

United States Department of Agriculture Natural Resources Conservation Service

Ecological Site Description

Site Type: Rangeland

Site Name: Shallow Clay

Site ID: R055CY017SD

Major Land Resource Area (MLRA): 55C – Southern Black Glaciated Plains

Physiographic Features

This site occurs on moderately to steeply sloping uplands.

Landform: hill, ridge

Aspect: N/A



	<u>Minimum</u>	<u>Maximum</u>
Elevation (feet):	1,300	2,000
Slope (percent):	9	35
Water Table Depth (inches):	80	80
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):	None	None
Frequency:	None	None
Duration:	None	None
Runoff Class:	Very high	Very high

Climatic Features

MLRA 55C is considered to have a continental climate – cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature may also abound. 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 typically ranges from 19 to 25 inches per year. The average annual temperature is about 47°F. January is the coldest month with average temperatures ranging from about 15°F (Howard, South Dakota (SD)), to about 20°F (Wagner, SD). July is the warmest month with temperatures averaging from about 73°F (Howard, SD), to about 77°F (Wagner, 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 12 miles per hour (mph) annually, ranging from about 13 mph during the spring to about 11 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. Greenup of cool-season plants may occur in September and October when adequate soil moisture is present.

	<u>Minimum</u>	<u>Maximum</u>
Frost-free period (days):	137	159
Freeze-free period (days):	156	180
Mean Annual Precipitation (inches):	19	25

Average Monthly Precipitation (inches) and Temperature (°F):

	Precip. Min.	Precip. Max	Temp. Min.	Temp. Max.
January	0.42	0.54	3.4	31.0
February	0.51	0.81	8.1	36.3
March	1.00	1.61	20.5	47.7
April	2.05	2.50	33.6	62.7
May	2.85	3.47	44.8	74.6
June	3.35	4.15	54.9	84.1
July	2.38	2.97	59.9	91.1
August	2.23	2.87	57.7	88.8
September	1.61	2.71	48.2	79.4
October	1.39	1.76	36.1	65.9
November	0.62	1.09	21.7	47.4
December	0.42	0.65	9.4	34.8

Climate Stations		Period	
Station ID	Location or Name	From	To
SD4037	Howard	1893	2008
SD5228	Marion	1901	2008
SD5561	Miller	1902	2008
SD8767	Wagner	1916	2008

For local climate stations that may be more representative, refer to <http://www.wcc.nrcs.usda.gov>.

Riparian and Wetland Features

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

Representative Soil Features

The soils in this site are well-drained and formed in clayey residuum weathered from shale. The clay to surface layer is about four inches thick. The bedrock which occurs at 13 to 16 inches is impervious shale which is virtually impenetrable to plant roots. The soils have a very slow infiltration rate. This site may show slight evidence of rills, wind scoured areas, and/or pedestalled plants. Water flow paths are broken, irregular in appearance, or discontinuous with numerous debris dams or vegetative barriers. Some amount of erosion is occasionally present on this site even in the Reference State.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about 15 percent. Wind erosion can also be a hazard when vigor of plants is reduced due to stress from grazing or prolonged periods of below average precipitation. Low available water capacity and very slow permeability strongly influences the soil-water-plant relationship.

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

Parent Material Kind: residuum
Parent Material Origin: shale, calcareous
Surface Texture: clay
Surface Texture Modifier: none
Subsurface Texture Group: clayey
Surface Fragments ≤3” (% Cover): 0-2
Surface Fragments >3” (%Cover): 0
Subsurface Fragments ≤3” (% Volume): 0-4
Subsurface Fragments >3” (% Volume): 0

	<u>Minimum</u>	<u>Maximum</u>
Drainage Class:	well	well
Permeability Class:	very slow	very slow
Depth (inches):	10	20
Electrical Conductivity (mmhos/cm)*:	0	2
Sodium Absorption Ratio*:	0	1
Soil Reaction (1:1 Water)*:	6.6	8.4
Soil Reaction (0.1M CaCl₂)*:	NA	NA
Available Water Capacity (inches)*:	1	2
Calcium Carbonate Equivalent (percent)*:	0	10

*These attributes represent from 0-40 inches or to the first restrictive layer.

Plant Communities

Ecological Dynamics of the Site

This site developed under Northern Great Plains climatic conditions, light to severe grazing by bison and other large herbivores, sporadic natural or man-caused wildfire (often of light intensities), 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.

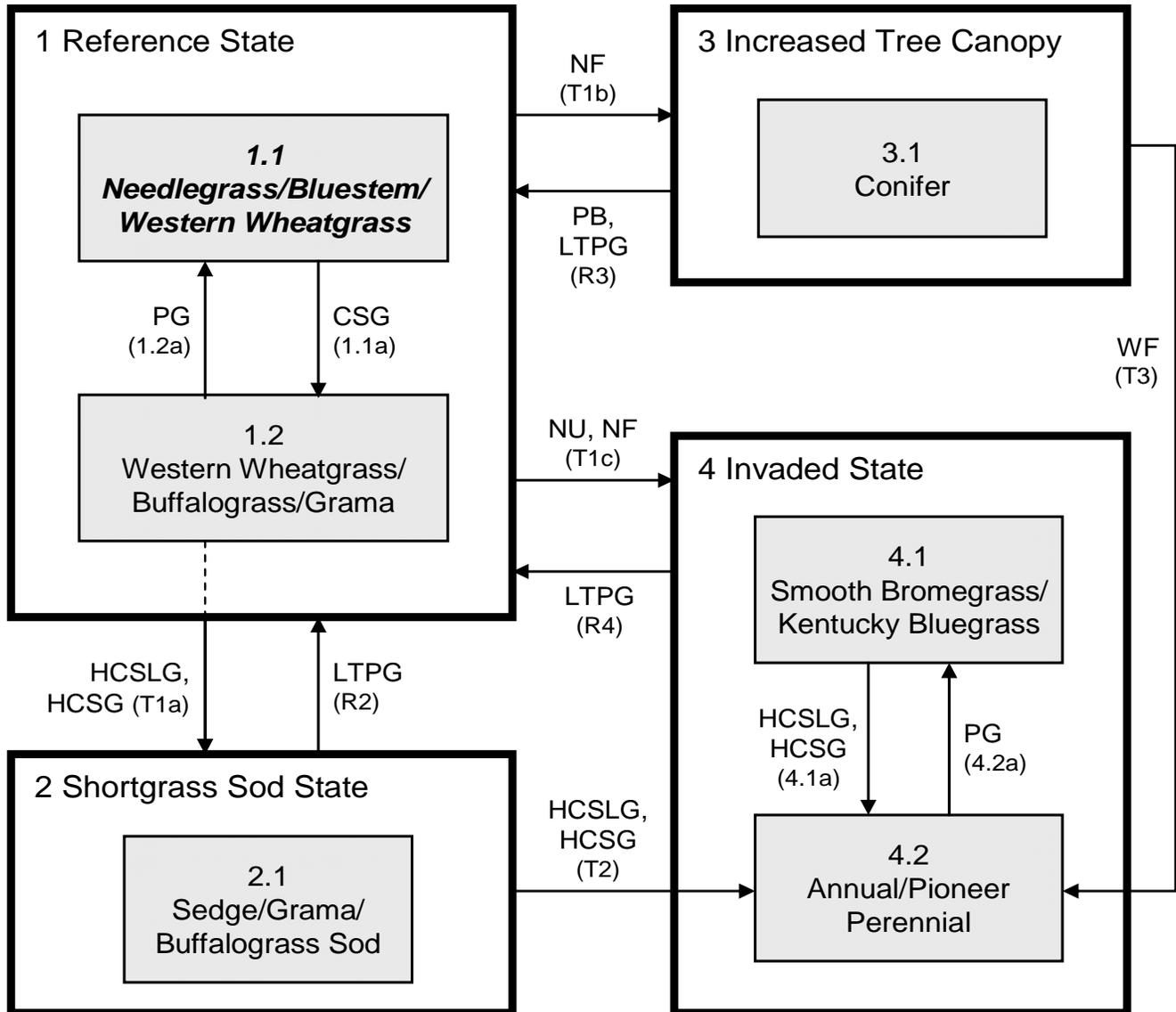
Continuous season-long grazing (during the typical growing season of May through October) and/or repeated seasonal grazing (e.g., every spring, every summer) without adequate recovery periods following each grazing occurrence causes this site to depart from the Needlegrass/Bluestem/Western Wheatgrass Plant Community. Sedge and other short grasses will increase and eventually develop into a sod. Little bluestem will increase initially and then begin to decrease. Green needlegrass, needleandthread, porcupine grass, sideoats grama, big bluestem, and western wheatgrass will decrease in frequency and production. Extended periods of nonuse and/or lack of fire will result in excessive litter and a plant community dominated by cool-season grasses such as western wheatgrass, bluegrass, smooth brome grass, and cheatgrass.

Interpretations are primarily based on the Needlegrass/Bluestem/Western Wheatgrass 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 community phases, 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.

Plant Communities and Transitional Pathways



Refer to narrative for details on pathways: **CSG** – Continuous seasonal grazing; **HCSG** – Heavy continuous seasonal grazing; **HCSLG** – Heavy continuous season-long grazing; **LTPG** – Long-term prescribed grazing; **NF** – No fire; **NU** – Non-use; **PB** – Prescribed burning; **PG** – Prescribed grazing; **WF** - Wildfire.

Plant Community Composition and Group Annual Production

COMMON/GROUP NAME	SCIENTIFIC NAME	SYMBOL	1.1 Needlegrass/Bluestem/ Western Wheatgrass		
			Group	lbs./acre	% Comp
GRASSES & GRASS-LIKES				1760 - 1980	80 - 90
COOL-SEASON BUNCHGRASSES			1	330 - 550	15 - 25
green needlegrass	Nassella viridula	NAVI4	1	220 - 440	10 - 20
porcupine grass	Hesperostipa spartea	HESP11	1	44 - 220	2 - 10
needleandthread	Hesperostipa comata ssp. comata	HECOC8	1	44 - 220	2 - 10
Canada wildrye	Elymus canadensis	ELCA4	1	0 - 110	0 - 5
TALL WARM-SEASON GRASSES			2	220 - 550	10 - 25
big bluestem	Andropogon gerardii	ANGE	2	220 - 550	10 - 25
tall dropseed	Sporobolus compositus var. compositus	SPCOC2	2	0 - 176	0 - 8
prairie sandreed	Calamovilfa longifolia	CALO	2	0 - 110	0 - 5
WHEATGRASS			3	220 - 550	10 - 25
western wheatgrass	Pascopyrum smithii	PASM	3	220 - 550	10 - 25
MID WARM-SEASON GRASSES			4	220 - 440	10 - 20
sideoats grama	Bouteloua curtipendula	BOCU	4	110 - 330	5 - 15
little bluestem	Schizachyrium scoparium	SCSC	4	110 - 330	5 - 15
prairie dropseed	Sporobolus heterolepis	SPHE	4	0 - 110	0 - 5
SHORT WARM-SEASON GRASSES			5	22 - 110	1 - 5
blue grama	Bouteloua gracilis	BOGR2	5	22 - 110	1 - 5
buffalograss	Bouteloua dactyloides	BODA2	5	22 - 110	1 - 5
sand dropseed	Sporobolus cryptandrus	SPCR	5	0 - 66	0 - 3
OTHER NATIVE GRASSES			6	22 - 110	1 - 5
prairie junegrass	Koeleria macrantha	KOMA	6	22 - 66	1 - 3
other grasses		2GRAM	6	0 - 110	0 - 5
GRASS-LIKES			7	22 - 110	1 - 5
sedge	Carex spp.	CAREX	7	22 - 110	1 - 5
other grass-likes		2GL	7	0 - 66	0 - 3
FORBS			9	110 - 220	5 - 10
catclaw sensitive briar	Mimosa nuttallii	MINU6	9	0 - 44	0 - 2
cudweed sagewort	Artemisia ludoviciana	ARLU	9	22 - 44	1 - 2
cutleaf ironplant	Machaeranthera pinnatifida	MAPI	9	0 - 22	0 - 1
deervetch	Lotus unifoliolatus var. unifoliolatus	LOUNU	9	0 - 22	0 - 1
dotted gayfeather	Liatris punctata	LIPU	9	22 - 44	1 - 2
false boneset	Brickellia eupatorioides	BREU	9	0 - 44	0 - 2
goldenrod	Solidago spp.	SOLID	9	22 - 44	1 - 2
heath aster	Symphotrichum ericoides	SYER	9	22 - 44	1 - 2
milkweed	Asclepias spp.	ASCLE	9	0 - 22	0 - 1
penstemon	Penstemon spp.	PENST	9	0 - 44	0 - 2
prairie coneflower	Ratibida columnifera	RACO3	9	22 - 44	1 - 2
purple coneflower	Echinacea angustifolia	ECAN2	9	22 - 66	1 - 3
purple prairie clover	Dalea purpurea	DAPU5	9	0 - 22	0 - 1
scarlet globemallow	Sphaeralcea coccinea	SPCO	9	0 - 22	0 - 1
scurfpea	Psoraleidum spp.	PSORA2	9	22 - 44	1 - 2
stiff sunflower	Helianthus pauciflorus	HEPA19	9	22 - 44	1 - 2
textile onion	Allium textile	ALTE	9	0 - 22	0 - 1
western ragweed	Ambrosia psilostachya	AMPS	9	22 - 44	1 - 2
yellow wild buckwheat	Eriogonum flavum var. flavum	ERFLF	9	0 - 22	0 - 1
native forbs		2FN	9	22 - 88	1 - 4
SHRUBS			10	44 - 176	2 - 8
leadplant	Amorpha canescens	AMCA6	10	22 - 88	1 - 4
plains pricklypear	Opuntia polyacantha	OPPO	10	0 - 22	0 - 1
rose	Rosa spp.	ROSA5	10	22 - 44	1 - 2
skunkbush sumac	Rhus trilobata	RHTR	10	0 - 44	0 - 2
western snowberry	Symphoricarpos occidentalis	SYOC	10	22 - 44	1 - 2
yucca	Yucca glauca	YUGL	10	22 - 44	1 - 2
other shrubs		2SHRUB	10	0 - 66	0 - 3
TREES			11	0 - 44	0 - 2
bur oak	Quercus macrocarpa	QUMA2	11	0 - 44	0 - 2
eastern redcedar	Juniperus virginiana	JUVI	11	0 - 44	0 - 2
Rocky Mountain juniper	Juniperus scopulorum	JJUSC2	11	0 - 44	0 - 2
other trees		2TREE	11	0 - 44	0 - 2

Annual Production lbs./acre	LOW	RV	HIGH
GRASSES & GRASS-LIKES	1260	1903	2505
FORBS	100	165	250
SHRUBS	40	110	200
TREES	0	22	45
TOTAL	1400	2200	3000

This list of plants and their relative proportions are based on near normal years. Fluctuations in species composition and relative production may change from year to year dependent upon precipitation or other climatic factors. RV = Representative value.

Plant Community Composition and Group Annual Production

COMMON/GROUP NAME	SYMBOL	1.1 Needlegrass/Bluestem/ Western Wheatgrass			1.2 Western Wheatgrass/ Buffalograss/Grama			2.1 Sedge/Grama Buffalograss/Sod			3.1 Conifer		
		Grp	lbs./acre	% Comp	Grp	lbs./acre	% Comp	Grp	lbs./acre	% Comp	Grp	lbs./acre	% Comp
GRASSES & GRASS-LIKES			1760 - 1980	80 - 90		1275 - 1425	85 - 95		765 - 810	85 - 90		700 - 910	50 - 65
COOL-SEASON BUNCHGRASSES		1	330 - 550	15 - 25	1	30 - 150	2 - 10	1	9 - 63	1 - 7	1	28 - 210	2 - 15
green needlegrass	NAV14	1	220 - 440	10 - 20	1	0 - 150	0 - 10	1	0 - 27	0 - 3	1	14 - 210	1 - 15
porcupine grass	HESP11	1	44 - 220	2 - 10	1	0 - 45	0 - 3	1	0 - 27	0 - 3	1	0 - 70	0 - 5
needleandthread	HECOC8	1	44 - 220	2 - 10	1	0 - 45	0 - 3	1	0 - 54	0 - 6	1	0 - 70	0 - 5
Canada wildrye	ELCA4	1	0 - 110	0 - 5							1	14 - 140	1 - 10
TALL WARM-SEASON GRASSES		2	220 - 550	10 - 25	2	0 - 150	0 - 10	2			2		
big bluestem	ANGE	2	220 - 550	10 - 25	2	0 - 75	0 - 5						
tall dropseed	SPCOC2	2	0 - 176	0 - 8	2	0 - 150	0 - 10						
prairie sandreed	CALO	2	0 - 110	0 - 5									
WHEATGRASS		3	220 - 550	10 - 25	3	225 - 450	15 - 30	3	0 - 45	0 - 5	3	28 - 280	2 - 20
western wheatgrass	PASM	3	220 - 550	10 - 25	3	225 - 450	15 - 30	3	0 - 45	0 - 5	3	28 - 280	2 - 20
MID WARM-SEASON GRASSES		4	220 - 440	10 - 20	4	30 - 150	2 - 10	4	0 - 45	0 - 5	4	28 - 140	2 - 10
sideoats grama	BOCU	4	110 - 330	5 - 15	4	30 - 150	2 - 10	4	0 - 45	0 - 5	4	14 - 112	1 - 8
little bluestem	SC8C	4	110 - 330	5 - 15	4	0 - 75	0 - 5				4	14 - 112	1 - 8
prairie dropseed	SPHE	4	0 - 110	0 - 5									
SHORT WARM-SEASON GRASSES		5	22 - 110	1 - 5	5	75 - 300	5 - 20	5	9 - 90	1 - 10	5	0 - 70	0 - 5
blue grama	BOGR2	5	22 - 110	1 - 5	5	15 - 120	1 - 8	5	0 - 45	0 - 5	5	0 - 42	0 - 3
buffalograss	BODA2	5	22 - 110	1 - 5	5	30 - 225	2 - 15	5	0 - 63	0 - 7	5	0 - 56	0 - 4
sand dropseed	SPCR	5	0 - 66	0 - 3	5	15 - 120	1 - 8	5	0 - 45	0 - 5	5	0 - 70	0 - 5
OTHER NATIVE GRASSES		6	22 - 110	1 - 5	6	15 - 75	1 - 5	6	9 - 45	1 - 5	6	14 - 70	1 - 5
prairie junegrass	KOMA	6	22 - 66	1 - 3	6	15 - 45	1 - 3	6	9 - 27	1 - 3	6	14 - 42	1 - 3
other grasses	2GRAM	6	0 - 110	0 - 5	6	0 - 75	0 - 5	6	0 - 45	0 - 5	6	0 - 70	0 - 5
GRASS-LIKES		7	22 - 110	1 - 5	7	30 - 150	2 - 10	7	135 - 360	15 - 40	7	14 - 70	1 - 5
sedge	CAREX	7	22 - 110	1 - 5	7	30 - 150	2 - 10	7	135 - 360	15 - 40	7	14 - 70	1 - 5
other grass-likes	2GL	7	0 - 66	0 - 3	7	0 - 75	0 - 5	7	0 - 72	0 - 8	7	0 - 42	0 - 3
NON-NATIVE GRASSES		8			8	30 - 150	2 - 10	8	90 - 270	10 - 30	8	0 - 70	0 - 5
annual bromegrass	BROMU				8	0 - 75	0 - 5	8	9 - 90	1 - 10	8	0 - 70	0 - 5
bluegrass	POA				8	30 - 150	2 - 10	8	45 - 225	5 - 25	8	0 - 70	0 - 5
smooth bromegrass	BRIN2				8	0 - 30	0 - 2	8	0 - 90	0 - 10	8	0 - 42	0 - 3
FORBS		9	110 - 220	5 - 10	9	75 - 150	5 - 10	9	45 - 90	5 - 10	9	70 - 140	5 - 10
catclaw sensitive briar	MINU6	9	0 - 44	0 - 2									
common pepperweed	LEDE				9	0 - 30	0 - 2	9	0 - 27	0 - 3	9	0 - 28	0 - 2
cutweed sagewort	ARLU	9	22 - 44	1 - 2	9	15 - 45	1 - 3	9	9 - 27	1 - 3	9	14 - 42	1 - 3
cutleaf ironplant	MAPI	9	0 - 22	0 - 1							9	0 - 14	0 - 1
deervetch	LOUNU	9	0 - 22	0 - 1							9	0 - 14	0 - 1
dotted gayfeather	LIPU	9	22 - 44	1 - 2	9	0 - 15	0 - 1				9	0 - 14	0 - 1
false boneset	BREU	9	0 - 44	0 - 2									
field pennycress	THAR5				9	0 - 30	0 - 2	9	0 - 27	0 - 3	9	0 - 28	0 - 2
goldenrod	SOLID	9	22 - 44	1 - 2	9	15 - 45	1 - 3	9	9 - 18	1 - 2	9	0 - 28	0 - 2
heath aster	SYER	9	22 - 44	1 - 2	9	15 - 30	1 - 2	9	9 - 18	1 - 2	9	14 - 42	1 - 3
milkweed	ASCLE	9	0 - 22	0 - 1	9	0 - 15	0 - 1				9	0 - 14	0 - 1
penstemon	PENST	9	0 - 44	0 - 2									
prairie coneflower	RACO3	9	22 - 44	1 - 2	9	0 - 15	0 - 1				9	0 - 28	0 - 2
purple coneflower	ECAN2	9	22 - 66	1 - 3	9	0 - 15	0 - 1				9	0 - 28	0 - 2
purple prairie clover	DAPU5	9	0 - 22	0 - 1							9	0 - 14	0 - 1
scarlet globemallow	SPCO	9	0 - 22	0 - 1	9	0 - 15	0 - 1	9	0 - 9	0 - 1	9	0 - 14	0 - 1
scurfpea	PSORA2	9	22 - 44	1 - 2	9	0 - 30	0 - 2	9	0 - 9	0 - 1	9	14 - 28	1 - 2
stiff sunflower	HEPA19	9	22 - 44	1 - 2									
sweetclover	MELIL				9	0 - 150	0 - 10	9	0 - 72	0 - 8	9	0 - 70	0 - 5
textile onion	ALTE	9	0 - 22	0 - 1									
western ragweed	AMPS	9	22 - 44	1 - 2	9	15 - 45	1 - 3	9	9 - 18	1 - 2	9	14 - 28	1 - 2
yellow wild buckwheat	ERFLF	9	0 - 22	0 - 1							9	0 - 14	0 - 1
native forbs	2FN	9	22 - 88	1 - 4	9	0 - 45	0 - 3	9	0 - 27	0 - 3	9	0 - 42	0 - 3
introduced forbs	2FI				9	0 - 75	0 - 5	9	0 - 45	0 - 5	9	0 - 42	0 - 3
SHRUBS		10	44 - 176	2 - 8	10	30 - 75	2 - 5	10	18 - 54	2 - 6	10	28 - 98	2 - 7
leadplant	AMCA6	10	22 - 88	1 - 4	10	0 - 15	0 - 1				10	0 - 14	0 - 1
plains pricklypear	OPPO	10	0 - 22	0 - 1	10	0 - 30	0 - 2	10	0 - 27	0 - 3	10	0 - 14	0 - 1
rose	ROSA5	10	22 - 44	1 - 2	10	0 - 15	0 - 1	10	0 - 9	0 - 1	10	14 - 42	1 - 3
skunkbush sumac	RHTR	10	0 - 44	0 - 2	10	0 - 30	0 - 2	10	0 - 9	0 - 1	10	0 - 28	0 - 2
western snowberry	SYOC	10	22 - 44	1 - 2	10	15 - 30	1 - 2	10	9 - 36	1 - 4	10	14 - 42	1 - 3
yucca	YUGL	10	22 - 44	1 - 2	10	15 - 45	1 - 3	10	9 - 36	1 - 4	10	0 - 28	0 - 2
other shrubs	2SHRUB	10	0 - 66	0 - 3	10	0 - 45	0 - 3	10	0 - 27	0 - 3	10	0 - 42	0 - 3
TREES		11	0 - 44	0 - 2	11	0 - 30	0 - 2	11	0 - 18	0 - 2	11	210 - 490	15 - 35
bur oak	QUMA2	11	0 - 44	0 - 2	11	0 - 30	0 - 2	11	0 - 18	0 - 2	11	0 - 280	0 - 20
eastern redcedar	JUVI	11	0 - 44	0 - 2	11	0 - 30	0 - 2	11	0 - 18	0 - 2	11	0 - 490	0 - 35
Rocky Mountain juniper	JUSC2	11	0 - 44	0 - 2	11	0 - 30	0 - 2	11	0 - 18	0 - 2	11	0 - 490	0 - 35
other trees	2TREE	11	0 - 44	0 - 2	11	0 - 30	0 - 2	11	0 - 18	0 - 2	11	0 - 140	0 - 10
Annual Production lbs./acre			LOW RV HIGH		LOW RV HIGH		LOW RV HIGH		LOW RV HIGH		LOW RV HIGH		LOW RV HIGH
GRASSES & GRASS-LIKES			1260 - 1903 - 2505		705 - 1320 - 1820		445 - 788 - 1230		525 - 882 - 955				
FORBS			100 - 165 - 250		70 - 113 - 165		40 - 68 - 95		65 - 105 - 155				
SHRUBS			40 - 110 - 200		25 - 53 - 80		15 - 36 - 55		25 - 63 - 105				
TREES			0 - 22 - 45		0 - 15 - 35		0 - 9 - 20		185 - 350 - 585				
TOTAL			1400 - 2200 - 3000		800 - 1500 - 2100		500 - 900 - 1400		800 - 1400 - 1800				

This list of plants and their relative proportions are based on near normal years. Fluctuations in species composition and relative production may change from year to year dependent upon precipitation or other climatic factors. RV = Representative value. Refer to PLANTS database for scientific names and codes: <http://plants.usda.gov>

Plant Community and Vegetation State Narratives

Reference State (State 1)

This state represents the natural range of variability that dominates the dynamics of this ecological site (ES). This state is codominated by cool- and warm-season grasses. In pre-European times, the primary disturbance mechanisms for this site in the reference condition included frequent fire 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. The dominant cool- and warm-season species can decline and a corresponding increase in short-statured species will occur.

1.1 Needlegrass/Bluestem/Western Wheatgrass Plant Community Phase

Interpretations are based primarily on the Needlegrass/Bluestem/Western Wheatgrass Plant Community Phase (this is also considered to be climax). The potential vegetation is about 80 percent grasses or grass-like plants, 10 percent forbs, 8 percent shrubs, and 2 percent trees. The community is codominated by cool- and warm-season grasses. The major grasses include western wheatgrass, big bluestem, green needlegrass, sideoats grama, and little bluestem. Other grass and grass-like species include needleandthread, porcupine grass, blue grama, buffalograss, and sedges. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community in regards to site/soil stability, watershed function, and biologic integrity.

The following growth curve is an estimate of the monthly percentages of total annual growth of the dominant species expected during an average year:

Growth curve number: SD6303

Growth curve name: Pierre Shale Plains, cool-season/warm-season codominant.

Growth curve description: Cool-season, warm-season codominant.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0	0	3	10	20	28	21	10	5	3	0	0

Transitions or pathways leading to other plant communities are as follows:

- 1.1a – Continuous seasonal grazing which includes grazing at moderate to heavy stocking levels at the same time of year each year or a combination of disturbances such as extended periods of below average precipitation coupled with periodic heavy grazing will shift this community to the *1.2 Western Wheatgrass/Buffalograss/Grama Plant Community Phase*.

1.2 Western Wheatgrass/Buffalograss/Grama Plant Community Phase

This plant community developed under continuous seasonal grazing or from over utilization during extended drought periods. The potential plant community is made up of approximately 83 percent grasses and grass-like species, 10 percent forbs, 5 percent shrubs, and 2 percent trees. Dominant grasses include western wheatgrass, buffalograss, blue grama, and sideoats grama. Grasses of secondary importance include sedge, green needlegrass, Kentucky bluegrass, and tall dropseed. Forbs commonly found in this plant community include cudweed sagewort, goldenrod, and western ragweed. When compared to the Needlegrass/Bluestem/Western Wheatgrass Plant Community Phase (1.1), blue grama and buffalograss have increased. Needlegrasses and tall warm-season grasses have decreased and production has also been reduced. This plant community is moderately resistant to change. The herbaceous species present are well adapted to grazing; however, species

composition can be altered through long-term overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term.

The following growth curve is an estimate of the monthly percentages of total annual growth of the dominant species expected during an average year:

Growth curve number: SD6303

Growth curve name: Pierre Shale Plains, cool-season/warm-season codominant.

Growth curve description: Cool-season, warm-season codominant.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0	0	3	10	20	28	21	10	5	3	0	0

Transitions or pathways leading to other plant communities are as follows:

- T1b – Heavy continuous seasonal grazing (stocking levels well above carrying capacity for extended portions of the growing season, and at the same time of year each year, typically beginning early in the season) or heavy continuous season-long grazing will convert this plant community to the *2.1 Sedge/Grama/Buffalograss Sod Plant Community Phase* and the *Shortgrass Sod State (State 2)*.
- 1.2a – 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 *1.1 Needlegrass/Bluestem/Western Wheatgrass Plant Community Phase*.

2.1 Sedge/Grama/Buffalograss Sod Plant Community

This plant community evolved under heavy continuous season-long grazing or from over utilization during extended drought periods. The potential plant community is made up of approximately 82 percent grasses and grass-like species, 10 percent forbs, 6 percent shrubs, and 2 percent trees. Dominant grass and grass-like species include sedge, buffalograss, blue grama, and sideoats grama. Grasses of secondary importance include needleandthread, bluegrass, annual brome grass, and smooth brome grass. Forbs commonly found in this plant community include cudweed sagewort, goldenrod, and sweet clover. When compared to the Needlegrass/Bluestem/Western Wheatgrass Plant Community Phase (1.1), short-statured species are dominant on this plant community. Tall/mid cool- and warm-season grasses have decreased significantly. This vegetation state is very resistant to change. The herbaceous species present are well adapted to grazing; however, composition can be altered through long-term prescribed grazing.

This plant community is less productive than most other phases. The thick sod prevents other species from getting established. Lack of litter and reduced plant vigor causes higher soil temperatures, poor water infiltration rates, and high evapotranspiration which give the short-statured species a competitive advantage. Soil erosion will be minimal due to the sod forming habit of dominant species in this phase.

The following growth curve is an estimate of the monthly percentages of total annual growth of the dominant species expected during an average year:

Growth curve number: SD6303

Growth curve name: Pierre Shale Plains, cool-season/warm-season codominant.

Growth curve description: Cool-season, warm-season codominant.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0	0	3	10	20	28	21	10	5	3	0	0

Transitions or recovery pathways leading to other plant communities are as follows:

- R2 – Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) may lead this plant community phase over a threshold to the *Reference State (State 1)*. This will likely take a long period of time, possibly up to 10 years or more, and recovery may not be attainable. Under certain circumstances, the harsh conditions created by the shortgrass sod can lead to the elimination of invasive grass species such as Kentucky bluegrass and smooth brome grass.
- T2 – Heavy continuous seasonal grazing (stocking levels well above carrying capacity for extended portions of the growing season, and at the same time of year each year, typically beginning early in the season) or heavy continuous season-long grazing will convert this plant community to the *4.2 Annual/Pioneer Perennial Sod Plant Community Phase* and the *Invaded State (State 4)*.

Invaded State (State 4)

This state is the result of invasion and dominance of introduced species. This state is characterized by the dominance of Kentucky bluegrass and smooth brome grass and an increasing thatch layer that effectively blocks introduction of other plants into the system. Plant litter accumulation tends to favor the more shade tolerant introduced grass species. The nutrient cycle is also impaired and the result is typically a higher level of nitrogen which also favors the introduced species. Increasing plant litter decreases the amount of sunlight reaching plant crowns thereby shifting competitive advantage to shade tolerant introduced grass species. Studies indicate that soil biological activity is altered, and this shift apparently exploits the soil microclimate and encourages growth of the introduced grass species. Once the threshold is crossed, a change in grazing management alone cannot cause a reduction in the invasive grass dominance. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the plant community composition.

4.2 Annual/Pioneer Perennial Plant Community Phase

This plant community evolved under heavy continuous season-long grazing or from over utilization during extended drought periods. The potential plant community is made up of approximately 50 to 80 percent grasses and grass-like species, 10 to 25 percent forbs, and 5 to 25 percent shrubs and trees. The dominant species are highly variable in this phase, often consisting of invasive species such as annual brome grass, Kentucky bluegrass, and invasive forbs. Other plant species, from adjacent ecological sites, can become minor components of this plant community. This plant community is susceptible to invasion of Canada thistle and other nonnative species because of the relatively high percent of bare ground.

Compared to the Needlegrass/Bluestem/Western Wheatgrass Plant Community Phase (1.1), annual brome grass, invasive forbs, and percent of bare ground have increased. Western wheatgrass, needlegrasses and other cool-season grasses and grass-like species have decreased as have the warm-season species including big bluestem, sideoats grama, little bluestem, plains muhly, and prairie dropseed. Plant diversity is low (plant richness may be high, but areas are often dominated by a few species).

The ecological processes are difficult to restore because of the loss of plant diversity and overall soil disturbance. Soil erosion is potentially very high because of the bare ground and shallow rooted

herbaceous plant community. Water runoff will increase and infiltration will decrease due to animal related soil compaction and loss of root mass due to low plant diversity and vigor.

This plant community will require significant economic inputs and time to move towards another plant community. This movement is highly variable in its succession. This is due to the loss of diversity (including the loss of the seed bank), within the existing plant community, and the plant communities on adjacent sites. This community can be renovated to improve the production capability, however if management changes are not made the vegetation could revert back to a threeawn/annual community.

The following growth curve is an estimate of the monthly percentages of total annual growth of the dominant species expected during an average year:

Growth curve number: SD6301

Growth curve name: Pierre Shale Plains, cool-season dominant.

Growth curve description: Cool-season dominant.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0	0	4	12	25	36	10	5	4	4	0	0

Transitions or restoration pathways leading to other states are as follows:

- R4 - Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) may lead this plant community phase over a threshold to the *Reference State (State 1)*. This will likely take a long period of time, possibly up to 10 years or more, and recovery may not be attainable. Depending on the slope, aspect, and size, and if adequate perennial plants exist, this change can occur more rapidly.
- 4.2a – 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 *4.1 Smooth Bromegrass/Kentucky Bluegrass Plant Community Phase*.

Transition from Reference State (State 1) to the Increased Tree Canopy State (State 3)

- T1b – No fire for extended periods of time will lead the *Reference State (State 1)* across a threshold resulting in the *Increased Tree Canopy State (State 3)*. This transition also requires the presence of eastern redcedar and/or Rocky Mountain juniper, or other trees that can increase on this site. It is a result of a disruption of the natural historic fire regime that occurred in the past.

Increased Tree Canopy State (State 3)

This state consists of areas where tree canopy increases to a level that impedes the reproductive capability of the major native perennial grass species. The increase in tree canopy is a result of a disruption of the natural historic fire regime that kept the trees at an immature stage.

3.1 Conifer Plant Community Phase

This plant community develops under non-use, no fire, and encroachment by eastern redcedar, Rocky Mountain juniper, and/or occasionally deciduous trees such as bur oak. These species expand on this site due to suppression of fire. The tree canopy is 15 percent or greater. The potential plant community is made up of approximately 48 percent grasses and grass-like species, 10 percent forbs,

7 percent shrubs, and 35 percent trees. Dominant grasses and grass-likes include western wheatgrass, green needlegrass, Canada wildrye, sideoats grama, little bluestem, and sedges. As the canopy increases, warm-season grasses tend to decrease as the cool-season grasses initially increase. Forbs commonly found in this community include cudweed sagewort, goldenrod, and sweetclover. Nonnative species such as annual brome grasses and bluegrass will tend to invade.

Compared to the Needlegrass/Bluestem/Western Wheatgrass Plant Community Phase (1.1), juniper increases significantly. The grass component decreases dramatically as the buildup of juniper needles increases. Annual herbaceous production also decreases significantly. While the juniper 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. A significant reduction of juniper can be accomplished through timber harvest or crown fire. The vegetation in the understory is capable of enduring fire; however, very hot crown fires will have a detrimental effect to the plant community.

The following growth curve is an estimate of the monthly percentages of total annual growth of the dominant species expected during an average year:

Growth curve number: SD6311

Growth curve name: Pierre Shale Plains, heavy conifer canopy.

Growth curve description: Mature eastern redcedar 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

Transitions or pathways leading to other plant communities are as follows:

- R3 – Prescribed burning in conjunction with long-term prescribed grazing may lead this plant community across a threshold back to the *Reference State (State 1)*. This would have to take place before the trees reach maturity and are still susceptible to fire and reproductive propagules of the perennial grasses are still present.
- T3 – Wildfire that is intense enough to crown and kill mature trees will cause this plant community to cross a threshold and lead to the *Invaded State (State 4)* and specifically to the *Annual/Pioneer Perennial Plant Community Phase (4.2)*.

Transition from the Reference State (State 1) to the Invaded State (State 4)

- T1c – Non-use and no fire for extended periods of time (typically for 10 or more years) will likely lead this state over a threshold resulting in the *4.1 Smooth Brome grass/Kentucky Bluegrass Plant Community Phase* within the *Invaded State (State 4)*.

4.1 Smooth Brome grass/Kentucky Bluegrass Plant Community Phase

This plant community phase is a result of extended periods of nonuse and no fire. It is characterized by a dominance of smooth brome grass and Kentucky bluegrass. The dominance is at times so complete that other species are difficult to find on the site. A thick duff layer may also accumulate at or above the soil surface. Nutrient cycling is greatly reduced and native plants have great difficulty becoming established. When dominated by smooth brome grass, infiltration is moderately reduced and runoff is moderate. Production can be equal to or higher than the interpretive plant community. However, when dominated by Kentucky bluegrass, infiltration is greatly reduced and runoff is high. Production in this case will likely be significantly less. In either case, the period that palatability is high is relatively short, as these cool-season species mature rapidly. Energy capture is also reduced.

The following growth curve is an estimate of the monthly percentages of total annual growth of the dominant species expected during an average year:

Growth curve number: SD6301

Growth curve name: Pierre Shale Plains, cool-season dominant.

Growth curve description: Cool-season dominant.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0	0	4	12	25	36	10	5	4	4	0	0

Transitions or pathways leading to other plant communities are as follows:

- 4.1a – Heavy continuous seasonal grazing (stocking levels well above carrying capacity for extended portions of the growing season and at the same time of year each year) or heavy continuous season-long grazing will convert this plant community to the *4.2 Annual/Pioneer Perennial Plant Community Phase*.
- R4 - Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) may lead this plant community phase over a threshold to the *Reference State (State 1)*. This will likely take a long period of time, possibly up to 10 years or more, and recovery may not be attainable. Success depends on whether native reproductive propagules remain intact on the site.

Ecological Site Interpretations

Animal Community – Wildlife Interpretations

-- Under Development --

Needlegrass/Bluestem/Western Wheatgrass Plant Community Phase (1.1):

Western Wheatgrass/Buffalograss/Grama Plant Community Phase (1.2):

Sedge/Grama/Buffalograss Sod Plant Community Phase (2.1):

Conifer Plant Community Phase (3.1):

Smooth Bromegrass/Kentucky Bluegrass Plant Community Phase (4.1):

Annual/Pioneer Perennial Plant Community Phase (4.2):

Animal Preferences (Quarterly – 1,2,3,4[†])

Common Name	Cattle	Sheep	Horses	Deer	Antelope	Bison	Elk
Grasses and Grass-likes							
big bluestem	U D P D	U D U U	U D P D	U D U U	U D U U	U D P D	U D P D
blue grama	U D P U	D P P D	U D P U	D P P D	D P P D	U D P U	U D P U
buffalograss	U U D U	N U D U	U U D U	N U D U	N U D U	U U D U	U U D U
Canada wildrye	U D U U	N U N N	U D U U	N U N N	N U N N	U D U U	U D U U
green needlegrass	U P U D	N P N P	U P U D	N P N P	N P N P	U P U D	U P U D
little bluestem	U D D U	N D N N	U D D U	N D N N	N D N N	U D D U	U D D U
needleandthread	U D U D	N D N U	U D U D	N D N U	N D N U	U D U D	U D U D
porcupine grass	U P U D	N D N U	U P U D	N D N U	N D N U	U P U D	U P U D
prairie dropseed	N U P U	N U D U	N U P U	N U D U	N U D U	N U P U	N U P U
prairie junegrass	U D U D	N D N U	U D U D	N D N U	N D N U	U D U D	U D U D
prairie sandreed	U D D U	U D U U	U D D U	U U D U	U U D U	U D D U	U D D U
sand dropseed	N U N N	N U N N	N U N N	N U N N	N U N N	N U N N	N U N N
sedge	U D U D	U P N D	U D U D	U D U D	U D U D	U D U D	U D U D
sideoats grama	U D P U	U P D U	U D P U	U P D U	U P D U	U D P U	U D P U
tall dropseed	N U N N	N U N N	N U N N	N U N N	N U N N	N U N N	N U N N
western wheatgrass	U P D U	N D N N	U P D U	N D N N	N D N N	U P D U	U P D U
Forbs							
catclaw sensitive briar	U D P U	U P P U	U D P U	U P P U	U P P U	U D P U	U P P U
cudweed sagewort	U U U U	U U D U	U U U U	U U D U	U U D U	U U U U	U U D U
cutleaf ironplant	U U U U	N U U N	U U U U	N U U N	N U U N	U U U U	N U U N
deervetch	U U U U	U D D U	U U U U	U D D U	U D D U	U U U U	U D D U
dotted gayfeather	U U D U	U P P U	U U D U	U P P U	U P P U	U U D U	U P P U
false boneset	U U D U	N D U N	U U D U	N D U N	N D U N	U U D U	N D U N
goldenrod	U U D U	N U U N	U U D U	N U U N	N U U N	U U D U	N U U N
heath aster	U U D U	U U P U	U U D U	U U P U	U U P U	U U D U	U U P U
milkweed	U U U U	N N N N	U U U U	N N N N	N N N N	U U U U	N N N N
penstemon	U U U U	U P P U	U U U U	U P P U	U P P U	U U U U	U P P U
prairie coneflower	U U D U	U P P U	U U D U	U P P U	U P P U	U U D U	U P P U
purple coneflower	U U D U	U P P U	U U D U	U P P U	U P P U	U U D U	U P P U
purple prairie clover	U D P U	U P P U	U D P U	U P P U	U P P U	U D P U	U P P U
scarlet globemallow	U U D U	U D D U	U U D U	U D D U	U D D U	U U D U	U D D U
scurfpea	U U U U	N U U N	U U U U	N U U N	N U U N	U U U U	N U U N
stiff sunflower	U D P U	U D P U	U D P U	U D P U	U D P U	U D P U	U D P U
textile onion	U D U U	U D D U	U D U U	U D D U	U D D U	U D U U	U D D U
western ragweed	U U U U	N N N N	U U U U	N N N N	N N N N	U U U U	N N N N
yellow wild buckwheat	N N U N	N N U N	N N U N	N N U N	N N U N	N N U N	N N U N
Shrubs and Trees							
bur oak	T T T T	T T T T	N N N N	N U D U	N N N N	T T T T	N U D U
eastern redcedar	U N N U	U N N U	U N N U	D U U D	U N N U	U N N U	U N N U
leadplant	U P D U	U P D U	U P D U	U P D U	U P D U	U P D U	U P D U
plains pricklypear	N N N N	N N N N	N N N N	N N N N	N N N N	N N N N	N N N N
Rocky Mountain juniper	U N N U	U N N U	U N N U	D U U D	U N N U	U N N U	U N N U
rose	U D D U	U D D U	U D D U	U D D U	U D D U	U D D U	U D D U
skunkbush sumac	D U U D	D U U D	D U U D	D U U D	D U U D	D U U D	D U U D
western snowberry	U U U U	U U U U	U U U U	D U D D	U U U U	U U U U	D U U U
yucca	D N N D	D U U D	D N N D	D U U D	D U U D	D N N D	D U U D

N = not used; **U** = undesirable; **D** = desirable; **P** = preferred; **T** = toxic

[†] Quarters: 1 – Jan., Feb., Mar.; 2 – Apr., May, Jun.; 3 – Jul., Aug., Sep.; 4 – Oct., Nov., Dec.

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 ES 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.

Plant Community	Average Annual Production (lbs./acre, air-dry)	Stocking Rate* (AUM/acre)
Needlegrass/Bluestem/Western Wheatgrass (1.1)	2,200	0.60
Western Wheatgrass/Buffalograss/Grama (1.2)	1,500	0.41
Smooth Bromegrass/Kentucky Bluegrass (4.1)	2,000	0.55
Sedge/Grama/Buffalograss Sod (2.1)	900	0.25

*Based on 912 lbs./acre (air-dry weight) per Animal Unit Month (AUM) and on 25 percent harvest efficiency (refer to United States Department of Agriculture (USDA) Natural Resources Conservation Service (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.

Hydrology Functions

Water is the principal factor limiting forage production on this site. This site is typically dominated by soils in hydrologic group D. Infiltration and runoff potential for this site varies from moderate to high depending on soil hydrologic group, 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. Dominance by blue grama, buffalograss, bluegrass, and/or smooth bromegrass 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 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 esthetic 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.

Supporting Information

Associated Sites

Clayey (R055CY011SD), Loamy (R055CY010SD), Thin Upland (R055CY012SD)

Similar Sites

(R055CY011SD) – Clayey [less big bluestem; higher production]

(R055CY012SD) – Thin Upland [more little bluestem, more needleandthread, and porcupine grass]

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: Stan Boltz, Range Management Specialist, NRCS.

State Correlation

This site has been correlated in SD in MLRA 55C.

Field Offices/Counties

Armour	Douglas	Huron	Beadle	Plankinton	Aurora
Chamberlain	Brule	Lake Andes	Charles Mix	Redfield	Spink
Clark	Clark	Madison	Lake	Salem	McCook
De Smet	Kingsbury	Miller	Hand	Tyndall	Bon Homme
Faulkton	Faulk	Mitchell	Davison/Hanson	Wessington Springs	Jerauld
Highmore	Hyde	Parker	Turner	Woonsocket	Sanborn
Howard	Miner	Parkston	Hutchinson	Yankton	Yankton

Relationship to Other Established Classifications

Level IV Ecoregions of the Conterminous United States: 42e – Southern Missouri Coteau, 42f – Southern Missouri Coteau Slope, 46n – James River Lowland.

Other References

High Plains Regional Climate Center, University of Nebraska, 830728 Chase Hall, Lincoln, NE 68583-0728. (<http://www.hprcc.unl.edu/>)

USDA, NRCS. National Water and Climate Center, 101 SW Main, Suite 1600, Portland, OR 97204-3224. (<http://wcc.nrcs.usda.gov>)

USDA, NRCS. National Range and Pasture Handbook, September 1997

USDA, NRCS. National Soil Information System, Information Technology Center, 2150 Centre Avenue, Building A, Fort Collins, CO 80526. (<http://nasis.nrcs.usda.gov>)

USDA, NRCS. 2001. The PLANTS Database, Version 3.1 (<http://plants.usda.gov>). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Site Description Approval

SD, State Range Management Specialist

Date