USDA Natural Resources Conservation Service

Ecological site EX044B01B060
Overflow (Ov) LRU 01 Subset B

Last updated: 9/08/2023
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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 044B–Central Rocky Mountain Valleys

Major Land Resource Area (MLRA) 44B, Central Rocky Mountain Valleys, is nearly 3.7 million acres of southwest Montana. This MLRA borders two other MLRAs: 43B, Central Rocky Mountains and Foothills, and 46, Northern and Central Rocky Mountain Foothills.
The major watersheds of this MLRA are the Missouri and Yellowstone Rivers and their associated headwaters, such as the Beaverhead, Big Hole, Jefferson, Ruby, Madison, Gallatin, and Shields Rivers. Limited portions of the MLRA are west of the Continental Divide along the Clark Fork River. These waters allow for extensive irrigation for crop production in an area that is generally only compatible with rangeland and grazing. The Missouri River and its headwaters are behind several reservoirs used for irrigation water, hydroelectric power, and municipal water.

The primary land use of this MLRA is production agriculture (grazing, small grain production, and hay) with limited mining. Urban development is high, with large expanses of rangeland being converted to subdivisions for a rapidly growing population.

MLRA 44B consists of one Land Resource Unit (LRU) and 7 Climate-based LRU subsets. Annual precipitation ranges from a low of 9 inches to a high of near 24 inches. The driest areas tend to be in the valley bottoms of southwest Montana, in the rain shadow of the mountains. The wettest portions tend to be near the edges of the MLRA, where it borders MLRA 43B. Frost-free periods also vary greatly, with less than 30 days in the Big Hole Valley to approximately 110 days in the warm valleys along the Yellowstone and Missouri Rivers.
MLRA 44B's plant communities are highly variable but are dominated by a cool-season grass and shrub-steppe community on the rangeland and a mixed coniferous forest in the mountains. Warm-season grasses occupy an extremely limited extent and number of species in this MLRA. Most subspecies of big sagebrush are present, to some extent, across the MLRA.

LRU notes

LRU 01 Climatic Subset B Central Concept:
• Moisture Regime: Ustic
• Temperature Regime: Frigid
• Dominant Cover: rangeland (mixed grassland and sagebrush steppe)
• Representative Value (RV) of range of Effective Precipitation: 15-19 inches
• Representative Value (RV) of range of Frost Free Days: 90-110 days

Climate Subset B exists in primarily in the Madison, Gallatin, Meagher, and Park Counties.

Classification relationships

Mueggler and Stewart. 1980. Grassland and Shrubland habitat types of Western Montana
1. Stipa comata/Bouteloua gracilis h.t.

2. Agropyron spicatum/Bouteloua gracilis h.t.
3. Festuca scabrella/Agropyron spicatum h.t.
4. *Artemisia tridentata*/Festuca scabrella h.t.

EPA Ecoregions of Montana, Second Edition:
Level I: Northwestern Forested Mountains
Level II: Western Cordillera
Level III: Middle Rockies & Northern Great Plains
Level IV: Paradise Valley
Townsend Basin
Dry Intermontane Sagebrush Valleys

Level I: Great Plains
Level II: West-Central Semi-Arid Prairies
Level III: Northwestern Great Plains
Level IV: Shield-Smith Valleys
Non-calcareous Foothill Grassland

Ecological site concept

• Site receives additional effective offsite water however additional moisture is not associated with a water table
• Soils are
o Generally not saline or saline-sodic
o Moderately deep, deep, or very deep
o Typically less than 5 percent stone and boulder cover (15 percent maximum)
o Soil surface texture ranges from loam to clay loam in surface mineral 4 inches.
• Parent material is alluvium

Associated sites

EX044B01B032	**Loamy (Lo) LRU 01 Subset B** The Loamy ecological site is often a neighboring site with similar plant community.

Similar sites

EX044B01B032	**Loamy (Lo) LRU 01 Subset B** The Loamy ecological site is often a neighboring site with similar plant community. The Loamy site does not receive additional moisture so production is often lower with drier plant species most common.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata* (2) *Symphoricarpos albus*
Herbaceous	(1) *Leymus cinereus* (2) *Festuca campestris*

Legacy ID

R044BB060MT

Physiographic features

This ecological site occurs mostly in narrow, ephemeral drainage ways, swales, and floodplains. This location on the landscape allows for the site to receive additional moisture in the form of runoff from adjacent sites as a result of a precipitation event and not as a result of a water table. Slopes are typically gentle and rarely exceed 15 percent. Landform shape is either concave (across the slope) and linear (downslope) or a combination of both concave slope shapes (swale).

Table 2. Representative physiographic features

Slope shape across	(1) Concave
Slope shape up-down	(1) Linear (2) Concave
Landforms	(1) Intermontane basin > Flood plain (2) Intermontane basin > Drainageway (3) Intermontane basin > Swale
Flooding duration	Extremely brief (0.1 to 4 hours) to brief (2 to 7 days)
Elevation	4,500–6,000 ft
Slope	1–15%
Water table depth	40 in
Aspect	Aspect is not a significant factor

Climatic features

The Central Rocky Mountain Valleys MLRA has a continental climate. 50 to 60 percent of the annual long-term average total precipitation falls between May and August. Most of the precipitation in the winter is snow on frozen ground. Average precipitation for LRU 01 Subset B is 17 inches, and the frost-free period averages 100 days. Precipitation is highest in May and June.

See Climatic Data Sheet for more details (Section II of the Field Office Technical Guide: http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=MT) or reference the following climatic web site: http://www.wrcc.dri.edu/climsum.html

Table 3. Representative climatic features

Frost-free period (characteristic range)	64-78 days
Freeze-free period (characteristic range)	107-114 days
Precipitation total (characteristic range)	14-16 in
Frost-free period (actual range)	58-79 days
Freeze-free period (actual range)	105-116 days
Precipitation total (actual range)	13-16 in
Frost-free period (average)	70 days
Freeze-free period (average)	110 days
Precipitation total (average)	15 in

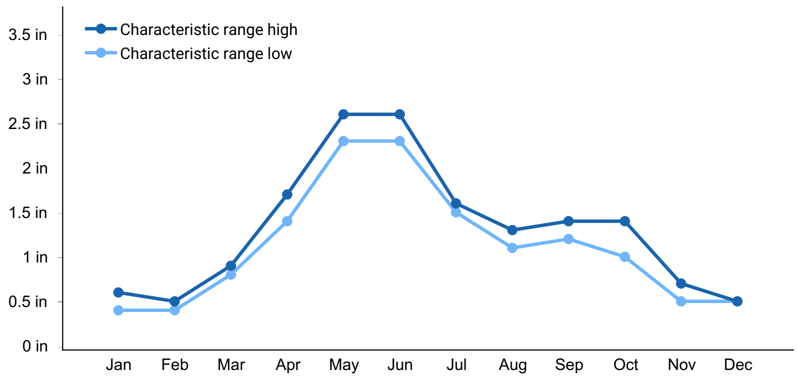


Figure 1. Monthly precipitation range

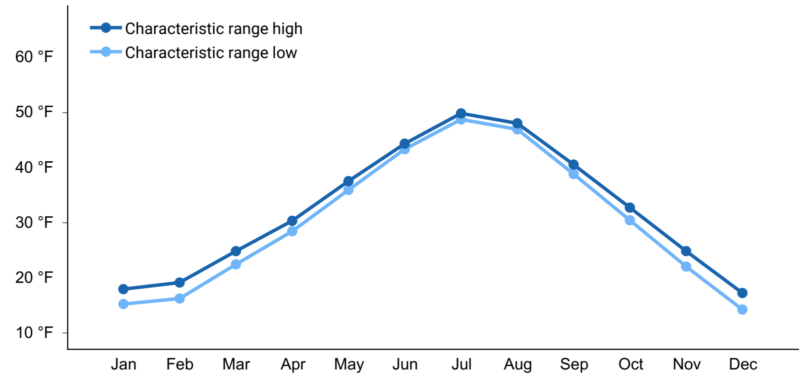


Figure 2. Monthly minimum temperature range

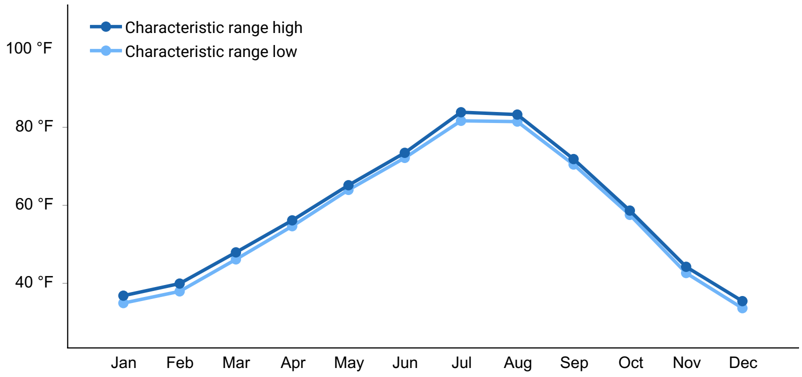


Figure 3. Monthly maximum temperature range

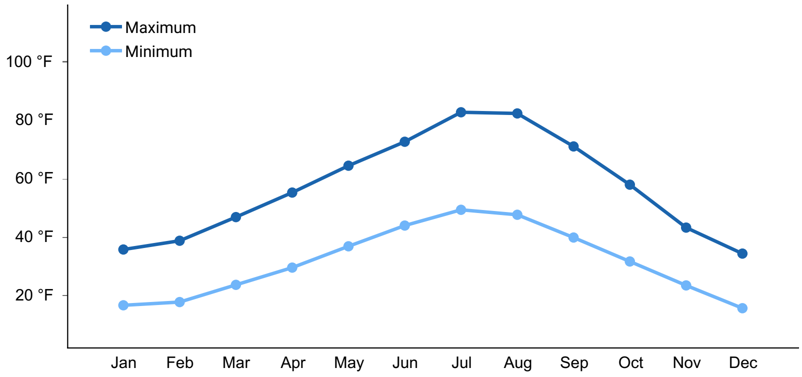


Figure 4. Monthly average minimum and maximum temperature

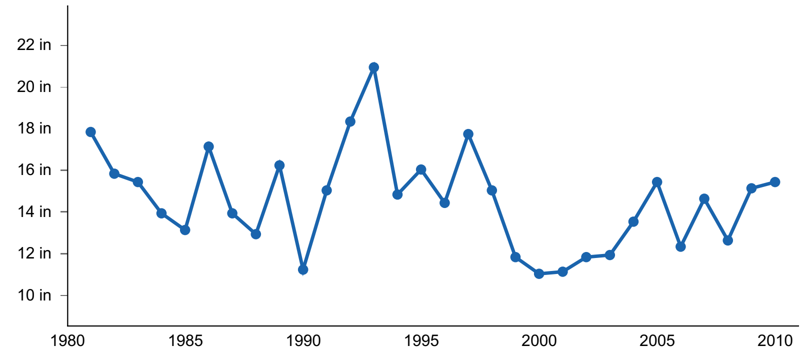


Figure 5. Annual precipitation pattern

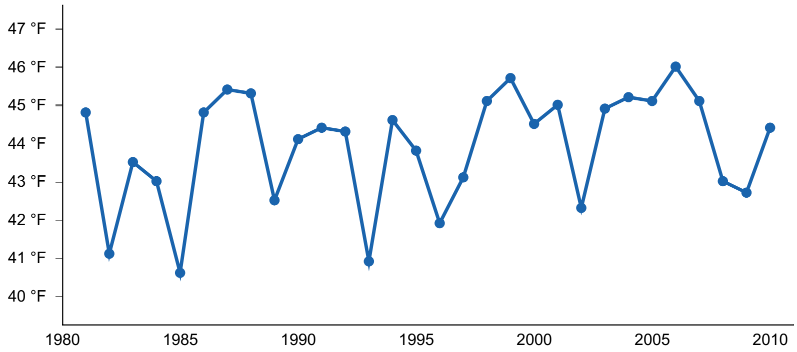


Figure 6. Annual average temperature pattern

Climate stations used

- (1) WHITE SULPHUR SPRNGS 2 [USC00248930], White Sulphur Springs, MT
- (2) LIVINGSTON 12 S [USC00245080], Livingston, MT
- (3) LIVINGSTON MISSION FLD [USW00024150], Livingston, MT

Influencing water features

The site exists in ephemeral drainageways and swales where additional water is received in response to precipitation events. Surface and subsurface water flow off neighboring areas. The site may have a water table greater than 40 inches deep and, if present, is very seasonal in nature.

Wetland description

This site receives additional soil moisture; however, this is extremely brief. This briefness does not allow for hydric soils or hydrophytic plants to be expressed. Both surface and subsurface water may flow beyond this ecological site into neighboring wetland sites.

Soil features

The soils associated with this ecological site are moderately deep to very deep with moderate permeability. The parent material is alluvium. These soils are non-hydric. Typical soil surface textures are variable with loam or clay loam surface textures. The common soils series in this ecological site includes Work and Pachel. These soils may exist across multiple ecological sites due to natural variations in slope, texture, rock fragments, and pH.

Table 4. Representative soil features

Parent material	(1) Alluvium–igneous, metamorphic and sedimentary rock
Surface texture	(1) Loam (2) Clay loam
Family particle size	(1) Fine (2) Fine-loamy
Drainage class	Well drained
Permeability class	Moderate to moderately slow
Depth to restrictive layer	20–100 in
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–3%
Available water capacity (0-40in)	5.5–7.1 in
Soil reaction (1:1 water) (0-40in)	7.8–8.4

Subsurface fragment volume <=3" (10-20in)	0–10%
Subsurface fragment volume >3" (10-20in)	0–3%

Ecological dynamics

The reference plant community is dominated by basin wildrye (*Leymus cinereus*), rough fescue (*Festuca campestris*), bluebunch wheatgrass (*Pseudoroegneria spicata*), green needlegrass (*Nassella viridula*), western wheatgrass (*Pascopyrum smithii*), and thickspike wheatgrass (*Elymus lanceolatus*). Subdominant species may include big sagebrush (*Artemisia tridentata*), slender wheatgrass (*Elymus trachycaulus*), snowberry (*Symphoricarpos albus*), and rose (*Rosa woodsii*). This potential is suggested by investigations showing a predominance of perennial grasses on near-pristine range sites (Ross et al., 1973). Natural variability within the reference state can be high with long-term seasonal dry cycles, promoting a plant community similar to the Loamy ecological site, while wet cycles promote a more productive basin wildrye and green needlegrass dominated system.

As the community changes away from reference, rhizomatous grasses tend to increase. If allowed to continue, non-native sod-forming grasses such as Kentucky bluegrass (*Poa pratensis*) and quackgrass (*Elymus repens*) tend to take over the site. These species are extremely competitive and are difficult to control once established. Throughout this time, bare ground tends to be relatively low; in fact, a sodbound site may actually have less bare ground than the reference. However, due to the short-rooted nature of the sod-forming grasses, headcutting and gully erosion can occur.

Historical records indicate that, prior to the introduction of livestock (cattle and sheep) during the late 1800s, elk and bison grazed this ecological site. Due to the nomadic nature and herd structure of bison, areas that were grazed received periodic, high-intensity, short-duration grazing pressure. The gold boom in the 1860s brought the first herds of livestock overland from Texas, and homesteaders began settling the area. During this time, cattle were the primary domestic grazers in the area. In the 1890s, Montana sheep production began to increase and dominated the livestock industry until the 1930s. Since the 1930s, cattle production has dominated the livestock industry in the region (Wyckoff and Hansen 2001).

Natural fire was a major ecological driver of this entire ecological site. Fire tended to prevent tree and shrub growth in large areas and restrict it to small patches, which promoted an herbaceous plant community. The natural fire return interval was, however, likely shorter than 35 years (Arno and Gruell 1983).

Some of the major invasive species that can occur on this site include (but are not limited to) spotted knapweed (*Centaurea stoebe*), leafy spurge (*Euphorbia esula*), sulphur cinquefoil (*Potentilla recta*), Canada thistle (*Cirsium arvense*), dandelion (Taraxicum spp.), quackgrass (Elymus repends), and Kentucky bluegrass (*Poa pratensis*). Cheatgrass (Bromus techtorum), however, has become a dominant invasive species in recent years.

Plant Communities and Transitions
A state and transition model (STM) for this ecological site is depicted below. Thorough descriptions of each state, transition, plant community, and pathway follow the model. This model is based on available experimental research, field data, field observations, and interpretations by experts. It is likely to change as knowledge increases.

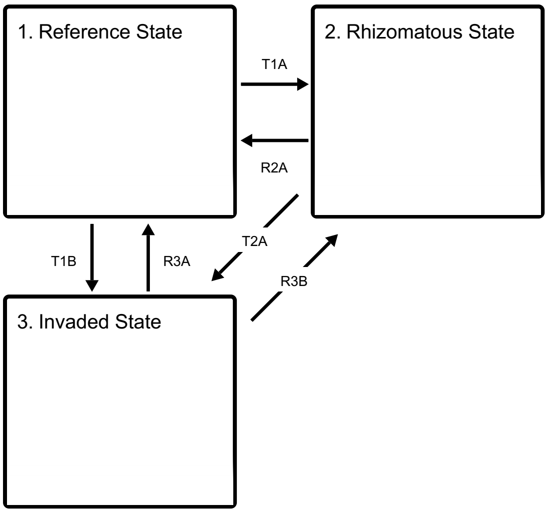
The plant communities within the same ecological site will differ across the MLRA due to the naturally occurring variability in weather, soils, and aspect. The biological processes on this site are complex; therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are intended to cover the core species and known range of conditions and responses.

Both percent species composition by weight and percent canopy cover are referenced in this document. Canopy cover drives the transitions between communities and states because of the influence of shade, the interception of rainfall, and the competition for available water. Species composition by dry weight remains an important descriptor of the herbaceous community and of the community as a whole. Woody species are included in the species composition for the site. Calculating the similarity index requires species composition by dry weight.

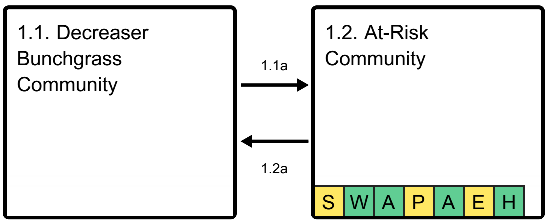
Although there is considerable qualitative experience supporting the pathways and transitions within the state and transition model (STM), no quantitative information exists that specifically identifies threshold parameters between grassland types and invaded types in this ecological site. For information on STMs, see the following citations: Bestelmeyer et al. (2003), Bestelmeyer et al. (2004), Bestelmeyer and Brown (2005), and Stringham et al. (2003).

State and transition model

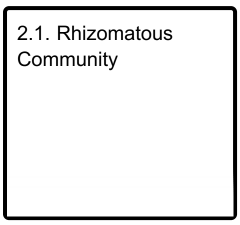
Ecosystem states



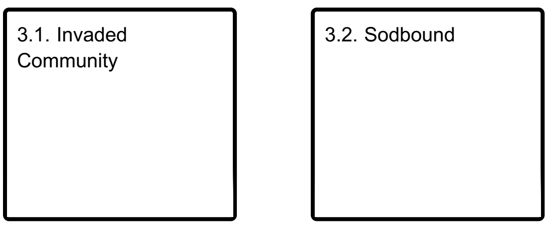
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference State

The Reference State of this ecological site consists of two (2) potential plant communities: the Decreaser Bunchgrass Community and the At Risk Community. These are described below but are generally characterized by a mid-statured, cool-season grass community with limited shrub production. Community 1.1 is dominated by basin wildrye, rough fescue, and green needlegrass and is considered the reference, while Community 1.2 has a codominance of decreaser and increaser bunchgrasses with an increase in big sagebrush. These communities may meld into each other due to the varying conditions that occur in Southwest Montana, particularly during dry cycles.

Community 1.1
Decreaser Bunchgrass Community

In the Decreaser Bunchgrass Community, tall and mid-statured bunchgrasses dominate. Basin wildrye, rough fescue, and green needlegrass are dominant under the core concept in this climate subset. On the driest of overflow sites, bluebunch wheatgrass is present as a codominant species but is often reduced to a subdominant species as moisture is increased. Nebraska sedge and Baltic rush are minor components of the reference state in areas with higher precipitation or that receive more additional moisture within this LRU. Big sagebrush (basin and Wyoming subspecies) as well as snowberry (*Symphoricarpos albus*) are the dominant shrubs. Minor components of wild rose (*Rosa woodsii*), silver buffaloberry (Sheperdia argentea), and shrubby cinquefoil (*Dasiphora fruticosa*) may exist. Sagebrush may not exist in areas that have short-term flooding and/or ponding. In this situation, silver buffaloberry or shrubby cinquefoil tend to replace big sagebrush.

Dominant plant species

- common snowberry (*Symphoricarpos albus*), shrub
- shrubby cinquefoil (*Dasiphora fruticosa*), shrub
- Woods' rose (*Rosa woodsii*), shrub
- big sagebrush (*Artemisia tridentata*), shrub
- basin wildrye (*Leymus cinereus*), grass
- rough fescue (*Festuca campestris*), grass
- green needlegrass (*Nassella viridula*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- mountain goldenbanner (*Thermopsis montana*), other herbaceous
- lupine (*Lupinus*), other herbaceous
- goldenrod (*Solidago*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- old man's whiskers (*Geum triflorum*), other herbaceous

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1870	2500	2750
Shrub/Vine	175	230	260
Forb	160	200	225
Total	**2205**	**2930**	**3235**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	5-15%
Grass/grasslike foliar cover	70-80%
Forb foliar cover	5-10%
Non-vascular plants	0-3%
Biological crusts	1-5%
Litter	50-70%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	0-1%

Table 7. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	1-5%
Grass/grasslike basal cover	15-25%
Forb basal cover	3-5%
Non-vascular plants	0-1%
Biological crusts	1-5%
Litter	50-70%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	0-1%

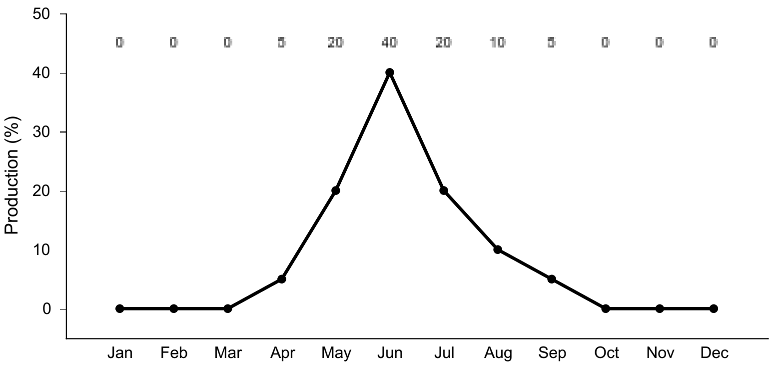


Figure 8. Plant community growth curve (percent production by month). MT0815, Cool & warm season grasses on overflow areas. Includes all overflow sites dominated by cool season grass with warm season grasses also present..

Community 1.2
At-Risk Community

The At Risk Community is defined by a plant community formed primarily of a codominance of midstatured bunchgrasses and rhizomatous grasses with an increase in forbs and shrubs. This is typically a result of non-prescribed grazing removing most of the basin wildrye and green needlegrass. In fact, green needlegrass may be absent from this community or be at such a low density that it no longer contributes to the structural integrity of the community. Western yarrow sees the greatest increase of the forbs. This community is extremely susceptible to invasive non-native species due to an increase in bare ground expected due to a reduction of basal area occupied by the larger bunchgrasses. In this community, Kentucky bluegrass possibly exists in a trace amount, which poses a risk to the hydrologic function, biotic integrity, and site stability due to its shallow root structure and ability to overtake areas. Leafy spurge and Canada thistle may also easily invade this community.

Dominant plant species

- common snowberry (*Symphoricarpos albus*), shrub
- shrubby cinquefoil (*Dasiphora fruticosa*), shrub
- silver sagebrush (*Artemisia cana*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- basin wildrye (*Leymus cinereus*), grass
- green needlegrass (*Nassella viridula*), grass
- Idaho fescue (*Festuca idahoensis*), grass
- lupine (*Lupinus*), other herbaceous
- cinquefoil (*Potentilla*), other herbaceous
- mountain goldenbanner (*Thermopsis montana*), other herbaceous
- scurfpea (*Psoralidium*), other herbaceous

Pathway 1.1a
Community 1.1 to 1.2

The community pathway from the Decreaser Bunchgrass Community (1.1) to the At-Risk Community (1.2) is primarily driven by improper grazing. The Decreaser Bunchgrass Community is a desirable location for grazing animals and is susceptible to overgrazing even when balanced grazing is occurring across the landscape. When vigor declines enough for plants to die or become smaller, species with higher grazing tolerance increase in vigor and production as they access the resources previously used by the larger bunchgrasses. The decrease in species composition of basin wildrye, rough fescue, and green needlegrass may be equal to that of rhizomatous grasses, specifically western wheatgrass and thickspike wheatgrass. This indicates that the reference plant community has shifted to the At-Risk Community (1.2). The driver for community shift 1.1a is improper grazing management or prolonged drought. This shift is triggered by the loss of vigor of basin wildrye, soil erosion, or prolonged drought coupled with improper grazing. Blaisdell (1958) stated that drought and warmer-than-normal temperatures are known to advance plant phenology by as much as one month. During drought years, plants may be especially sensitive or reach a critical stage of development earlier than expected.

Pathway 1.2a
Community 1.2 to 1.1

The At-Risk Community (1.2) will return to the Decreaser Bunchgrass Community (1.1) with proper grazing management and appropriate grazing intensity. Favorable moisture conditions will facilitate or accelerate this transition. It may take several years of favorable conditions for the community to transition back to a wildrye dominated state. The driver for this community shift (1.2a) is the increased vigor of the mid-statured bunchgrasses, resulting in increased biomass production and dominance of the plant community. The trigger for this shift is the change in grazing management favoring basin wildrye. In general, conservative grazing management styles such as deferred or rest rotations utilizing moderate grazing (less than 50 percent use) coupled with favorable growing conditions like cool, wet springs are these triggers. These systems tend to promote increases in soil organic matter, which promotes microfauna and can increase infiltration rates. Inversely, long periods of rest at a time when this state is considered stable may not result in an increase in native bunchgrasses, and it has been suggested (Noy-Meir 1975) that these long periods of rest or underutilization may actually drive the system to a lower level of stability by creating large amounts of standing biomass, dead plant caudex centers, and gaps in the plant canopy.

State 2
Rhizomatous State

State 2, Rhizomatous State, has been altered by long-term unmanaged, heavy grazing. In this State, drought conditions may speed the departure from reference.

Community 2.1
Rhizomatous Community

This plant community is primarily dominated by rhizomatous grasses such as western wheatgrass and thickspike wheatgrass, with limited amounts of mid-statured bunchgrasses. This community often has an increased presence of big sagebrush as part of a drying trend. Native "increaser" forbs will begin to dominate the forb community (western yarrow, goldenrod). Invasive species such as the common dandelion may be present in low amounts. Overall, production is reduced, as is litter cover. The Rhizomatous Community has an increase in bare ground from Reference, which can affect site stability due to reduced organic matter and shallower rooting depths of present plants. Hydrologic function is impaired as a response to reduced deep-rooted bunchgrasses and increased evapotranspiration. The transition from reference is in response to long-term drought, unmanaged grazing, or, in limited cases, increased fire frequency.

State 3
Invaded State

Heavy disturbance has allowed for bare ground and invasive species to dominate the site. Native plants may persist, but dominance has been transferred to non-native grasses and forbs. Hydrologic function is nearly lost as runoff increases. Site stability is greatly reduced from the Reference State due to reduced soil organic matter and a subsequent change in soil microbiota. This is a terminal state, and restoration to reference cannot be obtained without great expenditure of energy and finances. The resulting community of attempted restoration will not have the same hydrology and functional/structural groups expressed in Reference. Often, an attempted restoration will still contain invasive species at a level at which they will likely return to the Invaded State.

Community 3.1
Invaded Community

The Invaded Community consists primarily of non-native grasses and forbs. Many of these species are considered noxious weeds such as Canada thistle, Sulphur cinquefoil, and leafy spurge.

Community 3.2
Sodbound

Kentucky bluegrass is the primary grass species with common dandelion frequently being the dominant forb. Other introduced grasses such as smooth brome (Bromus inermus), Canada bluegrass (*Poa compressa*), and Quackgrass (*Elymus repens*) exist in smaller amounts. These non-native grasses are incredibly successful in the Overflow site as they are shallow rooted and are better able to utilize increased soil moisture. Associated with this community, is typically poor site stability and altered hydrologic function. As Kentucky bluegrass and other rhizomatous species increase, bare ground tends to increase. These shallow rooted species are not able to hold the site and classic headcutting and gully erosion are common.

Transition T1A
State 1 to 2

The Reference State (1) transitions to the Rhizomatous State (2) if tall and mid-statured bunchgrasses decrease to below 20 percent or if bare ground cover increases beyond 10 percent. The driver for this transition is the loss of taller bunchgrasses, which creates open areas in the plant canopy with bare soil. Soil erosion reduces soil fertility, which drives transitions to the Altered State. There are several other key factors signaling the approach of transition T1A: increases in soil physical crusting, an increase in rhizomatous grasses, decreases in cover of cryptogamic crusts, decreases in soil surface aggregate stability, and/or evidence of erosion including water flow patterns, development of plant pedestals, and litter movement. The trigger for this transition is improper grazing management and/or long-term drought, leading to a decrease in basin wildrye composition to less than 10 percent and a reduction in total plant canopy cover.

Transition T1B
State 1 to 3

Rapid invasion of the Reference State is often a result of repeated heavy disturbance from non-managed grazing (often combined with prolonged drought), stressing native bunchgrasses. Seeds of non-native grasses and forbs readily germinated in the bare ground between bunchgrass culms.

Restoration pathway R2A
State 2 to 1

The Rhizomatous State (2) has lost soil or vegetation attributes to the point that recovery to the Reference State (1) will require reclamation efforts such as soil rebuilding, intensive mechanical and cultural treatments, and/or revegetation (via seeding or sprig planting in the case of basin wildrye). Examples of mechanical treatment may be brush control, while cultural treatments may include prescribed grazing, targeted brush browsing, or prescribed burning. Low intensity prescribed fires to reduce competitive increaser plants as well as reduce the potential Kentucky bluegrass invasion. A low-intensity fire will also reduce big sagebrush densities. In areas with the potential for annual grass infestations, fire should be carefully planned or avoided. The drivers for this restoration pathway are reclamation efforts along with proper grazing management.

Transition T2A
State 2 to 3

With continued disturbance, the Rhizomatous State can deteriorate, losing the majority of the native bunchgrasses as well as reducing the native rhizomatous grasses. Non-managed grazing is the driver of this transition. Limited impacts from prolonged drought may influence this transition as well. Disturbance-adapted non-native species compete for limited resources, reducing the vigor of native species. Bare ground between Kentucky bluegrass tillers significantly increases. This transition results in significantly reduced site stability as well as an increased risk of runoff. This combination may be expressed in headcutting during brief runoff events.

Restoration pathway R3A
State 3 to 1

Restoration of the Invaded State (3) to the Reference State (1) requires substantial energy input. The drivers for the restoration pathway are the removal of invasive species, restoration of native bunchgrass species, persistent management of invasive species, and proper grazing management. Without continued control, invasive species are likely to return (probably rapidly) due to the presence of seeds and/or other viable material in the soil and management-related practices that increase soil disturbance. If invaded by conifer encroachment, treatment depends on the condition of the rangeland. Sites invaded by Kentucky bluegrass and smooth brome (Bromus inermus) have been successfully restored by prescribed fire and herbicide treatments (Matt A. Bahm et al. 2011). Prescribed fire of Kentucky bluegrass invaded sites has shown to temporarily increase runoff; however, one year post-fire treatment of Kentucky bluegrass, infiltration rates increased (Gerhard 2019). Sites that have transitioned from the Rhizomatous State (2) to the Invaded State (3) may be severely lacking in soil and vegetative properties that will allow for restoration to the Reference State. Hydrologic function damage may be irreversible, especially with accelerated gully erosion.

Restoration pathway R3B
State 3 to 2

If invasive species are removed before remnant populations of bunchgrass are drastically reduced, the Invaded State (3) can revert to the Rhizomatous state. The driver for the reclamation pathway is weed management without reseeding. Continued Integrated Pest Management (IPM) will be required as many of the invasive species that can occupy the Invaded State have extended dormant seed life. The trigger is invasive species control.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Decreaser Bunchgrass/Grasslike**			1875–2250	
	basin wildrye	LECI4	*Leymus cinereus*	750–1300	15–30
	rough fescue	FECA4	*Festuca campestris*	120–400	5–10
	green needlegrass	NAVI4	*Nassella viridula*	125–275	3–7
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	120–240	3–5
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–175	0–10
	Columbia needlegrass	ACNE9	*Achnatherum nelsonii*	0–150	0–5
	needlegrass	ACHNA	*Achnatherum*	0–125	0–5
	Nebraska sedge	CANE2	*Carex nebrascensis*	0–125	0–5
2	**Rhizomatous Grass/Grasslike**			250–375	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–375	0–10
	thickspike wheatgrass	ELLA3	*Elymus lanceolatus*	0–375	0–10
	plains reedgrass	CAMO	*Calamagrostis montanensis*	50–100	1–3
	arctic rush	JUAR2	*Juncus arcticus*	0–25	0–1
3	**Increaser Bunchgrass/Grasslike**			125–250	
	needle and thread	HECO26	*Hesperostipa comata*	0–150	0–15
	Sandberg bluegrass	POSE	*Poa secunda*	0–75	0–10
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–75	0–6
	clustered field sedge	CAPR5	*Carex praegracilis*	0–75	0–3
Shrub/Vine					
4	**Shrub**			160–300	
	shrubby cinquefoil	DAFR6	*Dasiphora fruticosa*	10–200	0–10
	common snowberry	SYAL	*Symphoricarpos albus*	10–150	3–10
	big sagebrush	ARTR2	*Artemisia tridentata*	40–125	5–15
	Woods' rose	ROWO	*Rosa woodsii*	0–50	0–3
	silver buffaloberry	SHAR	*Shepherdia argentea*	0–50	0–3
	currant	RIBES	*Ribes*	0–50	0–3
Forb					
5	**Forb**			145–255	
	lupine	LUPIN	*Lupinus*	60–160	3–6
	American vetch	VIAM	*Vicia americana*	40–100	0–5
	goldenbanner	THERM	*Thermopsis*	20–70	1–5
	silverweed cinquefoil	ARAN7	*Argentina anserina*	20–60	0–3
	cinquefoil	POTEN	*Potentilla*	10–60	0–3
	common yarrow	ACMI2	*Achillea millefolium*	20–50	1–3
	Rocky Mountain iris	IRMI	*Iris missouriensis*	0–50	0–3
	Indian paintbrush	CASTI2	*Castilleja*	20–50	1–3
	mountain deathcamas	ZIEL2	*Zigadenus elegans*	0–40	0–1
	lousewort	PEDIC	*Pedicularis*	0–20	0–1
	violet	VIOLA	*Viola*	0–20	0–1

Animal community

The Overflow (Ov) ecological site of the Central Rocky Mountains Valleys provides a variety of wildlife habitat for an array of species. Prior to the settlement of this area, large herds of antelope, elk, and bison roamed. Though the bison that once utilized this landscape have been replaced with domestic livestock, wildlife still utilizes this largely intact landscape for habitat.

The relatively high grass component of the Reference Community provides excellent nesting cover for multiple neotropical migratory birds as well as hiding habitat for larger animals.

Greater sage grouse likely utilize most states of this ecological site as there are high amounts of forbs and insects as a result of the favorable soil moisture. Even in an Altered State, sage grouse will utilize the increased forb and shrub cover for both foraging and hiding cover. This site would be considered critical habitat for most lifestages of the greater sage grouse.

Managed livestock grazing is suitable on this site due to the potential to produce an abundance of high-quality forage. This is often a preferred site for grazing by livestock, and animals tend to congregate in these areas. In order to maintain the productivity of this site, grazing on adjoining sites with less production must be managed carefully to make sure utilization on this site is not excessive. Management objectives should include maintenance or improvement of the native plant community. Careful management of the timing and duration of grazing is important. Shorter grazing periods and adequate deferment during the growing season are recommended for plant maintenance, health, and recovery.

Continual non-prescribed grazing of this site will be injurious, will alter the plant composition and production over time, and will result in the transition to the Altered State. The transition to other states will depend on the duration of poorly managed grazing as well as other circumstances such as weather conditions and fire frequency.

The Altered State is subject to further degradation to the Invaded State. Management should focus on grazing management strategies that will prevent further degradation, such as seasonal grazing deferment or winter grazing where feasible. Communities within this state are still stable and healthy under proper management. Forage quantity and/or quality may be substantially decreased from the Reference State.

Grazing is possible in the Invaded State. Invasive species are generally less palatable than native grasses. Forage production is typically greatly reduced in this state. Due to the aggressive nature of invasive species, sites in the Invaded State face an increased risk of further degradation to the Invaded State. Grazing has to be carefully managed to avoid further soil loss and degradation and possible livestock health issues.

Prescriptive grazing can be used to manage invasive species. In some instances, carefully targeted grazing (sometimes in combination with other treatments) can reduce or maintain the species composition of invasive species.

Hydrological functions

The hydrologic cycle functions best in the Reference State (1) with good infiltration and deep percolation of rainfall; however, the cycle degrades as the vegetation community declines. Rapid rainfall infiltration, high soil organic matter, good soil structure, and good porosity accompany high bunchgrass canopy cover. High ground cover reduces raindrop impact on the soil surface, which keeps erosion and sedimentation transport low. Water leaving the site will have a minimal sediment load, which allows for high water quality in associated streams. High rates of infiltration will allow water to move below the rooting zone during periods of heavy rainfall. The Decreaser Bunchgrass Community (1.1) should have no rills or gullies present, and drainage ways should be vegetated and stable. Water flow patterns, if present, will be barely observable. Plant pedestals are essentially nonexistent. Plant litter remains in place and is not moved by wind or water.

Improper grazing management results in a community shift to the At Risk Community (1.2). This plant community has a similar canopy cover but slightly higher bare ground. Therefore, the hydrologic cycle is functioning at a level similar to the water cycle in the Decreaser Bunchgrass Community (1.1).

In the Invaded State (3) canopy and ground cover are greatly reduced compared to the Reference State (1), which impedes the hydrologic cycle. Infiltration will decrease and runoff will increase due to reduced ground cover, the presence of shallow-rooted species, rainfall splash, soil capping, reduced organic matter, and poor structure. Sites invaded by non-native rhizomatous grasses are at a particularly high risk of runoff and headcutting. Sparse ground cover and decreased infiltration can combine to increase the frequency and severity of flooding within a watershed. Soil erosion is accelerated, the quality of surface runoff is poor, and sedimentation increases.

Recreational uses

This site provides some limited recreational opportunities for hiking, horseback riding, big game and upland bird hunting. The forbs have flowers that appeal to photographers. This site provides valuable open space.

Wood products

n/a

Inventory data references

Information presented was derived from the site's Range Site Description (Overflow 15-19" P.Z., Northern Rocky Mountain Valleys, South, East of Continental Divide), NRCS clipping data, literature, field observations, and personal contacts with range-trained personnel (i.e., used professional opinion of agency specialists, observations of land managers, and outside scientists).

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Approval

Kirt Walstad, 9/08/2023

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Grant Petersen
Contact for lead author	grant.petersen@usda.gov
Date	03/08/2020
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are not present in the reference condition.

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2. **Presence of water flow patterns:** Water flow patterns are not present in the reference condition.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals are not evident in the reference condition.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is low (0-1 percent).

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5. **Number of gullies and erosion associated with gullies:** Gullies are not present in the reference condition

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Wind scoured, or depositional areas are not evident in the reference condition.

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement is limited to high runoff events such as spring snowmelt and after convective storms. Typically herbaceous material movement is less than 3 to 5

feet in these high flow events. Outside of these extremes litter movement will not occur.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** The average soil stability rating is 5-6 under plant canopies and plant interspaces. The A horizon is 6-8 inches thick.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil Structure at the surface is moderate, fine granular. A Horizon should be 6-8 inches thick with color, when wet, typically ranging in Value of 3 or less and Chroma of 2 or less. Local geology may affect color in which it is important to reference the Official Series Description (OSD) for characteristic range. https://soilseries.sc.egov.usda.gov/osdname.aspx

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Evenly distributed across the site, bunchgrasses improve infiltration while rhizomatous grass protects the surface from runoff forces. Infiltration of the Overflow ecological site is well drained but has a slow infiltration rate. An even distribution of tall & mid stature bunchgrasses (75-80%) of site production, cool season rhizomatous grasses (10%) along with a mix of shortgrass (5-10%), forbs (5-10%) and shrubs (5-10%).

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** A compaction layer is not present in the reference condition. Soil profile may contain an abrupt transition to an Argillic horizon which can be misinterpreted as compaction, however, the soil structure will be fine to medium subangular blocky, where a compaction layer will be platy or structureless (massive).

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Tall & Mid-statured, cool season, perennial bunchgrasses (basin wildrye, rough fescue, green needlegrass)

    Sub-dominant: Rhizomatous grasses ≥ shrubs > Increaser Bunchgrasses > forbs > subshrubs

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Mortality in herbaceous species is not evident. Species with bunch growth forms may have some natural mortality in centers is 3% or less.

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14. **Average percent litter cover (%) and depth (in):** Total litter cover ranges from 50 to 70 percent. Most litter is irregularly distributed on the soil surface and is less than .25 inch.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Imperial: Average 2900 lbs per acre. Low: 2200 High 3200 lbs per acre.

Metric: Average 3250 kilograms per hectare. Low: 2466 kg/ha High: 3587 kg/ha
Production varies based on effective precipitation and natural variability of soil properties for this ecological site.

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Potential invasive (including noxious) species (native and non-native). Invasive species on this ecological site include (but not limited to) dandelion, annual brome spp., spotted knapweed, yellow toadflax, leafy spurge, Kentucky bluegrass, smooth brome

    Native species such as rocky mtn Juniper, big sagebrush, Sandberg's bluegrass, etc. when their populations are significant enough to affect ecological function, indicate site condition departure.

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17. **Perennial plant reproductive capability:** In the reference condition, all plants are vigorous enough for reproduction either by seed or rhizomes in order to balance natural mortality with species recruitment.
