USDA Natural Resources Conservation Service

Ecological site R052XN179MT
Shallow Clay (SwC) 10-14" p.z.

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General information

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

MLRA notes

Major Land Resource Area (MLRA): 052X–Brown Glaciated Plains

The Brown Glaciated Plains, MLRA 52, is an expansive and agriculturally and ecologically significant area. It consists of around 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 the till is sedimentary bedrock largely consisting of Cretaceous shale, sandstone and mudstone (Vuke et al. 2007). It is commonly exposed on hillslopes, particularly along drainage ways. 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, and the maximum glacial extent occurred 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 mixed grass 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 fully understood at this time.

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 because 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 Grassland
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: Mesomorphic Shrub and Herb Vegetation Class (2)
• Subclass: Temperate and Boreal Grassland and Shrubland Subclass (2.B)
• Formation: Temperate Grassland, Meadow, and Shrubland Formation (2.B.2)
• Division: Great Plains Grassland and Shrubland Division (2.b.2.Nb)
• Macrogroup: Hesperostipa comata – Pascopyrum smithii – Festuca hallii Grassland Macrogroup (2.B.2.Nb.2)
• Group: Pascopyrum smithii - Hesperostipa comata - Schizachyrium scoparium - Bouteloua spp. Mixed-grass Prairie Group (2.B.2.Nb.2.c)
• Alliance: Pascopyrum smithii – Nassella viridula Northwestern Great Plains Herbaceous Alliance
• Association: None identified

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) & Glaciated Northern Grasslands (42j)

Ecological site concept

This ecological site occurs on hillslopes, plains, and ridges where soils are less than 20 inches deep and have a clay content greater than 35 percent. Slopes vary from 0 to 60 percent, but are typically greater than 15 percent. The distinguishing characteristics of this site are lithic or paralithic bedrock less than 20 inches from the soil surface and a clay content of greater than 35 percent. Soils are derived from clayey residuum, or clayey alluvium over shale. Soil surface textures (upper 4 inches) contain more than 35 percent clay. Underlying horizons are typically weakly developed and commonly contain shale fragments. Calcium carbonate equivalent is typically less than 5 percent, but may be up to 15 percent in some cases. This site is nonacid, with pH values greater than 5.6 throughout the soil profile. Vegetation is typically sparse and soil exposure relatively high. Characteristic vegetation is western wheatgrass (Pascopyrum smithii), green needlegrass (Nassella viridula), Nuttall's saltbush (Atriplex nuttallii), and winterfat (Krascheninnikovia lanata).

Associated sites

R052XN162MT	**Clayey (Cy) 10-14" p.z.** soils >20 inches in depth, higher production, and no hardpan, different species composition
R052XN176MT	**Shallow to Gravel (SwGr) 10-14" p.z.** similar position in landscape, soils with depth restriction that limits available moisture, soils 10-20” deep to sands or loamy sands
R052XN178MT	**Shallow (Sw) 10-14" p.z.** soil depth less than or equal to 20 inches to a restrictive layer; less forage production; parent material variable
R052XN172MT	**Dense Clay (DC) 10-14" p.z.** has a hard restrictive layerinthesoilator near the surface, salt tolerant plants maybe present but are rarely dominant

Similar sites

R053AE078MT	**Shallow Clay (Swc) (Legacy) RRU 53AE** Bluebunch wheatgrass is only a trace species in HCPC.
R052XC215MT	**Shallow Clay (SwC) 10-14" p.z.** Little bluestem is still a part of the HCPC, especially in eastern portions of this RRU.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Atriplex nuttallii* (2) *Krascheninnikovia lanata*
Herbaceous	(1) *Pascopyrum smithii* (2) *Nassella viridula*

Physiographic features

This ecological site occurs on rolling or strongly dissected uplands with shale outcrops. Soils generally have a clay loam to clay surface layer, subsoil, and shale bedrock at a depth of 10 to 20 inches. Slopes usually range from 15 to 35%, but can be less than 15%, and can occasionally reach 60%. Elevations normally vary from 2,200 to 3,500 feet.

Table 2. Representative physiographic features

Landforms	(1) Plain (2) Hill (3) Ridge
Runoff class	Very high
Flooding frequency	None
Ponding frequency	None
Elevation	2,200–3,500 ft
Slope	15–35%
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified

Elevation	1,875–3,800 ft
Slope	0–60%

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)	85-123 days
Freeze-free period (characteristic range)	116-142 days
Precipitation total (characteristic range)	10-14 in
Frost-free period (average)	94 days
Freeze-free period (average)	125 days
Precipitation total (average)	12 in

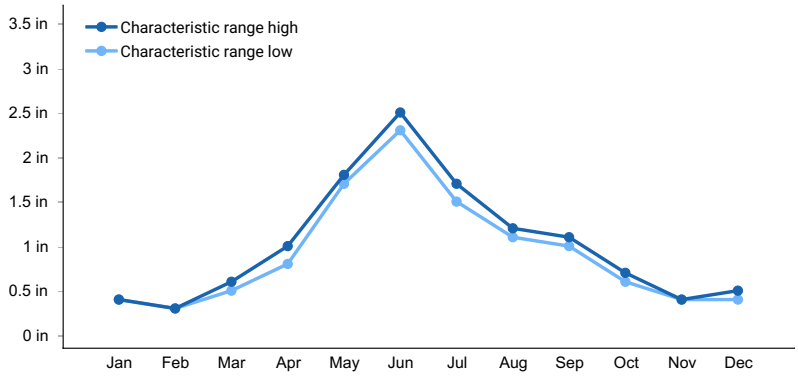


Figure 1. Monthly precipitation range

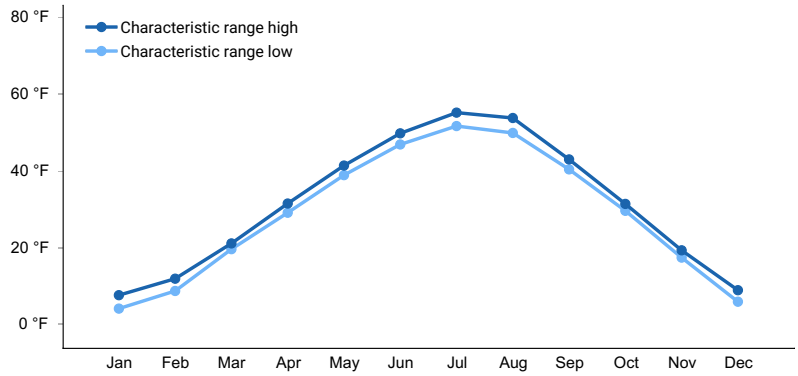


Figure 2. Monthly minimum temperature range

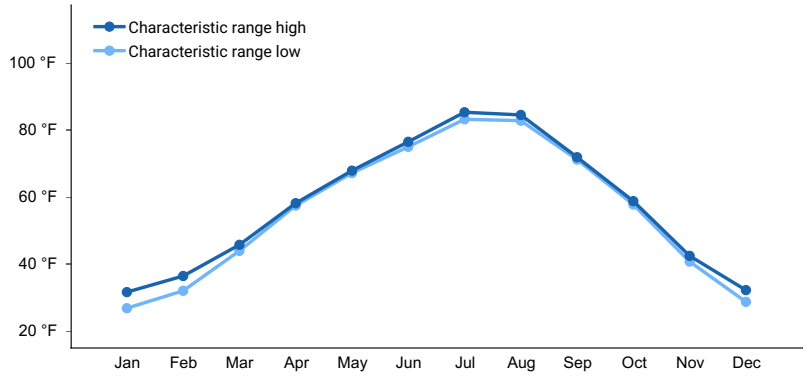


Figure 3. Monthly maximum temperature range

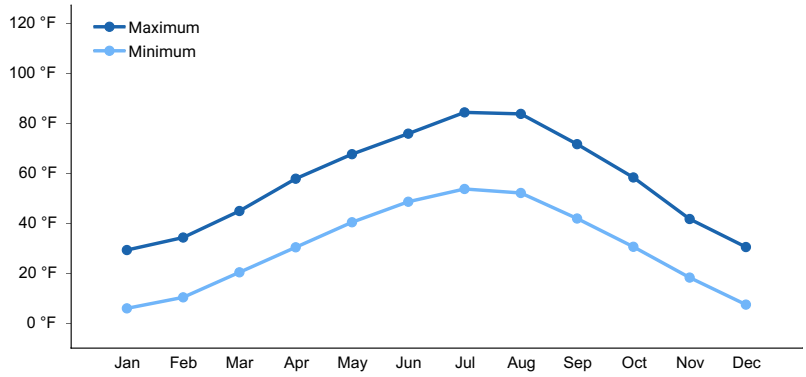


Figure 4. Monthly average minimum and maximum temperature

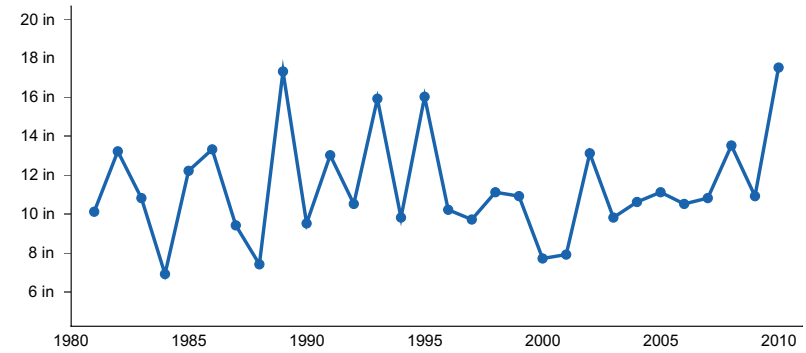


Figure 5. Annual precipitation pattern

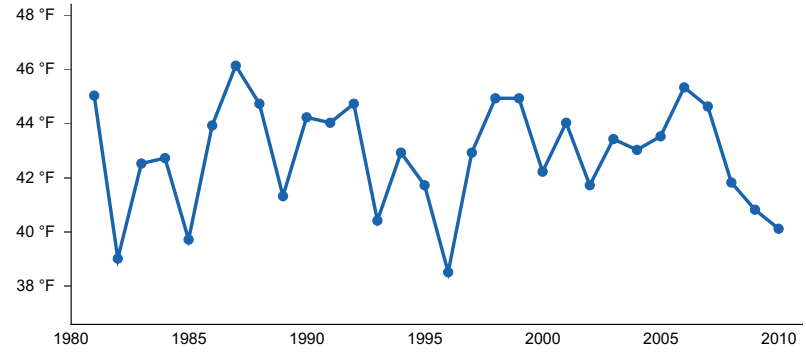


Figure 6. Annual average temperature pattern

Climate stations used

- (1) 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 shallow, well drained soils formed in material weathered from clay shale. The soils occupy upland positions. Clay shale bedrock is at a depth of 10 to 20 inches. The surface texture is clay or silty clay. Subsoil textures are usually silty clay. Permeability is very slow. Soil ph varies from 6.6 – 8.4. This site is characterized by the following soil components: Lisam, Neldore, Yawdim and Neldohr.

Table 5. Representative soil features

Parent material	(1) Residuum–shale
Surface texture	(1) Clay loam (2) Clay (3) Silty clay
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Very slow
Depth to restrictive layer	10–20 in
Soil depth	10–20 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	1.5–3 in
Calcium carbonate equivalent (Depth not specified)	0–5%
Electrical conductivity (Depth not specified)	0–8 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–13
Soil reaction (1:1 water) (Depth not specified)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	6–19%
Subsurface fragment volume >3" (Depth not specified)	0–2%

Ecological dynamics

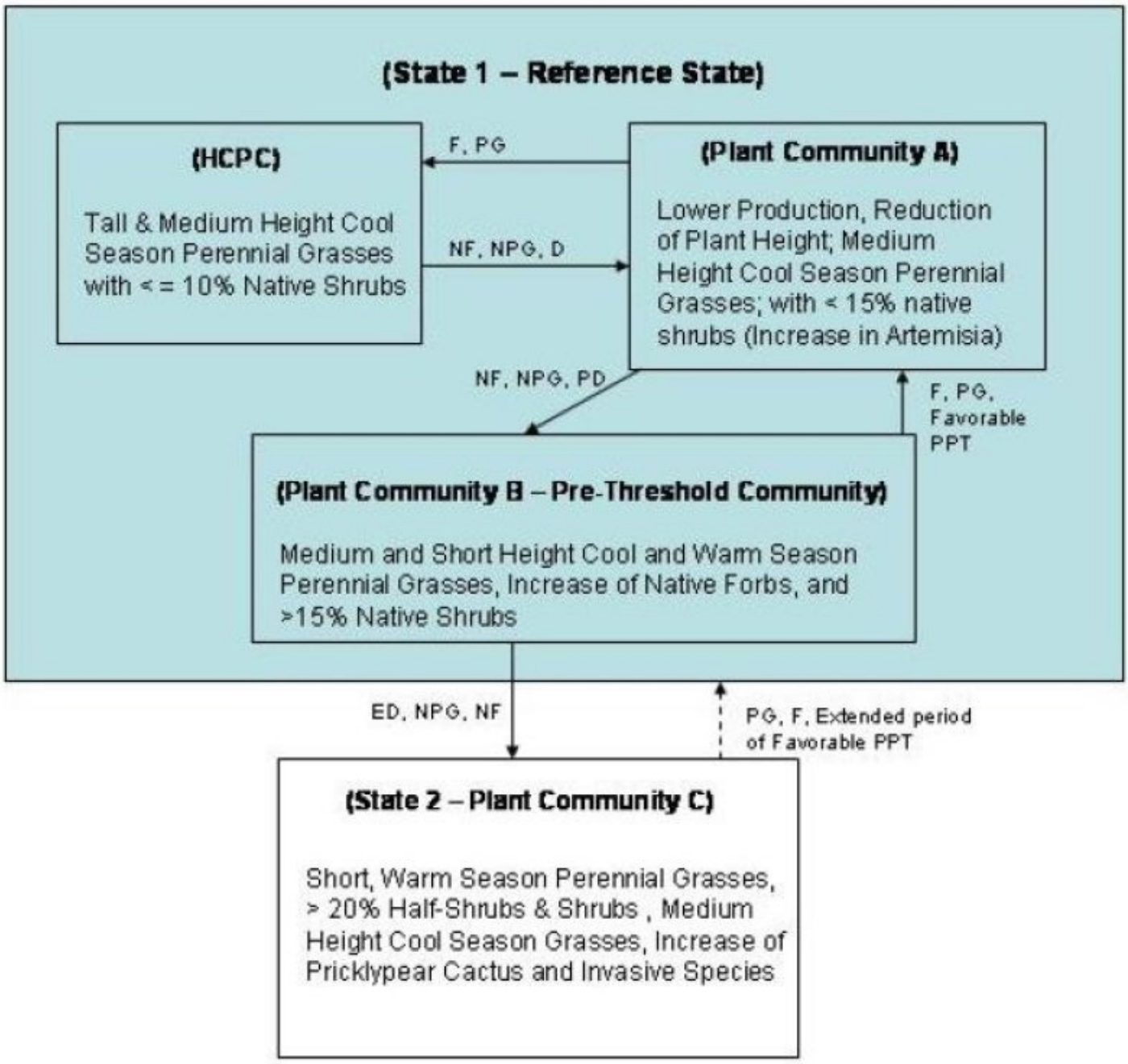
This site developed through time under the influence of climate, geological materials, fire, plants and animals. Research on upland ecological sites consistently shows that precipitation is the principal factor altering productivity (Heitschmidt et al. 2005). The same authors concluded that grazing reduces herbage standing crop, whereas its effects on aboveground net primary production vary with timing of grazing and precipitation events, along with the functional and structural composition of the plant community. Prior to the arrival of European man, these lands may have burned every 10-12 years (Frost 1998).

The resultant historic climax plant community (HCPC) is the basis for plant community interpretations. The HCPC has been 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 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 1000 lbs/ac in normal years, 700 lbs/ac in “unfavorable” years, and 1300 lbs/ac in “favorable” years.
This site is resistant to disturbance, especially when late-successional plants dominate the site. Departures from the HCPC generally result from management actions, drought, and/or a change in the natural fire regime. The site is considered fragile in the sense that vegetative vigor and composition will rapidly decline with continued adverse impacts. Plant communities that retain a high percentage of late successional species are highly resilient. With favorable precipitation and/or prescribed grazing treatments these plant communities can return to the HCPC. In contrast, significant succession is unusual within early-seral communities.

State and Transition Diagram
Successional pathways of Shallow Clay 10-14” p.z. ecological sites 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 pathways that commonly occur within the Reference State (State 1) are shown in the following diagram. The transition from State 1 to State 2 and a plant community representative of State 2 are also illustrated. Ecological processes are discussed in the plant community descriptions that follow the diagram.

State and transition model

Shallow Clay 10-14" p.z. RRUs 52XC, 52XN, and 53AE



Legend:
NF – No Fire
F – Fire (natural interval 10-12 years)
NPG – Non-prescribed Grazing
PG – Prescribed Grazing
PPT -- Precipitation
D – Drought (3-5 years)
PD – Prolonged Drought (5-7 years)
ED – Extended Drought (> 7years)

State 1
Reference State

Community 1.1
Historic Climax Plant Community (HCPC) Tall- and medium-height cool-season perennial

grasses with less than or equal to 10 percent native shrubs.

Tall- and medium-height cool-season perennial grasses with less than or equal to 10 percent native shrubs. The cool season western wheatgrass and green needlegrass are the dominant plants on this ecological site. They account for about 75% of the total annual production in the HCPC. Drought and non-prescribed grazing reduces the competitiveness of the dominant species, and allows lower successional grasses (plains reedgrass, prairie junegrass, needleandthread, sandberg bluegrass, and blue grama) to increase on the site. Plains muhly, a palatable, warm season, short grass may occur in this community. About 10% of the total production is made by a mix of warm and cool season short grasses and sedges. Forbs contribute about 5% of the total annual production. Two warm season legumes (purple and white prairie clover) and a cool season legume (American vetch) are important components of the HCPC. They fix nitrogen, and are highly palatable forage for livestock and many species of wildlife. Three additional legumes (milkvetch, scurfpea and prairie thermopsis) also occur in the community however their value as forage plants is much lower. Onion, hoods phlox, buckwheat, hoods phlox, scarlet globemallow and biscuitroot may occur as small percentages of the total annual production. The latter group contains a mix of warm and cool season species whose relative occurrence on the site is largely influenced by the timing and amount of precipitation. Nuttall saltbush and winterfat are two common shrubs on this site. Both species make most of their growth during the cool part of the growing season, and are excellent browse for grazing animals. Silver sagebrush, big sagebrush, fringed sagebrush, rubber rabbitbrush, prairie rose, and pricklypear cactus may occur as small percentages of the total annual production. Shrubs normally make up about 10% of the total annual production. Broom snakeweed, annual bromes, and annual forbs are not a part of the HCPC. Their presence indicates possible ecological deterioration, or downward trend. Total annual production averages 1000 lbs/ac during normal years. However, production declines as the site regresses from the HCPC to lower successional communities. Regression may result from grazing management strategies that do not allow adequate recovery periods between grazing events, drought, and/or the disruption of the normal fire regime. The above disturbances favor the replacement of green needlegrass and western wheatgrass by blue grama, sandberg bluegrass, prairie junegrass, scarlet globemallow, onion, and hoods phlox. Nuttall saltbush may also be replaced by broom snakeweed, fringed sagewort, etc. Cheatgrass and Japanese brome may colonize the site as it further deteriorates from the HCPC and associated plant communities. As a result of these vegetative changes, there is less litter to protect the soil and infiltration is reduced. Hydrologic cycles are impaired when plant communities are unable to effectively use precipitation. Plant basal cover averages 25%. Litter varies from 50-60%, and bare ground averages 10%. Thus, runoff and erosion are not major concerns in the HCPC on the shallow clay ecological site. Runoff and soil erosion normally increase as the HCPC regresses to earlier seral states. The major plant species composition and production by dry weight are shown for the HCPC in the following table. Total annual production has been derived from several sources, and has been adjusted to represent a typical annual moisture cycle.

Resilience management. The HCPC is comprised of a mixture of cool and warm season grasses 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 1000 lbs/ac in normal years, 700 lbs/ac in “unfavorable” years, and 1300 lbs/ac in “favorable” years.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	600	850	1100
Shrub/Vine	80	100	130
Forb	20	50	70
Total	**700**	**1000**	**1300**

Table 7. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0%
Grass/grasslike foliar cover	0%
Forb foliar cover	0%
Non-vascular plants	0-1%

Biological crusts	0-1%
Litter	50-60%
Surface fragments >0.25" and <=3"	0-1%
Surface fragments >3"	0-1%
Bedrock	0-1%
Water	0%
Bare ground	10-20%

Table 8. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	1-5%
Grass/grasslike basal cover	20-30%
Forb basal cover	1-2%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 9. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	0-1%	0-15%	0-25%
>0.5 <= 1	–	0-40%	0-40%	0-50%
>1 <= 2	–	0-50%	0-40%	0-25%
>2 <= 4.5	–	0-10%	0-5%	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 1.2
Plant Community A Lower production, reduction of plant height, medium-height cool-season perennial grasses, with less than 15 percent native shrubs (increase in Artemisia)

Lower production, reduction of plant height, medium-height cool-season perennial grasses, with less than 15 percent native shrubs (increase in Artemisia) Non-prescribed grazing and drought reduce plant height and plant litter. Total annual production is about 80% of the production found in HCPC. Surface runoff and soil temperature increases and infiltration decreases. Shallow-rooted short grasses (sandberg bluegrass, blue grama, and prairie junegrass) and sedges gain a competitive advantage over medium height, deep-rooted cool season perennial grasses (bluebunch wheatgrass, green needlegrass and western wheatgrass). They are able to compete more successfully with the mid-grasses because of the ability of relatively shallow root systems to utilize shallowly

penetrating moisture. Western wheatgrass, bluebunch wheatgrass, and green needlegrass contribute about 60% of the total annual production. Vigor of these high-successional grasses has declined, and individual plant growth is reduced from what it is in the HCPC. Production of the short grasses increases relative to their percentage contribution in the HCPC. Although a few annual forbs are present on disturbed areas, the forb component continues to contribute about 10% of the total annual production. Fringed sagewort and silver sagebrush increased at the expense of nuttall saltbush and winterfat. Therefore, total shrub production is 5-10% of total annual production. Most of the species characteristic in the HCPC community are present in Community A. Therefore, it is highly resilient and resistant to change. Trend is influenced by the interaction of climatic factors and livestock grazing management practices.

Community 1.3
Plant Community B - Pre-threshold Community Medium- and short-height cool and warm-season perennial grasses, increase of native forbs, and greater than 15 percent native shrubs.

Medium and short-height cool and warm-season perennial grasses, increase of native forbs, and greater than 15 percent native shrubs. This Community is dominated by a mix of medium and short height, cool and warm season grasses. Western wheatgrass, green needlegrass, and bluebunch wheatgrass represent from 40-50% of total annual production. Little bluestem is present only in trace amounts. Blue grama, threadleaf sedge, sandberg bluegrass and other low successional grasses expanded their influence in the community. Total annual production is about 75% of the production in Community A, or about 50% of what it was in the HCPC. Prairie thermopsis, hoods phlox, wild onion, western yarrow, and scarlet globemallow increased and now contribute about 15% of the total annual production. The density of fringed sagewort and broom snakeweed (warm season half-shrubs) increased relative to their presence in the higher successional communities. Pricklypear cactus is usually present in this community. Total annual production averages 550 lbs/ac. In comparison to the HCPC, total plant cover and amount of litter declines. A disproportionate amount of litter that is on the ground is material from lower successional plants. Bare ground increases to about 20%. Plant community B is called the “pre-threshold community”. It is critical that this community be recognized and strategies implemented to prevent further regression. Compared to the HCPC, water flow patterns are more numerous than expected, there is slight to moderate active pedestalling, there is more bare ground than expected, there is moderate movement of smaller size litter deposits into depressions or against obstructions, infiltration is slightly to moderately decreased due to the shift toward more short grasses in the plant community. The reproductive capabilities of green needlegrass and western wheatgrass are somewhat limited relative to recent climatic conditions (USDI and USDA 2000). Community B is less resilient and much less resistant to change than Community A. Once Community B regresses to a lower state, normal successional processes are less likely to occur in a timely fashion.

Pathway 1.1A
Community 1.1 to 1.2

No fire, non-prescribed grazing, drought (3 to 5 years) Non-prescribed grazing, drought and/or a cessation of the natural fire regime will cause regression from HCPC to Community A.

Pathway 1.2A
Community 1.2 to 1.1

Fire (natural interval 10 to 12 years), prescribed grazing Favorable growing conditions, the implementation of prescribed grazing, or periodic fire will move Plant Community A to the HCPC. This succession is possible within a couple of years.

Pathway 1.2B
Community 1.2 to 1.3

No fire, non-prescribed grazing, prolonged drought (5 to 7 years) Community A will regress to Community B under non-prescribed grazing, prolonged drought, or an extended period lacking a natural fire regime. The rate of regression varies with the intensity of the disturbances. Severe drought may cause retrogression within a couple years.

Pathway 1.3A

Community 1.3 to 1.2

Fire (natural interval 10 to 12 years), prescribed grazing, favorable precipitation Community B is fairly resilient, and it does not persist in a steady state. Prescribed grazing and/or a period of favorable precipitation will usually induce succession from Community B to Community A (Branson and Miller 1981).

State 2
Degraded State

Plant Community C

Community 2.1
Plant Community C - Short, Warm-season Perennial Grasses/Shrubs

Short, Warm-season Perennial Grasses, greater than 20 percent half shrubs and shrubs, medium height cool-season grasses, increase of pricklypear cactus and invasive species. This plant community is dominated by blue grama and other short warm season perennial grasses. Prairie junegrass, sandberg bluegrass and other cool season short grasses are also common. Western wheatgrass persists as slender stalks, with minimal seed production. Low-successional grasses and sedges contribute about 50% of the total annual production. Fringed sagewort, broom snakeweed and Nuttall saltbush contribute more than 20% of the total annual production. Low successional forbs also contribute about 20% of the production. Broom snakeweed and pricklypear cactus are conspicuous in the community. Total annual production averages about 400 lbs/ac, a 25% reduction from Community B. Litter cover averages about 15%. Water flow patterns are numerous and there is moderate active pedestalling. Bare ground is moderately to much higher than expected. Compared to the HCPC, there has been a structural shift from medium height to short grasses, and a functional shift from cool to warm season plants. Reproductive capability of mid height cool season grasses is greatly reduced relative to recent climatic conditions.

Transition T1A
State 1 to 2

Extended drought (greater than 7 years), non-prescribed grazing, no fire Community B is much less resistant to change than Community A. Lower production, lower vegetative cover, less litter, and increased bare ground increases Community B’s susceptibility to disturbance. Extended drought and non-prescribed grazing can cause regression to State 2.

Restoration pathway R2A
State 2 to 1

Prescribed grazing, fire (natural interval 10 to 12 years), extended period of favorable precipitation Prescribed grazing reduces the probability of further regression in this State, but it does not ensure significant succession to State 1. Succession from State 2 to State 1 may occur with prescribed grazing combined with an extended period of favorable precipitation. This potential succession is depicted with a “dashed” arrow in the state and transition diagram. Succession can also be induced by mechanical treatments and range seeding.

Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-season Bunchgrasses**			400–800	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	300–500	–
	green needlegrass	NAVI4	*Nassella viridula*	100–300	–
1	**Rhizomatous Wheatgrasses**			100–300	
	western wheatgrass	PASM	*Pascopyrum smithii*	50–150	–
	tufted wheatgrass	ELMA7	*Elymus macrourus*	50–150	–

3	**Warm-season Bunchgrasses**			0–600	
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–500	–
	little bluestem	SCSC	*Schizachyrium scoparium*	50–150	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–50	–
4	**Miscellaneous Grasses**			0–100	
	blue grama	BOGR2	*Bouteloua gracilis*	0–100	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–50	–
	plains reedgrass	CAMO	*Calamagrostis montanensis*	0–50	–
	threadleaf sedge	CAFI	*Carex filifolia*	0–50	–
	needleleaf sedge	CADU6	*Carex duriuscula*	0–50	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–50	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–50	–
	Grass, native	2GN	*Grass, native*	0–50	–
Forb					
5	**Dominant Forbs**			10–50	
	American vetch	VIAM	*Vicia americana*	10–50	–
2	**Clovers**			20–100	
	purple prairie clover	DAPU5	*Dalea purpurea*	10–50	–
	white prairie clover	DACA7	*Dalea candida*	10–50	–
7	**Miscellaneous Forbs**			0–40	
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–50	–
	aster	ASTER	*Aster*	0–50	–
	scurfpea	PSORA2	*Psoralidium*	0–50	–
	common yarrow	ACMI2	*Achillea millefolium*	0–50	–
	bastard toadflax	COUM	*Comandra umbellata*	0–50	–
	milkvetch	ASTRA	*Astragalus*	0–50	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–50	–
	spiny phlox	PHHO	*Phlox hoodii*	0–50	–
	onion	ALLIU	*Allium*	0–50	–
	Forb, native	2FN	*Forb, native*	0–50	–
Shrub/Vine					
8	**Dominant Shrubs**			30–130	
	Nuttall's saltbush	ATNU2	*Atriplex nuttallii*	10–50	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	10–50	–
	silver sagebrush	ARCA13	*Artemisia cana*	10–50	–
9	**Miscellaneous Shrubs**			0–30	
	big sagebrush	ARTR2	*Artemisia tridentata*	0–50	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–50	–
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–50	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–50	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–1	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–1	–

Animal community

Livestock Management

The Shallow Clay 10-14” p.z. ecological site is fairly productive and is suited for livestock grazing. However, prescribed grazing management is needed. This site is often associated with slopes that may be susceptible to erosion. Species composition is favorable to livestock, and is susceptible to heavy stocking and season long grazing. The cool season medium height grasses are generally selectively grazed, giving the short grasses a competitive advantage. Grazing during early spring may also result in soil compaction. Any additional factors reducing infiltration and increasing runoff on this site are management concerns. Shorter grazing periods developed in conjunction with adequate periods of deferment to facilitate regrowth, replenish carbohydrate pools, and accumulate litter on the soil surface are recommended.

This ecological site, as do most other sites in the northern mixed prairie, has a short grass component. The short grasses usually increase with grazing and decrease with protection or prescribed grazing. However, succession in direct response to a change in grazing pressure is not guaranteed in the Northern Great Plains.

Sampling four-year old ungrazed exclosures and grazed areas with 35% utilization, Vogel and Van Dyne (1966) found essentially the same basal cover of grasses, sedges, forbs, litter and bare soil on protected and grazed sites. They concluded that four years was too short of a time for cover to change significantly. Hofmann and Ries (1989) observed similar results following a four-year study in North Dakota. Even after 41 years of exclosure, changes in species composition can be relatively small when the site is in the dry, low production portion of northern mixed prairie (Brand and Goetz, 1986). They concluded that site characteristics limited the development of potential vegetation with the exclusion of grazing, but the potential impacts of prescribed grazing on succession were not discussed. The shallow clay ecological site is not as productive as the sites evaluated by Vogel and Van Dyne, Hofmann and Ries, or by Brand and Goetz. Therefore, range managers should recognize the environmental limitations of this site. While a prescribed grazing system is always a good recommendation, it may not guarantee significant succession.

This ecological site is suited for prescribed grazing by livestock. Because of the terrain, and propensity of shrubs, this site may be more compatible for sheep, rather than cattle grazing. Although poisonous plants are not normally a problem, death camas and other forbs may cause losses if livestock are grazing in early spring, before there is adequate growth of suitable forage plants.

Wildlife Interpretations

The HCPC associated with this ecological site provides diverse and valuable wildlife habitat. This site often occurs as a mosaic with other ecological sites, thus creating “ecotones” that serve as a magnet to attract many species of wildlife. Antelope and mule deer prefer grazing this site because of the Nuttall saltbush and other shrubs. When this site occurs in the landscape as a mosaic with other sites, thermal and escape cover are provided for many species of wildlife.

This ecological site becomes less valuable for deer and antelope when plant diversity declines with regression. For example, the disappearance of the bluebunch wheatgrass, green needlegrass, western wheatgrass, and the reduction of Nuttall saltbush would shorten the length of the “green forage” season. The increase of blue grama, hoods phlox etc. is associated with the loss of palatable forbs. These changes also adversely impact foraging opportunities for deer, antelope, upland birds, etc. Because of insufficient vegetative structural diversity, residual grass carry-over and litter cover, the value of the plant community found in State 2 is greatly reduced for wildlife habitat.

Hydrological functions

Water is the main factor limiting vegetative production on this site. Soil components in this ecological site are normally classed into Hydrologic Group D. These soils have a very high runoff potential, with hydrologic runoff curves of 89 to 80. Field investigations are needed to adjust the curves when plant communities deteriorate from the HCPC. Areas with ground cover less than 50% have the greatest potential for reduced infiltration and higher runoff.

Recreational uses

This site provides hunting opportunities for upland game species. Outdoor enthusiasts may also appreciate the serenity and openness of this site.

Wood products

This site has no significant value for wood products.

Other information

This ecological site is not highly resistant to disturbances. Species diversity is adversely affected by season long continuous grazing and by heavy stocking. Medium height grasses are replaced by short grasses. The number of structural/functional groups is reduced with regression from the HCPC. The amount of solar energy that is captured and converted to carbohydrates for plant growth is reduced in State 2. A reduction in total vegetative growth results in less potential vegetation that can be transformed into litter. Litter reductions result in less infiltration, and more runoff and soil erosion.

Inventory data references

Data Source Number of Records Sample Period State County
SCS-Range-417 1 1991-92 MT Phillips
(note: regarded with skepticism; SI = 66%; production = 520lbs/ac, of which 180 lbs were forbs)
ECS-1
Modified Double Sampling 8 2002-2004 MT Phillips, Blaine, Valley, Roosevelt,
Daniels
Ross, R. L. and H. E. Hunter. 1976. Climax vegetation of Montana. USDA Soil Conservation Service. Bozeman, MT.
USDA-SCS-MT 1981 Technical Range Site Description

Other references

Brand, M.D. and H. Goetz. 1986. Vegetation of exclosures in Southwestern North Dakota. J. Range Manage. 39:434-437.
Branson, F. A., and R. F. Miller. 1981. Effects of increased precipitation and grazing management on Northeastern Montana rangelands. J. Range Manage. 34(1):3-11.
Briske, D. D., S. D. Fuhlendorf, and F. E. Smeins, 2005. State-and-transition models, thresholds, and rangeland health: a synthesis of ecological concepts and perspectives.
Rangeland Ecol. Manage 58:1-10.
Frost, C. C. 1998. Presettlement fire frequency regimes of the United States: a first approximation. Pages 70-81. in Teresa L. Pruden and Leonard A. Brennan (eds.). Fire in ecosystem management: shifting paradigm from suppression to prescription. Tall Timbers Fire Ecology Conference Proceedings. No. 20. Tall Timbers Research Station, Tallahassee, FL.
Heitschmidt, R. K., K. D. Klement, and M. R. Haferkamp. 2005. Interactive effects of drought and grazing on Northern Great Plains rangelands. Rangeland Ecol. Manage. 58:11-19.
Hofmann, L. and R.E. Ries. 1989. Animal performance and plant production from continuously grazed cool-season reclaimed and native pastures. J. Range Manage. 42:248-251.
U.S. Department of Interior and U.S. Department of Agriculture. 2000. Interpreting indicators of rangeland health. Tech. Ref. 1734-6.
Vogel, W.G. and G.M. Van Dyne. 1966. Vegetation responses to grazing management on a foothill sheep range. J. Range Manage. 19:80-85.

Contributors

Kirt Walstad

Approval

Kirt Walstad, 1/24/2024

Acknowledgments

Site Description Revisions
The 2005 Shallow Clay 10-14” p.z. ecological site description replaces earlier dated versions of the Shallow Clay 10-14” p.z. description 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	Kirt Walstad
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 15–35% and with at least 85% of the soil surface well-covered, rills, if evident will be rare, but may occur in bare areas after extreme convection storms – rills in this case would be narrow and less than 10 feet in length.

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2. **Presence of water flow patterns:** Will be evident on this site with the steeper slopes, and with areas of bare ground, there may be areas which show accumulations of litter due to water movement, even after minor storm events.

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3. **Number and height of erosional pedestals or terracettes:** Wind erosion will be rare on this site, but water erosion on the steeper slopes may have plants that could have pedestals and terracettes which could be 0.5 inch in height at the top of the slope and 1.0 inch towards the bottom of the slope.

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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 15% or less on this site.

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5. **Number of gullies and erosion associated with gullies:** Current gully erosion will not be evident on this site, but there

may be gullies which have “healed” from the distant past.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Appearance or evidence of these erosional features or 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):** Litter movement will be minimal on the gradual slopes, however on the steeper slopes there will be evidence of litter movement (i.e. debris dams) which may travel up to 10 feet.

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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 between 1 and 4 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 blocky; A horizon depth is 1 – 3 ”.

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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 bunchgrasses (Bluebunch wheatgrass >> cool season rhizomatous grasses (Western wheatgrass) = perennial forbs > cool season short grasses (Sandberg bluegrass) > shrubs = warm season shortgrass (Blue grama) = sedges.

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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.

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

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 800 - 1200 #/acre. This would be the expected production for the reference state during adequate moisture years. 1000 pounds would be the expected production in a 12 inch precipitation zone.

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:** Blue grama, Japanese brome, a variety of annual or biennial weedy forbs, fringed sagewort, rubber rabbitbrush, broom snakeweed, curlycup gumweed, prickly pear cactus, cheatgrass.

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.