Ecological site R052XN161MT
Silty (Si)
10-14" p.z.

Last updated: 4/14/2025
Accessed: 09/24/2026

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): 052X–Brown Glaciated Plains

The Brown Glaciated Plains, MLRA 52, is an expansive, agriculturally and ecologically significant area. It consists of approximately 14.5 million acres and stretches across 350 miles from east to west, encompassing portions of 15 counties in north-central Montana. This region represents the southwestern limit of the Laurentide Ice Sheet and is considered to be the driest and westernmost area within the vast network of glacially derived prairie pothole landforms of the northern Great Plains. Elevation ranges from 2,000 feet (610 meters) to 4,600 feet (1,400 meters). Soils are primarily Mollisols, but Entisols, Inceptisols, Alfisols, and Vertisols are also common. Till from continental glaciation is the predominant parent material, but alluvium and bedrock are also common. Till deposits are typically less than 50 feet thick, and in some areas glacially deformed bedrock occurs at or near the soil surface (Soller, 2001). Underlying sedimentary bedrock largely consisting of Cretaceous shale, sandstone, and mudstone (Vuke et al., 2007) is commonly exposed on hillslopes, particularly along drainageways. Significant alluvial deposits occur along glacial outwash channels and major drainages, including portions of the Missouri, Teton, Marias, Milk, and Frenchman Rivers. Large glacial lakes, particularly in the western half of the MLRA, deposited clayey and silty lacustrine sediments (Fullerton et al., 2013). Much of the western portion of this MLRA was glaciated towards the end of the Wisconsin age, with the maximum glacial extent occurring approximately 20,000 years ago (Fullerton et al., 2004). The result is a geologically young landscape that is predominantly a level till plain interspersed with lake plains and dominated by soils in the Mollisol and Vertisol orders. These soils are very productive and generally are well suited to dryland farming. Much of this area is aridic-ustic. Crop-fallow dryland wheat farming is the predominant land use. Areas of rangeland typically are on steep hillslopes along drainages. The rangeland, much of which is native mixedgrass prairie, increases in abundance in the eastern half of the MLRA. The Wisconsin-age till in the north-central part of this area typically formed large disintegration moraines with steep slopes and numerous poorly drained potholes. A large portion of Wisconsin-age till occurring on the type of the level terrain that would typically be optimal for farming has large amounts of less-suitable sodium-affected Natrustalfs. Significant portions of Blaine, Phillips, and Valley Counties were glaciated approximately 150,000 years ago during the Illinoisan age. Due to erosion and dissection of the landscape, many of these areas have steeper slopes and more exposed bedrock than areas glaciated during the Wisconsin age (Fullerton and Colton, 1986). While much of the rangeland in the aridic-ustic portion of MLRA 52 is classified as belonging to the “dry grassland” climatic zone, sites in portions of southern MLRA 52 may belong to the “dry shrubland” climatic zone. The dry shrubland zone represents the northernmost extent of the big sagebrush (Artemisia tridentata) steppe on the Great Plains. Because similar soils occur in both southern and northern portions of the MLRA, it is currently hypothesized that climate is the primary driving factor affecting big sagebrush distribution in this area. However, the precise factors are not yet fully understood. Sizeable tracts of largely unbroken rangeland in the eastern half of the MLRA and adjacent southern Saskatchewan are home to the Northern Montana population of greater sage-grouse (Centrocercus urophasianus), and large portions of this area are considered to be a Priority Area for Conservation (PAC) by the U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service, 2013). This population is unique among sage grouse populations in the fact that many individuals overwinter in the big sagebrush steppe (dry shrubland) in the southern portion of the MLRA and then migrate to the northern portion of the MLRA, which lacks big sagebrush (dry grassland), to live the rest of the year (Smith, 2013). Areas of the till plain near the Bearpaw and Highwood Mountains as well as the Sweetgrass Hills and Rocky Mountain foothills are at higher elevations, receive higher amounts of precipitation, and have a typic-ustic moisture regime. These areas have significantly more rangeland production than the drier aridic-ustic portions of the MLRA and have enough moisture to produce crops annually rather than just bi-annually, as in the drier areas. Ecological sites in this higher precipitation area are classified as the moist grassland climatic zone.

Classification relationships

NRCS Soil Geography Hierarchy • Land Resource Region: Northern Great Plains • Major Land Resource Area (MLRA): 052 Brown Glaciated Plains • Climate Zone: Dry Shrubland National Hierarchical Framework of Ecological Units (Cleland et al., 1997; McNab et al., 2007) • Domain: Dry • Division: Temperate Steppe • Province: Great Plains-Palouse Dry Steppe Province 331 • Section: Northwestern Glaciated Plains 331D • Subsection: Montana Glaciated Plains 331Dh • Landtype Association/Landtype Phase: N/A National Vegetation Classification Standard (Federal Geographic Data Committee, 2008) • Class: Xeromorphic Woodland, Scrub and Herb Vegetation Class

(3) • Subclass: Cool Semi-Desert Scrub and Grassland Subclass (3.B) • Formation: Cool Semi-Desert Scrub and Grassland Formation (3.B.1) • Division: Cool Semi-Desert Scrub and Grassland Division (3.B.1.Ne) • Macrogroup: Artemisia tridentata - Artemisia tripartita ssp. tripartita - Purshia tridentata Steppe and Shrubland Macrogroup (3.B.1.Ne.3) • Group: Artemisia tridentata - Artemisia tripartita - Purshia tridentata Big Sagebrush Steppe and Shrubland Group (3.B.1.Ne.3.b) • Alliance: Artemisia tridentata ssp. wyomingensis Mesic Steppe and Shrubland Alliance • Association: Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii Shrub Grassland EPA Ecoregions • Level 1: Great Plains (9) • Level 2: West-Central Semi-Arid Prairies (9.3) • Level 3: Northwestern Glaciated Plains (42) • Level 4: North-Central Brown Glaciated Plains (42o) and Glaciated Northern Grasslands (42j)

Ecological site concept

This provisional ecological site occurs occurs on till plains, hillslopes, outwash fans, alluvial fans, and high stream terraces where slopes are less than 15 percent. This site is typically on linear or concave backslopes, footslopes, shoulders, or summits. This site is characterized by moderately deep to very deep (greater than 20 inches to bedrock) medium textured soils. Surface textures are of the fine-loamy or fine-silty textural family (35 percent clay) and soils frequently have a mollic epipedon. Calcium carbonate equivalent is less than 5 percent in the upper 5 inches. Characteristic vegetation is Wyoming big sagebrush (Artemisia tridentata subsp. wyomingensis), western wheatgrass (Pascopyrum smithii), and needle and thread (Hesperostipa comata).

Associated sites

R052XN168MT	**Silty-Steep (SiStp) 10-14" p.z.** Slopes >15%; less forage production; different species composition.
R052XN162MT	**Clayey (Cy) 10-14" p.z.** Similar landscape position; different species composition and soil texture.
R053AE062MT	**Sandy (Sy) (Legacy) RRU 53AE** Similar landscape position; different species composition and soil texture.
R052XN166MT	**Overflow (Ov) 10-14" p.z.** Receives additional run-in moisture from Surrounding landscape; different species composition; higher productivity.
R052XN178MT	**Shallow (Sw) 10-14" p.z.** Soil depth less than or equal to 20 inches to a restrictive layer.

Similar sites

R053AE060MT	**Loamy (Lo) (Legacy) RRU 53AE** Neighboring MLRA, productivity and species shift.
R052XC217MT	**Silty (Si) 10-14" p.z.** Neighboring LRU, productivity and species shift.

Table 1. Dominant plant species

Tree	Not specified

Shrub	(1) *Krascheninnikovia lanata*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Nassella viridula*

Physiographic features

This site usually occurs on till plains, but is also found on alluvial fans, and knolls. Slopes vary from 1-15%, but are usually less than 8%. Elevations generally range from 2,000 to 3,500 feet.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Till plain (3) Alluvial fan
Runoff class	Very low to medium
Flooding duration	Brief (2 to 7 days)
Flooding frequency	None to rare
Ponding frequency	None
Elevation	610 – 1,070 m
Slope	0 – 10 %
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding duration	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	570 – 1,160 m

Slope	0 – 20 %

Climatic features

A semi-arid, temperate climate characterizes the Glaciated Plains. The predominance of cool season species has evolved to take advantage of the precipitation regime that peaks in late spring-early summer (June). Seventy-five percent of the annual precipitation usually falls as steady, soaking, frontal system rains. Summer rains usually come with thunderstorms. Precipitation is the most important factor influencing production (Heitschmidt et al 2005). Severe drought occurs on average in two out of every ten years (Cooper, et al., 2001).

Table 4 Representative climatic features

Frost-free period (characteristic range)	90-120 days
Freeze-free period (characteristic range)	120-140 days
Precipitation total (characteristic range)	250-360 mm
Frost-free period (average)	90 days
Freeze-free period (average)	130 days
Precipitation total (average)	310 mm

- (1) CHESTER [USC00241692], Chester, MT
- (2) GLASGOW [USW00094008], Glasgow, MT
- (3) HAVRE CITY CO AP [USW00094012], Havre, MT
- (4) SHELBY [USC00247500], Shelby, MT

Influencing water features

This site is not influenced by water from streams.

Wetland description

This site is not influenced by water from wetlands.

Soil features

These soils formed from glacial till. The surface layer of these soils varies from 0-7 inches in depth and are typically loam, silt loam, gravelly loam, clay loam, silty clay loam or sandy clay loam. Underlying layers are often clay loams, loams or silty clay loams. Soils are well drained, and are more than 20 inches deep to bedrock. Permeability varies from very slow to slow. Soil ph varies from 6.1-8.4.

Table 5. Representative soil features

Parent material	(1) Till (2) Alluvium

Surface texture	(1) Loam (2) Silt loam (3) Clay loam
Family particle size	(1) Fine-loamy
Drainage class	Well drained
Permeability class	Moderately slow to moderate
Soil depth	50 – 200 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (Depth not specified)	12.7 – 17.78 cm
Electrical conductivity (Depth not specified)	Not specified
Soil reaction (1:1 water) (Depth not specified)	6.1 – 8.4
Subsurface fragment volume <=3" (Depth not specified)	0 – 10 %
Subsurface fragment volume >3" (Depth not specified)	0 – 10 %

Ecological dynamics

This ecological site developed through time under the influence of climate, geological parent material, fire, plants and animals. Research consistently shows that precipitation is the principal factor altering productivity on ecological sites in the Northern Great Plains (Heitschmidt et al. 2005). The same authors concluded that grazing reduces herbage standing crop, whereas its effects on above ground net primary production varies with timing of grazing and precipitation events, along with the functional and structural composition of the plant community.

It is theorized that these lands burned on a natural interval of 5-7 years (Frost 1998). Fires were ignited by lightning and by Early Americans who were attempting to manipulate the environment.

The resultant historic climax plant community (HCPC) is the basis for plant community interpretations. The HCPC was determined by evaluating rangeland relic areas, and other areas protected from excessive disturbance. The HCPC is comprised of a mixture of cool and warm season grasses, forbs and shrubs. About 85% of the annual production is from grasses and sedges, most of which is produced during the cool season. Forbs and shrubs contribute 10% and 5%, respectively, to total annual production. Total vegetative production averages 1600 lbs/ac during normal years.

This site is resistant and resilient to disturbance. Departures in the HCPC are brought about by management actions, drought, a change in the natural fire regime, colonization and recruitment of noxious weeds, etc. The integrity of the site can be readily damaged with the continued absence of prescribed grazing and during prolonged drought. As the HCPC regresses to lower seral stages, the deep-rooted perennial grasses are replaced by blue grama, sandberg bluegrass, fringed sagewort, hoods phlox, threadleaf sedge, hairy goldenaster, and dense clubmoss. The dominance of these “lower-successional” species in the plant community disrupts ecological processes, impairs the biotic integrity of the site, and restricts the system’s ability to recover to higher seral states. The potential of succession back to the HCPC varies with the interaction of all environmental factors.

State and Transition Diagram

Trends in plant community dynamics, states, transitional pathways and thresholds have been evaluated and determined through experience and research. Successional pathways of the Silty 10-14” p.z. ecological site cannot be satisfactorily described using traditional theories of plant succession leading to a single climax community (Briske et al. 2005). As the HCPC regresses to an early seral state, it is theorized that a threshold is crossed somewhere within the mid-seral state. Plant communities occurring below this threshold are in a steady state. Succession back to the HCPC does not occur within a reasonable length of time, and/or without a large input of energy.

Three plant communities and the successional and regressional pathways that commonly occur within the Reference State (State 1) are shown in the following diagram. In addition, the transitions from Plant Community B (State 1) to State 2 (Plant Community C) and State 3 (Plant Community D) are also illustrated. A third transition denotes the pathway from State 1 to an introduced perennial grass seeding (State 4). Ecological processes are discussed in the plant community descriptions, which follow the diagram.

State and transition model

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-season Tall Bunchgrasses**			179-448	
	green needlegrass	NAVI4	*Nassella viridula*	90-224	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	90-224	–
2	**Rhizomatous Wheatgrasses**			179-448	
	western wheatgrass	PASM	*Pascopyrum smithii*	90-224	–
	tufted wheatgrass	ELMA7	*Elymus macrourus*	90-224	–
3	**Cool-season Medium Bunchgrasses**			314-1166	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	224-897	–
	needle and thread	HECO26	*Hesperostipa comata*	90-269	–
4	**Warm-season Bunchgrasses**			0-179	
	little bluestem	SCSC	*Schizachyrium scoparium*	0-90	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0-90	–
5	**Miscellaneous Grasses**			18-179	
	threadleaf sedge	CAFI	*Carex filifolia*	18-90	–
	Sandberg bluegrass	POSE	*Poa secunda*	18-90	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	18-90	–
	blue grama	BOGR2	*Bouteloua gracilis*	18-90	–
	plains reedgrass	CAMO	*Calamagrostis montanensis*	18-90	–
	Grass, native	2GN	*Grass, native*	18-90	–
Forb					
6	**Dominant Forbs**			36-179	
	American vetch	VIAM	*Vicia americana*	18-90	–

	dotted blazing star	LIPU	*Liatris punctata*	18-90	–
3	**Clovers**			36-179	
	purple prairie clover	DAPU5	*Dalea purpurea*	18-90	–
	white prairie clover	DACA7	*Dalea candida*	18-90	–
8	**Miscellaneous Forbs**			18-101	
	Forb, native	2FN	*Forb, native*	18-90	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	18-90	–
	common yarrow	ACMI2	*Achillea millefolium*	18-90	–
	aster	ASTER	*Aster*	18-90	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	18-90	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	18-90	–
	scurfpea	PSORA2	*Psoralidium*	18-90	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	18-90	–
	spiny phlox	PHHO	*Phlox hoodii*	18-90	–
	lesser spikemoss	SEDE2	*Selaginella densa*	0-1	–
Shrub/Vine					
9	**Dominant Shrubs**			18-90	
	winterfat	KRLA2	*Krascheninnikovia lanata*	18-90	–
10	**Miscellaneous Shrubs**			11-78	
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	11-90	–
	silver sagebrush	ARCA13	*Artemisia cana*	11-90	–
	snowberry	SYMPH	*Symphoricarpos*	11-90	–
	prairie sagewort	ARFR4	*Artemisia frigida*	11-90	–
	rose	ROSA5	*Rosa*	11-90	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0-90	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0-1	–

Table 7. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 8. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 9. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 10. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 11. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Animal community

Livestock Management This site evolved with grazing (bison, elk, deer and antelope, grasshoppers and jackrabbits, prairie dogs, etc.) fire and climatic extremes. The site is highly resistant to disturbances which may alter its ecological processes. It is also resilient. Following perturbations such as drought, which allows blue grama and other increasers to increase at the expense of the mid and tall grasses, succession occurs with subsequent rainfall. Total annual production averages 1600 lbs/ac during normal years. Forage production shows far greater variations in response to changes in annual precipitation than to different grazing intensities (Heitschmidt et al 2005). However, proper stocking rates and a planned grazing system are needed to ensure that the site remains in the Reference State #1.

Without proper grazing management, the tall and mid grass community regresses to a blue grama, prairie junegrass, dense clubmoss community. In comparison to the high seral state, suggested stocking rates on sites in early seral states are about 75% lower. Experience indicates that planned grazing prevents further deterioration on sites in low seral states. Once the plant communities of the Reference State regress to early-successional communities, mechanical treatment may be necessary to induce and facilitate succession back across the threshold. Poisonous plants are not normally a problem on this site. However, some of the milk vetches, death camas, larkspur, etc. may cause losses when forage demand by livestock exceeds forage supply. These conditions are most likely to occur during drought or by “turning-livestock-out” in early spring, before soil and vegetation conditions are ready for grazing. Wildlife Interpretations The Silty 10-14” p.z. ecological site that is in high seral or HCPC stages provides forage for mule deer and antelope during most of the year. However, the overall forage potential is limited by the relatively low production and diversity of forbs and shrubs. Low shrub cover also limits the potential of the site for thermal and escape cover. Most deer use occurs along the edges of the site where it borders woody draws, coulees, badland range sites, etc. The species diversity and cover associated with either the high seral or HCPC states also provide habitat for sharp-tailed grouse and other upland birds. Much of the use occurs along the transitions between the Silty 10-14” p.z. site and woodland draws. The relative absence of big sagebrush limits the potential of this site for sage grouse habitat. The few sage grouse that exist in the Glaciated Plains are associated with silver sagebrush. Species diversity and litter also provide favorable habitats for deer mice, rabbits and other small mammals. Golden eagles, redtail and ferruginous hawks are often circling over the landscape searching for prey. Sites that are in mid to low seral states are less suitable for big game, upland birds and small mammals. However, they are more suitable for prairie dogs. Prairie dog towns also have potential for use by burrowing owls, mountain plovers, and other wildlife species. Plant Preferences by Animal Kind Refer to NRCS Field Office Technical Guide, Section IIE, General Information, for tables displaying plant preferences by livestock and wildlife.

Hydrological functions

Soils associated with this ecological site are in Hydrologic Soil Groups B and C. Infiltration rates are generally moderate. The runoff potential is also moderate, depending on slope and ground cover. Good hydrologic conditions exist on this site when it is in either a high seral state or at HCPC. Canopy cover (grass, forbs and shrubs) is greater than 90% in these communities, which is conducive to high infiltration rates and minimal runoff and erosion. Sites in early or low seral state are generally considered to be in poor hydrologic condition. Concerns are valid, not because of the amount of bare ground, but because the dense clubmoss and blue grama restrict the ability of the desirable tall and mid-grasses to utilize available moisture. Erosion is probably minor on most of these Silty 10-14” p.z. sites because soil is either protected by mid and tall, cool-season grasses, or by dense clubmoss and blue grama. Regardless of condition, bare ground is usually minimal.

Wood products

This site has no significant value for wood products.

Other products

This site is suitable for livestock grazing from May through October. Because grasses comprise about 80% of the production, the site is better-suited for cattle rather than sheep grazing.

Other information

The Silty 10-14” p.z. ecological site in the northern Glaciated Plains is resistant to perturbations. However, the site loses its resiliency when the plant community regresses from a high to a mid seral state. As the site moves from HCPC to lower seral states, reproductive capability of desirable plants is restricted, annual production is less than 1/3 of its potential, litter is reduced, and the number of structural/functional groups are reduced.

Inventory data references

Data Source Number of Records Sample Period State County SCS-Range-417 ECS-1 Modified Double Sampling 92 2001-2004 MT Blaine, Roosevelt, Sheridan Valley, Daniels

Other references

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Contributors

Kirt Walstad

Approval

Kirt Walstad, 4/14/2025

Acknowledgments

Site Description Revisions The 2005 Silty 10-14” p.z. ecological site description replaces earlier dated versions of Silty 10-14” p.z. descriptions in Rangeland Resource Unit 52XN. This 2005 revision incorporates the State and Transition Model theory, additional data on site productivity, and an improved understanding of many rangeland health indicators. Site Description Approval This ecological site description is approved with the understanding that it is no more than another step in our continual effort to update the NRCS technical guide. In order to facilitate the process, NRCS field personnel are encouraged to forward existing information and/or new data that can be used to improve the utility of this site description. Please forward the information and data to the State Rangeland Management Specialist. Authors Date Approval Date Dr. John Lacey 02/28/2005 Loretta J. Metz 03/19/2005 Maxine Rasmussen, Area RMS, Glasgow, MT Jon Siddoway, Area RMS, Great Falls, MT Rick Bandy, Area RSS, Great Falls, MT Greg Snell, Area RSS, Glasgow, MT

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)	Siddoway/Bandy
Contact for lead author	Great Falls Area Office, Great Falls, MT Reference site used? No
Date	04/19/2005
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills: Slopes most common on this site are between 0 – 8% and with at least 95% of the soil surface well-covered there are no rills even with the most extreme convection storms. Rills would be rare on slopes of 9 – 15%.**

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2. **Presence of water flow patterns:** Due to the soil surface being well covered and minimal slope there is no evidence of past or current soil deposition or erosion for this site.

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3. **Number and height of erosional pedestals or terracettes:** Wind and water erosion will not be evident on this site, so pedestals and terracettes will not be present.

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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 should be 5% or less on this site.

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5. **Number of gullies and erosion associated with gullies:** Gully erosion will not be evident on this site.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Appearance or evidence of these erosional features on the landscape would not be present on this site.

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7. **Amount of litter movement (describe size and distance expected to travel):** Because there is little bare ground, litter movement will be minimal at most. Because the site is dominated by the taller bunchgrasses, litter size will reflect the height and diameter of the reproductive culms and leaves of these grasses as well as the lesser dominate mid-size grasses.

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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):** Resistance to erosion will be high with soil stability values of 5 or 6; areas of bare soil on this site may have values less than 5 if not under plant canopy.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface structure is granular; A horizon depth is 3 – 5".

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Dominance of taller, deep rooted bunchgrasses will maximize infiltration and minimize runoff throughout the site.

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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):** Will not be present generally, but there may be areas that have "healed" from former bison trails and wallows as well as more current livestock trails which could have a compaction layer below the soil surface.

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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:

Sub-dominant:

Other:

Additional: Cool season, taller grasses (Bluebunch wheatgrass) >> cool season mid-grasses (Needleandthread) = cool season rhizomatous grasses (Western wheatgrass) > cool season short grasses (Sandberg bluegrass) = perennial forbs > warm season shortgrass (Blue grama) = shrubs.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence): Will be low for all functional groups in a given year. Prolonged droughts which last more than 3 years may show increases in mortality and decadence for all plant groups.**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production): 1200 - 1850 #/acre. This would be the expected production for the reference state during adequate moisture years. 1600 pounds would be the expected production in a 12 inch precipitation zone.**

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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: Dense clubmoss, blue grama, Japanese brome, a variety of annual or biennial weedy forbs, fringed sagewort, broom snakeweed, prickly pear cactus, cheatgrass.**

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17. **Perennial plant reproductive capability: During adequate moisture years bunchgrasses will generally produce seeds, however the cool season rhizomatous grasses may not necessarily produce seed even with adequate moisture.**
