Ecological site R063BY018SD
Dense Clay

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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.

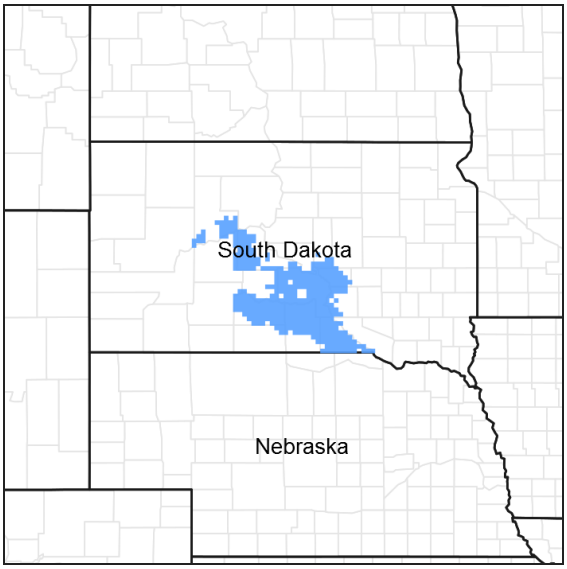

Figure 1. Mapped extent

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): 063B–Southern Rolling Pierre Shale Plains

MLRA Notes:
The Southern Rolling Pierre Shale Plains (MLRA 63B) is approximately 4,460 square miles in size. The majority of the MLRA is located in South Dakota (82 percent), and the remaining 18 percent is located in Nebraska. Interstate 90 crosses the northern portion through Chamberlin, SD. There are several American Indian Reservations, including the Lower Brule, Crow Creek, Santee, and Yankton Reservations.
This MLRA is an area of old plateaus and terraces that have been deeply eroded, with nearly level to rolling long slopes and well-defined dendritic drainage systems. The rivers and creek valleys have smooth floors and steep walls. The majority of the MLRA is located in the unglaciated section of the Missouri Plateau, Great Plains Province. The northeast corner of the MLRA, east of the Missouri River, is located in the glaciated section with higher areas having deposits of glacial drift. The southwestern tip is located in the High Plains Section.
Elevations range from 1,310 feet to 1,640 feet on the bottom lands along the Missouri River, and from 1,310 feet to 1,970 feet on the shale plains uplands.
The Missouri and Niobrara Rivers, and the confluence of the White and Missouri Rivers, occur within this MLRA. Lake Francis Case, Fort Randall Dam, and Lewis and Clark Lake are also within this MLRA's borders.
Cretaceous Pierre Shale underlies most of the area. This is a marine sediment with layers of volcanic ash that has been altered to smectitic clays. These clays shrink as they dry and swell as they become wet, causing significant problems for road and structural foundations.

Younger Niobrara chalk occurs in the southern part of the MLRA. Alluvial sand and gravel underlie the valley floors along major streams.

Soils are shallow to very deep, generally well drained, and with loamy or clayey textures. Annual precipitation is 19 to 26 inches, mostly falling during the growing season, as frontal storms during the spring and convective thunderstorms in summer. The average annual temperature is 45°-50°F. The freeze-free period averages 165 days, and ranges from 145 to 185 days.

Vegetation is a transition between tall prairie grasses and mixed prairie grasses. Green needlegrass, porcupinegrass, western wheatgrass, and big bluestem are the major species. Little bluestem, buffalograss, sideoats grama, and sedges are dominant on the shallow soils. Buffaloberry, skunkbush sumac, and prairie rose are common on steep slopes along the major streams. Prairie cottonwood and a variety of willow species are common on flood plains along the major streams. Green ash, boxelder, chokecherry, bur oak, and buffaloberry occur in draws and narrow valleys. Encroachment of Rocky Mountain juniper and eastern redcedar on to the river breaks is becoming a concern.
The majority of the land is utilized for ranching (60 percent) and farming (27 percent). Major resource concerns for the area are wind erosion, water erosion, maintenance of the content of organic matter and soil productivity, and management of soil moisture.

Classification relationships

USDA - Land Resource Region G – Western Great Plains Range and Irrigated Region, Major Land Resource Area (MLRA) 63B – Southern Rolling Pierre Shale Plains (USDA-NRCS, Ag Handbook 296).

EPA - Level IV Ecoregions of the Continental United States:

Northwestern Glaciated Plains - 42f – Southern Missouri Coteau Slopes, 42g – Ponca Plains, 42h – Southern River Breaks, 42p – Holt Tablelands

North Western Great Plains - 43C – River Breaks, 43f – Subhumid Pierre Shale Plains, 43r – Niobrara River Breaks.

Ecological site concept

The Dense Clay ecological site occurs throughput the MLRA. It is located on alluvial fans, plains, and terraces. Slopes range from 2 to 9 percent but can occur on slopes up to 25 percent. Soils are moderately deep to very deep and formed from dense clayey alluvium or residuum from soft shale. The clay surface layer is 2 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 western wheatgrasses and green needlegrass. Prickly pear cactus is typically present in the plant community but in minor amounts.

Note: Opal soil is correlated to both Dense Clay and Clayey Ecological Sites. Only the local saline phase of Opal, in Brule and Buffalo Counties of SD, is correlated to the Dense Clay site.

Chantier is a borderline shallow/moderately deep soil, but is still correlated to the Dense Clay site.

Associated sites

R063BY011SD	**Clayey** The Clayey site can be adjacent to or intermixed with the Dense Clay site. Typically it will be found downslope of the Dense Clay site.
R063BY017SD	**Shallow Clay** The Shallow Clay site can be found adjacent to or intermixed with the Dense Clay site.
R063BY021SD	**Clayey Overflow** The Clayey Overflow site can be found adjacent to or downslope of the Dense Clay site.

Similar sites

R063BY013SD	**Claypan** The Claypan site will have more short warm-season grasses, higher plant diversity, and higher forage production.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Nassella viridula*

Physiographic features

This site occurs on nearly level to sloping uplands.

Table 2. Representative physiographic features

Landforms	(1) Alluvial fan (2) Plain (3) Terrace
Runoff class	High to very high
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	None to rare
Ponding frequency	None
Elevation	1,300–2,000 ft
Slope	2–9%
Aspect	Aspect is not a significant factor

Climatic features

MLRA 63B is considered to have a continental climate: cold winters and hot summers, low humidity, light rainfall, and ample sunshine. Extremes in temperature may also abound. The climate is the result of MLRA 63B'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 typically ranges from 18 to 25 inches per year. The average annual temperature is about 48°F. January is the coldest month with average temperatures ranging from about 15°F (Stephan, SD), to about 22°F (Winner, SD). July is the warmest month with temperatures averaging from about 73°F (Stephan, SD), to about 76°F (Winner, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 56°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 (mph) annually, ranging from about 13 mph during the spring to about 10 mph 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 mph. 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 (characteristic range)	113-122 days
Freeze-free period (characteristic range)	130-154 days
Precipitation total (characteristic range)	21-24 in
Frost-free period (actual range)	110-126 days

Freeze-free period (actual range)	127-155 days
Precipitation total (actual range)	20-25 in
Frost-free period (average)	118 days
Freeze-free period (average)	141 days
Precipitation total (average)	23 in

Climate stations used

- (1) PICKSTOWN [USC00396574], Lake Andes, SD
- (2) LYNCH [USC00255040], Lynch, NE
- (3) WINNER [USC00399367], Winner, SD
- (4) NIOBRARA [USC00255960], Niobrara, NE
- (5) GANN VALLEY 4NW [USC00393217], Gann Valley, SD
- (6) STEPHAN 2 NW [USC00397992], Highmore, SD
- (7) WOOD [USC00399442], Wood, 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 2 to 5 inches thick. The subsurface layers are moderately deep to very deep with a clay texture (The Chantier soil is borderline between moderately deep to shallow). When dry these soils crack. The soils have a very slow infiltration rate except after dry periods when initial uptake may be rapid due to cracking of the surface. Gilgai microrelief occurs in some areas. Wet surface compaction can occur with heavy traffic. This site should show slight to no evidence of rills or wind scoured areas. 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.

Major soil in MLRA 63B correlated to the Dense Clay site: Bullcreek and Chantier.
As noted, the local, saline, phase of Opal is correlated to the Dense Clay site in Brule and Buffalo Counties of South Dakota. Opal is otherwise correlated to the Clayey ecological site.

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

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

Table 4. Representative soil features

Parent material	(1) Alluvium–clayey shale (2) Residuum–clayey shale
Surface texture	(1) Clay
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Very slow to slow
Soil depth	19–80 in
Surface fragment cover <=3"	0–4%
Available water capacity (0-40in)	1–4 in

Calcium carbonate equivalent (0-40in)	0–10%
Electrical conductivity (0-40in)	0–16 mmhos/cm
Sodium adsorption ratio (0-40in)	0–15
Soil reaction (1:1 water) (0-40in)	6.6–9
Subsurface fragment volume <=3" (Depth not specified)	0–4%

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 and 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.

These soils are high in clay and have a low available water capacity. The shrink-swell potential is very high, resulting in cracks greater than 2 inches wide during dry periods. Western wheatgrass, with its strong rhizomes and high drought tolerance, is able to thrive in these soils.
Western wheatgrass dominates the site and production is closely related to its vigor. 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-Green Needlegrass Plant Community (1.1). 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 is a diagram that illustrates the common plant community phases that can occur on the site and the transition pathways between communities. These are the most common plant community phases based on current knowledge and experience, and changes may be made as more data is collected. Narratives following the diagram contain more detail pertaining to the ecological processes.

State and transition model

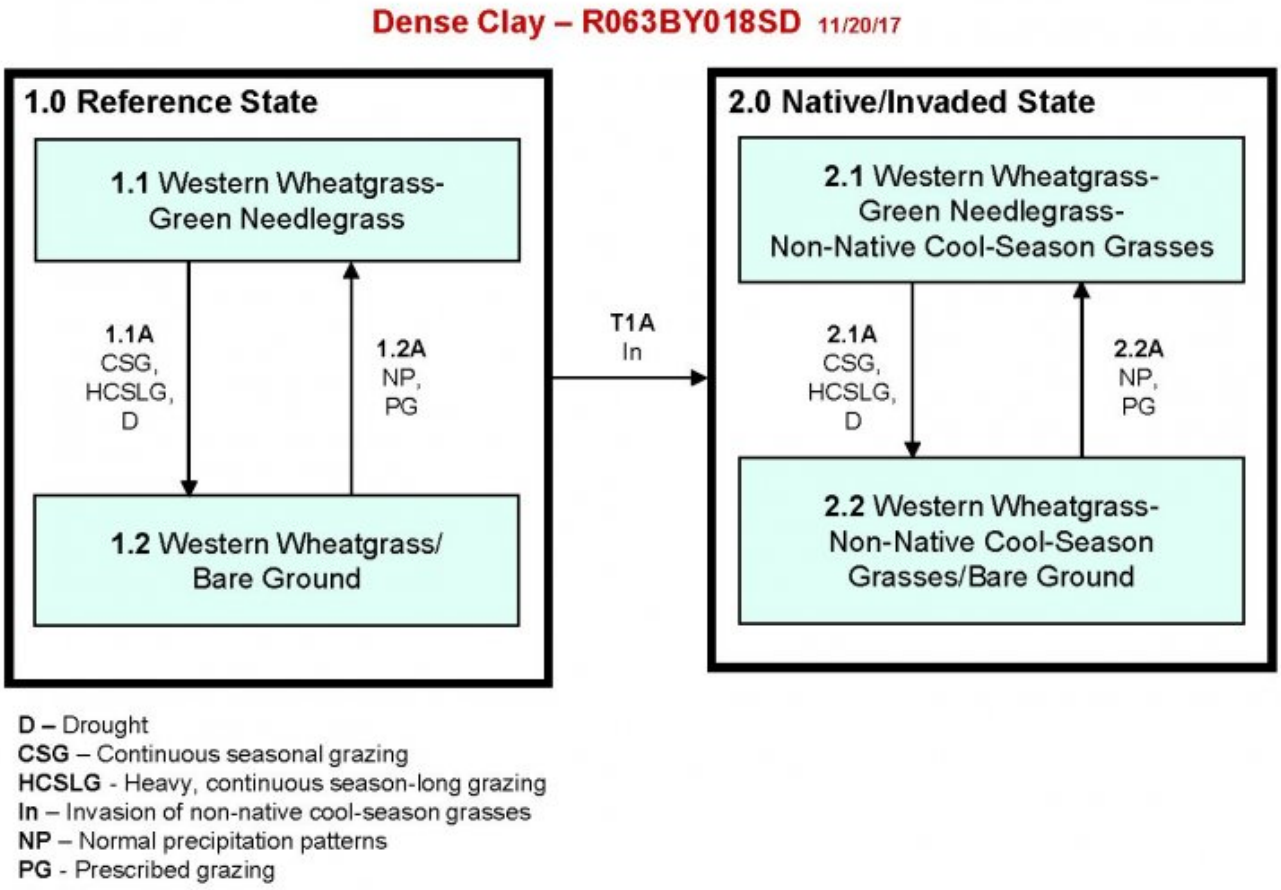

Diagram Legend - Dense Clay - R063BY018SD

T1A	Invasion of non-native cool-season annual and/or perennial grasses.	
CP 1.1A	1.1 - 1.2	Continuous seasonal grazing or heavy, continuous season-long grazing, and extend drought.
CP 1.2A	1.2 - 1.1	Prescribed grazing and a return to normal precipitation patterns following drought.
CP 2.1A	2.1 - 2.2	Continuous seasonal grazing or heavy, continuous season-long grazing, and extended drought.
CP 2.2A	2.2 - 2.1	Prescribed grazing and a return to normal precipitation patterns following drought.

State 1
Reference State

This State represents what is believed to show the natural range of variability that dominates the dynamics of this ecological site prior to European settlement. This state is dominated by cool-season grasses. In pre-European times, the primary disturbance mechanisms for this site in the Reference condition included somewhat frequent fire, precipitation cycles and grazing by large herding ungulates. Timing of fires and grazing coupled with weather events dictated the dynamics that occurred within the natural range of variability. Today, this State can be found on areas that are properly managed with grazing and/or prescribed burning, and sometimes on areas receiving occasional short periods of rest. Cool-season species can decline and a corresponding increase in short, warm-season grasses will occur. Under extended periods of disturbance, the main change is a reduction in vigor and production and an increase in bare ground.

Community 1.1
Western Wheatgrass-Green Needlegrass

Figure 8. Dense Clay - R063BY018SD - PCP 1.1.

Interpretations are based primarily on the Western Wheatgrass-Green Needlegrass Plant Community, which is also considered to be Reference Plant Community (1.1). 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 5 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 western wheatgrass. 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, saltbush, 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 potential hazard of soil erosion. The actual plant composition may not be greatly changed, inherently the production of this plant community can vary tremendously with fluctuations in precipitation. Having average or above average precipitation, the plant community can make a fast recovery. If disturbed, dense clays are resilient. 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.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1100	1611	2105
Forb	85	135	200
Shrub/Vine	15	54	95
Total	**1200**	**1800**	**2400**

Figure 10. Plant community growth curve (percent production by month). SD6302, Pierre Shale Plains, cool-season dominant, warm-season subdominant.. Cool-season dominant, warm-season subdominant, uplands..

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
Western Wheatgrass/Bare Ground

This plant community develops under droughty conditions, heavy spring grazing or long-term heavy, continuous

grazing. The potential vegetation is made up of about 80 percent grasses and grass-like plants, 10 percent forbs, and 10 percent shrubs. The grass component is often completely dominated by western wheatgrass. Other perennial grasses are generally not found on this site or are greatly diminished. Drought and heavy spring use will lower basal density of green needlegrass and western wheatgrass, creating opportunities for invasive species such as field pennycress, curlycup gumweed, sweetclover, and annual forbs to occur. Brittle cactus and plains pricklypear are the commonly found shrubs. When compared to the Western Wheatgrass-Green Needlegrass Plant Community (1.1), 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 likelihood of cheatgrass, field bromegrass, and bluegrass 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, the hazard of soil erosion is high. This plant community is somewhat resistant to change. Moving this plant community toward the Western Wheatgrass-Green Needle Plant Community can be accomplished through prescribed grazing and/or favorable climatic conditions.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	440	865	1280
Shrub/Vine	15	60	110
Forb	45	75	110
Total	**500**	**1000**	**1500**

Figure 12. 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

Continuous seasonal grazing (grazing at moderate to heavy stocking levels at the same time of year each year), or heavy, continuous season-long grazing, or extended period of drought will shift this community to the Western Wheatgrass/*Bare Ground* Plant Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing, and possibly including periodic rest, will convert this plant community to the Western Wheatgrass-Green Needlegrass Plant Community (1.1). This pathway can also occur with a return to normal precipitation patterns.

Conservation practices

Prescribed Grazing

State 2
Native/Invaded Grass State

This plant community results from the invasion of non-native, invasive species such as cheatgrass, field bromegrass, bluegrass, and/or smooth bromegrass. This plant community will have similar plant composition to the Reference State (1.0). The main difference is that the plant communities in this State will have up to 15 percent non-native cool-season grasses.

Community 2.1
Western Wheatgrass-Green Needlegrass-Non-Native Cool-Season Grasses

This plant community results from an invasion of non-native, invasive species such as Kentucky bluegrass, smooth bromegrass, downy bromegrass, and/or field bromegrass. This plant community will have similar plant composition to the Western Wheatgrass-Green Needlegrass Plant Community (1.1). The main difference is that this plant community phase will have up to 15 percent of non-native cool-season grass species.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1100	1611	2105
Forb	85	135	200
Shrub/Vine	15	54	95
Total	**1200**	**1800**	**2400**

Figure 14. Plant community growth curve (percent production by month). SD6302, Pierre Shale Plains, cool-season dominant, warm-season subdominant.. Cool-season dominant, warm-season subdominant, uplands..

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 2.2
Western Wheatgrass-Non-Native Cool-Season Grasses/Bare Ground

This plant community develops under droughty conditions, heavy spring grazing, or long-term heavy continuous grazing. The potential vegetation is made up of about 80 percent grasses and grass-like plants, 10 percent forbs, and 10 percent shrubs. The grass component is often completely dominated by western wheatgrass. Other perennial grasses are generally not found on this site or are greatly diminished. Drought and heavy spring use will lower basal density of green needlegrass and western wheatgrass, creating opportunities for invasive species such as cheatgrass, field bromegrass, Kentucky bluegrass, field pennycress, curlycup gumweed, sweetclover, and annual forbs to occur. Brittle cactus and plains pricklypear are the commonly found shrubs. When compared to the Western Wheatgrass-Green Needlegrass Plant Community (1.1), the vigor, production, and basal density of the grasses have been reduced. Often the site will be bare ground with a few sprigs of western wheatgrass, cheatgrass, field bromegrass, and Kentucky bluegrass 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, the hazard of soil erosion is high. This plant community is somewhat resistant to change.

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	440	865	1280
Shrub/Vine	15	60	110
Forb	45	75	110
Total	**500**	**1000**	**1500**

Figure 16. 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 2.1A

Community 2.1 to 2.2

Continuous seasonal grazing (grazing at moderate to heavy stocking levels at the same time of year each year), or heavy, continuous season-long grazing, or extended periods of drought will shift this community to the Western Wheatgrass-Annual Bromegrass/*Bare Ground* Plant Community (2.2).

Pathway 2.2A
Community 2.2 to 2.1

Prescribed grazing (alternating season of use and providing adequate recovery periods), or periodic light to moderate grazing possibly including periodic rest, will convert this plant community to the Western Wheatgrass-Green Needlegrass-Non-Native Cool-Season Grasses Plant Community (1.2). This pathway can also occur with a return to normal precipitation patterns.

Conservation practices

Prescribed Grazing

Transition T1A
State 1 to 2

Invasion of non-native cool-season annual and perennial grasses and other invasive and/or noxious species will lead this plant community phase over a threshold to the Native/Invaded State (2.0). Once this threshold is crossed, it highly unlikely to recover.

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			630–990	
	western wheatgrass	PASM	*Pascopyrum smithii*	630–990	–
2	**Needlegrass**			270–630	
	green needlegrass	NAVI4	*Nassella viridula*	270–630	–
3	**Mid Warm-Season Grass**			36–180	
	sideoats grama	BOCU	*Bouteloua curtipendula*	36–180	–
4	**Short Warm-Season Grasses**			36–180	
	blue grama	BOGR2	*Bouteloua gracilis*	18–144	–
	buffalograss	BODA2	*Bouteloua dactyloides*	18–72	–
	saltgrass	DISP	*Distichlis spicata*	0–54	–
5	**Grass-likes**			18–90	
	needleleaf sedge	CADU6	*Carex duriuscula*	18–90	–
	threadleaf sedge	CAFI	*Carex filifolia*	0–54	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–54	–
6	**Non-Native Grasses**			0	
Forb					
7	**Forbs**			90–180	
	Forb, native	2FN	*Forb, native*	18–54	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–36	–

	textile onion	ALTE	*Allium textile*	18–36	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	18–36	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–36	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–36	–
	desertparsley	LOMAT	*Lomatium*	18–36	–
	spiny phlox	PHHO	*Phlox hoodii*	18–36	–
	goldenrod	SOLID	*Solidago*	0–36	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	18–36	–
	white heath aster	SYER	*Symphyotrichum ericoides*	18–36	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	18–36	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–18	–
	American vetch	VIAM	*Vicia americana*	0–18	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–18	–
	pussytoes	ANTEN	*Antennaria*	0–18	–
Shrub/Vine					
8	**Shrubs**			18–90	
	saltbush	ATRIP	*Atriplex*	0–54	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	18–54	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–36	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–36	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–36	–

Table 10. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			250–600	
	western wheatgrass	PASM	*Pascopyrum smithii*	250–600	–
2	**Needlegrass**			20–150	
	green needlegrass	NAVI4	*Nassella viridula*	20–150	–
3	**Mid Warm-Season Grass**			20–100	
	sideoats grama	BOCU	*Bouteloua curtipendula*	20–100	–
4	**Short Warm-Season Grasses**			50–150	
	blue grama	BOGR2	*Bouteloua gracilis*	20–120	–
	buffalograss	BODA2	*Bouteloua dactyloides*	10–100	–
	saltgrass	DISP	*Distichlis spicata*	10–70	–
5	**Grass-likes**			20–100	
	needleleaf sedge	CADU6	*Carex duriuscula*	20–80	–
	threadleaf sedge	CAFI	*Carex filifolia*	0–50	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–50	–
6	**Non-Native Grasses**			0	
Forb					
7	**Forbs**			50–100	

	sweetclover	MELIL	*Melilotus*	0–50	–
	Forb, introduced	2FI	*Forb, introduced*	0–40	–
	Forb, native	2FN	*Forb, native*	10–30	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–30	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–30	–
	common dandelion	TAOF	*Taraxacum officinale*	0–30	–
	field pennycress	THAR5	*Thlaspi arvense*	0–30	–
	yellow salsify	TRDU	*Tragopogon dubius*	0–30	–
	desertparsley	LOMAT	*Lomatium*	0–20	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	10–20	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–20	–
	spiny phlox	PHHO	*Phlox hoodii*	10–20	–
	goldenrod	SOLID	*Solidago*	0–10	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–10	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–10	–
	pussytoes	ANTEN	*Antennaria*	0–10	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–10	–
	textile onion	ALTE	*Allium textile*	0–10	–
Shrub/Vine					
8	**Shrubs**			20–100	
	plains pricklypear	OPPO	*Opuntia polyacantha*	10–40	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–30	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–30	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	10–30	–

Table 11. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			630–810	
	western wheatgrass	PASM	*Pascopyrum smithii*	630–810	–
2	**Needlegrass**			180–450	
	green needlegrass	NAVI4	*Nassella viridula*	180–450	–
3	**Mid Warm-Season Grass**			18–90	
	sideoats grama	BOCU	*Bouteloua curtipendula*	18–90	–
4	**Short Warm-Season Grasses**			36–180	
	blue grama	BOGR2	*Bouteloua gracilis*	18–144	–
	buffalograss	BODA2	*Bouteloua dactyloides*	18–72	–
	saltgrass	DISP	*Distichlis spicata*	0–54	–
5	**Grass-likes**			18–90	
	needleleaf sedge	CADU6	*Carex duriuscula*	18–90	–
	threadleaf sedge	CAFI	*Carex filifolia*	0–54	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–54	–

	grass)				
6	**Non-Native Grasses**			90–450	
	field brome	BRAR5	*Bromus arvensis*	18–270	–
	cheatgrass	BRTE	*Bromus tectorum*	18–270	–
	bluegrass	POA	*Poa*	0–180	–
	smooth brome	BRIN2	*Bromus inermis*	0–180	–
Forb					
7	**Forbs**			90–180	
	Forb, native	2FN	*Forb, native*	18–54	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–36	–
	textile onion	ALTE	*Allium textile*	18–36	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	18–36	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–36	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–36	–
	desertparsley	LOMAT	*Lomatium*	18–36	–
	spiny phlox	PHHO	*Phlox hoodii*	18–36	–
	goldenrod	SOLID	*Solidago*	0–36	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	18–36	–
	white heath aster	SYER	*Symphyotrichum ericoides*	18–36	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	18–36	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–18	–
	American vetch	VIAM	*Vicia americana*	0–18	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–18	–
	pussytoes	ANTEN	*Antennaria*	0–18	–
Shrub/Vine					
8	**Shrubs**			18–90	
	saltbush	ATRIP	*Atriplex*	0–54	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	18–54	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–36	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–36	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–36	–

Table 12. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			250–500	
	western wheatgrass	PASM	*Pascopyrum smithii*	250–500	–
2	**Needlegrass**			0–50	
	green needlegrass	NAVI4	*Nassella viridula*	0–50	–
3	**Mid Warm-Season Grass**			0–50	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–50	–
4	**Short Warm-Season Grasses**			50–150	
	blue grama	BOGR2	*Bouteloua gracilis*	20–120	–

	blue grama	BOGR2	*Bouteloua gracilis*	20–120	
	buffalograss	BODA2	*Bouteloua dactyloides*	10–100	–
	saltgrass	DISP	*Distichlis spicata*	10–70	–
5	**Grass-likes**			10–100	
	needleleaf sedge	CADU6	*Carex duriuscula*	10–80	–
	threadleaf sedge	CAFI	*Carex filifolia*	0–50	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–50	–
6	**Non-Native Grasses**			50–250	
	field brome	BRAR5	*Bromus arvensis*	10–150	–
	cheatgrass	BRTE	*Bromus tectorum*	10–150	–
	bluegrass	POA	*Poa*	0–100	–
	smooth brome	BRIN2	*Bromus inermis*	0–100	–
Forb					
7	**Forbs**			50–100	
	sweetclover	MELIL	*Melilotus*	0–50	–
	Forb, introduced	2FI	*Forb, introduced*	0–40	–
	Forb, native	2FN	*Forb, native*	10–30	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–30	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–30	–
	common dandelion	TAOF	*Taraxacum officinale*	0–30	–
	field pennycress	THAR5	*Thlaspi arvense*	0–30	–
	yellow salsify	TRDU	*Tragopogon dubius*	0–30	–
	desertparsley	LOMAT	*Lomatium*	0–20	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	10–20	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–20	–
	spiny phlox	PHHO	*Phlox hoodii*	10–20	–
	goldenrod	SOLID	*Solidago*	0–10	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–10	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–10	–
	pussytoes	ANTEN	*Antennaria*	0–10	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–10	–
	textile onion	ALTE	*Allium textile*	0–10	–
Shrub/Vine					
8	**Shrubs**			20–100	
	plains pricklypear	OPPO	*Opuntia polyacantha*	10–40	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–30	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–30	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	10–30	–

Animal community

Grazing Interpretations:
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 ESD). 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.

The following stocking rates are based on 912 lbs./acre (air-dry weight) per Animal-Unit-Month (AUM), with a 25 percent harvest efficiency of preferred and desirable forage species. An AUM is defined as the equivalent amount of forage required by a 1,000-pound cow with calf up to 6 months of age for one month (refer to USDA NRCS, National Range and Pasture Handbook).

Plant Community: Western Wheatgrass-Green Needlegrass (1.1)
Average Annual Production (lbs./acre, air-dry): 1,800
Stocking Rate (AUM/acre): 0.49

Plant Community: Western Wheatgrass/*Bare Ground* (1.2)
Average Annual Production (lbs./acre, air-dry): 1,000
Stocking Rate (AUM/acre): 0.27

Plant Community: Western Wheatgrass-Green Needlegrass-Non-Native Cool-Season Grasses (2.1)
Average Annual Production (lbs./acre, air-dry): 1,800
Stocking Rate (AUM/acre): 0.49

Plant Community: Western Wheatgrass-Non-Native Cool-Season Grasses/*Bare Ground* (2.2)
Average Annual Production (lbs./acre, air-dry): 1,000
Stocking Rate (AUM/acre): 0.27

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 forage production on this site. This site is dominated by soils in hydrologic group D. Infiltration is slow and runoff potential for this site is high. In many cases, areas with greater than 75 percent ground cover have the greatest potential for higher infiltration and lower runoff. An example of an exception would be where shortgrasses form a strong sod and dominate the site.
Dominance by blue grama and/or buffalograss will result in reduced infiltration and increased runoff. 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 for hydrologic soil groups, runoff quantities, and hydrologic curves, Part 630.).

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 National Ecological Site Handbook (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 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; Rick Peterson, RMS, NRCS; and Dana Larsen, RMS, NRCS.

Other references

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Approval

David Kraft, 9/27/2018

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ESD updated by Rick L. Peterson on 12/4/17
Editorial Review by Carla Green Adams.

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
Contact for lead author	Stan Boltz, stanley.boltz@sd.usda.gov, 605-352-1236
Date	02/20/2009
Approved by	Stan Boltz
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.

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

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

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

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

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

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter should fall in place. Slight amount of movement of smallest size class litter is possible, but not normal.

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

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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.

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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.

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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):** 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.

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: Wheatgrass (mid, cool-season rhizomatous) >>

    Sub-dominant: Tall, cool-season bunchgrasses >

    Other: Mid, warm-season grasses = short, warm-season grasses = forbs > grass-like species = 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):** Litter cover typically ranges from 40 to 60 percent, and depth is typically 0.25 inches.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Total annual production ranges from 1,200 to 2,400 pounds/acre, with the reference value being 1,800 pounds/acre (air-dry basis).

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.

17. **Perennial plant reproductive capability:** Perennial grasses should have vigorous rhizomes or tillers.