USDA Natural Resources Conservation Service

Ecological site R064XY162WY
Shallow Hartville Uplift

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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): 064X–Mixed Sandy and Silty Tableland and Badlands

The Mixed Sandy and Silty Tableland and Badlands (MLRA 64) is shared almost equally between South Dakota (42 percent) and Nebraska (41 percent). A small portion is in Wyoming (17 percent). The MLRA consists of 11,895 square miles. The towns of Kadoka and Pine Ridge, South Dakota; Chadron and Alliance, Nebraska; and Lusk, Wyoming, are all within the boundaries of this MLRA.

The following areas of special interest are in this MLRA: Agate Fossil Beds National Monument, Chadron State Park, Fort Robinson State Park, and the Pine Ridge Indian Reservation; parts of the Oglala and Buffalo Gap National Grasslands, which are in the Nebraska National Forest; and nearly all of Badlands National Park. The Badlands are internationally renowned for their Oligocene vertebrate fossils.

The northern section of the MLRA consists of old plateaus and terraces that have been deeply eroded by wind, water, and time. The southern section consists of nearly level to broad intervalley remnants of smooth fluvial plains. These two sections are separated by the Pine Ridge escarpment. Elevations gradually increase from 2,950 to 5,073 feet from east to west. The main drainageway through Badlands National Park is the White River. The headwaters of both the White River and Niobrara River are in MLRA 64. The Pine Ridge escarpment is at the northernmost extent of the Ogallala Aquifer.

Tertiary continental sediments consisting of sandstone, siltstone, and claystone underlie most of the area. Many of the bedrock units in the southern third of the MLRA are covered by loess. Soils range from shallow to very deep and from generally well drained to excessively drained. They are loamy or sandy. The Badlands consist of stream-laid layers of silt, clay, and sand mixed with layers of volcanic ash.

Average annual precipitation for the area is 14 to 20 inches. Most of the rainfall occurs as frontal storms in the spring and early summer. This area supports a mixture of short-, mid-, and tall-statured warm- and cool-season grasses. On the Pine Ridge escarpment, these plants grow in association with ponderosa pine, Rocky Mountain juniper, western snowberry, skunkbush sumac, common chokecherry, and rose. Wyoming big sagebrush grows in minor amounts in the drier, far western portion of the MLRA; however, small remnant stands can be found in the eastern portion of the Oglala National Grassland in Nebraska.

Sixty percent of the MLRA is grassland, 11 percent of which is under Federal management. Twenty-two percent of the area is used as cropland, and 4 percent is forested. Major resource concerns include wind erosion, water erosion, and surface water quality (USDA-NRCS, 2006, Ag Handbook 296).

For development of ecological sites, MLRA 64 is divided into two precipitation zones (PZ): 14 to 17 inches per year and 17 to 20 inches per year. The wetter zone extends from the western end of the Pine Ridge escarpment near Lusk, Wyoming, eastward along the escarpment through Nebraska and into the Big Badlands area of South Dakota. The drier zone extends from Wyoming eastward to Alliance and Oshkosh, Nebraska, south of the Pine Ridge Escarpment. MLRA 64 stops at the western edge of the Nebraska Sand Hills (MLRA 65).

A unique geologic area known as the Hartville Uplift is in the far southwest corner of the 14 to 17 inch precipitation zone. The Hartville Uplift is an elongated, north-northwest-oriented, broad domal arch of Laramide age (70-50 million years ago). It extends approximately 45 miles between Guernsey and Lusk, Wyoming, and is 15 miles wide at its widest point. Erosion has exposed a core of granite and Precambrian metasedimentary and metavolcanic rocks (Steele et al., 2018). In addition to the ecological sites in the 14 to 17 inch precipitation zone of MLRA 64, three unique ecological site descriptions were developed to describe the soils and plant community dynamics in the Hartville Uplift.

Classification relationships

►USDA◄
Land Resource Region G—Western Great Plains Range and Irrigated Region:
Major Land Resource Area (MLRA) 64—Mixed Sandy and Silty Tableland and Badlands

►U.S. Environmental Protection Agency (EPA)◄
Level IV Ecoregions of the Conterminous United States:
High Plains—25:
Pine Ridge Escarpment—25a.
Flat to Rolling Plains—25d.
Pine Bluffs and Hills—25f.
Sandy and Silty Tablelands—25g.
Northwestern Great Plains—43:
White River Badlands—43h.
Keya Paha Tablelands—43i.

►USDA Forest Service◄
Ecological Subregions: Sections and Subsections of Conterminous United States:
Great Plains and Palouse Dry Steppe Province—331:
Western Great Plains Section—331F:
Subsections:
Shale Scablands—331Fb.
White River Badlands—331Fh.
Pine Ridge Escarpment—331Fj.
High Plains—331Fk.
Hartville Uplift—331Fm.
Western Nebraska Sandy and Silty Tablelands—331Fn.
Keye Paha Tablelands—331Ft.
Powder River Basin Section—331G:
Subsection: Powder River Basin—331Ge.

Ecological site concept

The Shallow HU ecological site in the Hartville Uplift (HU) area of southeast Wyoming is unique for MLRA 64. It is on hills, ridges, and hill slopes. Slopes range from 2 to 70 percent. The soils formed in residuum or colluvium derived from shale, limestone, sandstone, and granite. Soils are shallow, between 10 and 20 inches deep. They have a surface layer of very channery or very cobbly sandy loam to loam that is 2 to 10 inches thick. The subsurface layers are typically skeletal and have up to 80 percent rock fragments. Some soils are highly calcareous to the surface. This site does not receive additional moisture from run off or overflow.

The vegetation of this ecological site consists of a mix of cool- and warm-season grasses. Little bluestem, sideoats grama, and blue grama are the dominant warm-season grasses. Cool-season grasses and grass-like species, including needle and thread, bluebunch wheatgrass, and threadleaf sedge, make up a significant portion of the composition. Forbs are common and diverse, and alder-leaf mountain mahogany is in almost all locations. Large stands of black sagebrush can be found on highly calcareous soils derived from limestone. Ponderosa pine and Rocky Mountain juniper are present in some areas. In places, they grow in significant amounts, especially on the metamorphic rock and granite derived residuum. North- and east-facing slopes tend to be wetter and cooler and support more vegetation. South- and west-facing slopes are drier and have more exposed, bare ground.

Associated sites

R064XY011NE	**Sandy 14-17" PZ** The Sandy 14-17” PZ ecological site is on landscapes that are less sloping than and adjacent to or down slope from the Shallow HU site.
GX064X01X015	**Loamy 14-17" PZ** The Loamy 14-17” PZ ecological site is on landscapes that are less sloping than and adjacent to or down slope from the Shallow HU site.
R064XY112WY	**Gravelly Hartville Uplift** The Gravelly HU ecological site is on landscapes adjacent to or intermixed with the Shallow HU site.

Similar sites

R064XY176WY	**Very Shallow Hartville Uplift** The Very Shallow HU ecological site is in landscape positions similar to those of the Shallow HU site, but the soils are less than 10 inches deep. The Very Shallow HU site has less little bluestem and considerably less forage production than the Shallow HU site.
R064XY037NE	**Thin Upland** The Thin Upland ecological site is in landscape positions similar to those of the Shallow HU site, but the soils are greater than 20 inches deep. The Thin Upland site has more little bluestem, fewer shrubs, and higher forage production than the Shallow HU site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Cercocarpus montanus*
Herbaceous	(1) *Schizachyrium scoparium* (2) *Hesperostipa comata ssp. comata*

Physiographic features

The Shallow HU site is on nearly level to steeply sloping uplands and escarpments.

Table 2. Representative physiographic features

Landforms	(1) Hills > Hillslope (2) Upland > Ridge
Runoff class	Medium to very high
Flooding frequency	None
Elevation	1,372–1,890 m
Slope	2–70%
Water table depth	203 cm

Climatic features

Climate 14-17” Hartville Uplift (HU)
MLRA 64 has a continental climate consisting of cold winters and hot summers, low humidity, light rainfall, and ample sunshine. Extremes in temperature are common in some years. The climate results from MLRA 64 being near the geographic center of North America. There are few natural barriers on the Northern Great Plains. Air masses move freely across the plains and account for rapid changes in temperature.

Average annual precipitation for the Hartville Uplift area is 15.4 inches per year. The normal average annual temperature is about 46 °F. January is the coldest month with average temperatures around 24 °F (Lusk 2 SW, WY). July is the warmest month with average temperatures around 69 °F (Lusk 2 SW, WY). The range of normal

average monthly temperatures between the coldest and warmest months is about 50 °F. This large annual range attests to the continental nature of the climate of this area. Wind speeds are estimated to average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime winds are generally stronger than nighttime winds. Occasionally, strong storms bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of cool-season plants begins in early to mid-March, slowing or ceasing in late June. Growth of warm-season plants begins about mid-May and continues to early or mid-September. Cool-season plants may green-up in September and October if adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (characteristic range)	85 days
Freeze-free period (characteristic range)	108-114 days
Precipitation total (characteristic range)	356-432 mm
Frost-free period (actual range)	85 days
Freeze-free period (actual range)	107-116 days
Precipitation total (actual range)	356-432 mm
Frost-free period (average)	85 days
Freeze-free period (average)	111 days
Precipitation total (average)	381 mm

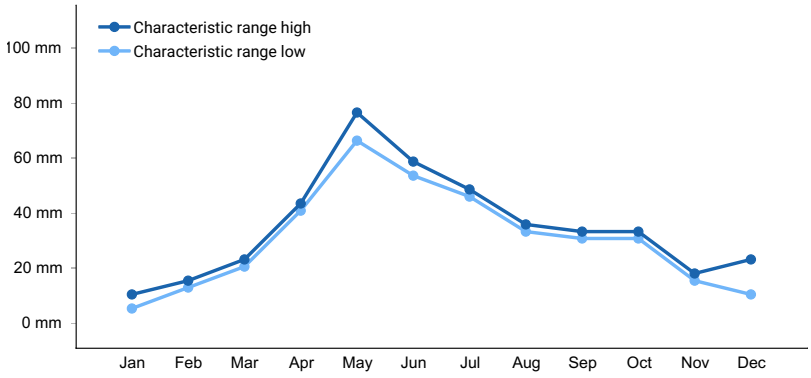

Figure 1. Monthly precipitation range

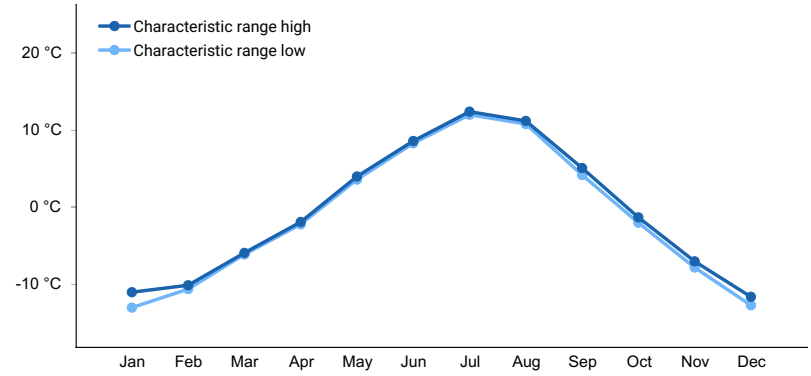

Figure 2. Monthly minimum temperature range

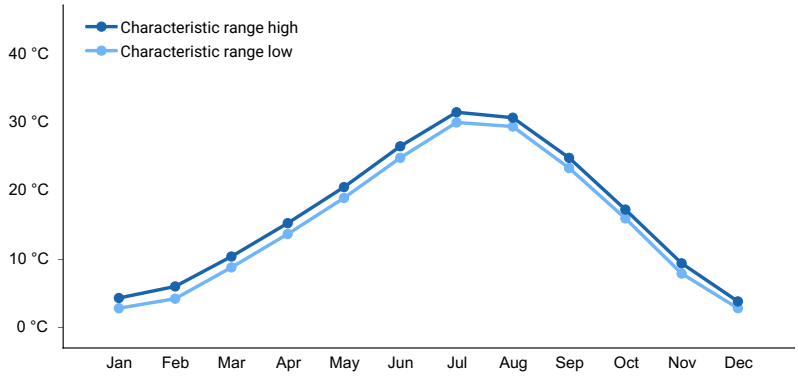

Figure 3. Monthly maximum temperature range

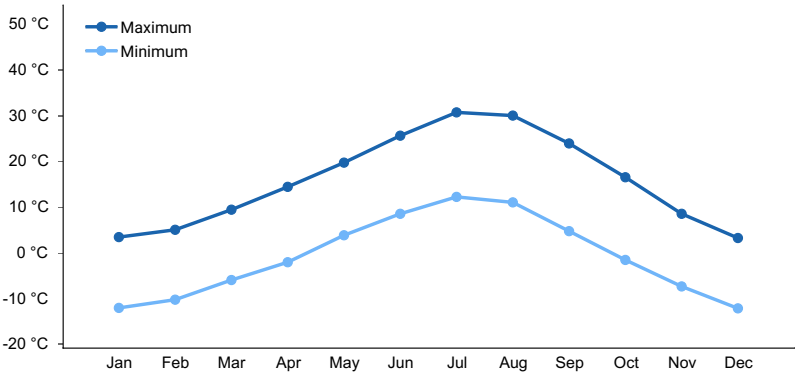

Figure 4. Monthly average minimum and maximum temperature

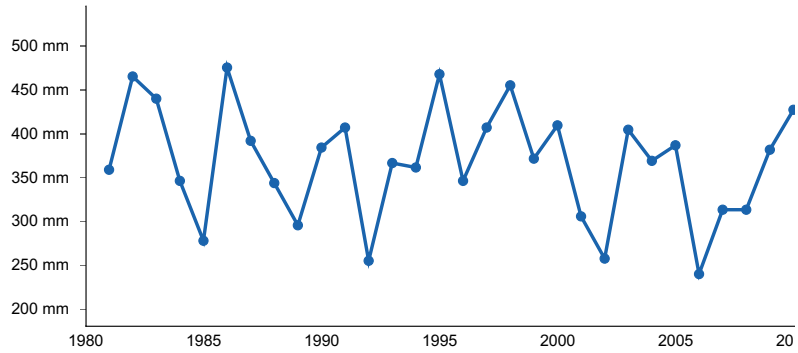

Figure 5. Annual precipitation pattern

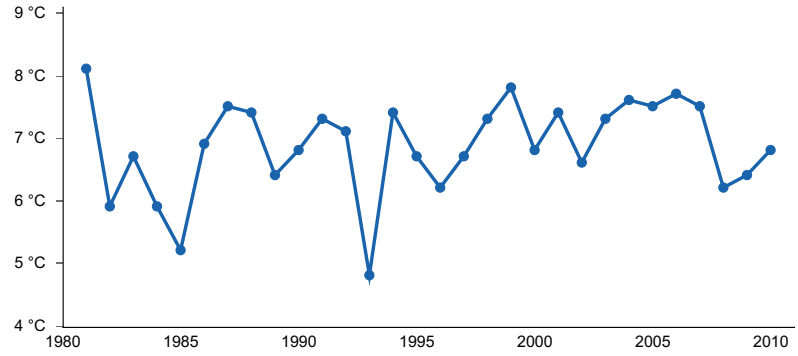

Figure 6. Annual average temperature pattern

Climate stations used

- (1) GLENDO 6NE [USC00483936], Glendo, WY
- (2) OLD FT LARAMIE [USC00486852], Yoder, WY
- (3) LUSK 2 SW [USC00485830], Lusk, WY

Influencing water features

No riparian or wetland features are directly associated with the Shallow HU ecological site.

Soil features

The soils of this site have a surface layer of They have a surface layer of very channery or very cobbly sandy loam to loam. The surface layer is 2 to 10 inches thick and has a moderate infiltration rate. The soils are shallow (10–20 inches in depth), well drained or somewhat excessively drained, and formed in residuum from limestone, sandstone, and granite. Typical slope ranges are 2 to 70 percent. These soils are typically calcareous at or near the surface; however, carbonates are not always distinguishable in the surface layer. Subsoil layers range from very fine sandy loam to silt loam. Subsurface soil layers restrict water movement and root penetration below a depth of 20 inches.

This site shows slight to no evidence of rills, wind-scoured areas, or pedestalled plants. Water flow paths are broken, are irregular in appearance, or are discontinuous and have numerous debris dams or vegetative barriers. The soil surface is stable and intact.

Major Soils Correlated to the Shallow HU Ecological Site: Snavee, Motoqua, Wendover, Brown, Storsun, Taluce, Trelona, and Lambman.

Two unnamed soil variants (Lithic Haplustolls) are located in Niobrara County, Wyoming. The moist variant formed in residuum derived from igneous and metamorphic rock. The other formed in residuum derived from limestone.

Water erosion is the main hazard affecting the soils of this site. The hazard of water erosion increases on slopes greater than about 15 percent. Low available water capacity caused by the shallow rooting depth strongly influences the soil-water-plant relationship.

More information regarding the soil is available in soil survey reports. Contact the local USDA Service Center for details specific to your area of interest, or go online to access USDA’s Web Soil Survey.

Table 4. Representative soil features

Parent material	(1) Residuum–limestone and sandstone (2) Residuum–granite (3) Residuum–sandstone and siltstone
Surface texture	(1) Very cobbly, very channery loam (2) Very cobbly, very channery sandy loam
Family particle size	(1) Loamy (2) Loamy-skeletal over sandy or sandy-skeletal
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate to moderately rapid
Depth to restrictive layer	25–51 cm
Soil depth	25–51 cm
Surface fragment cover <=3"	0–50%
Surface fragment cover >3"	0–20%
Available water capacity (101.6cm)	5.08–7.62 cm
Calcium carbonate equivalent (101.6cm)	0–25%
Electrical conductivity (101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (101.6cm)	0

Soil reaction (1:1 water) (101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (101.6cm)	0–75%
Subsurface fragment volume >3" (101.6cm)	0–25%

Ecological dynamics

The Shallow HU ecological site developed under Northern Great Plains climatic conditions; light to severe grazing by bison and other large herbivores; sporadic, natural or human-caused wildfire (often of light intensities); and other biotic and abiotic factors that typically influence soil and site development. Changes occur in the plant communities due to short-term weather variations, effects of native and exotic plant and animal species, and management actions. Although the following plant community descriptions are typical of the transitions between communities, severe disturbances, such as periods of well below average precipitation and the introduction of non-native cool-season grasses, can cause significant shifts in plant communities and species composition.

In the Hartville Uplift, those areas of the Shallow ecological site that have north- or east-facing slopes tend to be wetter, cooler, and support more vegetation than the south- or west-facing slopes, which are drier and have more exposed bare ground. North- and east-facing slopes, especially on the metamorphic rock and granite derived soils, can support dense stands of ponderosa pine and Rocky Mountain juniper. Conifers grow in minor numbers on south- and west-facing slopes. Alderleaf mountain mahogany typically grows on all slopes, regardless of aspect. Very hot fires can have a detrimental effect on the site and the associated plant communities. After hot fires remove conifers from the plant communities, conifers will not regenerate for many decades, if ever. Alderleaf mountain mahogany re-sprouts following fire but may take many years to gain significant height. In places, highly calcareous soils that formed in limestone residuum support extensive stands of black sagebrush.

This site is susceptible to invasion of non-native annual cool-season grasses if the extent of bare ground increases due to management or fire. Annual brome grasses have not, however, become so dominant that they drive the plant community dynamics.

Continuous season-long grazing (during the typical growing season of May through October) or repeated seasonal grazing (e.g., every spring, every summer) without adequate recovery periods following each grazing occurrence causes this site to depart from the reference plant community. The reference plant community is the Little Bluestem-Needlegrass-Blue Grama/Mountain Mahogany Plant Community (1.1).

Interpretations are primarily based on the Little Bluestem-Needlegrass-Blue Grama/Mountain Mahogany Plant Community (1.1). The community was determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Also studied were trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts. Plant communities, states, transitional pathways, and thresholds were determined through similar studies and experience.

The following state-and-transition diagram illustrates the common plant communities on the site and the transition pathways between the communities. The ecological processes are discussed in more detail in the plant community descriptions following the diagram.

State and transition model

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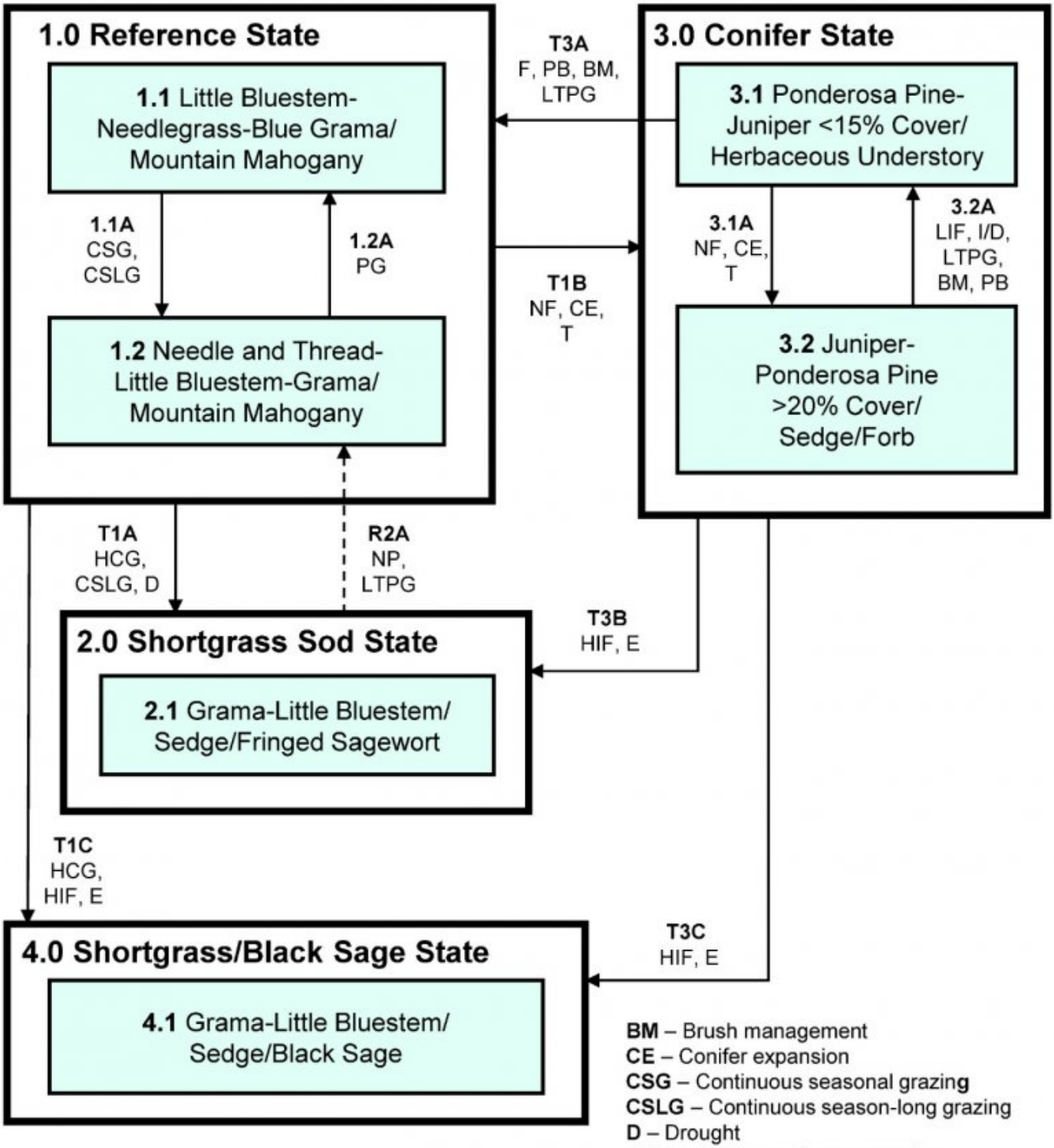

Hartville Area of MLRA 64
Shallow soils adjacent to rock outcrop can be the source of pine and juniper expansion or encroachment.
Other soil series correlated to the Shallow HU ecological site may not have the potential to transition to the Conifer State (3.0).
In areas where the parent material is derived from limestone, the soils can be highly calcareous and produce a significant amount of black sagebrush.

BM – Brush management
CE – Conifer expansion
CSG – Continuous seasonal grazing
CSLG – Continuous season-long grazing
D – Drought
HCG – Heavy continuous grazing
HIF – High intensity fire
I/D – Insect and disease
LIF – Low intensity fire
LTPG – Long-term prescribed grazing
NF – No fire
NP – Return to normal precipitation patterns
NU – No use
PB – Prescribed burning
PG – Prescribed grazing
S – Seeding for erosion control
T – Time
- - - → Recovery may not be fast or feasible

Diagram Legend: Shallow HU - R064XY162WY

T1A	1.0 to 2.0	Heavy, continuous grazing; continuous season-long grazing; or heavy grazing in combination with drought.
T1B	1.0 to 3.0	Long-term no fire; expansion of conifers on the site; and time.
T1C	1.0 to 4.0	Heavy, continuous grazing; high-intensity fire; or ground disturbance followed by soil erosion.
T3A	3.0 to 1.0	Long-term prescribed grazing after one of the following: low-intensity fire, prescribed burning, or brush management.
T3B	3.0 to 2.0	High-intensity fire and possibly soil erosion.
T3C	3.0 to 4.0	High-intensity fire and possibly soil erosion.

R2A	2.0 to 1.0	Long-term prescribed grazing and a return to normal precipitation patterns. This transition may take an extended period of time and in the end not meet management objectives.

1.1A	1.1 to 1.2	Continuous seasonal grazing; or continuous season-long grazing.
1.2A	1.2 to 1.1	Prescribed grazing with proper stocking, change in season of use, and adequate time for recovery.
3.1A	3.1 to 3.2	Long-term no fire, expansion of conifers, and time.
3.2A	3.2 to 3.1	Low-intensity fire; insect damage; disease damage; prescribed burning; or brush management followed by long-term prescribed grazing that includes proper stocking, change in season of use, and adequate time for recovery.

State 1
Reference State

The Reference State (1.0) represents the best estimate of the natural range of variability that dominated the dynamics of the Shallow HU ecological site prior to European settlement. This site is dominated by warm- and cool-season grasses. Forbs are common and diverse, shrubs species vary depending on precipitation and slope aspect. Ponderosa pine and Rocky Mountain juniper can grow naturally on steep slopes and ridges adjacent to rock outcrops. Alderleaf mountain mahogany can grow on all slopes. Grazing, fire, and drought are the major drivers between plant communities.

Dominant plant species

- alderleaf mountain mahogany (*Cercocarpus montanus*), shrub
- little bluestem (*Schizachyrium scoparium*), grass
- blue grama (*Bouteloua gracilis*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass
- threadleaf sedge (*Carex filifolia*), grass
- wheatgrass (*Agropyron*), grass
- hairy grama (*Bouteloua hirsuta*), grass
- plains muhly (*Muhlenbergia cuspidata*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- milkvetch (*Astragalus*), other herbaceous
- purple prairie clover (*Dalea purpurea*), other herbaceous
- prairie sagewort (*Artemisia frigida*), other herbaceous
- yucca (*Yucca*), other herbaceous

Community 1.1
Little Bluestem-Needlegrass-Blue Grama/Mountain Mahogany

Interpretations are based primarily on the Little Bluestem-Needlegrass-Blue Grama/Mountain Mahogany Plant Community (1.1). This community is also considered the Reference Plant Community (1.1). It is in areas that are properly managed with grazing and prescribed burning. It can also be in areas that receive occasional short periods of rest. The potential vegetation is about 80 percent grasses or grass-like plants, 5 percent forbs, and 15 percent shrubs and trees. A mixture of cool- and warm-season grasses dominates the site. The major grasses include little bluestem, needle and thread, blue grama, and wheatgrass. Other grasses and grass-like plants include hairy grama, plains muhly, and threadleaf sedge. Significant forbs include milkvetch and purple prairie clover. Shrubs include alderleaf mountain mahogany, fringed sagewort, and yucca. Trees can include ponderosa pine and Rocky Mountain juniper. This plant community is extremely resilient and well adapted to the Northern Great Plains climatic

conditions. The diversity in plant species allows for high drought tolerance. Community dynamics, nutrient cycle, water cycle, and energy flow are functioning properly. Plant litter is properly distributed with very little movement off-site. Natural plant mortality is very low.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	762	962	1188
Shrub/Vine	22	167	336
Forb	56	92	129
Tree	–	12	28
Total	**840**	**1233**	**1681**

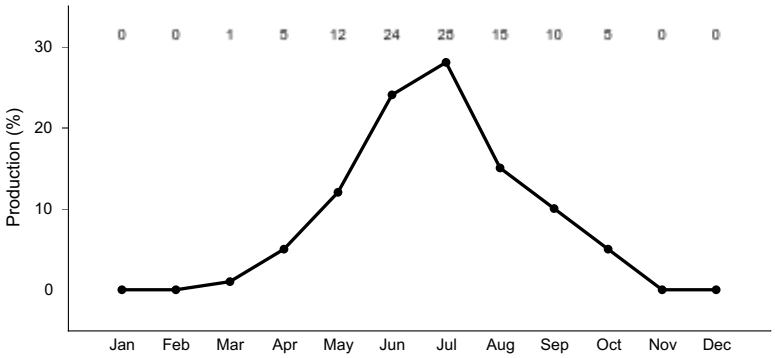

Figure 8. Plant community growth curve (percent production by month). WY6404, Pine Ridge/Badlands, warm-season dominant, cool-season subdominant. Hartville Uplift, warm-season dominant, cool-season subdominant.

Community 1.2
Needle and thread-Little Bluestem-Grama/Mountain Mahogany

This plant community evolved under continuous seasonal grazing or, in some cases, the combination of low stock densities and continuous season-long grazing. The potential vegetation is about 80 percent grasses or grass-like plants, 5 percent forbs, and 15 percent shrubs and trees. A mixture of cool- and warm-season grasses dominates the site. Needle and thread, little bluestem, and blue grama are significant species in this plant community. Compared to the reference community, sideoats grama and little bluestem have decreased in abundance and the short grasses and grass-like plants, such as blue grama, hairy grama, and sedge, have increased. Forbs commonly found in this plant community include milkvetch and purple prairie clover. Significant shrubs include alderleaf mountain mahogany, skunkbush sumac, and fringed sagewort. Scattered areas of a few ponderosa pine and Rocky Mountain juniper are common. This plant community is moderately resistant to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term.

Pathway 1.1A
Community 1.1 to 1.2

Continuous seasonal grazing or the combination of low stock densities and continuous season-long grazing convert plant community 1.1 to the Needle and thread-Little Bluestem-Grama/Mountain Mahogany Plant Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing that includes proper stocking rates, change in season of use, and adequate time for plant recovery following grazing convert plant community 1.2 to the Little Bluestem-Needlegrass-Blue Grama/Mountain Mahogany Plant Community (1.1).

State 2
Shortgrass Sod State

The Shortgrass Sod State (2.0) is dominated by shortgrass species and upland sedges. This state is the result of grazing management or heavy grazing in combination with drought that does not provide adequate recovery time for tall- and mid-statured warm- and cool-season grasses. It can also be the result of a high-intensity fire occurring in the Conifer State (3.0). The hydrologic function of state 2.0 may be altered from that of state 1.0. Runoff is high, and infiltration is low. State 2.0 is very resistant to change through grazing management alone.

Dominant plant species

- broom snakeweed (*Gutierrezia sarothrae*), shrub
- blue grama (*Bouteloua gracilis*), grass
- hairy grama (*Bouteloua hirsuta*), grass
- sedge (*Carex*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- prairie sagewort (*Artemisia frigida*), other herbaceous
- woolly plantain (*Plantago patagonica*), other herbaceous
- pussytoes (*Antennaria*), other herbaceous
- Cuman ragweed (*Ambrosia psilostachya*), other herbaceous

Community 2.1
Grama-Little Bluestem/Sedge/Fringed Sagewort

This plant community evolves from heavy continuous grazing or from continuous season-long grazing over several years. Plant diversity is lost as the short grasses become dominant in the plant community. Sedges and the grazing-tolerant blue grama or hairy grama mostly replace little bluestem, needle and thread, and wheatgrasses. Sideoats grama and remnant little bluestem remain in the plant community, but they are less productive because of the mid-summer grazing pressure. Because of the grazing pressure, fringed sagewort, broom snakeweed, woolly Indianwheat, pussytoes, and Cuman ragweed become more prevalent. Non-native species such as cheatgrass can potentially invade this plant community. This plant community can also develop if a high-intensity fire results in the removal of most or all conifers from a conifer-dominated plant community. Initially, weedy species, such as common mullein, thistle, and annual grasses and forbs, occupy the site. In time, upland sedges and shortgrass species dominate. This plant community is typically resistant to change. In comparison to the Reference State (1.0), runoff increases, and infiltration decreases. Continued overuse results in considerable bare ground and high erosion potential.

State 3
Conifer State

The Conifer State (3.0) develops where ponderosa pine and Rocky Mountain juniper become established and expand in extent. As the canopy cover of conifers increases, the herbaceous component declines in extent and more bare ground is exposed. As the extent of bare ground increases, conifers establish more readily. Grazing can contribute to this transition, but the transition can also occur independently of human influence other than fire suppression.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- Rocky Mountain juniper (*Juniperus scopulorum*), tree
- alderleaf mountain mahogany (*Cercocarpus montanus*), shrub
- needle and thread (*Hesperostipa comata ssp. comata*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- blue grama (*Bouteloua gracilis*), grass
- sedge (*Carex*), grass
- plains muhly (*Muhlenbergia cuspidata*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass

- western wheatgrass (*Pascopyrum smithii*), grass
- white sagebrush (*Artemisia ludoviciana*), other herbaceous
- manystem pea (*Lathyrus polymorphus*), other herbaceous
- pussytoes (*Antennaria*), other herbaceous
- prairie sagewort (*Artemisia frigida*), other herbaceous

Community 3.1
Ponderosa Pine-Juniper <15% Cover/Herbaceous Understory

Historically, ponderosa pine and juniper were confined to ridges and steep, north- or east-facing slopes that were adjacent to rock outcrops. This plant community develops due to fire suppression and the expansion of ponderosa pine and juniper on the ecological site. Mature ponderosa pine and juniper make up approximately 15 percent of the canopy in this plant community. The understory is about 80 percent grasses and grass-like species, 10 percent forbs, and 10 percent shrubs and trees. Dominant grasses and grass-like species include needle and thread, little bluestem, sideoats grama, blue grama, and sedge. Grasses of secondary importance include plains muhly, bluebunch wheatgrass, and western wheatgrass. Common forbs in this community include white sagebrush (cudweed sagewort), manystem pea, and pussytoes. Shrubs can include fringed sagewort and alderleaf mountain mahogany. Compared to the Little Bluestem-Needlegrass-Blue Grama/Mountain Mahogany Plant Community (1.1), the extent of ponderosa pine and juniper is increased. The grass component decreases as the buildup of pine and juniper needles increases. Annual herbaceous production also decreases. Although the conifer canopy provides excellent protection from the weather for both livestock and wildlife, it is not capable of supporting large numbers of wildlife and livestock due to decreased production. Plant community 2.1 is resistant to change. A significant reduction in the number of conifers can only be accomplished through fire or through mechanical removal. The vegetation in the understory is capable of enduring fire without a detrimental effect on the site and the associated plant community.

Community 3.2
Juniper-Ponderosa Pine >20% Cover/Sedges/Forb

This plant community develops where long-term fire suppression results in the expansion of ponderosa pine and juniper on the ecological site. Mature ponderosa pine and juniper make up greater than 20 percent of the canopy in this plant community. A thick duff layer, composed of pine needles and cones, can develop under the pine canopy. The duff limits the growth of the herbaceous understory. The understory is about 75 percent grasses and grass-like species, 10 percent forbs, and 15 percent shrubs and immature trees. Dominant grasses and grass-like species include upland sedges, needle and thread, and little bluestem. Grasses of secondary importance include plains muhly and Sandberg bluegrass. Common forbs in this community include white sagebrush (cudweed sagewort) and pussytoes. Shrubs can include skunkbush sumac and alderleaf mountain mahogany. Compared to the Little Bluestem-Needlegrass-Blue Grama/Mountain Mahogany Plant Community (1.1), the extent of ponderosa pine and juniper is significantly increased. The grass component is dramatically decreased because of the buildup of pine and juniper needles. Annual production is also significantly decreased. This plant community is resistant to change. A significant reduction in the number of conifers can only be accomplished through fire or through mechanical brush management. The vegetation in the understory is capable of enduring fire; however, very hot crown fires have a detrimental effect on the site and the associated plant community that can last for many years.

Pathway 3.1A
Community 3.1 to 3.2

Long-term fire suppression, the expansion of conifers in the site, and time commonly move this plant community to the Ponderosa Pine-Juniper >20% Canopy Cover/Sedge/Forb Plant Community (3.2). Conifers expand in extent, and the herbaceous understory declines.

Pathway 3.2A
Community 3.2 to 3.1

Insects; epidemics; low-intensity fires; timber thinning or harvest; periodic prescribed burning followed by long-term prescribed grazing; and time may move plant community 3.2 back to the Ponderosa Pine-Juniper <15% Canopy Cover/Herbaceous Understory Plant Community (3.1).

State 4
Shortgrass/Black Sage State

The Shortgrass/Black Sage State (4.0) is dominated by shortgrasses, upland sedges, and black sagebrush. The soils are highly calcareous and formed in residuum derived from limestone. This state is likely the result of grazing management that did not provide adequate recovery time for tall- and mid-statured warm- and cool-season grasses. It may also be the result of a high-intensity fire event followed by soil erosion. The hydrologic function of this state is likely altered from that of State 1.0. Runoff is high, and infiltration is low. It is not apparent if state 4.0 can transition to any other state under current management regimes. Many of the steeper ridges support mature ponderosa pine and Rocky Mountain juniper. This site may have supported a conifer overstory at one time, but conifers do not currently appear to be expanding. The dominant shortgrasses and sedges on this site are very resistant to change.

Dominant plant species

- black sagebrush (*Artemisia nova*), shrub
- creeping juniper (*Juniperus horizontalis*), shrub
- blue grama (*Bouteloua gracilis*), grass
- threadleaf sedge (*Carex filifolia*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Community 4.1
Grama-Little Bluestem/Sedge/Black Sage

This plant community develops from heavy continuous grazing or high-intensity fire, either from the Reference State (1.0) or the Conifer State (3.0). The dominant species are blue grama, threadleaf sedge, sideoats grama, little bluestem, black sagebrush, and creeping juniper. The site tends to be very droughty because of the high proportion of carbonates in the soil. Runoff tends to be high, and infiltration tends to be low. The high proportion of carbonates in the soil can hinder plant community 4.1 from transitioning to any other state under current management regimes. Many of the steeper ridges have mature ponderosa pine and Rocky Mountain juniper, but the extent of these species does not appear to be expanding. The Grama-Little Bluestem/Sedge/Black Sage Plant Community (4.1) appears to be very resistant to change.

Transition T1A
State 1 to 2

Heavy continuous grazing; continuous season-long grazing without change in season of use; or heavy grazing in combination with drought transition the Reference State (1.0) to the Shortgrass Sod State (2.0).

Transition T1B
State 1 to 3

Long-term fire suppression, expansion of conifers, time, and, in places, unique climatic conditions that allow for pine regeneration transition the Reference State (1.0) to the Conifer State (3.0).

Transition T1C
State 1 to 4

Heavy continuous grazing; high-intensity fire; or ground disturbance followed by soil erosion will transition the Reference State (1.0) to the Shortgrass/Black Sage State (4.0).

Restoration pathway R2A
State 2 to 1

Long-term prescribed grazing that includes proper stocking rates, change in season of use, and adequate time for plant recovery after grazing can convert this plant community to the Reference State (1.0). A return to normal precipitation patterns following drought helps with recovery. This transition may not be rapid or meet management

objectives.

Transition T3A
State 3 to 1

Prescribed burning or wildfire followed by long-term prescribed grazing move state 3.0 towards Reference State (1.0), which is herbaceous dominated. Mechanical removal of conifers through brush management followed by long-term prescribed grazing can also allow the understory to develop and transition to the Reference State (1.0). Trees on the steeper escarpments may escape most fires and thereby provide a seed source for future conifer expansion. This transition is most likely from the Ponderosa Pine-Juniper <15% Cover/Herbaceous Understory Plant Community (3.1).

Transition T3B
State 3 to 2

High-intensity fire and in some cases excessive soil erosion cause State 3.0 to transition to the Shortgrass Sod State (2.0). Initially weedy species become established. Examples include annual grasses and forbs, common mullein, and thistles. Within a relatively short time, however, upland sedges, shortgrasses, and little bluestem dominate the plant community. Trees on the steeper escarpments and in the deeper canyons may escape most fires and thereby provide a seed source for future ponderosa pine expansion. This transition can occur from any plant community within the Conifer State (3.0) but is more likely from the Juniper-Ponderosa Pine >20% Cover/Sedge/Forb Plant Community (3.2).

Transition T3C
State 3 to 4

On the limestone derived soils, high-intensity fire and possibly excessive soil erosion can cause a transition to the Shortgrass/Black Sage State (4.0). Initially weedy species become established. Examples include annual grasses and forbs, common mullein, and thistles. Within a relatively short time, however, upland sedges, shortgrasses, and little bluestem dominate the plant community. Trees on the steeper escarpments may escape most fires and persist on the site. This transition can occur from any plant community within the Conifer State (3.0) but is more likely to occur from the Juniper-Ponderosa Pine >20% Cover/Sedge/Forb Plant Community (3.2).

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall- and Mid -Stature Warm-Season Grasses**			185–370	
	little bluestem	SCSC	*Schizachyrium scoparium*	185–308	–
	sand bluestem	ANHA	*Andropogon hallii*	0–25	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–12	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–11	–
2	**Mid-Stature Cool-Season Grasses**			123–370	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	123–247	–
	western wheatgrass	PASM	*Pascopyrum smithii*	25–185	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	25–185	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–123	–
	green needlegrass	NAVI4	*Nassella viridula*	0–12	–
3	**Short- Warm-Season Grasses**			62–247	
	blue grama	BOGR2	*Bouteloua gracilis*	62–247	–

	blue grama	BOGR2	*Bouteloua gracilis*	62–247	
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–62	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–62	–
4	**Other Native Grasses and Grass-Likes**			25–123	
	threadleaf sedge	CAFI	*Carex filifolia*	25–123	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	12–62	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–62	–
	sedge	CAREX	*Carex*	0–62	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–37	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–25	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–25	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–12	–
5	**Non-Native Cool-Season Grasses**			–	
	cheatgrass	BRTE	*Bromus tectorum*	–	–
	field brome	BRAR5	*Bromus arvensis*	–	–
	Kentucky bluegrass	POPR	*Poa pratensis*	–	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	–	–
Forb					
6	**Forbs**			62–123	
	dotted blazing star	LIPU	*Liatris punctata*	12–62	–
	pussytoes	ANTEN	*Antennaria*	0–62	–
	Indian breadroot	PEDIO2	*Pediomelum*	0–62	–
	spiny phlox	PHHO	*Phlox hoodii*	0–62	–
	milkvetch	ASTRA	*Astragalus*	12–37	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–37	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	12–37	–
	purple prairie clover	DAPU5	*Dalea purpurea*	12–25	–
	manystem pea	LAPO2	*Lathyrus polymorphus*	12–25	–
	Forb, perennial	2FP	*Forb, perennial*	0–25	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–25	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–25	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–25	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	12–25	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	12–25	–
	scurfpea	PSORA2	*Psoralidium*	12–25	–
	field sagewort	ARCA12	*Artemisia campestris*	0–25	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–12	–
	beardtongue	PENST	*Penstemon*	0–12	–
	stemless four-nerve daisy	TEACA2	*Tetraneuris acaulis var. acaulis*	0–12	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–12	–
	hoary verbena	VEST	*Verbena stricta*	0–12	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–12	–
Shrub/Vine					
7	**Shrubs**			2–28	

7	**Shrubs**			2–25	
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	25–247	–
	black sagebrush	ARNO4	*Artemisia nova*	0–185	–
	creeping juniper	JUHO2	*Juniperus horizontalis*	0–62	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–62	–
	pricklypear	OPUNT	*Opuntia*	0–62	–
	prairie sagewort	ARFR4	*Artemisia frigida*	12–62	–
	soapweed yucca	YUGL	*Yucca glauca*	0–62	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–37	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–25	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–12	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	0–12	–
Tree					
8	**Trees**			0–25	
	ponderosa pine	PIPO	*Pinus ponderosa*	0–25	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–25	–

Animal community

Wildlife Interpretations
MLRA 64 is in the drier areas of a northern mixed-grass prairie ecosystem in which sagebrush steppes to the west yield to grassland steppes to the east. Prior to European settlement, this MLRA consisted of diverse grassland and shrubland habitats interspersed with varying densities of depressional, instream wetlands and woody riparian corridors. These habitats provided critical life cycle components for many users. Many species of grassland birds, small mammals, reptiles, and amphibians and herds of roaming bison, elk, and pronghorn were among the inhabitants adapted to this semi-arid region. Roaming herbivores, as well as several species of small mammals and insects, were the primary consumers linking the grassland resources to large predators, such as the wolf, mountain lion, and grizzly bear, and to smaller carnivores, such as the coyote, bobcat, fox, and raptors. The prairie dog was once abundant and remains a keystone species within its range. The black-footed ferret, burrowing owl, ferruginous hawk, mountain plover, and swift fox are associated with prairie dog complexes.

Historically, the northern mixed-grass prairie was a disturbance-driven ecosystem in which fire, herbivory, and climate functioned as the primary disturbance factors, either singly or in combination. Following European settlement, livestock grazing, cropland conversion, elimination of fire, energy development, and other anthropogenic factors influenced species composition and abundance. Introduced and invasive species further affected plant and animal communities. The bison was a historical keystone species but has been extirpated in this area as a free-ranging herbivore. The loss of the bison and the reduction of prairie dog populations and fire as ecological drivers greatly influenced the character of the remaining native plant communities and altered wildlife habitats. Human development reduced habitat quality for area-sensitive species.

Within MLRA 64, the Shallow HU ecological site provides upland grassland cover with an associated forb, shrub, and tree component. The site was typically part of an expansive grassland landscape that included combinations of Badlands, Thin Breaks, Clayey, Claypan, Dense Clay, Loamy, Saline, Sandy, Overflow, Subirrigated, and Terrace ecological sites.

The site provided habitat for species requiring unfragmented grassland. Important habitat features and components that are commonly or exclusively on this site include leks for sharp-tailed grouse; upland nesting habitat for grassland birds; forbs and insects for brood habitat; and a forage source for small and large herbivores. Populations are declining for many grassland and shrub steppe nesting bird species. Extirpated species include free-ranging American bison, grizzly bear, gray wolf, black-footed ferret, mountain plover, Rocky Mountain locust, and swift fox.

The majority of the Shallow HU ecological site remains intact and provides increasingly important habitat for

grassland and shrub-steppe nesting birds, small rodents, coyote, and a variety of reptiles, amphibians, and insects. Invasive species, such as annual bromegrasses and cheatgrass, have impacted the biological integrity of the site for some grassland birds. Changes in historic fire regime and domestic grazing have impacted the relative composition of forbs, shrubs, and grasses.

Little Bluestem-Needlegrass-Blue Grama/Mountain Mahogany (1.1): The predominance of grasses in this community favors herbivores. Insects, including pollinators, play a role in maintaining the forb community and provide a forage base for grassland birds and other species. The complex structural diversity of plant populations provides habitat for a wide array of migratory and resident birds. Grasshopper sparrow, chestnut-collared longspur, Sprague's pipit, horned lark, lark bunting, and sharp-tailed grouse are common and benefit from the structure and composition this plant community provides. Diverse prey populations are available for grassland raptors, such as ferruginous hawk, Swainson's hawk, golden eagle, and prairie falcon.

The diversity of grasses, forbs, and shrubs provides high nutrition levels for small and large herbivores, including voles, mice, spotted ground squirrel, white-tailed jackrabbit, black-tailed jackrabbit, and deer. The higher stature of this plant community provides thermal, protective, and escape cover for herbivores and grassland birds. Predators that use this plant community include coyote, American badger, red fox, and long-tailed weasel. This plant community provides habitat for amphibians and reptiles, such as the gopher snake, milk snake, and prairie rattlesnake.

Grazing Interpretations
Because the production and accessibility of plant communities described in the Shallow HU ecological site can be highly variable, a resource inventory is necessary to document plant composition and production.

Initial suggested stocking rates should be calculated using a base of 912 lbs/acre (air-dry weight) per animal-unit-month (AUM). Use a 25 percent harvest efficiency of preferred and desirable forage species (refer to USDA-NRCS National Range and Pasture Handbook). An AUM is defined as the equivalent amount of forage required by a 1,000-pound cow with or without calf, for one month.

Hydrological functions

Water is the principal factor limiting herbage production on this site. The site is dominated by soils in hydrologic group D. Infiltration is moderately slow or moderate. Runoff varies from low to high depending on slope and ground cover. In many cases, areas that have greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. Exceptions exist where short grasses form a dense sod and dominate the site. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff. Refer to the USDA-NRCS National Engineering Handbook, Part 630, for hydrologic soil groups, runoff quantities, and hydrologic curves.

Recreational uses

This site provides opportunities for hunting upland game species. The wide variety of plants that bloom from spring until fall have aesthetic value that appeals to visitors.

Wood products

Some soils correlated to the Shallow HU ecological site may produce a minor amount of marketable ponderosa pine. These trees, however, are likely to be inaccessible to modern timber harvesting equipment.

Other products

Harvesting the seeds of native plants can provide additional income on this site.

Other information

Revision Notes: Provisional
This Provisional ecological site description (ESD) has passed Quality Control (QC) and Quality Assurance (QA) to ensure the it meets the 2014 NESH standards for a Provisional ecological site description.

Site Development and Testing Plan
Future work, as described in an official project plan, is necessary to validate the information in this provisional ecological site description. The plan will include field activities for low-, medium-, and high-intensity sampling, soil correlations, and analysis of the data. Annual field reviews should be done by soil scientists and vegetation specialists. Final field review, peer review, quality control, and quality assurance reviews are required to produce the final document.

More intensive soils investigations and clipping data are needed for the Hartville Uplift. The information is needed regarding the three primary geologic formations (limestone, metamorphic rock, and granite) and the soils that have developed on these strata. There appear to be significant differences between plant communities based on the underlying geology and corresponding soils. The communities were combined in this document. These differences, however, may necessitate two or three separate ecological sites.

Inventory data references

Information presented here was derived from NRCS clipping data and other inventory data. Field observations from range-trained personnel were also used. Those involved in developing this site include: Stan Boltz, range management specialist (RMS), NRCS; George Gamblin, RMS, NRCS; Rick Peterson, RMS, NRCS; and Kent Cooley, conservation soil scientist, NRCS.

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Approval

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Acknowledgments

This provisional ecological site description was developed by Rick L. Peterson and George Gamblin on December 17, 2018.

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)	
Contact for lead author	
Date	05/13/2025
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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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):**

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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:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

---

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

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

---

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:**

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17. **Perennial plant reproductive capability:**
