historical photo points (Hann and others 1997; Losensky 1995) along with reference to the current succession and disturbance literature discussed in the introduction to this chapter.

Morgan and others (1996) mapped fire regimes that were based primarily upon frequency (the interval between successive fires) and severity (the fires' effects on the dominant overstory vegetation). They used two sets of decision rules (one set for historical regimes and another set for the current period regimes) to assign fire regime classes to cover types. Assignments were based upon published literature, a fire history database (Barret 1995), and expert opinion.

The decision rules for the current regimes reflected the influence of fire suppression, invasion of exotic plants, and other human-caused factors. Neither of the rule sets used vegetation structure nor fuels for modeling potential fire behavior. Consequently, we had less confidence in the current fire-regime map and associated regime change maps, than in the historical fire regime map. However, we believe that the indices of historical and current fire regime classes could be confidently used to assess broad-scale trends. In addition, if used in conjunction with other proxy variables, we believe that the fire regime classes could also be used to estimate potential fire risk and fire behavior.

We used five indices to estimate regional risks of severe fire behavior and severe fire effects. The five indices were based on the proportion of an ERU that had: (1) mixed or lethal historical fire severity; (2) an increase of fire severity or decrease of fire frequency (that is, an increase of infrequent and very infrequent classes) between historical and current periods; (3) a high probability of fire occurrence; (4) a high probability of severe fire behavior; and (5) the presence of rural/wildland interface. Fire-occurrence probabilities were based on seven years (1986-1992) of subwatershed fire-occurrence records. The fire behavior index incorporated elevation, precipitation, and temperature gradients. The overall index of severe fire risk was calculated as the average value of the five indices described above (see Hann and others 1997, Long and others 1996, and Menakis and others 1996 for a more detailed description of methodologies).

We also developed indexes for precipitation, seasonal climate gradients, and topoedaphic conditions to use in assessing succession and disturbance processes (Hann and others 1997). Coefficients were calculated for rule sets to estimate amounts of net wildfire, wildfire suppression cost, forest crown wildfire, forest surface/mixed wildfire, forest insect/disease, smoke, and soil disturbance. Subbasin landforms were developed by identifying the dominant subsection landforms for each subbasin.

Road density classes were mapped from a rule set using categories of land ownership, land use, life form, elevation, slope, and a GIS road data set obtained from United Parcel Service (Menakis and others 1996). The density classes and relationships to the categories were extrapolated from mid-scale subwatershed road data. Although we were not able to test the extrapolation rule set, or conduct a comparison analysis between the final broad-scale road density map and the sampled subwatersheds, we were able to evaluate the logic of the road density classes and refine the rule sets. Although we do not have a high degree of confidence in the absolute values of the broad-scale road density classes, we do believe that they can be appropriately used to assess broad-scale trends of relatively large geographic areas (for example, clusters of subbasins, basins, and ERUs).

The mid-scale subwatershed road data, photo points, and reconnaissance notes were used to develop interpretations of fine-scale effects of roads (Hann and others 1997).

Broad-scale Changes in Cover Types

Forty-one broad-scale cover types were mapped at 1-square-kilometer resolution to describe the current and historical period vegetation of the Basin (appendix 3-E). Cover types were named for the vascular plant species having the dominant canopy cover for rangeland types (Shiflet 1994) and the dominant basal area for forest types (Eyre 1980). The current cover type map was created by Hardy and others (1996) by refining a land cover characterization map that was constructed from a 1991 classification of Advanced Very High Resolution Radiometer (AVHRR) satellite imagery (Loveland and Ohlen 1993, Loveland and others 1991). This map was revised using rule sets developed from knowledge of the PVT, a rectification procedure using CRBSUM, and information gained from workshops attended by ecologists familiar with the Basin (Keane and others 1996b, Hann and others 1997; Menakis and others 1996). The historical cover type map was produced by Losensky (1994) using archived maps and government records published near the turn of the century and revised using a rectification process similar to that for the current. Because the base historical map was compiled from many maps of varying scales and quality, it was difficult to cross-reference historical and current cover types. This was especially true for urban and agricultural areas. The derivation of current and historical vegetation layers and rectification with current and historical PVT layers was fully described by Menakis and others (1996) and Hann and others (1997).

Two spatial scales and three indices of change were used in this assessment to quantify areal changes of cover types between historical and current periods. Compositional changes were assessed across the Basin as a whole, as well as within the 13 ERUs (map 3.3) within the Basin. These changes were evaluated with respect to the cover type (that is, class change), to a region (that is, Basin or ERU change), and to the historical range of each cover type (that is, departure index).

Class changes quantified the proportional change of a cover type's area between the historical and current periods. Class change was estimated by:

$CC = [(CTA_C - CTA_H)/ CTA_H] * 100$

where

CC = percentage of class changed,

CTA_C = current area of cover type, and

CTA_H = historical area of cover type.

Regional changes quantified the areal proportion of the region (Basin or ERU) that was altered as a result of the change in areal extent of a cover type. Regional change was estimated by:

$RC = [(CTA_C - CTA_H) / RA] * 100$

where

RC = percentage of region changed,

CTA_C = current area of cover type,

CTA_H = historical area of cover type, and

RA = regional area (Basin or ERU).

Transition matrices of cover types were constructed to further our understanding of class and regional changes (Jones 1996). The transition matrices tracked the flux of individual 1-square-kilometer pixels from one cover type to another between the historical and current periods. For example, did a pixel that was classified as a ponderosa pine cover type during the historical period remain ponderosa pine, or did it change to another cover type in the current period? The dominant transitions within a region (that is, those affecting at least 1% of the Basin or an ERU) were summarized.

Cover type departure indices were determined by comparing the current period areal extent of each type to their modeled median 75-percent and 100- percent historical ranges. The median 75-percent range is 75 percent of the difference between minimum and maximum, which excludes 12.5 percent of the range from each end. We computed the median 75-percent range to exclude some of the more extreme variation. Historical ranges of cover types were simulated for the Basin and individual ERUs using the CRBSUM (Keane and others 1996b). The minimum and maximum values from a single 100-year or 400-year run of the CRBSUM, and appropriate outputs for simulation years 0, 50, 100, 200, 300, or 400 were used to define historical ranges. The initial conditions for the historical simulations and the simulation process were described by Menakis and others (1996) and Long and others (1996), respectively. We then calculated the median 75-percent historical range by adding or subtracting 12.5 percent of the historical range to the historical minimum and historical maximum, respectively. Five departure classes were defined based on the relationship between the current area of each cover type and its simulated median 75-percent and 100-percent historical ranges (table 3.7; fig. 3.10).

We used class changes, regional changes, and departure indices to determine ecologically significant changes of cover types. We judged the absolute value of class changes greater than or equal to 20 percent and regional changes greater than or equal to 1 percent as ecologically significant, but only if the departure indices indicated that the current area of the cover type occurred outside its median 75-percent historical range (that is, departure classes 1, 2, 4, and 5). In turn, areal changes resulting in departures classes 1, 2, 4, and 5, were ecologically significant if either the historical or current period areas of a cover type exceeded 1 percent of the region, and the class change exceeded 5 percent.

The herbaceous wetlands, shrub wetlands, and aspen cover types appeared to be under-represented in the historical vegetation layer and over-represented in the current layer. These types, which generally occur in scattered, relatively small- to medium-sized patches, tend to be underestimated as mapping resolution increases (Turner and others 1989). Because the historical vegetation layer was developed at a coarser resolution than the current period vegetation layer (Menakis and others 1996), it was likely that the two mapping efforts contained different biases. In fact, rectification with the PVTs indicated that the herbaceous wetlands, shrub wetlands, and aspen cover types were likely more abundant on the historical landscape than the data indicated [see appendix 3-F for a description of PVTs, and Menakis and others (1996) for the derivation of the historical vegetation layer]. Changes in these three types were not reported because they could not be accurately quantified.

Broad-scale Changes in Terrestrial Community Types

Twenty-four broad-scale terrestrial community types were derived by aggregating 41 cover types and 25 structural stages (appendices 3-B and 3-G). Structural stages represented the developmental changes in a plant community's structure (Oliver and Larson 1990). Oliver's (1981) original forest structural stages were modified by O'Hara and others (1996) to account for the influence of natural and anthropogenic disturbances on successional development in forest and woodland types. Willard and Villnow (1996) developed a set of structural stages for rangelands that were later revised for use in a coarse-scale application. The current period structural stage map was created from a discriminant analysis of mid-scale data layers extrapolated to the broad scale (Keane and others 1996b). Data of historical structural stages were generated from historical information compiled by Losensky (1994), in which the areal extent of structural stages was summarized by cover type and county, and then extrapolated to Bailey's (1995) ecological section. Historical structural stages were then randomly assigned to pixels based upon the historical cover type and proportional area of structural stage within an ecological section (Keane and others 1996b). Cover types and structural stages were aggregated into terrestrial community types based upon moisture, temperature, elevational gradients, and similar broad-scale structures. Terrestrial community types were mapped at 1-square-kilometer resolution.

As with the analysis of cover types, two spatial scales and three indices of change were used to quantify areal changes of terrestrial communities between historical and current periods. Compositional changes were assessed across the Basin as a whole, and for ERUs within the Basin (map 3.3). These changes were evaluated with respect to the terrestrial community (that is, class change), the region (that is, Basin or ERU), and the historical range of a community's area (that is, departure index).

Class changes quantified the proportion of a terrestrial community's area that varied between historical and current periods, whereas regional changes quantified the areal proportion of the region (Basin or ERU) that was altered as a result of a change in areal extent of a terrestrial community type. The class and regional changes of terrestrial communities were estimated in the same manner as they were for cover types. Transition matrices of terrestrial communities were constructed to further our understanding of class and regional changes (Jones 1996). The dominant transitions within a region (that is, those affecting at least 1% of the Basin or an ERU) were summarized.

As with the cover type departures, terrestrial community type departures were determined by comparing the current period areal extent of each type to their modeled median 75-percent and 100- percent historical ranges. Ecologically significant changes between historical and current period terrestrial communities were determined in the same manner used for cover types.

The same problem was experienced with riparian terrestrial community types as was experienced with riparian cover types. Consequently, the changes of riparian terrestrial communities were not reported because they could not be accurately quantified.

Broad-scale Changes of Physiognomic Types

Cover types and structural stages were aggregated into 20 physiognomic types to assess successional and disturbance processes (appendix 3-C). The physiognomic types corresponded to the terrestrial community types in non-forest (that is, rangeland) settings. However, in forest settings the physiognomic types incorporated shade tolerance/shade intolerance, in addition to structural and seral status. The aggregation of cover types to infer shade-tolerant and shade-intolerant groups should be used cautiously, particularly with model projections of HRVs. Although we believe the data for mid- and late-seral stages to be fairly reliable, the values for early-seral stages are questionable. Broad-scale physiognomic types cannot be directly associated with forest age, such as regeneration, young, mature, or old. However, we believe physiognomic types can be associated with forest age classes if they are stratified by PVG and disturbance history.

Regional trends of physiognomic types were stratified by PVG and land ownership, and assessed for the Basin and each of the 13 ERUs. In addition, the current areal extent of physiognomic types was compared to the HRV for each strata. The HRV was based upon the historical extent, and a single 100-year run of CRBSUM (using historical disturbance regimes) with outputs at 50 and 100 years. Consequently, three values (historical year 0, historical year 50, and historical year 100) were used to estimate historical minimum and maximum values.

Broad-scale Subbasin Vegetation Departures

Terrestrial community type departures were developed to estimate the magnitude of broad-scale habitat changes in forest and rangeland habitats within subbasins. One-square-kilometer resolution, continuous, broad-scale data summarized by subbasin (map 3.6) was used to assess habitat departures of forest and rangeland ecosystems. After aggregating 41 cover types and 21 structural stages into 24 terrestrial community types, the forest terrestrial community types having late-seral single-layered and late-seral multi-layered structures were further collapsed into a “late” class. Departure classes (table 3.7) were then estimated by subbasin for nine forest terrestrial community types and three non-forest (that is, rangeland) community types. We estimated current period departures for those terrestrial community types that composed at least 1 percent of the area of a subbasin for any output period of the historical CRBSUM run, or for the current period condition. Departure values were not determined for anthropogenic community types (that is, cropland, exotic, and urban), nor community types that remained relatively stable between historical and current periods (that is, alpine, rock/barren, and water community types). Departures were also not estimated for riparian community types because historical occurrence of riparian cover types was typically underestimated and current period occurrence was typically overestimated (Jones and Hann 1996b).

Subbasin departure classes were estimated in a similar manner as were the Basin and ERU departures of cover types and terrestrial communities. However, in the subbasin, the departures were determined on an individual subbasin level. Consequently, the current areal extent of each type within individual subbasins was compared to the modeled median 75-percent and 100-percent historical ranges of each type within a subbasin. Subbasin historical ranges of terrestrial communities were determined for the Basin and ERUs in the same manner as the historical ranges of cover types and terrestrial communities. The persistence of species within a subbasin was presumed not to be at risk if the current period area of the species’ primary habitat fell within or above the median range of historical data. Consequently, we believed it would be informative to assess the fragmentation of areas in which the risks to persistence would be relatively low. We computed four fragmentation indices for subbasins in which a community type occurred within or above its historical range: (1) percent area (percentage of those subbasins in which a community composed a substantial proportion); (2) number of patches; (3) median patch size (count of subbasins within a patch); and (4) maximum patch size.

Broad-scale Changes of Vegetation Patterns

We evaluated the patterns of physiognomic groups and terrestrial communities to assess landscape and regional patterns of vegetation, respectively, within the Basin.

Physiognomic Group Patterns

Physiognomic groups were derived from an aggregation of 41 cover types and 25 structural stages having similar gross compositional and structural characteristics (table 3.8). Physiognomic group patterns were in turn created by classifying subwatersheds (6th field HUCs) (map 3.5) according to their pattern and composition of dominant physiognomic groups. In the coarsest sense, patterns were simplified as “uniform”, “mosaic”, or “mixed”. Uniform patterns existed where the dominant physiognomic group constituted a minimum of 80 percent of the subwatershed. The pattern was classified as mosaic where the dominant physiognomic group composed 60 to 80 percent of the subwatershed. In a mixed pattern, the dominant physiognomic group composed less than 60 percent of the subwatershed. A more descriptive pattern classification was also developed that used a hierarchy of pattern and dominant/codominant physiognomic groups. Changes of physiognomic group patterns were summarized by ERUs (map 3.3).

Transition matrices were prepared for each ERU to summarize the changes of physiognomic group patterns between the historical and current periods. Changes were quantified in relation to the physiognomic group (that is, class change or proportional change) and in relation to the ERU (that is, the proportional change of an ERU due to a change in a particular physiognomic group). The most dominant transitions within an ERU were evaluated to develop an understanding of the major pattern changes that had occurred between historical and current periods. In general, to be considered major, fluxes had to occur across a minimum of 1 percent of an ERU.

A coarse assessment of fragmentation trends was conducted by analyzing the net change in areal extent of ERUs that had fluxed between more uniform or more fragmented landscapes (that is, uniform to mosaic or mixed, and mosaic to mixed). The percentage of the ERU that remained in the same pattern class between historical and current periods was used to estimate a stability index. Conversely, a departure index for ERUs was calculated to quantify the magnitude of change between historical and current broad-scale physiognomic group patterns. The departure index was calculated by:

$$PD = 100 - \left[\frac{200 \Sigma_k \text{minimum}\left(h_k, c_k\right)}{\Sigma_k h_k + \Sigma_k c_k} \right]$$

where
PD = departure index,
k = number of classes,
h_k = the historical value for class k, and
c_k = the current value for class k.

ERU departure indices were classified on a relative scale as low, moderate, and high for values less than 33.3, 33.3 to 66.6, and exceeding 66.6, respectively.

Terrestrial Community Group Patterns

Historical and current period patterns of broad-scale terrestrial community groups were assessed for the LCA, an area that extended slightly beyond the boundaries of the Basin (maps 3.1 and 3.2). The historical and current period vegetation maps were derived using different methods and resolutions (Menakis and others 1996). Consequently, comparisons of landscape patterns between historical and current periods were difficult. To ameliorate the problems associated with resolution, the 1-square-kilometer current and historical vegetation layers were resampled to 4-square-kilometer resolution, and the 24 terrestrial community types were further aggregated into 12 terrestrial community groups (table 3.9). We believe that using a coarser 4-

square-kilometer resolution and a coarser classification of vegetation types improved the comparability of historical and current period vegetation patterns. As previously discussed, changes of riparian vegetation types between historical and current periods could not accurately be assessed. Consequently, pattern changes of any riparian community groups were not reported in this chapter.

FRAGSTATS (McGarigal and Marks 1994) was used to estimate class (that is, terrestrial community groups) and landscape metrics to assess pattern changes of the LCA as a whole, as well as pattern changes of each of the 12 community groups occurring within the LCA (table 3.10). Multiple metrics (that is, areal extent, largest patch index, patch number, and mean patch size) were evaluated to assess fragmentation. Indicators of an increase in fragmentation included decline in areal extent, a declining largest patch index, and a declining mean patch size, whereas the number of patches would generally be expected to increase. Conversely, indicators of a landscape becoming more homogeneous and contiguous included increasing areal extents, increasing largest patch index, increasing mean patch size, and declining numbers of patches. Because of the coarse resolution of this analysis and the different mapping methods involved, we assumed ecologically significant changes occurred when current period metrics deviated by 20 percent or more from historical metrics.

Table 3.4—Total percentages by management region, land ownership group, and management class.

Management Region	Land Ownership Group, Management Class[1]	Percent of Management Region	Percent of Total Basin
EEIS[2]	BLM/FS[3] Natural Processes	9.9	4.8
	BLM/FS Roadless Human-Influenced Processes	1.7	0.8
	BLM/FS Roaded Human-Influenced Processes	25.2	12.3
	BLM/FS Roadless Natural/Human-Influenced Processes	1.2	0.6
	BLM/FS Roaded Natural/Human-Influenced Processes	3.4	1.6
	National Park and Other Wilderness	0.4	0.2
	Private or Other Lands	47.7	23.1
	Tribal, State, or Other Public Land	10.6	5.2
Total		100.0	48.6
UCRB[4]	BLM/FS Natural Processes	14.4	7.4
	BLM/FS Roadless Human-Influenced Processes	5.5	2.8
	BLM/FS Roaded Human-Influenced Processes	30.0	15.4
	BLM/FS Roadless Natural/Human-Influenced Processes	8.7	4.5
	BLM/FS Roaded Natural/Human-Influenced Processes	2.9	1.5
	National Park and Other Wilderness	1.9	1.0
	Private or Other Lands	28.2	14.5
	Tribal, State, or Other Public Land	8.4	4.3
Total		100.0	51.4

EEIS and UCRB Total	100.0

[1] Information from EIS data files.
[2] Eastside EIS assessment area.
[3] Bureau of Land Management- and Forest Service-administered lands.
[4] Upper Columbia River Basin EIS assessment area.

Table 3.6—Succession and disturbance regimes developed for broad-scale assessment.

	Average Disturbance Interval (years)				
Regime (Code)	Intermediate Mixed[1] / Non-lethal[2]	Lethal	Severity	Description	Examples
Cycling	NA[3]	1+	Moderate-High	Succession is reinitiated by disturbances that are lethal[4] to most or all of the upper-layer and some or all of the lower-layer vegetation.	
Accelerated Cycle (AC)	5-50	30-300	Moderate	Intermediate disturbances that accelerate growth of disturbance-adapted species, often creating an irregular fine-scale mosaic of patches of different vegetation structures. Eventually cycled by a lethal disturbance.	Conifer potential vegetation types (PVTs) with non-lethal or mixed fires, insect, or disease effects that thin the stands of susceptible species, allowing the resistant species to accelerate growth; shrub PVTs with non-lethal or mixed fires, insects, disease, grazing, or beaver cutting effects that open-up stands.
Long Cycle (LC)	NA	101 - 300	High	Successional cycle is long, with reinitiation from seedlings and some resprouting. Intermediate disturbances may happen but they have minimal effects on composition,structure, and density.	Conifer PVTs with longer-lived, fast-growing, shade-intolerant, conifer species that dominate after crown fires, insect attacks, windthrow, or other lethal effects that cycle the community.

Moderate Cycle (MC)	NA	5 - 100	Moderate	Successional cycle is moderately long, with reinitiation from a mixture of resprouting plants and seedlings. Intermediate disturbances may happen but they have minimal effects on composition, structure, and density.	Shrub PVTs where succession after lethal burning, herbicide application, chaining, or insect topkill takes from 10 to 25 years to reestablish the dominant shrub layer; conifer or broadleaf PVTs with short-lived, fast-growing, shade-intolerant, conifer or broadleaf species that dominate after crown fires, insect attacks, windthrow, or other lethal effects that cycle the community; floods in floodplain areas that cycle broadleaf, conifer, or shrub vegetation; cutting or flooding by beaver in riparian areas; avalanche paths; conifer PVTs where lethal disturbance cycles the vegetation prior to dominance by conifers, keeping the system in an herb or shrub dominated stage.
Retrogressive Cycle (RC)	NA	10 - 50	Low	Disturbances that reverse successional direction to an earlier seral stage, typically an annual or biannual cycle of grazing stress insect/pathogen mortality, drought mortality,or pollutant mortality.	Conifer PVTs with fire exclusion resulting in a dense upper layer that undergoes relatively little annual mortality from insects, disease, and stress that cumulatively are a lethal effect to the dominant vegetation a long period (10-50 yrs); grazing that selectively causes mortality in relatively small annual increments such that over a long period there is a complete change in dominant vegetation composition or structure; invasion by exotic plants that can compete more effectively than native plants due to environment or disturbance (grazing, fire, tillage, or roads).
Short Cycle (SC)	NA	1 - 4	High	Successional cycle is very short with a composition of new seedlings, annuals, biennials, or weedy perennial species.	Annual high water in channel zone/draw area adjacent to the channel; annual tillage in agriculture; soil or gravel surfaced roads with annual grading and runoff; annual grass and weed dominated vegetation with high amounts of bare soil; annual avalanche path areas.
Very Long Cycle (VC)	NA	301+	High	Successional cycle is very long, with reinitiation primarily from seedlings. Intermediate disturbances may happen but they have minimal effects on composition, structure, and density.	Conifer PVTs with a sequence of dominance by shade-intolerant tree species that succeed to shade-tolerant tree species and then are cycled by crown fires, insect attacks, windthrow, or other lethal effects on the dominant upper layer vegetation.

Maintenance	5 - 50	NA	Low	Succession is maintained in one structural stage by periodic disturbances that do not cycle the upper-layer vegetation but are lethal to species in the lower layer that would grow up into and change the upper layer.	
Frequent Maintenance (FM)	5 - 25	NA	Low	Intermediate effects produce relatively uniform upper and lower layers of vegetation with relatively short intervals between maintenance disturbances.	Warm conifer PVTs with non-lethal fires, insects, disease, or grazing effects that selectively remove the susceptible understory species allowing for recruitment of resistant species into the overstory; warm grassland, shrubland, and conifer PVTs with non-lethal and mixed fires, insects, disease, or grazing effects that maintain the dominant grass or forb vegetation.
Less FrequentMaintenance (GM)	26 - 50	NA	Low	Intermediate effects produce relatively uniform upper and lower layers of vegetation with moderate intervals between disturbances.	Cooler conifer PVTs with non-lethal fires, insects, disease, or grazing effects that selectively remove the susceptible understory species allowing for recruitment of resistant species into the overstory; cooler grassland, shrubland, and conifer PVTs with non-lethal and mixed fires, insects, disease, or grazing effects that maintain the dominant grass or forb vegetation.
Irregular Maintenance (IM)	26 - 50	NA	Low	Intermediate effects produce relatively irregular upper layers of vegetation and multiple lower layers.	Wet conifer, broadleaf, or shrub PVTs with mixed fires, insects, disease, or grazing effects that selectively remove small patches of susceptible species in any vegetative layer allowing for recruitment of resistant species into the structure.

[1] Mixed disturbances maintain a salt and pepper, fine-scale mosaic within a patch by cycling clumps and gaps; mixed disturbances leave patches intact, but maintain a rough textural pattern of clumps and gaps; mixed disturbances can be lethal (maintaining scattered gaps or creating gaps); or non-lethal (creating gaps that are intermingled with clumps).
[2] Non-lethal disturbances do not cycle the upper layer of vegetation; non-lethal disturbances selectively thin susceptible plants in all layers of the patch.
[3] NA = Not Applicable.
[4] Lethal disturbances cycle the upper layer of vegetation in the patch, and may cycle the lower layers.

Table 3.7—Cover type and terrestrial community departure classes.

Departure Class	Relationship of Current Period Area to Historical Ranges

1	A_C[1] < Historical Minimum
2	Historical Minimum $\leq A_C <$ Median 75% Historical Range
3	A_C is within Median 75% Historical Range
4	Median 75% Historical Range $< A_C \leq$ Historical Maximum
5	$A_C >$ Historical Maximum

[1] A_C = Current area.

Table 3.8—Physiognomic groups used to assess coarse landscape patterns of subwatersheds within the Basin.

Physiognomic Group	Description
Agriculture	Agricultural types including irrigated and non-irrigated crop land, hayland, and seeded pasture.
Forest / Woodland Early-seral	Forest and woodland early-seral structures (that is, stand initiation[1]).
Forest / Woodland Mid-seral	Forest and woodland mid-seral structures including stem exclusion open and closed, understory reinitiation, and young multi-storied stands.
Forest / Woodland Late-seralMulti-layer	Forest and woodland late-seral multi-layered stand structures.
Forest / Woodland Late-seral Single-layer	Forest and woodland late-seral single-layered stand structures.

Herbland	Herbland structures including both native and exotic grasses and forbs, and sedge-dominated open and closed stands.
Low Shrub	Low shrub structures including open and closed shrub stands less than 0.76 meters in height.
Mid Shrub	Mid shrub structures including open and closed shrub stands 0.76 to 2.00 meters in height.
Rock	Rock and barren structures.
Tall Shrub	Tall shrub structures including both open and closed shrub stands exceeding 2 meters in height.
Urban	Urban and industrial areas.
Water	Large bodies of water.

[1] See appendix 3-G for structural stages descriptions.

Table 3.9—Aggregation of 24 terrestrial community types into 12 terrestrial community groups for analysis of broad-scale changes in vegetation patterns.

Terrestrial Community Group	Terrestrial Community Type
Agriculture	Agricultural
Alpine	Alpine
Exotic Herbland	Exotic Herbland
Lower Montane Forest[1]	Early-seral Lower Montane[1] Forest
	Mid-seral Lower Montane[1] Forest
	Late-seral Lower Montane[1] Multi-layer Forest
	Late-seral Lower Montane[1] Single-layer Forest
Montane Forest	Early-seral Montane Forest
	Mid-seral Montane Forest

	Late-seral Montane Multi-layer Forest
	Late-seral Montane Single-layer Forest
Rock	Rock / Barren
Subalpine Forest	Early-seral Subalpine Forest
	Mid-seral Subalpine Forest
	Late-seral Subalpine Multi-layer Forest
	Late-seral Subalpine Single-layer Forest
Upland Herbland	Upland Herbland
Upland	Shrubland
Upland Woodland	Upland Woodland
Urban	Urban
Water	Water
NU[2]	Riparian Herbland
NU	Riparian Shrubland
NU	Riparian Woodland

[1] Originally referred to as Ponderosa pine Forest.

[2] NU = Not Used. Patterns were not assessed for the riparian terrestrial community types because these types generally occurred in scattered, relatively small- to medium-sized patches, and tended to be underestimated as mapping resolution increased. Consequently, because the historical vegetation layer was developed at a coarser resolution than the current period vegetation layer, it was likely that the two mapping efforts contained different biases. Therefore, changes of riparian vegetation types between historical and current periods could not accurately be assessed.

Table 3.10—Landscape metrics used to assess broad-scale vegetation patterns.

Metric[1]	Scale[2]	Description (units)
%LAND	Class	Percent of the landscape (%)

CONTAG	Landscape	Contagion Index
PR	Landscape	Patch Richness (#)
SHDI	Landscape	Shannon's Diversity Index
SHEI	Landscape	Shannon's Evenness Index
SIDI	Landscape	Simpson's Diversity Index
SIEI	Landscape	Simpson's Evenness Index
ED	Class / Landscape	Edge Density (m/ha)
LPI	Class / Landscape	Largest Patch Index (%)
MPS	Class / Landscape	Mean Patch Size (ha)
NP	Class / Landscape	Number of patches (#)

Adapted from McGarigal and Marks (1994).

[1] Metric: a means of measuring or specifying values of variability.

[2] Scale: Class indicates that metric is calculated for individual habitat types (that is, terrestrial community group); landscape indicates that metric is calculated for the landscape as a whole, regardless of habitat type; class/landscape indicates that metric is used for both class and landscape.

APPENDIX 3-A

Aggregation of Native (HRV[1]) and Current Potential Vegetation Types (PVTs) Into Potential Vegetation Groups (PVGs).

Potential Vegetation Group	Native and Current Potential Vegetation Type
Agricultural	Dry Crop / Pasture Land[2]
	Irrigated Crop Land[2]
Alpine	Alpine Shrub-Herbaceous
Cold Forest	Mountain Hemlock East Cascades[5]
	Mountain Hemlock Inland[5]
	Mountain Hemlock / Red Fir[5]
	Spruce-Fir Dry with Aspen
	Spruce-Fir Dry without Aspen
	Spruce-Fir (LPP > WBP[3])
	Spruce-Fir (WBP > LPP[4])
	Whitebark Pine / Subalpine Larch North
	Whitebark Pine / Subalpine Larch South
Cool Shrub	Mountain Big Sagebrush-Mesic-East
	Mountain Big Sagebrush-Mesic-East with Conifer
	Mountain Big Sagebrush-Mesic-West
	Mountain Big Sagebrush Mesic West with Juniper
	Mountain Shrub
Dry Forest	Dry Douglas-fir with Ponderosa Pine
	Dry Douglas-fir without Ponderosa Pine
	Dry Grand Fir / White Fir
	Interior Ponderosa Pine
	Lodgepole Pine-Oregon
	Lodgepole Pine-Yellowstone
	Pacific Ponderosa Pine / Sierra Nevada Mixed-Conifer
Dry Grass	Fescue Grassland
	Fescue Grassland with Conifer
	Wheatgrass Grassland

Potential Vegetation Group	Native and Current Potential Vegetation Type
Dry Shrub	Antelope Bitterbrush
	Big Sagebrush
	Big Sagebrush-Cool
	Big Sagebrush-Warm
	Low Sagebrush-Mesic
	Low Sagebrush-Mesic with Juniper
	Low Sagebrush-Xeric
	Low Sagebrush-Xeric with Juniper
	Salt Desert Shrub
	Threetip Sagebrush
Moist Forest	Cedar / Hemlock East Cascades
	Cedar / Hemlock Inland
	Grand Fir / White Fir East Cascades
	Grand Fir / White Fir Inland
	Moist Douglas-fir
	Pacific Silver Fir
	Spruce-Fir Wet
Riparian Herb	Riparian Graminoid
	Riparian Sedge
Riparian Shrub	Mountain Riparian Low Shrub
	Saltbrush Riparian
	Willow / Sedge
Riparian Woodland	Aspen
	Cottonwood Riverine
Rock	Barren
Urban	Urban[2]
Water	Water
Woodland	Juniper
	Limber Pine
	Mountain Mahogany
	Mountain Mahogany with Big Sagebrush
	White Oak

[1]Native and HRV are synonymous terms, defined in this chapter as the pre-Euro-American settlement regime.
[2]Indicates a PVT that did not exist in the native regime.
[3] Lodgepole pine more abundant than Whitebark pine.
[4] Whitebark pine more abundant than Lodgepole pine.
[5]Shifted from moist forest to cold forest in 2nd version of assessment PVGs.

APPENDIX 3-F

Historical potential vegetation types, associated cover types, and structural stages.

Potential Vegetation Type	Cover Type	Structural Stage[1]
Historical Wheatgrass Grassland	Wheatgrass Bunchgrass	CHERB
	Native Forbs	OHERB
Historical Antelope Bitterbrush	Wheatgrass Bunchgrass	CHERB
		OHERB
	Bitterbrush / Bluebunch Wheatgrass	CLSHR
Historical Big Sagebrush	Wheatgrass Bunchgrass	CHERB
		OHERB
	Big Sagebrush	CLSHR
Historical Low Sagebrush - Mesic	Wheatgrass Bunchgrass	CHERB
		OHERB
	Low Sagebrush	CLSHR
		OLSHR
Historical Low Sagebrush - Mesic with Juniper	Wheatgrass Bunchgrass	CHERB
		OHERB
	Juniper / Sagebrush	OSS_W
		SI_W
		UR_W
		YMS_W
	Low Sagebrush	CLSHR
		OLSHR
Historical Low Sagebrush - Xeric	Wheatgrass Bunchgrass	OHERB
	Low Sagebrush	CLSHR
		OLSHR
Historical Low Sagebrush - Xeric with Juniper	Wheatgrass Bunchgrass	OHERB
	Juniper Woodlands	OMS_W
		SI_W
		YMS_W
	Low Sagebrush	CLSHR
		OLSHR
Historical Big Sagebrush - Warm	Wheatgrass Bunchgrass	CHERB
	Big Sagebrush	OLSHR
	Low Sagebrush	OLSHR

Potential Vegetation Type	Cover Type	Structural Stage[1]
Historical Big Sagebrush - Cool	Wheatgrass Bunchgrass	CHERB
	Big Sagebrush	OLSHR
	Low Sagebrush	OLSHR
Historical Cottonwood Riverine	Cottonwood / Willow	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Douglas-fir	OMS_F
		YMS_F
	Interior Ponderosa Pine	OMS_F
		OSS_F
		UR_F
	Shrub Wetlands	CMSHR
		OMSHR
Historical Fescue Grassland	Fescue-Bunchgrass	CHERB
		OHERB
	Native Forbs	CHERB
Historical Mountain Big Sagebrush - Mesic / East	Wheatgrass Bunchgrass	OHERB
	Fescue-Bunchgrass	OHERB
	Mountain Big Sagebrush	CMSHR
Historical Mountain Big Sagebrush - Mesic / East with Juniper	Wheatgrass Bunchgrass	OHERB
	Fescue-Bunchgrass	OHERB
	Mixed Conifer Woodlands	SI_W
		UR_W
	Mountain Big Sagebrush	CMSHR
Historical Mountain Big Sagebrush - Mesic / West	Wheatgrass Bunchgrass	OHERB
	Fescue-Bunchgrass	CHERB
	Mountain Big Sagebrush	CMSHR
		OMSHR
Historical Mountain Big Sagebrush - Mesic / West with Juniper	Wheatgrass Bunchgrass	OHERB
	Fescue-Bunchgrass	CHERB
	Juniper / Sagebrush	OSS_W
		SI_W
		UR_W
		YMS_W
	Mountain Big Sagebrush	CMSHR
		OMSHR
Historical Salt Desert Shrub	Wheatgrass Bunchgrass	OHERB
	Salt Desert Shrub	CLSHR

Potential Vegetation Type	Cover Type	Structural Stage[1]
Historical Threetipp Sagebrush	Wheatgrass Bunchgrass	OHERB
	Big Sagebrush	CHERB
		CLSHR
Historical Willow / Sedge	Herbaceous Wetlands	OHERB
	Shrub Wetlands	CTSHR
Historical Aspen	Aspen	SEC_F
		SI_F
		UR_F
		YMS_F
	Fescue-Bunchgrass	CHERB
	Shrub or Herb / Tree Regen[2]	CMSHR
Historical Mountain Mahogany	Wheatgrass Bunchgrass	OHERB
	Fescue-Bunchgrass	OHERB
	Mountain Mahogany	CLSHR
		OMSHR
Historical Mountain Mahogany with Big Sagebrush	Wheatgrass Bunchgrass	OHERB
	Fescue-Bunchgrass	OHERB
	Mountain Big Sagebrush	CLSHR
	Mountain Mahogany	CLSHR
		OMSHR
Historical Mountain Shrub	Chokecherry / Serviceberry / Rose	CLSHR
		OLSHR
		OMSHR
		OTSHR
	Fescue-Bunchgrass	CHERB
Historical Riparian Graminoid - Historical Saltbrush Riparian	Native Forbs	CHERB
	Herbaceous Wetlands	CHERB
	Salt Desert Shrub	OMSHR
	Shrub Wetlands	OLSHR
Historical Riparian Sedge	Herbaceous Wetlands	CHERB
Historical Mountain Riparian Low Shrub	Herbaceous Wetlands	CHERB
	Shrub Wetlands	CLSHR
Historical Fescue Grassland with Conifer	Fescue-Bunchgrass	CHERB
	Mixed-Conifer Woodlands	OMS_W
		SE_W
		SI_W
		YMS_W

Potential Vegetation Type	Cover Type	Structural Stage[1]
Historical Juniper	Fescue-Bunchgrass	CHERB
		OHERB
	Juniper Woodlands	OMS_W
		OSS_W
		SI_W
		UR_W
		YMS_W
Historical Alpine Shrub - Herbaceous	Alpine Tundra	CLSHR
		OLSHR
Cedar / Hemlock - Eastern Cascades	Grand Fir / White Fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Douglas-fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Lodgepole Pine	SEC_F
		SI_F
		UR_F
	Shrub or Herb / Tree Regen	OLSHR
	Western Larch	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Western Redcedar / Western Hemlock	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Western White Pine	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F

Potential Vegetation Type	Cover Type	Structural Stage[1]
Cedar / Hemlock - Inland	Grand Fir / White Fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Douglas-fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Lodgepole Pine	SEC_F
		SI_F
		UR_F
	Shrub or Herb / Tree Regen	OLSHR
	Western Larch	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Western Redcedar / Western Hemlock	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Western White Pine	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
Dry Douglas-fir / without Ponderosa Pine	Interior Douglas-fir	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Mountain Big Sagebrush	CMSHR
	Shrub or Herb / Tree Regen	CHERB
		CMSHR
		OLSHR

Potential Vegetation Type	Cover Type	Structural Stage[1]
Dry Douglas-fir / with Ponderosa Pine	Fescue-Bunchgrass	OHERB
	Interior Douglas-fir	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Ponderosa Pine	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Shrub or Herb / Tree Regen	CHERB
		CMSHR
Dry Grand Fir / White Fir	Grand Fir / White Fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Douglas-fir	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Ponderosa Pine	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Shrub or Herb / Tree Regen	CMSHR
Limber Pine	Limber Pine	OMS_F
		SEO_F
		SI_F
		UR_F
	Shrub or Herb / Tree Regen	CMSHR
Lodgepole Pine - Yellowstone	Lodgepole Pine	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Shrub or Herb / Tree Regen	CMSHR

Potential Vegetation Type	Cover Type	Structural Stage[1]
Lodgepole Pine - Oregon	Lodgepole Pine	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Shrub or Herb / Tree Regen	CMSHR
Moist Douglas-fir	Interior Douglas-fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
Interior Ponderosa Pine		OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Lodgepole Pine	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Shrub or Herb / Tree Regen	CMSHR
	Western Larch	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
Grand Fir / White Fir - Eastern Cascades	Grand Fir / White Fir	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Douglas-fir	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Ponderosa Pine	OMS_F

Potential Vegetation Type	Cover Type	Structural Stage[1]
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Lodgepole Pine	SEC_F
		SI_F
		UR_F
		YMS_F
	Shrub or Herb / Tree Regen	OLSHR
	Western Larch	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Western White Pine	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
Grand Fir / White Fir - Inland	Grand Fir / White Fir	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Douglas-fir	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Ponderosa Pine	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Lodgepole Pine	SEC_F
		SI_F
		UR_F
		YMS_F

Potential Vegetation Type	Cover Type	Structural Stage[1]
	Shrub or Herb / Tree Regen	OLSHR
	Western Larch	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Western White Pine	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
Mountain Hemlock - Eastern Cascades	Engelmann Spruce / Subalpine Fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Douglas-fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Lodgepole Pine	SEC_F
		SI_F
		UR_F
		YMS_F
	Mountain Hemlock	OMS_F
		SEC_F
		SI_F
		UR_F
		MS_F
	Shrub or Herb / Tree Regen	OTSHR
	Western Larch	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Western White Pine	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F

Potential Vegetation Type	Cover Type	Structural Stage[1]
Mountain Hemlock - Inland	Engelmann Spruce / Subalpine Fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Douglas-fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Lodgepole Pine	SEC_F
		SI_F
		UR_F
		YMS_F
	Mountain Hemlock	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Shrub or Herb / Tree Regen	OTSHR
	Western Larch	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Western White Pine	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
Interior Ponderosa Pine	Exotic Forbs / Annual Grass	CHERB
	Fescue - Bunchgrass	CHERB
	Interior Ponderosa Pine	OMS_F
		OSS_F
		SEO_F
		SI_F
		UR_F
		YMS_F
	Mountain Big Sagebrush	OMSHR
	Shrub or Herb / Tree Regen	OLSHR

Potential Vegetation Type	Cover Type	Structural Stage[1]
Pacific Ponderosa Pine / Mixed-Conifer	Pacific Ponderosa Pine	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Shrub or Herb / Tree Regen	OLSHR
	Sierra Nevada Mixed-Conifer	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
Mountain Hemlock / Shasta Fir	Grand Fir / White Fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Douglas-fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Lodgepole Pine	SEC_F
		SI_F
		UR_F
		YMS_F
	Mountain Hemlock	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Red Fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Shrub or Herb / Tree Regen	OTSHR
	Western White Pine	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F

Potential Vegetation Type	Cover Type	Structural Stage[1]
Pacific Silver Fir	Engelmann Spruce / Subalpine Fir	SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Douglas-fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Mountain Hemlock	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
	Pacific Silver Fir / Mountain Hemlock	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Shrub or Herb / Tree Regen	OLSHR
	Western Larch	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Western Redcedar / Western Hemlock	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
Spruce / Fir - Dry with Aspen	Aspen	SEC_F
		SI_F
		UR_F
	Engelmann Spruce / Subalpine Fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Douglas-fir	OMS_F
		OSS_F
		SEC_F

Potential Vegetation Type	Cover Type	Structural Stage[1]
		SI_F
		UR_F
		YMS_F
	Lodgepole Pine	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Shrub or Herb / Tree Regen	CMSHR
Spruce / Fir - Dry without Aspen	Aspen	SEC_F
		SI_F
		UR_F
	Engelmann Spruce / Subalpine Fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Douglas-fir	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Lodgepole Pine	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Shrub or Herb / Tree Regen	CMSHR
Spruce / Fir - Wet	Engelmann Spruce / Subalpine Fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Interior Douglas-fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Lodgepole Pine	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F

Potential Vegetation Type	Cover Type	Structural Stage[1]
	Shrub or Herb / Tree Regen	OLSHR
	Western Larch	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Western White Pine	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
Spruce / Fir (WBP>LPP[3])	Engelmann Spruce / Subalpine Fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Lodgepole Pine	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Shrub or Herb / Tree Regen	CMSHR
	Whitebark Pine	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
Spruce / Fir (LPP>WBP[4])	Engelmann Spruce / Subalpine Fir	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Lodgepole Pine	OMS_F
		OSS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Shrub or Herb / Tree Regen	CMSHR
	Whitebark Pine	OMS_F
		OSS_F
		SEC_F

Potential Vegetation Type	Cover Type	Structural Stage[1]
		SI_F
		UR_F
		YMS_F
Whitebark Pine / Subalpine Larch - North	Shrub or Herb / Tree Regen	CMSHR
	Whitebark Pine / Subalpine Larch	OMS_F
		SEO_F
		SI_F
		UR_F
		YMS_F
	Whitebark Pine	OSS_F
Whitebark Pine /Subalpine Larch - South	Shrub or Herb / Tree Regen	CMSHR
	Whitebark Pine / Subalpine Larch	OMS_F
		SEO_F
		SI_F
		UR_F
		YMS_F
	Whitebark Pine	OSS_F
White Oak	Wheatgrass Bunchgrass	OHERB
	Oregon White Oak	OMS_W
		OSS_W
		SI_W
		UR_W
		YMS_W
	Shrub or Herb / Tree Regen	CMSHR
Wheatgrass Grassland	Wheatgrass Bunchgrass	CHERB
	Exotic Forbs / Annual Grass	CHERB
		OHERB
	Fescue-Bunchgrass	CHERB
	Native Forbs	OHERB
Antelope Bitterbrush	Wheatgrass Bunchgrass	CHERB
		OHERB
	Antelope Bitterbrush / Bluebunch Wheatgrass	CLSHR
Big Sagebrush Grassland	Wheatgrass Bunchgrass	CHERB
		OHERB
	Big Sagebrush	CLSHR
Low Sagebrush - Mesic	Wheatgrass Bunchgrass	CHERB
		OHERB
	Exotic Forbs / Annual Grass	OHERB
	Fescue - Bunchgrass	OHERB
	Low Sagebrush	CLSHR
		OLSHR

Potential Vegetation Type	Cover Type	Structural Stage[1]
Low Sagebrush - Mesic with Juniper	Wheatgrass Bunchgrass	CHERB
		OHERB
	Exotic Forbs / Annual Grass	OHERB
	Fescue - Bunchgrass	OHERB
	Juniper / Sagebrush	OSS_W
		SI_W
		UR_W
	Juniper Woodlands	OMS_W
		UR_W
	Low Sagebrush	CLSHR
		OLSHR
Low Sagebrush - Xeric	Wheatgrass Bunchgrass	OHERB
	Low Sagebrush	CLSHR
		OLSHR
Low Sagebrush - Xeric with Juniper	Wheatgrass Bunchgrass	OHERB
	Juniper Woodlands	OMS_W
		SI_W
		YMS_W
	Low Sagebrush	CLSHR
		OLSHR
Big Sagebrush - Warm	Wheatgrass Bunchgrass	CHERB
		OHERB
	Big Sagebrush	OLSHR
	Exotic Forbs / Annual Grass	CHERB
	Fescue - Bunchgrass	CHERB
	Low Sagebrush	OLSHR
Big Sagebrush - Cool	Wheatgrass Bunchgrass	CHERB
		OHERB
	Big Sagebrush	OLSHR
	Exotic Forbs / Annual Grass	CHERB
	Fescue - Bunchgrass	CHERB
	Low Sagebrush	OLSHR
Cottonwood Riverine	Cottonwood / Willow	OMS_F
		SEC_F
		SI_F
		UR_F
		YMS_F
	Exotic Forbs / Annual Grass	CHERB
	Interior Douglas-fir	OMS_F
		YMS_F
	Interior Ponderosa Pine	OMS_F

Potential Vegetation Type	Cover Type	Structural Stage[1]
		OSS_F
		UR_F
	Shrub Wetlands	CMSHR
		OMSHR
Fescue Grassland	Wheatgrass Bunchgrass	OHERB
	Cropland / Hay / Pasture	CHERB
	Exotic Forbs / Annual Grass	OHERB
	Fescue - Bunchgrass	CHERB
		OHERB
	Native Forbs	CHERB
Mountain Big Sagebrush - Mesic / East	Wheatgrass Bunchgrass	OHERB
	Exotic Forbs / Annual Grass	OHERB
	Fescue-Bunchgrass	OHERB
	Mountain Big Sagebrush	CMSHR
		OMSHR
Mountain Big Sagebrush - Mesic / East with Conifer	Wheatgrass Bunchgrass	OHERB
	Exotic Forbs / Annual Grass	OHERB
	Fescue - Bunchgrass	OHERB
	Mixed-Conifer Woodlands	SI_W
		UR_W
	Mountain Big Sagebrush	CMSHR
		OMSHR
Mountain Big Sagebrush - Mesic / West	Wheatgrass Bunchgrass	CHERB
		OHERB
	Big Sagebrush	CMSHR
		OMSHR
	Exotic Forbs / Annual Grass	OHERB
	Fescue - Bunchgrass	CHERB
		OHERB
	Mountain Big Sagebrush	CMSHR
		OMSHR
Mountain Big Sagebrush - Mesic / West with Juniper	Wheatgrass Bunchgrass	CHERB
		OHERB
	Big Sagebrush	CMSHR
		OMSHR
	Exotic Forbs / Annual Grass	OHERB
	Fescue - Bunchgrass	CHERB
		OHERB
	Juniper / Sagebrush	OSS_W
		SI_W
		UR_W

Potential Vegetation Type	Cover Type	Structural Stage[1]
	Juniper Woodlands	OMS_W
		YMS_W
	Mountain Big Sagebrush	CMSHR
		OMSHR
Salt Desert Shrub	Wheatgrass Bunchgrass	CHERB
		OHERB
	Salt Desert Shrub	CLSHR
		OLSHR
Three Tipp Sagebrush	Wheatgrass Bunchgrass	OHERB
	Big Sagebrush	CHERB
		CLSHR
		OLSHR
	Exotic Forbs / Annual Grass	OHERB
Willow / Sedge	Exotic Forbs / Annual Grass	OHERB
	Herbaceous Wetlands	OHERB
	Shrub Wetlands	CTSHR
Aspen	Aspen	SEC_F
		SI_F
		UR_F
		YMS_F
	Exotic Forbs / Annual Grass	CHERB
	Fescue - Bunchgrass	CHERB
	Shrub or Herb / Tree Regen	CMSHR
Mountain Mahogany	Wheatgrass Bunchgrass	OHERB
	Fescue - Bunchgrass	OHERB
	Mountain Mahogany	CLSHR
		OMSHR
Mountain Mahogany with Big Sagebrush	Wheatgrass Bunchgrass	OHERB
	Fescue - Bunchgrass	OHERB
	Mountain Big Sagebrush	CLSHR
	Mountain Mahogany	CLSHR
		OMSHR
Mountain Shrub	Chokecherry / Serviceberry / Rose	CLSHR
		OLSHR
		OMSHR
		OTSHR
	Fescue - Bunchgrass	CHERB
Riparian Graminoid	Native Forbs	CHERB

Potential Vegetation Type	Cover Type	Structural Stage[1]
Saltbrush Riparian	Herbaceous Wetlands	CHERB
	Salt Desert Shrub	OMSHR
	Shrub Wetlands	OLSHR
Riparian Sedge	Herbaceous Wetlands	CHERB
Mountain Riparian Low Shrub	Wheatgrass Bunchgrass	CHERB
	Herbaceous Wetlands	CHERB
	Shrub Wetlands	CLSHR
Fescue Grassland with Conifer	Exotic Forbs / Annual Grass	OHERB
	Fescue - Bunchgrass	CHERB
	Mixed Conifer Woodlands	OMS_W
		SE_W
		SI_W
		YMS_W
Juniper	Exotic Forbs / Annual Grass	OHERB
	Fescue - Bunchgrass	CHERB
		OHERB
	Juniper Woodlands	OMS_W
		OSS_W
		SI_W
		UR_W
		YMS_W
Alpine Shrub - Herbaceous	Alpine Tundra	CLSHR
		OLSHR
Irrigated Crop Land	Cropland / Hay / Pasture	CHERB
		CROP
	Fescue - Bunchgrass	CHERB
		OHERB
	Urban	URBAN
Dry Crop / Pasture Land	Cropland / Hay / Pasture	CHERB
		CROP
	Fescue - Bunchgrass	CHERB
	Urban	URBAN
Urban	Urban	URBAN
Water	Water	WATER
Barren	Barren	ROCK

[1]See appendix 3-G for description of structural stages:

Structural Stage	Abbreviation
Stand Initiation Forest	SI_F
Stem Exclusion Open Canopy Forest	SEO_F
Stem Exclusion Closed Canopy Forest	SEC_F
Understory Reinitiation Forest	UR_F
Young Multi-strata Forest	YMS_F
Old Multi-strata Forest	OMS_F
Old Single-strata Forest	OSS_F
Stand Initiation Woodland	SI_W
Stem Exclusion Woodland	SE_W
Understory Reinitiation Woodland	UR_W
Young Multi-strata Woodland	YMS_W
Old Multi-strata Woodland	OMS_W
Old Single-strata Woodland	OSS_W
Open Herbland	OHERB
Closed Herbland	CHERB
Closed Low Shrub	CLSHR
Open Low Shrub	OLSHR
Open Mid Shrub	OMSHR
Closed Mid Shrub	CMSHR
Open Tall Shrub	OTSHR
Closed Tall Shrub	CTSHR
Agricultural	CROP
Urban	URBAN
Water	WATER
Rock	ROCK

[2]Regeneration (renewal or restoration of structures).
[3]Whitebark pine more abundant than Lodgepole pine.
[4]Lodgepole pine more abundant than Whitebark pine.

Mod Urban/Wildlands (L) Low Integrity High Fire Risk	< Dry forest or range-dominated river subbasins with moderate amounts of urban/wildland interface and high fire risk in those areas. < Low consideration for forest integrity and low, with some moderate consideration for aquatic and range integrity. < Low amounts of wilderness and semi-primitive areas. < Mixed low to high amounts of BLM- and FS-administered lands. < Includes forest clusters 5 and 7, and primarily range clusters 3 and 6.
Low Urban/Wildlands (M) Low-Moderate Integrity Moderate Fire Risk	< Moist forest-dominated or cooler range-dominated river subbasins with low urban/wildland interface and moderate fire risk in those areas. < Low to moderate consideration for aquatic and forest integrity, with moderate to high for range integrity. < Low to moderate levels of wilderness and semi-primitive areas. < High amounts of BLM- and FS-administered lands. < Includes forest clusters 4 and 7, and primarily range clusters 5 and 7.
Low Urban/Wildlands (H) High Integrity Moderate Fire Risk	< River subbasins with low amounts of urban/wildland interface and moderate fire risk in those areas. < High, with some moderate, consideration of forest, range, and aquatic integrity. < High amounts of wilderness and semi-primitive areas. < High amounts of BLM- and FS-administered lands. < Forest clusters 1 and 2, and primarily range clusters 2 and 5.