USDA Natural Resources Conservation Service

# Ecological site R054XY023ND
# Loamy Overflow

Accessed: 02/08/2025

## General information

**Provisional**. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

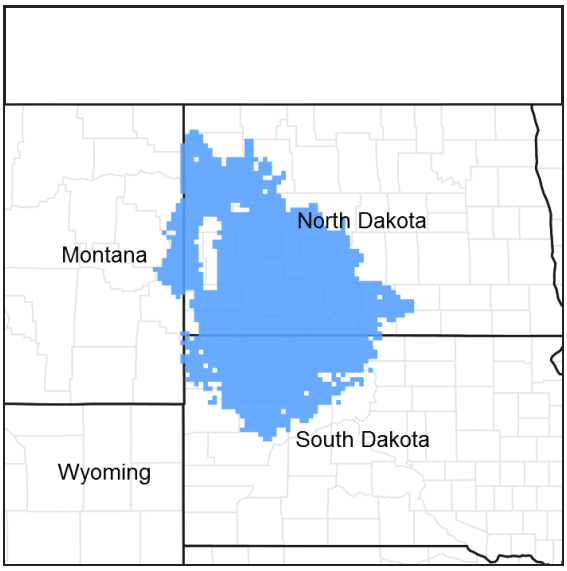



**Figure 1. Mapped extent**

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

## MLRA notes

Major Land Resource Area (MLRA): 054X–Rolling Soft Shale Plain

Revision Note- Entering the revised version 5/18/2010 -Megan Baxter

## Classification relationships

Level IV Ecoregions of the Conterminous United States: 43a – Missouri Plateau.

## Associated sites

| | |
|---|---|
| R054XY020ND | **Clayey** |
| R054XY026ND | **Sandy** |
| R054XY031ND | **Loamy** |
| R054XY032ND | **Subirrigated** |
| R054XY037ND | **Wet Meadow** |

## Similar sites

| | |
|---|---|
| R054XY041ND | **Loamy Terrace**<br>[Well drained soils on a river or stream terrace in a position that will flood occasionally (once in ten years) with no apparent water table. Down slope from loamy, sandy, clayey, and sands, and upslope form subirrigated ecological sites. Indicator species are western wheatgrass evenly mixed with green needlegrass, American vetch, and western snowberry or silver sagebrush, and with possible trees. This site has far less big bluestem, more western wheatgrass and green needlegrass, less frequent flooding events, less production.] |
| R054XY032ND | **Subirrigated**<br>[Some what poorly drained soils with no evidence of lime or salts. Water table found at a depth of1.5 to 4' from the soil surface at some point during the growing season. Found upslope from wet meadow sites and downslope of overflow sites; can be in micro low or high positions within the listed associated sites. Indicator species are big bluestem intermixed with switchgrass and American licorice with shrubs like western snowberry. The site has more switchgrass, prairie cordgrass, less green needlegrass; higher production.] |
| R054XY042ND | **Sandy Terrace**<br>[Well drained soils on a river or stream terrace in a position that will flood occasionally (once in ten years) with no apparent water table. Indicator species are prairie sandreed evenly mixed with sand bluestem, some Canada wildrye, penstemon, and leadplant and/or western snowberry, and with possible trees. This site has prairie sandreed and sand bluestem, far less big bluestem, less frequent flooding events, less production.] |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | Not specified |
| Shrub | Not specified |
| Herbaceous | (1) *Andropogon gerardii*<br>(2) *Nassella viridula* |

## Physiographic features

This site occurs on frequently flooded intermittent stream and flood plains of stream.

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Swale<br>(2) Flood plain |
| Flooding duration | Extremely brief (0.1 to 4 hours) to brief (2 to 7 days) |
| Flooding frequency | Frequent to very frequent |
| Ponding frequency | None |
| Elevation | 1,600–3,600 ft |
| Slope | 1–9% |
| Water table depth | 48–72 in |
| Aspect | Aspect is not a significant factor |

## Climatic features

MLRA 54 is considered to have a continental climate – cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are characteristic. The climate is the result of this MLRA's location in the geographic center of North America. There are few natural barriers on the northern Great Plains. The air masses move unobstructed across the plains and account for rapid changes in temperature.

Annual precipitation ranges from 14 to 18 inches per year. The normal average annual temperature is about 42° F. January is the coldest month with average temperatures ranging from about 13° F (Beach, ND) to about 16° F (Bison, SD). July is the warmest month with temperatures averaging from about 69° F (Beach, ND) to about 72° F (Timber Lake, SD). The range of normal average monthly temperatures between the coldest and warmest months

is about 57° F. This large annual range attests to the continental nature of this MLRA's climate. Hourly winds are estimated to average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of native cool-season plants begins in late March and continues to early to mid July. Native warm-season plants begin growth in mid May and continue to the end of August. Green up of cool-season plants can occur in September and October when adequate soil moisture is present.

**Table 3. Representative climatic features**

| | |
|---|---|
| Frost-free period (average) | 136 days |
| Freeze-free period (average) | 157 days |
| Precipitation total (average) | 18 in |

## Influencing water features

C6
Rosgen System)

## Soil features

The common features of soils in this site are the silt loam to fine sandy loam textured subsoil and slopes of 1 to 6 percent. The soils in this site are moderately well to well drained and formed in alluvium. The silt loam to fine sandy loam surface layer is 5 to 20 inches thick. The soils have a moderately slow to moderately rapid infiltration rate. This site should show slight to no evidence of rills, wind scoured areas or pedestalled plants. Water flow paths are broken, irregular in appearance or discontinuous with numerous debris dams or vegetative barriers. The soil surface is stable and intact.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases where vegetative cover is not adequate. 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 sites:
North Dakota http://www.nd.nrcs.usda.gov/
South Dakota http://www.sd.nrcs.usda.gov/
Montana http://www.mt.nrcs.usda.gov/

**Table 4. Representative soil features**

| | |
|---|---|
| Surface texture | (1) Silt loam<br>(2) Loam<br>(3) Fine sandy loam |
| Family particle size | (1) Loamy |
| Drainage class | Moderately well drained |
| Permeability class | Moderately slow to rapid |
| Soil depth | 72 in |
| Surface fragment cover <=3" | 0% |
| Surface fragment cover >3" | 0% |
| Available water capacity (0-40in) | 4–7 in |
| Calcium carbonate equivalent (0-40in) | 0–15% |

| | |
|---|---|
| Electrical conductivity (0-40in) | 0–4 mmhos/cm |
| Sodium adsorption ratio (0-40in) | 0–5 |
| Soil reaction (1:1 water) (0-40in) | 6.1–8.4 |
| Subsurface fragment volume <=3" (Depth not specified) | 0–10% |
| 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 herbivores and occasional fire. Changes will occur in the plant communities due to climatic conditions and/or management actions. Due to the nature of the soils, the site is considered very stable. Under continued adverse impacts, a slow decline in vegetative vigor and composition will occur. Under favorable vegetative management treatments the site can quickly return to the Reference Plant Community.

The plant community upon which interpretations are primarily based is the Reference Plant Community. The Reference Plant Community 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. Subclimax plant communities, states, transitional pathways, and thresholds have been determined through similar studies and experience.

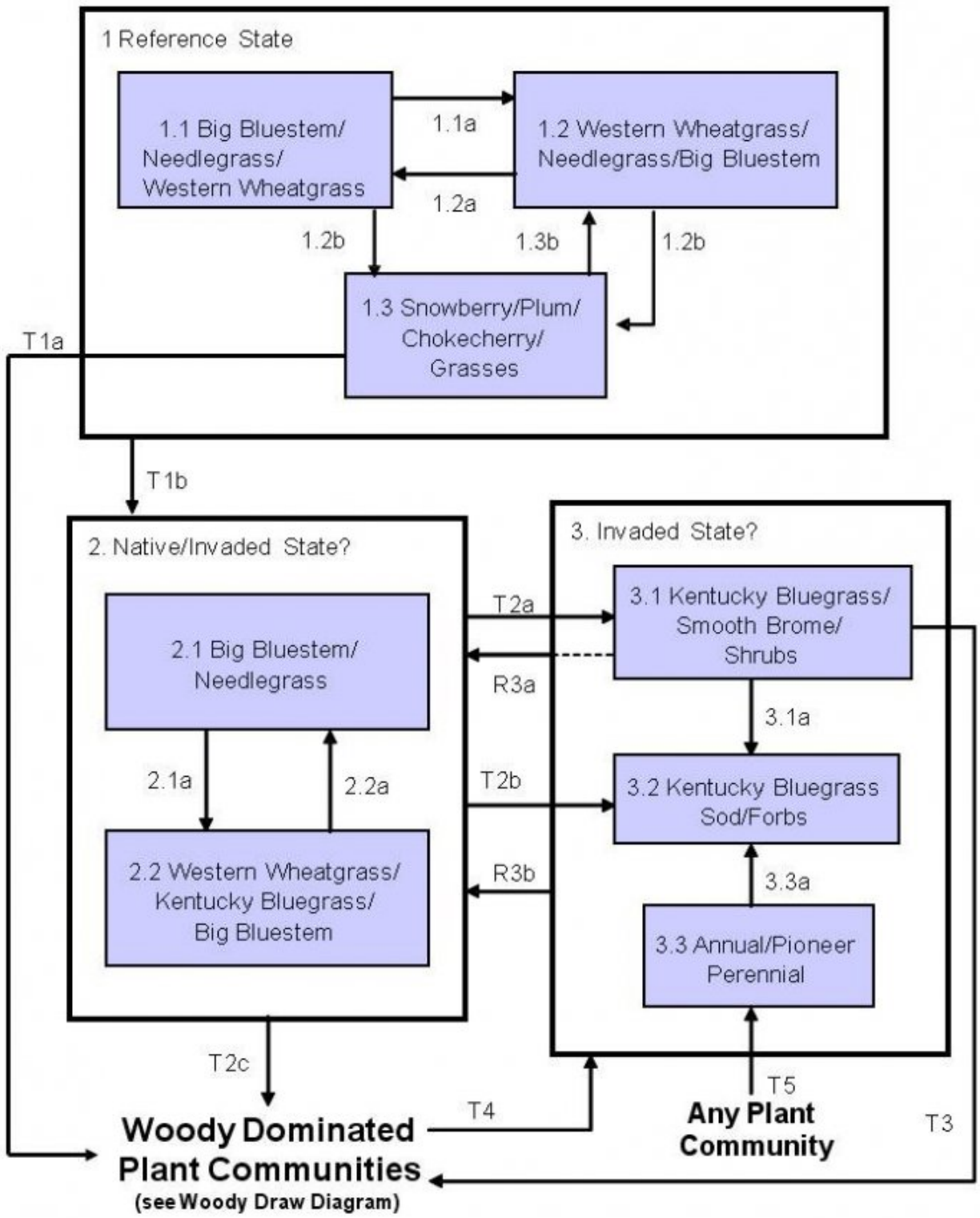
Continuous grazing without adequate recovery periods following each grazing occurrence over several years causes this site to depart from the Reference Plant Community. Species such as western wheatgrass and blue grama will initially increase. Big bluestem, green needlegrass, and sideoats grama will decrease in frequency and production. In time, heavy continuous grazing will likely cause blue grama to dominate the site and then this plant community is relatively stable and the competitive advantage prevents other species from establishing. This plant community is less productive than the Reference Plant Community. Runoff increases and infiltration will decrease. Soil erosion will be minimal.

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 Kentucky bluegrass and/or smooth bromegrass. In time, shrubs such as western snowberry and chokecherry will likely increase and then dominate the site.

Due to a general invasion of exotic species (such as Kentucky bluegrass and smooth bromegrass) across the MLRA within this site, returning to the 1.1 Wheatgrass/Needlegrass Plant Community Phase may not be possible. Today, the 2.1 Wheatgrass/Needlegrass Plant Community Phase 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




**2.1a, T2b, 3.1A –** Heavy continuous grazing; **T1a –** reduction in fire frequency; **T2a, T2c –** Non-use, no fire; **R3a –** Prescribed burning followed by prescribed grazing; **2.2a –** Prescribed grazing with adequate recovery opportunity; **R3b –** Range seeding followed by prescribed grazing; **3.2a -** Time with or without grazing; **T1b –** Introduction of non-native species; **T3 –** non-use, no fire; **T4 -** Catastrophic fire or mechanical removal; **T5 –** Cropped go-back

**State 1**
**Reference**

This state description represents the natural range of variability that dominated the dynamics of this ecological site.

Historically, this state ranged from a tall, warm season grass dominated site to one dominated by deciduous saplings and shrubs depending upon disturbance regime. The primary disturbance mechanisms for this site in the reference condition included frequent fire and grazing by large herding ungulates. Timing of fires and grazing coupled with weather events dictated the dynamics that occurred within the natural range of variability. Dominance during the herbaceous phases of this state shifted between warm season and cool season grasses. Although slight shifts may occurred in timing of energy capture, hydrologic function and nutrient cycling between plant community phases within the Reference State, overall the ecological processes were functioning at near optimum levels. High basal density and deep root systems resulted in low runoff rates and high infiltration rates. Small areas of trees and shrubs may have existed within this state due to irregularity of burn patterns. Small areas which escaped fire may have permitted trees/shrubs to become established. These areas may have served as a seed source for further expansion of the woody dominated plant community as the fire frequency was altered after settlement.

## Community 1.1
## Big Bluestem/Green Needlegrass

The plant community upon which interpretations are primarily based is the Big Bluestem/Needlegrass plant community phase. This community evolved with grazing by large herbivores and occasional prairie fire. The vegetation was about 85 to 95 percent grasses and grass-like plants, 5 to 10 percent forbs, 3 to 5 percent shrubs, and 1 to 2 percent trees. Major grasses included big bluestem, green needlegrass, porcupine grass, switchgrass and western wheatgrass. Other grasses that occurred within this community included Canada wildrye, and bearded wheatgrass. Major forbs and shrubs included American licorice, sunflower, goldenrod, and western snowberry. Scattered green ash, American elm and other native tree species may have occurred. This plant community was well adapted to the Northern Great Plains climatic conditions. Individual species varied greatly in production depending on growing conditions (timing and amount of precipitation and temperature). Community dynamics, nutrient cycle, water cycle and energy flow were properly functioning. Due the diversity of warm and cool season species within this plant community phase, energy capture was spread more evenly throughout the growing season compared to other plant community phases within this state. Plant litter was properly distributed, in contact with the soil surface and with very little movement off-site. Natural plant mortality was very low. The diversity in plant species allowed for high drought tolerance. Run-off from adjacent sites and moderate or high available water capacity provided a favorable soil-water-plant relationship.

**Table 5. Annual production by plant type**

| Plant Type | Low (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Grass/Grasslike | 2120 | 2784 | 3420 |
| Forb | 155 | 240 | 350 |
| Shrub/Vine | 95 | 128 | 165 |
| Tree | 30 | 48 | 65 |
| **Total** | **2400** | **3200** | **4000** |

**Figure 5. Plant community growth curve (percent production by month). ND5403, Missouri Slope, Native Grasslands, Warm-season dominant. Warm-season 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
## Western Wheatgrass/Needlegrasses/Big Bluestem

The pathway described in 1.1a reduced the tall warm season grass component in stature and extent while the grazing tolerant mid statured cool season grasses increased. The tall warm season grasses did not disappear from the plant community but were greatly reduced in vigor. The vegetation was about 65 to 93 percent grasses and grass-like plants, 5 to 15 percent forbs, 2 to 8 percent shrubs, and 1 to 2 percent trees. Major grasses included western wheatgrass, green needlegrass, porcupine grass, and blue grama. Big bluestem, switchgrass and Indiangrass were reduced to minor components. Forbs such as western yarrow, goldenrods, and western ragweed

would have increased in extent and proportions. Due to the increase in the cool season grass component of the plant community, energy capture shifted to the early portion of the growing season. Nutrient cycling and hydrological processes still functioned at expected levels.

**Figure 6. Plant community growth curve (percent production by month). ND5401, Missouri Slope, Native Grasslands, Cool-season Dominant. Cool-season, mid-grass 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 1.3
### Snowberry/Plum/Chokecherry/Grasses

Although this community phase appeared shrub dominated, grasses still constituted the majority of the production for this community phase. The vegetation was about 50 to 78 percent grasses and grass-like plants, 5 to 10 percent forbs, 15 to 30 percent shrubs, and 2 to 10 percent trees. Major grasses included western wheatgrass, green needlegrass, slender/bearded wheatgrass and Canada wildrye. Big bluestem and switchgrass were minor components. Prominent forbs would have included meadow anemone, goldenrods, and American licorice. Shrub species would have included snowberry, plum, chokecherry, hawthorn, leadplant, and rose. Within this plant community phase, scattered mature trees such as American elm, boxelder and green ash would have been present but majority of tree species would have been maintained at the seedling and sapling stage.

### Pathway 1.1a
### Community 1.1 to 1.2

This pathway occurred as a result of fire followed by intense grazing by native herbivores for a period of years. Successive years of below normal precipitation may also have contributed to this shift.

### Pathway 1.2a
### Community 1.2 to 1.1

A return to normal fire, grazing and weather regimes resulted in a plant community shift to the 1.1 Big Bluestem/Needlegrass/Western Wheatgrass Plant Community Phase

### Pathway 1.2b
### Community 1.2 to 1.3

Avoidance of fire due to micro site and weather. Several years of above normal precipitation and lack of fire would have shifted the competitive advantage to the shrub component resulting in a shift to community phase 1.3.

### Pathway 1.3b
### Community 1.3 to 1.2

A combination of intense disturbance events (fire, drought, grazing) occurring over multiple years reduced shrub vigor allowing a shift toward an herbaceous dominated plant community.

## State 2
## Native/Invaded Grass

This state is very similar to the reference state. The invasion of introduced cool season sodgrasses has altered the natural range of variability for this ecological site. This state is still dominated by mid and tall native warm and cool season grasses, 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. Timing and intensity of grazing events coupled with weather dictate the dynamics that occur within this state. The cool season native grass can decline and an increase in introduced sod grasses will occur. Many times, this state appears as a mosaic of community phases caused primarily by continuous season-long grazing.

### Community 2.1
### Big Bluestem/Needlegrass

This plant community phase closely resembles plant community phase 1.1 with the addition of trace amounts of non-native species (1 to 3 percent). The vegetation is about 85 to 95 percent grasses and grass-like plants, 5 to 10 percent forbs, 3 to 5 percent shrubs, and 1 to 2 percent trees. Major grasses include big bluestem, green needlegrass, porcupine grass, switchgrass and western wheatgrass. Other grasses within this community included Canada wildrye, and bearded wheatgrass. Major forbs and shrubs include American licorice, sunflower, goldenrod, and western snowberry. Scattered green ash, American elm and other native tree species may occur on the site. Ecological processes are functioning at levels near what would be expected for the Reference State although nutrient cycling may be somewhat altered due to changes in disturbance regimes (lack of fire, frequency and intensity of grazing events) and energy capture may be shifted slightly to more late spring, early summer.

**Figure 7. Plant community growth curve (percent production by month). ND5403, Missouri Slope, Native Grasslands, Warm-season dominant. Warm-season 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 2.2
### Western Wheatgrass/Kentucky Bluegrass/Big Bluestem

This plant community phase is characterized by a shift to mid cool season rhizomatous grasses with minor amounts of tall warm season and mid cool season bunchgrasses still present. The vegetation is about 75 to 90 percent grasses and grass-like plants, 5 to 10 percent forbs, 5 to 10 percent shrubs, and 0 to 3 percent trees. Dominant grasses would include western wheatgrass and Kentucky bluegrass with minor amounts of needlegrasses, big bluestem and switchgrass. Major forbs would include western ragweed, goldenrods and western yarrow. Chokecherry and snowberry would be the dominate shrubs. Scattered green ash and American elm trees may be present. Energy capture by this plant community phase has shifted from late spring and summer to early spring through early summer. Infiltration rates would be reduced due to the dominance of shallow rooted rhizomatous grasses and reduction in bunchgrasses. Soil erosion rates would still be low although if present, livestock trails may begin to show signs of slight erosion or small head cuts.

**Figure 8. Plant community growth curve (percent production by month). ND5401, Missouri Slope, Native Grasslands, Cool-season Dominant. Cool-season, mid-grass 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 |

### Pathway 2.1a
### Community 2.1 to 2.2

Heavy continuous season-long grazing will shift the competitive advantage from the tall warm season and mid cool season bunchgrasses to the more grazing tolerant mid and short statured cool season rhizomatous grasses.

### Pathway 2.2a
### Community 2.2 to 2.1

The implementation of prescribed grazing including adequate recovery periods between grazing events and season of use change will initiate this pathway by shifting the competitive advantage away from the mid and short cool season rhizomatous grasses to the tall warm season and cool season bunchgrasses.

## State 3
## Invaded

This state is the result of invasion and dominance by Kentucky bluegrass, smooth brome and/or pioneer

annual/perennial species depending upon the intensity and frequency of disturbance regime. 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 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 non-native sodgrasses rebound and again dominate the system.

### Community 3.1
### Kentucky Bluegrass/Smooth Bromegrass/Shrubs

This plant community phase is characterized by a co-dominance of Kentucky bluegrass and smooth bromegrass. Lack of further disturbance usually results in dominance by smooth bromegrass. Some remnant native grasses such as green needlegrass and big bluestem may still be present. Grasses constitute about 70 to 90 percent of the production with forbs contributing 5 to 10 percent, shrubs 5 to 15 percent and trees 1 to 3 percent. Dominant forbs include cudweed sagewort, goldenrod, and American licorice. Shrubs would include snowberry, plum, chokecherry and prairie rose. The opportunity for high intensity spring burns is reduced by early green up and increased moisture and humidity at the soil surface. Grazing pressure cannot induce 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 dominate species and lack of litter to soil surface contact.

**Figure 9. Plant community growth curve (percent production by month). ND5406, Missouri Slope, Introduced Cool-season Grasses. Introduced cool-season grasses.**

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 3 | 10 | 35 | 35 | 5 | 2 | 8 | 2 | 0 | 0 |

### Community 3.2
### Kentucky Bluegrass Sod/Forbs

This plant community phase is characterized by a dense Kentucky bluegrass sod. Kentucky bluegrass is the dominant grass species with minor amounts of other grasses such as western wheatgrass and ticklegrass as well as grass-likes still represented. Forb species would include curly-cup gumweed, western yarrow and stiff goldenrod. Shrubs are very limited but may include snowberry. The opportunity for spring burns is severely limited due to lack of fine fuel and early green up. Production is reduced due to lack of plant vigor. Infiltration is greatly reduced due to the dense Kentucky bluegrass sod. Energy capture is shifted to early through late spring.

**Figure 10. Plant community growth curve (percent production by month). ND5406, Missouri Slope, Introduced Cool-season Grasses. Introduced cool-season grasses.**

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 3 | 10 | 35 | 35 | 5 | 2 | 8 | 2 | 0 | 0 |

### 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 T5 transitional pathway. In this MLRA, the most probable origin of this phase is secondary succession following cropland abandonment but can also result from heavy livestock or wildlife concentration on small areas for prolonged periods. 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. The dominant vegetation includes pioneer annual grasses, forbs, invaders, and early successional biennial and perennial species. Grasses may include red threeawn, sixweeks fescue, smooth brome, crested wheatgrass, annual brome, needleandthread, prairie junegrass, western wheatgrass and little bluestem. The dominant forbs include curlycup gumweed, marestail, salsify, Kochia, field bindweed, thistles, western ragweed, pussytoes, prostrate verbena and other early successional species. Shrubs that may be present include prairie rose, fringed sagewort and broom snakeweed. Plant species from adjacent ecological sites may become minor components of this plant community. The community also is susceptible to invasion of other non-native species due to severe soil

disturbances and relatively high percent of bare ground. Many annual and perennial forbs, including non-native species, have invaded the site. Soil erosion is potentially high. Reduced surface cover, low plant density, low plant vigor, loss of root biomass, and soil compaction, all contribute to decreased water infiltration, increased runoff, and accelerated erosion rates. Significant economic inputs, management and time would be required to move this plant community toward a higher successional stage and a more productive plant community. Secondary succession is highly variable, depending upon availability and diversity of a viable seed bank of higher successional species within the existing plant community and neighboring plant communities. This plant community can be renovated to improve the production capability, but management changes would be needed to maintain the new plant community.

### Pathway 3.1a
### Community 3.1 to 3.2

Heavy continuous season-long grazing will result in a shift to the Kentucky Bluegrass/Forb plant community phase by favoring the very grazing tolerant Kentucky bluegrass and unpalatable forbs. Smooth bromegrass will be reduced to a minor component while the shrubs will be reduced in vigor.

### 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 with the primary difference being the lack of western snowberry and remnant native grass species.

## State 4
## Wooded

Historically, this state existed as small patches of trees and shrubs scattered across the site. For simplification purposes, the pre-European transition returning from the wooded state to the reference state is not shown on the state and transition diagrams. Repeated intense disturbances (e.g., fire, fire coupled with grazing) would have reverted these smaller patches of trees to the herbaceous dominated Reference State. Alterations to the historic fire and grazing disturbance regimes have resulted in these scattered tree/shrub patches forming almost continuous woody dominated plant communities across the site. This state is characterized by an overstory of tall trees, an understory of shrubs and, depending upon the amount of canopy cover, an herbaceous understory of sedges and/or Kentucky bluegrass or other introduced grasses.

### Community 4.1
### Green Ash/American Elm/Kentucky Bluegrass/Smooth Bromegrass

This plant community phase is characterized by a “park like appearance” with scattered mature green ash and American elm. Little to no tree regeneration occurs. Snowberry and scattered chokecherry are the primary shrubs. Invasive cool season sod forming grasses becomes the dominant herbaceous cover. The establishment of tree seedlings is further limited by the competitive nature of these grasses. If a seed source is located nearby, Russian olive may also become established within this community phase.

### Community 4.2
### Juniper/Green Ash

This plant community closely resembles phase 4.2 but has been invaded by Rocky Mountain Juniper. The development of this plant community is dependent upon a juniper seed source being adjacent or within close proximity to this site. As the juniper becomes established, it will eventually come to dominate the site, out competing the deciduous trees and shrubs for resources.

### Pathway 4.2a
### Community 4.1 to 4.2

Lack of fire and an introduction of Rocky Mountain Juniper seed from a nearby site will initiate this pathway.

### Transition T1b
### State 1 to 2

This is the transition from the native herbaceous or herbaceous/shrub dominated reference state to the herbaceous dominated native/invaded state. This transition occurs when propagules of non-native species such as Kentucky bluegrass and/or smooth bromegrass are present and become established on the site. This occurs as natural and/or management actions (altered grazing and/or fire regime) favor a decline in the composition of the warm season native species and an increase in cool season sodgrasses. Chronic season-long or heavy late season grazing facilitates this transition. Complete rest from grazing and no fire events can also lead to this transition. The threshold between states is crossed when the non-natives become established on the site.

### Transition T1a
### State 1 to 4

This is the transition from the native herbaceous or herbaceous/shrub dominated Reference State to a state that is dominated by mature trees and shrubs. Change in fire frequency allowed woody plant species to grow large enough to escape the next fire event. As trees increased in size, canopy cover increased which altered micro-climate and reduced fine fuel amounts resulting in reduced fire intensity and frequency. This would have been the primary pathway under the historic disturbance regime and would have resulted in a mosaic pattern of small wooded patches interspersed within herbaceous plant community phases.

### Transition T5
### State 2 to 3

This pathway is most commonly associated with the cessation of cropping without the benefit of range or pasture seeding resulting in a “go-back” situation. This may be compounded with excessive grazing which further inhibits the establishment of perennial grasses and forbs.

### Transition T2a
### State 2 to 3

This represents the transition from the more native dominated Native/Invaded State to a plant community phase dominated by non-native cool season rhizomatous grasses. Complete rest from grazing and elimination of fire are the two major contributors to this transition, especially when smooth brome is present. 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

This represents the transition from the more native dominated Native/Invaded State to a plant community phase dominated by a dense Kentucky bluegrass sod and grazing tolerant forbs. Heavy continuous season-long grazing is the major contributor to this transition. 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 T2c
### State 2 to 4

This represents the transition from the Native/Invaded State (State 2) to the Woody Dominated Plant Communities State (State 4) under the current disturbance regime. Lack of fire and grazing shifts the competitive advantage to the trees and shrubs. Rather than patches of trees and shrubs interspersed within herbaceous dominated plant communities as referenced in T1a transitional pathway results in an expansion of the patches into an almost continuous woody dominated site.

### Transition R3a

### 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 in community phase 3.1. 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. 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.

### Transition R3b
### State 3 to 2

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 chemical herbicides and the use of mechanical seeding methods using adapted varieties of the dominant native grasses are possible and can be successful. After establishment of the native plant species, management objectives must include the maintenance of those species, the associated reference state functions and continued treatment of the introduced sodgrasses.

### Transition T3
### State 3 to 4

This transition is initiated by the removal of disturbance. No fire, no grazing.

### Transition T4
### State 4 to 3

This transitional pathway involves a dramatic decrease in the amount and extent of the woody component of the plant community through either catastrophic fire and/or mechanical removal of the trees and shrubs. Potentially, this pathway could also be initiated or compounded with the introduction of various tree and/or shrub diseases or pests.

### Transition T6
### State 4 to 3

Catastrophic fire or mechanical removal of trees and shrubs would result in a shift back towards the Invaded State (State 3).

### Transition T6
### State 4 to 3

This transition occurs as a result of long term heavy season-long grazing or long term non-use. Heavy season-long grazing by livestock greatly lessens or eliminates tree regeneration and enhances a highly competitive herbaceous understory of Kentucky bluegrass which will further reduce tree regeneration. As the existing green ash and American elm trees mature and expire, the resulting plant community consists of a Kentucky bluegrass sod and scattered mature green ash trees. Long term non-disturbance will also result in the same shift. Tree regeneration is limited by the accumulation of a thick layer of plant litter as well as competition from the Kentucky bluegrass understory.

## Additional community tables

**Table 6. Community 1.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Lb/Acre) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Grass/Grasslike** | | | | | |
| 1 | **Tall Warm-Season** | | | 800–1120 | |
| | big bluestem | ANGE | *Andropogon gerardii* | 640–960 | – |
| | switchgrass | PAVI2 | *Panicum virgatum* | 160–320 | – |

| | | | | | |
|---|---|---|---|---|---|
| | Indiangrass | SONU2 | *Sorghastrum nutans* | 0–64 | – |
| 2 | **Wheatgrass** | | | 320–480 | |
| | western wheatgrass | PASM | *Pascopyrum smithii* | 320–480 | – |
| | slender wheatgrass | ELTRS | *Elymus trachycaulus ssp. subsecundus* | 32–64 | – |
| | slender wheatgrass | ELTRT | *Elymus trachycaulus ssp. trachycaulus* | 32–64 | – |
| 3 | **Needlegrass** | | | 480–640 | |
| | green needlegrass | NAVI4 | *Nassella viridula* | 320–640 | – |
| | porcupinegrass | HESP11 | *Hesperostipa spartea* | 64–160 | – |
| 4 | **Mid Warm-Season** | | | 96–160 | |
| | sideoats grama | BOCU | *Bouteloua curtipendula* | 96–160 | – |
| | little bluestem | SCSC | *Schizachyrium scoparium* | 0–64 | – |
| 5 | **Other Native Grasses** | | | 64–96 | |
| | Grass, perennial | 2GP | *Grass, perennial* | 32–64 | – |
| | blue grama | BOGR2 | *Bouteloua gracilis* | 32–64 | – |
| | Canada wildrye | ELCA4 | *Elymus canadensis* | 32–64 | – |
| | needle and thread | HECOC8 | *Hesperostipa comata ssp. comata* | 32–64 | – |
| | prairie dropseed | SPHE | *Sporobolus heterolepis* | 32–64 | – |
| 6 | **Grass-Likes** | | | 96–160 | |
| | Pennsylvania sedge | CAPE6 | *Carex pensylvanica* | 64–160 | – |
| | Grass-like (not a true grass) | 2GL | *Grass-like (not a true grass)* | 32–96 | – |
| | shortbeak sedge | CABR10 | *Carex brevior* | 32–64 | – |
| **Forb** | | | | | |
| 8 | **Forbs** | | | 160–320 | |
| | purple prairie clover | DAPU5 | *Dalea purpurea* | 32–64 | – |
| | goldenrod | SOLID | *Solidago* | 32–64 | – |
| | white heath aster | SYER | *Symphyotrichum ericoides* | 32–64 | – |
| | American vetch | VIAM | *Vicia americana* | 32–64 | – |
| | Forb, perennial | 2FP | *Forb, perennial* | 0–64 | – |
| | common yarrow | ACMI2 | *Achillea millefolium* | 32–64 | – |
| | American licorice | GLLE3 | *Glycyrrhiza lepidota* | 32–64 | – |
| | Maximilian sunflower | HEMA2 | *Helianthus maximiliani* | 32–64 | – |
| | silverleaf Indian breadroot | PEAR6 | *Pediomelum argophyllum* | 0–32 | – |
| | upright prairie coneflower | RACO3 | *Ratibida columnifera* | 0–32 | – |
| | Canadian anemone | ANCA8 | *Anemone canadensis* | 32 | – |
| | white sagebrush | ARLU | *Artemisia ludoviciana* | 32 | – |
| | Flodman's thistle | CIFL | *Cirsium flodmanii* | 0–32 | – |
| | meadow zizia | ZIAP | *Zizia aptera* | 0–32 | – |
| | northern bedstraw | GABO2 | *Galium boreale* | 0–32 | – |
| **Shrub/Vine** | | | | | |
| 9 | **Shrubs** | | | 96–160 | |
| | western snowberry | SYOC | *Symphoricarpos occidentalis* | 64–96 | – |
| | Saskatoon serviceberry | AMAL2 | *Amelanchier alnifolia* | 32–64 | |

| | | | | | |
|---|---|---|---|---|---|
| | Saskatoon serviceberry | AMAL2 | *Amelanchier alnifolia* | 32–64 | – |
| | leadplant | AMCA6 | *Amorpha canescens* | 0–64 | – |
| | hawthorn | CRATA | *Crataegus* | 32–64 | – |
| | American plum | PRAM | *Prunus americana* | 32–64 | – |
| | chokecherry | PRVI | *Prunus virginiana* | 32–64 | – |
| | golden currant | RIAU | *Ribes aureum* | 32–64 | – |
| | prairie rose | ROAR3 | *Rosa arkansana* | 32–64 | – |
| | western poison ivy | TORY | *Toxicodendron rydbergii* | 0–32 | – |
| | Subshrub (<.5m) | 2SUBS | *Subshrub (<.5m)* | 0–32 | – |
| **Tree** | | | | | |
| 10 | **Trees** | | | 32–64 | |
| | green ash | FRPE | *Fraxinus pennsylvanica* | 32–64 | – |
| | American elm | ULAM | *Ulmus americana* | 0–32 | – |
| | Tree | 2TREE | *Tree* | 0–32 | – |

**Table 7. Community 3.3 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Lb/Acre) | Foliar Cover (%) |
|---|---|---|---|---|---|

## Animal community

Animal Community – Grazing Interpretations
This site is well adapted to managed grazing by domestic livestock. The predominance of herbaceous plants across all 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

Water is the principal factor limiting herbage production on this site. The site is dominated by soils in hydrologic groups B and C, with localized areas in hydrologic group D. Infiltration and runoff potential for this site varies from moderate to high depending on soil hydrologic group and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. An exception would be where shortgrasses form a dense sod and dominate the site. Areas where ground cover is less than 50% 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 opportunities for upland game species. The wide variety of plants which bloom from spring until fall have an esthetic value that appeals to visitors.

## Wood products

No appreciable wood products are present on the 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 and other inventory data. Also, field knowledge of range-trained personnel was used. Information presented here has been derived from NRCS clipping and other inventory data. All descriptions were peer reviewed and/or field tested by various private, state and federal agency specialist.
Those involved in developing this site description include: Dennis Froemke, NRCS Range Management Specialist; Jeff Printz, NRCS State Range Management Specialist; L. Michael Stirling, NRCS Range Management Specialist; Stan Boltz, NRCS Range Management Specialist; Josh Saunders, NRCS Range Management Specialist; Darrell Vanderbusch, NRCS Resource Soil Scientist; Jody Forman, NRCS Grazing Land Management Specialist; David Dewald, NRCS State Biologist; and Brad Podoll, NRCS Biologist.
Data Source Number of Records Sample Period State County
SCS-RANGE-417 0
Ocular estimates 8 1986 – 2001 ND Dunn, Hettinger, Morton

## Other references

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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.

| | |
|---|---|
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| Approved by | Jeff Printz |
| Approval date | |
| Composition (Indicators 10 and 12) based on | Annual Production |

## Indicators

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

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

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3. **Number and height of erosional pedestals or terracettes:** Essentially non-existent.

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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 is less than 5%.

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5. **Number of gullies and erosion associated with gullies:** Active gullies should not be present. Existing gullies should be “healed” with a good vegetative cover.

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

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7. **Amount of litter movement (describe size and distance expected to travel):** Little to no litter movement. Plant litter remains in place and is not moved by erosional forces.

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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):** Plant cover and litter is at 95% or greater of soil surface and maintains soil surface integrity. Stability class anticipated to be 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:** High grass canopy and basal cover and small gaps between plants should reduce raindrop impact and slow overland flow, providing increased time for infiltration to occur. Healthy, deep rooted native grasses enhance infiltration and reduce runoff.

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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):** No compaction layer or soil surface crusting should be evident. Several thin stratified layers may be present at the soil surface due to erosional deposition.

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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, rhizomatous warm-season grasses > mid, cool-season bunch grasses >

    Sub-dominant: mid, cool-season rhizomatous grasses >

    Other: forbs > mid, warm-season bunch grasses > shrubs = grass-likes > trees.

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):** Very low.

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14. **Average percent litter cover (%) and depth ( in):** Litter cover 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):** Representative value = 3200 lbs/ac with a range of 2400 lbs/ac to 4000 lbs/ac (air dry weight) depending upon growing conditions

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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, smooth bromegrass, Kentucky bluegrass

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

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