USDA Natural Resources Conservation Service

Ecological site R112XY103KS
Loamy Upland

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General information

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

MLRA notes

Major Land Resource Area (MLRA): 112X–Cherokee Prairies

MLRA 112 (Cherokee Prairies) is in Kansas (48 percent), Oklahoma (29 percent), and Missouri (23 percent) makes up about 20,885 square miles (54,092 square kilometers).

This area is in the Osage Plains Section of the Central Lowland Province of the Interior Plains. It is a gently sloping to rolling dissected plains. Elevation ranges from 120 to 1,540 feet (30 to 470 meters). Even though the area is thoroughly dissected, local relief typically is only 3 to 10 feet (1 to 3 meters) and major valleys generally are less than 8 feet (25 meters) below the adjacent uplands.

The extent of the major hydrologic unit area is made up of major rivers such as the Neosho, Verdigris, Osage, and Marais des Cygnes. The Harry Truman reservoir lies in the western part of Lake of the Ozarks in Missouri and is on the Osage and Grand Rivers.

This area is dominantly underlain by Pennsylvanian and in some areas, Permian and Mississippian sandstone, shale, and limestone bedrock. The northern part of the area has a thin mantle of loess. The dominant soils within this region are Mollisols and Entisols. Alfisols occur in the eastern part of the MLRA. There are small areas of Vertisols throughout the MLRA. It also contains small areas of Vertisols. Soils in this region are developed in residuum, loess, colluvium, and alluvium. These soils were developed under big bluestem, little bluestem, Indiangrass, and switchgrass on the western part of this area. The eastern part of the area and the valleys in the western part support hardwoods, mainly northern red oak, white oak, and shagbark hickory with islands of tall prairie grasses being common. Major wildlife species of this area are deer, cottontail rabbit, fox squirrel, and bobwhite quail.

This MLRA is mostly rangeland, hayland, and pasture. More than two-fifths of the area supports pasture grasses and legumes. The western part of this area generally supports tall prairie grasses. Big bluestem, little bluestem, Indiangrass, and switchgrass are the main species. The cropland is used to produce winter wheat, soybeans, corn, grain sorghum, and other feed grains. The forested areas are mainly on steep valley sides and in low-lying areas on flood plains.

Classification relationships

U.S. Department of Agriculture
Major Land Resource Area (MLRA) 112 - Cherokee Prairies

US Forest Service Ecoregions (1994-1995):
Domain name: Humid Temperate Domain
Division name: Prairie Division
Province name: Prairie Parkland (Temperate) Province
Province code: 251

Terrestrial Natural Community Type in Missouri (Nelson, 2010): The reference state for this ecological site is most similar to a Dry-Mesic Sandstone/Shale Prairie, or a Dry-Mesic Limestone/Dolomite Prairie.

National Vegetation Classification System Vegetation Association (NatureServe, 2010):
The reference state for this ecological site is most similar to Schizachyrium scoparium - Sorghastrum nutans - Andropogon ternarius - Coreopsis grandiflora Sandstone - Shale Herbaceous Vegetation (CEGL002212).

Geographic relationship to the Missouri Ecological Classification System (Nigh and Schroeder, 2002): This ecological site is throughout the Scarped Osage Plains Subsection-, and in the Northern Land Type Associations of the Cherokee Plains Subsection.

NatureServe (2018):
Class: Shrub & Herb Vegetation
Subclass: Temperate & Boreal Grassland & Shrubland
Formation: Temperate Grassland & Shrubland
Division: Central North American Grassland & Shrubland
Macrogroup: Central Lowlands Tallgrass Prairie
Group: Central Tallgrass Prairie
Alliance: Central Dry & Dry-Mesic Tallgrass Prairie

Ecological site concept

This site is made up of somewhat poorly to well drained soils with a surface layer of silt loam, loam, and silty clay loam and a loamy or clayey subsoil. It is generally on a slope range of 1 to 15 percent. Soils are moderately deep to very deep, and are silt loam loess overlying residuum from shale, sandstone, or limestone. The reference plant community is prairie dominated by little and big bluestem, Indiangrass, sideoats grama, and a wide variety of prairie wildflowers.

Associated sites

R112XY101KS	**Claypan Upland** The Claypan Upland ecological site is upslope from the Loamy Upland ecological site. This site is made up of poorly to moderately well drained soils with a silt loam surface and an abrupt textural change to silty clay or clay at about 10 to 15 inches. It is generally on a slope range of 0 to 3 percent.
R112XY102KS	**Clayey Upland** The Clayey Upland ecological site is on similar landform positions to those of the Loamy Upland ecological site. This site is made up of poorly to moderately well drained soils with silt loam to silty clay surface layers, and clayey subsoils. It is generally on a slope range of 1 to 15 percent.
R112XY104KS	**Gravelly Upland** The Gravelly Upland Ecological Site is on similar landform positions to those of the Loamy Upland Ecological Site. This site is made up of moderately well to well drained soils with silty clay loam surface layers and clayey subsoils that often have moderate to high amounts of limestone or shale fragments. It is generally on a slope range of 2 to 15 percent.

Similar sites

R112XY120MO	**Loamy Upland Drainageway** The Loamy Upland Drainageway is similar to the Loamy Upland because of the highly organic loamy soils and dominant warm season grasses. However, the Loamy Upland Drainageway is located within a drainageway and has a parent material of alluvium.
R112XY125KS	**Loamy Floodplain** The Loamy Floodplain is similar to the Loamy Upland because of the highly organic loamy soils and dominant warm season grasses. However, the Loamy Floodplain is located within a floodplain and has a parent material of alluvium.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii* (2) *Schizachyrium scoparium*

Physiographic features

The Loamy Upland Ecological Site is on upland summits, shoulders, backslopes, and footslopes. Slope typically ranges from 1 to 15 percent on this site. The site generates runoff to adjacent, down-slope ecological sites. The site is not subject to flooding.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Shoulder (3) Backslope (4) Footslope
Landforms	(1) Plains (2) Hills > Hillslope (3) Upland
Runoff class	Medium to high
Flooding frequency	None
Ponding frequency	None
Elevation	140–425 m
Slope	1–15%
Water table depth	30–122 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 112 (Cherokee Prairies) has a continental climate marked by strong seasonality. In winter, dry-cold air masses periodically swing south from the northern plains and Canada. If they invade reasonably humid air, snowfall and rainfall result. In summer, moist, warm air masses swing north from the Gulf of Mexico and can produce abundant amounts of rain, either by fronts or by convectional processes. In some summers, high pressure stagnates over the region, creating extended droughty periods. Spring and fall are transitional seasons when abrupt changes in temperature and precipitation may occur due to successive, fast-moving fronts separating contrasting air masses. Seasonality in precipitation is very pronounced due to strong continental influences. June precipitation, for example, averages three to four times greater than January precipitation. During years when precipitation comes in a fairly normal manner, moisture is stored in the top layers of the soil during the winter and early spring, when evaporation and transpiration are low. During the summer months the loss of water by evaporation and transpiration is high, and if rainfall fails to occur at frequent intervals, drought will result. Drought directly influences ecological communities by limiting water supplies, especially at times of high temperatures and high evaporation rates.

Representative climatic features shown in Table 3 were derived from the climate stations selected for use within the MLRA.

Table 3. Representative climatic features

Frost-free period (characteristic range)	148-181 days
Freeze-free period (characteristic range)	186-202 days
Precipitation total (characteristic range)	1,067-1,143 mm

Frost-free period (actual range)	145-182 days
Freeze-free period (actual range)	185-204 days
Precipitation total (actual range)	1,041-1,168 mm
Frost-free period (average)	166 days
Freeze-free period (average)	194 days
Precipitation total (average)	1,118 mm

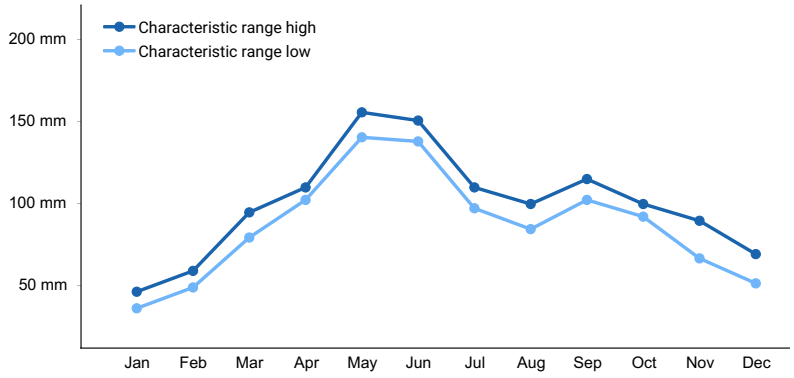


Figure 1. Monthly precipitation range

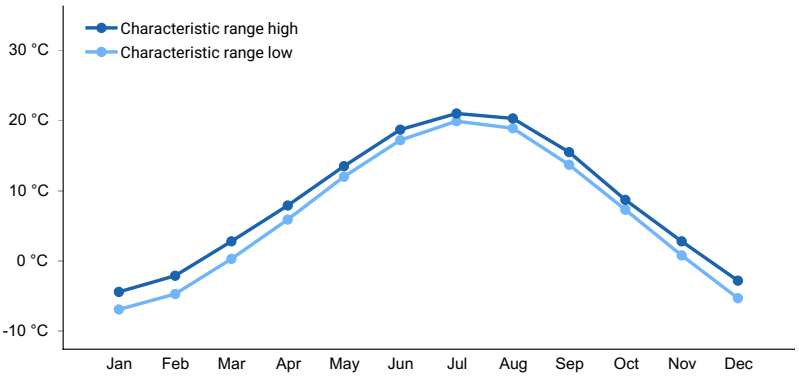


Figure 2. Monthly minimum temperature range

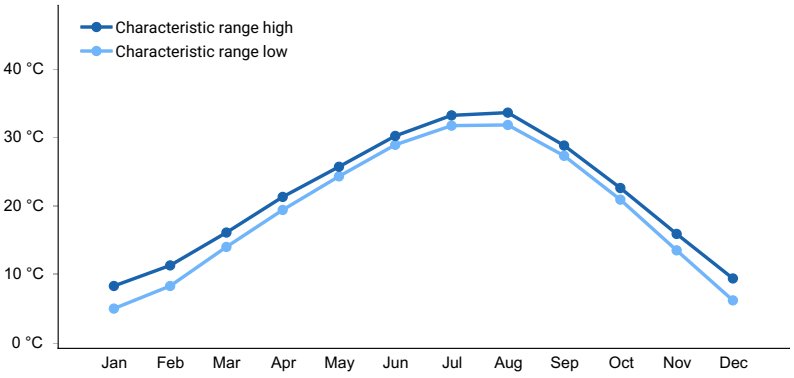


Figure 3. Monthly maximum temperature range

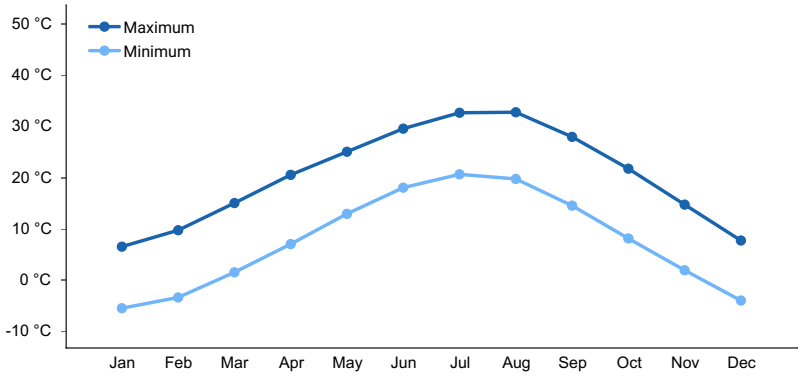


Figure 4. Monthly average minimum and maximum temperature

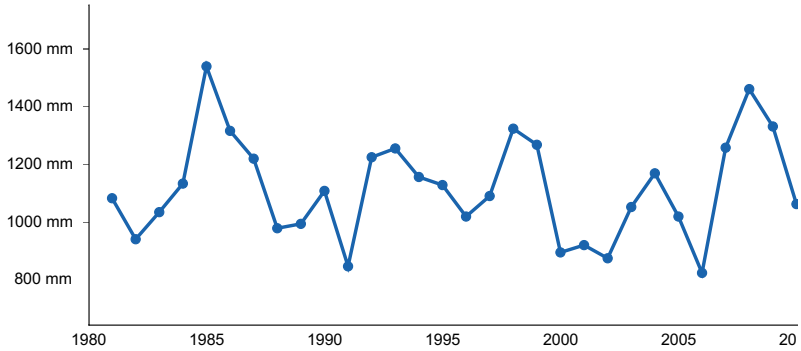


Figure 5. Annual precipitation pattern

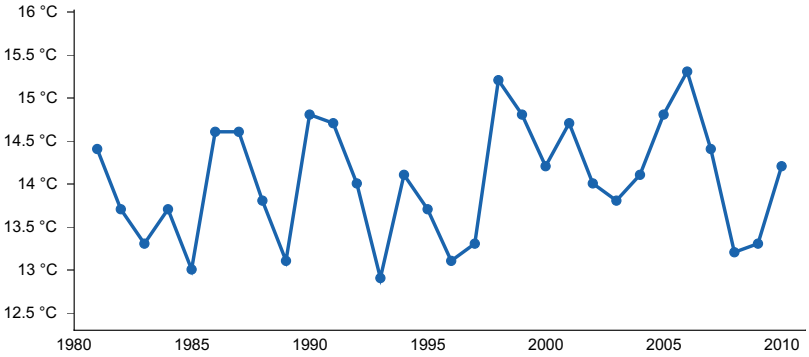


Figure 6. Annual average temperature pattern

Climate stations used

- (1) ELDORADO SPRINGS [USC00232511], El Dorado Springs, MO
- (2) CLAREMORE 2 ENE [USC00341828], Claremore, OK
- (3) NOWATA [USC00346485], Nowata, OK
- (4) GARNETT 1 E [USC00143008], Garnett, KS
- (5) MOUND CITY [USC00145528], Mound City, KS
- (6) INDEPENDENCE [USC00143954], Independence, KS

Influencing water features

This site does not have any water features that influence the vegetation or management of the site. This site is in upland positions and is generally a run-off site for precipitation.

Soil features

Soils that make up the Loamy Upland Ecological Site formed under prairie vegetation, and therefore have a dark, organic-rich surface horizon. The parent material is loess over residuum from shale, sandstone, or limestone. The soils have a surface layer of silt loam, loam, and silty clay loam and a loamy or clayey subsoil. Soils that have a

clayey subsoil are affected by seasonal wetness. Soil series associated with this site include Barco, Barden, Bates, Bucyrus, Catoosa, Choteau, Deepwater, Dennis, Elmont, Liberal, Lula, Newtonia, Okemah, Prue, and Summit soils.

Figure 7. Bates soil series profile.

Table 4. Representative soil features

Parent material	(1) Residuum–limestone, sandstone, and shale
Surface texture	(1) Silt loam (2) Silty clay loam (3) Loam
Drainage class	Somewhat poorly drained to well drained
Permeability class	Very slow to moderate
Soil depth	51–203 cm
Surface fragment cover <=3"	0–4%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	15.24–20.32 cm
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	5.1–7.8
Subsurface fragment volume <=3" (Depth not specified)	0–10%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The Loamy Upland Ecological Site is characterized as a tallgrass prairie dominated by big bluestem, Indian grass, switchgrass, little bluestem, sideoats grama, and a wide variety of prairie wildflowers. In some cases, Osage-orange, eastern redcedar, and roughleaf dogwood grow in small groves or as scattered individuals across the prairie landscape. On lower slopes and draws where water periodically accumulates, species such as switchgrass, eastern gamagrass, prairie cordgrass, sedge, and bunchflower are part of the diverse mix of prairie species.

The complex interaction of many ecological factors and processes influenced plant communities historically found and currently present on the Loamy Upland site. Primary influences are climate, fire, and grazing. Upon European settlement, non-native seed introduction and extreme disturbance (tillage) became potential influences on the site.

The reference plant community for this site is dominated by warm-season perennial grasses, a composite of predominantly tallgrasses and midgrasses interspersed with numerous perennial forbs. A small component of shrubs and cool-season grasses also occurs on this site. The reference plant community withstood extreme conditions of excessive moisture and extended drought, fire that occurred frequently (every 1 to 3 years) and in varying seasons, and grazing by large herbivores that varied in intensity, timing, frequency, duration, and distribution.

Reduction in fire intensity and frequency allows fire-intolerant trees and shrubs to establish and increase on the site. The density and spatial proximity of tree and shrub seed sources affects the sites vulnerability to trees and shrubs in conjunction with the reduction in fire intensity and frequency. Drought conditions and excessive grazing directly influence the quantity of herbaceous material present and thus the intensity a fire could have, if ignited. Fragmented landscapes and fire suppression efforts directly impact the frequency at which fires can occur on the site.

Grazing by large herbivores that had great variability in intensity, timing, frequency, duration, and distribution on the landscape is now performed by livestock confined by fencing and variability dictated by the livestock manager. Excessive grazing, plants experiencing intensive and frequent leaf removal, is now more likely to occur and not only reduces herbaceous material present for fire, but also influences plant composition and structure.

Plant species in the reference plant community are highly preferred by grazing livestock and when excessively grazed, will diminish when endured for several consecutive years. At the same time, less preferred plants or plants that require less leaf material to persist will increase their presence, shifting dominance of species and/or functional and structural groups.

Non-native seed introduction to the site occurs indirectly and/or directly. Indirect introduction is the most common and occurs based on the spatial presence of the non-native species and the method of seed dispersal (wind, wildlife, water, vehicles, machinery, livestock, etc.). Direct introduction could have occurred from overseeding the site with an introduced species without full knowledge of the ecological consequences of the seed introduction.

While fire and grazing can be significant disturbances, tillage of the site causes drastic changes in ecological processes. Past tillage caused total destruction of the original native plant community, and while being farmed, major degradation of the inherent structure and fertility of the surface soil layer occurred along with the loss of surface soil in the form of water erosion. Current species composition of these sites, after tillage ceased, depends on seed introduction from surrounding native seed sources (natural succession) or on the species mixture reseeded.

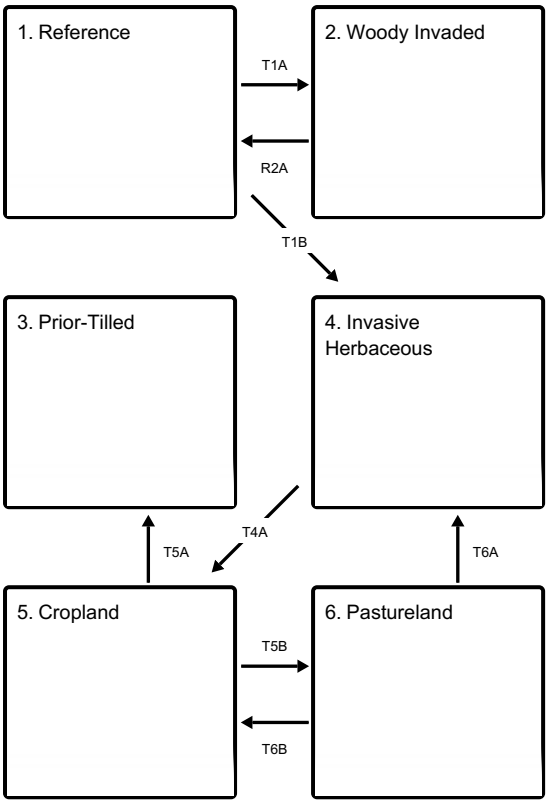
The state and transition model is provided to diagram the complex interactions briefly discussed here. The model includes states, plant communities, transitions, and restoration pathways detailing what experts have gathered from available experimental research, field observations, professional consensus, and interpretations. There may be other states or plant communities, with additional transitions and restoration pathways, not shown in the model, as well as noticeable variations within those illustrated.

The state and transition model consists of six states and ten community phases. These states and community phases interact based on the timing, intensity, and frequency of prescribe burning and prescribed grazing, introduction of invasive species, and tillage practices. The Reference State (1) is typically burned every 1 to 3 years. Fire removes dead plant litter and provides room for a lush growth of prairie vegetation. Fires also keeps woody species from invading the rangeland. This reference state is managed by controlling the intensity, frequency, duration, timing, and number of grazing animals. Grazing modifies vegetation structure and influences ecological processes.

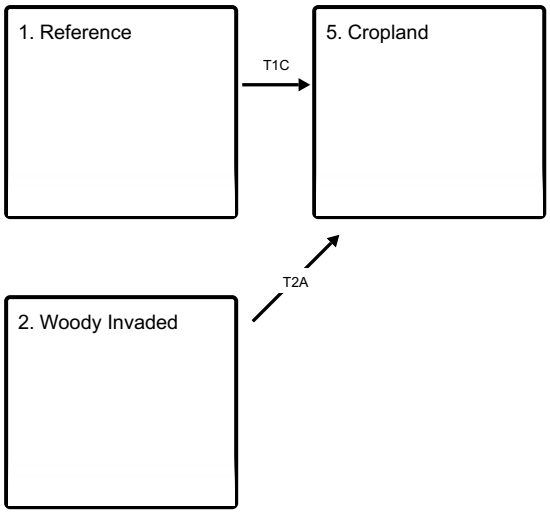
The Woody Invaded State (2) is characterized by a fire frequency and return interval greater than 20 years and a canopy cover percent between 40 and 60 percent. The Prior-Tilled State (3) consists of sites that were allowed to regenerate through natural revegetation or artificially reseeded after tillage practices have ceased. The Invasive Herbaceous State (4) is characterized by invasive, non-native grasses and forbs. The Cropland State (5) consists of land converted to agricultural cropland and dominated by row crops. The Pastureland State (6) is characterized by seeded grasses, usually cool season, that receive fertilizer and irrigation inputs to maintain the pasture, often used for grazing.

State and transition model

Ecosystem states



States 1, 5 and 2 (additional transitions)



T1A - Long term fire suppression

T1B - Invaded by non-native grasses and forbs.

T1C - Tillage and seeding of agricultural crops.

R2A - Removal of woody species by fire and/or mechanical methods.

T2A - Tillage and seeding of agricultural crops.

T4A - Tillage and seeding of agricultural crops.

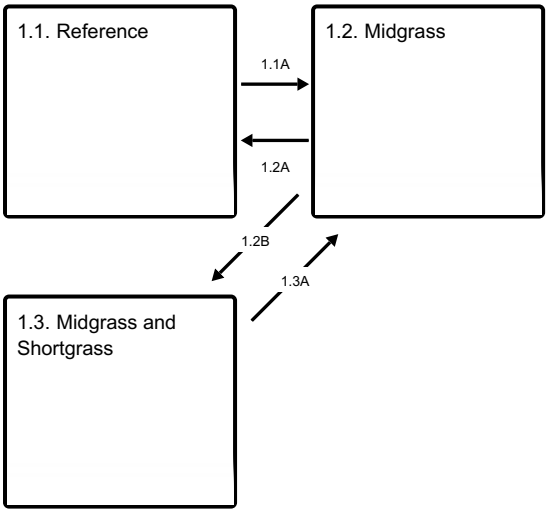
T5A - Natural revegetation or reseeding

T5B - Seeding of grasses and pasture management

T6A - Invaded by non-native grasses and forbs.

T6B - Tillage and seeding of agricultural crops

State 1 submodel, plant communities



1.1A - Heavy grazing without adequate rest and recovery

1.2A - Adaptive grazing that ensures adequate leaf retention of tallgrass species and incorporates periods of growing season deferment.

1.2B - Long-term (>20 years) heavy grazing with no rest and no recovery

1.3A - Prescribed grazing with adequate rest and recovery period during the growing season

State 2 submodel, plant communities

2.1. Shrub and/or Tree

State 3 submodel, plant communities

3.1. Go-Back

3.2. Reseed

State 4 submodel, plant communities

4.1. Caucasian Bluestem

4.2. Sericea Lespedeza

State 5 submodel, plant communities

5.1. Cropland

State 6 submodel, plant communities

6.1. Fescue, Brome, Bluegrass

State 1
Reference

Figure 8. Tallgrass prairie in the Reference State

The Reference State is dominated by warm-season perennial grasses, a composite of predominantly native species of tallgrasses and midgrasses, interspersed with numerous perennial forbs. A small component of shrubs and cool-season grasses also occur. This state has three plant community phases that are dynamic in nature and are dependent on fire frequency and grazing impacts..

Characteristics and indicators. An introduction and/or increase of woody plants can occur in the Reference State and initiates the transition to the Woody Invaded State. The lengthening of fire return interval, lack of fire intensity, and lack of competition from the warm-season perennial grasses, the greater the chance of woody species to establish and increase. Within the Reference State, the woody vegetation will generally be less than 15 percent canopy cover per acre. An introduction of seed from introduced, invasive or noxious plants can occur in the Reference State and is the starting point for transition to the Pastureland and/or Invasive Herbaceous State. If introduced, invasive, or noxious plants are present, they should not exceed those percentages shown in the plant communities identified in the Pastureland State and Invasive Herbaceous State. Tillage has not been a disturbance in the Reference State.

Resilience management. The Reference State is maintained through fire, grazing, and management. Fire will have a return interval of one to three years that includes the timing and intensity to negatively impact undesirable species. Grazing will include a forage-animal balance and adaptive decision-making to ensure the dominant plants within the reference plant community can maintain vigor. Management will include strategies to prevent non-native seed introduction (woody or herbaceous) and scouting with targeted control methods if initial establishment occurs.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- compassplant (*Silphium laciniatum*), other herbaceous
- Nuttall's sensitive-briar (*Mimosa nuttallii*), other herbaceous
- purple prairie clover (*Dalea purpurea*), other herbaceous
- Illinois bundleflower (*Desmanthus illinoensis*), other herbaceous

Dominant resource concerns

- Plant productivity and health

Community 1.1
Reference

Figure 9. Reference Plant Community

The interpretive plant community for the Loamy Upland ecological site is the Reference Plant Community and represents the original plant community that existed prior to European settlement. Characterized as open grassland essentially free of trees and large shrubs, it is dominated by tall, warm-season grasses including big bluestem, switchgrass, and Indiangrass. Little bluestem, a midgrass, is also a major component of this community. These grasses will account for 75 to 80 percent of vegetation produced annually. Eastern gamagrass and prairie cordgrass sometimes occur where soils are wetter due to underground seepage or run-in from adjacent slopes. Other prevalent midgrasses are marsh bristlegrass, purpletop tridens, sideoats grama, composite dropseed, plains muhly, and purple lovegrass. Shortgrasses are not a notable component of this community. The site supports a wide variety of forbs interspersed throughout the grass sward. The most abundant forbs include compassplant, wholeleaf rosinweed, Maximilian sunflower, sawtooth sunflower, stiff sunflower, pitcher sage, and purple pale echinacea. Nuttall's sensitive-briar, prairie bundleflower, slender lespedeza, and roundhead lespedeza are the most abundant legumes. In some areas, shrubs such as leadplant and New Jersey tea occur over the site.

Resilience management. This is a stable plant community when grazing and fire are adequately managed. A prescribed grazing program that incorporates periods of grazing rest and recovery of key forage species during the growing season benefits the tallgrasses as well as the more palatable forb species. Excessive grazing and livestock trailing can quickly impact soil stability and lead to sheet and gully erosion. Because this site often occurs on summits, shoulders, and other high elevations on the landscape, it is preferred by grazing animals during the hot days of late summer. Cattle and other livestock commonly graze into the prevailing southerly winds and find loafing areas in this site to gain relief from heat and insects. Concentrated livestock use, such as winter-feeding areas, can cause compaction of the wet, clay soils and stress the dominant tallgrasses.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- switchgrass (*Panicum virgatum*), grass

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2959	4685	6411
Forb	336	532	729
Shrub/Vine	67	106	146
Total	**3362**	**5323**	**7286**

Community 1.2
Midgrass

Figure 11. Midgrass Plant Community

This plant community developed as a result of many years of repeated, heavy grazing. Compared to the Reference Plant Community, there has been a reduction in the more palatable tallgrasses and forbs with an increase in midgrasses and other forbs. Tallgrasses such as big bluestem, Indiangrass, and switchgrass still remain, but the proportion of midgrasses has increased to 30 to 40 percent of the total annual production. Most abundant midgrasses include composite dropseed, little bluestem, purpletop tridens, marsh bristlegrass, beaked panicum, broomsedge bluestem, and sideoats grama. Palatable forbs such as Maximilian sunflower, compassplant, wholeleaf rosinweed, Nuttall's sensitive-briar, and prairie bundleflower have decreased and largely been replaced by white heath aster, white sagebrush, Cuman ragweed and Canada goldenrod. Forbs produce 8 to 10 percent of the total annual production. In some locations shrubs such as smooth sumac, roughleaf dogwood, and coralberry comprise up to 10 percent of the vegetation. A variety of invasive trees such as osage orange, honeylocust, and eastern redcedar may also be present.

Resilience management. The Midgrass plant community persists with the use of a forage-animal imbalance as a grazing strategy and a longer fire return interval, approximately 5 to 7 years. The forage-animal imbalance results in excessive grazing (plants experiencing intensive and frequent leaf removal) on preferred species such as big bluestem, Indiangrass, and palatable legumes. Lack of fire allows residual build-up of old growth on less palatable species and a potential increase in woody species that further amplifies animal selection of desirable plants.

Dominant plant species

- leadplant (*Amorpha canescens*), shrub
- New Jersey tea (*Ceanothus americanus*), shrub
- broomsedge bluestem (*Andropogon virginicus*), grass
- marsh bristlegrass (*Setaria parviflora*), grass
- composite dropseed (*Sporobolus compositus*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- white sagebrush (*Artemisia ludoviciana*), other herbaceous
- Canada goldenrod (*Solidago altissima*), other herbaceous
- white heath aster (*Symphyotrichum ericoides*), other herbaceous
- Cuman ragweed (*Ambrosia psilostachya*), other herbaceous

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition

Community 1.3
Midgrass and Shortgrass

This community is dominated by short-grasses and the less desirable midgrasses. Compared to the Reference Plant Community, the amount of tall-grasses and the more palatable midgrasses is significantly decreased from many years (>20) of overgrazing. Major midgrass species include composite dropseed, purpletop tridens, silver

beardgrass, broomsedge bluestem, beaked panicum, sideoats grama, and marsh bristlegrass. Major short-grasses include Kentucky bluegrass, fall witchgrass, thin paspalum, Scribner's rosette grass, buffalograss, tumble windmill grass, hairy grama, and prairie threeawn. Major forbs in the community are Cuman ragweed, tall eupatorium, Canada goldenrod, Missouri goldenrod, white sagebrush, white heath aster, interior ironweed, hoary verbena, lanceleaf ragweed, annual marshelder, and annual ragweed. The most common shrubs include coralberry, wingleaf sumac, blackberry, and roughleaf dogwood. Slippery elm, common hackberry, eastern redcedar, and Osage-orange are the major trees. Shrubs and trees typically do not comprise over 10 to 15 percent of the total production.

Dominant plant species

- coralberry (*Symphoricarpos orbiculatus*), shrub
- winged sumac (*Rhus copallinum*), shrub
- blackberry (*Rubus*), shrub
- roughleaf dogwood (*Cornus drummondii*), shrub
- composite dropseed (*Sporobolus compositus*), grass
- purpletop tridens (*Tridens flavus*), grass
- broomsedge bluestem (*Andropogon virginicus*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- fall witchgrass (*Digitaria cognata*), grass
- buffalograss (*Bouteloua dactyloides*), grass
- Cuman ragweed (*Ambrosia psilostachya*), other herbaceous
- tall thoroughwort (*Eupatorium altissimum*), other herbaceous
- Canada goldenrod (*Solidago canadensis*), other herbaceous
- white sagebrush (*Artemisia ludoviciana*), other herbaceous

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition

Pathway 1.1A
Community 1.1 to 1.2

Reference **Midgrass**

The mechanisms that transition the Reference Plant Community to a Midgrass Plant Community include repetitive, excessive leaf removal of the key tallgrass forage species in conjunction with longer fire return intervals than historically occurred in the Reference Plant Community. The repetitive, excessive leaf removal is driven by a forage-animal imbalance (no rest or recovery). Drought conditions with below average rainfall during the first half of the growing season will amplify the annual imbalance due to overall reduced forage production and extended (>3 years) drought will accelerate the rate of transition. Having longer fire return intervals and a forage-animal imbalance lasting for periods greater than 10 years will shift functional and structural plant group dominance towards a midgrass plant community. Initial increases in forbs, as tallgrasses are reduced in vigor, could trigger a desire by land managers to utilize herbicides to reduce forb presence. Broadcast application of broadleaf herbicides will remove legumes and forbs and result in a grass dominated community but not improve tallgrass species vigor.

Context dependence. Plant community composition shifts from Tallgrass to Midgrass dominant.

Pathway 1.2A
Community 1.2 to 1.1

Midgrass

Reference

The restoration from a Midgrass Plant Community to a Reference Plant Community requires a shift in management (10-15 years) that includes a forage-animal balance allowing sufficient leaf material to remain on the key tallgrass forage species (big bluestem, switchgrass, Indiangrass, and little bluestem) and palatable legumes within the Reference Plant Community. Adaptive decision-making is required to allow adequate rest and recovery for the key plants and meet a forage-animal balance, especially when drought conditions are encountered. If woody species are present, prescription fires every 6-8 years will be necessary for their removal and/or maintenance. Targeted spot treatment of non-native plants (herbaceous and woody) is needed if present.

Context dependence. Short-term (less than 5 years) adjustment in management can improve tallgrass vigor, but functional and structural group dominance change is likely to require 7 to 10 years depending on growing season moisture during that time-frame.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

Pathway 1.2B
Community 1.2 to 1.3

Pathway 1.2B consists of management controlled by repetitive heavy use, no rest or recovery of the key forage species, and no forage and animal balance for many extended grazing seasons. This type of management for periods greater than 20 years shifts the functional and structural plant group dominance towards a Midgrass and Shortgrass Plant Community (1.3).

Pathway 1.3A
Community 1.3 to 1.2

Pathway 1.3A consists of planned grazing that manages the intensity, frequency, duration, timing, and number of grazing animals to modify vegetation structure and influence ecological processes. This management could include reduced use, extended periods of rest, and seeding of desired species.

Context dependence. Causes of plant community shift include management (for 10 to 15 years) that allows adequate rest and recovery of the key forage species (little bluestem, sideoats grama, big bluestem, switchgrass, and Indiangrass) in the Midgrass Plant Community (1.2) . If woody species are present, prescribed burning every 6 to 8 years is necessary for their removal, maintenance, or both.

Conservation practices

Prescribed Burning
Prescribed Grazing

State 2
Woody Invaded

Figure 12. Woody State

The Woody Invaded State is dominated by a shrub and/or tree plant community. The increase and spread of shrubs and trees resulted from an absence of fire and will be accelerated by seed introduction and/or spread. Woody plants can increase up to 34% from a lack of fire according to a study from 1937 to 1969, in contrast to a 1% increase on burned areas (Bragg and Hulbert, 1976). Periodic burning will hinder the establishment of most woody species and favor forbs and grasses. However, not all unburned areas have a woody plant invasion. Birds, small mammals, and livestock are instrumental in the distribution and spread of seed for most tree and shrub species common to this site. The speed of encroachment varies considerably and can occur on both grazed and non-grazed sites.

Characteristics and indicators. Hydrologic function in the Woody Invaded State is affected by the amount of shrub and/or tree cover compared to the Reference State. Canopy interception loss can vary from 25.4% to 36.7% (Thurow and Hester, 1997). A small rainfall event is usually retained in the foliage and does not reach the litter layer at the base of the tree. Only when canopy storage is reached and exceeded does precipitation fall to the soil surface. Interception losses associated with the accumulation of leaves, twigs, and branches at the bases of trees are considerably higher than losses associated with the canopy. The decomposed material retains approximately 40% of the water that is not retained in the canopy (Thurow and Hester, 1997). Soil properties affected include biological activity, infiltration rates, and soil fertility. The Woody Invaded State has not had tillage as a disturbance and could have plants identified in the Pastureland State present on the site.

Resilience management. The Woody Invaded State is sustained by lack of fire and lack of woody plant control methods such as mechanical, chemical, or biological. Livestock that utilize browse will have greater livestock production potential in this state than those preferring plants in the Reference State. The lack of sunlight, due to shading by the shrubs and/or trees, will favor cool-season grasses that can reduce fire intensity if fire timing is during their active growth period and would help sustain the Woody Invaded State.

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree
- Osage-orange (*Maclura pomifera*), tree
- honeylocust (*Gleditsia triacanthos*), tree
- elm (*Ulmus*), tree
- coralberry (*Symphoricarpos orbiculatus*), shrub
- roughleaf dogwood (*Cornus drummondii*), shrub
- smooth sumac (*Rhus glabra*), shrub
- blackberry (*Rubus*), shrub
- little bluestem (*Schizachyrium scoparium*), grass
- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- switchgrass (*Panicum virgatum*), grass
- sedge (*Carex*), grass

Dominant resource concerns

- Plant productivity and health

- Plant structure and composition

Community 2.1
Shrub and/or Tree

The Shrub and/or Tree Plant Community is dominated by trees and shrubs and may account for 40 to 60 percent total vegetation. Major trees include slippery elm, Siberian elm and common hackberry. Other trees such as osage orange, honeylocust, and eastern redcedar are common invaders that become established in some areas. Abundant shrubs consist primarily of coralberry, roughleaf dogwood, smooth sumac, flameleaf sumac, and blackberry. Coralberry is generally the most abundant shrub and often forms low, dense thickets throughout the site. The spread of shrubs and trees results from the absence of fire because periodic burning tends to hinder the establishment of most these woody species and favors grasses and forbs. It should be noted, however, that not all unburned areas have a woody plant problem and that the rate of encroachment varies considerably depending on seed availability in surrounding areas. Longtime overgrazing can also lead to encroachment. In these situations, the associated grasses will usually consist of Scribner's rosette grass, Kentucky bluegrass, composite dropseed, purpletop tridens, marsh bristlegrass, and sedges. Common associated forbs include white sagebrush, interior ironweed and white heath aster. Shrubs and trees will also invade areas where both grazing and fire have been excluded for many years because the heavy accumulation of plant mulch and litter retards herbage growth and provides a favorable habitat for seed germination and establishment of many shrub species. The associated grasses in this situation may include big bluestem, Indiangrass, little bluestem, Virginia wildrye, Canada wildrye, sedges. Associated forbs include prairie bundleflower, Canada goldenrod, hairy sunflower and Maximilian sunflower. Grass production is significantly reduced by competition from forbs and woody species. Grass yields vary from 30 to 40 percent of the total vegetative production while forbs often produce 10 to 50 percent of the total.

Resilience management. The Shrub and/or Tree Community is sustained by lack of fire and lack of woody plant control methods such as mechanical, chemical, or biological. A prescribed burning program accompanied by prescribed grazing will gradually return the plant community to one dominated by desirable grasses and Forbs. Special planning will be necessary to assure that sufficient amounts of fine fuel are available to carry fires with enough intensity to control woody species. Use of labeled herbicides as a brush management tool will usually be necessary to reduce populations of fire-resistant species like Osage orange and honeylocust and accelerate the recovery of desired vegetative cover.

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree
- Osage-orange (*Maclura pomifera*), tree
- honeylocust (*Gleditsia triacanthos*), tree
- elm (*Ulmus*), tree
- coralberry (*Symphoricarpos orbiculatus*), shrub
- roughleaf dogwood (*Cornus drummondii*), shrub
- smooth sumac (*Rhus glabra*), shrub
- blackberry (*Rubus*), shrub
- little bluestem (*Schizachyrium scoparium*), grass
- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- switchgrass (*Panicum virgatum*), grass
- sedge (*Carex*), grass
- Canadian wildrye (×*Elyleymus hirtiflorus*), grass

State 3
Prior-Tilled

The Prior-Tilled State consists of abandoned cropland where the original plant community was destroyed through inversion by tillage but revegetation has occurred. Two plant communities are identified in the Prior-Tilled State and are identified by revegetation factors. The communities are identified as being naturally revegetated through succession (Go-back) or planted/seeded to species similar in composition to the reference plant community (Reseed). Plant species composition in the Prior-Tilled State is difficult to define due to the variability of plant communities that can exist.

Characteristics and indicators. The Prior-Tilled State is an alternative state since the energy, hydrologic, and nutrient cycles are significantly altered to that of the Reference State in its natural disturbance regime. Repeated tillage and planting of annual crops resulted in major changes in soil conditions. Reductions in organic matter, mineral levels, soil structure, oxygen levels, and water holding capacity, along with increased runoff/erosion and shifts in the populations of soil-dwelling organisms, are common in this state. The extent of these changes are dependent upon duration of cropping, crop types grown, and other management practices. Bulk density, aggregate stability, soil structure, and plant functional and structural groups are not fully restored to that of the Reference State. Mechanical tillage can destroy soil aggregation. Soil aggregates are an example of dynamic soil property change. Aggregate stability is critical for infiltration, root growth, and resistance to water and wind erosion (Brady and Weil, 2008).

Resilience management. The Prior-Tilled State is a result of a land use management decision and is sustained by diminished soil function. Implementation of practices that positively impact plant community diversity, energy flow, and nutrient and water cycle, should benefit rehabilitation. Documentation does not support rehabilitation to a Reference State within known management time frames.

Dominant plant species

- prairie threeawn (*Aristida oligantha*), grass
- prairie cupgrass (*Eriochloa contracta*), grass
- buffalobur nightshade (*Solanum rostratum*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- switchgrass (*Panicum virgatum*), grass
- annual ragweed (*Ambrosia artemisiifolia*), other herbaceous
- common sunflower (*Helianthus annuus*), other herbaceous
- Korean clover (*Kummerowia stipulacea*), other herbaceous
- Illinois bundleflower (*Desmanthus illinoensis*), other herbaceous
- Maximilian sunflower (*Helianthus maximiliani*), other herbaceous

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition

Community 3.1
Go-Back

This plant community occurs on areas that were formerly farmed. When tillage operations ceased, the areas were allowed to revegetate or “go back” naturally in contrast to artificial reseeding to a selected species or group of species. The go-back process is a slow, gradual transformation that requires many years and many successional changes or stages in the plant community. The speed and extent of revegetation depends on the size of the area, level of grazing management and the proximity of the area to existing seed sources. In the initial stages of revegetation, the site is usually dominated by annual forbs such as annual ragweed, Canadian horseweed, common sunflower, annual marshelder, and Korean clover. Gradually these are replaced by annual grasses including prairie threeawn, prairie cupgrass, buffalo bur, tumblegrass, little barley, cheatgrass, and witchgrass. As plant succession progresses the plant community gradually becomes dominated by perennials. The major grasses include sand dropseed, composite dropseed, purpletop tridens, silver beardgrass, broomsedge bluestem, tumble windmill grass, buffalograss, sedges, Scribner’s rosette grass, and Carolina crabgrass. Common forbs are Cuman ragweed, white sagebrush, wavyleaf thistle, hoary verbena, Baldwin ironweed, brown eyed susan, white heath aster, Canada goldenrod, and Green antelopehorn milkweed. Combinations of these plants can form a stable community. In time with prescribed grazing management, other perennial grasses and forbs common in the Reference Plant Community return to the site. Some go-back areas are invaded by trees and shrubs. The more common include elm, common hackberry, eastern redcedar, eastern cottonwood, and roughleaf dogwood. Occasional burning is effective in controlling these woody plants. Total annual production varies by site. This depends on seasonal precipitation and the stage of plant succession in the plant community.

Resilience management. Following termination of cultivation, total annual production is quite variable and full recovery of the original plant community, including forbs and legumes, may take many decades. Additions of

organic matter and minerals, deferred grazing, prescribed burning, and related management practices described earlier for this ecological site can be beneficial to the rehabilitation.

Dominant plant species

- prairie threeawn (*Aristida oligantha*), grass
- prairie cupgrass (*Eriochloa contracta*), grass
- buffalobur nightshade (*Solanum rostratum*), grass
- annual ragweed (*Ambrosia artemisiifolia*), other herbaceous
- common sunflower (*Helianthus annuus*), other herbaceous

Community 3.2
Reseed

This plant community occurs on areas that were formerly farmed and reseeded with a mixture of native species common in the Tallgrass Plant Community. Most seeding mixtures consisted of a blend of grasses that include sand Big bluestem, Indiangrass, switchgrass, little bluestem, sideoats grama, blue grama, and western wheatgrassEastern gamagrass. In some locations, seed of legumes and forbs such as prairie bundleflower and Maximilian sunflower were included in the mixture. Once these areas become fully established, and the natural historical disturbances such as grazing and burning are included in management, production is comparable to that of the Tallgrass Plant Community. Total annual production ranges varies according to the species planted, established plants, and years of establishment. When reseeded areas and areas supporting native rangeland exist in the same pasture, they seldom are utilized at the same intensity because domestic livestock usually prefer plants growing on the native rangeland areas. When feasible, reseeded plant communities should be managed as separate pastures or units. Some seeded areas are invaded by trees and shrubs during the establishment period of the desired plants. These invader species commonly include elm, common hackberry, eastern redcedar, and eastern cottonwood. Occasional burning is effective in controlling establishment of these woody plants.

Resilience management. Following termination of cultivation, total annual production is quite variable and full recovery of the original plant community, including forbs and legumes, may take many decades. Additions of organic matter and minerals, deferred grazing, prescribed burning, and related management practices described earlier for this ecological site can be beneficial to the rehabilitation.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- switchgrass (*Panicum virgatum*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- Illinois bundleflower (*Desmanthus illinoensis*), other herbaceous
- Maximilian sunflower (*Helianthus maximiliani*), other herbaceous

State 4
Invasive Herbaceous

The Invasive Herbaceous State is identified by a significant presence of non-native herbaceous plant species and is characterized by the composition of plant species and soil functions that govern the ecological processes.

Characteristics and indicators. Species that define this state include sericea lespedeza and Caucasian bluestem. Sericea lespedeza and Caucasian bluestem community phases are partially defined by the total production exceeding 15% by weight on a per acre basis. Ecological processes within this state that are affected and differ from the Reference State are hydrologic cycle and nutrient cycle. Water content and infiltration rates are also affected by the species in the plant community phase.

Resilience management. The Invasive Herbaceous State is sustained through continued reduction in health and vigor of native plant species and the increase in health and vigor, including seed production, of non-native herbaceous species. Ensuring a lack of forage quality due to season of grazing, and type of grazing animal, of the non-native plants will deter grazing of non-native plant species and increase grazing pressure on native plant species. A general lack of treatment measures for individual species control, maintenance, and/or eradication will

also allow persistence of this state.

Dominant plant species

- sericea lespedeza (*Lespedeza cuneata*), shrub
- Caucasian bluestem (*Bothriochloa bladhii*), grass

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition

Community 4.1
Caucasian Bluestem

Caucasian bluestem is present at levels exceeding 15% by weight on a per acre basis and governing the ecological processes and potential uses of this community. Caucasian bluestem might be the most serious threat and most aggressive of the introduced, invasive, and noxious species of this time. Interspatial erosion can be present due to the clumpy growth of the plant which leads to a rough surface to walk or drive on. Caucasian bluestem is allelopathic (producing toxic chemicals that negatively impact the germination and/or growth of other plants) and often exists as a monoculture due to its competitive ability. Having this species present on a site can and will allow further invasion of adjacent sites if proactive prevention and control measures are not implemented. Research and trial studies are continuously being conducted on control measures for Caucasian bluestem. Soil dynamic property changes include infiltration, biological activity, and soil fertility.

Resilience management. Caucasian bluestem is extremely competitive with its allelopathic nature, lower palatability compared to native species, ability to persist with heavy utilization, and tolerance to drought. To prevent further loss of native plant composition, ensure native plant vigor remains high via a forage-animal balance based on forage composition and palatability, and utilize spot application of herbicides to control new and existing Caucasian bluestem plants. Fire can be utilized to remove standing dead growth and increase palatability of Caucasian bluestem in a mixed plant community, especially initial spring growth. Impacts to Caucasian bluestem via alternate timing of fire (late summer) is currently being investigated. There have been cases where the native taller grasses appear to shade and out-compete the Caucasian bluestem, but more commonly, it is crowding out the native grass as it spreads. There are ungrazed places on the Konza Prairie Research and biological station where Caucasian bluestem was introduced from feeding livestock contaminated hay and it is now crowding out the native grass.

Dominant plant species

- Caucasian bluestem (*Bothriochloa bladhii*), grass

Community 4.2
Sericea Lespedeza

Sericea lespedeza (*Lespedeza cuneata*) is present at levels exceeding 15% by weight on a per acre basis and governing the ecological processes and potential uses of this community. Sericea lespedeza is invasive and listed as a statewide noxious weed in Kansas. It competes with the native plant community for sunlight, water, and nutrients, and produces allelopathic compounds (toxic chemicals that negatively impact the germination and/or growth of other plants). It also contains tannins, that limit palatability, and produces copious amounts of seed that remain viable in the soil for decades. This species will quickly invade rangelands without proactive control measures.

Resilience management. Sericea lespedeza (*Lespedeza cuneata*) is extremely competitive with its allelopathic nature, lower palatability compared to native species, and good seedling vigor. To prevent further loss of native plant composition, ensure native plant vigor remains high via a forage-animal balance based on forage composition and palatability, utilize spot application of herbicides to control new and existing sericea lespedeza plants, and consider diversifying grazing livestock type. Control measures for sericea lespedeza involve herbicide application following extension recommendations and product label for proper rates and timing. Utilization and control can also be provided through sheep and goat grazing. Conventional management practices such as prescribed grazing with

cattle and dormant-season fire have been less than effective in preventing the spread of sericea lespedeza in rangelands. Some suppression of sericea lespedeza has been observed after mowing or summer burning. Late summer fire significantly reduces seed production the year of burn. An integrated approach is needed when treating this species.

Dominant plant species

- sericea lespedeza (*Lespedeza cuneata*), shrub

State 5
Cropland

This State is dominated by row crops such as corn, soybeans, and wheat. It occurs on sites that have been mechanically tilled and converted to agricultural cropland. After tillage, efforts are then taken to plant various crops through a conservation cropping system.

Dominant plant species

- wheat (*Triticum*), grass
- corn (*Zea mays*), other herbaceous
- soybean (*Glycine max*), other herbaceous

Community 5.1
Cropland

This community occurs on areas where land use has been converted to intensive agriculture cropland through mechanical tillage and a conservation cropping system. Primary crops include corn and soybeans.

Dominant plant species

- wheat (*Triticum*), grass
- corn (*Zea mays*), other herbaceous
- soybean (*Glycine max*), other herbaceous

State 6
Pastureland

The Pastureland State is identified by a significant presence of non-native herbaceous plant species and is characterized by the composition of plant species, agronomic inputs from direct fertilization, and soil functions that govern the ecological processes. Sites consisting of introduced species and managed for their continued presence or spread should not be evaluated within this model and instead, consider using a separate land use model such as Pasture.

Characteristics and indicators. Tall fescue, smooth brome, and Kentucky bluegrass are partially defined by the total production exceeding 40% by weight on a per acre basis. Ecological processes within this state that are affected and differ from the Reference State are hydrologic cycle and nutrient cycle. Water content and infiltration rates are also affected by the species in the plant community phase.

Resilience management. Pastureland is sustained through continued reduction in health and vigor of native plant species and the increase in health and vigor, including seed production, of non-native herbaceous species. Agronomic inputs from direct fertilization or nutrient-rich runoff from adjacent crop fields will provide advantages for non-native cool-season grass species growth. Ensuring a lack of forage quality due to season of grazing, type of grazing animal, or chemical composition of the non-native plants will deter grazing of non-native plant species and increase grazing pressure on native plant species. A general lack of treatment measures for individual species control, maintenance, and/or eradication will also allow persistence of this state.

Dominant plant species

- tall fescue (*Schedonorus arundinaceus*), grass
- smooth brome (*Bromus inermis*), grass

- Kentucky bluegrass (*Poa pratensis*), grass

Community 6.1
Fescue, Brome, Bluegrass

Tall fescue, smooth brome, and Kentucky bluegrass (all being cool-season grasses) are present at levels exceeding 40% by weight on a per acre basis and are governing the ecological processes and potential uses of this community. Timing of plant growth has shifted from summer (May through August) and now mostly occurs in spring and fall (March to May and September to November). Fire intensity of late spring burns can be greatly impeded due to the significant quantity of cool-season grass present. Any one or a combination of these species can be considered an invaded community. Soil dynamic property changes include biological activity and soil fertility.

Resilience management. Tall fescue, smooth brome, and Kentucky bluegrass are sustained or increased with nutrient additions and absence of fire. To prevent further loss of native plant composition, avoid nutrient additions, ensure native plant vigor remains high via a forage-animal balance based on forage composition and seasonal availability, utilize herbicides when natives are dormant but cool-seasons are actively growing, and utilize consecutive late spring prescribed burns. Chemical control will involve herbicide application following extension recommendations and product label for proper rates and timing. Intensifying grazing pressure (leaf removal of cool-season grasses) during the spring and fall and removing grazing pressure during the summer will reduce cool-season grass vigor and allow native warm-season plants an opportunity to maximize growth and gain vigor. Prescribed burning will require sufficient standing dead material in order to conduct a burn in late spring as warm-season grasses initiate growth. If the goal is continued presence or spread of tall fescue, smooth brome, or Kentucky bluegrass, consider using a separate land use model such as Pasture.

Dominant plant species

- tall fescue (*Schedonorus arundinaceus*), grass
- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

Transition T1A
State 1 to 2

Reference **Woody Invaded**

Long term fire suppression (20+ years) will transition the Reference State to a Woody State. A lack of fire events will allow woody species to establish and increase, shifting the site to dominant trees and shrubs with a reduction in desirable grasses and forbs in the understory.

Transition T1B
State 1 to 4

A transition from Reference to an Invasive Herbaceous State occurs when the site is invaded by either Caucasian bluestem and/or Sericea lespedeza with the total production exceeding 15% by weight on a per acre basis.

Transition T1C
State 1 to 5

Tillage (or no-till if that management style is preferred) and seeding of agricultural crops will transition this site from a Reference State to a Cropland State.

Restoration pathway R2A
State 2 to 1

Woody Invaded Reference

Restoration actions to return to a Reference State may include machinery woody removal and prescribed fire. Efforts will be costly, labor-intensive, and can take many years, if not decades. Once canopy levels reach greater than 20 percent, estimated cost to remove trees is very expensive and includes high energy inputs.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

Transition T2A
State 2 to 5

Tillage (or no-till if that management style is preferred) and seeding of agricultural crops will transition this site from a Woody Invaded State to a Cropland State.

Transition T4A
State 4 to 5

Tillage (or no-till if that management style is preferred) and seeding of agricultural crops will transition this site from an Invasive Herbaceous State to a Cropland State.

Transition T5A
State 5 to 3

Allowing the site to naturally revegetate as it regenerates, or reseeding the site with native grasses and forbs with proper management afterwards will transition this site from a Cropland to a Prior-Tilled State.

Transition T5B
State 5 to 6

Seeding of cool season grasses and forbs and proper pasture management will transition this Cropland to a Pastureland.

Transition T6A
State 6 to 4

A transition from Pastureland to an Invasive Herbaceous State occurs when the site is invaded by either Caucasian bluestem and/or Sericea lespedeza with the total production exceeding 15% by weight on a per acre basis.

Transition T6B
State 6 to 5

Tillage (or no-till if that management style is preferred) and seeding of agricultural crops will transition this site from a Pastureland to a Cropland.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)

Group	Common Name	Symbol	Scientific Name	(Kg/Hectare)	(%)
Grass/Grasslike					
1	**Tallgrasses Dominant 63%**			2466–3363	
	big bluestem	ANGE	*Andropogon gerardii*	1681–1984	–
	Indiangrass	SONU2	*Sorghastrum nutans*	504–661	–
	eastern gamagrass	TRDA3	*Tripsacum dactyloides*	280–560	–
	switchgrass	PAVI2	*Panicum virgatum*	0–45	–
	Florida paspalum	PAFL4	*Paspalum floridanum*	0–28	–
	composite dropseed	SPCO16	*Sporobolus compositus*	0–28	–
2	**Midgrasses Subdominant 23%**			785–1233	
	little bluestem	SCSC	*Schizachyrium scoparium*	785–1104	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–28	–
	purple lovegrass	ERSP	*Eragrostis spectabilis*	0–28	–
	marsh bristlegrass	SEPA10	*Setaria parviflora*	0–28	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–28	–
3	**Cool-season grasses Trace 2%**			0–118	
	Canada wildrye	ELCA4	*Elymus canadensis*	0–28	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–28	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–28	–
	sedge	CAREX	*Carex*	0–28	–
	Virginia wildrye	ELVI3	*Elymus virginicus*	0–28	–
Forb					
4	**Forbs Mnor 10%**			280–532	
	button eryngo	ERYU	*Eryngium yuccifolium*	0–17	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	2–17	–
	cobaea beardtongue	PECO4	*Penstemon cobaea*	0–17	–
	compassplant	SILA3	*Silphium laciniatum*	2–17	–
	fringeleaf wild petunia	RUHU	*Ruellia humilis*	0–17	–
	groundplum milkvetch	ASCR2	*Astragalus crassicarpus*	0–17	–
	Illinois bundleflower	DEIL	*Desmanthus illinoensis*	2–17	–
	Illinois ticktrefoil	DEIL2	*Desmodium illinoense*	0–17	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	6–17	–
	pitcher sage	SAAZG	*Salvia azurea var. grandiflora*	1–17	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–17	–
	roundhead lespedeza	LECA8	*Lespedeza capitata*	1–17	–
	longbract spiderwort	TRBR	*Tradescantia bracteata*	0–17	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–17	–
	white prairie clover	DACA7	*Dalea candida*	0–17	–
	ashy sunflower	HEMO2	*Helianthus mollis*	2–17	–
	white wild indigo	BAAL	*Baptisia alba*	0–17	–
	Baldwin's ironweed	VEBA	*Vernonia baldwinii*	0–17	–
	blue wild indigo	BAAUM	*Baptisia australis var. minor*	0–17	–
	interior ironweed	VEBAI2	*Vernonia baldwinii ssp. interior*	0–17	–

	white sagebrush	ARLU	*Artemisia ludoviciana*	0–17	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–17	–
	longbract wild indigo	BABR2	*Baptisia bracteata*	0–17	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–17	–
	tall blazing star	LIAS	*Liatris aspera*	0–17	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–17	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–17	–
	aromatic aster	SYOB	*Symphyotrichum oblongifolium*	0–11	–
	longflower beeblossom	OEFI2	*Oenothera filiformis*	0–11	–
	blackeyed Susan	RUHI2	*Rudbeckia hirta*	0–11	–
	false boneset	BREU	*Brickellia eupatorioides*	0–11	–
	butterfly milkweed	ASTU	*Asclepias tuberosa*	0–11	–
	Indianhemp	APCA	*Apocynum cannabinum*	0–11	–
	green antelopehorn	ASVI2	*Asclepias viridis*	0–11	–
	hairy hawkweed	HILO2	*Hieracium longipilum*	0–11	–
	white heath aster	SYER	*Symphyotrichum ericoides*	1–11	–
	Carolina larkspur	DECAV2	*Delphinium carolinianum ssp. virescens*	0–11	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–11	–
	heartleaf four o'clock	MINY	*Mirabilis nyctaginea*	0–11	–
	prairie groundsel	PAPL12	*Packera plattensis*	0–11	–
	narrowleaf mountainmint	PYTE	*Pycnanthemum tenuifolium*	0–11	–
	stiff goldenrod	OLRI	*Oligoneuron rigidum*	0–11	–
	tall thoroughwort	EUAL3	*Eupatorium altissimum*	0–11	–
	whorled milkweed	ASVE	*Asclepias verticillata*	0–11	–
	hoary verbena	VEST	*Verbena stricta*	0–11	–
Shrub/Vine					
5	**Shrubs Trace 2%**			34–106	
	leadplant	AMCA6	*Amorpha canescens*	22–39	–
	New Jersey tea	CEAM	*Ceanothus americanus*	11–39	–
	prairie rose	ROAR3	*Rosa arkansana*	0–39	–

Animal community

Grazing Interpretations

Calculating Safe Stocking Rates: Proper stocking rates should be incorporated into a grazing management strategy that protects the resource, maintains or improves rangeland health, and is consistent with management objectives. In addition to usable forage, safe stocking rates should consider ecological condition, trend of the site, past grazing use history, season of use, stock density, kind and class of livestock, forage digestibility, forage nutritional value, variation of harvest efficiency based on preference of plant species, and/or grazing system, and site grazeability factors (such as steep slopes, site inaccessibility, or distance to drinking water).

Often the current plant community does not entirely match any particular Community Phase as described in this Ecological Site Description. Because of this, a resource inventory is necessary to document plant composition and production. Proper interpretation of inventory data will permit the establishment of a safe initial stocking rate.

No two years have exactly the same weather conditions. For this reason, year-to-year and season-to-season fluctuations in forage production are to be expected on grazing lands. Livestock producers must make timely adjustments in the numbers of animals or in the length of grazing periods to avoid overuse of forage plants when production is unfavorable, and to make advantageous adjustments when forage supplies are above average.

Initial stocking rates should be improved through the use of vegetation monitoring and actual use records that include number and type of livestock, the timing and duration of grazing, and utilization levels. Actual use records over time will assist in making stocking rate adjustments based on the variability factors. Average annual production must be measured or estimated to properly assess useable forage production and stocking rates.

Wildlife*

Game species that utilize this ecological site include:
Northern Bobwhite will utilize this ecological site for food (seeds, insects) and cover needs (escape, nesting and roosting cover).

Cottontail rabbits will utilize this ecological site for food (seeds, soft mast) and cover needs.

Turkey will utilize this ecological site for food (seeds, green browse, soft mast, insects) and nesting and brood-rearing cover. Turkey poults feed heavily on insects provided by this site type.

White-tailed deer will utilize this ecological site for browse (plant leaves in the growing season, seeds and soft mast in the fall/winter). This site type also can provide escape cover.

Bird species associated with this ecological site's reference state condition:
Breeding birds as related to vegetation structure (related to time since fire, grazing, haying, and mowing):

Vegetation Height Short (0.5 meter, low litter levels, bare ground visible):
Grasshopper Sparrow, Horned Lark, Upland Sandpiper, Greater Prairie Chicken, Northern Bobwhite

Vegetation Height Moderate (0.5 – 1 meter, moderate litter levels, some bare ground visible): Eastern Meadowlark, Dickcissel, Field Sparrow, Upland Sandpiper, Greater Prairie Chicken, Northern Bobwhite, Blue Grosbeak, Scissor-Tailed Flycatcher, Eastern Kingbird, Lark Sparrow

Vegetation Height Tall (> 1 meter, moderate-high litter levels, little bare ground visible):
Henslow's Sparrow, Dickcissel, Greater Prairie Chicken, Field Sparrow, Northern Bobwhite, Sedge Wren, Northern Harrier

Brushy – Mix of grasses, forbs, native shrubs (e.g., Rhus copallina, Prunus americana), native vines (Rubus spp., Rosa carolina) and small trees (e.g., Cornus racemosa):
Bell's Vireo, Yellow-Breasted Chat, Loggerhead Shrike, Brown Thrasher, Common Yellowthroat

Winter Resident: Short-Eared Owl, Northern Harrier

Amphibian and reptile species associated with this ecological site's reference state condition: prairies with crawfish burrows may have Northern Crawfish Frog (Rana areolata circulosa); Ornate Box Turtle (Terrapene ornata ornata), Western Slender Glass Lizard (Ophisaurus attenuatus attenuatus), Prairie Ring-necked Snake (Diadophis punctatus arnyi), Prairie Kingsnake (Lampropeltis calligaster calligaster), and Bullsnake (Pituophis catenifer sayi).

Prairies with ephemeral vernal fishless wetlands: Western Chorus Frog (Pseudacris triseriata triseriata), Plains Leopard Frog (Rana blairi), Eastern Tiger Salamander (Ambystoma tigrinum), and Great Plains Narrow-mouthed Toad (Gastrophryne olivacea).

Small mammals associated with this ecological site's reference state condition:
Least Shrew (Cryptotis parva), Plains Pocket Gopher (Geomys bursarius), Prairie Vole (Microtus ochrogaster), Meadow Jumping Mouse (Zapus hudsonius), and Badger (Taxidea taxus).

Many native insect species are likely associated with this ecological site, especially native bees, ants, beetles, butterflies and moths, and crickets, grasshoppers and katydids. However information on these groups is often lacking enough resolution to assign them to individual ecological sites.

Insect species known to be associated with this ecological site's reference state condition: Regal Fritillary butterfly (Speyeria idalia) whose larvae feed primarily on native prairie violets (Viola pedata, V. pedatifida, and V. sagittata); Mottled Dusky Wing butterfly (Erynnis martialis), Ottoe Skipper butterfly (Hesperia ottoe), Arogos Skipper butterfly (Atrytone arogos iowa), Golden Byssus butterfly (Problema byssus kumskaka), Delaware Skipper butterfly (Atryone logan logan), and Crossline Skipper butterfly (Polites origenes). The larvae of the moth Eucosma bipunctella bore into compass plant (Silphium laciniatum) roots and feed and the larvae of the moth Eucosma giganteana bore into a number of Silphium species roots and feed. Native bees, important pollinators, that may be associated with this ecological site's reference condition include: Colletes brevicornis, Andrena beameri, A. helianthiformis, Protandrena rudbeckiae, Halictus parallelus, Lasioglossum albipennis, L. coreopsis, L. disparilis, L. nymphaereum, Ashmeadiella bucconis, Megachile addenda, Anthidium psoraleae, Eucera hamata, Melissodes coloradensis, M. coreopsis, and M. vernoniae. The Short-winged Katydid (Amblycorypha parvipennis), Prairie Mole Cricket (Gryllotalpa major), Green Grasshopper (Hesperotettix speciosus) and Two-voiced Conehead katydid (Neoconcephalus bivocatus) are possible orthopteran associates of this ecological site.

Other invertebrate associates include the Grassland Crayfish (Procambarus gracilis).

*This section prepared by Mike Leahy, Natural Areas Coordinator, Missouri Department of Conservation, 2013

Hydrological functions

TBD (to be determined)

Recreational uses

none noted

Wood products

N/A

Other information

Forestry

Management: This ecological site is not recommended for traditional timber management activity. Historically this site was dominated by a ground cover of native prairie grasses and forbs. Some scattered open grown trees may have also been present. May be suitable for non-traditional forestry uses such as windbreaks, environmental plantings, alley cropping (a method of planting, in which rows of trees or shrubs are interspersed with rows of crops) or woody bio-fuels.

Inventory data references

Information presented here has been derived from NRCS clipping data, numerous ocular estimates and other inventory data. Field observations from experienced range-trained personnel was used extensively to develop this ecological site description.

NRCS contracted the development of MLRA 112 ESDs in 2005. Extensive review and improvements were made to those foundational ESDs.

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Contributors

Chris Tecklenburg ES specialist, Hutchinson, KS
Doug Spencer, State Grazinglands Specialist, Salina, KS
Doug Wallace, ACES, MO
Gene Campbell, Soil Survey Project Leader, Clinton, MO
Andrea Brazell, Ecological Site Specialist, Clinton, MO

Approval

Suzanne Mayne-Kinney, 11/05/2024

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Chris Tecklenburg/Revision 8-20-2020 Original authors 1-15-2005 David Kraft, John Henry, Doug Spencer and Dwayne Rice
Contact for lead author	State Grazinglands Specialist for Kansas.
Date	08/20/2020
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** No natural rill formation common or part of the Loamy Upland ecological site.

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2. **Presence of water flow patterns:** There are no water flow patterns evidenced by litter, soil, or gravel redistribution, or pedestalling of vegetation or stones that break the flow of water as a result of overland flow.

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3. **Number and height of erosional pedestals or terracettes:** There is no evidence of pedestals or terracettes that would indicate the movement of soil by water and/or by wind on this site.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Less than 5% bare ground is found on this site. It is the remaining ground cover after accounting for ground surface covered by vegetation (basal and canopy [foliar] cover), litter, standing dead vegetation, gravel/rock, and visible biological crust (e.g., lichen, mosses, algae).

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5. **Number of gullies and erosion associated with gullies:** No evidence of accelerated water flow resulting in downcutting of the soil.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** No wind-scoured or blowout areas where the finer particles of the topsoil have blown away, sometimes leaving residual gravel, rock, or exposed roots on the soil surface. Also, there are no areas of redeposited soil onto this site from another site due to the wind, i.e., depositional areas.

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7. **Amount of litter movement (describe size and distance expected to travel):** No evidence of litter movement (i.e., dead plant material that is in contact with the soil surface).

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil surfaces may be stabilized by soil organic matter which has been fully incorporated into aggregates at the soil surface, adhesion of decomposing organic matter to the soil surface, and biological crusts. A soil stability kit will score a range from 5-6.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Dennis OSD:

   A--0 to 28 cm (0 to 11 inches); very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium and fine granular structure; slightly hard, friable; common worm casts; moderately acid; gradual smooth boundary. [25 to 38 cm (10 to 15 inches) thick]

   AB--28 to 33 cm (11 to 13 inches); brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; slightly hard, friable; common very dark grayish brown (10YR 3/2) worm casts; strongly acid; clear smooth boundary. [0 to 10 cm (0 to 4 inches) thick]

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Functional and structural groups are that of the Reference Plant Community (see functional and structural group worksheet). Note changes to plant communities if different than that of the functional and structural group worksheet.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** There is no evidence of a compacted soil layer less than 6 inches from the soil surface. Soil structure is similar to that described in Indicator 9. Compacted physical features will include platy, blocky, dense soil structure over less dense soil layers, horizontal root growth, and increase bulk density (measured by weighing a known volume of oven-dry soil).

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: Group 1 Tallgrass dominant 63% 2200-3000 lbs. big bluestem 1500-1770, Indiangrass 450-590, eastern gamagrass 250-500. switchgrass 0-40, Florida paspalum 0-25, composite dropseed 0-25,

    Sub-dominant: Group 2 Midgrass subdominant 23% 700-1100 lbs. little bluestem 700-985, sideoats grama 0-25, purple lovegrass 0-25, marsh bristlegrass 0-25, porcupinegrass 0-25.

    Other: Group 3 Cool-season Trace 2% 0-105 lbs. All 0-25; Canada wildrye, prairie junegrass, Scribner's rosette grass, sedge, Virginia wildrye
    Group 4 Forbs Minor 10%, 250-475 lbs. see reference plant community list
    Group 5 Shrubs Trace 2%, 30-95 lbs. leadplant 20-35, New Jersey Tea 10-35, prairie rose 0-35

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Recruitment of plants is occurring and there is a mixture of many age classes of plants. The majority of the plants are alive and vigorous. Some mortality and decadence is expected for the site, due to drought, unexpected wildfire, or a combination of the two events. This would be expected for both dominant and subdominant groups.

14. **Average percent litter cover (%) and depth (in):** Plant litter is distributed evenly throughout the site. There is no restriction to plant regeneration due to depth of litter. When prescribed burning is practiced, there will be little litter the first half of the growing season.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** All species (e.g., native, seeded, and weeds) alive in the year of the evaluation, are included in the determination of total above ground production. Site potential (total annual production) ranges from 3,000 lbs in a below-average rainfall year and 6,500 lbs in an above-average rainfall year. The representative value for this site is 4,750 lbs production per year.

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: There are no noxious weeds present. Invasive plants make up a small percentage of plant community, and invasive brush species are < 5% canopy.

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17. **Perennial plant reproductive capability:** Plants on site exhibit the required vigor and growth to be able to reproduce vegetatively or by seed. Current management activities do not adversely effect the capability of plants to reproduce.
