USDA Natural Resources Conservation Service

Ecological site R056AY096ND
Subirrigated Sands

Accessed: 05/02/2024

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.

Classification relationships

Level IV Ecoregions of the Conterminous United States: 48a Glacial Lake Agassiz Basin; 48b Beach Ridges and Sand Deltas; 48c Saline Area; 48d Lake Agassiz Plains.

Associated sites

R056AY087ND	**Limy Subirrigated**
R056AY091ND	**Sandy**
R056AY095ND	**Subirrigated**
R056AY104ND	**Choppy Sands**

Similar sites

R056AY090ND	**Sands**
R056AY091ND	**Sandy**
R056AY104ND	**Choppy Sands**

Table 1. Dominant plant species

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

Physiographic features

This site typically occurs on nearly level to undulating uplands.

Table 2. Representative physiographic features

Landforms	(1) Outwash plain (2) Delta plain (3) Lake plain
Flooding frequency	None

Ponding frequency	None
Elevation	198–305 m
Slope	0–6%
Water table depth	91–152 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 56 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 18 to 23 inches per year. The average annual temperature is about 40°F. January is the coldest month with average temperatures ranging from about 1°F (Pembina, North Dakota (ND)) to about 11°F (Wheaton, Minnesota (MN)). July is the warmest month with temperatures averaging from about 68°F (Pembina, ND) to about 73°F (Wheaton, MN). The range of normal average monthly temperatures between the coldest and warmest months is about 65°F. This large annual range attests to the continental nature of this area's climate. Winds are estimated to average about 13 miles per hour annually, ranging from about 15 miles per hour during the spring to about 11 miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of cool season plants begins in early to mid March, slowing or ceasing in late June. Warm season plants begin growth about mid May and continue to early or mid September. Green up of cool season plants may occur in September and October when adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (average)	143 days
Freeze-free period (average)	162 days
Precipitation total (average)	584 mm

Influencing water features

This site has a seasonally high water table during the months of April, May and June which influences the production and species composition of the site.

Soil features

These are very deep, moderately well drained coarse textured soils. Saturated hydraulic conductivity is moderately rapid to rapid and available water capacity is moderate to low. Some soils have a loamy or clayey substratum with a saturated hydraulic conductivity of moderately slow or slow and an available water capacity of moderate or high. Salinity and sodicity are absent. Soils on this site are highly susceptible to wind erosion. This site is on nearly level to gently sloping outwash plains, terraces, flood plains, lake plains and delta plains. Slope ranges from 0 to 6 percent. This site should show slight to no evidence of rills, wind scoured areas or pedestalled plants. Water flow paths and rills are not present. The soil surface is stable and intact.

These soils are susceptible to water and wind erosion. Loss of the soil surface layer can result in a shift in species composition and/or production.

Major soil series correlated to this ecological site can be found in Section II of the Natural Resources Conservation Service Field Office Technical Guide or the following web site:
http://www.nrcs.usda.gov/technical/efotg/

Table 4. Representative soil features

Surface texture	(1) Fine sandy loam (2) Loamy fine sand (3) Loamy sand
Family particle size	(1) Sandy
Drainage class	Moderately well drained
Permeability class	Moderately rapid
Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0–1%
Available water capacity (0-101.6cm)	10.16–17.78 cm
Calcium carbonate equivalent (0-101.6cm)	0–30%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–15%
Subsurface fragment volume >3" (Depth not specified)	0–5%

Ecological dynamics

The site developed under Northern Great Plains climatic conditions, and included natural influence of large herding herbivores and frequent fire. Changes will occur in the plant communities due to weather fluctuations and/or management actions. Under adverse impacts, a slow decline in vegetative vigor and composition will occur. Under favorable conditions the site has the potential to resemble the reference state. Interpretations for this site are based on the Bluestems/needlegrass/Indiangrass Plant Community Phase (1.1). The Reference State 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 considered. Community phases, community pathways, states, transitions, thresholds and restoration pathways have been determined through similar studies and experience.

The natural disturbance regime consisted of frequent fires caused both by natural and Native American ignition sources. These fires occurred during any season of the year, but were concentrated in the spring and late summer or early fall. Lightening fires occurred most frequently in July and August while fires started by Native Americans occurred in April, September and October. Large ungulate grazing was heavy and occurred often, but usually for short durations. Grazing may have been severe when occurring after a fire event. The grazing and fire interaction especially when coupled with drought events, set up the dynamics discussed and displayed in the following state and transition diagram and descriptions.

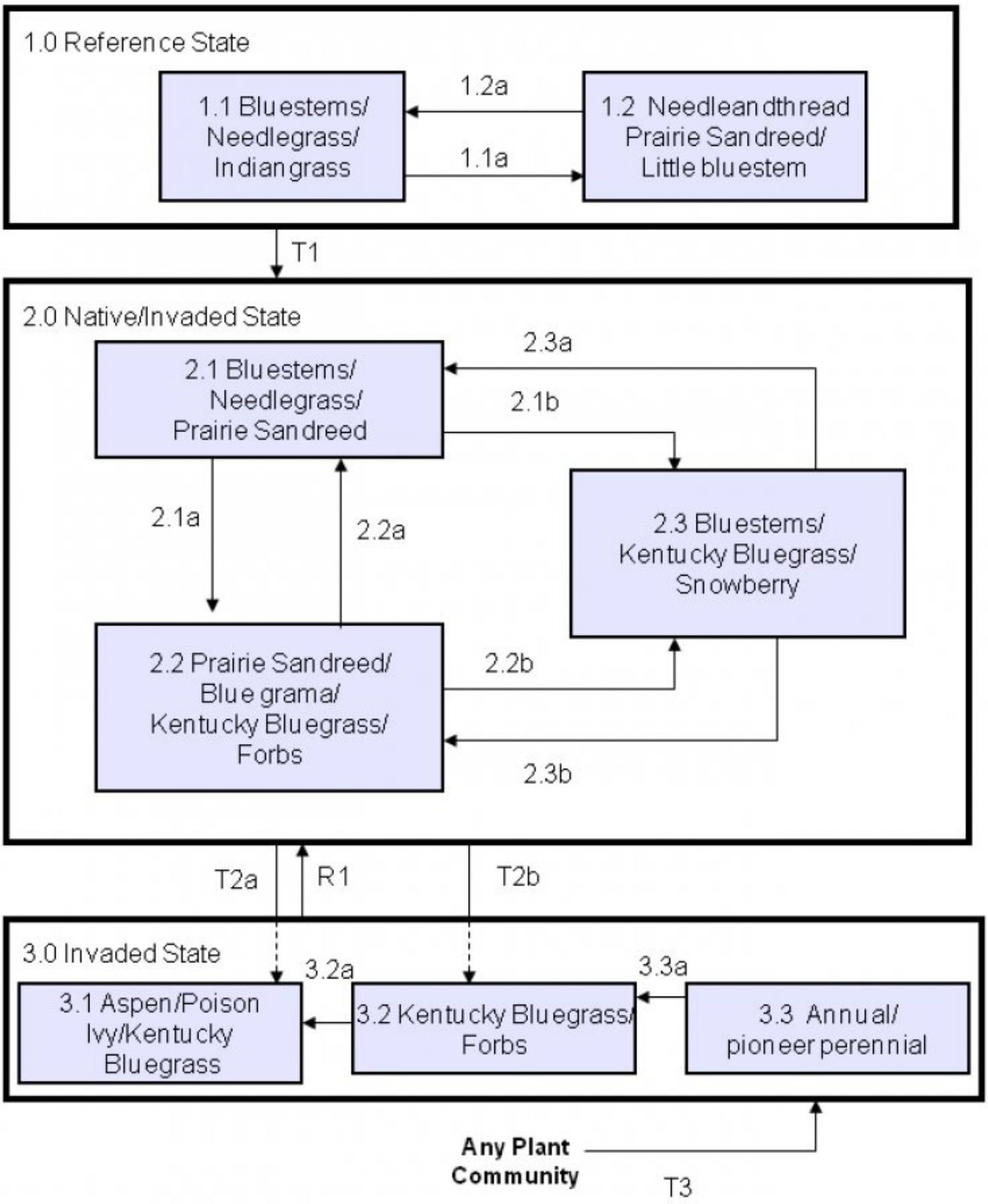
This ecological site has been grazed by domestic livestock since introduced into the area. The introduction of domestic livestock, elimination of fire, and the use of fencing and reliable water sources have radically changed the disturbance regime of this site. Heavy continuous grazing and/or continuous seasonal (spring) grazing, without adequate recovery periods following each grazing occurrence causes this site to depart from the reference plant community. Big bluestem and Indiangrass will decrease in frequency and production. Forbs, and Kentucky bluegrass if present; will begin to increase. In time, heavy continuous grazing will cause Kentucky bluegrass to dominate and forbs to increase. The resulting plant community is relatively stable and competitive advantage prevents other species from establishing. Extended periods of non-use and/or lack of fire will result in a plant

community having high litter levels, which favors an increase in shrubs such as western snowberry, a reduction in warm-season grasses with a corresponding increase in Kentucky bluegrass. The resulting plant community is relatively stable and competitive advantage prevents other species from establishing. Extended periods of non-use and/or lack of fire will result in a plant community having high litter levels, which favors an increase in shrubs, trees, a reduction in warm-season grasses with a corresponding increase in Kentucky bluegrass and/or smooth bromegrass. Shrubs such as western snowberry increase in this situation, especially in areas prone to snow accumulation and drift.

Due to a general invasion of exotic species (such as Kentucky bluegrass and smooth bromegrass) across the MLRA within his site, returning to the 1.1 Bluestems/Needlegrass/Indiangrass Plant Community Phase may not be possible. Today, the 2.1 Bluestems/Needlegrass/Prairie Sandreed Plant Community Phases most resembles the 1.1 Reference Plant Community Phase in appearance and function.

Following the state and transition diagram are narratives for each of the described states and community phases. These may not represent every possibility, but they are the most prevalent and repeatable states/community phases. The plant composition tables shown below have been developed from the best available knowledge at the time of this revision. As more data are collected, some of these community phases and/or states may be revised or removed, and new ones may be added. The main purpose for including the descriptions here is to capture the current knowledge and experience at the time of this revision.

State and transition model



1.2a – Below normal precipitation and/or spring fire followed by intense grazing; **1.1a** – Return to normal precipitation and disturbance regime; **T1** – Altered disturbance regime, introduction of non-native species; **2.1a** – Heavy, continuous grazing; **2.1b, 2.2b, T2a, 3.2a** - Removal of fire and grazing; **2.2a , 2.3a, 2.3b** – Prescribed grazing; **T2b** – Heavy, continuous season-long grazing; **3.3a** – Continuous grazing; **T3** – cropped go-back;

State 1
Reference

This state represents the natural range of variability that dominated the dynamics of this ecological site. This state was diverse, stable, productive and well adapted to the Northern Great Plains. The high water table supplied much of the moisture for plant growth. Plant litter was properly distributed with little movement and natural plant mortality was very low. This was a sustainable state in terms of soil stability, hydrologic function and biologic integrity. This state was dominated by warm-season grasses, with lesser amounts of cool-season grasses and a wide variety of forbs. The primary disturbance mechanisms for this site in the reference condition included periodic 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. Mid and tall statured grass species would have declined with a corresponding increase in short statured warm-season grasses and cool-season grass-like species in response to periods of prolonged drought. Periods of above normal precipitation would have shifted this plant community to one dominated by prairie cordgrass, northern reedgrass, switchgrass, sedges and spikerush.

Community 1.1
Bluestems/Needlegrass/Indiangrass

This community phase was the most dominant both temporally and spatially. The prevailing climate and weather patterns favored the development of this community phase dominated by tall and mid warm-season such as big bluestem, prairie sandreed and Indiangrass and mid cool-season grasses such as porcupine grass. Other grass and grass-like species included switchgrass, little bluestem, sideoats grama, needleandthread, blue grama, and sedge. A wide variety of native perennial forbs were present, such as narrow leaf stoneseed, bracted spiderwort, goldenrods, purple prairie clover and cudweed sagewort Interpretations are based primarily on this plant community phase. Grasses and grass-likes make up 85 to 90 percent, forbs 5 to 10 percent and shrubs 5 to 10 percent of the plant community composition by weight. This plant community phase is further described in the “Plant Community Composition and Group Annual Production” portion of this ecological site description. Bare ground would have been 5 to 10 percent, with litter cover averaging 70 to 80 percent, less than ¼ inches in depth and in contact with soil surface. Energy capture would have occurred from late spring through late summer. Soil stability would have averaged 5.5 or higher. Infiltration rates would have averaged 5 inches per hour or more due to high percent of bunchgrasses and deep rooted, tall statured, warm season grasses present in the plant community.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2365	3049	3654
Shrub/Vine	163	269	415
Forb	163	269	415
Total	**2691**	**3587**	**4484**

Figure 5. Plant community growth curve (percent production by month). ND5604, Red River Valley of the North, warm-season dominant, cool-season sub-dominant.. Warm-season dominant, cool-season sub-dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	1	5	20	38	25	8	3	0	0	0

Community 1.2
Needleandthread/Prairie Sandreed/Little bluestem

Although still dominated by grasses (80 to 90 percent of the production), the appearance of this plant community phase would have been altered by the diverse mixture of forbs resulting from the fire event and the increased grazing pressure following the burn. Dominant grasses would have included needleandthread, prairie sandreed, little bluestem, sideoats grama and blue grama. Forbs such as, sunflowers, goldenrods, purple prairie clover, heath aster, and bracted spiderwort would have constituted 10 percent of the site production. Shrubs would include

leadplant, rose and white meadowsweet The amount of bare ground would have been similar to the reference plant community while litter cover would have been reduced. Infiltration rates would have been reduced slightly but would return to reference state condition as the plant community recovered from the disturbances. Nutrient cycling may have improved slightly over the reference plant community due to the effects of the burn and the lower carbon to nitrogen ratio of the resulting fresh vegetation.

Pathway 1.1a
Community 1.1 to 1.2

Spring fire followed by intense grazing by native ungulates characterized this pathway. This level of grazing intensity resulted in a slight reduction in the more grazing sensitive species such as Indiangrass. The spring fire would have also resulted in an increase in the number and extent of forbs. The increase in grazing pressure as a result of the fire would have lasted several growing seasons. Similar plant community composition changes would have occurred as a result of drought coupled with grazing and possibly fire.

Pathway 1.2a
Community 1.2 to 1.1

A return to normal disturbance intervals (fire, grazing and precipitation) would have permitted the tall statured warm-season grasses, and mid statured cool season bunch grasses to regain dominance, both visually and by weight.

State 2
Native/Invaded

This state is very similar to the reference state in appearance and function. The invasion of introduced species has altered the natural range of variability for this ecological site. This state still has a strong component of warm and cool-season native grass species, but invasive introduced cool-season sodgrasses are now present in all community phases of this state. The primary disturbance mechanisms for this state include grazing by domestic livestock and infrequent fires. Grazing, coupled with weather events, dictate the dynamics that occur within this state. Fire could still play an important role, but is typically suppressed or applied in a manner which does not mimic the historical disturbance regime (frequency and timing). The tall warm and mid stature cool-season native grasses can decline and an increase in introduced sod grasses will occur.

Community 2.1
Bluestem/Needlegrass/Prairie sandreed

This community phase most closely resembles the Reference State in appearance and ecological functions (e.g., hydrologic, biotic and soil/site stability). The warm- and cool-season co-dominated community is maintained with grazing systems that allow for adequate recovery periods following grazing events, and potentially the combination of grazing and prescribed burning which closely mimics the natural disturbance regime. This community phase closely resembles the Reference State community phase 1.1 (see narrative for 1.1 Bluestem/Needlegrass/Indiangrass). The basic difference between this community phase and 1.1 of the Reference State is the presence of minor amounts of introduced cool-season grasses and forbs. This is likely a naturally nitrogen deficient plant community, but perhaps less so than the Reference State. A change in the nutrient cycle on this ecological site possibly due to the introduction of non-native leguminous forb species may be a causative factor leading to the eventual dominance of cool-season introduced grasses in the Invaded State (State 3.0)

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2365	3049	3654
Shrub/Vine	163	269	415
Forb	163	269	415
Total	**2691**	**3587**	**4484**

Figure 7. Plant community growth curve (percent production by month). ND5603, Red River Valley of the North, warm-season/cool-season co-dominant.. Cool-season, warm-season co-dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	6	21	40	20	6	4	1	0	0

Community 2.2
PrairieSandreed/Blue Grama/Kentucky Bluegrass/Forbs

Grazing pressure reduces the mid/tall, less grazing tolerant species, while the shorter more grazing tolerant species increase. Litter amounts are reduced, and energy capture shifts to slightly earlier in the growing season due to a decline in the later maturing native grass component and an increase in the earlier maturing grass-likes and non-native grasses. Kentucky bluegrass increases and may approach 30 percent of this community. Vegetation consists of about 80 to 90 percent grass and grass-like species, 5 to 15 percent forbs, and 2 to 5 percent shrubs. Significant grass species include Kentucky bluegrass, needleandthread, and prairie sandreed. The common forbs include western ragweed, scouring rush, and goldenrod. The common shrub would be western snowberry. This community phase is often dispersed throughout the pasture, in an overgrazed/undergrazed pattern, typically referred to as patch grazing. Some areas (overgrazed) will exhibit the impacts of heavy use, while other areas (undergrazed) will have a build-up of litter and a high amount of plant decadence. This is a typical pattern found in properly stocked pastures grazed season-long. In the undergrazed patches, litter buildup reduces plant vigor and density, and native seedling recruitment declines. Due to a lack of tiller stimulation and sunlight, native bunchgrasses typically develop dead centers and native rhizomatous grasses are limited to small colonies. In the overgrazed patches, plant vigor is reduced and the competitive advantage goes towards the grazing tolerant species such as Kentucky bluegrass. This community phase is approaching the threshold which would readily lead to the Invaded State. If management is significantly altered, this community phase can still be reverted back to the Bluestem/Needlegrass/Prairie sandreed community (Phase 2.1). Grazing management that allows for adequate recovery periods will tend to restore the ecological functions of this site. Fire can play a role in reducing the introduced cool-season species. The combination of grazing and fire may be the most effective in shifting this community phase towards a community resembling the Reference State. Soil erosion is low.

Community 2.3
Bluestems/Kentucky Bluegrass/Snowberry

The removal of disturbances has allowed Kentucky bluegrass to increase to 20 to 30 percent of the annual production. Tall and mid statured warm and cool season native grasses such as Big Bluestem, Indiangrass, switchgrass, little bluestem, sideoats grama, porcupine grass and needleandthread constitute at least 40 percent of the annual production. Native forbs such as Maximilian sunflower, goldenrods, Heath aster, western yarrow, western ragweed, cudweed sagewort are present along with introduced forbs such as sweet clover and black medic. Shrubs species include western snowberry and prairie rose. Adjacent to right of ways smooth brome may move into the community due to the lack of disturbance. Annual production is similar to the reference plant community. Energy capture has shifted to more early spring to midsummer due to the invasion of cool-season sod formers. Bare ground is less than 1 percent and associated with rodent activity. Litter cover (extent) is similar to the reference plant community, however the depth has increased to greater than 5 inches and is not in contact with the soil surface. This community phase is approaching the threshold which could readily transition to the Invaded State. If management is significantly altered, this community phase can still be reverted back to the Bluestem/Needlegrass/Prairie Sandreed Plant Community Phase 2.1. Grazing management that allows for adequate recovery periods will tend to restore the ecological functions of this site. Fire can play a role in reducing the introduced cool-season species. The combination of properly applied grazing management and repeated prescribed fire may be the most effective method to move this community phase towards a community resembling the reference plant community. Prescribed fire will have to be applied several times for effective control.

Figure 8. Plant community growth curve (percent production by month). ND5603, Red River Valley of the North, warm-season/cool-season co-dominant.. Cool-season, warm-season co-dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	6	21	40	20	6	4	1	0	0

Pathway 2.1a
Community 2.1 to 2.2

This community pathway is triggered by a change in the natural disturbance regime, most often caused by either heavy, continuous season-long grazing or continuous seasonal grazing without adequate recovery periods (grazing at the same season of year for extended periods during the active growing season of the dominant native grasses). Along this pathway, the timing of energy capture shifts from early to mid summer to spring and early summer. The change in plant functional and structural groups and the composition and distribution of the vegetation causes a decrease in production and an increase in runoff with a corresponding decrease in infiltration. Nutrient cycling is

restricted as the rooting depth of the vegetation decreases with the change in functional and structural groups. Plant community diversity is reduced with a loss of some native forbs and grasses.

Pathway 2.1b
Community 2.1 to 2.3

The removal of all disturbances (grazing and fire) will initiate this pathway. The lack of disturbance results in an accumulation of plant litter which alters the micro climate at the soil surface and limits the amount of sunlight reaching the plant crowns. This shifts the competitive advantage to the shade tolerant introduced species such as Kentucky bluegrass.

Pathway 2.2a
Community 2.2 to 2.1

This community pathway is initiated by implementation of prescribed grazing management which includes adequate recovery periods following each grazing event, and stocking levels which match the available resources. If properly implemented, this will shift the competitive advantage from the introduced cool-season species to the native cool and warm-season grass species. The addition of prescribed burning may expedite this shift.

Conservation practices

Prescribed Burning
Prescribed Grazing

Pathway 2.2b
Community 2.2 to 2.3

Non-use and no fire. Lack of disturbances shifts the competitive advantage to the non-native species. Kentucky bluegrass increases. Smooth brome increases adjacent to roads or right of ways. The removal of all disturbances (grazing and fire) will initiate this pathway. The lack of disturbance results in an accumulation of plant litter which alters the micro climate at the soil surface and limits the amount of sunlight reaching the plant crowns. This shifts the competitive advantage to the shade tolerant introduced species such as Kentucky bluegrass. Shrubs such as snowberry also benefit from this change.

Pathway 2.3a
Community 2.3 to 2.1

This community pathway is initiated by implementation of prescribed grazing management which includes adequate recovery periods following each grazing event, stocking levels which match the available resources, and application of prescribed fire. If properly implemented, this will shift the competitive advantage from the introduced cool-season species to the tall and mid warm-season grass species.

Conservation practices

Prescribed Burning
Prescribed Grazing

Pathway 2.3b
Community 2.3 to 2.2

This community pathway is initiated by implementation of prescribed grazing management which includes adequate recovery periods following each grazing event, and stocking levels which match the available resources. If properly implemented, this will shift the competitive advantage from the introduced cool-season species to the native cool and warm-season grass species. The shrub component is not expected to shift to the level described in 2.2 without prescribed fire or mechanical treatment and will remain at 15 percent of the composition by weight.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

State 3
Invaded

This state is the result of invasion and dominance of Kentucky bluegrass and/or snowberry. Other non-native species in this state could be smooth bromegrass, Canada thistle and leafy spurge. This state is characterized by these species and an increasing thatch layer that effectively blocks introduction of other plants into the system. Once the state is well established, even drastic events such as high intensity fires driven by high fuel loads of litter and thatch will not result in more than a very short term reduction of these two species. These events may reduce the dominance of the introduced sodgrasses, but due to the large amount of rhizomes in the soil there is no opportunity for the native species to establish and dominate before the introduced sodgrasses recover and again dominate the system. This state also includes the Annual, Pioneer Perennial community phase which is highly variable depending on the disturbance which causes this transition (T3). Over time, the Annual, Pioneer Perennial community phase will likely become dominated by introduced cool-season grasses, and shift to the Kentucky Bluegrass/Forb community phase (3.2).

Community 3.1
Aspen/Poison Ivy/Kentucky Bluegrass

Western snowberry, poison ivy, and aspen can increase and become a major component in this community phase. The herbaceous understory is dominated by the shade tolerant cool-season sodgrasses including smooth brome and Kentucky bluegrass. Common forbs include goldenrod, American licorice, western ragweed, heath aster, and western yarrow. Remnants of native warm- and cool-season grasses are still present, but greatly reduced in extent, vigor and production. Infiltration is reduced and runoff is increased when compared to the Reference State but soil erosion remains low. Nutrient cycling is limited by the rooting depth of these species, the lack of leguminous forbs, and the alteration of the soil biotic community. Organic matter oxidizes in the air rather than being incorporated into the soil due to lack of animal impact and reduced soil biological activity. Energy capture into the system is restricted to a short window provided by the early season species and the high amount of dead standing plant material. This community phase is somewhat resistant to change. Once reached, time and external resources will be needed to see any immediate recovery. The combination of both prescribed grazing and prescribed fire is the most effective in moving this plant community towards State 2.

Figure 9. Plant community growth curve (percent production by month). ND5601, Red River Valley of the North, cool-season dominant.. Cool-season dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	8	24	45	10	3	5	2	0	0

Community 3.2
Kentucky Bluegrass/Forbs

This community phase is dominated by Kentucky bluegrass with lesser amounts of sedge. Common forbs would include goldenrod, western yarrow, aster, western ragweed and a variety of introduced forbs. The longer this community phase exists the more resistant and resilient it becomes. Natural or management disturbances that reduce the cover of Kentucky bluegrass are very short lived due to the abundance of rhizomes of Kentucky bluegrass in the soil and the lack of propagules of other species present. Production is limited to the sod forming species. Energy capture into this system is limited to one early growing species. Runoff increases and is the highest of any plant community phase on this ecological site. Nutrient cycling is severely limited to the rooting depth of the Kentucky bluegrass and production is limited. Noxious weeds are likely to be present.

Community 3.3
Annual/Pioneer Perennial

The Annual, Pioneer Perennial community phase is highly variable depending on the level and duration of disturbance related to the T3 transitional pathway. In this MLRA, the most probable origin of this phase is secondary succession following cropland abandonment. This plant community will initially include a variety of annual forbs and grasses. Over time, the introduced cool-season perennial grasses will begin to establish on this site.

Pathway 3.2a
Community 3.2 to 3.1

The removal of all disturbances (grazing and fire) will initiate this pathway. The lack of disturbance results in an accumulation of plant litter which alters the micro climate at the soil surface and limits the amount of sunlight reaching the plant crowns. This shifts the competitive advantage to the shade tolerant introduced species such as Kentucky bluegrass, snowberry and other shrubs.

Pathway 3.3a
Community 3.3 to 3.2

With grazing and time, the grazing tolerant Kentucky bluegrass will continue to increase leading to community phase 3.2. In the absence of grazing, this pathway will lead to a community phase resembling 3.1.

Transition T1
State 1 to 2

Transition from Reference State (State 1) to Native/Invaded State (State 2) This was the transition from the native warm-season grass dominated reference state to a state that has been invaded by introduced species. When propagules of non-native species such as Kentucky bluegrass are present, this transition occurs as natural and/or management actions favored a decline in the composition of warm-season rhizomatous grasses and an increase in cool-season sodgrasses. This transition was compounded by a change in the historic grazing and fire regime where native herbivores would follow periodic fires with grazing. This historic grazing/fire sequence has largely been replaced by season-long grazing. Complete rest from grazing and suppression of fire can also hasten this transition. The threshold between states was crossed when Kentucky bluegrass, smooth bromegrass, and other

introduced species became established on the site. These species occupy functional/structural groups that were not present in the Reference State.

Transition T3
State 1 to 3

Transition from Any Plant Community to Invaded State (State 3), Annual/Pioneer Perennial Community Phase This transition occurs with cessation of cropping practices being applied to any plant community phase on this ecological site.

Transition T3
State 2 to 3

Transition from Any Plant Community to Invaded State (State 3), Annual/Pioneer Perennial Community Phase This transition occurs with cessation of cropping practices being applied to any plant community phase on this ecological site.

Transition T2a
State 2 to 3

Transition from Native/Invaded State (State 2) to Aspen/Poison Ivy/Kentucky Bluegrass (Plant Community Phase 3.1) Complete rest from grazing and elimination of fire are the two major contributors to this transition, especially when smooth brome is present. The opportunity for high intensity spring burns is severely reduced by early green up, and increased moisture and humidity at the soil surface. 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 introduced grass species dominance. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30% of the plant community and native grasses represent less than 40% of the plant community composition.

Transition T2b
State 2 to 3

Transition from Native/Invaded State (State 2) to Kentucky Bluegrass/Forbs (Plant Community Phase 3.2) Heavy continuous season-long grazing is the primary driver of this transition. The very grazing tolerant species have the competitive advantage during this transition. The opportunity for high intensity spring burns (which can serve to reduce the introduced cool-season species) is severely reduced by early green up and the lack of fuel. The nutrient cycle is impaired due to a shift from perennial native legumes to introduced legumes and the lack of available carbon for soil biota due to accumulation in the surface layer root mat. These two factors result in reduced soil biological activity. 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 introduced grass species dominance. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30% of the plant community and native grasses represent less than 40% of the plant community composition.

Restoration pathway R1
State 3 to 2

This restoration pathway may be initiated with the combination of prescribed burning followed by high levels of prescribed grazing management. The success of this restoration pathway depends on the presence of a remnant population of native grasses. This remnant population may not be readily apparent without close inspection. The application of prescribed burning may be needed at relatively short intervals in the early phases of this restoration process. However, the initial application of prescribed fire can have detrimental effects on remnant native bunchgrass crowns. Damage may be reduced by adjusting prescription parameters. Some previous efforts have

shown promise with early season prescribed burning; however, fall burning may also be effective under certain circumstances. Both prescribed grazing and prescribed burning are necessary to successfully initiate this restoration pathway. It may be possible using selected plant materials and agronomic practices to approach something very near the functioning of the Native/Invaded State (State 2). Application of herbicides and the use of mechanical treatments and seeding methods using adapted varieties of the dominant native grasses are possible and can be successful. After establishment of the native grasses, management objectives must include the maintenance of those species, the associated reference state functions and continued treatment of the introduced sodgrasses, and noxious weeds.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing
Herbaceous Weed Control

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			538–897	
	prairie sandreed	CALO	*Calamovilfa longifolia*	179–538	–
	big bluestem	ANGE	*Andropogon gerardii*	179–538	–
	switchgrass	PAVI2	*Panicum virgatum*	72–359	–
	Indiangrass	SONU2	*Sorghastrum nutans*	72–359	–
	sand bluestem	ANHA	*Andropogon hallii*	0–179	–
	prairie cordgrass	SPPE	*Spartina pectinata*	0–72	–
2	**Cool-Season Bunchgrasses**			179–538	
	porcupinegrass	HESP11	*Hesperostipa spartea*	179–538	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	36–179	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–108	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–108	–
3	**Mid Warm-Season Grasses**			179–538	
	little bluestem	SCSC	*Schizachyrium scoparium*	179–538	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	72–359	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–179	–
4	**Mid Cool-Season Grasses**			72–179	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–179	–
5	**Short Warm-Season Grasses**			36–179	
	blue grama	BOGR2	*Bouteloua gracilis*	36–179	–
6	**Other Native Grasses**			36–179	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	36–179	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	36–108	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–72	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–72	–

7	**Grass-likes**			72–359	
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	36–287	–
	Pennsylvania sedge	CAPE6	*Carex pensylvanica*	36–287	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–108	–
Forb					
8	**Forbs**			179–359	
	white sagebrush	ARLU	*Artemisia ludoviciana*	36–108	–
	Forb, native	2FN	*Forb, native*	36–108	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	36–72	–
	purple prairie clover	DAPU5	*Dalea purpurea*	36–72	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	36–72	–
	flat-top goldentop	EUGR5	*Euthamia graminifolia*	36–72	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	0–72	–
	stiff goldenrod	OLRI	*Oligoneuron rigidum*	36–72	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	36–72	–
	white heath aster	SYER	*Symphyotrichum ericoides*	36–72	–
	longbract spiderwort	TRBR	*Tradescantia bracteata*	36–72	–
	blazing star	LIATR	*Liatris*	0–36	–
	narrowleaf stoneseed	LIIN2	*Lithospermum incisum*	0–36	–
	lobelia	LOBEL	*Lobelia*	0–36	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–36	–
	silky prairie clover	DAVI	*Dalea villosa*	0–36	–
	field sagewort	ARCA12	*Artemisia campestris*	0–36	–
	prairie milkweed	ASSU3	*Asclepias sullivantii*	0–36	–
	Geyer's sandmat	CHGE2	*Chamaesyce geyeri*	0–36	–
	Canadian horseweed	COCAC3	*Conyza canadensis var. canadensis*	0–36	–
Shrub/Vine					
9	**Shrubs**			179–359	
	prairie willow	SAHU2	*Salix humilis*	0–143	–
	white meadowsweet	SPAL2	*Spiraea alba*	36–108	–
	prairie rose	ROAR3	*Rosa arkansana*	36–108	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–108	–
	leadplant	AMCA6	*Amorpha canescens*	36–108	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	36–72	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–36	–

Table 8. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			538–897	
	prairie sandreed	CALO	*Calamovilfa longifolia*	179–538	–
	big bluestem	ANGE	*Andropogon gerardii*	179–538	–

	switchgrass	PAVI2	*Panicum virgatum*	72–359	–
	Indiangrass	SONU2	*Sorghastrum nutans*	72–359	–
	sand bluestem	ANHA	*Andropogon hallii*	0–179	–
	prairie cordgrass	SPPE	*Spartina pectinata*	0–72	–
2	**Cool-Season Bunchgrasses**			179–538	
	porcupinegrass	HESP11	*Hesperostipa spartea*	179–538	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	36–179	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–108	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–108	–
3	**Mid Warm-Season Grasses**			179–538	
	little bluestem	SCSC	*Schizachyrium scoparium*	179–538	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	72–359	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–179	–
4	**Mid Cool-Season Grasses**			72–179	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–179	–
5	**Short Warm-Season Grasses**			36–179	
	blue grama	BOGR2	*Bouteloua gracilis*	36–179	–
6	**Other Native Grasses**			36–179	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	36–179	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	36–108	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–72	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–72	–
7	**Grass-likes**			72–359	
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	36–287	–
	Pennsylvania sedge	CAPE6	*Carex pensylvanica*	36–287	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–108	–
8	**Non-Native Grasses**			36–108	
	Kentucky bluegrass	POPR	*Poa pratensis*	36–72	–
	Grass, introduced	2GI	*Grass, introduced*	0–36	–
	quackgrass	ELRE4	*Elymus repens*	0–36	–
Forb					
9	**Forbs**			179–359	
	white sagebrush	ARLU	*Artemisia ludoviciana*	36–108	–
	Forb, native	2FN	*Forb, native*	36–108	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	36–72	–
	purple prairie clover	DAPU5	*Dalea purpurea*	36–72	–
	stiff goldenrod	OLRI	*Oligoneuron rigidum*	36–72	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	36–72	–
	white heath aster	SYER	*Symphyotrichum ericoides*	36–72	–
	longbract spiderwort	TRBR	*Tradescantia bracteata*	36–72	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	36–72	–
	flat-top goldentop	EUGR5	*Euthamia graminifolia*	36–72	–

	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	0–72	–
	blazing star	LIATR	*Liatris*	0–36	–
	narrowleaf stoneseed	LIIN2	*Lithospermum incisum*	0–36	–
	lobelia	LOBEL	*Lobelia*	0–36	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–36	–
	silky prairie clover	DAVI	*Dalea villosa*	0–36	–
	field sagewort	ARCA12	*Artemisia campestris*	0–36	–
	prairie milkweed	ASSU3	*Asclepias sullivantii*	0–36	–
	Geyer's sandmat	CHGE2	*Chamaesyce geyeri*	0–36	–
	Canadian horseweed	COCAC3	*Conyza canadensis var. canadensis*	0–36	–
10	**Non-Native Forbs**			36–108	
	Forb, introduced	2FI	*Forb, introduced*	0–36	–
	leafy spurge	EUES	*Euphorbia esula*	0–36	–
	sweetclover	MELIL	*Melilotus*	0–36	–
	black medick	MELU	*Medicago lupulina*	0–36	–
Shrub/Vine					
11	**Shrubs**			179–359	
	prairie willow	SAHU2	*Salix humilis*	0–143	–
	white meadowsweet	SPAL2	*Spiraea alba*	36–108	–
	prairie rose	ROAR3	*Rosa arkansana*	36–108	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–108	–
	leadplant	AMCA6	*Amorpha canescens*	36–108	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	36–72	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–36	–

Animal community

Animal Community – Grazing Interpretations
This site is adapted to managed grazing by domestic livestock provided caution is exercised when soils are saturated. The predominance of herbaceous plants across most plant community phases best lends these sites to grazing by cattle but other domestic grazers with differing diet preferences may also be a consideration depending upon management objectives. Often, the current plant community does not entirely match any particular plant community (as described in the ecological site description). Because of this, a resource inventory is necessary to document plant composition and production. Proper interpretation of this inventory data will permit the establishment of a safe, initial stocking rate for the type and class of animals and level of grazing management. More accurate stocking rate estimates should eventually be calculated using actual stocking rate information and monitoring data.

Hydrological functions

-- Under Development --

Recreational uses

-- Under Development --

Wood products

-- Under Development --

Other products

-- Under Development --

Other information

-- Under Development --

Inventory data references

Information presented here has been derived from NRCS and other federal/state agency clipping and inventory data. Also, field knowledge of range-trained personnel was used. All descriptions were peer reviewed and/or field-tested by various private, state and federal agency specialists. Those involved in developing this site description include: Stan Boltz, NRCS State Rangeland Management Specialist; Bernadette Braun, USFS Rangeland Management Specialist; Stacey Swenson, USFS Rangeland Management Specialist; Jeff Printz, NRCS State Rangeland Management Specialist; Dr. Kevin Sedivec, Extension Rangeland Management Specialist; Dr. Shawn Dekeyser, North Dakota State University; Rob Self, The Nature Conservancy; Lee Voigt, NRCS Area Rangeland Management Specialist; Dr. Mark Gonzales, USFS Hydrologist; David Dewald, NRCS State Biologist; Keith Anderson, NRCS Soil Scientist, Fred Aziz; NRCS Area Resource Soil Scientist; and Steve Sieler, NRCS Soil Scientist.

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Contributors

Jeff Printz

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)	Bernadette Braun, Lee Voigt, Jeff Printz
Contact for lead author	Jeff.printz@nd.usda.gov 701-530-2080
Date	02/07/2012
Approved by	Jeff Printz
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None.

2. **Presence of water flow patterns:** None.

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

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 5 to 10%. Small, disconnected patches 3 inches or less in size.

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

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

7. **Amount of litter movement (describe size and distance expected to travel):** None. Plant litter remains in place.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Average soil aggregate stability is 5 or greater.

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

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

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None.

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Tall, warm-season rhizomatous grasses >

    Sub-dominant: Mid, cool-season bunchgrasses = mid, warm-season grasses >

    Other: Forbs = shrubs = grass-likes > mid and short cool-season grasses = short, warm-season grass

    Additional: Due to differing root structure and distribution, Kentucky bluegrass and smooth bromegrass do not fit into reference plant community F/S groups.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** None.

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14. **Average percent litter cover (%) and depth (in):** Plant litter is in contact with soil surface.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Ranges from 2400 to 4000 lbs/ac air dry depending upon growing conditions with a representative value (RV) of 3200 lbs./acre air dry.

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

for the ecological site: State and Local noxious weeds. Kentucky bluegrass, smooth bromegrass, Russian olive.

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