USDA Natural Resources Conservation Service

Ecological site R063AY018SD
Dense Clay

Last updated: 6/26/2024
Accessed: 05/13/2025

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.

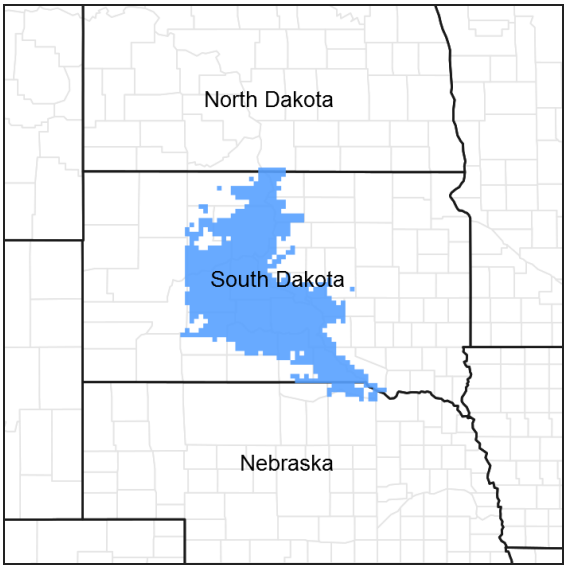


Figure 1. Mapped extent

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): 063A–Northern Rolling Pierre Shale Plains

MLRA 63A is approximately 10,160 square miles in size, the majority of which is in South Dakota and a very small portion in North Dakota. The MLRA extends west of the northern half of the South Dakota reach of the Missouri River. All five of the major rivers draining western South Dakota cross this area. From north to south, these are the Grand, Moreau, Cheyenne, Bad, and White Rivers.

Elevation range from 1,300 to 1,640 feet on the bottom land along the Missouri River to 1,640 to 2,950 feet on the shale plain uplands. Cretaceous Pierre Shale underlies almost all of this area. This is a marine sediment having layers of volcanic ash that has been altered to smectitic clays. These clays shrink as they dry and swell as they get wet. Tertiary and Quaternary river deposits, remnants of erosion from the Black Hills uplift, cap isolated highlands in this area. Deposits of alluvial sand and gravel occur on the valley floors adjacent to the major streams in the area. The average annual precipitation in this area is 15 to 20 inches.
The vegetation in this area is a transition from eastern tall grass prairie to a western mixed grass prairie, (USDA-NRCS, Ag Handbook 296).

Classification relationships

Land Resource Region (LRR): G - Western Great Plains Range and Irrigated Region, Major Land Resource Area

(MLRA): 63A Northern Rolling Pierre Shale Plains, (USDA-NRCS, Ag Handbook 296).
Level IV Ecoregions of the Conterminous United States, 2013: 43c – River Breaks and 43f – Subhumid Pierre Shale Plains.

Ecological site concept

The Dense Clay Ecological Site occurs throughput the MLRA. It is located in upland valleys, alluvial fans and stream terraces. Slopes range from 0 to 15 percent but can occur on slopes up to 45 percent. Soils are formed from dense clayey alluvium or residuum from soft shale. The clay surface layer is 1 to 5 inches thick. When the soil is dry, cracks 1/2 inch to 2 inches wide and several feet long can extend to a depth below 20 inches. Permeability is very slow unless the soil is dry. Bare ground will be common. Principal vegetation consists of sparse stands of rhizomatous wheatgrasses and green needlegrass. Prickly pear cactus is typically present in the plant community but in minor amounts.

Note: The Dupree soil component is correlated to both Dense Clay and Shallow Porous Clay Ecological Sites. The Dupree soil typically ranges from medium acid to slightly alkaline; however, strongly and extremely acid phases have been recognized and are correlated to the Shallow Porous Clay Ecological Sites. These two sites have very different plant community phases.

Associated sites

R063AY011SD	**Clayey**
R063AY015SD	**Thin Claypan**
R063AY021SD	**Clayey Overflow**

Similar sites

R063AY011SD	**Clayey** Clayey [more short grasses; higher production]
R063AY015SD	**Thin Claypan** Thin Claypan [more short grasses and plains pricklypear; contains slickspots]

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii*

Physiographic features

This site occurs on nearly level to sloping uplands, upland valleys alluvial fans and stream terraces.

Table 2. Representative physiographic features

Landforms	(1) Terrace (2) Fan (3) Plain
Elevation	488–823 m
Slope	0–15%
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 63A is considered to have a continental climate – cold winters and hot summers, low humidity, light rainfall, and abundant sunshine. Extreme temperature fluctuations are also common. The climate is the result of this MLRA's location near the geographic center of North America. There are few natural barriers on the Northern Great Plains and air masses move freely across the plains and account for rapid changes in temperature.

Annual precipitation ranges from 16 to 20 inches per year. The average annual temperature is about 47°F. January is the coldest month with average temperatures ranging from about 11°F (Pollock, South Dakota (SD)), to about 22°F (Cedar Butte, SD). July is the warmest month with temperatures averaging from about 72°F (Pollock, SD), to about 76° F (Cedar Butte, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 58°F. This large annual range attests to the continental nature of this area's climate. 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 are generally 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 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 (average)	130 days
Freeze-free period (average)	151 days
Precipitation total (average)	483 mm

Climate stations used

- (1) POLLOCK [USC00396712], Pollock, SD
- (2) COTTONWOOD 2 E [USC00391972], Kadoka, SD
- (3) KENNEBEC [USC00394516], Kennebec, SD
- (4) CEDAR BUTTE 1NE [USC00391539], White River, SD

Influencing water features

No riparian areas or wetland features are directly associated with this site.

Soil features

The soils in this site are well drained and formed in clayey alluvium or residuum from soft shale. The clay surface layer is 1 to 5 inches thick. The soils have a slow to very slow infiltration rate except after dry periods when initial uptake may be rapid due to cracking of the surface. Gilgai microrelief occurs in most areas. When dry these soils crack. Wet surface compaction can occur with heavy traffic. This site should show slight to no evidence of rills or wind scoured areas. It is not uncommon to have some pedestalling of plants due to the inherent instability of the soils. Water flow paths are broken, irregular in appearance, or discontinuous with numerous debris dams or vegetative barriers. The soil surface is stable and intact. Subsurface soil layers are restrictive to water movement and root penetration.

These soils are highly susceptible to wind and water erosion. The hazard of water erosion increases on slopes greater than 6 percent or where vegetative cover is not adequate.

Soils correlated to the Dense Clay Ecological Site in MLRA 63A include: Bullcreek, Swanboy, Chantier and Dupree. The Dupree soil typically ranges from medium acid to slightly alkaline; however, strongly and extremely acid phases have been recognized and are correlated to the Shallow Porous Clay Ecological Site.

Access Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/) for specific local soils information.

Table 4. Representative soil features

Parent material	(1) Alluvium–clayey shale
Surface texture	(1) Clay
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Very slow to moderately slow
Soil depth	25–152 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	5.08–10.16 cm
Calcium carbonate equivalent (0-101.6cm)	0–10%
Electrical conductivity (0-101.6cm)	0–18 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–15
Soil reaction (1:1 water) (0-101.6cm)	5.6–9
Subsurface fragment volume <=3" (Depth not specified)	0–20%
Subsurface fragment volume >3" (Depth not specified)	0–10%

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 describe more typical transitions that will occur, severe disturbances, such as periods of well below average precipitation, can cause significant shifts in plant communities and/or species composition. Green needlegrass is more prevalent in the western portions of the MLRA, and partially replaces the wheatgrasses.

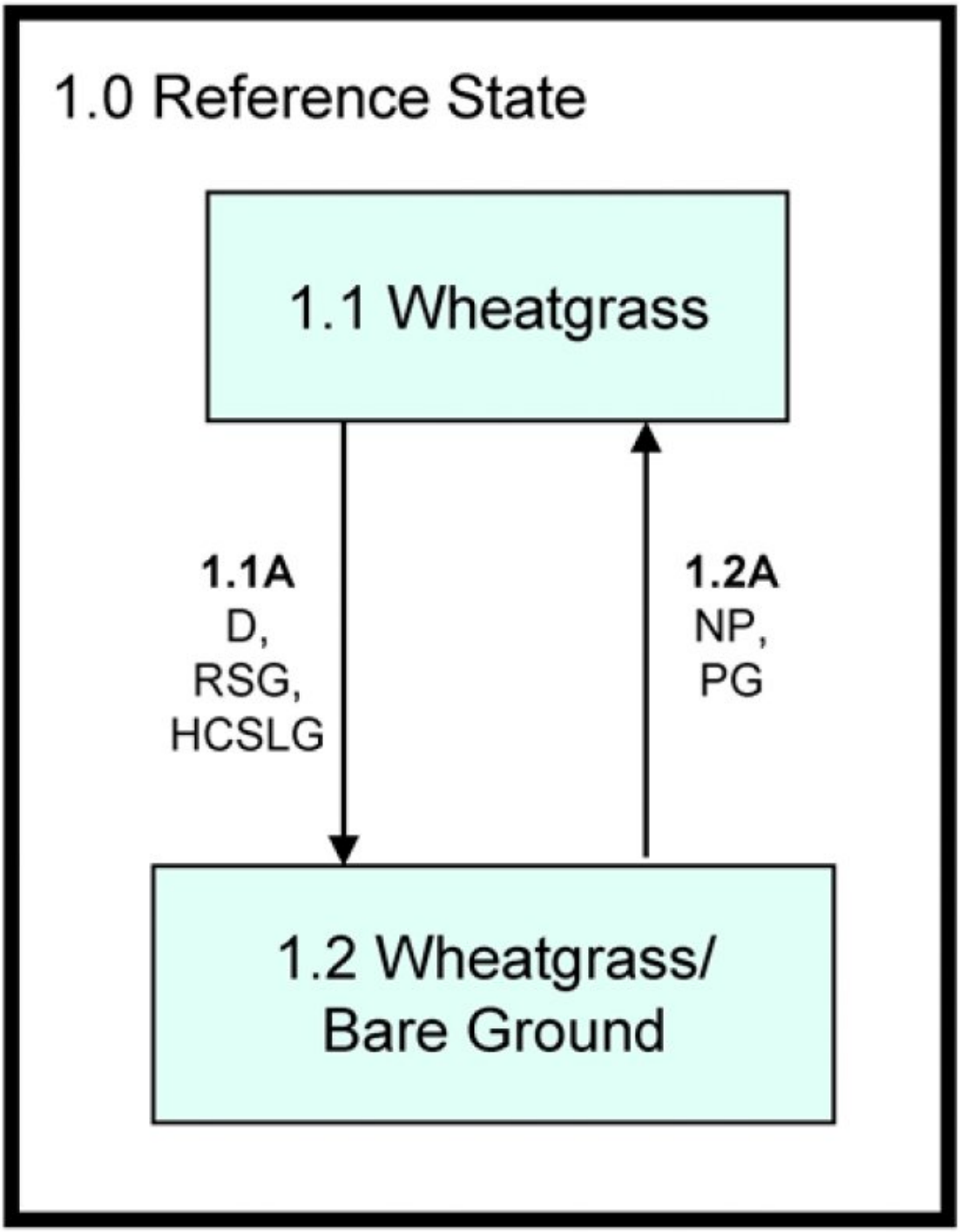
These soils are high in clay and have a low available water capacity. The shrink-swell potential is very high, resulting in cracks up to 2 inched in width during dry periods. The native wheatgrasses with their strong rhizomes and high drought tolerance are able to thrive in these soils. Wheatgrasses dominate the site and production is closely related to the vigor of the native wheatgrass. Slick spots are sometimes associated with this site. Slick spots are bare ground areas that are affected by high sodium concentrations. The soil factors are the dominant influence and grazing management does not typically affect these areas.

Interpretations are primarily based on the Western Wheatgrass Plant Community. It has been determined by study of 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 will be discussed in

more detail in the plant community descriptions following the diagram.

State and transition model



D – Drought
HCSLG - Heavy, continuous season-long grazing
NP – Normal precipitation patterns
PG - Prescribed grazing

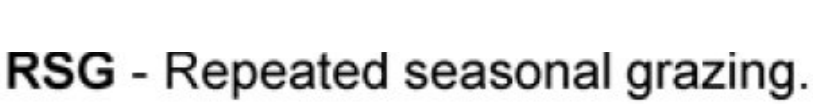


Figure 6. Dense Clay - R063AY018SD

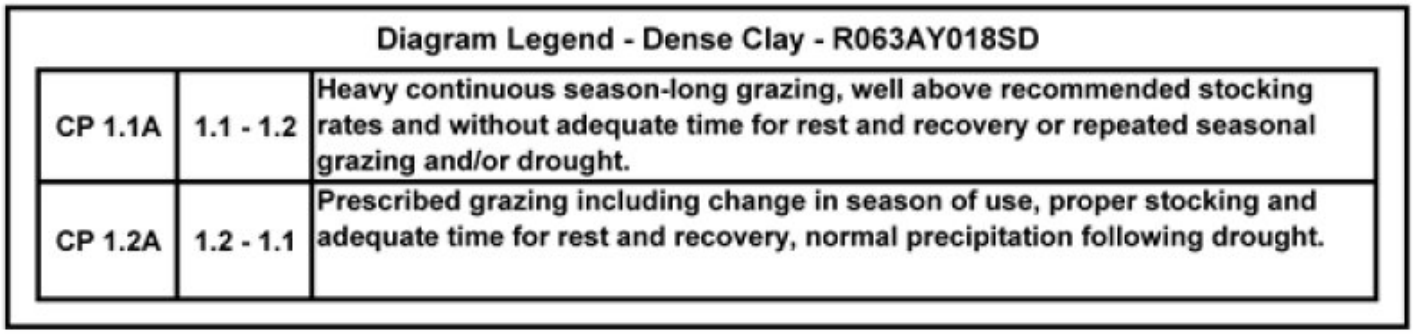


Diagram Legend - Dense Clay - R063AY018SD

CP 1.1A	1.1 - 1.2	Heavy continuous season-long grazing, well above recommended stocking rates and without adequate time for rest and recovery or repeated seasonal grazing and/or drought.
CP 1.2A	1.2 - 1.1	Prescribed grazing including change in season of use, proper stocking and adequate time for rest and recovery, normal precipitation following drought.

Figure 7. Dense Clay - R063A018SD

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 reference, is dominated by rhizomatous wheatgrass, green needlegrass, forbs and a minor amount of cactus. Heavy grazing and/or drought will not significantly change the species composition but will cause a dramatic decrease in total annual production. Erosion of the surface horizon is also a likely outcome with heavy grazing. In pre-European times the primary disturbances included grazing by large ungulates and small mammals and drought. Favorable growing conditions occurred during the spring, and warm months of June through August. Today a similar state can be found in areas where proper livestock use has occurred.

Community 1.1
Wheatgrass Plant Community

Interpretations are based primarily on the Western Wheatgrass Plant Community, which is also considered to be the reference plant community phase. This plant community evolved with grazing by large herbivores and occasional fire, and can be maintained with prescribed grazing, prescribed burning, or areas receiving occasional short periods of rest or deferment. The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs, and 2 percent shrubs. Cool-season grasses dominate the plant community. The major grasses include western wheatgrass and green needlegrass. Plant diversity is low, being dominated by wheatgrasses. Other grasses and grass-likes occurring on this site may include buffalograss, blue grama, sideoats grama, and sedge. The dominant forbs include biscuitroot, heath aster, and wild parsley. Shrubs that can occur in this plant community are brittle cactus and plains pricklypear. Plant diversity is relatively low. This plant community is well adapted to the Northern Great Plains climatic conditions. However, two to three years of drought can greatly reduce the vigor and abundance of the green needlegrass and western wheatgrass, while increasing the percent bare ground and creating moderate to high soil erosion potential. The actual plant composition may not be greatly changed, inherently the production of this plant community can vary tremendously with fluctuation is precipitation. Having average precipitation or above average, the plant community can make a fast recovery. If disturbed, dense clays are resilient. Mechanical practices such as deep ripping and furrowing can improve the hydrology, which invigorates the plant community. The native wheatgrass is strongly rhizomatous and adapted to droughty, saline soils. Water infiltration is low and runoff is very high due to the high clay content of the soil. Plant litter is properly distributed with some movement offsite and natural plant mortality is low. Transitional pathways and/or community pathways leading to other plant communities are as follows:

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	919	1529	2018
Forb	78	127	185
Shrub/Vine	11	26	39
Total	**1008**	**1682**	**2242**

Figure 9. Plant community growth curve (percent production by month). SD6301, Pierre Shale Plains, cool-season dominant.. Cool-season dominant on uplands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	4	12	25	36	10	5	4	4	0	0

Community 1.2
Wheatgrass, Bare Ground Plant Community

This plant community develops under droughty conditions, heavy spring grazing, or long-term heavy continuous grazing. The potential vegetation is made up of 90 percent grasses and grass-like plants, 5 percent forbs, and 5 percent shrubs. The grass component is almost entirely native wheatgrasses. Other perennial grasses are generally not found on this site. Drought and heavy spring use will lower basal density of green needlegrass and native wheatgrasses creating opportunities for invasive species pennycress, curlycup gumweed, sweetclover, and annual forbs to occur. Brittle cactus and prickly pear are the commonly found shrubs. When compared to the Wheatgrass Plant Community, the vigor production and basal density of the grasses has been reduced. Often the site will be bare ground with a few sprigs of western wheatgrass and a likely chance of cheatgrass invading the site. Cool-season grass production is lessened along with a reduction in warm-season grasses such as blue grama and buffalograss. Plant diversity is extremely low. Due to low basal density, soil erosion hazards are high. This plant community is resistant to change. Moving this plant community toward the Wheatgrass Plant Community can be accomplished through prescribed grazing, favorable climatic conditions, or severe disturbances such as mechanical ripping and chiseling.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	661	1159	1659
Forb	6	37	67
Shrub/Vine	6	37	67
Total	**673**	**1233**	**1793**

Figure 11. Plant community growth curve (percent production by month). SD6301, Pierre Shale Plains, cool-season dominant.. Cool-season dominant on uplands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	4	12	25	36	10	5	4	4	0	0

Pathway 1.1A
Community 1.1 to 1.2

Dryer than normal or droughty precipitation cycles, repeated seasonal grazing, and heavy, continuous season-long grazing will shift the community to a Western Wheatgrass/*Bare Ground* Plant Community.

Pathway 1.2A
Community 1.2 to 1.1

With prescribed grazing and above average precipitation, this plant community will move towards the Wheatgrass Plant Community.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			841–1345	
	western wheatgrass	PASM	*Pascopyrum smithii*	841–1345	–
2	**Needlegrass**			34–168	
	green needlegrass	NAVI4	*Nassella viridula*	34–168	–
3	**Warm-season Grasses**			84–252	
	buffalograss	BODA2	*Bouteloua dactyloides*	34–168	–
	blue grama	BOGR2	*Bouteloua gracilis*	34–168	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–84	–
	saltgrass	DISP	*Distichlis spicata*	0–50	–
4	**Grass-likes**			17–84	
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–84	–
	needleleaf sedge	CADU6	*Carex duriuscula*	17–84	–
Forb					
6	**Forbs**			84–168	
	Forb, native	2FN	*Forb, native*	17–50	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–34	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	17–34	–
	white heath aster	SYER	*Symphyotrichum ericoides*	17–34	–
	desertparsley	LOMAT	*Lomatium*	17–34	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	17–34	–
	spiny phlox	PHHO	*Phlox hoodii*	0–17	–
	American vetch	VIAM	*Vicia americana*	0–17	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–17	–
	textile onion	ALTE	*Allium textile*	0–17	–
	pussytoes	ANTEN	*Antennaria*	0–17	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–17	–
	spurge	EUPHO	*Euphorbia*	0–17	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–17	–
Shrub/Vine					
7	**Shrubs**			17–34	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–34	–
	saltbush	ATRIP	*Atriplex*	0–34	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	17–34	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–34	–

Table 8. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			678–1048	
	western wheatgrass	PASM	*Pascopyrum smithii*	678–1048	–
2	**Needlegrass**			0–25	
	green needlegrass	NAVI4	*Nassella viridula*	0–25	–
3	**Warm-season Grasses**			0–62	
	buffalograss	BODA2	*Bouteloua dactyloides*	0–62	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–62	–
	saltgrass	DISP	*Distichlis spicata*	0–37	–
4	**Grass-likes**			0–37	
	needleleaf sedge	CADU6	*Carex duriuscula*	0–37	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–12	–
5	**Non-Native Grasses**			0–123	
	field brome	BRAR5	*Bromus arvensis*	0–123	–
	cheatgrass	BRTE	*Bromus tectorum*	0–123	–
Forb					
6	**Forbs**			12–62	
	Forb, introduced	2FI	*Forb, introduced*	0–37	–
	sweetclover	MELIL	*Melilotus*	0–37	–
	Forb, native	2FN	*Forb, native*	0–25	–
	common dandelion	TAOF	*Taraxacum officinale*	0–25	–
	yellow salsify	TRDU	*Tragopogon dubius*	0–25	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–25	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–12	–
	pussytoes	ANTEN	*Antennaria*	0–12	–
	spiny phlox	PHHO	*Phlox hoodii*	0–12	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–12	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–12	–
Shrub/Vine					
7	**Shrubs**			12–62	
	brittle pricklypear	OPFR	*Opuntia fragilis*	12–62	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–49	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–25	–

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). Because of this, 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.

Wheatgrass; Average Annual Production(lbs./acre, air-dry) 1500
Stocking Rate(AUM/acre) 0.41

Wheatgrass, *Bare Ground* Average Annual Production (lbs./acre, air-dry) 1100
Stocking Rate (AUM/acre) 0.30

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

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 forage production on this site. This site is dominated by soils in hydrologic group D. Infiltration is very slow to slow and runoff potential is 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 example of an exception would be where shortgrasses form a strong 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 Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

Recreational uses

This site provides hunting, hiking, photography, bird watching, and other opportunities. The wide varieties of plants that bloom from spring until fall have an aesthetic value that appeals to visitors.

Wood products

No appreciable wood products are typically present on this site.

Other products

Seed harvest of native plant species can provide additional income on this site.

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 requirement as an Approved ESD as laid out in the 2003 National Range and Pasture Handbook (NRPH). The document fully describe 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 towards an Approved status.

Site Development and Testing Plan:
Future work, as described in a Project Plan, to validate the information in this Provisional Ecological Site Description is needed. 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. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document.

Inventory data references

Information presented here has been 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: April Boltjes, Range Management Specialist (RMS), NRCS; Stan Boltz, RMS, NRCS; Kent Cooley, Soil Scientist, NRCS; Rick Peterson, RMS, NRCS; and L. Michael Stirling, RMS, NRCS.

There are SCS-RANGE-417 2 colledted from 1968-1977 in Carson and Stanley counties in SD

Other references

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Contributors

Stan Boltz

Approval

Suzanne Mayne-Kinney, 6/26/2024

Acknowledgments

Peterson, Rick L. ESD Update 6/10/16

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.

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Date	05/08/2010
Approved by	Suzanne Mayne-Kinney
Approval date	

Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None. Soil cracking is natural and not caused by erosion.

2. **Presence of water flow patterns:** None, or barely visible and discontinuous.

3. **Number and height of erosional pedestals or terracettes:** None.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 5 to 30 percent is typical; the higher bare ground levels would appear during extended dry periods.

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):** Litter should fall in place. Slight amount of movement of smallest size class litter is possible, but not normal.

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 3 or greater. Surface organic matter usually adheres to the soil surface. Soil surface fragments will typically retain structure at least for short periods when dipped in distilled water. Some fragments will dissolve in less than 1 minute.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** A-horizon should be 1 to 5 inches thick but with light to dark gray colors when moist. Structure typically is platy parting to subangular blocky or occasionally fine granular in the upper 1/2 inch.

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 rhizomatous grasses, tufted perennial cool-season grasses, and short warm-season grasses) with fine and coarse roots positively influences infiltration. Infiltration is not often affected by a change in plant composition as the rhizomatous cool-season species typically dominate.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** A-horizon naturally has some platy structure. Compaction layers, if formed by management, do not typically persist. Compaction will be difficult to determine. Evidence of compaction can sometimes

be confirmed by signs of recent concentration of livestock.

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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: Rhizomatous wheatgrasses >>

    Sub-dominant: Short/mid warm-season grasses >

    Other: Tall cool-season bunchgrass = Forbs > Grass-likes > Shrubs

    Additional:

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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.

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14. **Average percent litter cover (%) and depth (in):** Liiter cover ranges from 20 to 60 percent. Lower litter levels would occur during extended dry periods. Normal levels are roughly > 40%. Litter depth is less than 1/4 inch.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Total annual production ranges from 900 to 2,000 pounds per acre, with the reference value being 1,500 pounds per acre (air-dry asis).

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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.
