Chapter 3 - Ecological Concepts and Classification

3.0 Ecosystem Management Goals and Assumptions

This assessment assumes that the overall purpose of ecosystem management is to restore and maintain ecological integrity and social and economic resiliency. Ecosystem integrity measures the degree to which all components of an ecosystem are represented and properly functioning. Resiliency is a term used to characterize the ability of the ecosystem to adapt to change (Quigley et al. 1996). More specific goals that can be used as benchmarks in assessing ecosystem condition are shown below.

- Maintain evolutionary and ecological processes. This means understanding basic biophysical conditions and processes within an area, and their associated disturbance regimes.
- Manage with an understanding of multiple ecological domains and evolutionary time frames. This means considering the broad spatial and temporal context in which management actions occur.
- Maintain viable populations of native and desired non-native species. This helps to maintain ecosystem function.
- Manage for places with definable human values. Gaining a better understanding of how different people define special places can help reduce conflict.
- Manage to maintain a sustainable mix of ecosystem goods, functions, and conditions that society wants. Some goods are commodities, some are experiences, some are valued for their existence, and some are functions like nutrient cycling that sustain a system's ability to produce other goods.

3.1 Biophysical and Social Concepts

3.1.1 Biophysical Environments

Biophysical environments are the geologic, climatic, and landform settings that constrain ecological processes (Quigley et al. 1997). They describe ecosystems that behave in a similar manner. This description helps interpret and predict patterns of plant communities, wildlife habitats, stream channels, and dominant disturbance processes and successional pathways. In this assessment, landforms, climate, habitat type groups (potential vegetation), and geology were used to build classification systems that help interpret and predict condition and response in a diverse landscape like the Slate Creek watershed.

Mapped classifications used in this assessment include habitat type groups (HTGs), aquatic landtype associations (ALTAs) and vegetation response units (VRUs). Subwatersheds are differentiated to show particular homogenous landscape patterns or conditions.

Habitat Type Groups (HTGs)

Habitat types, or potential vegetation groups, are a useful way to group lands capable of supporting similar plant communities in the absence of disturbance. Habitat types tend to have predictable patterns of disturbance, succession, and productivity, although topographic setting may also strongly influence disturbance and forest succession. Habitat types have been grouped for this analysis after Applegate et al. 1995. Habitat type groups are shown in Map 32 and described in Appendix P. Where field data were not available, the habitat type group was predicted for each stand based on photo interpretation.

Habitat Type Groups are important elements of Vegetation Response Units.

Vegetation Response Units (VRUs)
VRUs are broad ecological land units that display unique patterns of habitat type groups (potential vegetation) and terrain. VRUs have similar patterns of disturbance and successional processes. Patterns of plant community composition, age class structure, and patch size will tend to fall within certain ranges for each VRU. VRUs were used in this assessment to estimate resource capabilities, ecological integrity, and responses to natural and human caused disturbances. The components used to build the VRU classification system are habitat type groups (potential vegetation), landform, and presettlement disturbance processes (like fire regimes). They are a product of geology, landform, climate, and soil. Brief descriptions of the VRUs for the watershed are contained in Chapter 5. VRUs are shown in Map 31. Most characterization of vegetation and terrestrial wildlife are by VRU.

Aquatic Landtype Associations (ALTAs)
ALTAs display historic aquatic settings that consider both terrestrial disturbance regimes (fire, erosion) and aquatic disturbance regimes (runoff character, flood timing and how channels process peak flows and sediment inputs). They may have considerable overlap with VRUs. ALTAs consider not only landform, geology, and vegetation, but weigh elevation fairly heavily because of the role of ground water temperature and base flows in limiting aquatic habitats, and the relative significance of rain on snow at lower elevations, and sustained runoff at higher elevations. ALTAs are built looking at not only the component landforms, but the included channel systems, in particular, their size and gradient. ALTAs are shown in Map 9.

Subwatersheds
Watersheds are geographic units which drain to a common point on a stream. Watersheds have been delineated and numbered in a hierarchical coding system, with the Salmon River being a 3rd code basin, the Lower Salmon River being a 4th code subbasin, and Slate Creek being a 5th code watershed. Within the 5th code Slate Creek watershed there are twenty 6th code subwatersheds. On the Nez Perce National Forest, these have also been referred to as prescription watersheds. They are shown on Map 10.

For purposes of this assessment, the 6th code subwatersheds have been grouped into nine geographic areas or subwatersheds. These subwatersheds have uniquely characteristic combinations of biophysical environments, ecological processes, past management activities, and current social and biological trends. They are used here to organize recommendations for future management strategies to achieve sustainable landscape conditions.

See Chapter 4, section 4.4 for the names and sizes of the nine subwatersheds in the Slate Creek drainage. Chapter 7 outlines the integrated management recommendations for each subwatershed.

Stream Order
Stream orders are numbers assigned to streams starting at their headwaters and working downstream toward the stream's mouth. For example, a first order stream is the smallest identified channel, with no tributaries. In the most commonly used stream ordering system, two first order streams combine to form a second order stream. Two second order streams combine to form a third order, and so on.

Channel Types
Channel types (also known as stream types) are designations used in a system of classifying streams based on observable features that have process and functional implications. Basic characteristics that distinguish channel types include thread, entrenchment (access to floodplains), sinuosity, width to depth ratio, gradient, and substrate size (Rosgen, 1994). Channel types are significant in that various stream types process energy (i.e. water) and sediment in different ways. Channel types are further described and diagrammed in Appendix E.

3.1.2 Landscape Dynamics

Natural Range of Variability
Historic and presettlement are used synonymously in this document to describe the time period prior to European settlement (about 1850) and extensive alteration of the landscape.

Ecosystems are not static and their conditions vary over time and space. The historic range of variability describes the dynamic nature of ecosystems. The historic or presettlement range of conditions found in a setting is used to understand the likely range of conditions found under natural disturbance regimes. A key assumption of this concept is that when systems are pushed outside their normal range, then there is increased risk that biological diversity and proper ecological function may not be maintained.

In the Slate Creek analysis, existing landscape conditions were compared to their historic range. Since documentation covering the historic period is limited for the watershed, it was necessary to estimate the range of historic conditions by extrapolating from more recent documentation and photos and applying scientific principles related to what we know about disturbance regimes.

Plant Succession
Succession is the progression in which species dominate a plant community over time after a major disturbance. Typically, many species will invade a site after a wildfire or timber harvest, but some will assert dominance early in plant community development, like fireweed or lodgepole pine. Later, other species will assume dominance, like subalpine fir or grand fir. Subsequent major or minor disturbances may retain a plant community on its current successional state (like a low severity fire), return succession to an early state (like a stand replacing fire) or affect some plants differently than others (like root disease which may kill grand fir and leave white pine).

Landscape Disturbance
A disturbance is an event that causes a significant change from the normal pattern in an ecosystem. It may change ecosystem processes, the community, the population, or the environment (Pickett and White, 1985). Disturbance regime refers to the frequency, severity, scale and other attributes of a recurring disturbance, like fire, flood, or drought (Hobbs and Huenneke, 1992).

Plant and animal species have typically evolved adaptations of life history, form, or function to survive as individuals, populations or species in the disturbance regime typical of their environment. An example is the seed of lodgepole pine, which may be released from its cone only when the cone is heated by a hot forest fire. The trees are killed; the species is sustained.

Another adaptation is the migratory life history of many fishes; their tendency to occupy different areas of a stream or different streams during spawning, rearing, and adult life, and their tendency to stray into new streams (Rieman and McIntyre, 1993). All these are behaviors that help them avoid unfavorable habitats and find and use favorable habitats, in an environment where favorable habitats shift in space and time with fire, flood, and other natural disturbances.

When humans add an additional disturbance regime of timber harvest, road building, grazing, and other impacts on streams, and apply that regime across most the landscape, the scale and ubiquity of disturbance dramatically alter the environment to which some fish species are adapted.

Understanding the effects of changed disturbance regimes for terrestrial and aquatic systems is emphasized throughout this analysis. Restoration of the pattern of disturbance appropriate to a given setting was a key consideration in developing management themes and recommendations in later chapters.

Press and Pulse Disturbances
An important concept emphasized in this analysis is the change from a 'pulse' disturbance to a 'press' disturbance (Yount and Niemi, 1990; Frissell 1993).

A pulse disturbance causes a relatively short-lived alteration of species or habitat, and recovery to within the bounds of the natural range will occur. An example is the effect of a wildfire on vegetation state or stream habitat. The fire is a discrete event, and recovery to the pre-fire state occurs.

A press disturbance shifts the ecosystem to a new state, either through perpetuation of the disturbance or long term alteration of the ecosystem. Irreversible climate change would be a press disturbance. Timber harvest usually acts like a pulse disturbance, unless it is at such a scale and magnitude that vegetation recovery cannot occur. Road construction frequently responds as a press disturbance, because sediment and runoff regimes are altered permanently, until the road is removed. Even after removal, recovery of stream communities may take several decades.

Natural Disturbance Processes

The following events are some of the more recognized natural terrestrial disturbances that have shaped landscape conditions in the watershed:

Fire - Fire events of variable frequency, severity, and extent affect vegetation patterns over time and space. The significance of wildfire in presettlement times can scarcely be overestimated in determining the landscape conditions. Presettlement fire regimes were mapped based on potential vegetation and terrain. They are shown in Map 34. Fire history from about 1870 to 1929 is shown in Map 33.

Visual evidence of fire in the watershed was probably more common than not during the last two thousand years of relative climatic equilibrium. Because of the level of historic fire disturbance, seral grasses, forbs, shrubs and tree species were present to a greater degree than occurs today in many VRUs. In comparison, much smaller areas of the watershed have burned since about 1930 to the present, as a result of successful fire suppression.

Volcanic Ash Fall - The eruption of Mt. Mazama (now Crater Lake) 6,700 years ago precipitated a fall of volcanic ash that has formed an important surface soil material. The ability of ash to hold moisture and resist erosion has increased soil productivity where it is present. The frequency and severity of volcanic eruptions are hard to predict, and ash as a soil resource must be considered irreplaceable.

Insects and Diseases - Common pathogens which play a role in forest succession processes in the analysis area include mistletoe, bark beetles, defoliators, stem decays and root rots. Pathogen activity often advances forest succession favoring shade tolerant tree species. Their activity can benefit ecosystems by promoting woody debris recruitment, providing food for many bird, insect, and small mammal species, recycling nutrients, or creating forest openings that increase habitat diversity. Native pathogens and insects played a key part in creating the diversity of forests present at the time of European settlement (Hann and Hagle, 1993).

Detrimental effects can also result where pathogens reduce existing shade to streams, cause the significant decline or loss of a species or structural stage in the landscape, or promote a rapid increase of fuel loadings, placing a large area at risk to severe fire.

The level of activity for any particular pathogen changes through time, and depends on existing vegetation conditions and climatic conditions. The ICRB Scientific Assessment (Quigley et al. 1997) concluded that forests in the Interior Columbia River Basin have become more susceptible to outbreaks of insects and diseases, because of increased stand densities and increasing dominance of more disease-susceptible late seral tree species. These changes in vegetation have occurred in the Slate Creek area, as well.

3.1.3 Watershed Dynamics

The soils, landforms, and streams in the watershed are the result of numerous geologic and climatic events, including a general regional uplift of the northern Rocky Mountains and several episodes of glaciation and climate change.

Erosion Processes

Mass erosion, primarily geologic creep, is the dominant erosion process in natural landscapes, with minor incidents of debris avalanche and surface erosion after intense wildfires or in response to storm events. The stream channel system is also a source, as well as a conveyance and sink for sediment. As early settlers began moving into the watershed, surface erosion processes became more prevalent in areas of road construction, mining, timber harvest and grazing.

Roads have increased chronic surface and mass erosion rates beyond rates associated with periods between natural watershed disturbances. See Figures 5.14 and 5.15. An extensive network of roads has been constructed in a variety of settings; including some sensitive areas such as stream bottoms and unstable landtypes. Roads built on unstable landtypes have resulted in some large scale landslides (see Map 7).

The risk of management induced mass failures increases when road development and timber harvest activities are located on steep breaklands and mountain slopes.

The highest risk for increases in surface erosion are in areas where roads have been built on soil substrata with high erosion hazards. Areas of high risk of sediment production from substratum erosion are shown in Map 5. Areas of high surface erosion from fire and timber harvest are shown in Map 4.

Debris torrents are the rapid movement of water, rock, soil and vegetation down a stream channel. Areas with high risk of debris torrents are shown in Maps 6 and 7. The risk is generally confined to the channels within these areas, although harvest or road building in shallow soils above these channels may contribute to that risk by increasing the water moving through the soil in these areas.

Streamflow Processes

The soils, landforms, and streams have developed and adapted to a wide range of runoff events from spring snowmelt, rain-on-snow, and thunderstorm runoff. Runoff in the watershed is dominated by spring snowmelt, with a recession to baseflows in summer, fall, and winter. Typically, rain or snowmelt in much of the watershed will quickly infiltrate soils and subsoils because of the surface volcanic ash cap.

Floods are a significant natural disturbance process which can be characterized by their frequency, severity, and extent. Broad valleys with meandering streams were subject to fairly frequent, low severity flooding. Flood energy was efficiently dissipated. Narrow valleys with high gradient streams were subject to infrequent severe flooding at high elevations, and more frequent severe flooding at low elevations.

Road construction and other activities in floodplains can reduce the ability of the floodplain to dissipate flood energy, and increase the impact of flooding on channels and aquatic habitats. This can happen when roads occupy the floodplain, thus reducing stream width and concentrating the flow energy in a deeper, narrower channel. Flood frequency may increase with harvest, fire or road drainage systems that make landscapes respond more rapidly to rain or snowmelt.

Riparian Conditions

Riparian conditions are dependant on the vegetation near streams and the physical condition of streambanks, valley floors, and streamside slopes. Streamside vegetation buffers the streams from temperature changes and sediment, provides organic material to the stream, and helps maintain stable streambanks.

Depending on the channel type and size of stream, the relative magnitude of these functions can vary widely. For example, large woody debris is often a significant component of physical channel structure and stability in small to medium size streams, but plays a less important role in

large rivers. Roads, fire, timber harvest, mining, and grazing may significantly affect the beneficial functions of riparian vegetation (see Map 14).

Physical riparian conditions are equally important to stream function. For example, channel and bank condition are key features in determining the effects of high streamflows. If banks are unstable or the stream has been downcutting, erosion is often accelerated and streams can be disconnected from their floodplains. The condition of streamside toeslopes will often determine whether they will be undercut by high streamflows, or deliver sediment through mass erosion.

3.1.4 Aquatic and Terrestrial Species Population Dynamics

Aquatic Population Dynamics

Aquatic species, particularly the fish species considered in this assessment, have a population structure and function that has evolved within disturbance-based ecosystems. These disturbances include things like fires, floods, drought, vegetative succession, erosion, and channel changes. These species have developed alternate response strategies, such as resident and migratory life histories. The mix of these two strategies within subpopulations varies based on the specific setting in which populations have developed. This balance between local adaptation within subpopulations and the intermixing of genetic material within a metapopulation is an example of disturbance adaptation. A metapopulation is a collection of localized populations that are generally distinct, yet are genetically interconnected through movement of individuals among populations.

Additionally, the intermixing within a metapopulation provides for refounding or rebuilding of populations that have been affected by local disturbances. The long term viability of these species is dependent on their ability to sustain these types of adaptive population dynamics.

Fish Assemblages

To integrate the species specific information on distribution and abundance, this document uses a series of fish assemblages. These groupings combine information regarding the presence and relative density of fish present within a reach into a single classification. This classification denotes the dominate species, based on relative abundance, along with the other species present. The species assemblages presented here were not generated using some type of association analysis, like the species assemblage approach in the ICBEMP, and are not intended to represent unique ecological groupings. The species assemblages are intended to display a summary of fish distribution information for the watershed.

Terrestrial

Population dynamics of terrestrial wildlife species can be explained by the net result of numerous interacting variables including habitat suitability, quality and productivity, natality rates, mortality rates (both natural and human induced), predation, inter-species competition, population densities as well as influences produced by environmental pollutants or contaminants.

The individual variable that applies the greatest relative restriction on growth or viability of a given population is called the population limiting factor.

3.1.5 Human Disturbance Processes

Timber Harvest

Timber harvest is a man-caused disturbance that varies in frequency, severity and extent. It was once considered to simulate effects of wildfire, but differs in some important respects, including general lower spatial variability, the removal of large wood, frequent soil scarification or compaction, and differences in organic carbon and nutrient cycling.

Roads

Roads have no natural equivalent as a disturbance regime. Their impacts are greatest at the time of construction, but continue throughout the existence of the road.

The initial construction disturbance may be a source for sediment into nearby streams, may constrain the stream channel where roads occupy the floodplain, or may reduce stream shading by removing trees from the streamside zone.

Roads and their ditchlines may route water and sediment to streams more rapidly and efficiently than the natural surface and subsurface hydrologic system. Roads provide a disturbed substrate that invasive annual plants and weeds can readily colonize. Roads may alter movement patterns of larger animals or act as barriers to movement of some plants and smaller animals. Roads provide convenient access for human uses. These uses may have favorable or unfavorable effects on ecological conditions.

Mining
Mining may occur as a one time or repeated disturbance that can have long lasting consequences for local landform, stream channel morphology, and streamside plant communities.

Grazing
Grazing of herbaceous and woody vegetation occurred historically from wildlife and occurs today from native animals and domestic livestock. Differences between livestock grazing and wildlife herbivory may occur because livestock and wildlife prefer different plant species, because livestock numbers may be maintained at constant levels through periods of drought or high predator numbers, and cows may spend more time in riparian habitats than native wildlife. Also, native wildlife and domestic livestock may graze plants at different seasons of the year.

Recreation
Recreational improvements and use, particularly within riparian zones, may have undesirable effects on aquatic resources. While at a much smaller scale than timber harvest and roads, trails and developed sites remove shade, compact soil and directly route sediment to streams. These actions contribute to a reduction in the quality of aquatic habitat. Trails into remote areas provide access to resources vulnerable to human uses, (i.e. fishing and hunting).

Increasing use of motorized off-road vehicles may increase maintenance needs for some trails, disturb or stress wildlife (especially in winter), and conflict with non-motorized recreationists.

3.1.6 Social Concepts

Human Population Dynamics
Human population dynamics can include a variety of factors: age distribution, population trends, migration, population life-styles and population location. An analysis of population dynamics can help in predicting future demands that are likely to be placed on natural resources.

Sense of Place
Place is how people relate to and understand an area. People's perceptions of place give that area special meaning to themselves, their community and their culture. Research shows that place attachment is passed down through generations, becoming part of peoples' heritage and culture. Place is an integral component of community life because collective definitions of socially important places help to form and maintain community bonds and priorities. People who depend on an area for their subsistence or livelihood may have a different sense of place than people who value an area for its aesthetic or spiritual properties. This assessment identifies special places within each subwatershed.

Timber Dependency
Timber dependent communities have been defined as those in which primary forest products manufacturing facilities provided 10% or more of the total employment in the community. The Science Assessment (Quigley et al. 1997) for the Columbia River Basin concluded that in the entire Columbia River Basin, 29 communities were considered timber dependent. Grangeville was considered the only timber dependent community within a reasonable distance of Slate Creek.

Wildland/Urban Interface

Wildland/ Urban interface refers to the people-wildlands interaction risks. Such risks can be thought of in two types. First, there are the risks to the ecological integrity of an area when the demands of people outstrip the capability of the ecosystem to absorb such impacts. Second, people's personal assets and the elements they value may be put at risk as human habitation near or within the wildland setting increases. An example is the risk to private property assets near or within the wildland setting by wildfire.

Recreation Opportunity Spectrum

The Recreation Opportunity Spectrum (commonly called ROS) is a framework that is used to inventory and communicate the land's recreational attributes. The size of area, distance from roads or trails, and degrees of naturalness are some attributes considered when classifying settings for recreation potential.

Examples of ROS categories found in the subbasin are:

- Rural, Roaded Modified,
- Roaded Natural,
- Semi-Primitive Motorized and Semi-Primitive Nonmotorized, and
- Primitive.

ROS allows the land manager to identify and categorize a variety of recreation areas that will appeal to people with varied desires and recreational expectations. The recreational user can then choose from a range of possible recreation settings, dependent on their individual desires, equipment and skills.

Visual Management System

The Visual Management System (VMS), Volume 2, Chapter 1 Agriculture Handbook 462, identifies measurable standards for the visual management of lands inventoried. There are five visual quality objectives (VQO) that include or fall between preservation to maximum modification. Each of these objectives describe a different degree of acceptable alteration of the natural landscape based on the importance of aesthetics. The degree of alteration is measured in terms of visual contrast with the surrounding natural landscape.

There are two additional short term visual management goals:

1) rehabilitation to upgrade landscapes where visual impacts do not meet the quality objectives for that particular area, and

2) enhancement to improve landscapes which have a potential for greater natural appearing variety.

During Forest Plan revision the Scenery Management System (SMS), will be implemented. SMS evolved from and will replace VMS as the principle model to inventory and analyze aesthetic values on National Forest lands.

While the essence of the system remains essentially intact, it differs from VMS in that; there is an increased role for the public throughout the inventory and planning process. SMS also borrows from and is integrated with the basic concepts and terminology of Ecosystem Management. Scenic Integrity Levels (SIL) are the frame of reference used to inventory naturalness of the lands being viewed and any alterations to these lands. Scenic integrity levels are somewhat comparable to Visual Quality Objectives (VQO). In either case, harsh alterations to the landscape decrease the existing scenic integrity of a natural appearing landscape, while subtle alterations do not.

A comparison of system terms may assist in the transition from VMS to SMS (see Table 3.10 below).

Table 3.10 - Comparison of Scenic Integrity Levels and Visual Quality Objectives

Scenic Integrity Level	Degree of Landscape Alteration	Visual Quality Objectives
Very High	Unaltered Landscape	Preservation
High	Appears Altered	Retention
Moderate	Slightly Altered	Partial Retention

Low	Moderately Altered	Modification
Very Low	Heavily Altered	Maximum Modification
Unacceptably Low	Extremely Altered	None (not an objective)

Although seeming similar, these approaches to visual resources or scenery management are remarkably different. Visual resource management expressed in terms of VQO referred to the visibility of management activities on the land solely. This approach manages scenic resources for the public's enjoyment, but with less understanding of the biological consequences. This approach accepted nature as more or less static. While with landscape aesthetics, ecosystems provide the environmental context of scenery management and its inventory and analysis. It is not simply the appearance of National Forest land, but the array of environmental features that makes a place naturally complete. Scenic integrity levels measure the degree to which a landscape is visually perceived to be "complete." Therefore, a landscape management goal of high scenic integrity should also be one that expresses high ecosystem integrity.

Columbia River Basin Assessment Socioeconomic Indicators

Economic resiliency ratings were determined by measuring the diversity in the employment sector of an area. High economic resiliency equates to areas where people have ready access to a range of alternative employment opportunities if specific firms or business sectors experience downturns. The high economic resiliency areas are usually associated with areas having larger populations. The economic resiliency rating for Idaho County is moderate.

Social resiliency ratings were measured using 4 factors: civic infrastructure (i.e. leadership and preparedness for change), economic diversity, social and cultural diversity (i.e. population size and mix of skills) and amenity infrastructure. The social resiliency rating for Idaho County is moderate.

Socioeconomic resiliency is a composite rating which combines 3 factors: population density, economic resiliency and life-style diversity. This rating provides a relative measure of how vulnerable an area is to change. It is important to note that socioeconomic resiliency has no correlation to economic or social well being. Indeed, some of the highest per capita income levels occur in areas with low ratings. The socioeconomic resiliency rating for Idaho County is low.

ICBEMP has released a report which examines the economic and social conditions of 543 communities in the Upper Columbia River Basin (Economic and Social Conditions of Communities, USDA Forest Service, 1998). The analysis looked at geographic isolation, community specialization in different industries, and association with Forest Service and BLM-administered lands.

This study concludes that isolated towns, like Riggins, White Bird, and Grangeville, are different from non-isolated towns, in that a higher percentage of their population may be more specialized in agriculture, wood products, mining, or Federal Government. The study also found that isolated towns have a high percent of USFS or BLM lands within a 20 mile radius. Grangeville is considered an isolated trade center, with additional specialization in State and local government, services, finance, insurance, construction, and real estate. Forest Service offices like those in Slate Creek, Fenn, Elk City and Grangeville contribute tangible economic and social benefits, through jobs, buildings, utilities, and community support. Specialization in recreation may be as important as any of these industries, but little income or employment data are available to examine this relationship.