USDA Natural Resources Conservation Service

Ecological site R052XN178MT
Shallow (Sw) 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. Mixedgrass 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 hills, ridges with outcrops of shale, sandstone or rock; where soils are 10 to 20 inches deep. Loam and silt loam are the dominant textures. Slopes vary from 4 to 35 percent, but can be as steep as 65 percent.

The distinguishing characteristics of this site are lithic or paralithic bedrock less than 20 inches from the soil surface. Soils are derived from residuum from interbedded sedimentary rock. Soil surface textures (upper 4 inches) contain less than 35 percent clay. Underlying horizons are typically weakly developed. 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 range from 7.4 to 9.0 throughout the soil profile. Vegetation is typically sparse and soil exposure relatively high. Characteristic vegetation is bluebunch wheatgrass (Pseudoroegneria spicata), needle and thread (Hesperostipa comata), western wheatgrass (Pascopyrum smithii), and green needlegrass (Nassella viridula).

Associated sites

R052XN161MT	**Silty (Si) 10-14" p.z.** soils >20 inches in depth, and slopes < 15%.
R052XN168MT	**Silty-Steep (SiStp) 10-14" p.z.** soils >20 inches deep and occurs on slopes greater than 15%.
R052XN179MT	**Shallow Clay (SwC) 10-14" p.z.** soils are clayey over clayey shale.

Similar sites

R052XC214MT	**Shallow (Sw) 10-14" p.z.** Similar Concept, shift in plants and production, different LRU.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Rhus trilobata* (2) *Krascheninnikovia lanata*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Hesperostipa comata*

Physiographic features

This site occurs on undulating to rolling hills on the sedimentary and sandstone uplands with outcrops of shale, sandstone or rock. Slopes usually vary from 4 to 35 percent, but can be as steep as 65%. Elevations normally vary from 2,500 to 3,500 feet.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Ridge (3) Plain
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	2,500–3,500 ft
Slope	4–35%
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	1,850–4,500 ft
Slope	1–65%

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)	74-113 days
Freeze-free period (characteristic range)	111-135 days
Precipitation total (characteristic range)	10-14 in
Frost-free period (average)	88 days
Freeze-free period (average)	124 days
Precipitation total (average)	12 in

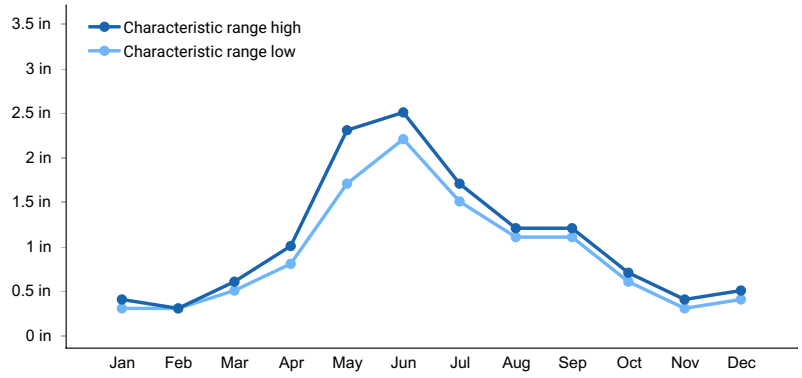


Figure 1. Monthly precipitation range

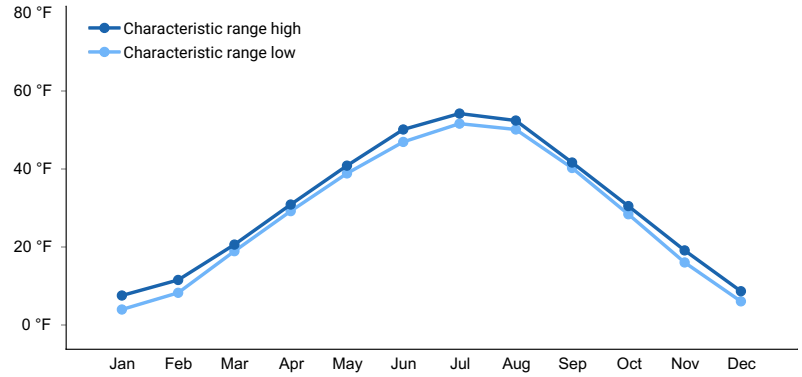


Figure 2. Monthly minimum temperature range

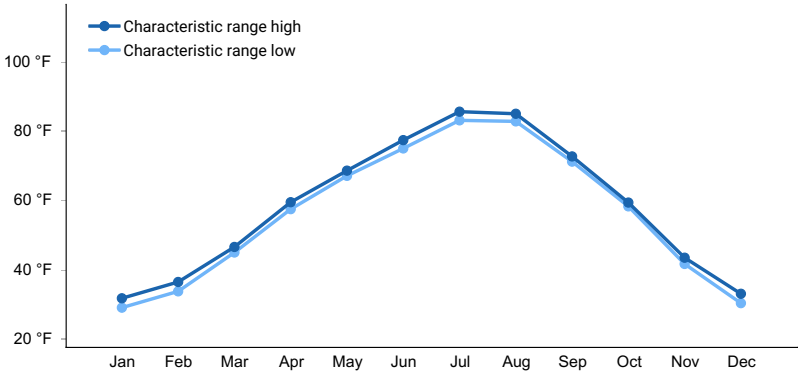


Figure 3. Monthly maximum temperature range

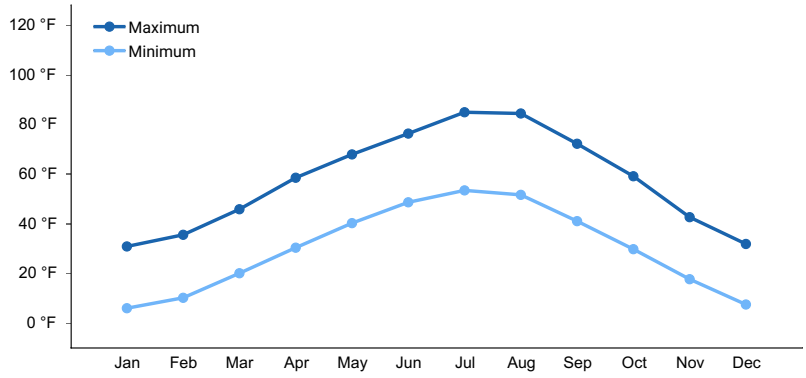


Figure 4. Monthly average minimum and maximum temperature

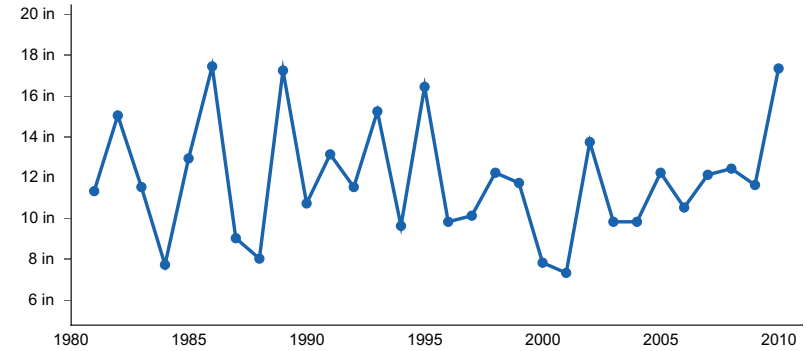


Figure 5. Annual precipitation pattern

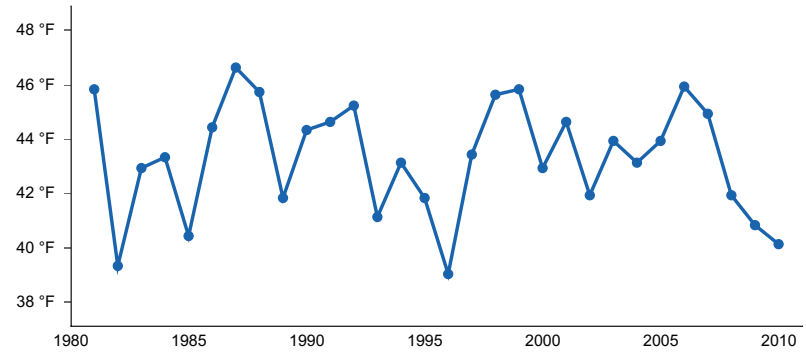


Figure 6. Annual average temperature pattern

Climate stations used

- (1) CHESTER [USC00241692], Chester, MT
- (2) CHINOOK [USC00241722], Chinook, MT
- (3) HAVRE CITY CO AP [USW00094012], Havre, MT
- (4) MALTA 35 S [USC00245340], Zortman, MT
- (5) 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 are 10 to 20 inches deep. Sandstone bedrock or weakly consolidated sedimentary beds begin at 10-20

inches. Most herbaceous roots extend less than 20 inches below the soil surface. The Cabba, Cabbart, Ernem, Castner, Cheadde, and Rentsac soil components characterize this site. Loam and silt loam are the dominant textures. Soil ph varies from 7.4 – 9.0.

Table 5. Representative soil features

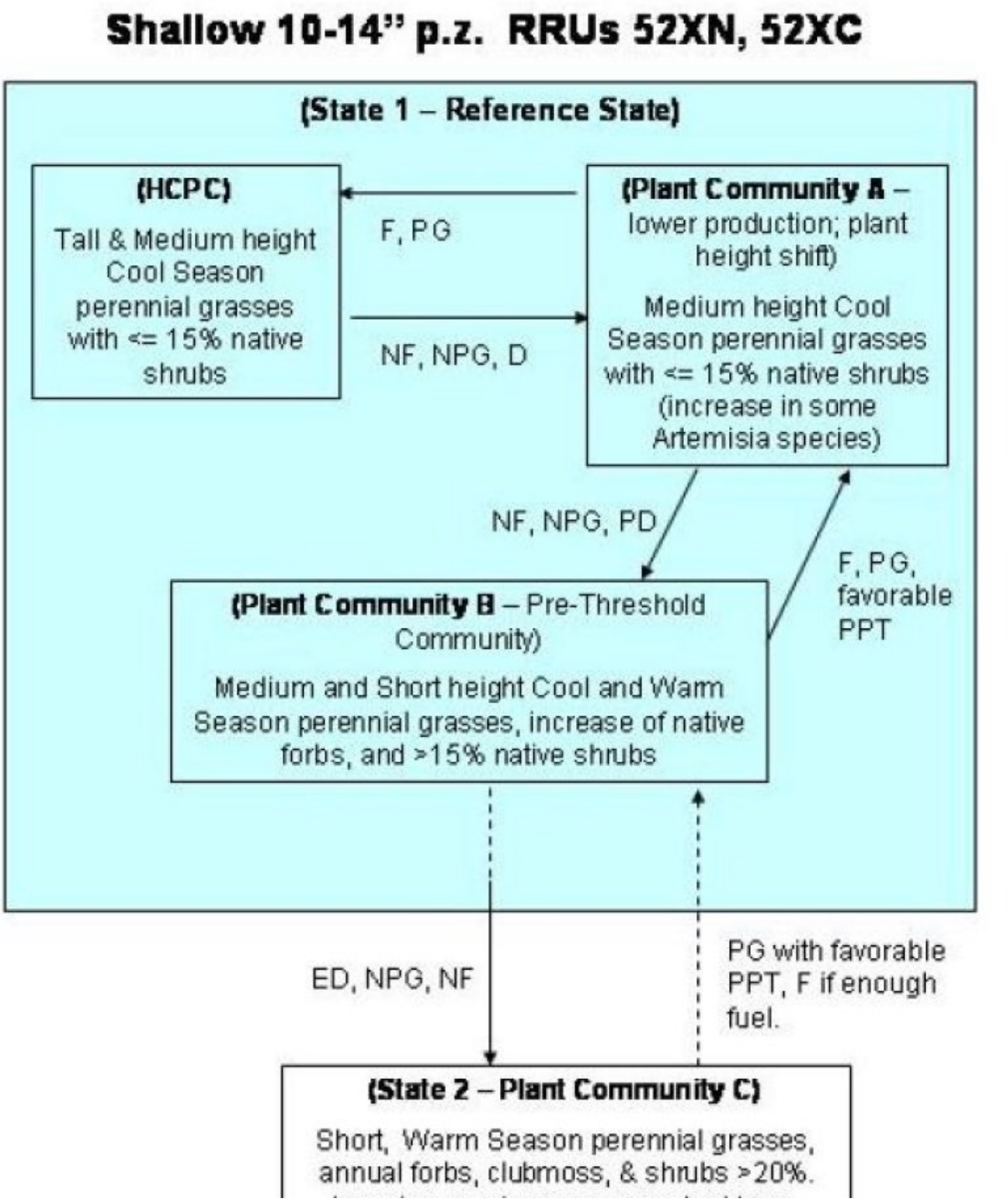
Parent material	(1) Residuum–interbedded sedimentary rock
Surface texture	(1) Loam (2) Silt loam (3) Silty clay loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately slow
Depth to restrictive layer	10–20 in
Soil depth	10–20 in
Surface fragment cover <=3"	0–10%
Surface fragment cover >3"	0–2%
Available water capacity (Depth not specified)	3–4 in
Electrical conductivity (Depth not specified)	0–4 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	7.4–9
Subsurface fragment volume <=3" (Depth not specified)	13–16%
Subsurface fragment volume >3" (Depth not specified)	0–4%

Ecological dynamics

Ecological Dynamics of the Site
This site developed through time under the influence of climate, geological materials, fire, plants and animals. Research consistently shows that precipitation is the principle 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 caries 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 10-12 years (Frost 1998). However, environmental characteristics of this site limit herbage production and subsequent fuel accumulation. Therefore, in comparison to other upland ecological sites, the role of fire is probably less significant in the development of this site.
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 70% of the annual production is from grasses and sedges, most of which is produced during the cool season. Forbs and shrubs contribute 10 and 20%, respectively, to total annual production. Total vegetative production averages 900 lbs/ac in normal years, 600 lbs/ac in “unfavorable” years, and 1100 lbs/ac in “favorable” years.
Departures from the HCPC generally result from management actions, drought, and/or a change in the natural fire regime. Because of shallow soils and steep slopes, plant communities are not highly resistant to disturbance. The site is considered fragile in the sense that vegetative vigor and composition will rapidly decline with continued adverse impacts. With favorable precipitation and/or prescribed grazing treatments the plant community can return to the HCPC. However, succession may be slow. Trends in plant community dynamics states, transitional pathways, and thresholds have been evaluated and determined through experience and research.

State and Transition Diagram
Successional pathways of the Shallow 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 in the mid-seral state. Succession back to the HCPC often does not occur within a reasonable length of time, without a large input of energy.
Three plant communities within the Reference State (State 1) and the transition to a representative community of State 2 are depicted in the following state and transition model. Successional pathways between the communities within State 1 are also depicted. Ecological processes are discussed below in the plant community descriptions.

State and transition model



Invasive species more prevalent here.

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

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 15 percent native shrubs.

Tall and medium height cool-season perennial grasses with less than or equal to 15 percent native shrubs. Bluebunch wheatrgrass, western/thickspike wheatgrass, green needlegrass, little bluestem, and needleandthread are the most common grasses in this community. Bluebunch wheatgrass is more prevalent in the western portion, rather than the eastern portion of the Glaciated Plains. These tall and mid, cool season grasses account for 60-70 percent of the total production. Two warm season, short grasses (plains muhly and blue grama) and a mix of cool season short grasses (prairie junegrass, plains reedgrass, and sandberg bluegrass) commonly occur in the HCPC. Total production by short grasses usually represents less than 10% of the total production. Needleandthread, a mid-successional cool season bunchgrass, may produce from 10-20% of the total annual production. American vetch (cool season) and purple and white prairie clover (warm season) are native, nitrogen-fixing legumes. They are valuable forage plants and are also an integral part of the HCPC. Milkvetch and prairie thermopsis are two additional legumes that fix nitrogen. However, they are generally rated as fair and poor forage for livestock, respectively. Bastard toadflax, aster, and hoods phlox should be no more than a minor component of the forb community. Skunkbush sumac and winterfat, respectively, are important cool and warm season shrubs. They should be present in the HCPC. Shrubs such as creeping juniper, broom snakeweed, prickly pear cactus and fringed sagewort should be no more than a minor component of the community. Similarity indices >75% are associated with this community. Tall and mid cool season grasses generally dominate the HCPC. However, the Shallow 10-14” p.z. ecological site is not characterized by a precise assemblage of species that remains constant from place to place or from year to year. Variability is apparent in productivity and occurrence of individual species. For example, little bluestem and sideoats grama production is favored on north and east aspects, while bluebunch wheatgrass and needleandthread growth is favored on south and west aspects. Little bluestem and needleandthread also prefer coarse textured soils, rather than fine textured soils. The HCPC often regresses to lower seral stages. 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 sequence. The above disturbances favor the replacement of little bluestem, bluebunch wheatgrass, western/thickspike wheatgrasses, and other deep-rooted, perennial grasses by blue grama, sandberg bluegrass, prairie junegrass, hairy goldenaster, hoods phlox and clubmoss. Winterfat, skunkbush sumac, and other desirable shrubs may also be replaced by broom snakeweed, fringed sagewort, etc. Cheatgrass and Japanese brome may colonize the site. As the result of these vegetative changes, there is less litter to protect the soil and less infiltration. Hydrologic cycles are impaired as plant communities are unable to effectively use precipitation. Plant cover (litter, and canopy of grasses, forbs and shrubs) is greater than 70% Therefore, plant cover and litter are adequate to optimize infiltration, minimize runoff and erosion, and provide good hydrologic conditions. Research and experience have not shown that excess litter adversely impacts ecological processes on the shallow 10-14” ecological site. The diverse mix of species found at HCPC help warm and cool season grasses, forbs, and shrubs ensures that the soil profile contains an adequate mix of deep and shallow roots to maintain or increase infiltration rates and reduce runoff. Runoff and soil erosion normally increase as the HCPC regresses to earlier seral states. However, the ecological role of fire on Shallow

sites is not fully understood. Fires would presence of clubmoss cover may reduce runoff and soil erosion on some soils. Clubmoss is also very competitive. Once it forms a mat, observations and experience along Montana's Highline indicate that plant succession and site resiliency are adversely impacted. Most ecologists recognize that significant managerial changes are needed before a clubmoss community can return to HCPC. The HCPC is believed to have evolved with periodic fires occurring at intervals of 10-12 years. Fires temporarily reduce litter and favor, thus allowing more runoff. However, fire favors the succession of grasses and forbs at the expense of half-shrubs and shrubs. It is believed that frequent fires would have reduced clubmoss. As fire frequency decreased with the establishment of ranches and farms, clubmoss and the woody component of some communities may have increased. Where fuel loads increased above historic levels, today's fires may burn hotter and increase the potential for accelerated wind and water erosion.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	420	630	770
Shrub/Vine	120	180	220
Forb	60	90	110
Total	**600**	**900**	**1100**

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	40-50%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0-5%
Bedrock	0-1%
Water	0%
Bare ground	10-20%

Table 8. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	5-10%
Grass/grasslike basal cover	10-15%
Forb basal cover	1-4%
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%	0-1%	0-1%
>0.5 <= 1	–	0-25%	0-25%	0-45%
>1 <= 2	–	0-50%	0-50%	0-45%
>2 <= 4.5	–	0-25%	0-25%	0-10%
>4.5 <= 13	0-1%	–	–	–
>13 <= 40	0-1%	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 1.2
Plant Community A - Lower Production; plant hight shift Medium height cool-season perennial grasses with less than or equal to 15 percent native shrubs (increase in some Artemisia species).

Medium height cool-season perennial grasses with less than or equal to 15 percent native shrubs (increase in some Artemisia species). Plant Community A is characterized by a mix of tall, mid and short grasses and sedges. Range inventories conducted by NRCS on the Fort Peck and Belknap Reservations indicate similarity indices of 55-75 are indicative of this community. The lower-stature plants tend to produce less forage than the mid grasses that they replaced. In contrast to the HCPC, total vegetation production may be 10-20% lower in Community A In comparison to the HCPC, the amount of needleandthread grass has increased, while western/thickspike wheatgrasses decreased. Blue grama and threadleaf sedge increased and are more common in the community. The total percentage of warm season, lower successional species (hariy goldenaster, scurfpeas, hoods phlox, and aster) has increased. Although some of the native shrubs decline in vigor and abundance, fringed sagewort and silver sagebrush often increase. Thus the total shrub component may be greater than 15%. Effects of grazing management and/or climatic conditions are visible. Preferred forage species are grazed and/or stunted, canopy cover is reduced, litter is reduced, and bare ground is increased. In comparison to the HCPC, this community is slightly drier. Thus, species such as blue grama, prairie junegrass and some increaser forbs have gained a competitive advantage over the tall, cool-season, deep-rooted perennial grasses. The short grasses are able to compete more successfully with the tall grasses because of the ability of relatively shallow root systems to utilize shallowly penetrating moisture, characteristic of drier habitats (Coupland, 1961).

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. Plant Community B is dominated by a mix of medium and short grasses. In comparison to Community A, the short grasses contain more blue grama, a warm season species. The number of warm season forbs, such as hairy goldenaster, aster, and western yarrow increase and replace the prairie clovers, American vetch, and black Sampson. The warm season half-shrub, fringed sagewort, also increases. Thus, this community is characterized by a functional shift from a cool season dominant to more warm season species. Litter varies from 10-15%. In contrast to the HCPC, there is about1/3 more bare ground. Rills, flow patterns and litter deposits are visible. Similarity indices of 45-55 characterize this plant community. Blue grama, threadleaf sedge, needleandthread and clubmoss have increased in the community by replacing some of the mid grasses. Total annual production normally varies from 500-600 lbs/ac. Plant community B is called the “pre-threshold community”. It is a critical that this community be recognized and strategies implemented to prevent further regression. Although this community can improve to either Community A or HCPC through successional processes, further disturbance will result in regression to a lower state. Once Community B regresses to a lower state, normal successional processes are usually restricted.

Pathway 1.1A
Community 1.1 to 1.2

No fire, non-prescribed grazing, and drought (3 to 5 years) Non-prescribed grazing, drought and/or a cessation of fire 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 Succession from Plant Community A to HCPC occur fairly readily, and usually result from either planned grazing management, reintroduction of the natural fire regime, and/or periods of favorable precipitation. This succession can occur within a few 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, of an extended period of no fire. 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 This varies with environmental conditions. Generally, as the percentage of warm season short grasses and warm season forbs increase above 35%, succession to Plant Community A and eventually HCPC become slower and are less likely to occur. Succession is more likely to occur with prolonged periods of favorable rainfall combined with prescribed grazing. A reintroduction of the natural fire regime may also aid in shifting Plant Community B back to Plant Community A or the HCPC.

State 2
Degraded State

Plant Community C

Community 2.1
Plant Community C Short, warm-season perennial grasses, annual forbs, clubmoss, and shrubs greater than 20 percent invasive species more prevalent here

Short, warm-season perennial grasses, annual forbs, clubmoss, and shrubs greater than 20 percent invasive species more prevalent here Blue grama, threadleaf sedge and clubmoss dominate the community. The group of short, warm season grasses and sedges produce nearly ½ of the vegetation. Prickly pear cactus and annual grasses have also increased. Western/thickspike wheatgrasses and bluebunch wheatgrass occur as scattered plants or remnants. Needleandthread declined in vigor and it has been supplanted by lower-successional grasses and forbs. Similarity indices vary from 0-35. Total annual vegetation production averages about 300 lbs. Litter cover declines to 15-20%. However, the decline in litter is partially off-set by an increase in clubmoss cover (often exceeding 20%). Initial runoff rates from clubmoss-covered soils are reduced compared to bare ground, but may increase as the clubmoss becomes saturated. Because of the steep slopes and shallow soils, soil erosion is a major resource concern.

Transition T1A
State 1 to 2

Extended drought (greater than 7 years), non-prescribed grazing, no fire Transitions from State 1 (Plant Community B) to State 2 occur under prolonged, heavy continuous grazing. Prolonged drought exacerbates the retrogression, and lack of the natural fire regime also facilitates the transition.

Restoration pathway R2A
State 2 to 1

Prescribed grazing with favorable precipitation, fire (natural interval 10 to 12 years) if enough fuel This plant community (State 2) is resistant to change. Blue grama and clubmoss form a thick sod which provides a competitive advantage for limited precipitation. Although the sod appears to prevent seedling establishment of high-successional species, recent research indicates the absence of seedlings within a mat of clubmoss is due to an inadequate seed bank in the soil (Romo and Bai 2004). When clubmoss cover is more than 20-25%, succession is not expected to occur within a reasonable length of time. However, significant succession may occur if the top soil is intact and if clubmoss is no more than a minor component of the plant community. Succession would be favored by prescribed grazing, an extended period of favorable precipitation and the re-implementation of the natural fire regime. The potential for succession is depicted by the dashed line in the diagram. Significant economic inputs and time are required to move this plant community toward a higher successional state (those communities found in State #1) when the plant community is dominated by clubmoss, or if the soil surface has been lost to erosion. Production on a Shallow 10-14” p.z. ecological site is 40-50% less than it is on ecological sites with soils > 20 inches deep (eg, Silty 10-14” p.z., Clayey 10-14” p.z., and Sandy 10-14” p.z.). The lower response potential from mechanical treatment has a proportionate effect on the potential economic benefits. Therefore, mechanical treatments and range seeding are not normally recommended on shallow sites. In comparison to “normal” sites, environmental risks (such as erosion) are greater while economic benefits are less.

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 Grasses**			90–450	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–270	–
	needle and thread	HECO26	*Hesperostipa comata*	90–180	–
1	**Rhizomatous Wheatgrasses**			90–225	
	western wheatgrass	PASM	*Pascopyrum smithii*	45–115	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	45–110	–
3	**Warm-season Grasses**			180–360	
	prairie sandreed	CALO	*Calamovilfa longifolia*	90–180	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	45–90	–
	little bluestem	SCSC	*Schizachyrium scoparium*	45–90	–
4	**Miscellaneous Grasses**			0–90	
	blue grama	BOGR2	*Bouteloua gracilis*	0–90	–
	threadleaf sedge	CAFI	*Carex filifolia*	0–90	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–90	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–90	–
	plains reedgrass	CAMO	*Calamagrostis montanensis*	0–90	–
	Grass, native	2GN	*Grass, native*	0–90	–
Forb					
5	**Dominant Forbs**			9–45	
	American vetch	VIAM	*Vicia americana*	9–45	–
3	**Clovers**			18–90	
	purple prairie clover	DAPU5	*Dalea purpurea*	9–45	–
	white prairie clover	DACA7	*Dalea candida*	9–45	–
7	**Miscellaneous Forbs**			0–50	

	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–45	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–45	–
	pussytoes	ANTEN	*Antennaria*	0–45	–
	bastard toadflax	COUM	*Comandra umbellata*	0–45	–
	milkvetch	ASTRA	*Astragalus*	0–45	–
	beardtongue	PENST	*Penstemon*	0–45	–
	spiny phlox	PHHO	*Phlox hoodii*	0–45	–
	buckwheat	ERIOG	*Eriogonum*	0–45	–
	Forb, native	2FN	*Forb, native*	0–45	–
	lesser spikemoss	SEDE2	*Selaginella densa*	0–1	–
Shrub/Vine					
8	**Dominant Shrubs**			20–90	
	skunkbush sumac	RHTR	*Rhus trilobata*	10–45	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	10–45	–
9	**Miscellaneous Shrubs**			0–180	
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–45	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–45	–
	snowberry	SYMPH	*Symphoricarpos*	0–45	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–45	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–45	–
	rose	ROSA5	*Rosa*	0–45	–
	creeping juniper	JUHO2	*Juniperus horizontalis*	0–45	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–45	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–45	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–45	–

Animal community

Livestock Management

The Shallow 10-14” p.z. ecological site is suited for livestock grazing. However, prescribed grazing management is needed. Forage production is limited by shallow soils and occasional steep slopes, which adversely affect grazing distribution and utilization. Species composition is susceptible to heavy stocking and season long grazing. Non-prescribed grazing on steep slopes and shallow soils results in soil compaction, a decrease in vegetative cover and litter, and a subsequent increase in bare ground. Surface runoff, soil erosion and site deterioration are the end result.

Coupland (1992) reviewed research on the mixed grass prairie and concluded that, “for various reasons, grazed habitats tend to be drier than ungrazed grassland.” This is also true on the Shallow 10-14” p.z. ecological site. Grazing reduces plant density, plant height, and litter. There is less vegetative cover to protect the soil from the sun and wind. The amount of litter declines because there is a lower supply of dead leaves, and some dead materials are trampled into the soil surface.

The Shallow 10-14” p.z. ecological site, as do most other sites in the northern mixed prairie, has a component of warm season, short grass species. The short grasses usually increase with grazing and decrease with prescribed grazing. However, succession is not guaranteed in the northern mixed prairie. 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 plant 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 (non-use by livestock), 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). Although they concluded that site characteristics limited the development of potential vegetation with the exclusion of grazing, the authors did not discuss the potential impacts of prescribed grazing on succession. The Shallow 10-14” p.z. ecological site is not as productive as the sites evaluated in the above research. Therefore, range managers should recognize the environmental limitations of this site. Prescribed grazing management is always a good recommendation.
Seeding and/or mechanical treatment are usually not recommended on the Shallow 10-14” p.z. ecological site. However, range management goals may include treating a large area of deeper soils, in which the shallow site is a minor component of a larger mapping unit. In this situation it is often impractical to avoid the shallow component, thus treating the smaller area is incidental to treating the larger area of deeper soils.

Wildlife Interpretations
The HCPC associated with the Shallow 10-14” p.z. ecological site provides diverse and valuable wildlife habitat. This ecological site often occurs as a mosaic with other ecological sites, thus creating more “ecotones”. This results in an increase in “edge effects” which potentially benefit most species of wildlife. The landscape provides thermal and escape cover. Mule deer and antelope utilize the abundance and diversity of forbs and shrubs. The mix of cool and warm season forage species (grasses, forbs and shrubs) ensures the availability of forage for wildlife from early spring through the fall seasons.
Shallow 10-14” p.z. ecological sites become less valuable for deer and antelope when plant diversity is low. For example, the disappearance of either the tall warm season grass or cool season grasses would shorten the length of the “green forage” season. The increase of blue grama, clubmoss, hoods phlox etc. is also associated with the loss of higher successional forbs. These changes tend to adversely impact foraging opportunities for deer, antelope, upland birds, etc. Densities of a specific species of mouse, rat or other small mammal vary with habitat conditions characterizing the respective Communities and States.

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 C. These soils have a medium to very high runoff potential, with hydrologic curves of 74 to 86. Field investigations are needed to adjust the curves when plant communities deteriorate from the HCPC. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff.

Recreational uses

This site provides hunting opportunities for upland game species. Photographers also appreciate the Shallow 10-14” p.z. ecological site for its diverse mix of plants, beauty and solitude.

Wood products

This site has no significant value for wood products.

Other information

The Shallow 10-14” p.z. ecological site is not highly resistant to disturbances. Species diversity is adversely affected by season long continuous grazing and by heavy stocking. Mid and tall grasses are replaced by short grasses. The number of structural/functional groups is reduced with retrogression, which adversely affects the amount of solar energy that is captured and converted to carbohydrates. 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. Rills and gullies are not evident in the HCPC.

Inventory data references

Data Source Number of Records Sample Period State County
SCS-Range-417
ECS-1
Modified Double Sampling 13 2004 MT Blaine, Phillips, Daniels
Valley, Roosevelt
USDA-SCS-MT 1981 Technical Range Site Description

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Contributors

Kirt Walstad

Approval

Kirt Walstad, 1/24/2024

Acknowledgments

Site Description Revisions
The 2005 Shallow 10-14” p.z. ecological site description replaces earlier dated versions of the Shallow 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 0–45% and with at least 90% 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 10% 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 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 1 – 3”.

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.

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.

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) = warm season rhizomatous grass (Prairie sandreed) > shrubs > cool season short grasses (Sandberg bluegrass) = perennial forbs > warm season shortgrass (Blue grama).

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):** 650 - 1100 #/acre. This would be the expected production for the reference state during adequate moisture years. 900 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:** Dense clubmoss, blue grama, Red threeawn, Japanese brome, a variety of annual or biennial weedy forbs, fringed sagewort, broom snakeweed, 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.