USDA Natural Resources Conservation Service

Ecological site R060AY017SD
Shallow Clay

Last updated: 6/25/2024
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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.

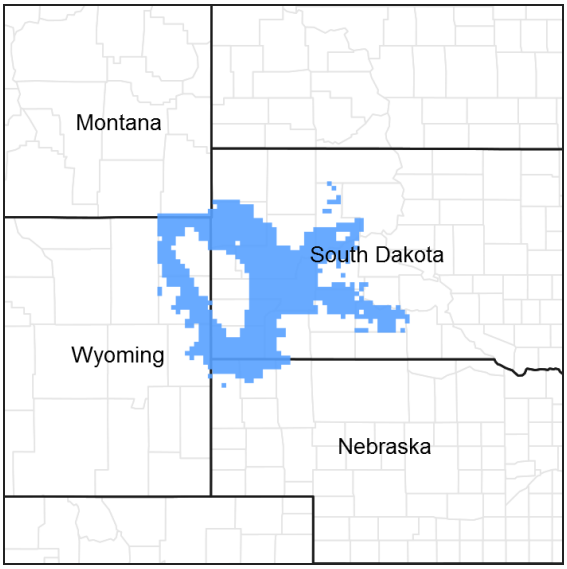

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 060A–Pierre Shale Plains

The Pierre Shale Plains (MLRA 60A) consists of approximately 10,150 square miles, the majority of which is located in South Dakota (70 percent), and small portions are in Montana (2 percent), Nebraska (8 percent), and Wyoming (20 percent). It encircles the Black Hills (MLRA 62) and the Dakota Hogback (MLRA 61). MLRA 60A includes portions of the Oglala, Buffalo Gap, and Thunder Basin National Grasslands. It also includes small sections of the Pine Ridge Indian Reservation, Badlands National Park, and Black Hills National Forest. The Cheyenne and Belle Fourche Rivers flow through the MLRA.

MLRA 60A is in the unglaciated section of the Missouri Plateau, of the Great Plains Province of the Interior Plains. It is an area of old plateaus and terraces that have been deeply eroded. Cretaceous Pierre Shale underlies almost all of this MLRA. This is a marine sediment with layers of volcanic ash that has been altered to smectitic clay. These clays shrink as they dry and swell as they receive moisture. Soils are shallow to very deep and generally are well drained and clayey.

Elevations generally range from 2,620 to 3,610 feet throughout the MLRA, but can range up to 4,260 feet. The average annual precipitation for the western side of the MLRA is 13 to 16 inches, whereas the eastern side receives 16 to 18 inches. A suite of ecological sites have been written specifically for these two precipitation zones. The Locator Map shows the break between the two precipitation zones.

This area supports a mixed natural prairie vegetation consisting of both cool- and warm-season grasses and forbs. Wyoming big sagebrush occurs primarily in the drier western portion of the MLRA; however, small remnant stands can be found in the eastern portion. Dominant land uses of the area primarily are ranching and, to a lesser extent, farming. Major resource concerns to this MLRA are wind erosion and surface water quality.

Classification relationships

USDA - Land Resource Region G – Western Great Plains Range and Irrigated Region, Major Land Resource Area (MLRA) 60A – Pierre Shale Plains.

EPA - Level IV Ecoregions of the Continental United States: 43e – Sagebrush Steppe, 43g Semiarid Pierre Shale Plains, and 43k – Dense Clay Prairie.

Ecological site concept

The Shallow Clay ecological site occurs throughout the MLRA. It is located on upland landscapes and does not receive additional moisture from runoff or overflow. Typical slopes range from 6 to 60 percent. Soils are shallow, between 10 and 20 inches deep, with clay, silty clay, or silty clay loam surface textures 1 to 6 inches thick. Soils are typically calcareous above the bedrock. Fine to very fine, soft weathered shale fragments are common (up to 50 percent by volume) below 4 inches. The shale bedrock can be fractured in the upper part, and some fine roots can be found extending up to 30 inches below the surface.

The vegetation in the Reference State consists of a mix of cool- and warm-season grasses. Rhizomatous wheatgrass and needlegrass are dominant; however, warm-season grasses, including little bluestem, sideoats grama, big bluestem, and prairie sandreed, can make up a significant portion of the composition. Forbs are common and diverse. Shrubs include leadplant and rose. Yucca can be common, especially on ridges. Wyoming big sagebrush and bluebunch wheatgrass will be common in the western portion of the MLRA. This site is susceptible to encroachment by conifers.

Associated sites

R060AY011SD	**Clayey 13-16" P.Z.** The Clayey 13-16” PZ site can be found adjacent to the Shallow Clay site, but with lesser slopes.
R060AY030SD	**Porous Clay** The Porous Clay site can be found adjacent to the Shallow Clay site, but the soils will be derived from acid shale.
R060AY040SD	**Clayey 16-18" P.Z.** The Clayey 16-18” PZ site can be found adjacent to the Shallow Clay site, but with lesser slopes.
R060AY043SD	**Shallow Porous Clay** The Shallow Porous Clay site can be found adjacent to the Shallow Clay Site, but the soils will be derived from acid shale.

Similar sites

R060AY011SD	**Clayey 13-16" P.Z.** The Clayey 13-16” PZ site will have less sideoats grama and fewer shrubs. Forage production will be higher.
R060AY040SD	**Clayey 16-18" P.Z.** The Clayey 16-18” PZ site will have less sideoats grama and little bluestem and fewer shrubs. Forage production will be higher.
R060AY024SD	**Shallow Loamy** The Shallow Loamy site will have more needle and thread, and less green needlegrass.

Table 1. Dominant plant species

Tree	Not specified

Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Bouteloua curtipendula*

Physiographic features

This site typically occurs on gently to steeply sloping uplands.

Table 2. Representative physiographic features

Landforms	(1) Plain (2) Hill (3) Ridge
Flooding frequency	None
Ponding frequency	None
Elevation	762–1,311 m
Slope	6–60%
Aspect	Aspect is not a significant factor

Climatic features

The climate in this MLRA is typical of the drier portions of the Northern Great Plains, where sagebrush steppes to the west yield to grassland steppes to the east. Annual precipitation for the entire MLRA ranges from 13 to 18 inches per year, with most occurring during the growing season. Temperatures show a wide range between summer and winter and between daily maximums and minimums, due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air masses from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in winter and bring rapid rises in temperature. Extreme storms may occur during the winter, but the more severe occur during late fall, late winter, and spring.

The normal average annual temperature is about 46°F. January is the coldest month with average temperatures ranging from about 19°F (Moorcroft CAA, WY) to about 22°F (Belle Fourche, SD). July is the warmest month with temperatures averaging from about 70°F (Moorcroft CAA, WY) to about 72°F (Belle Fourche, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 51°F. Hourly winds 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 generally are stronger than nighttime, and occasional strong storms may 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. Warm-season plants begin growth about mid-May and can continue to early or mid-September. Green-up of cool-season plants may occur in September and October when adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (characteristic range)	98-105 days
Freeze-free period (characteristic range)	123-129 days
Precipitation total (characteristic range)	381-457 mm
Frost-free period (actual range)	76-108 days
Freeze-free period (actual range)	113-133 days
Precipitation total (actual range)	356-457 mm
Frost-free period (average)	97 days
Freeze-free period (average)	124 days

Precipitation total (average)	406 mm

Climate stations used

- (1) UPTON [USC00489205], Upton, WY
- (2) REDBIRD [USC00487555], Lance Creek, WY
- (3) BELLE FOURCHE [USC00390559], Belle Fourche, SD
- (4) WASTA [USC00398911], Owanka, SD
- (5) MOORCROFT 3S [USW00024088], Moorcroft, WY
- (6) ARDMORE 1 NW [USC00390236], Edgemont, SD

Influencing water features

No significant water features influence this site.

Wetland description

Not Applicable.

Soil features

The soils in this site are well drained and formed in residuum weathered from shale. The surface layer is 1 to 6 inches thick with clay to silty clay loam textures. The soils will range from slight to moderately alkaline. Some series will have an impervious shale layer at 10 to 20 inches however, other soil series will have a fractured shale layer with up to 50 percent by volume of fine to very fine, soft weathered shale fragment and roots extending to a depth of 30 inches. The soils have a slow to very slow infiltration rate. This site should show slight to no evidence of rills, wind-scoured areas or pedestalled plants. Water flow paths are broken, irregular in appearance or discontinuous with numerous debris dams or vegetative barriers.

Soils correlated to the Shallow Clayey ecological site include: Conata, Grummit, Hilight, Midway, Orella, Samday, and Samsil.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about 5 percent. Available water capacity and permeability will strongly influences the soil-water-plant relationship. More information can be found in the various soil survey reports. Contact the local USDA Service Center for soil survey reports that include more detail specific to your location.

Table 4. Representative soil features

Surface texture	(1) Clay (2) Silty clay loam (3) Silty clay
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Very slow to moderately slow
Soil depth	25–51 cm
Surface fragment cover <=3"	0–25%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	5.08–7.62 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	0–8 mmhos/cm

Sodium adsorption ratio (0-101.6cm)	0–13
Soil reaction (1:1 water) (0-101.6cm)	6.1–9
Subsurface fragment volume <=3" (Depth not specified)	5–15%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

This site developed under Northern Great Plains climatic conditions, natural influences of large herbivores, occasional fire, and other biotic and abiotic factors that typically influence soil/site development. Changes will occur in the plant communities due to short-term weather variations, impacts of native and/or exotic plant and animal species, and management actions. While the following plant community descriptions specify more typical transitions between communities that will occur, severe disturbances, such as periods of well-below average precipitation, can cause significant shifts in plant communities and/or species composition.

As this site deteriorates, species such as blue grama and sedge will increase. Cool-season grasses such as green needlegrass, bluebunch wheatgrass, and rhizomatous wheatgrasses will decrease in frequency and production. Warm-season grasses, including little bluestem and prairie sandreed, will also decrease.

The plant community upon which interpretations are primarily based is the Reference Plant Community (1.1). The Reference Plant Community has been determined by studying rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts also have been used. Plant communities, states, transitional pathways, and thresholds have been determined through similar studies and experience.

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

State and transition model

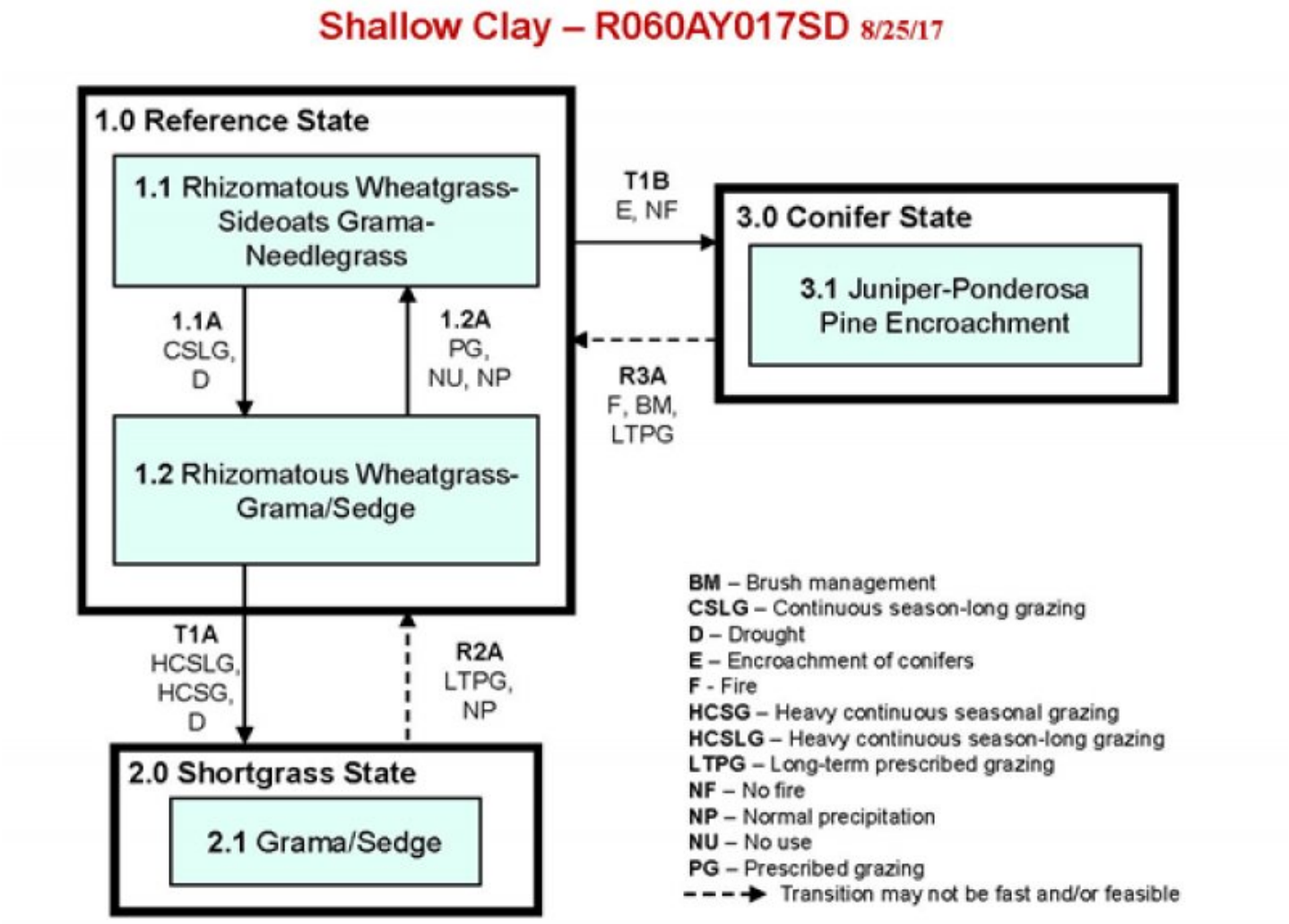

Figure 8. Shallow Clay - R060AY017SD.

Diagram Legend - Shallow Clay - R060AY017SD

T1A	Heavy, continuous season-long grazing or heavy, continuous seasonal grazing, without adequate recovery, or heavy grazing in combination with drought.
T1B	Encroachment of juniper and/or ponderosa pine, and no fire.
R2A	Long-term prescribed grazing with change in season of use, and time for adequate recovery, and a return to normal precipitation patterns. Restoration may not be rapid or achievable.
R3A	Fire or prescribed burning, or mechanical brush management to remove conifer encroachment followed by long-term prescribed grazing with change in season of use, and time for adequate recovery. Restoration may not be rapid or achievable.

CP 1.1A	1.1 - 1.2	Continuous season-long grazing in combination with drought.
CP 1.2A	1.2 - 1.1	Prescribed grazing with proper stocking, change in season of use and adequate time for recovery, and a return to normal precipitation following drought, and possibly extended periods of deferment or no use.

Figure 9. Shallow Clay - R060AY017SD

State 1
Reference State

This state represents what is believed to show the natural range of variability that dominated the dynamics in this ecological site prior to European settlement. This site in the Reference State (1.0) is dominated by cool- and warm-season grasses. In pre-European times the primary disturbances included fire, grazing by large ungulates and small mammals, and drought. Favorable growing conditions occurred during the spring and the warm months of June through August. This State can be found on areas having a history of proper grazing management, including adequate recovery periods between grazing events.

Community 1.1
Rhizomatous Wheatgrass-Sideoats Grama-Green Needlegrass

Figure 10. Shallow Clay - PCP 1.1.

Interpretations are primarily based on the Rhizomatous Wheatgrass-Sideoats Grama-Green Needlegrass Plant Community (1.1). This is also considered the Reference Plant Community. Potential vegetation is about 80 to 90 percent grasses or grass-like plants, 5 to 10 percent forbs, 5 to 10 percent shrubs, and 0 to 2 percent trees. Major grasses include western wheatgrass, green needlegrass, and sideoats grama. Other grasses and grass-likes occurring on this plant community include little bluestem, blue grama, prairie sandreed, big bluestem, bluebunch wheatgrass (in the western portion of the MLRA), and sedges. Forbs that commonly occur include purple coneflower, goldenpea, prairie coneflower, and scurfpea. Shrubs that are common in the MLRA include leadplant, rose, yucca, silver sagebrush, and Wyoming big sagebrush. Big sagebrush is more likely to occur in the western portions of the MLRA, and can make up from 5 to 10 percent of the annual production. Trees can include Rocky Mountain juniper and ponderosa pine. This plant community is well adapted to the Northern Great Plains climatic conditions. Individual species can vary greatly in production depending on growing conditions (timing and amount of precipitation and temperature). Community dynamics, nutrient cycle, water cycle, and energy flow are functioning properly. Plant litter is properly distributed with very little movement off-site, and natural plant mortality is very low. The diversity in plant species allows for high tolerance to drought. Runoff from adjacent sites and moderate or high available water capacity provides a favorable soil-water-plant relationship.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	975	1334	1681
Forb	73	115	163
Shrub/Vine	73	112	157
Tree	–	8	17
Total	**1121**	**1569**	**2018**

Figure 12. Plant community growth curve (percent production by month). SD6002, Pierre Shale Plains, cool-season dominant, warm-season sub-dominant.. Cool-season dominant, warm-season sub-dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	10	23	34	15	6	5	4	0	0

Community 1.2
Rhizomatous Wheatgrass-Grama/Sedge

This plant community develops under continuous season-long grazing by large herbivores. The potential vegetation consists of about 80 to 90 percent grasses and grass-likes, 5 to 15 percent forbs, 5 to 10 percent shrubs, and 0 to 2 percent trees. The major grasses and grass-likes include western wheatgrass, blue grama, and sedge. Other grasses occurring on this plant community include sideoats grama, little bluestem, needle and thread, and threeawn. Forbs commonly occurring include yarrow, cudweed sagewort, goldenpea, prairie coneflower, and scurfpea. Shrubs commonly found include fringed sagewort and broom snakeweed. When compared to the Reference Plant Community (1.1), blue grama and sedges have increased. Green needlegrass, little bluestem, sideoats grama, prairie sandreed, and big bluestem have decreased. Non-native species such as cheatgrass, salsify, curlycup gumweed, thistle, and sweetclover will likely invade this plant community. This plant community is stable and protected from excessive erosion. The dominant herbaceous species are very adapted to grazing; however, the midgrass species and the more palatable forbs will decrease in the community through continuous seasonal grazing. This plant community tends to be resilient if disturbance is not long-term.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	684	953	1211
Shrub/Vine	50	84	118
Forb	50	78	112
Tree	–	6	17
Total	**784**	**1121**	**1458**

Figure 14. Plant community growth curve (percent production by month). SD6002, Pierre Shale Plains, cool-season dominant, warm-season sub-dominant.. Cool-season dominant, warm-season sub-dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	10	23	34	15	6	5	4	0	0

Pathway 1.1A
Community 1.1 to 1.2

Continuous season-long grazing combined with drought will convert the plant community to the Rhizomatous Wheatgrass-Grama/Sedge Plant Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing, in combination with a return to normal precipitation patterns and/or an extended period of rest or no use, will move this plant community to the Rhizomatous Wheatgrass-Sideoats Grama-Green Needlegrass Plant Community (1.1).

State 2
Shortgrass State

This state is dominated by warm-season shortgrass species and upland sedges. It is the result of grazing practices that remove the mid- stature cool- and warm-season grasses, and provide a competitive advantage to shortgrasses and grass-like species that are grazing- resistant. Water infiltration has decreased and runoff has increased in this state. This state is very resilient and resistant to change through grazing management alone.

Community 2.1
Grama/Sedge

This plant community develops under heavy, continuous grazing, or with continuous, seasonal grazing with concentrated use in the early part of the growing season (as in calving/lambing pastures). It is made up of approximately 85 to 95 percent grasses (primarily short, warm-season grasses), 1 to 5 percent forbs, 5 to 10 percent shrubs, and 0 to 2 percent trees. The dominant grasses or grass-likes include blue grama, buffalograss, and sedge. Other grasses may include western wheatgrass, prairie Junegrass, threeawn, and annual brome. The dominant forbs include slimflower scurfpea, pussytoes, curlycup gumweed, and scarlet globemallow. The dominant shrubs are fringed sagewort and plains pricklypear. Compared to the Reference Plant Community (1.1), short grasses have increased, and the cool-season midgrasses have diminished greatly. Some forbs and cactus have either increased and/or invaded the site. Plant diversity is low. This plant community is very stable. Generally, this plant community will require significant management input and time to move it away from this plant community. On-site soil erosion is low. Infiltration is low, and runoff is high. Typically the runoff is very clean, but off-site areas can be significantly impacted due to the increased runoff.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	420	596	773
Shrub/Vine	28	50	67
Forb	–	20	39
Tree	–	6	17
Total	**448**	**672**	**896**

Figure 16. Plant community growth curve (percent production by month). SD6004, Pierre Shale Plains, warm-season dominant, cool-season sub-dominant. Warm season dominant, cool-season sub-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	18	25	25	15	7	0	0	0

State 3
Conifer State

This State occurs when Rocky Mountain juniper, eastern redcedar, and/or ponderosa pine encroach onto the site. As the juniper/pine become established, the herbaceous component declines and more bare ground is exposed. As bare ground increases, juniper/pine establishes more readily. Grazing can contribute to this transition, but it can also occur independently without human influence other than fire suppression.

Community 3.1
Juniper-Ponderosa Pine Encroachment

This plant community more commonly occurs in the eastern, 16 to 18 inch precipitation zone of this MLRA. Historically, ponderosa pine and juniper were confined to rocky ridges and steep shallow slopes with rock outcrops, located adjacent to this ecological site. Currently, juniper species and ponderosa pine are expanding onto this ecological site due to the suppression of fire. Juniper/pine canopy is greater than 15 percent of mature trees. The understory is made up of about 60 to 85 percent grasses and grass-like species, 5 to 10 percent forbs, and 2 to 10 percent shrubs. Dominant grasses and grass-likes include western wheatgrass, green needlegrass, little bluestem, sideoats grama, blue grama, and sedge. As the canopy increases, warm-season grasses tend to decrease as the cool-season grasses initially increase. Forbs commonly found in this community include fringed sagewort, western yarrow, and pussytoes. Non-native species such as cheatgrass and Kentucky bluegrass will tend to invade this plant community. The total annual herbaceous production can vary greatly depending on the canopy cover of the overstory. When compared to the Reference Plant Community (1.1), juniper or ponderosa pine increases significantly. The grass component decreases dramatically as the buildup of pine and juniper needles increases.

Annual herbaceous production also decreases significantly. While the juniper/pine 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. This plant community is resistant to change. A significant reduction of juniper/pine can only be accomplished through brush management or fire. The vegetation in the understory is capable of enduring fire; however, very hot fires will have a detrimental effect to the plant community. Reclamation of juniper/pine-dominated areas can be costly and prove to be temporary without proper management (i.e., prescribed burning and prescribed grazing).

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	639	995	1345
Tree	62	168	280
Shrub/Vine	22	81	140
Forb	62	101	140
Total	**785**	**1345**	**1905**

Figure 18. Plant community growth curve (percent production by month). SD6011, Pierre Shale Plains, heavy conifer canopy. Mature ponderosa pine/juniper overstory. .

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3	7	11	24	27	12	5	4	3	2	1

Transition T1A
State 1 to 2

Heavy, continuous season-long grazing, heavy, continuous seasonal grazing, and/or drought will transition this plant community (1.2) to the Shortgrass State (2.0).

Transition T1B
State 1 to 3

Encroachment juniper and/or ponderosa pine, and no fire will transition this plant community to the Conifer State (3.0).

Restoration pathway R2A
State 2 to 1

Long-term prescribed grazing which allows for adequate plant recovery periods and a return to normal precipitation patterns will move this plant community toward the Reference State (1.0). This transition may or may not be rapid or meet management goals.

Restoration pathway R3A
State 3 to 1

Prescribed burning or wildfire, followed by long-term prescribed grazing, will move this plant community toward the Reference State (1.0). Mechanical brush management followed by long-term prescribed grazing may also result in a transition to the Reference State. The transition my not be rapid or achievable.

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					

1	**Rhizomatous Wheatgrasses**			314–628	
	western wheatgrass	PASM	*Pascopyrum smithii*	314–628	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	16–157	–
2	**Cool Season Mid Grasses**			157–392	
	green needlegrass	NAVI4	*Nassella viridula*	157–392	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–157	–
3	**Warm Season Mid Grasses**			157–392	
	sideoats grama	BOCU	*Bouteloua curtipendula*	157–392	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	157–392	–
	little bluestem	SCSC	*Schizachyrium scoparium*	31–157	–
	little bluestem	SCSC	*Schizachyrium scoparium*	31–157	–
4	**Warm Season Short Grasses**			78–235	
	blue grama	BOGR2	*Bouteloua gracilis*	78–157	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–78	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–78	–
5	**Other Native Grasses and Grass-likes**			78–235	
	big bluestem	ANGE	*Andropogon gerardii*	31–126	–
	sedge	CAREX	*Carex*	16–78	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–47	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	16–47	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–47	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	6–47	–
	Grass, perennial	2GP	*Grass, perennial*	0–47	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–31	–
	squirreltail	ELEL5	*Elymus elymoides*	0–31	–
Forb					
7	**Forbs**			78–157	
	Forb, perennial	2FP	*Forb, perennial*	0–47	–
	yarrow	ACHIL	*Achillea*	0–47	–
	onion	ALLIU	*Allium*	0–47	–
	pussytoes	ANTEN	*Antennaria*	0–47	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–47	–
	milkvetch	ASTRA	*Astragalus*	0–47	–
	false boneset	BREU	*Brickellia eupatorioides*	0–47	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	0–47	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–47	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–47	–
	alpine golden buckwheat	ERFLF	*Eriogonum flavum var. flavum*	0–47	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–47	–
	dotted blazing star	LIPU	*Liatris punctata*	0–47	–
	desertparsley	LOMAT	*Lomatium*	0–47	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–47	–

	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–47	–
	large Indian breadroot	PEES	*Pediomelum esculentum*	0–47	–
	scurfpea	PSORA2	*Psoralidium*	0–47	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–47	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–47	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–47	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–47	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–47	–
	thistle	CIRSI	*Cirsium*	0–31	–
Shrub/Vine					
8	**Shrubs**			78–157	
	big sagebrush	ARTR2	*Artemisia tridentata*	0–78	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–47	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–47	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–47	–
	rose	ROSA5	*Rosa*	16–47	–
	soapweed yucca	YUGL	*Yucca glauca*	0–47	–
	Subshrub (<.5m)	2SUBS	*Subshrub (<.5m)*	0–47	–
	leadplant	AMCA6	*Amorpha canescens*	16–47	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–47	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–47	–
Tree					
9	**Trees**			0–16	
	juniper	JUNIP	*Juniperus*	0–16	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–16	–

Table 10. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrasses**			168–336	
	western wheatgrass	PASM	*Pascopyrum smithii*	168–336	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–56	–
2	**Cool Season Mid Grasses**			0–168	
	green needlegrass	NAVI4	*Nassella viridula*	0–168	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–22	–
3	**Warm Season MidGrasses**			112–280	
	sideoats grama	BOCU	*Bouteloua curtipendula*	56–168	–
	little bluestem	SCSC	*Schizachyrium scoparium*	22–168	–
4	**Warm Season Short Grasses**			112–336	
	blue grama	BOGR2	*Bouteloua gracilis*	112–280	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–112	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–56	–

5	**Native Grasses and Grass-likes**			56–280	
	sedge	CAREX	*Carex*	56–168	–
	squirreltail	ELEL5	*Elymus elymoides*	0–56	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–56	–
	threeawn	ARIST	*Aristida*	0–56	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	11–34	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–34	–
	Grass, perennial	2GP	*Grass, perennial*	0–34	–
6	**Non-native Grasses**			0–56	
	cheatgrass	BRTE	*Bromus tectorum*	0–56	–
	Kentucky bluegrass	POPR	*Poa pratensis*	0–56	–
Forb					
7	**Forbs**			56–112	
	sweetclover	MELIL	*Melilotus*	0–56	–
	yarrow	ACHIL	*Achillea*	0–45	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	11–45	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–45	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–45	–
	goatsbeard	TRAGO	*Tragopogon*	0–34	–
	milkvetch	ASTRA	*Astragalus*	0–34	–
	thistle	CIRSI	*Cirsium*	0–34	–
	alpine golden buckwheat	ERFLF	*Eriogonum flavum var. flavum*	0–34	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–34	–
	onion	ALLIU	*Allium*	0–34	–
	pussytoes	ANTEN	*Antennaria*	0–34	–
	scurfpea	PSORA2	*Psoralidium*	0–34	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–34	–
	Forb, perennial	2FP	*Forb, perennial*	0–34	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–34	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–22	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–22	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–22	–
	dotted blazing star	LIPU	*Liatris punctata*	0–22	–
	desertparsley	LOMAT	*Lomatium*	0–22	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–22	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–22	–
Shrub/Vine					
8	**Shrubs**			56–112	
	big sagebrush	ARTR2	*Artemisia tridentata*	0–90	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–56	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–56	–
	prairie sagewort	ARFR4	*Artemisia frigida*	11–56	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–34	–

	rose	ROSA5	*Rosa*	11–34	–
	soapweed yucca	YUGL	*Yucca glauca*	0–34	–
	Subshrub (<.5m)	2SUBS	*Subshrub (<.5m)*	0–34	–
Tree					
9	**Trees**			0–11	
	juniper	JUNIP	*Juniperus*	0–11	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–11	–

Table 11. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrasses**			7–67	
	western wheatgrass	PASM	*Pascopyrum smithii*	7–67	–
3	**Warm Season Mid Grasses**			34–135	
	little bluestem	SCSC	*Schizachyrium scoparium*	0–101	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–67	–
4	**Warm Season Short Grasses**			168–370	
	blue grama	BOGR2	*Bouteloua gracilis*	168–336	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–101	–
5	**Native Grasses and Grass-likes**			67–168	
	sedge	CAREX	*Carex*	67–135	–
	threeawn	ARIST	*Aristida*	7–54	–
	squirreltail	ELEL5	*Elymus elymoides*	0–34	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–34	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	7–20	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–20	–
	Grass, perennial	2GP	*Grass, perennial*	0–20	–
6	**Non-native Grasses**			7–67	
	Kentucky bluegrass	POPR	*Poa pratensis*	0–54	–
	cheatgrass	BRTE	*Bromus tectorum*	7–34	–
Forb					
7	**Forbs**			7–34	
	sweetclover	MELIL	*Melilotus*	0–34	–
	scurfpea	PSORA2	*Psoralidium*	0–34	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–34	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–34	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–20	–
	goatsbeard	TRAGO	*Tragopogon*	0–20	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–20	–
	Forb, perennial	2FP	*Forb, perennial*	0–20	–
	yarrow	ACHIL	*Achillea*	0–20	–
	onion	ALLIU	*Allium*	0–20	–

	pussytoes	ANTEN	*Antennaria*	0–20	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	7–20	–
	milkvetch	ASTRA	*Astragalus*	0–20	–
	thistle	CIRSI	*Cirsium*	0–20	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–13	–
	alpine golden buckwheat	ERFLF	*Eriogonum flavum var. flavum*	0–13	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–13	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–7	–
	dotted blazing star	LIPU	*Liatris punctata*	0–7	–
Shrub/Vine					
8	**Shrubs**			34–67	
	big sagebrush	ARTR2	*Artemisia tridentata*	0–67	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	7–34	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–34	–
	soapweed yucca	YUGL	*Yucca glauca*	0–34	–
	prairie sagewort	ARFR4	*Artemisia frigida*	7–34	–
	rose	ROSA5	*Rosa*	7–20	–
	Subshrub (<.5m)	2SUBS	*Subshrub (<.5m)*	0–13	–
Tree					
9	**Trees**			0–11	
	juniper	JUNIP	*Juniperus*	0–11	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–11	–

Animal community

The following table lists annual suggested initial stocking rates with average growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of conservation planning. Often, the current plant composition does not entirely match any particular plant community (as described in this Ecological Site Description). Therefore, a resource inventory is necessary to document plant composition and production. More accurate carrying capacity estimates should eventually be calculated using the following stocking rate information along with animal preference data and actual stocking records, particularly when grazers other than cattle are involved. With consultation of the land manager, more intensive grazing management may result in improved harvest efficiencies and increased carrying capacity.

Plant Community = Rhizomatous Wheatgrass-Sideoats Grama-Green Needlegrass (1.1)
Average Annual Production (lbs./ac., air-dry) = 1400
Stocking Rate (AUM/ac) = 0.38

Plant Community = Rhizomatous Wheatgrass-Grama/Sedge (1.2)
Average Annual Production (lbs./ac., air-dry) = 1000
Stocking Rate (AUM/ac) = 0.27

Plant Community = Grama/Sedge (2.1)
Average Annual Production (lbs./ac., air-dry) = 600
Stocking Rate (AUM/ac) = 0.16

Plant Community = Juniper-Ponderosa Pine Encroachment (3.1)
Average Annual Production (lbs./ac., air-dry) = Variable
Stocking Rate (AUM/ac) = Variable

Based on 912 lbs./acre (air-dry weight) per Animal Unit Month (AUM), and on 25 percent harvest efficiency of preferred and desirable forage species (refer to USDA NRCS, National Range and Pasture Handbook).

Total annual production on-site may contain vegetation deemed undesirable or untargeted by the grazing animal. Therefore, AUM values may have been reduced to reflect only preferred or desirable forage species.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage. During the dormant period, the forage for livestock will likely be lacking protein to meet livestock requirements, and added protein will allow ruminants to better utilize the energy stored in grazed plant materials. A forage quality test (either directly or through fecal sampling) should be used to determine the level of supplementation needed.

Hydrological functions

Water is the principal factor limiting herbage production on this site. The site is dominated by soils in hydrologic group D. Infiltration varies from very slow to moderately slow, and runoff varies from medium to very high depending on slope and ground cover. In many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An exception would be where shortgrasses form a dense sod and dominate the site. Normally areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff (refer to Section 4, NRCS National Engineering Handbook for further information).

Recreational uses

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

Other products

Selected seed harvest of certain unique native plant species can provide additional income.

Other information

Revision Notes: “Previously Approved” Provisional
This Provisional ecological site concept has passed Quality Control (QC) and Quality Assurance (QA) to ensure that the site meets the 2014 NESH standards for a Provisional ecological site. This is an updated “Previously Approved” ESD which represents a first-generation tier of documentation that, prior to the release of the 2014 National Ecological Site Handbook (NESH), met all requirements as an “Approved” ESD as laid out in the 1997, rev.1, 2003 National Range and Pasture Handbook (NRPH). The document fully described the Reference State and Community Phase in the State-and-Transition model. All other alternative states are at least described in narrative form. The “Previously Approved” ESD has been field-tested for a minimum of five years and is a proven functional document for conservation planning. The “Previously Approved” ESD does not contain all tabular and narrative entries as required in the current “Approved” level of documentation, but it is expected that the “Previously Approved” ESD will continue refinement toward an “Approved” status.

Site Development and Testing Plan:
Future work, as described in a Project Plan, is necessary to validate the information in this Provisional Ecological Site Description. This will include field activities to collect low-, medium-, and high-intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. The final field review, peer review, quality control, and quality assurance reviews of the ESD will be required to produce the final document.

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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 description include: Everet Bainter, Range Management Specialist, NRCS; Stan Boltz, Range Management Specialist, NRCS; Darrel DuVall, Range Management Specialist, NRCS; Jill Epley, Range Management Specialist, NRCS; Glen Mitchell, Range Management Specialist, NRCS; Cheryl Nielsen, Range Management Specialist, NRCS; Rick Peterson, Range Management Specialist, NRCS; and Mike Stirling, Range Management Specialist, NRCS.

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Contributors

Stan C. Boltz
Rick L. Peterson

Approval

Suzanne Mayne-Kinney, 6/25/2024

Acknowledgments

ESD updated by Rick L. Peterson on 8/24/17

MLRA 60A Provisional Level Quality Control (QC) Process 9/28/17

Ecological Site from MLRA 60A were Previously Approved ESDs and meet the requirements as stated in the 2003 National Range and Pasture Handbook.

The Sites were updated to the Provisional Level by Rick L. Peterson, ESS, Rapid City, SSO in FY17.

The sites were reviewed by George Gamblin, RMS, Wheatland, WY and Mitch Faulkner, RMS, Belle Fourche, SD. Mitch Faulkner acted as the Provisional QC. The Sites were then reviewed and approved at the Provisional Level by David Kraft, Regional ESS, Salina, KS.
Worked closely with Kent Cooley, Area SS, with MLRA key development and soils narratives

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)	Stan Boltz, Ryan Beer, Mitch Iverson, Thad Berrett, Cheryl Nielsen
Contact for lead author	stanley.boltz@sd.usda.gov, 605-352-1236
Date	06/04/2008
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Slight to none, typically on steeper slopes and discontinuous.

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2. **Presence of water flow patterns:** None, or barely visible and discontinuous with numerous debris dams when present.

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3. **Number and height of erosional pedestals or terracettes:** Few pedastalled plants typically on steeper slopes.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 0 to 15 percent is typical.

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

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

7. **Amount of litter movement (describe size and distance expected to travel):** Small size litter classes will generally move short distances, some medium size class litter will move very short distances. Litter debris dams are occasionally present.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil aggregate stability ratings should typically be 5 to 6, normally 6. Surface organic matter adheres to the soil surface. Soil surface fragments will typically retain structure indefinitely when dipped in distilled water.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** A-horizon should be 2 to 4 inches thick with light to dark brownish gray colors. Structure should typically be fine granular at least in the upper A-horizon.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Combination of shallow and deep rooted species (mid & tall rhizomatous and tufted perennial cool- and warm-season grasses) with fine and coarse roots positively influences infiltration.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None – when dry, B horizons can be hard and appear to be compacted, but no platy structure will be present.

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: Rhizomatous wheatgrass >>

    Sub-dominant: Mid/tall cool-season bunchgrasses = mid warm-season grasses > short warm-season grasses >

    Other: Forbs = shrubs

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very little evidence of decadence or mortality. Bunch grasses have strong, healthy centers and shrubs are vigorous.

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):** Production ranges from 1,000-1,800 lbs./acre (air-dry weight). Reference value production is 1,400 lbs./acre (air-dry weight).

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** State and local noxious weeds

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17. **Perennial plant reproductive capability:** All species exhibit high vigor relative to climatic conditions. Do not rate based solely on seed production. Perennial grasses should have vigorous rhizomes or tillers.
