USDA Natural Resources Conservation Service

Ecological site R052XN176MT
Shallow to Gravel (SwGr) 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

The distinguishing characteristics of this site are depth to gravels being 10 to 20 inches from the soil surface and a clay content of less than 35 percent. Soils are derived from gravelly alluvium. This ecological site occurs on steep terraces and knolls. Slopes usually range from 0 to 15%.

Associated sites

R052XN162MT	**Clayey (Cy) 10-14" p.z.** soils >20 inches in depth, higher production, and no hardpan, different species composition
R052XN166MT	**Overflow (Ov) 10-14" p.z.** different position on landscape, site benefits from extra moisture, more production,different species, permanent water table > 42 inches

R052XN179MT	**Shallow Clay (SwC) 10-14" p.z.** soils 10-20” deep to bedrock’ soils are clayey over clayey shale
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

R052XC216MT	**Shallow to Gravel (SwGr) 10-14" p.z.** Shift in plant communities and production, different LRU.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Juniperus horizontalis* (2) *Yucca glauca*
Herbaceous	(1) *Pascopyrum smithii* (2) *Pseudoroegneria spicata*

Physiographic features

This ecological site occurs on nearly level to steep terraces and knolls. Slopes usually range from 0 to 15%, can occur on slopes greater than 15%. Elevations normally vary from 2,200 to 3,500 feet.

Table 2. Representative physiographic features

Landforms	(1) Outwash terrace (2) Alluvial fan (3) Knoll
Runoff class	Low to high
Flooding frequency	None
Ponding frequency	None
Elevation	2,200–3,500 ft
Slope	0–15%
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	0–35%

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)	74-135 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

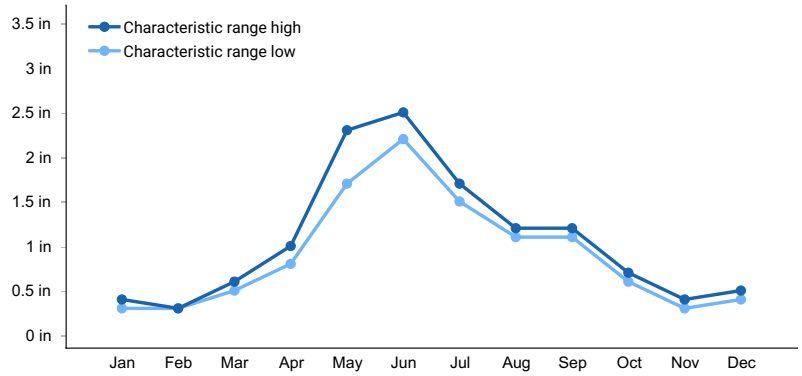


Figure 1. Monthly precipitation range

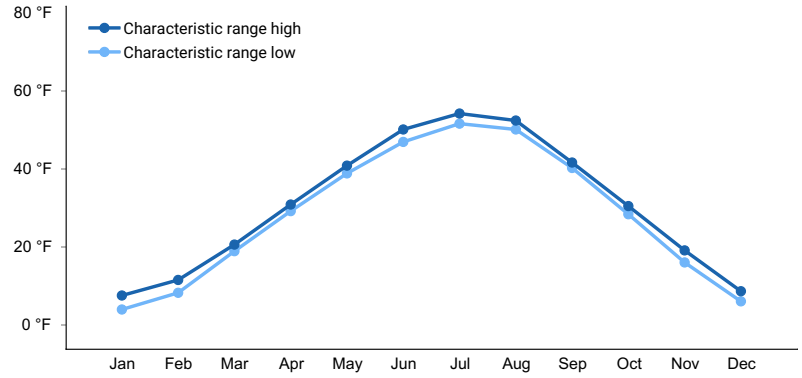


Figure 2. Monthly minimum temperature range

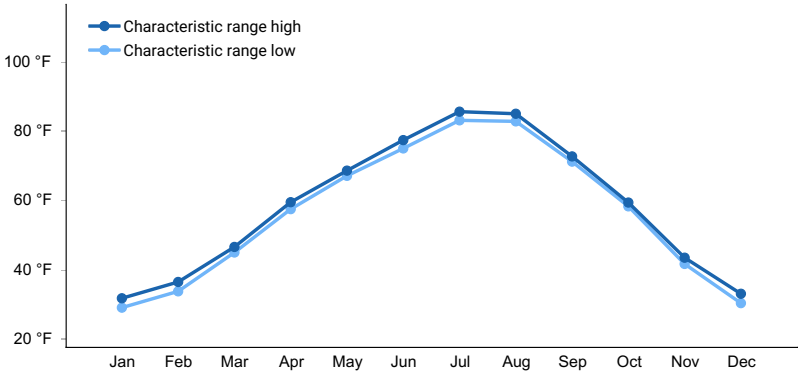


Figure 3. Monthly maximum temperature range

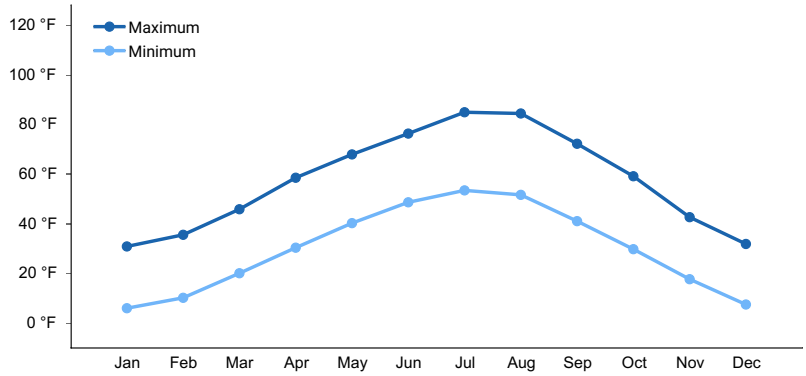


Figure 4. Monthly average minimum and maximum temperature

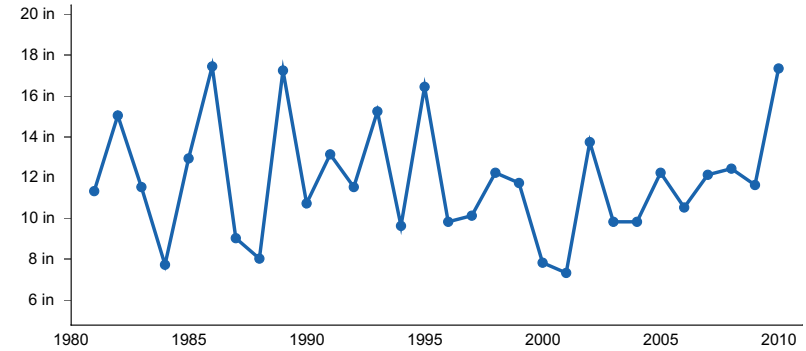


Figure 5. Annual precipitation pattern

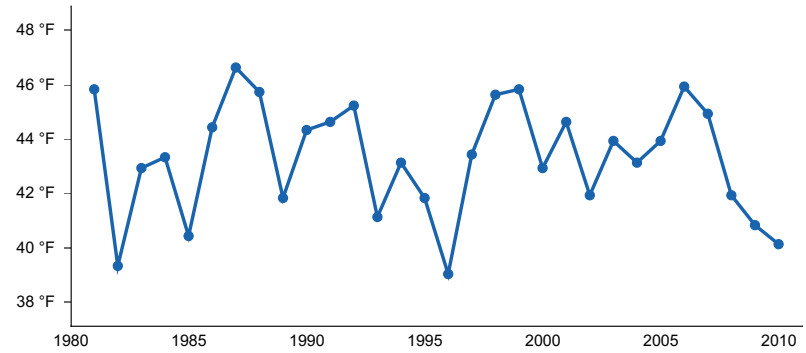


Figure 6. Annual average temperature pattern

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 moderately deep to very deep. Depth to sand and gravel is typically 10-20 inches. The soils occupy

uplands and side slopes of valleys. These are well drained soils that formed in gravelly alluvium. Permeability class is moderate to moderately slow. The surface textures are loam, sandy loam and fine sandy loam. Subsurface textures are usually clay loam and sandy clay loam. The upper 10-12 inches of the soil has less gravel than the next 8-10 inches. Soil ph varies from 6.6 to 9.0. This site is characterized by the following soil components: Beaverell.

Table 5. Representative soil features

Parent material	(1) Alluvium–igneous, metamorphic and sedimentary rock
Surface texture	(1) Gravelly loam (2) Gravelly sandy loam (3) Gravelly fine sandy loam
Family particle size	(1) Fine-loamy (2) Fine-loamy over sandy or sandy-skeletal
Depth to restrictive layer	20–60 in
Soil depth	20–78 in
Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	2–3 in
Calcium carbonate equivalent (Depth not specified)	0–10%
Electrical conductivity (Depth not specified)	0–4 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–8
Soil reaction (1:1 water) (Depth not specified)	6.6–9
Subsurface fragment volume <=3" (Depth not specified)	16–19%
Subsurface fragment volume >3" (Depth not specified)	5–21%

Ecological dynamics

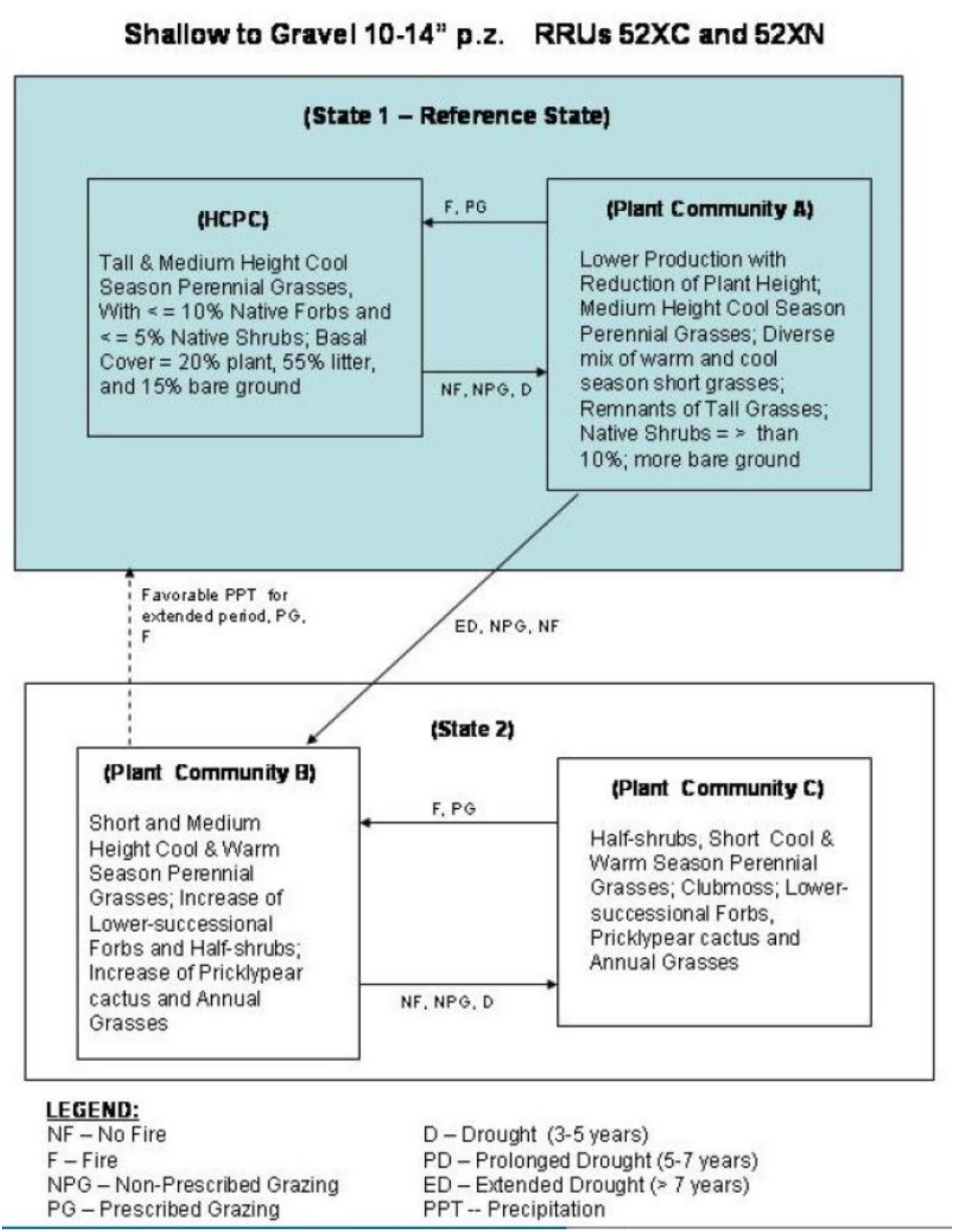
This site developed through time under the influence of climate, geological materials, fire, plants and animals. Research on upland ecological sites consistently shows that precipitation is the principal factor altering productivity (Heitschmidt et al. 2005). The same authors concluded that grazing reduces 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. Some ecologists believe that these lands may have 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 normal upland range sites, the role of natural 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, forbs and shrubs. About 85% of the annual production is from grasses and sedges, most of which is produced during the cool season. Forbs and shrubs contribute 10% and 5%, respectively, to total annual production. Total vegetative production averages 1000 lbs/ac in normal years, 700 lbs/ac in “unfavorable” years, and 1200 lbs/ac in “favorable” years.

This site is resistant to disturbance 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 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 to Gravel 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 often does not occur within a reasonable length of time, or without a large input of energy.
Two 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 two plant communities representative of State 2 are also illustrated. Ecological processes are discussed in the plant community descriptions that follow the diagram.

State and transition model



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% native forbs and less than or equal to 5% native shrubs, basal cover equals 20% plant, 55% litter, and 15% bare ground

Tall and medium-height cool-season perennial grasses, with less than or equal to 10% native forbs and less than or equal to 5% native shrubs, basal cover equals 20% plant, 55% litter, and 15% bare ground Three cool season perennial grasses (western wheatgrass, thickspike wheatgrass and bluebunch wheatgrass) are the dominant plants in this community. They account for about 75% of the total annual production in the HCPC. One high-successional warm season short grass (plains muhly) commonly occurs in the HCPC communities, while the distribution of a second species (little bluestem) is restricted to the central glaciated plains (RRU 52XC). 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. Although it is a fairly palatable cool season grass, needleandthread is well-adapted to the droughty conditions of this site, and acts as an indicator species. Needleandthread's contribution to total annual production varies from < 5% in the HCPC to > 30% in the early seral state. About 10% of the total production is made by a mix of warm and cool season short grasses and sedges. Forbs contribute about 10% 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. Scurfpea is another warm season legume that fixes nitrogen, but it is not a desirable forage plant. Dotted gayfeather is another high-successional warm season species that occurs in the HCPC communities. Stemless hymenoxys, scarlet globemallow, white milkwort, hairy goldenaster, prairie coneflower, manyflowered aster, green sagewort, hoods phlox and biscuitroot may occur in the HCPC, but should contribute no more than a few pounds of annual production per acre. 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. Creeping juniper, yucca, silver sagebrush and fringed sagewort are common shrubs. Although these species have some value as browse for deer and antelope, they are highly valued as forage. Pricklypear cactus and brittle cactus may occur as a trace or very small components of the total community. Shrubs normally make up about 5% of the total annual production. Dense clubmoss, often occurs as a minor component in the HCPC. However, it often increases when the plant community is stressed by drought or other environmental factors. Although it is difficult to explain the density of clubmoss in specific communities, some soil scientists believe that heavy infestations of dense clubmoss are associated with the presence of an argillic layer in the soil. 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 bluebunch wheatgrass, plains muhly, thickspike wheatgrass and western wheatgrass by lower successional species (blue grama, sandberg bluegrass, prairie junegrass, scarlet globemallow, etc.). Young fringed sagewort plants become more apparent as range health declines. Cheatgrass and Japanese brome may invade the site. As the result of these vegetative changes, there is less litter to protect the soil and less infiltration. Hydrologic cycles are impaired when plant communities are unable to effectively use precipitation. Plant basal cover averages about 20%, while litter varies from 50-60%. Bare ground averages 15%. Although runoff and erosion are not major concerns in the HCPC, they are increasing concerns 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.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	600	850	1020
Shrub/Vine	80	100	120
Forb	20	50	60
Total	**700**	**1000**	**1200**

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	55-65%
Surface fragments >0.25" and <=3"	0-1%
Surface fragments >3"	0-1%
Bedrock	0%
Water	0%
Bare ground	15-25%

Table 8. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	1-5%
Grass/grasslike basal cover	15-25%
Forb basal cover	1-5%
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%	0-20%	0-25%
>0.5 <= 1	–	0-40%	0-50%	0-50%
>1 <= 2	–	0-50%	0-25%	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 with reduction of plant height, medium-height cool-season perennial grasses, diverse mix of warm and cool-season short grasses, remnants of

tall grasses, native shrubs equal to or greater than 10%, more bare ground

Lower production with reduction of plant height, medium-height cool-season perennial grasses, diverse mix of warm and cool-season short grasses, remnants of tall grasses, native shrubs equal to or greater than 10%, more bare ground Non-prescribed grazing and drought reduce plant height and plant litter. Total annual production is about 80% of production in the 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 perennial grasses (bluebunch wheatgrass, thickspike wheatgrass 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 thickspike wheatgrass contribute from 40-50% of the total annual production. Vigor of these high successional grasses declined, and individual plant growth is reduced from what it is in the HCPC. Production of the short grasses increases to about 35% of total annual production. Forb production increases (> 15% of total annual production) significantly above production in the HCPC. Fringed sagewort increased, but total shrub production remains at about 5% of total annual production. Plant community A is called the “pre-threshold community”. It is critical that this community be recognized. Range inventory data collected by the NRCS on Fort Peck and Fort Belknap Reservations from 2001-2004 indicate that this community is characterized by 10-12% needleandthread and 25-35% short grasses. 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 up against obstructions, infiltration is slightly to moderately affected by the shift toward more short grasses in the plant community. The reproductive capabilities of bluebunch wheatgrass and western wheatgrass are somewhat limited relative to recent climatic conditions (USDI and USDA 2000). Except for in the western portions of the Glaciated Plains where it often remains as the dominant species, bluebunch wheatgrass composition significantly declines in the central glaciated plains. Community A is less resilient and much less resistant than the HCPC. Although it can improve to the HCPC through successional processes, further disturbance will result in regression to a lower state. Once Community A regresses to a lower state, normal successional processes are often restricted.

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, 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.

State 2
Degraded State

Community 2.1
Plant Community B Short and medium-height cool and warm-season perennial grasses, increase of lower-successional forbs and half-shrubs, increase of pricklypear cactus and annual grasses

Short and medium-height cool and warm-season perennial grasses, increase of lower-successional forbs and half-shrubs, increase of pricklypear cactus and annual grasses This Community is dominated by a mix of short height, cool and warm season grasses. Western wheatgrass and bluebunch wheatgrass represent less than 10% of total annual production. Blue grama, threadleaf sedge, sandberg bluegrass and other low successional grasses expanded their influence in the community. Needle and thread represents about 30% of total annual production. Hoods phlox, wild onion, western yarrow, green sagewort, scarlet globemallow and clubmoss increased and now contribute 15-20% of the total annual production. Clubmoss cover is often positively related to the presence of an argillic horizon in the soil. The density of fringed sagewort and broom snakeweed (warm season half-shrubs) increased relative to their presence in the higher successional communities. Pricklypear and brittle cactus are usually present in this community. Japanese brome, cheatgrass, and other annual plants are present in most

disturbed areas. Total annual production varies from 200-400 lbs/ac. In comparison to the HCPC, litter varies from 20-30%. Bare ground increases to 30-40%.

Community 2.2
Plant Community C Half-shrubs, short cool- and warm-season perennial grasses, clubmoss, lower-successional forbs, pricklypear cactus, and annual grasses

Half-shrubs, short cool- and warm-season perennial grasses, clubmoss, lower-successional forbs, pricklypear cactus, and annual grasses This community is dominated by fringed sagewort and broom snakeweed. Silver sagebrush and pricklypear cactus are usually present. Short grasses (blue grama, prairie junegrass, sandberg blue grass, etc.) contribute from 50-60% of the total annual production. The short grasses, along with clubmoss often form a dense sod. Needleandthread contributes another 30% of the total annual production. High-successional perennial grasses contribute less than 5% of total annual production. Japanese brome and cheatgrass occur in disturbed areas, and as scattered plants dispersed throughout the shortgrass sod. Total annual production varies from 200-350 lbs/ac. Litter averages 15%. Bare ground usually varies from 20-35%.

Pathway 2.1A
Community 2.1 to 2.2

No fire, non-prescribed grazing, drought (3 to 5 years) Communities B and C are resistant to disturbances. However, they do not have a precise assemblage of species for which the proportions are the same from place to place or from year to year. Variability is apparent in productivity and occurrence of individual species. Environmental factors such as rainfall, grazing pressure, and fire will cause species composition shifts within these communities. Community B usually shifts toward C with adverse conditions.

Pathway 2.2A
Community 2.2 to 2.1

Fire, prescribed grazing Communities B and C are resistant to disturbances. However, they do not have a precise assemblage of species for which the proportions are the same from place to place or from year to year. Variability is apparent in productivity and occurrence of individual species. Environmental factors such as rainfall, grazing pressure, and fire will cause species composition shifts within these communities. Community C tends to shift to B with favorable conditions.

Transition T1A
State 1 to 2

Extended drought (greater than 7 years), non-prescribed grazing, no fire Community A will regress to Communities B or C in State 2 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 of years.

Restoration pathway R2A
State 2 to 1

Favorable precipitation for extended period, prescribed grazing, fire Communities B and C are resistant to change and do not readily shift to another State. Prescribed grazing reduces the probability of further regression in this State, but it does not ensure significant succession to State 1. In some places the soil and hydrology of the site has been altered by the shift from tall and mid grasses in the HCPC to the short grasses and half shrubs in these communities. Therefore, these communities represent a steady state, and they often remain there. Steady-state plant communities change only as a result of natural events that are beyond the normal range of events or as a result of human actions. An extended period of favorable precipitation combined with prescribed grazing and the re-introduction of fire into the system may induce significant succession (Branson and Miller 1981). This potential is depicted by the dashed line in the state and transition diagram. Mechanical treatments and range seeding are not normally recommended on this site.

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**			550–1000	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	400–700	–
	needle and thread	HECO26	*Hesperostipa comata*	150–300	–
1	**Rhizomatous Wheatgrasses**			100–250	
	western wheatgrass	PASM	*Pascopyrum smithii*	50–125	–
	tufted wheatgrass	ELMA7	*Elymus macrourus*	50–125	–
3	**Warm-season Bunchgrasses**			150–350	
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	100–200	–
	little bluestem	SCSC	*Schizachyrium scoparium*	50–150	–
4	**Miscellaneous Grasses**			0–100	
	blue grama	BOGR2	*Bouteloua gracilis*	0–50	–
	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 Forb**			50–100	
	American vetch	VIAM	*Vicia americana*	50–100	–
4	**Clovers**			100–200	
	purple prairie clover	DAPU5	*Dalea purpurea*	50–100	–
	white prairie clover	DACA7	*Dalea candida*	50–100	–
7	**Miscellaneous Forbs**			0–60	
	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	–
	spiny phlox	PHHO	*Phlox hoodii*	0–50	–
	onion	ALLIU	*Allium*	0–50	–
	Forb, native	2FN	*Forb, native*	0–50	–
	lesser spikemoss	SEDE2	*Selaginella densa*	0–1	–
Shrub/Vine					
8	**Miscellaneous Shrubs**			0–120	
	creeping juniper	JUHO2	*Juniperus horizontalis*	0–50	–
	soapweed yucca	YUGL	*Yucca glauca*	0–50	–

	silver sagebrush	ARCA13	*Artemisia cana*	0–50	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–50	–
	prairie rose	ROAR3	*Rosa arkansana*	0–50	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	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 to Gravel 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 factor reducing infiltration and increasing runoff on this site is a management concern. 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. This 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.
Poisonous plants are not normally a problem on this site. Losses that do occur are usually result in livestock being forced to consume the poisonous plants because of an inadequate supply of desirable forage.

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 its position in the landscape. However, its value for thermal and escape cover is limited by the lack of shrubs.
This ecological site becomes less valuable for deer and antelope when plant diversity declines with regression. For example, the disappearance of the bluebunch wheatgrass and western wheatgrass 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 Plant Communities in State 2 are 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 B. When cover conditions are good, these soils have a low runoff potential.

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 0
ECS-1
Modified Double Sampling 12 2002-2004 MT Phillips, Blaine, Valley, Roosevelt,
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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.
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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 to Gravel 10-14” p.z. ecological site description replaces earlier dated versions of the Shallow to Gravel 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)	Loretta Metz, Maxine Rasmussen, Jon Siddoway
Contact for lead author	Area Rangeland Management Specialist, Glasgow Area Office, MT Reference site used? No
Date	05/04/2005
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills should not be present in HCPC. On slopes > 15%, careful examination will yield slight evidence of rills following a rainfall event in HCPC. On slopes > 15%, if in Plant community A, careful examination will yield slight evidence of rills regardless of precipitation event. On slopes > 15%, in HCPC and in plant community A, rill would be less than ½ inch deep, linear, but short in length

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2. **Presence of water flow patterns:** Careful examination will yield slight evidence of water flow patterns following a rainfall event in HCPC on slopes > 15%. On slopes > 15%, if in Plant community A, careful examination will yield slight evidence of water flow patterns regardless of precipitation events.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals or terracettes would essentially be nonexistent in HCPC. On slopes > 8%, if in Plant community A, careful examination will yield occasional pedestals and terracettes approximately ¼ inch above the soil surface.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Up to 15% of the soil surface is bare ground in HCPC. In plant community A, 15-20% bare ground is possible

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5. **Number of gullies and erosion associated with gullies:** None.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None.

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement is not expected in HCPC. On slopes > 8%, in Plant community A, litter, both fine and coarse, movement is readily observable.

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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):** Stability class anticipated to be 1 to 4, depending on soil surface texture.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The surface layer is 0.5” to 4” thick and typically gravelly sandy loam surface textures. Surface color ranges brown and very dark brown. Soil organic matter ranges steadily between 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:** In HCPC, 75-85% plant canopy and 20% basal cover with small gaps between plants should reduce raindrop impact and slow overland flow, providing increased time for infiltration to occur. Healthy, deep rooted native grasses enhance infiltration and reduce runoff. Infiltration rate is moderate to moderately slow. If in plant community A, 70-80% plant canopy and 15% basal cover with small gaps between plants will still reduce raindrop impact and decrease overland flow.

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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):** No compaction layer or soil surface crusting should be evident in any of the State 1 plant communities. Unconsolidated sand or gravel layer begins at 10-20 inches.

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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: Tall and mid stature cool season bunch grasses = mid stature warm season bunch grasses > mid-stature cool season rhizomatous grasses > forbs > shrubs. Plant community A: Mid-stature cool season bunch grasses > mid-stature cool season rhizomatous grasses > short warm season rhizomatous grasses > forbs > shrubs.

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Plant mortality and decadence very low in HCPC and Plant community A. In periods of drought, shrubs would exhibit decadence in the state 1 reference communities.

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):** 700 - 1200 #/acre from Plant community A to HCPC.

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:** Needle and thread, threadleaf sedge, plains prickly pear, blue grama, Hood's phlox, hairy goldenaster, dense clubmoss and fringed sagewort

17. **Perennial plant reproductive capability:** All species are capable of reproducing in HCPC. In Plant community A, plant seedlings will be weighed in favor of marginal and undesirable species. Replacement of desirable species will be very few.