This document is part of a collection of [Ecological Integrity Assessments] addressing 67 of Washington's 99 [Ecological Systems]. These documents were prepared by the Washington Natural Heritage Program with funding provided by the Washington Department of Fish and Wildlife.

Ecological Integrity Assessment: Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland

Ecological Summary

The Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland ecological system occurs at lower montane to foothill elevations in the mountains and large valleys of northeastern Wyoming and western Montana, west through Idaho into the Blue Mountains of Oregon, and north into the Okanagan and Fraser plateaus of British Columbia and the Canadian Rockies. In Washington, this ecological system occurs at elevations from 1500-5500 ft (500 to 1650 m), ranging from small meadows to open parks surrounded by conifers within lower montane forests in the mountains surrounding the Columbia Basin and as foothill and valley grasslands below the lower tree line. The system lies above the Intermountain Basins Big Sagebrush Steppe and below or within Northern Rocky Mountain Ponderosa Pine and Northern Rocky Mountain Dry-Mesic Forest ecological systems. It can be confused with the higher elevation Columbia Basin Canyon Dry Grasslands, remnants of the Columbia Basin Palouse Prairie, Intermountain Basins Montane Big Sagebrush Steppe, and the Northern Rocky Mountain Subalpine-Upper Montane Grassland systems.

In Washington, this system typically receives 20-30 inches (50 -75 cm) annual precipitation much as snow and spring rains. Soils are relatively deep to shallow, often with coarse fragments, and non-saline. Soils dry by mid-summer and limit tree and shrub invasion. Unvegetated mineral soil is commonly found between clumps of grass and occasionally a moss/lichen cover particularly on rocky sites. Steep slopes, shallow skeletal soils, and sites with heavy native ungulate use that reduce foliar and litter cover have more exposed soil and apparently support more soil moss/lichens (Johnson and Swanson 2005). Greater crust cover occurs on north- and east-facing slopes at mid elevations with stable, silt-loam or calcareous soils where not disturbed (Tyler 2006) or where vascular cover and litter are not limiting soil moss/lichens.

The most important species are cool-season, perennial bunchgrasses and forbs (>25% cover), sometimes with a sparse (<10% cover) shrub layer. Mid-tall bunchgrasses, such as *Pseudoroegneria spicata, Festuca campestris, Festuca idahoensis* or *Koeleria macrantha,* commonly dominate sites on level to moderate slopes and on steep slopes not associated with canyons. *Danthonia unispicata* and *Poa secunda* are important shorter bunchgrasses. Other possible graminoids include *Achnatherum occidentale (= Stipa* *occidentalis), Achnatherum richardsonii, Bromus inermis, Calamagrostis rubescens, Carex geyeri, Carex pensylvanica, Elymus trachycaulus, Festuca washingtonica, Hesperostipa comata*, *Hesperostipa curtiseta, Leymus cinereus,* and *Pascopyrum smithii*. Other grassland species include *Artemisia frigida,* and *Selaginella densa*. Shrub species may be scattered, including *Eriogonum heracleoides, Amelanchier alnifolia, Rosa* spp., *Symphoricarpos* spp., *Juniperus communis, Artemisia tridentata*, and *Artemisia tripartita*. Common associated forbs include *Geum triflorum, Galium boreale, Campanula rotundifolia, Antennaria* spp*., Geranium viscosissimum*, and *Potentilla gracilis*.

A high-frequency fire regime (presumed to be less than 35 years, (Johnson and Swanson 2005), along with soil drought and herbivory, retards shrub and tree invasion resulting in a patchy distribution of shrubs and trees when present. The most droughty sites produce little and discontinuous fuel and likely have much longer fire regimes. Isolation of grassland patches by fragmentation may also limit seed dispersal of native shrubs leading to persistence of the grassland. Elk, deer and bighorn sheep are native large grazers in the canyon who used particularly in spring.

Stressors

The stressors described below are those primarily associated with the loss of extent and degradation of the ecological integrity of existing occurrences. The stressors are the cause of the system shifting away from its natural range of variability. In other words, type, intensity, and duration of these stressors is what moves a system's ecological integrity rank away from the expected, natural condition (e.g. A rank) toward degraded integrity ranks (i.e. B, C, or D).

The primary land uses that alter the natural processes of the Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland system are associated with livestock practices, exotic species, fire regime alteration, direct soil surface disturbance, and fragmentation. Excessive grazing stresses the system through soil disturbance increasing the probability of establishment of native disturbance increasers and annual grasses, particularly exotic annual bromes (*Bromus commutatus*, *japonicus*, *mollis*, *tectorum*) and *Ventenata dubia*) on more xeric sites and exotic perennial grasses *Bromus inermis*, *Phleum pratense,* and *Poa pratensis* on more mesic sites. Other exotic species threatening this ecological system through invasion and potential complete replacement of native species include *Hypericum perfoliatum, Potentilla recta, Euphorbia esula*, and knapweeds, especially *Centaurea biebersteinii (= Centaurea maculosa)*. Persistent grazing will further diminish native perennial cover, expose bare ground, and increase exotics (Johnson and Swanson 2005). Darambazar (2007) cites Johnston (1962) that when bare ground is approximately 15%, reduced infiltration and increased runoff occurs in *Festuca* grassland ecosystems. Fire further stresses livestock altered vegetation by increasing exposure of bare ground and consequent increases in exotic annuals and decrease in perennial bunchgrass. Grazing effects are usually concentrated in less steep slopes although grazing does create contour trail networks that can lead to addition slope failures. Fire suppression leads to deciduous shrubs, *Symphoricarpos* spp., *Physocarpus* *malvaceus, Holodiscus discolor*, and *Ribes* spp. and in some areas trees (*Pseudotsuga menziesii*) to increase.

Davies and others (2009) conclude that sites with heavy litter accumulation, (e.g., an ungrazed *Artemisia tridentata* ssp. *wyomingensis/Festuca idahoensis – Achnatherium thurberiana* community) are more susceptible to exotic annual invasion following fire than those with less litter accumulation. They note that introduced species and changes in climate can change ecosystem response to natural disturbance regimes. Johnson and Swanson (2005) note that *Festuca idahoensis* decreases following fire but following a flush of annuals sites regain pre-fire cover of *Festuca* after a few years.

Conceptual Ecological Model

The general relationships among the key ecological attributes associated with natural range of variability of the Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland Ecological System are presented in Figure 1.

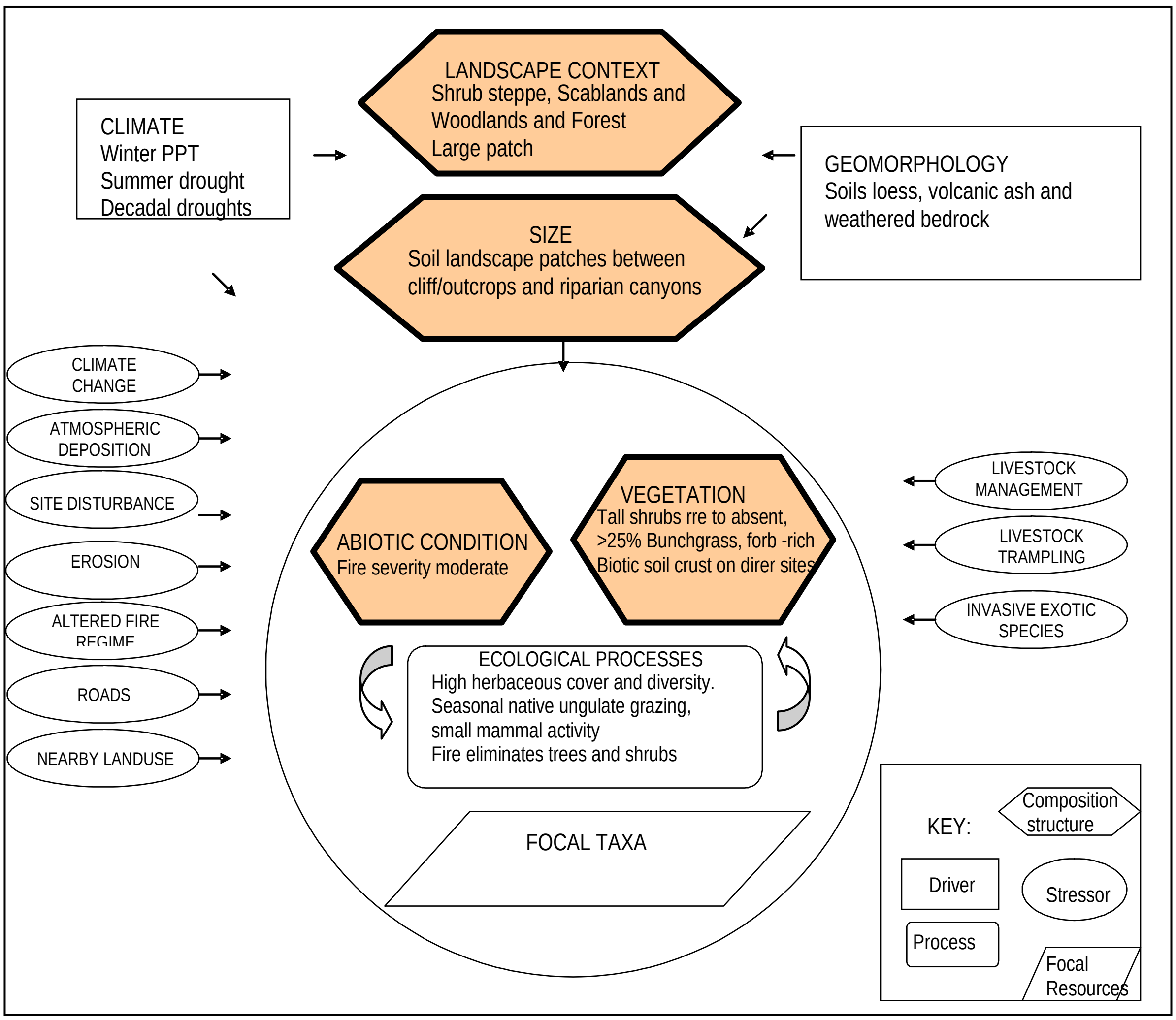

Figure 1. Conceptual Ecological Model for the Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland Ecological System.

Ecological Integrity Assessments

The assessment of ecological integrity can be done at three levels of intensity depending on the purpose and design of the data collection effort. The three-level approach is intended to provide increasing accuracy of ecological integrity assessment, recognizing that not all conservation and management decisions need equal levels of accuracy. The three-level approach also allows users to choose their assessment based in part on the level of classification that is available or targeted. If classification is limited to the level of forests vs. wetlands vs. grasslands, the use of remote sensing metrics may be sufficient. If very specific, fine-scale forest, wetland, and grassland types are the classification target then one has the flexibility to decide to use any of the three levels, depending on the need of the assessment. In other words, there is no presumption that a fine-level of classification requires a fine-level of ecological integrity assessment.

Because the purpose is the same for all three levels of assessment (to measure the status of ecological integrity of a site) it is important that the Level 1 assessment use the same kinds of metrics and major attributes as used at Levels 2 and 3. Level 1 assessments rely almost entirely on Geographic Information Systems (GIS) and remote sensing data to obtain information about landscape integrity and the distribution and abundance of ecological types in the landscape or watershed. Level 2 assessments use relatively rapid field-based metrics that are a combination of qualitative and narrative-based rating with quantitative or semi-quantitative ratings. Field observations are required for many metrics, and observations will typically require professional expertise and judgment. Level 3 assessments require more rigorous, intensive field-based methods and metrics that provide higher-resolution information on the integrity of occurrences. They often use quantitative, plot-based protocols coupled with a sampling design to provide data for detailed metrics.

Although the three levels can be integrated into a monitoring framework, each level is developed as a stand-alone method for assessing ecological integrity. **When conducting an ecological integrity assessment, one need only complete a single level that is appropriate to the study at hand.** Typically only one level may be needed, desirable, or cost effective. But for this reason it is very important that each level provide a comparable approach to assessing integrity, else the ratings and ranks will not achieve comparable information if multiple levels are used.

Level 1 EIA

A generalized Level 1 EIA is provided in Rocchio and Crawford (2009). Please refer to that document for the list of metrics applicable to this ecological system.

Level 2 EIA

The following tables display the metrics chosen to measure most of the key ecological attributes in the conceptual ecological model above. The EIA is used to assess the ecological condition of an assessment area, which may be the same as the element occurrence or a subset of that occurrence based on abrupt changes in condition or on artificial boundaries such as management areas. **Unless otherwise noted, metric ratings apply to both Level 2 and Level 3 EIAs. The difference between the two is that a Level 3 EIA will use more intensive and precise methods to determine metric ratings.** To calculate ranks, each metric is ranked in the field according the ranking categories listed below. Then, the rank and point total for each metric is entered into the EIA Scorecard and multiplied by the weight factor associated with each metric resulting in a metric 'score'. Metric scores within a key ecological attribute are then summed to arrive at a score (or rank). These are then tallied in the same way to arrive at an overall ecological integrity score.

Table 1. Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland Ecological Integrity Assessment Scorecard

Metric	**Justification**	**Rank**			
		A (5 pts.)	**B (4 pts.)**	**C (3 pts.)**	**D (1 pts.)**
Rank Factor: LANDSCAPE CONTEXT					
Key Ecological Attribute: *Edge Effects*					
Edge Length	The intactness of the edge can be important to biotic and abiotic aspects of the site.	75 – 100% of edge is bordered by natural communities	50 – 74% of edge is bordered by natural communities	25 – 49% of edge is bordered by natural communities	< 25% of edge is bordered by natural communities
Edge Width		Average width of edge is at least 100 m.	Average width of edge is at least 75-100 m.	Average width of edge is at least 25-75 m.	Average width of edge is at least <25 m.
Edge Condition		>95% cover native vegetation, <5% cover of non-native plants, intact soils	75–95% cover of native vegetation, 5–25% cover of non-native plants, intact or moderately disrupted soils	25–50% cover of non-native plants, moderate or extensive soil disruption	>50% cover of non-native plants, barren ground, highly compacted or otherwise disrupted soils
Key Ecological Attribute: *Landscape Structure*					
Connectivity	Intact areas have a continuous corridor of natural or semi-natural vegetation	Intact: Embedded in 90-100% natural habitat; connectivity is expected to be high.	Variegated: Embedded in 60-90% natural or semi-habitat; habitat connectivity is generally high, but lower for species sensitive to habitat modification;	Fragmented: Embedded in 20-60% natural or semi-natural habitat; connectivity is generally low, but varies with mobility of species and arrangement on landscape.	Relictual: Embedded in < 20% natural or semi-natural habitat; connectivity is essentially absent

Landscape Condition Model Index	The intensity and types of land uses in the surrounding landscape can affect ecological integrity.	Landscape Condition Model Index > 0.8		Landscape Condition Model Index 0.79 – 0.65	Landscape Condition Model Index < 0.65
Rank Factor: CONDITION					
Key Ecological Attribute: *Vegetation Composition*					
Relative Cover Native Plant Species	Native species dominate this system; non-natives increase with human impacts.	Cover of native plants = relative 95-100%.	Cover of native plants relative 80-95%.	Cover of native plants relative 50 to 79%.	Cover of native plants < relative 50%.
Relative Native Bunchgrass Cover	Native bunchgrass dominate; high cover is related to community resistance to invasion	Perennial bunchgrasses 80% relative cover and near site potential.	Perennial bunchgrasses 50-80% relative cover and reduced from site potential.	Perennial bunchgrasses 30-50% relative cover and reduced from site potential.	Perennial bunchgrass <30% relative cover and much reduced from site potential.
Absolute Cover of Invasive Species	Invasive species can inflict a wide range of ecological impacts. Early detection is critical. *Bromus tectorum* abundance is critical.	None present.	Invasive species present, but sporadic (<3% cover).	Invasive species prevalent (3–10% absolute cover).	Invasive species abundant (>10% absolute cover).
Relative Cover of Native Increasers	Some stressors such as grazing can shift or homogenize native composition toward species tolerant of stressors.	Absent or incidental	<10% cover	10-20% cover	>20% cover
Species Composition Note: Once developed, the Floristic Quality Assessment index could used here instead.	The overall composition of native species can shift when exposed to stressors.	Species diversity/abundance at or near reference standard conditions. Native species sensitive to anthropogenic degradation are present, functional groups indicative of anthropogenic disturbance (ruderal or "weedy" species) are absent to minor, and full range of diagnostic / indicator species are present.	Species diversity/abundance close to reference standard condition. Some native species reflective of past anthropogenic degradation present. Some indicator/ diagnostic species may be absent.	Species diversity/abundance is different from reference standard condition in, but still largely composed of native species characteristic of the type. This may include ruderal ("weedy") species. Many indicator/diagnostic species may be absent.	Vegetation severely altered from reference standard. Expected strata are absent or dominated by ruderal ("weedy") species, or comprised of planted stands of non-characteristic species, or unnaturally dominated by a single species. Most or all indicator/diagnostic species are absent.
Key Ecological Attribute: *Vegetation Structure*					

Biological Soil Crust	Crust cover and diversity is greatest where not impacted by trampling, other soil surface disturbance and fragmentation (Tyler 2006; Belnap et al. 2001)	Largely intact biological soil crust that nearly matches the site capability where natural site characteristics are **not** limiting, i.e. steep unstable, south aspect, dense native grass	Biological soil crust is evident throughout the site but its continuity is broken	Biological soil crust is present in protected areas and with a minor component elsewhere	Biological soil crust, if present , is found only in protected areas and there is a very limited suite of morphological groups
Key Ecological Attribute: *Physicochemical*					
Soil Surface Condition	Soil disturbance can result in erosion thereby negatively affecting many ecological processes; the amount of bareground varies naturally with site type.	Bare soil areas are limited to naturally caused disturbances such as burrowing or game trails	Some bare soil due to human causes but the extent and impact is minimal. The depth of disturbance is limited to only a few inches	Bare soil areas due to human causes are common. There may be disturbance/compaction to several inches. ORVs or other machinery may have left some shallow ruts.	Bare soil areas substantially & contribute to long-lasting impacts. Deep ruts from ORVs or machinery may be present, or livestock and/or trails are widespread.
Rank Factor: SIZE					
Key Ecological Attribute: *Size*					
Relative Size	Indicates the proportion lost due to stressors.	Site is at or minimally reduced from natural extent (>95% remains)	Occurrence is only modestly reduced from its original natural extent (80-95% remains)	Occurrence is substantially reduced from its original natural extent (50-80% remains)	Occurrence is severely reduced from its original natural extent (<50% remains)
Absolute Size	Absolute size based on steppe obligate grasshopper sparrow conservation size (B.C. 2004)	Over 1000 ha (2500 ac)	500-1000 ha (1250-<2500 ac)	10 –500 ha (25 -1250 ac)	Less than 10 ha (25 ac)

Level 3 EIA

Level 3 metrics would include more quantitative measures of the metrics listed above. In addition, further consideration might be given to:

- Quantitative measurements of range health indicators (Pellant and others 2005)
- Biological Soil Crust Stability Index (Rosentreter and Eldridge 2002)
- Microphytic species composition and abundance (Eldridge and Rosentreter 1999).

4.?.5 Triggers or Management Assessment Points

Ecological triggers or conditions under which management activities need to be reassessed are shown in the table below. Since the Ecological Integrity rankings are based on hypothesized thresholds, they are used to indicate where triggers might occur. Specific details about how these triggers translate for each metric can be found by referencing the values or descriptions for the appropriate rank provided in the Table above.

Table 2. Triggers for Level 2 & 3 EIA

Key Ecological Attribute or Metric	Trigger	Action
Any metric (except Connectivity)	▪ C rank ▪ Shift from A to B rank ▪ negative trend within the B rating (Level 3)	Level 2 triggers: conduct Level 3 assessment; make appropriate short-term management changes to ensure no further degradation Level 3 triggers: make appropriate management adjustments to ensure no additional degradation occurs. Continue monitoring using Level 3.
Any Key Ecological Attribute	▪ any metric has a C rank ▪ > ½ of all metrics are ranked B ▪ negative trend within the B rating (Level 3)	Level 2 triggers: conduct Level 3 assessment; make appropriate short-term management changes to ensure no further degradation Level 3 triggers: make appropriate management adjustments to ensure no additional degradation occurs. Continue monitoring using Level 3.

Protocol for Integrating Metric Ranks

If desired, the user may wish to integrate the ratings of the individual metrics and produce an overall score for the three rank factor categories: (1) Landscape Context; (2) Condition; and (3) Size. These rank factor rankings can then be combined into an Overall Ecological Integrity Rank. This enables one to report scores or ranks from the various hierarchical scales of the assessment depending on which best meets the user's objectives. Please see Table 5 in Rocchio and Crawford (2009) for specifics about the protocol for integrating or 'rolling-up' metric ratings.

Supporting documents for the EIAs can be found at:
http://www1.dnr.wa.gov/nhp/refdesk/communities/eia.html

Documentation about Ecological Systems can be found at:
http://www1.dnr.wa.gov/nhp/refdesk/communities/ecol_systems.html

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