USDA Natural Resources Conservation Service

Ecological site R102AY008SD
Sands

Accessed: 05/03/2024

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.

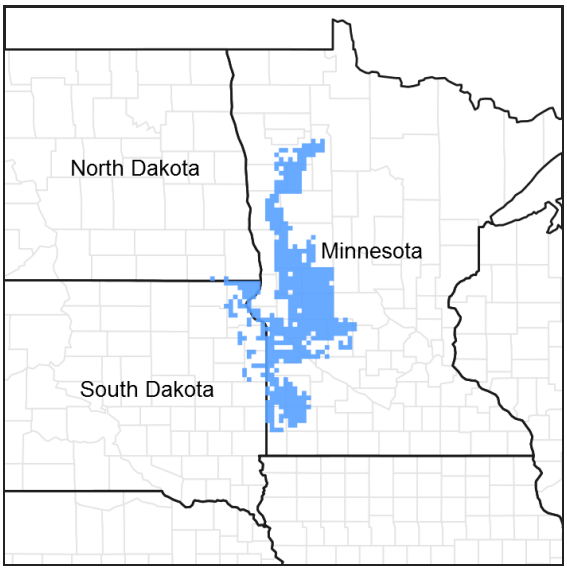


Figure 1. Mapped extent

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): 102A–Rolling Till Prairie

For further information on this Ecological Site Description (ESD), view on South Dakota Electronic Field Office Technical Guide (EFOTG), contact the NRCS State Office in Huron, SD, or MLRA Soil Survey Office in Redfield, SD.

Classification relationships

Level IV Ecoregions of the Conterminous United States: 46e – Tewaukon Dead Ice Moraine, 46k – Prairie Coteau, 46l – Prairie Coteau Escarpment, 46m – Big Sioux Basin, 46o – Minnesota River Prairie, 47b – Des Moines Lobe, 48d – Lake Agassiz Plain, 51j – Alexandria Moraines and Detroit Lakes Outwash Plain.

Associated sites

R102AY009SD	**Sandy**
R102AY010SD	**Loamy**
R102AY012SD	**Thin Upland**

Similar sites

R102AY009SD	**Sandy** (R102AY009SD) – Sandy [more needlegrass and less prairie sandreed; higher production]

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon hallii* (2) *Calamovilfa longifolia*

Physiographic features

This site occurs on gently to moderately steeply sloping uplands.

Table 2. Representative physiographic features

Landforms	(1) Moraine (2) Delta plain (3) Lake plain
Elevation	305–610 m
Slope	3–16%
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 102A is considered to have a continental climate – cold winters and relatively hot summers, low to moderate 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 21 to 27 inches per year. The average annual temperature is about 43°F. January is the coldest month with average temperatures ranging from about 5°F (Mahnomen 1 W, Minnesota (MN)), to about 14°F (Tracy, MN). July is the warmest month with temperatures averaging from about 69°F (Mahnomen 1 W, MN), to about 73°F (Tracy, MN). The range of normal average monthly temperatures between the coldest and warmest months is about 62°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. Greenup 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)	152 days
Freeze-free period (average)	174 days
Precipitation total (average)	686 mm

Influencing water features

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

Soil features

The soils in this site are well to somewhat excessively well-drained and formed in eolian deposits. The surface layer is 7 to 14 inches thick. The surface texture is typically loamy fine sand or loam, while the texture of the subsurface ranges from loamy fine sand to sand. Slopes range from 3 to 16 percent. This site should show slight to no evidence of rills, wind scoured areas, or pedestalled plants. Water flow paths will typically not be present. The soil surface is stable and intact. These soils are mainly susceptible to wind erosion. The hazard of erosion increases where vegetative cover is low or in poor condition. Occasional erosion may occur with flooding events. Low available water capacity influences the soil-water-plant relationship. Loss of the soil surface layer can result in a shift in species composition and/or production.

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

Table 4. Representative soil features

Surface texture	(1) Loamy fine sand (2) Loam
Family particle size	(1) Sandy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately rapid to rapid
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	10.16–12.7 cm
Calcium carbonate equivalent (0-101.6cm)	0–10%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–4%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

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.

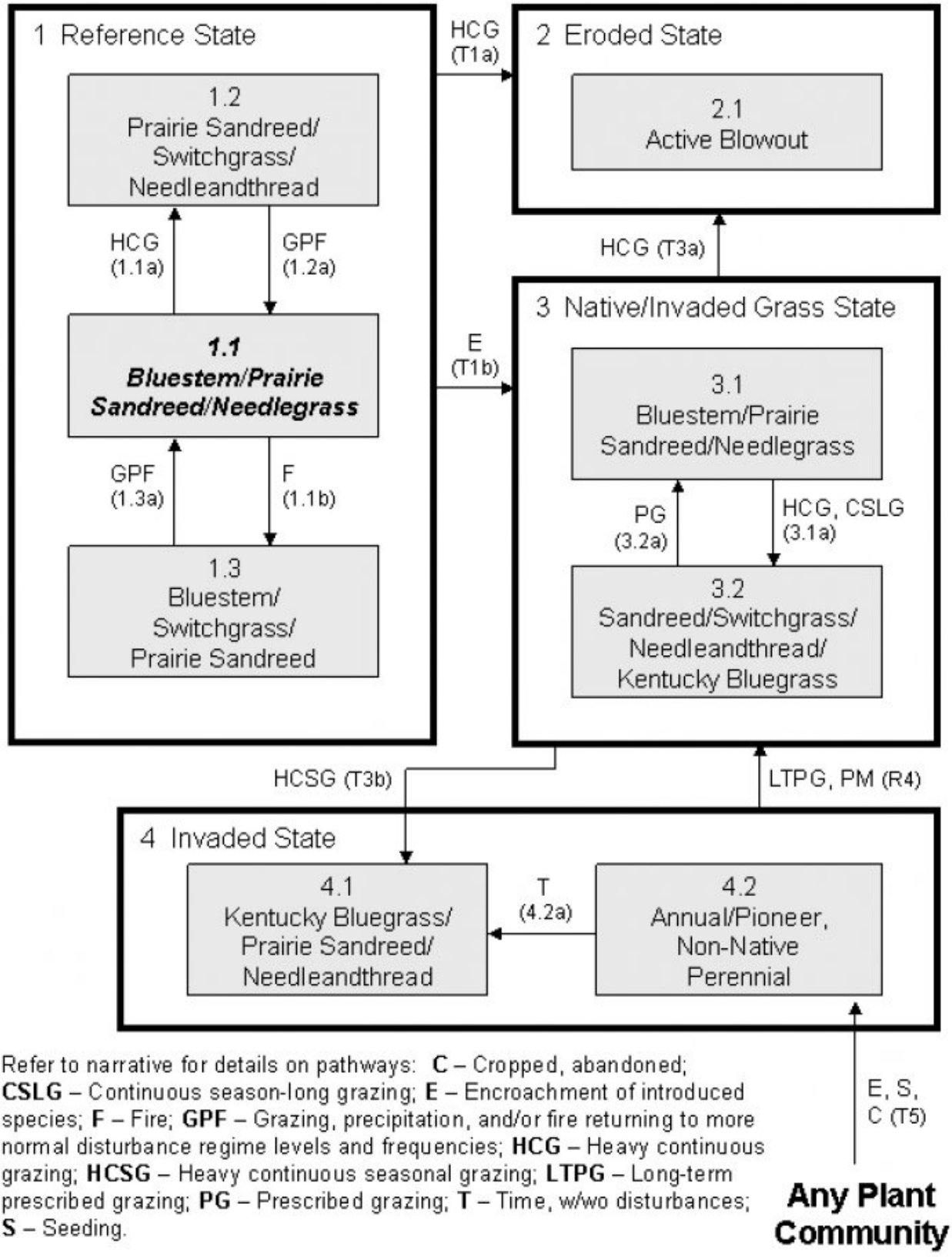
Heavy continuous grazing (season-long grazing during the typical growing season of April through October and/or repeated seasonal grazing during the same time of year each year) without adequate recovery periods following grazing events causes departure from the Bluestem/Needlegrass/Prairie Sandreed Plant Community Phase (3.1).

Sedge and blue grama will increase and eventually develop into a sod. Western wheatgrass will increase initially and then begin to decrease. Needleandthread, porcupine grass, sideoats grama, sand bluestem, and little bluestem 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 Kentucky bluegrass, smooth bromegrass, and cheatgrass.

Interpretations are primarily based on the 1.1 Bluestem/Needlegrass/Prairie Sandreed Plant Community Phase. 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.

State and transition model



Refer to narrative for details on pathways: **C** – Cropped, abandoned; **CSLG** – Continuous season-long grazing; **E** – Encroachment of introduced species; **F** – Fire; **GPF** – Grazing, precipitation, and/or fire returning to more normal disturbance regime levels and frequencies; **HCG** – Heavy continuous grazing; **HCSG** – Heavy continuous seasonal grazing; **LTPG** – Long-term prescribed grazing; **PG** – Prescribed grazing; **T** – Time, w/wo disturbances; **S** – Seeding.

State 1
Reference

This state represents the natural range of variability that dominated the dynamics of this ecological site (ES). This state was dominated by warm-season grasses with cool-season grasses being subdominant. In pre-European

times, the primary disturbance mechanisms for this site in the reference condition included periods of below and/or above average precipitation, sporadic fire, and herbivory by insects and large ungulates. Timing of fires and herbivory coupled with weather events dictated the dynamics that occurred within the natural range of variability. The less grazing tolerant tall warm-season grasses and cool-season grasses would have declined. Prairie sandreed would have increased with ongoing disturbance. With severe, prolonged disturbance plant vigor can rapidly decline and this state can move towards an active blowout. Today, a similar 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.

Community 1.1
Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase

Interpretations are based primarily on the Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase (this is also considered to be climax). The potential vegetation was about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. The community was dominated by warm-season grasses, with cool-season grasses subdominant. The major grasses included sand and/or big bluestem, prairie sandreed, switchgrass, little bluestem, needleandthread, and porcupine grass. Other grass or grass-like species included sideoats grama, western wheatgrass, blue grama, hairy grama, threadleaf sedge, Indiangrass, and sand dropseed. This plant community was resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allowed for high drought tolerance. This was a sustainable plant community in regards to site/soil stability, watershed function, and biologic integrity.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2354	3311	3990
Forb	163	278	432
Shrub/Vine	62	110	174
Total	**2579**	**3699**	**4596**

Figure 5. Plant community growth curve (percent production by month). SD0204, Rolling Till Prairie, warm-season dominant, cool-season subdominant.. Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	17	25	25	15	7	1	0	0

Community 1.2
Prairie Sandreed/Switchgrass/Needleandthread Plant Community Phase

This plant community evolved under heavy continuous grazing or from over utilization during extended drought periods. The potential plant community was made up of approximately 85 percent grasses and grass-like species, 10 percent forbs, and 5 percent shrubs. Dominant grasses included prairie sandreed, switchgrass, needleandthread, blue grama, sand dropseed, and threadleaf sedge. Grasses of secondary importance included little bluestem, purple lovegrass, hairy grama, western wheatgrass, sand and/or big bluestem, and porcupine grass. Forbs commonly found in this plant community included cudweed sagewort, green sagewort, western ragweed, and scurfpea. This plant community had similar plant composition to the 3.2 Sandreed/Switchgrass/Needleandthread/Kentucky Bluegrass Plant Community Phase (refer to the plant composition tables). The main difference is that this plant community phase did not have the presence of nonnative invasive species such as Kentucky bluegrass. When compared to the Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase (1.1), prairie sandreed, needleandthread, sand dropseed, threadleaf sedge, and blue grama increased. Bluestems and porcupine grass decreased and production was reduced. This plant community was moderately resistant to change. The herbaceous species present were well adapted to grazing; however, species composition could be altered through long-term overgrazing. If the herbaceous component was intact, it tended to be resilient if the disturbance was not long-term.

Figure 6. Plant community growth curve (percent production by month).

SD0204, Rolling Till Prairie, warm-season dominant, cool-season subdominant.. Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	17	25	25	15	7	1	0	0

Community 1.3
Bluestem/Switchgrass/Prairie Sandreed Plant Community Phase

This plant community was a result of fire occurring at relatively frequent intervals. This phase could have also resulted from a combination of grazing events immediately following early season fire (i.e., large ungulates attracted to highly nutritious vegetative growth following a fire). These events would have caused a reduction in cool-season grasses and an increase in warm-season grasses. The warm-season grasses were more tolerant of shorter return intervals of fire and would have increased in vigor and production leading to a temporary shift to this phase. Needlegrasses would have decreased most significantly amongst the cool-season grasses. The potential vegetation was about 80 percent grasses or grass-like plants, 15 percent forbs, and 5 percent shrubs. The community was dominated by warm-season grasses. The major grasses included sand and/or big bluestem, switchgrass, prairie sandreed, Indiangrass, little bluestem, and sideoats grama. Other grass or grass-like species included blue grama, hairy grama, sand dropseed, needleandthread, porcupine grass, and threadleaf sedge. This plant community was not resistant to change and would have readily shifted back to the 1.1 Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase with a return of more normal fire return intervals.

Figure 7. Plant community growth curve (percent production by month). SD0205, Rolling Till Prairie, warm-season dominant.. Warm-season dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	5	15	25	30	15	7	1	0	0

Pathway 1.1a
Community 1.1 to 1.2

Heavy continuous grazing which included herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or a combination of disturbances such as extended periods of below average precipitation coupled with periodic or chronic heavy grazing will shift this community to the 1.2 Prairie Sandreed/Switchgrass/Needleandthread Plant Community Phase.

Pathway 1.1b
Community 1.1 to 1.3

Fire occurring at relatively frequent intervals, and occasional grazing events immediately following early season fire caused a reduction in cool-season grasses and an increase in warm-season grasses. The warm-season grasses were more tolerant of shorter return intervals of fire, and would increase in vigor and production leading to a temporary shift to the 1.3 Big Bluestem/Switchgrass/Prairie Sandreed Plant Community Phase.

Pathway 1.2a
Community 1.2 to 1.1

Grazing, precipitation, and/or fire returned to normal disturbance regime levels and frequencies or periodic light to moderate grazing possibly including periodic rest will convert this plant community to the 1.1 Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase.

Pathway 1.3a
Community 1.3 to 1.1

Grazing, precipitation, and/or fire returned to normal disturbance regime levels and frequencies or periodic light to moderate grazing possibly including periodic rest will convert this plant community to the 1.1 Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase.

State 2
Eroded

Community 2.1
Active Blowout Plant Community Phase

This plant community evolved under heavy continuous season grazing or from over utilization during extended drought periods. The potential plant community is variable, sometimes nearly devoid of vegetation and other times having a considerable cover of grasses. The grasses that make up this plant community phase are those that have developed adaptations to withstand or avoid damage due to blowing sand and can withstand being buried. Typical species may include species such as sand bluestem, prairie sandreed, blowout grass, and other early pioneer species. This plant community phase is susceptible to wind erosion and the blowing and shifting sand may keep this community in an early seral phase.

Figure 8. Plant community growth curve (percent production by month). SD0205, Rolling Till Prairie, warm-season dominant.. Warm-season dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	5	15	25	30	15	7	1	0	0

State 3
Native/Invaded Grass

This state represents the more common range of variability that exists with higher levels of grazing management but in the absence of periodic fire due to fire suppression. This state is dominated by warm-season grasses with cool-season grasses being subdominant. It 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. Grazing tolerant will increase with disturbance.

Community 3.1
Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase

This plant community phase is similar to the 1.1 Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase but it also contains minor amounts of nonnative invasive grass species such as Kentucky bluegrass and smooth bromegrass (up to about 15 percent by air-dry weight). The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. The community is dominated by warm-season grasses, with cool-season grasses subdominant. The major grasses include sand and/or big bluestem, prairie sandreed, switchgrass, little bluestem, needleandthread, and porcupine grass. Other grass or grass-like species include sideoats grama, western wheatgrass, blue grama, hairy grama, threadleaf sedge, Indiangrass, and sand dropseed. 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.

Figure 9. Plant community growth curve (percent production by month). SD0204, Rolling Till Prairie, warm-season dominant, cool-season subdominant.. Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	17	25	25	15	7	1	0	0

Community 3.2
Sandreed/Switchgrass/Needleandthread/Kentucky Bluegrass Plant Community

This plant community is a result of heavy continuous grazing, continuous season-long grazing, or from over utilization during extended drought periods. The potential plant community is made up of approximately 85 percent grasses and grass-like species, 15 percent forbs, and 5 percent shrubs. Dominant grasses include prairie sandreed, switchgrass, needleandthread, blue grama, sand dropseed, and threadleaf sedge. Grasses of secondary

importance include little bluestem, purple lovegrass, hairy grama, western wheatgrass, sand and/or big bluestem, and porcupine grass. Forbs commonly found in this plant community include cudweed sagewort, green sagewort, western ragweed, and scurfpea. When compared to the Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase (1.1), prairie sandreed, needleandthread, sand dropseed, threadleaf sedge, and blue grama increase. Bluestems and porcupine grass decrease and production is 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.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1760	2507	3222
Forb	123	211	319
Shrub/Vine	22	84	157
Total	**1905**	**2802**	**3698**

Figure 11. Plant community growth curve (percent production by month). SD0204, Rolling Till Prairie, warm-season dominant, cool-season subdominant.. Warm-season dominant, cool-season subdominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	17	25	25	15	7	1	0	0

Pathway 3.1a
Community 3.1 to 3.2

Heavy continuous grazing (stocking levels well above carrying capacity for extended portions of the growing season, and often at the same time of year each year), or continuous season-long grazing, or a combination of disturbances such as extended periods of below average precipitation coupled with periodic heavy grazing will shift this community to the 3.2 Sandreed/Switchgrass/Needleandthread/Kentucky Bluegrass Plant Community Phase.

Pathway 3.2a
Community 3.2 to 3.1

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 3.1 Bluestem/Prairie Sandreed/Needlegrass Plant Community Phase.

Conservation practices

Prescribed Grazing

State 4
Invaded

This state is a result of encroachment mainly by invasive introduced cool-season grasses. The ecological processes are not functioning, especially the biotic processes and the hydrologic functions. The introduced cool-season grasses cause reduced infiltration and increased runoff. 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. The opportunity for high intensity spring burns is severely reduced by early greenup and increased moisture and humidity at the soil surface and grazing pressure cannot cause a reduction in sodgrass dominance. Production is limited to the sod forming species. Infiltration continues to decrease and runoff increases, energy capture into the system is restricted to early season low producing species. Nutrient cycling is limited by root depth of the dominant species.

Community 4.1
Kentucky Bluegrass/Prairie Sandreed/Needleandthread Plant Community Phase

This plant community phase is a result of heavy, continuous seasonal grazing or heavy, continuous season-long grazing. It is characterized by a dominance of Kentucky bluegrass, prairie sandreed, needleandthread, sedge, and blue grama. The dominance of Kentucky bluegrass is at times so complete that other species are difficult to find on the site. A relatively thick duff layer can sometimes accumulate at or above the soil surface. Nutrient cycling is greatly reduced and native plants have great difficulty becoming established. Infiltration is greatly reduced and runoff is high. Production will be significantly reduced when compared to the interpretive plant community. The period that palatability is high is relatively short, as Kentucky bluegrass matures rapidly. Energy capture is also reduced. Biological activity in the soil is likely reduced significantly in this phase.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1463	2141	2572
Forb	106	177	269
Shrub/Vine	–	36	73
Total	**1569**	**2354**	**2914**

Figure 13. Plant community growth curve (percent production by month). SD0202, Rolling Till Prairie, cool-season dominant, warm-season subdominant.. Cool-season dominant, warm-season subdominant..

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 4.2
Annual/Pioneer, Non-Native Perennial Plant Community Phase

This plant community developed under continuous heavy grazing or other excessive disturbances (e.g., heavy use areas, defoliation by rodents, etc.). The potential plant community is made up of approximately 40 to 80 percent grasses and grass-like species, 20 to 60 percent forbs, and 0 to 5 percent shrubs. The species present in this phase are highly variable, but often include nonnative invasive and/or early seral species. 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 invasive or early seral species.

Pathway 4.2a
Community 4.2 to 4.1

This community pathway occurs with the passage of time as successional processes take place and perennial plants gradually begin to establish on the site again. This pathway will lead to the 4.1 Kentucky Bluegrass/Prairie Sandreed/Needleandthread Plant Community Phase.

Transition T1a
State 1 to 2

Heavy continuous grazing (stocking levels well above carrying capacity for extended portions of the growing season, and often at the same time of year each year) will cause a shift over a threshold and convert this plant

community to the 2.1 Active Blowout Plant Community Phase and the Eroded State (State 2).

Transition T1b
State 1 to 3

Encroachment of non-native grasses such as Kentucky bluegrass, and disruption of natural disturbance regimes (typically as a result of fire suppression following settlement led this state over a threshold to the Native/Invaded Grass State (State 3).

Transition T5
State 1 to 4

Encroachment of non-native invasive/noxious species, abandonment of cropping, or seeding of introduced and/or native improved varieties of forage species may lead this plant community phase over a threshold to the Invaded State (State 4) and more specifically to the 4.2 Annual/Pioneer, Non-native Perennial Plant Community Phase. In the case of a seeding, refer to the corresponding Forage Suitability Group description for adapted species and expected production (production estimates in the Forage Suitability Group description may be unrealistically high due to the degraded condition of the site at this phase).

Transition T5
State 1 to 4

Encroachment of non-native invasive/noxious species, abandonment of cropping, or seeding of introduced and/or native improved varieties of forage species may lead this plant community phase over a threshold to the Invaded State (State 4) and more specifically to the 4.2 Annual/Pioneer, Non-native Perennial Plant Community Phase. In the case of a seeding, refer to the corresponding Forage Suitability Group description for adapted species and expected production (production estimates in the Forage Suitability Group description may be unrealistically high due to the degraded condition of the site at this phase).

Transition T5
State 1 to 4

Encroachment of non-native invasive/noxious species, abandonment of cropping, or seeding of introduced and/or native improved varieties of forage species may lead this plant community phase over a threshold to the Invaded State (State 4) and more specifically to the 4.2 Annual/Pioneer, Non-native Perennial Plant Community Phase. In the case of a seeding, refer to the corresponding Forage Suitability Group description for adapted species and expected production (production estimates in the Forage Suitability Group description may be unrealistically high due to the degraded condition of the site at this phase).

Transition T5
State 2 to 4

Encroachment of non-native invasive/noxious species, abandonment of cropping, or seeding of introduced and/or native improved varieties of forage species may lead this plant community phase over a threshold to the Invaded State (State 4) and more specifically to the 4.2 Annual/Pioneer, Non-native Perennial Plant Community Phase. In the case of a seeding, refer to the corresponding Forage Suitability Group description for adapted species and expected production (production estimates in the Forage Suitability Group description may be unrealistically high due to the degraded condition of the site at this phase).

Transition T3a
State 3 to 2

Heavy continuous grazing (stocking levels well above carrying capacity for extended portions of the growing season, and often at the same time of year each year) will cause a shift over a threshold and convert this plant community to the 2.1 Active Blowout Plant Community Phase and the Eroded State (State 2).

Transition T3b
State 3 to 4

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) will cause a shift across a threshold leading to the 4.1 Kentucky Bluegrass/Prairie Sandreed/Needleandthread Plant Community Phase within the Invaded State (State 4).

Transition T5
State 3 to 4

Encroachment of non-native invasive/noxious species, abandonment of cropping, or seeding of introduced and/or native improved varieties of forage species may lead this plant community phase over a threshold to the Invaded State (State 4) and more specifically to the 4.2 Annual/Pioneer, Non-native Perennial Plant Community Phase. In the case of a seeding, refer to the corresponding Forage Suitability Group description for adapted species and expected production (production estimates in the Forage Suitability Group description may be unrealistically high due to the degraded condition of the site at this phase).

Transition T5
State 3 to 4

Encroachment of non-native invasive/noxious species, abandonment of cropping, or seeding of introduced and/or native improved varieties of forage species may lead this plant community phase over a threshold to the Invaded State (State 4) and more specifically to the 4.2 Annual/Pioneer, Non-native Perennial Plant Community Phase. In the case of a seeding, refer to the corresponding Forage Suitability Group description for adapted species and expected production (production estimates in the Forage Suitability Group description may be unrealistically high due to the degraded condition of the site at this phase).

Restoration pathway R4
State 4 to 3

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 Native/Invaded Grass State (State 3). Pest management (i.e., herbicide) may also be needed to suppress cool-season invasive grasses. 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.

Conservation practices

Prescribed Grazing

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-season Grasses**			925–2034	
	sand bluestem	ANHA	*Andropogon hallii*	555–1480	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	370–1110	–
	switchgrass	PAVI2	*Panicum virgatum*	185–740	–
	big bluestem	ANGE	*Andropogon gerardii*	0–555	–
	Indiangrass	SONU2	*Sorghastrum nutans*	0–185	–
2	**Mid Warm-season Grasses**			370–740	
	little bluestem	SCSC	*Schizachyrium scoparium*	370–740	–

	sideoats grama	BOCU	*Bouteloua curtipendula*	0–111	–
3	**Needlegrass**			370–555	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	185–555	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	185–555	–
4	**Short Warm-season Grasses**			111–370	
	blue grama	BOGR2	*Bouteloua gracilis*	37–185	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	37–185	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	37–185	–
	thin paspalum	PASE5	*Paspalum setaceum*	0–111	–
5	**Other Native Grasses**			74–185	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–185	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	37–111	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	37–111	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–74	–
6	**Grass-likes**			37–185	
	threadleaf sedge	CAFI	*Carex filifolia*	37–185	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–111	–
Forb					
7	**Forbs**			185–370	
	Forb, native	2FN	*Forb, native*	31–94	–
	field sagewort	ARCA12	*Artemisia campestris*	37–74	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	37–74	–
	false boneset	BREU	*Brickellia eupatorioides*	37–74	–
	purple prairie clover	DAPU5	*Dalea purpurea*	37–74	–
	buckwheat	ERIOG	*Eriogonum*	0–74	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	37–74	–
	blazing star	LIATR	*Liatris*	37–74	–
	hoary puccoon	LICA12	*Lithospermum canescens*	37–74	–
	Carolina puccoon	LICA13	*Lithospermum caroliniense*	0–74	–
	beardtongue	PENST	*Penstemon*	37–74	–
	scurfpea	PSORA2	*Psoralidium*	37–74	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	37–74	–
	goldenrod	SOLID	*Solidago*	37–74	–
	white heath aster	SYER	*Symphyotrichum ericoides*	37–74	–
	longbract spiderwort	TRBR	*Tradescantia bracteata*	37–74	–
	hoary verbena	VEST	*Verbena stricta*	0–37	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–37	–
	prairie groundsel	PAPL12	*Packera plattensis*	0–37	–
	Carolina larkspur	DECAV2	*Delphinium carolinianum ssp. virescens*	0–37	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–37	–
	yellow sundrops	CASE12	*Calylophus serrulatus*	0–37	–

	Flodman's thistle	CIFL	*Cirsium flodmanii*	0–37	–
	groundplum milkvetch	ASCR2	*Astragalus crassicarpus*	0–37	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–37	–
Shrub/Vine					
8	**Shrubs**			63–157	
	leadplant	AMCA6	*Amorpha canescens*	31–94	–
	rose	ROSA5	*Rosa*	31–63	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–63	–
	snowberry	SYMPH	*Symphoricarpos*	0–31	–
	western sandcherry	PRPUB	*Prunus pumila var. besseyi*	0–31	–

Table 9. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-season Grasses**			560–1261	
	prairie sandreed	CALO	*Calamovilfa longifolia*	420–1121	–
	switchgrass	PAVI2	*Panicum virgatum*	140–560	–
	big bluestem	ANGE	*Andropogon gerardii*	0–84	–
	sand bluestem	ANHA	*Andropogon hallii*	0–84	–
2	**Mid Warm-season Grasses**			0–140	
	little bluestem	SCSC	*Schizachyrium scoparium*	0–140	–
3	**Needlegrass**			280–560	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	280–560	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–84	–
4	**Short Warm-season Grasses**			140–420	
	blue grama	BOGR2	*Bouteloua gracilis*	56–280	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	56–280	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–224	–
5	**Other Native Grasses**			28–224	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–140	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–56	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	28–56	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–28	–
6	**Grass-likes**			56–280	
	threadleaf sedge	CAFI	*Carex filifolia*	56–280	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–84	–
7	**Non-Native Grasses**			84–336	
	Kentucky bluegrass	POPR	*Poa pratensis*	56–336	–
	brome	BROMU	*Bromus*	28–224	–
Forb					
8	**Forbs**			140–280	

	Cuman ragweed	AMPS	*Ambrosia psilostachya*	28–112	–
	field sagewort	ARCA12	*Artemisia campestris*	28–84	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	28–84	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–84	–
	goldenrod	SOLID	*Solidago*	28–84	–
	Forb, introduced	2FI	*Forb, introduced*	0–84	–
	Forb, native	2FN	*Forb, native*	0–56	–
	scurfpea	PSORA2	*Psoralidium*	28–56	–
	white heath aster	SYER	*Symphyotrichum ericoides*	28–56	–
	hoary verbena	VEST	*Verbena stricta*	0–56	–
	buckwheat	ERIOG	*Eriogonum*	0–56	–
	blazing star	LIATR	*Liatris*	0–28	–
	prairie groundsel	PAPL12	*Packera plattensis*	0–28	–
	beardtongue	PENST	*Penstemon*	0–28	–
	Flodman's thistle	CIFL	*Cirsium flodmanii*	0–28	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–28	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–28	–
Shrub/Vine					
9	**Shrubs**			28–140	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–56	–
	snowberry	SYMPH	*Symphoricarpos*	0–56	–
	leadplant	AMCA6	*Amorpha canescens*	0–28	–
	rose	ROSA5	*Rosa*	0–28	–

Table 10. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-season Grasses**			118–471	
	prairie sandreed	CALO	*Calamovilfa longifolia*	47–471	–
	switchgrass	PAVI2	*Panicum virgatum*	0–235	–
2	**Needlegrass**			0–353	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–353	–
3	**Short Warm-season Grasses**			47–235	
	sand dropseed	SPCR	*Sporobolus cryptandrus*	24–188	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–118	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–47	–
4	**Other Native Grasses**			0–118	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–94	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–47	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–24	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–24	–
5	**Grass-likes**			24–165	
	threadleaf sedge	CAFI	*Carex filifolia*	24–165	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–47	–
6	**Non-Native Grasses**			588–1295	
	Kentucky bluegrass	POPR	*Poa pratensis*	471–1177	–
	brome	BROMU	*Bromus*	24–235	–
Forb					
7	**Forbs**			118–235	
	Forb, introduced	2FI	*Forb, introduced*	24–118	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	24–118	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	24–118	–
	field sagewort	ARCA12	*Artemisia campestris*	24–94	–
	Forb, native	2FN	*Forb, native*	0–71	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–71	–
	buckwheat	ERIOG	*Eriogonum*	0–71	–
	scurfpea	PSORA2	*Psoralidium*	24–71	–
	goldenrod	SOLID	*Solidago*	0–71	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–47	–
	hoary verbena	VEST	*Verbena stricta*	0–47	–
Shrub/Vine					
8	**Shrubs**			0–71	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–24	–

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 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.

Bluestem/Prairie Sandreed/Needlegrass (1.1 & 3.1)
Average Annual Production (lbs./acre, air-dry): 3300
Stocking Rate* (AUM/acre): 0.90

Sandreed/Switchgrass/Needleandthread/Kentucky Bluegrass (3.2)
Average Annual Production (lbs./acre, air-dry): 2500
Stocking Rate* (AUM/acre): 0.69

Kentucky Bluegrass/Prairie Sandreed/Needleandthread (4.1)
Average Annual Production (lbs./acre, air-dry): 2100
Stocking Rate* (AUM/acre): 0.58

Annual/Pioneer, Non-Native Perennial (4.2)
Average Annual Production (lbs./acre, air-dry): 900
Stocking Rate* (AUM/acre): 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.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group A. Infiltration is typically moderate to rapid and runoff potential for this site varies from negligible to low 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 and/or bluegrass 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.

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; and Bruce Kunze, Soil Scientist, NRCS.

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

Contributors

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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)	David Schmidt, Tim Nordquist, Stan Boltz
Contact for lead author	
Date	12/04/2007
Approved by	Stan Boltz
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills should not be present.

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

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3. **Number and height of erosional pedestals or terracettes:** Slight pedastalling on bunch grasses.

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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 less than 10% and less than 2 inches in diameter.

5. **Number of gullies and erosion associated with gullies:** Active gullies should not 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):** Little to no plant litter movement. Plant litter remains in place and is not moved by erosional forces.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class usually 4-6. Typical high root content protects soil surface from erosion.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Use soil series description for depth and color of A-horizon.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Healthy, deep rooted native grasses enhance infiltration and reduce runoff.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer should be evident.

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: Tall warm-season rhizomatous grass >> mid warm-season bunch grass

    Sub-dominant: > mid/tall cool-season bunch grass > short warm-season grass = forb = shrub

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very little to no evidence of decadence or mortality.

14. **Average percent litter cover (%) and depth (in):** 60-70%, roughly 0.5 inch thick or less. Litter cover is in contact with soil surface.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 2800 – 3700 lbs./acre air-dry weight, average 3,300 lbs./acre air-dry weight

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:** Refer to State and Local Noxious Weed List

17. **Perennial plant reproductive capability:** All species are capable of reproducing.