UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site ID: R044AB040MT

Site Name: Loamy Steep

Major Land Resource Area (MLRA): 044A Northern Rocky Mountain Valleys
For further information regarding MLRAs, refer to:
http://soils.usda.gov/survey/geography/mlra/index.html

Land Resource Unit (LRU) 44A-B:
- Moisture Phase: xeric - ustic
- Temperature Phase: frigid,cool – frigid, warm
- Dominant Cover: rangeland
- Representative Value (RV) Effective Precipitation: 14-19 inches
- RV Frost-Free Days: 70-120 days

Site Concept:
- Site does not receive any additional water.
- Soils are:
    - not saline or saline-sodic.
    - moderately deep, deep, or very deep with < 15% stone and boulder cover.
    - not skeletal within 20” of soil surface.
    - not strongly or violently effervescent with in surface mineral 4”.
- Surface textures usually range from very fine sandy loam to clay loam.
- Slope is ≥ 15%.
- A mollic epipedon is present.
- Clay content is ≤ 32% in surface mineral 4”.

PHYSIOGRAPHIC FEATURES
The Loamy Steep (LoStp) ecological site (R044AB040MT) is located within LRU “B” in MLRA “44A.” This ecological site occurs on strongly sloping alluvial fans, stream terraces, hills, till plains, lake plains, or moraines. The slope ranges from 15% to 55%. This site occurs on all exposures; effect of aspect can be significant in LRU assignment.

Predominant Landforms: (1) Moraines
(2) Stream terraces
(3) Alluvial fans

	Minimum	Maximum
Elevation (feet):	1,800	5,000
Slope (percent):	15%	55%
Water Table Depth (inches):	> 42	
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):	None	None
Frequency:	None	None
Duration:	None	None

CLIMATIC FEATURES

The dissected Northern Rocky Mountain Valleys of MLRA 44A are considered to have a maritime climate. Precipitation is fairly evenly distributed throughout the year with less than about 35% of the annual precipitation occurring during the growing season in Montana. Rainfall occurs as high-intensity, convective thunderstorms in the spring and fall. Most of the precipitation in the winter is snow or rain on fully or partially frozen ground. Average precipitation for LRU-B is 17”, and the frost-free period averages 95 days.

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.

	Minimum	Maximum
Frost-free period (days):	70	120
Freeze-free period (days):	90	140
Annual effective precipitation (inches):	14	19

Monthly precipitation (inches) and temperature (degrees F) distribution:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Avg.	1.48	1.07	1.14	1.25	1.97	2.22	1.1	1.13	1.3	1.25	1.49	1.54
Temp. Min.	17	20	25	32	39	45	49	47	40	32	25	19
Temp. Max.	32	39	47	58	67	74	84	83	72	58	42	33

Climate Stations:

MT245015 Libby 1 NE Ranger STN, Montana period of records 1895-2005
MT242221 Darby, Montana period of records 1948-2005
MT248043 Superior, Montana period of records 1914-2005
MT244558 Kalispell WSO Airport, Montana period of records 1899-2005
MT242104 Creston, Montana period of records 1949-2005
MT247286 St. Ignatius, Montana period of records 1896-2005
MT245735 Missoula 2 NE, Montana period of records 1966-2005

REPRESENTATIVE SOIL FEATURES

These soils contain a well-developed mollic epipedon and are typically very deep, well-drained soils that were formed in alluvium and till. Surface textures (< 2 mm) usually range from coarse sandy loam to clay loam and clay content is ≤ 32%. The soil may contain gravel and/or cobbles but they will not exceed an average of 35% by volume in the 10-20” layer.

Predominant Parent Materials:
Kind: Till and alluvium
Origin:

Typical Surface Texture (< 2 mm): (1) Loam
(2) Silty loam
(3) Clay loam

Typical Textural Family: Loamy

	Minimum	Maximum
Surface Fragments ≥ 10” (% cover)	0%	15%
% Coarse Fragments > 2 mm (% volume in 10-20” layer)	0%	34%
Drainage Class	Well	
Permeability Class	Moderately slow	Moderately rapid
Depth to Bedrock (inches)	> 20”	
Electrical Conductivity (mmhos/cm) within 4” Depth	0	1
Sodium Absorption Ratio within 16” Depth	0	12
Calcium Carbonate Equivalent within Surface 10”	0	< 20%
Soil Reaction within Surface 4”	6.3	8.2
Available Water Capacity (inches)	4	7.5

COMMUNITY PHASES

Ecological Dynamics of the Site

The Loamy Steep ecological site is characterized by the production and composition of plant species in the Reference Plant Community, which is defined by soils, precipitation, and temperature regime influencing the site. The presumed Reference Plant Community type of this site is dominated by cool-season perennial bunchgrass species, primarily rough fescue (*Festuca campestris)* with minor components of perennial forbs and shrubs, including common snowberry (*Symphoricarpos albus*). LRU-B occurs in the valleys of western Montana, on rangelands with a xeric and ustic soil moisture phase, a frigid, cool to frigid, warm soil temperature phase, 15-19” of effective precipitation, and between 70 and 120 consecutive frost-free days annually. This site is characterized by a medium-textured surface horizon with soils at least 20 inches deep, a mollic epipedon, and slopes that are > 15%.

The majority of precipitation comes early in the form of snow and spring rain. Summers are usually dry. The growing season is short and cool; primary growth typically occurs between May and July, and dominant plants are those that have adapted to these conditions.

In response to disastrous fires in 1910, new firefighting policies were established. Wildland fire suppression became an important driving factor in the ecology of western rangelands. Livestock grazing during the late 1800s and early 1900s often occurred at very heavy levels. Heavy grazing resulted in a severe reduction in fine fuels, which further reduced potential for natural fires. These two actions altered the natural fire interval.

Fire suppression, along with fine-fuels reduction, has interfered with the natural fire interval; many areas have not burned for over 100 years (Arno and Gruell 1986). Prior to 1900, the average natural fire return intervals were probably shorter than 35 years for this MLRA. Historic fire frequency may have ranged from 15 to 75 years. Trees and non-sprouting shrubs (i.e., Douglas fir (*Pseudotsuga menziesii*) and Rocky Mountain juniper (*Juniperus scopulorum*), respectively) were restricted to small patches or widely spaced plants. Following fire on medium-textured soils, perennial bunchgrasses apparently recovered in a few years and were present to fuel subsequent fires, which suppressed woody species and kept them as a minor component of the community (Arno and Gruell 1983).

Historical records indicate, prior to the introduction of livestock (cattle and sheep) during the late 1800s, elk and bison grazed this ecological site. Evidence shows periodic use by bison was in large numbers and concentrations. Forage for livestock was noted as minimal in areas recently grazed by bison (Lesica and Cooper 1997).

Significant livestock grazing has occurred on most of this ecological site in western Montana for more than 100 years (beginning with the 1860s gold boom and subsequent settlement through 1900). Indian horse herds were present and numerous for several hundred years prior. The primary type of European livestock grazed in this region has historically transitioned between sheep and cattle with early grazing (pre-1890) dominated by the cattle industry. In the 1890s Montana sheep production began to increase dramatically (> 400%) and dominated the cattle industry for approximately four decades. By the 1930s, livestock production once again favored the cattle industry, which continues to dominate livestock grazing in the region today (Wyckoff and Hansen 2001). The Loamy Steep ecological site is relatively accessible, and many examples were subject to heavy and/or season-long grazing until 1970 or later. Most of the deeper sites within MLRA 44A were plowed and converted to annual crops or tame pasture between 1880 and 1960.

Invasive species are an important part of the ecology of MLRA 44A. Notable invasive species include spotted knapweed (*Centaurea stoebe*), leafy spurge (*Euphorbia esula*), sulphur cinquefoil (*Potentilla recta*), and cheatgrass (*Bromus tectorum*). Most sites in MLRA 44A are impacted by these invasives. Sites are either currently invaded or have been treated to kill invasives, which reduces the production and changes the composition of forbs and shrubs. Even where invasives are not present, the threat of invasion drives management of this site.

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

Rangeland Health Reference Worksheets have been posted for this site on the Montana NRCS Web site (www.mt.nrcs.usda.gov) in Section II of the eFOTG under (F) Ecological Site Descriptions (ESDs).

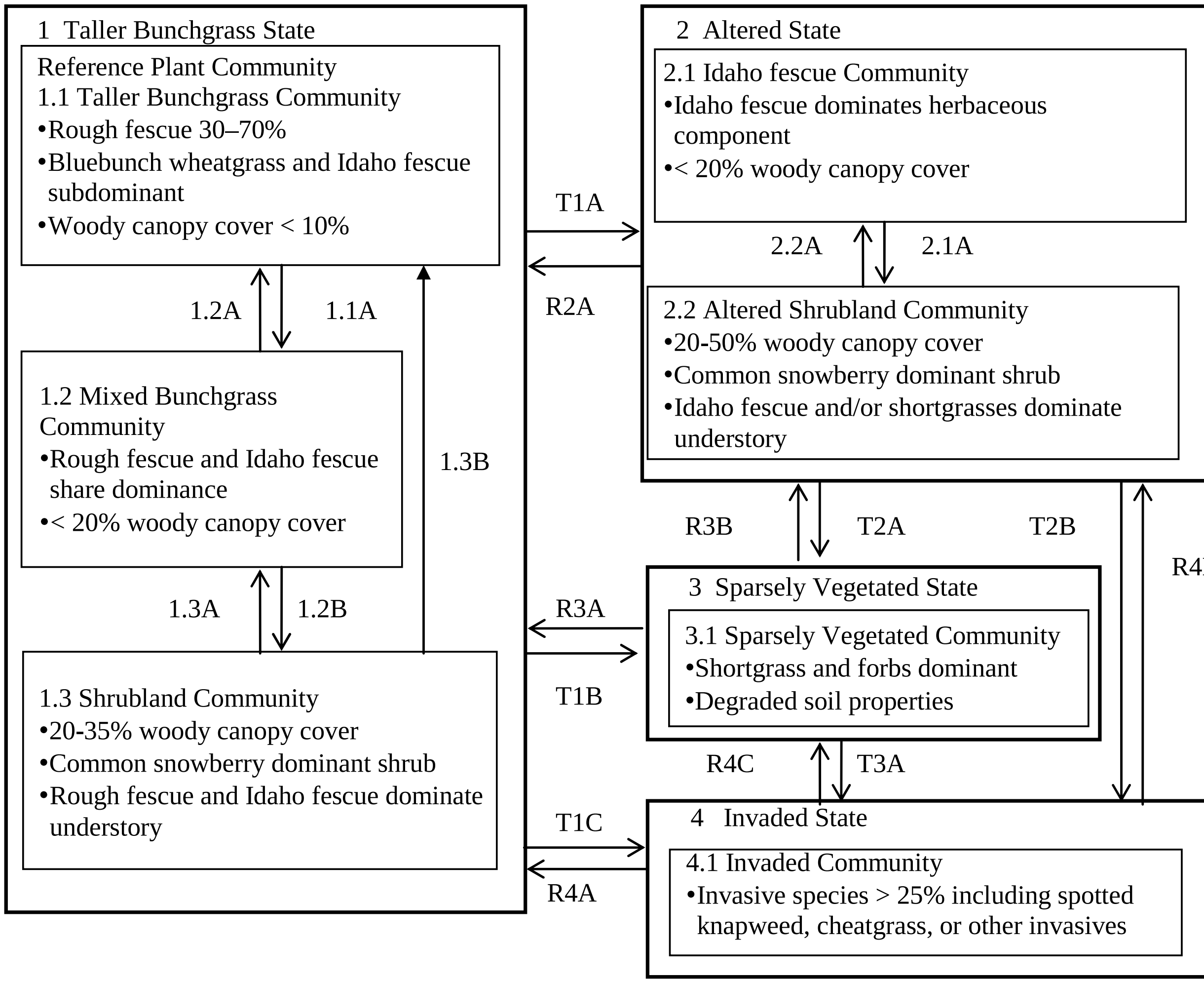
Plant Communities and Transitional Pathways

A STM for the Loamy Steep ecological site (44AB040MT) is depicted in Figure 1. Thorough descriptions of each state, transition, plant community, and pathway follow the model. This model is based on available experimental research, field observations, and interpretations by experts and is likely to change as knowledge increases.

Plant communities will differ across the MLRA because of 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. The species lists are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Both percent species composition by weight and percent canopy cover are used in this ESD. Most observers find it easier to visualize or estimate percent canopy for woody species (trees and shrubs). Canopy cover drives the transitions between communities and states because of the influence of shade and interception of rainfall. 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 species composition for the site. Calculating similarity index requires use of species composition by dry weight.

This STM includes only native communities and states. The converted communities are described in the Ecological Dynamics section above.



1.1A	Lack of Fire, Improper Grazing Management
1.2A	Fire, Proper Grazing Management
1.2B	Lack of Fire, Improper Grazing Management
1.3A	Fire, Proper Grazing Management
1.3B	Fire, Proper Grazing Management
2.1A	Overgrazing, Lack of Fire
2.2A	Fire, Proper Grazing Management
T1A	Overgrazing, Lack of Fire
T1B	Overgrazing, Soil Erosion
T1C	Introduction of Weedy Propagules
T2A	Overgrazing, Soil Erosion
T2B	Introduction of Weedy Propagules
T3A	Introduction of Weedy Propagules
R2A	Mechanical Brush Management, Range Seeding
R3A	Proper Grazing Management, Range Seeding
R3B	Range Seeding
R4A	Weed Management, Range Seeding
R4B	Weed Management, Woody Propagules Present
R4C	Weed Management, Wood Propagules Not Present

Figure 1. State and Transition Model: Loamy Steep R044AB040MT

STATE 1 SECTION

State Number: **1**

State Name: **Taller Bunchgrass State**

State Narrative:
This state is characterized by cool-season bunchgrasses and is represented by three communities that differ mainly in the percent composition of rough fescue and Idaho fescue (*Festuca idahoensis*). Forbs are a minor component in this state. Woody canopy cover is < 35 %.

Photo(s):

Community Phase Number: 1.1

Community Phase Name: Reference Plant Community – Taller Bunchgrass Community

Community Phase Narrative:
The Taller Bunchgrass Community (1.1) is dominated by rough fescue, a taller cool-season bunchgrass with a minor component of forbs and shrubs. Rough fescue is typically the dominant species in the Taller Bunchgrass Community (1.1), while bluebunch wheatgrass (*Pseudoroegneria spicata*) and Idaho fescue are subdominant. Many common forb species exist on this site, including western stoneseed (*Lithospermum ruderale*) and fleabane (*Erigeron spp*.). Shrub species, including common snowberry are present as a minor part of the community.

The Taller Bunchgrass State generally occurs on the Loamy Steep site in areas where proper grazing management practices have been implemented over a long period. The Taller Bunchgrass Community can be maintained through the implementation of properly managed grazing that provides adequate growing-season deferment to allow establishment of taller grass propagules and/or the recovery of vigor of stressed plants.

The Taller Bunchgrass Community (1.1) in general is resistant to change with proper grazing management and near normal precipitation. However, rough fescue will decrease in vigor and decline in species composition under continuous season-long grazing. Subdominant species, such as Idaho fescue, tolerate higher grazing pressure and may increase in cover under prolonged drought conditions. This increase drives the community shift to the Mixed Bunchgrass Community (1.2).

The Taller Bunchgrass Community (1.1) is moderately resilient to shrub invasion if properly managed. However, improper grazing will decrease the vigor of desirable grass species and result in an increase in shrub canopy. There will be a notable increase in less desirable plants such as Idaho fescue and shortgrasses. When this occurs the Taller Bunchgrass Community (1.1) will shift to a Mixed Bunchgrass Community (1.2). Once the ecological site becomes dominated by Idaho fescue it will transition to the Altered State (2).

Periodic fire increases the resilience of the Taller Bunchgrass Community (1.1) by reducing competition and canopy cover of woody species. Fire also removes decadent herbaceous material, particularly from taller bunchgrasses, which promotes increased vigor and seedling establishment. Timing and intensity of a fire are critical components that can have varying positive or negative effects on this plant community. Fire does increase risk of invasion from invasive species, most notably cheatgrass. At least two growing seasons of rest are recommended to allow plants to recover after fire.

Without fire and/or brush control, woody species on the site will increase and the site will shift to the Shrubland Community (1.3). This can occur with or without the degradation of the herbaceous community from rough fescue dominated to a community dominated by Idaho fescue. If degradation of the herbaceous component does occur, the site will transition to the Altered State (2).

Because the woody species that dominate in the Shrubland Community (1.3) are native species in the Taller Bunchgrass State, the shift to the Shrubland Community is a linear process with shrubs starting to increase soon after fire or brush control ceases.

Heavy continuous grazing will reduce plant cover, litter, and mulch. Bare ground will increase and expose the soil to erosion. Litter and mulch will move off-site as plant cover declines. When canopy cover decreases to below 50%, the surface horizon becomes less stable and erosion can occur. This will make it more difficult to reestablish rough fescue plants due to decreased soil fertility.

When overgrazing continues, invasive weedy grass and forb species move into the plant community and the site transitions to the Altered State (2), Sparsely Vegetated State (3) or the Invaded State (4). Until the Taller Bunchgrass Community (1.1) crosses the threshold into the Altered State (2.1), Sparsely Vegetated Community (3.1) or the Invaded Community (4.1), this community can be managed back toward the Taller Bunchgrass Community (1.1) using management practices including prescribed grazing, prescribed burning, and strategic weed control. It may take several years to achieve this state, depending upon the climate and the aggressiveness of the treatment.

While the Taller Bunchgrass Community (1.1) is resilient to degradation under proper management, the community remains at risk of invasion by aggressive non-native species because of the ability of spotted knapweed, leafy spurge, and cheatgrass to invade healthy rangelands and the widespread presence of propagules. Healthy plant communities are most resilient to invasives although many examples exist of well-managed areas that have been invaded by spotted knapweed.

Invasives impact plant communities even if the site does not yet have a critical population of invasives. Almost all reference sites had at least trace amounts of spotted knapweed and/or cheatgrass. It is believed that most sites with only trace amounts have been chemically treated for invasives at some point. These treatments would have impacted other broad-leafed species (forbs and shrubs). It is likely that this site had more potential for forb and shrub production than found on current reference sites. The natural fire regime would have favored an increase in forbs while maintaining shrubs as a very minor component.

Rock cover on the soil surface is minimal and does impact productivity of this site. Plant basal cover is expected to be about 20 to 30%, and bare ground is expected to be between 5 and 15%. The soils of this site have high soil stability values. There should be no signs of current erosion occurring on the site.

The following production figures do not represent the lowest or highest possible production for the Reference Plant Community (1.1). For example, the high figure is not the most production that can occur in a wet year in the most mesic portion of the LRU. These values represent the range of variability for each species across the extent of the ecological site. Usually, values in the low production column represent production at the dry end of the LRU, and those in the high production column represent production at the wet end of the LRU.

Even the most stable communities exist within a range of dynamic equilibrium of species composition. The following table shows an example of species composition; the example is not the only mix of species possible in the Taller Bunchgrass Community (1.1).

Species List - Reference Plant Community – 1.1

Plant Type - Grass/Grasslike — 80% of Community Composition

Group Number	Group Name	Scientific Plant Symbol	Common Name	Scientific Plant Name	Annual Production in Pounds/Acre Low	High
1	***Cool Season Bunchgrasses**				***840**	***1400**
	(70%)	FECA4	rough fescue	*Festuca campestris*	840	1400
		PSSP6	bluebunch wheatgrass	*Pseudoroegneria spicata*	360	600
		FEID	Idaho fescue	*Festuca idahoensis*	240	400
		ACHNA	needlegrass spp.	*Achnatherum spp.*	120	200
		HECO26	needleandthread	*Hesperostipa comata*	120	200
2	***Shortgrasses/ Rhizomatous Grasses/ Grasslikes**				***120**	***200**
	(10%)	KOMA	prairie junegrass	*Koeleria macrantha*	60	100
		POSE	Sandberg bluegrass	*Poa secunda*	60	100
		PASM	western wheatgrass	*Pascopyrum smithii*	60	100
		ELLA3	thickspike wheatgrass	*Elymus lanceolatus*	60	100
		CAREX	sedge spp.	*Carex spp.*	60	100
		PPGG	other perennial grasses		60	100

Plant Type - Forbs — 10% of Community Composition

Group Number	Group Name	Scientific Plant Symbol	Common Name	Scientific Plant Name	Annual Production in Pounds/Acre Low	High
3	***Forbs**				***120**	***200**
	(10%)	ACMI2	western yarrow	*Achillea millefolium*	60	100
		AGGL	mountain dandelion	*Agoseris glauca*	60	100
		ALAL3	pale alyssum	*Alyssum alyssoides*	60	100
		ANCY	candle anemone	*Anemone cylindrica*	60	100
		ANTEN	pussytoes spp.	*Antennaria spp.*	60	100
		ARHO2	Holboell's rockcress	*Arabis holboellii*	60	100
		ARSO2	twin arnica	*Arnica sororia Greene*	60	100
		ASTRA	milkvetch spp.	*Astragalus spp.*	60	100
		BASA3	arrowleaf balsamroot	*Balsamorhiza sagittata*	60	100
		CAAP	pointedtip mariposa lily	*Calochortus apiculatus*	60	100
		CARO2	harebell	*Campanula rotundifolia*	60	100
		COLI2	narrowleaf mountain trumpet	*Collomia linearis*	60	100
		COUM	bastard toadflax	*Comandra umbellata*	60	100
		ERHE2	parsnipflower buckwheat	*Eriogonum heracleoides*	60	100
		ERIGE2	fleabane spp.	*Erigeron spp.*	60	100
		GAAR	common gaillardia	*Gaillardia aristata*	60	100
		GABO2	northern bedstraw	*Galium boreale*	60	100

		GETR	prairie smoke	*Geum triflorum*	60	100
		GEVI2	sticky geranium	*Geranium viscosissimum*	60	100
		HECY2	roundleaf alumroot	*Heuchera cylindrica*	60	100
		HEVI4	hairy goldenaster	*Heterotheca villosa*	60	100
		LIRU4	western stoneseed	*Lithospermum ruderale*	60	100
		LOMAT	biscuitroot spp.	*Lomatium spp.*	60	100
		LUSE4	silky lupine	*Lupinus sericeus*	60	100
		MOFI	horsemint	*Monarda fistulosa*	60	100
		PENST	beardtongue spp.	*Penstemon spp.*	60	100
		PHLOX	phlox spp.	*Phlox spp.*	60	100
		PLPA2	woolly plantain	*Plantago patagonica*	60	100
		PODO4	Douglas' knotweed	*Polygonum douglasii*	60	100
		POTEN	cinquefoil spp.	*Potentilla spp.*	60	100
		SOMI2	Missouri goldenrod	*Solidago missouriensis*	60	100
		TRGR7	largeflower triteleia	*Triteleia grandiflora*	60	100
		ZIVE	meadow deathcamas	*Zigadenus venenosus*	60	100
		PPFF	other perennial forbs		60	100
		AAFF	other annual forbs		60	100

Plant Type - Shrubs **10% of Community Composition**

Group Number	Group Name	Scientific Plant Symbol	Common Name	Scientific Plant Name	Annual Production in Pounds/Acre Low	High
4	***Shrubs (10%)**				***120**	***200**
		ARFR4	fringed sagewort	*Artemisia frigida*	60	100
		ROWO	Woods' rose	*Rosa woodsii*	60	100
		SYAL	common snowberry	*Symphoricarpos albus*	60	100
		PPSS	other shrubs		60	100

* When calculating pounds allowable for a plant group, the production for that group, cannot exceed the annual production in pounds per acre at the low- or high-expected production for the group--for individual species in a group the maximum production allowable for each species is shown not to exceed the low- or high-production value depending on the location of this site in that LRU. This means if the site potential is closer to the lower parameters of the LRU (precipitation, soil properties), use the low values as a maximum. If the site potential is closer to the higher parameters of the LRU, use the high values as a maximum. If the site potential of the site is in the middle of the LRU, choose a value in the middle of the low and high as the maximum.

Community 1.1 Annual Production by Plant Type Table

Plant Type	Annual Production* (lbs/ac)		
	Low	**RV**	**High**
Grass/Grasslikes	960	1,280	1,600
Forbs	120	160	200
Shrubs/Vines	120	160	200
Trees	Trace	Trace	Trace
Totals	1,200	1,600	2,000

* Low represents production in a normal year at the dry end of the LRU. RV is the Representative Value for production of the LRU. High represents production at the wet end of LRU.

Percent Canopy and Ground Cover by Material Type

Summary Category	Low	High
Foliar Cover	55	70
Bare Ground	5	15
Basal Cover	20	30
Total Ground Cover	85	95
Total Litter	55	70

Soil Surface Cover

Soil Surface Category	Low	High
Bedrock	0	0
Boulders	0	0
Cobbles	0	5
Duff	0	0
Embedded Litter	0	3
Gravel	0	5
Visible Lichen	0	5
Moss	0	5
Soil	70	80
Stones	0	0
Basal Hits	20	30

Plant Growth Curve

Growth Curve Number:
Growth Curve Name: 44A- Uplands
Growth Curve Description: Includes all upland sites in 44A

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	25	35	15	10	5	0	0	0

Community Phase Number: 1.2

Community Phase Name: Mixed Bunchgrass Community

Community Phase Narrative:
This community is dominated rough fescue and subdominated by Idaho fescue with moderate overstory common snowberry. Common snowberry and Idaho fescue increase in species composition when rough fescue decreases due to improper grazing management and lack of fire and brush control. Rough fescue will have lower relative production and lower total production than in the Taller Bunchgrass Community (1.1). Bluebunch wheatgrass is subdominant. Other subdominant grass species that are more tolerant to grazing are likely to increase include Sandberg bluegrass (*Poa secunda*) needleandthread (*Hesperostipa comata*), prairie junegrass (*Koeleria macrantha*) and Kentucky bluegrass (*Poa pratensis*). Some increaser forbs species may include silky lupine (*Lupinus sericeus*), field chickweed (*Cerastium arvense*), ballhead sandwort (*Arenaria congesta*), northern bedstraw (*Galium boreale*) and pussytoes (*Antennaria spp*.). Fringed sagewort, Woods' rose (*Rosa woodsii*) and common snowberry (*Symphoricarpus albus*) are shrubs that also increase under prolonged drought or heavy grazing.

Heavy continuous grazing will reduce plant cover, litter, and mulch. Bare ground will increase and expose the soil to erosion. Litter and mulch will move off-site as plant cover declines. As long as the canopy cover remains > 50% and production of rough fescue and bluebunch wheatgrass is > 10% of total biomass production, the site can return to the Taller Bunchgrass Community (Pathway 1.2A).

The Mixed Bunchgrass (1.2) and the Shrubland Community (1.3) are “At-Risk” Communities. The transition to the Altered State can occur from any community within the Taller Bunchgrass State (1), it is not dependant on an increase of woody canopy cover, but on the decrease of rough fescue and bluebunch wheatgrass composition to < 10%. When overgrazing continues, increaser species such as Sandberg and native forb species will become more dominant and this triggers the transition from the Taller Bunchgrass State (1). Fire and/or brush control can be used to maintain the site in the Taller Bunchgrass State (1) as long as rough fescue production does not fall below 10%.

Until the Mixed Bunchgrass Community (1.2) crosses the threshold into the Altered State (2.0), this community can be managed back toward the Taller Bunchgrass Community (1.1) using management practices including prescribed grazing combined with prescribed burning and strategic brush control. It may take several years to make this shift, depending upon weather and aggressiveness of grazing management and brush treatment. Fire can be used to control smaller shrubs and trees. Chemical or mechanical treatment of larger shrubs and trees may be necessary in older stands.

Without any form of brush control, woody species continue to increase in canopy cover. Once woody canopy exceeds approximately 20% and attains reproductive capability, a shift to the Shrubland Community (1.3) has occurred.

Community Phase Number: 1.3

Community Phase Name: Shrubland Community

Community Phase Narrative:
The Shrubland Community (1.3) is characterized by greater than 20% woody canopy cover with rough fescue in the understory. Once woody canopy cover reaches 20%, the site will begin to take on the appearance of a shrubland. Rough fescue may remain dominant in the understory or share dominance with Idaho fescue.

Without fire, woody canopy cover increases and the Mixed Bunchgrass Community (1.2) shifts to the Shrubland Community (1.3). The dominant shrub species is common snowberry, and the understory is dominated by Idaho fescue. Other shrub and tree species include Woods’ rose (*Rosa woodsii*), fringed sagewort (*Artemisia frigida*), Douglas-fir (*Pseudotsuga menziesii*), and ponderosa pine (*Pinus ponderosa*).

The Shrubland Community (1.3) differs from the Altered Shrubland Community (2.2) in the amount of degradation present in the understory. Under proper grazing management, the herbaceous component will be dominated by rough fescue. As long as rough fescue has not fallen below 10% species composition, the Shrubland Community (1.3) can be managed back to the Taller

Bunchgrass Community (1.1) using prescribed grazing and strategic weed control. It may take several years to achieve this recovery, depending on growing conditions, vigor of remnant rough fescue plants, and the aggressiveness of the weed treatments. With improper grazing management, rough fescue will decline and less palatable grass species, such as Idaho fescue and forb species will dominate understory and the site transitions to the Altered State (2).

Community Phase Pathway 1.1A

Rough fescue loses vigor when overgrazed. When vigor declines enough for plants to die or become smaller, species with higher grazing tolerance (most often Idaho fescue) increase in vigor and production as they use the resources previously used by rough fescue and bluebunch wheatgrass. Decrease of species composition by weight of rough fescue to < 50% indicates that the plant community has shifted to the Mixed Bunchgrass Community (1.2). The driver for this community pathway 1.1A is improper grazing management. The trigger for this shift is the loss of vigor of rough fescue.

Community Phase Pathway 1.2A

The Mixed Bunchgrass Community (1.2) will return to the Taller Bunchgrass Community (1.1) with proper grazing management that provides sufficient critical growing season deferment in combination with proper grazing intensity. Favorable moisture conditions will facilitate or accelerate this transition. The driver for this community shift (1.2A) is the increase in vigor of rough fescue to the point that it represents more than 50% of species composition. The trigger for this shift is the change in grazing management that favors rough fescue.

Community Phase Pathway 1.2B

Shrubs make up a portion of the plant community in the Taller Bunchgrass Community (1.1), hence woody propagules are present. Therefore, the Taller Bunchgrass State is always at risk for shrub dominance and a shift to the Shrubland Community (1.3) in the absence of fire and brush management. The drivers for Community Phase Pathway (1.2B) are overgrazing and lack of fire and/or brush control. The mean fire return interval in the Taller Bunchgrass State is likely less than 35 years. Even with proper grazing and favorable climate conditions, lack of fire or brush control for 20 years will allow shrubs and trees to increase in canopy to reach the 20% threshold level. Improper grazing, prolonged drought, and a warming climate will provide a competitive advantage to shrubs, which will accelerate this process. The driver for this community shift is improper grazing management in combination with lack of fire and/or brush control.

Community Phase Change Pathway 1.3A

The Shrubland Community can return to the Mixed Bunchgrass Community after a fire as long as the understory is able to carry the fire and rough fescue crowns survive the fire and re-sprout and/or there is sufficient seed for rough fescue to re-vegetate the area.

Community Phase Change Pathway 1.3B

The Shrubland Community can return to the Taller Bunchgrass Community after a fire as long as the understory is able to carry the fire and rough fescue crowns survive the fire and re-sprout and/or there is sufficient seed for rough fescue to re-vegetate the area.

Transition T1A

The Taller Bunchgrass State (1) transitions to the Altered State (2) if rough fescue falls below 10% species composition. The trigger for this transition is the loss of taller bunchgrasses, which creates a shift in species composition towards lower productive species, especially Idaho fescue. This transition can occur from any community within the Taller Bunchgrass State (1), it is not dependant on an increase of woody canopy cover, but on the decrease of rough fescue production. The driver for this transition is improper grazing management and/or long-term drought leading to a decrease in rough fescue composition to < 10%.

Transition T1B

The Taller Bunchgrass State (1) transitions to the Sparsely Vegetated State (3) if plant canopy cover declines to < 25% or and rough fescue decreases to below 10% by dry weight. The trigger for this transition is the loss of taller bunchgrasses, which creates open spots of bare soil. Soil erosion is accompanied by decreased soil fertility driving the transitions to the Sparsely Vegetated State. There are several other key factors signaling the approach of transition T1B: increases in soil physical crusting, 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 driver for this transition is improper grazing management and/or long-term drought leading to a decrease in rough fescue composition to < 10 %.

Transition T1C

Regardless of grazing management, without some form of weed management (chemical, mechanical, or biological control), the Taller Bunchgrass State (1) can transition to the Invaded State (4) if aggressive invasive species, such as spotted knapweed and cheatgrass are introduced, even if the herbaceous component of the Reference Plant Community (1.1) is thriving. Healthy plant communities are most resilient to invasives. Long-term stress conditions for native species (e.g., overgrazing, drought, and fire) accelerate the process. If populations of invasive species reach critical levels, the site transitions to the Invaded State. The driver for this transition is the presence of aggressive invasive species.

Restoration Pathway R2A

Restoration of the Altered State to the Taller Bunchgrass State requires substantial energy input. The drivers for this restoration pathway are removal of woody species, restoration of native herbaceous species by reseeding rough fescue.

Restoration Pathway R3A

The Sparsely Vegetated State (3) has lost soil or vegetation attributes to the point that recovery to the Taller Bunchgrass State (1) will require reclamation efforts such as soil rebuilding, intensive mechanical treatments, and/or revegetation. The drivers for this restoration pathway are reclamation efforts and proper grazing management. The trigger is restoration efforts.

Restoration Pathway R4A
Restoration of the Invaded State (4) to the Taller Bunchgrass State (1) requires substantial energy input. The drivers for this restoration pathway are removal of invasive species, restoration of native bunchgrass species, ongoing management of invasives, and proper grazing management. Without maintenance, invasive species are likely to return (probably rapidly) because of the presence of propagules in the soil and an increase in soil disturbance. The drivers for this reclamation pathway are treatments to reduce or remove invasive/noxious species in combination with favorable growing conditions. The trigger is invasive species control.

STATE 2 SECTION

State Number: **2**

State Name: **Altered State**

State Narrative:
This state is characterized by having < 10% rough fescue and < 50% canopy cover. State 2 is represented by two communities that differ in the percent canopy cover of woody species. Production in this state is considerably lower than in the Taller Bunchgrass State (1). Some native plants tend to increase under prolonged drought and/or heavy grazing practices. A few of these species include Idaho fescue, needleandthread, Sandberg bluegrass, silky lupine, field chickweed, ballhead sandwort, common snowberry, Wood's rose and fringed sagewort.

Community Phase Number: 2.1

Community Phase Name: Idaho fescue Community

Community Phase Narrative:
The Idaho Fescue Community (2.1) is characterized by an herbaceous component dominated by Idaho fescue with rough fescue being < 10% of species composition by dry weight. This makes it difficult for rough fescue to increase with simply a change in grazing management alone.

This community may or may not have a shrub component with canopy cover up to 20%. If a shrub component is present, it will be dominated by common snowberry. The Idaho Fescue Community tends to occur if the forage component has been degraded but fire or brush control has kept the shrub community to < 20% cover. This community is at risk of shifting to the Altered Shrubland Community (2.2) if without fire or other brush control. This shift can be accelerated when improper grazing management occurs. This most often happens when stocking rates are not adjusted to compensate for the decrease in forage production as shrub production increases.

Canopy cover decreases compared to the Shrubland Community (1.2) to below 50%. Wind and water erosion may be eroding soil from the plant interspaces. Soil fertility is reduced, soil compaction is increased, and resistance to soil surface erosion has declined compared to the Taller Bunchgrass State (1).

Community Phase Number: 2.2

Community Phase Name: Altered Shrubland Community

Community Phase Narrative:
The Altered Shrubland Community (2.2) is characterized by > 20% woody canopy cover with Idaho fescue or shortgrasses in the understory. It has the appearance of shrub dominance with a degraded understory. The overstory is similar to the Shrubland Community (1.3) in the Taller Bunchgrass State (1). Common snowberry typically dominates the shrub component

If long-term lack of fire and heavy grazing continues, the Idaho Fescue Community (2.1) shifts to the Altered Shrubland Community (2.2) because of the increase in shrubs. The understory in the community can vary from a community with a grass component dominated by Idaho Fescue to an understory dominated by forbs and shortgrasses. Failure to adjust stocking rate as shrub cover increases results in further degradation of the herbaceous community causing an increase in bare ground between shrubs. At its most extreme this community can have a dense canopy of shrubs with sparse understory making the site difficult to return to a higher condition community even if brush is removed. Reseeding and other cultural practices may be needed.

When overgrazing continues, invasive grass and forb species move into the plant community and the site can transition to the Sparsely Vegetated State (3) or the Invaded State (4). Until the Altered Shrubland Community (2.2) crosses the threshold into the Sparsely Vegetated State (3) or the Invaded State (4) this community can be managed toward the Idaho Fescue Community (2.1) using prescribed grazing and strategic weed control.

Community Phase Pathway 2.1A
The Altered State is always at risk for shrub dominance and a shift to the Altered Shrubland Community (2.2) in the absence of fire and brush management. The drivers for Community Shift 2.1A are overgrazing and lack of fire and/or brush control. The mean fire return interval in the Altered State is likely less than 35 years. Even with proper grazing and favorable climate conditions, lack of fire or brush control for 20 years will allow shrubs and trees to increase in canopy to reach the 20% threshold level. Improper grazing, prolonged drought, and a warming climate will provide a competitive advantage to shrubs, which will accelerate this process. The driver for this community shift is improper grazing management in combination with lack of fire and/or brush control.

Community Phase Pathway 2.2A
The Altered Shrubland Community (2.2) can return to the Idaho Fescue Community (2.1) after a fire as long as the understory is able to carry the fire and Idaho fescue crowns survive the fire and re-sprout and/or there is sufficient seed Idaho fescue to re-vegetate the area.

Transition T2A
Removal of shrubs without proper grazing management can lead to an increase in bare ground and erosion of the fertile surface horizon and the site can degrade to the Sparsely Vegetated State (3). The driver for this transition is brush management without proper grazing management.

Transition T2B
Removal of shrubs can lead to an increase in bare ground. If invasive species are present, bare ground offers opportunity for invasive species to fill open areas, leading to the Invaded State (4). The driver for this transition is brush management in presence of invasive species.

Restoration Pathway R2A
Restoration of the Altered State to the Taller Bunchgrass State requires substantial energy input. The drivers for this restoration pathway are removal of woody species, restoration of native herbaceous species by reseeding rough fescue.

Restoration Pathway R3B
The Sparsely Vegetated State (3) has lost soil or vegetation attributes to the point that recovery to the Altered State (2) will require reclamation efforts such as soil rebuilding, intensive mechanical treatments, and/or reseeding in recommended areas only. If the reclamation efforts are performed without reseeding rough fescue, under unfavorable climatic conditions, or without proper grazing management, the site will return to the Altered State.

Restoration Pathway R4B
Weed management without reseeding taller bunchgrasses, favorable climatic conditions, or proper grazing management will lead to the Altered State (2).

STATE 3 SECTION

State Number: **3**

State Name: **Sparsely Vegetated State**

State Narrative:
The single community described below characterizes this state.

Community Phase Number: 3.1

Community Phase Name: Sparsely Vegetated Community

Community Phase Narrative:
Long-term grazing mismanagement with continuous growing-season pressure will reduce total productivity of the site and lead to an increase of bare ground. Once plant cover is reduced, the site is more susceptible to erosion. Soil erosion reduces soil fertility creating a reduction in plant production. This soil erosion or loss of soil fertility indicates the transition to the Sparsely Vegetated State (3). The decline may be exacerbated by extended drought conditions.

Very sparse plant cover and soil surface erosion characterize this community. Grass and forb, and shrub cover may be very sparse or clumped (canopy cover < 25%). Weeds, annual species, or shortgrass species dominate the plant community. Mid-stature perennial bunchgrass species (e.g., needleandthread) may exist, but only in patches.

Compared to the Taller Bunchgrass State (1) and the Altered State (2), this community has crossed a threshold (T1B, T2A) because of soil erosion, loss of soil fertility, or degradation of soil properties. If further soil erosion occurs, there will be a critical negative shift in the ecological processes of this site. The affects of soil erosion can alter the hydrology, soil chemistry, soil microorganisms, and soil physics to the point where intensive restoration is required to restore the site to another state or community. Simply changing grazing management cannot create sufficient change to restore the site within a reasonable period. It will require a considerable input of energy to move the site back to the Taller Bunchgrass State (1). This state has lost soil or vegetation attributes to the point that recovery to the Taller Bunchgrass State (1) will require reclamation efforts, i.e., soil rebuilding, intensive mechanical treatments, and/or reseeding.

In this community phase there may be a significant amount of bare ground, and large gaps may occur between plants. The transition to this state could occur because of overgrazing (often because of failure to adjust stocking rates in response to declining forage production because of increased dominance of unpalatable invasive species), long-term lack of fire, warming climate, or extensive drought. Potential exists for soils to erode to the point that irreversible damage may occur. If herbaceous cover decreases to the point that soils are no longer stable, the shrub overstory may not prevent soil erosion.

This plant community may be in a terminal state that will not return to the reference state because of degraded soil properties and loss of higher successional native plant species.

Transition T3A

Invasive species can occupy the Sparsely Vegetated State (3) and drive it to the Invaded State (4). The Sparsely Vegetated State is at risk of this transition occurring if invasive propagules are present. The driver for this transition is the presence of critical population levels (> 25%) of invasive species. The trigger is the presence of propagules of invasive species.

Restoration Pathway R3A

The Sparsely Vegetated State (3) has lost soil or vegetation attributes to the point that recovery to the Taller Bunchgrass State (1) will require reclamation efforts such as soil rebuilding, intensive mechanical treatments, and/or revegetation. The drivers for this restoration pathway are reclamation efforts and proper grazing management. The trigger is restoration efforts.

Restoration Pathway R3B

The Sparsely Vegetated State (3) has lost soil or vegetation attributes to the point that recovery to the Altered State (2) will require reclamation efforts such as soil rebuilding, intensive mechanical treatments, and/or reseeding in recommended areas only. If the reclamation efforts are performed without reseeding rough fescue, under unfavorable climatic conditions, or without proper grazing management, the site will return to the Altered State.

Restoration Pathway R4C

If invasive species are removed without sufficient remnant populations of reference community species (particularly rough fescue), a site in the Invaded State (4) is likely to return to the Sparsely Vegetated State (3) instead of the Taller Bunchgrass State (1). The driver for the reclamation pathway is weed management without reseeding. The trigger is invasive species control.

STATE 4 SECTION

State Number: **4**

State Name: **Invaded State**

State Narrative:
The single community described below characterizes this state.

Community Phase Number: 4.1

Community Phase Name: Invaded Community

Community Phase Narrative:
The Invaded State (4) is characterized by > 25 % of invasive species; spotted knapweed, leafy spurge, sulphur cinquefoil, and/or cheatgrass are the dominant invasive species in MLRA 44A. Introduced exotic plant species have been identified as one of the greatest threats to the integrity and productivity of native rangeland ecosystems and conservation of indigenous biodiversity (DiTomaso 2000; Mack et al. 2000). In addition to environmental consequences, damages caused and costs incurred to control invasive plants are several billion dollars each year in the United States (Pimentel et al. 2000).

Invasives are the driving factor throughout western Montana and they are a focal part of the ecology of MLRA 44A. Their ability to take over and dominate a site has become a big concern. Improper grazing management has contributed to the spread of these species.

The potential for altered ecosystem structure and function is high in the Invaded State (4) and can occur in many ways. The increase in invasive species, especially noxious weeds, can lead to reduction of the native bunchgrasses and an increase in the proportion of bare ground, which often results in reduced infiltration rates and increased surface runoff and erosion. Invasion by cheatgrass reduces above and below ground biomass (Ogle et al. 2003), increases plant litter, changes plant community canopy architecture (Belnap and Phillips 2001), reduces soil biota richness and abundance, reduces plant community richness (Belnap et al. 2005), increases wildfire frequency (Whisenant 1990), and potentially facilitates invasion by other noxious or invasive plants. Dense populations of invasive species can cause soil loss to increase because of lack of surface cover (Lacey et al. 1989).

Early in the invasion process there is a lag phase where invasive plant populations remain small and localized before expanding exponentially (Hobbs and Humphries 1995). Based on research conducted in noxious weed-invaded plant communities in Montana, it is reasonable to estimate that 25% dry weight composition of invasive plant species is the point in the invasion process where spread and abundance is increasing exponentially and where a plant community has crossed a threshold (Masters and Sheley 2001). For aggressive invasive species (i.e., spotted knapweed), this threshold could be < 10%.

Once invasive species dominate the site, either in species composition by weight or in their impact on the community, the threshold has been crossed to the Invaded State (4). Once invasive species such as spotted knapweed, cheatgrass, and leafy spurge become established, they are very difficult to eradicate. Therefore, considerable effort should be placed in preventing plant communities from crossing a threshold to the Invaded State (4) through early detection and proper management. Preventing new invasions is by far the most cost-effective control strategy and typically places an emphasis on education. Control measures used on the noxious plant species impacting this ecological site include chemical, biological, and cultural control methods. The best success has been found with an integrated weed management strategy that incorporates one or several of these options along with education and prevention efforts (DiTomaso 2000).

Production in the invaded community may vary greatly. A site dominated by spotted knapweed, where soil fertility and chemistry remain near potential, may have production near that of the reference community. A site with degraded soils and infestation of cheatgrass may produce only 10-20% as many pounds per acre a of the reference community.

Invasive plant species have effective reproductive strategies, long seed viability in the soil seed bank, and/or allelopathic properties (Williamson and Fitter 1996). Spotted knapweed has allelopathic properties whereby its roots exude catechin, which may limit the growth and establishment of other plant species (Callaway and Vivanco 2007; Bais et al. 2002), thus promoting its own success. An in-vitro experiment showed that other weeds like Dalmatian toadflax (*Linaria dalmatica*), kochia (*Kochia scoparia*), diffuse knapweed (*Centaurea diffusa*), and crops, such as wheat (*Triticum aestivum*), showed mortality on the fourteenth day after addition of root exudates from spotted knapweed (Bais et al. 2002). This allelopathic property creates highly resilient communities.

Cheatgrass has the ability to establish rapidly and attain community dominance following disturbances such as wildfire (Young and Evans 1978) or other disturbances that create bare soil. Cheatgrass is a successful invader because it has the ability to respond rapidly to increases in resource availability (Norton et al. 2004; Lowe et al. 2003) as well as to compete for water (Pellant 1996).

Cheatgrass was introduced into the United States in packing materials, ship ballast, and likely as a contaminant of crop seed. Cheatgrass was first found in the United States near Denver, Colorado, in the late 1800s. In the late 1800s and early 1900s, cheatgrass spread explosively in the ready-made seedbeds prepared by the trampling livestock hooves of overstocked rangelands. Cheatgrass has developed into a severe weed in several agricultural systems throughout North America, particularly western pastureland, rangeland, and winter wheat fields (NRCS 2009). Today, cheatgrass is found in most of the western states having reached its range of current distribution by 1930. In fact, a survey of 11 western states showed that cheatgrass was present on at least 60 million acres (Pellant 1996).

After arriving in 1893 on the San Juan Islands in Washington, spotted knapweed had established in over 24 counties in three northwestern states by 1924, with several large infestations near Missoula, Montana (Sheley et al. 2005). By 1975, spotted knapweed had spread into most of the western counties of Montana, and today, it is found in every county in Montana.

Leafy spurge, a native to Eurasia, was sighted in Park County, Montana as early as 1925 and has since been found in every county in Montana. Overgrazing by livestock has contributed to the spread of leafy spurge (Sheley et al. 2005).

Restoration Pathway R4A

Restoration of the Invaded State (4) to the Taller Bunchgrass State (1) requires substantial energy input. The drivers for this restoration pathway are removal of invasive species, restoration of native bunchgrass species, ongoing management of invasives, and proper grazing management. Without maintenance, invasive species are likely to return (probably rapidly) because of the presence of propagules in the soil and increases in soil disturbance. The drivers for this reclamation pathway are treatments to reduce or remove invasive/noxious species in combination with favorable growing conditions. The trigger is invasive species control.

Restoration Pathway R4B

Weed management without reseeding taller bunchgrasses, favorable climatic conditions, or proper grazing management will lead to the Altered State (2).

Restoration Pathway R4C

If invasive species are removed without sufficient remnant populations of reference community species (particularly rough fescue), a site in the Invaded State (4) is likely to return to the Sparsely Vegetated State (3) instead of the Taller Bunchgrass State (1). The driver for the reclamation pathway is weed management without reseeding. The trigger is invasive species control.

ECOLOGICAL SITE INTERPRETATIONS

Animal Community:

Livestock grazing is suitable on this site because of the potential to produce high quality forage. This site may be preferred for grazing by livestock, and animals may congregate in these areas, however if slopes are > 15% and distance from water is too great, livestock grazing will be limited. Management objectives should include maintenance or improvement of rangeland health attributes of this ecological site. Careful management of timing, intensity and duration of grazing to minimize grazing re-growth and providing adequate rest is important. Shorter grazing periods and changing season of use during the growing season are recommended for plant maintenance, health and recovery.

Continuous grazing with improper stocking rates throughout the growing season in pastures year after year will be detrimental, will alter the plant composition and production over time, and will result in a transition to the Mixed Bunchgrass Community (1.2) or the Shrubland Community (1.3) or potentially hasten a change to the Invaded State (4). Transition to other states will depend on how well the site is managed over time with grazing animals as well as other circumstances such as weather conditions over a period of time.

The transition to the Mixed Bunchgrass Community (1.2) or the Shrubland Community (1.3) can be the result of long-term, continuous grazing and/or repeated critical growing season grazing (early season grazing during stem elongation). This transition can also occur due to a combination of overgrazing and drought. Repeated grazing during stem elongation (generally mid-April through mid-June), can have detrimental affects, especially on the taller key bunchgrass species. Repeated spring grazing and/or repeated and prolonged summer grazing depletes stored carbohydrates, resulting in poor vigor of key forage plants over time and eventual death of these cool-season grasses – this can lead to an increase in less desirable native species and/or noxious weeds.

The Mixed Bunchgrass Community (1.2) and the Shrubland Community (1.3) can occur across the entire ecological site or can occur in a mosaic with higher and/or lower states. This is most notable in areas that attract additional grazing, such as water sources or salting locations.

The Mixed Bunchgrass Community (1.2) or the Shrubland Community (1.3) is subject to further degradation to the Altered State (2), the Sparsely Vegetated State (3) or the Invaded State (4). Management should focus on grazing management strategies that will prevent further degradation. Forage quantity and/or quality may be substantially reduced compared to the Reference Plant Community (1.1).

In the Altered State, forage production is substantially reduced compared to the Taller Bunchgrass State. Grazing is possible in the Sparsely Vegetated State and the Invaded State, but forage production is greatly reduced in both states. Grazing should be carefully managed to avoid soil loss and degradation of soil properties as well as to ensure adequate livestock health.

Prescriptive grazing should be included in a conservation plan to maintain vigor of key native plant species while targeting the invasive species problem. In some instances, carefully targeted grazing (sometimes in combination with other treatments) can reduce or eliminate populations of invasive species.

Distance to drinking water and slope can reduce grazing capacity within a management unit. Adjustments should only be made for the area that is considered necessary for reduction of animal numbers. For example 30% of a management unit may have 25% slopes and distances of > 1 mile from water; therefore the adjustment is only calculated for 30% of the unit (50% reduction on 30% of management unit). The table below is a general guide for ranches in Montana (Ricketts et al. 2004). Fencing, slope length, management, access, terrain and breeds are all factors that can increase or decrease the percent of grazable acres within a management unit. Adjustments should be made that incorporate pasture conditions when calculating stocking rates.

Stocking Rate Adjustments by Slope and Distance to Water on Rangelands for Cattle

Percent Slope	Distance to Water	% Acres Grazable
0% - 20%	0 - 1 mile	100%
0% - 20%	> 1 - 1.5 miles	75%
0% - 20%	> 1.5 - 2 miles	50%
0% - 20%	> 2 - 2.5 miles	25%
0% - 20%	> 2.5 miles	0%
21% - 40%	0 - 1 mile	75%
21% - 40%	> 1 - 1.5 miles	50%
21% - 40%	> 1.5 - 2 miles	25%
21% - 40%	> 2 miles	0%
41% - 60%	0 - 1 mile	50%
41% - 60%	> 1 - 1.5 miles	25%
41% - 60%	> 1.5 miles	0%
> 60%	0 - 1 miles	25%
> 60%	> 1 mile	0%

Hydrology Functions:
The water cycle functions best in the Taller Bunchgrass State (1) with good infiltration and deep percolation of rainfall. The water cycle degrades as the vegetation community declines. Rapid rainfall infiltration, high soil organic matter, good soil structure, and good porosity accompany high total ground cover of around 90%. High ground cover reduces raindrop impact on the soil surface, which keeps erosion and sedimentation transport low. Water leaving the site will have 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 Taller Bunchgrass Community (1.1) should have no rills or gullies present, and drainageways should be vegetated and stable.

Improper grazing management results in the transition to the Altered State (2). This state has reduced canopy cover, and increased bare ground. Therefore, infiltration is reduced and runoff increased due to reduced ground cover, rainfall splash, soil capping, reduced organic matter, and poor structure.

In the Sparsely Vegetated State (3) and the Invaded State (4) canopy and ground cover are greatly reduced compared to the Taller Bunchgrass State (1), which impairs the water cycle. Infiltration will greatly decrease and runoff will increase because of reduced ground cover, rainfall splash, soil capping, reduced organic matter, and poor structure. Sparse ground cover and decreased infiltration can combine to increase frequency and severity of flooding within a watershed. Soil erosion is accelerated, quality of surface runoff is poor, and sedimentation increases.

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

Wood Products:
None

Other Products:
None

Plant Preference by Animal Kind:
This rating system provides general guidance as to animal preference for plant species. It also indicates possible competition between kinds of herbivores for various plants. Grazing preference changes from time to time, especially between seasons, and between animal kinds and classes. Grazing preference does not necessarily reflect the ecological status of the plant within the plant community.

Legend:	P=Preferred	D=Desirable	U=Undesirable	E=Emergency
	N=Non-consumed	T=Toxic	Blank=Unknown or no data	
	Winter (W) = Jan., Feb., Mar. Summer (SU) = July, Aug., Sept.		Spring (SP) = Apr., May, June Fall (F) = Oct., Nov., Dec.	

Animal Kind: Cattle and Sheep

	Cattle				Sheep			
PLANT NAME	**W**	**SP**	**SU**	**F**	**W**	**SP**	**SU**	**F**
Green needlegrass	P	P	P	P	P	P	P	P
Western wheatgrass	P	D	D	P	D	D	D	D
Rough fescue	P	D	P	P	D	D	D	D
Idaho fescue	P	D	P	P	D	D	D	D
Bluebunch wheatgrass	P	D	P	P	D	D	D	D
Kentucky bluegrass	D	D	D	D	D	D	D	D
Needleandthread	D	D	D	D,T	D	D	D	D
Sandberg bluegrass	D	D	D	D	D	D	D	D
Threadleaf and needleleaf sedge	D	P	P	D	D	P	D	D
Canada bluegrass	D	D	D	D	D	D	D	D
Prairie junegrass	D	D	D	D	D	P	D	D
Plains muhly	D	D	D	D	D	D	D	D
Blue grama	D	D	D	D	D	P	P	D
Buffalograss	D	D	D	D	D	D	D	D
Cheatgrass	U	D	N	N	U	P	U	U
Blacksamson	N	D	D	D	D	P	P	D
Prairieclover spp.	N	D	D	D	D	D	D	D
Dotted gayfeather	N	P	P	P	D	P	D	D
Milkvetch spp.	N	D,T	D,T	D,T	D,T	P,T	D,T	D,T
American vetch	N	P	P	D	N	P	P	D
Prairie coneflower	N	D	D	D	D	D	D	D
Wild onion	N	P	P	N	N	P	P	N
Hood’s phlox	N	N	N	N	U	U	U	U
Pussytoes spp.	N	N	N	N	U	U	U	U
Wild parsley	N	D	D	U	N	D	D	U
Green sagewort	N	N	N	N	N	N	N	N
Scarlet globemallow	N	D	D	D	N	D	D	D
Twogrooved poisonvetch	N	T	T	T	N	T	T	T
White point loco	N	T	T	T	T,N	T,N	T,N	T,N
Low larkspur	N	N,T	N,T	N	N	D,T	D,T	N
Death camas	N	T	T	N	N	T	T	N
Winterfat	P	P	P	P	P	D	D	P
Nuttall’s saltbush	P	P	P	P	P	P	P	P
Prairie rose	N	N	N	N	D	D	D	D
Silver sagebrush	D	D	D	D	D	D	D	D
Green and rubber rabbitbrush	U	U	U	U	U	U	U	U
Wyoming big sagebrush	N	N	N	N	P	D	D	P
Mountain big sagebrush	N	N	N	N	D	U	D	D
Douglas-fir	N	N	N	N	U	U	U	U
Ponderosa pine	N	N	N	N	U	N	N	N
Rocky Mountain juniper	N	N	N	N	U	N	N	N
Greasewood	N	N	N,E	N,E	D	U, T	U	D
Fringed sagewort	N	N	N	N	U	U	U	U
Yucca	N	N	N	N	D	D	D	D
Broom snakeweed	N	N	N	U	U	U	U	U
Plains pricklypear	N	N	N	N	U	U	U	U

Animal Kind: Deer and Elk

	Elk				Deer			
PLANT NAME	**W**	**SP**	**SU**	**F**	**W**	**SP**	**SU**	**F**
Perennial grasses	P	P	P	P	D	P,D	D	D
Red threeawn	N	N	N	N	N	N	N	N
Annual grasses	N	P,D	N	D	N	P,D	N	D

Animal Kind: Deer and Elk (continued)

	Elk				Deer			
PLANT NAME	**W**	**SP**	**SU**	**F**	**W**	**SP**	**SU**	**F**
Sedges	D	P	P	P	D	P	P	P
Blacksamson	P	P	P	P	D	D	D	D
Prairieclover spp.	P	P	P	P	P	P	P	P
Dotted gayfeather	D	P	D	D	D	P	P	P
Milkvetch spp.	D	P	P	D	D	D	D	D
Scurfpea spp.	N	D	D	D	D	D	D	D
Hairy goldenaster	E	E	E	E	E	E	E	E
Goldenrod spp.	D	P	P	P	D	D	D	D
American licorice	P	P	D	D	D	P	D	D
Prairie coneflower	D	P	P	D	D	P	D	D
American vetch	P	P	P	P	D	P	P	P
Hood’s phlox	U	U	U	U	U	U	U	U
Wild parsley	U	D	U	U	U	D	U	U
Green sagewort	N	N	N	N	N	N	N	N
Scarlet globemallow	D	D	D	D	D	D	D	D
Twogrooved poisonvetch	N, T	N, T	N, T	N, T	N, T	N, T	N, T	N, T
White point loco	N, T	N, T	N, T	N, T	N, T	N, T	N, T	N, T
Death camas	N, T	N, T	N, T	N, T	N, T	N, T	N, T	N, T
Larkspur spp.	N, T	N, T	N, T	N, T	N, T	N, T	N, T	N, T
Winterfat	P	P	P	P	P	P	P	P
Prairie rose	U	U	U	U	E	D	E	E
Silver sagebrush	D	D	P	D	P	P	D	P
Wyoming big sagebrush	P	P	P	P	P	P	D	D
Mountain big sagebrush	D	U	D	D	D	U	D	D
Douglas-fir	U	U	U	U	U	U	U	U
Ponderosa pine	U	U	U	U	U	U	U	U
Rabbitbrush spp.	D	D	D	D	D	D	D	D
Rocky Mountain juniper	N	N	N	N	D	D	D	D
Fringed sagewort	D	U	U	D	D	U	U	D
Green sagewort	N	N	N	N	N	N	N	N
Plains pricklypear	N	N	N	N	N	N	N	N
Broom snakeweed	N	N	D	N	D	D	P	P

SUPPORTING INFORMATION

Associated Sites

Site Name:	**Site Number:**	**Narrative:**
Shallow Droughty	44AB138MT	
Shallow Loamy	44AB136MT	
Loamy	44AB032MT	
Droughty Steep	44AB038MT	

Similar Sites

Site Name	Site ID	Site Narrative
Thin Loamy	44AB162MT	This site differs by not having a mollic epipedon.
Loamy	44AB032MT	This site differs by being on slopes < 15%.
Droughty Steep	44AB005MT	This site differs by being skeletal at 10-20" soil depth, decreasing the water-holding capacity of the soil.
Clayey Steep	44AB136MT	This site occupies the same landscape positions and differs mainly by soil texture and plant community.
Shallow Loamy	43AB038MT	This site differs by having shallower soils (10-20" deep).

Inventory Data References (narrative):
Information presented was derived from NRCS clipping data, literature, field observations (based on three sampled sites and observations from numerous others), and personal contacts with range-trained personnel (i.e., professional opinion of agency specialists, observations of land managers, and outside scientists).

Inventory Data References:

Data Source	# of Records	Sample Period	State	County
Field Data	44AB040MT1	2008	MT	Lincoln
Field Data	44AB040MT2	2008	MT	Flathead
Field Data	44AB040MT3	2008	MT	Flathead
Field Data	44AB040MT4	2008	MT	Lake
Field Data	44AB040MT5	2008	MT	Lake
Field Data	44AB040MT6	2008	MT	Lake
Field Data	44AB040MT7	2008	MT	Lake

State Correlation:
This site has been correlated with the following states:
Montana

Authors and Description Approval:

Description Date: May 2009

Description Author(s): Synergy Resource Solutions, Inc., W. Lujan, N. Svendsen, K. Walstad, J. Siddoway, M. Hansen

Description Approval: Jon Siddoway

Description Approval Date: 12/15/2009

Revisions:

Reviser:

Revision Approval:

Revision Date:

Revision Notes:

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