Ecological site R106XY031NE
Shallow Savannah

Last updated: 6/09/2025
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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): 106X–Nebraska and Kansas Loess-Drift Hills

Named the “Nebraska and Kansas Loess-Drift Hills,” Major Land Resource Area (MLRA) 106 is divided almost evenly between southeastern Nebraska (52%), and northeastern Kansas, (48%). The approximately seven-million-acre landscape covers all or parts of thirty counties between the two states. The northern border is located on the north end of Saunders County, Nebraska, and the MLRA extends into Douglas County, Kansas in the south. The Nebraska cities of Beatrice and Lincoln are the major population centers in the north, while Topeka and Lawrence in Kansas are the primary cities in the south. The Platte, Little Nemaha, and the North Fork of the Big Nemaha Rivers flow through the Nebraska side of the MLRA, while the Black Vermillion, the Soldier, and the Delaware Rivers are the major waterways on the Kansas side. The Big Blue River runs through both states, while the Salt Creek hydrologic system located near Lincoln, Nebraska provides habitat for the only known population of the Federally listed endangered Salt Creek Tiger Beetle. This dissected glacial drift plain primarily consists of broad, smooth ridgetops, and slopes ranging from nearly level to steep. The elevation in MLRA 106 decreases from west to east, and ranges from nearly 1,650 feet to less than 790 feet above sea level. Stream valleys in this landscape are narrow and bordered by steep hills, with 10 to 20 feet of local relief. The river valleys are broader and may drop up to over 160 feet below the adjacent hilltops. The uplands are primarily comprised of glacial drift underlying a mantle of loess, while alluvial deposits are found in the stream and river valleys. Limestone and shale quarries are also located in MLRA 106. The predominant soil orders in this MLRA are mesic, udic, Mollisols, Alfisols, and Entisols. Loams and clays are the primary soil textures in this landscape. Sixty-two percent of the land in this MLRA has been broken out of native prairie and farmed, while only 23 percent of the grasslands remain. Livestock grazing, primarily by cattle, is the main industry on these remnants. Corn, wheat, soybeans, and grain sorghum are the primary commodity crops, but a significant number of acres are also planted to alfalfa for harvest as hay. With annual precipitation averaging from 40 inches in the southeast, to 28 inches in the northwest, irrigation for crop production is not a critical factor in most years. The historical matrix vegetation type is Tallgrass Prairie, and big and little bluestem, switchgrass, Indiangrass, sideoats, and blue grama make up the bulk of the warm season species. Historically, western wheatgrass was the dominant cool-season grass but today the dominant cool-season grasses are introduced grasses, smooth brome in the north and tall fescue in the south. Large and small patch vegetative communities are found primarily along the riparian zones, and on both upland and lowland saline sites. Woodlands make up about six percent of MLRA 106, consisting primarily of green ash, oak, hackberry, boxelder, and maple trees. Wildlife flourishes in this combination of crop and grassland environments. In a landscape historically occupied by bison herds, white-tailed deer are now the most abundant wild ungulates. A variety of smaller species, including coyote, raccoon, opossum, porcupines, muskrat, beaver, squirrel, and mink thrive in the region. Native grassland bird populations are limited by the lack of contiguous native prairie and the fragmented habitat created by the farmland. The rivers, streams, and lakes harbor excellent fisheries, and migrating and local waterfowl use the wetland complexes. These complexes provide ideal habitat for a number of wading and shore bird species as well. This landscape serves as a backdrop for a disturbance driven ecosystem, evolving under the influences of herbivory, fire, and variable climate. Historically, these processes created a heterogeneous mosaic of plant communities and structure heights across the region. Any given site in this landscape experienced fire every three to four years. Fires were caused by lightning strikes and were also set by Native Americans, who used fire for warfare, signaling, and to refresh the native grasses. The Indigenous inhabitants understood the value of fire as a tool and that the highly palatable growth following a fire provided excellent forage for their horses and attracted grazing game animals such as bison and elk. Land use patterns by post European settlers have fragmented the native grasslands through conversion to cropland, transportation corridors, and other developments. This has significantly altered the natural fire regime allowing encroachment by native and introduced shrubs and trees into the native prairie remnants throughout the MLRA. Aggressive fire suppression policies have exacerbated this process to the point that shrub and tree encroachment is a major ecological threat in the majority of both native and reseeded grasslands. Introduction of eastern red cedar as a windbreak species further facilitates invasion by this species. While eastern red cedar is native to the landscape, the historic population in MLRA 106 was limited to isolated pockets in rugged river drainageways that were protected from fire. Widespread plantings of windbreaks with eastern red cedar as a primary component have provided a seed source for the aggressive woody plant. The ensuing encroachment into the native grasslands degrades the native wildlife habit and causes significant forage loss for domestic livestock. Since it does not sprout from the roots, eastern red cedar is very susceptible to fire when under six feet tall. Management with prescribed fire is exceedingly effective if applied before this stage. Larger eastern red cedars

can also be controlled with fire, but successful application requires the use of specifically designed ignition and holding techniques.

Classification relationships

?USDA-NRCS (2022)? Land Resource Region – M, Central Feed Grains and Livestock Region Major Land Resource Area (MLRA) – 106 ?Fenneman (1916) Physiographic Regions ? Division – Interior Plains Province – Central Lowland Section – Dissected Till Plains ? USDA-USFS (2007) Ecoregions? Domain – Humid Temperate Division – Prairie Province – Prairie Parkland (Temperate) Section – Central Dissected Till Plains (251C) ?EPA Ecoregions (Omernik 1997)? I – Great Plains (9) II – Temperate Prairies (9.2) III – Western Corn Belt Plains (9.2.3) IV – Loess and Glacial Drift Hills (47i) ?Associated Counties? Nebraska: Butler, Cass, Gage, Jefferson, Johnson, Lancaster, Nemaha, Otoe, Pawnee, Richardson, Saline, Saunders, Seward Kansas: Atchison, Brown, Doniphan, Douglas, Franklin, Jackson, Jefferson, Johnson, Leavenworth, Marshall, Nemaha, Osage, Pottawatomie, Shawnee, Wabaunsee, Washington, Wyandotte

Ecological site concept

The Shallow Savannah ecological site is located on upland landscapes occupying ridges and slopes. It does not receive additional moisture from runoff or overflow. The typical slope range is from 3 to 45 percent. Soils are shallow, ranging in depth from 6 to 20 inches with surface textures of fine sandy loam, loam, silt loam or silty clay loam. These well to somewhat excessively well drained soils formed in residuum weathered from noncalcareous sandstone and interbedded sandy and silty shale. The vegetation of the Reference Community is dominated by tall and mid grasses under an open woody deciduous canopy. Primary grasses include big bluestem and little bluestem. Grasses of secondary importance include sideoats grama, Indiangrass, and switchgrass. Forbs are common and diverse. Trees are primarily oak, hickory, and elm. Vegetative production is less than that of the associated deeper soils. This site is more intact than many other upland sites within the MLRA and is better suited to grazing than to farming due to the shallow soils and steep slopes.

Associated sites

R106XY068NE	**Loamy Floodplain** The Loamy Floodplain ecological site is a run-on site often positioned down slope of the Shallow Savannah ecological site.
R106XY075NE	**Loamy Upland** The Loamy Upland ecological site is often located adjacent to the Shallow Savannah ecological site.
R106XY077NE	**Shallow Limy** The Shallow Limy ecological site is often adjacent to the Shallow Savannah ecological site.

Similar sites

R106XY077NE	**Shallow Limy** The Shallow Limy ecological sites are effervescent at or near the surface due to the presence of carbonates in the soil while Shallow Savannah ecological sites do not have the presence of carbonates.
R106XY075NE	**Loamy Upland** Loamy Upland ecological sites are found on deep to very deep soils (deeper than 36 inches) while Shallow Savannah ecological sites are typically only 6 to 20 inches deep. As a result, Loamy Upland ecological sites have a higher percentage of tallgrass species and higher productivity.

R106XY031NE	**Shallow Savannah** Savannah and Shallow Savannah ecological sites are found on similar landscape positions and their plant communities have a significant tree overstory. Savannah ecological sites are found on deep to very deep soils (deeper than 36 inches) while Shallow Savannah ecological sites are found on soils that are typically less than 20 inches deep.

Table 1. Dominant plant species

Tree	(1) *Quercus* (2) *Ulmus*
Shrub	(1) *Rhus*
Herbaceous	(1) *Andropogon gerardii* (2) *Schizachyrium scoparium*

Physiographic features

The Shallow Savannah ecological site is a runoff site on erosional uplands, often adjacent to a local drainageway. The plane and convex slopes range from nearly level to steeply sloping.

Table 2. Representative physiographic features

Landforms	(1) Upland > Hillslope
Runoff class	Low to very high
Flooding frequency	None
Ponding frequency	None
Elevation	220 – 520 m
Slope	0 – 50 %
Water table depth	180 cm
Aspect	Aspect is not a significant factor

Climatic features

Like most Great Plains landscapes, the climate in this MLRA is under the sway of the continental effect. This creates a regime of extremes, with summer highs often in the triple digits and winter lows plunging well below zero. Blizzards can occur anytime between early fall and late spring, dropping the temperature more than 50 degrees in just a few hours. These events can pile up several feet of snow, often driven by winds in excess of 50 miles an hour. The resulting huge snow drifts can cause serious hardship for livestock, wildlife, and humans. Winters can be open, with bare ground for most of the season, or closed, with several feet of snow persisting until

March. Most winters have a number of warm days interspersed with dropping temperatures, usually associated with approaching cold fronts. Spring brings violent thunderstorms, hail, and high winds. Tornadoes occur frequently.

About three-fourths of the precipitation falls as high intensity, convective thunderstorms from late spring through early autumn. The average annual precipitation gradient trends higher from northwest (28”) to southeast (40”), and the average annual temperature gradient trends higher from north (50°F) to south (55°F). Daily winds range from an average of 14 miles per hour during the spring to 11 miles per hour during the late summer. Occasional strong storms may bring brief periods of high winds with gusts to more than 80 miles per hour.

Native cool season plants begin growth in early April and continue to about mid-June. Native warm season plants begin growth in early June and continue to early August. Green up of cool season plants may occur in September and October.

Table 3 Representative climatic features

Frost-free period (characteristic range)	150-180 days
Freeze-free period (characteristic range)	190-200 days
Precipitation total (characteristic range)	990-1,040 mm
Frost-free period (actual range)	150-180 days
Freeze-free period (actual range)	190-210 days
Precipitation total (actual range)	970-1,070 mm
Frost-free period (average)	160 days
Freeze-free period (average)	190 days
Precipitation total (average)	1,020 mm

- (1) LAWRENCE [USC00144559], Lawrence, KS
- (2) LEAVENWORTH [USC00144588], Fort Leavenworth, KS
- (3) OSKALOOSA 4 NE [USC00146100], Mc Louth, KS
- (4) BONNER SPRINGS [USC00140957], Bonner Springs, KS
- (5) PERRY LAKE [USC00146333], Perry, KS
- (6) CLINTON LAKE [USC00141612], Lawrence, KS
- (7) KANSAS CITY DOWNTOWN AP [USW00013988], Kansas City, MO

Influencing water features

The vegetative communities on this site are not affected by the water table. Erosion can be a concern with a heavy precipitation event.

Soil features

The soils associated with the Shallow Savannah ecological site are located on uplands with slopes ranging from 3 to 45 percent. These soils were formed in residuum weathered from noncalcareous sandstone. Soils are shallow (less than 20 inches) with silt loam, silty clay loam, loam, or fine sandy loam surface textures which are typically 4 to 8 inches thick. Soils are well drained to somewhat excessively drained with high saturated hydraulic conductivity. The depth to lithic contact ranges from 8 to 20 inches.

Basehor and Vineland are the primary soil series associated with this ecological site. Additional information can be found in the various soil survey reports. Contact the local USDA Service Center for soil survey reports that include more detail specific to your location or visit Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov).

Figure 7. Basehor series profile, Shallow Savannah Ecological Site, MLRA 106.

Table 4. Representative soil features

Parent material	(1) Residuum – sandstone
Surface texture	(1) Silt loam (2) Silty clay loam (3) Loam (4) Fine sandy loam
Drainage class	Well drained to somewhat excessively drained
Permeability class	Slow to moderately rapid
Depth to restrictive layer	20 – 50 cm
Soil depth	20 – 50 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-50.8cm)	4.32 – 9.91 cm
Calcium carbonate equivalent (0-50.8cm)	Not specified
Electrical conductivity (0-50.8cm)	Not specified
Sodium adsorption ratio (0-50.8cm)	Not specified

Soil reaction (1:1 water) (0-50.8cm)	5.1 – 7.8
Subsurface fragment volume <=3" (0-50.8cm)	0 – 10 %
Subsurface fragment volume >3" (0-50.8cm)	0 – 10 %

Ecological dynamics

the Shallow Savannah ecological site developed under Central Great Plains climatic conditions, light to severe grazing by bison and other large herbivores, sporadic natural or human caused wildfires, and other biotic and abiotic factors which typically influence soil/site development. This continues to be a disturbance driven site, by herbivory, fire, and variable climate. Changes occur in the plant communities due to weather variations, impacts of native and exotic plant and animal species, and management actions.

One of the primary impacts to this site introduced by European settlers is season long, continuous grazing by domestic livestock. This management practice causes the repeated removal of the growing point and excessive defoliation of the leaf area of individual warm-season tall grasses. The resulting reduction of the ability of the plants to harvest sunlight depletes the root reserves, subsequently decreasing the root mass. This negatively impacts the ability of plants to compete for life sustaining nutrients, resulting in declining vigor and eventual mortality. The space created in the vegetative community is then occupied by a species that evades the negative grazing impacts by a growing season adaptation such as a cool season, shorter structure, or reduced palatability mechanism.

The State and Transition Model (STM) is depicted following this section and includes a Reference State (1) and a Native/Invaded State (2). Each state represents the crossing of a major ecological threshold due to alteration of the functional dynamic properties of the ecosystem. The main properties observed to determine this change are the soil and vegetative communities and the hydrologic cycle. The STM illustrates the common plant communities that can occur on the site and the transition pathways between communities (Bestelmeyer, 2010). The ecological processes will be discussed in more detail in the plant community descriptions following the diagram.

Each state may have one or more vegetative communities which fluctuate in species composition and abundance within the normal parameters of the state. Within each state, communities may degrade or recover in response to natural and human caused disturbances such as variation in the degree and timing of herbivory, presence or absence of fire, and climatic and local fluctuations in the precipitation regime.

Interpretations are primarily based on the Reference State and have 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 have been interpreted from heavily to lightly grazed areas, seasonal use pastures, and historical accounts. Plant communities, states, transitional pathways, and thresholds have been determined through similar studies and experience.

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

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

Table 6. Community 1.2 plant community composition

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

Table 7. Community 1.3 plant community composition

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

Table 8. Community 1.4 plant community composition

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

Table 9. Community 2.1 plant community composition

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

Table 10. Community 2.2 plant community composition

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

Animal community

LIVESTOCK – GRAZING INTERPRETATIONS: Grazing by domestic livestock is one of the major income producing industries in the area. Rangeland in this area may provide yearlong forage for cattle, sheep, or horses. During the dormant period, the protein levels of the forage may be lower than the minimum needed to meet livestock (primarily cattle and sheep) requirements. The following table lists suggested stocking rates for cattle under continuous season long grazing under normal growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. With consultation of the land manager, more intensive grazing management may result in improved harvest efficiencies and increased carrying capacity. Production and Carrying Capacity* Community 1.1, Reference Community: 1,800 lbs/acre, 0.64 AUM/acre *Based upon the following conditions: continuous season long grazing with cattle under average growing conditions, 25 percent harvest efficiency. Air dry forage requirements are based on 3 percent of animal body weight or 790 lbs per animal unit (AU) per month (M). An AU is generally one mature cow of approximately 1,000 pounds and a calf as old as 6 months or their equivalent. WILDLIFE INTERPRETATIONS: Major Land Resource Area (MLRA) 106 lies primarily within the tall grass prairie ecosystem. Prior to European settlement of North America, this area consisted of diverse grassland habitats interspersed with varying densities of depressional wetlands and limited woody riparian corridors. These habitats provided critical life cycle components for the grassland birds, prairie dogs, and herds of roaming bison, elk, and pronghorn that historically occupied this landscape. Diverse populations of small mammals and insects provided a bountiful prey base for raptors and omnivores such as coyotes, foxes, raccoons, and opossums. Native Americans, bobcats, wolves, and mountain lions occupied the apex predator niche. In addition, a wide variety of reptiles and amphibians thrived in this landscape. The tall grass prairie was a disturbance driven ecosystem with fire, herbivory, and climate functioning as the primary disturbances. Following European settlement of North America, elimination of fire, widespread conversion to cropland, and other sources of habitat fragmentation significantly altered the appearance and functionality of the entire ecosystem. The reduced stability of the system is reflected by major changes in the composition and abundance of the native flora and fauna. Introduced and invading species further degrade the ecological integrity of the plant and animal communities. Bison and prairie dogs were historically keystone species, but free-roaming bison herds and nearly all prairie dogs have been extirpated in this region. The loss of bison and fire as ecological drivers greatly influenced the character of the remaining native grasslands and the habitats they provide. Historically, an ecological mosaic of the sites provided habitat for species requiring unfragmented grasslands. Important habitat features and components found commonly or exclusively on modern day remnants include upland nesting habitat for grassland birds and game birds; nesting and escape cover for waterfowl; forbs and insects for brood rearing habitat; and a forage source for small and large herbivores. Fragmentation has reduced habitat quality for numerous area sensitive species, as highlighted by the decline of the greater prairie chicken. Many grassland nesting bird populations such as dickcissel and Henslow's sparrow are also declining. In this fragmented landscape, native grassland bird populations face increasing competition from the opportunistic European starlings and house sparrows and are subject to nest parasitism from brown headed cowbirds. Tree encroachment creates habitat that favors generalist species such as American robin and mourning dove, and provides perches for raptors, increasing the predation mortality. Introduced species such as smooth bromegrass, reed canary grass, Kentucky bluegrass, nodding plumeless thistle (musk thistle), and Canada thistle further degrade the biological integrity of many of these remnant prairies. 1. REFERENCE STATE: The Shallow Savannah ecological site provides habitat for numerous wildlife species. The combination of tall grasses, forbs, shrubs, and trees provide food, nesting, and loafing cover for deer, quail, numerous songbirds, and small mammals. It may also be suitable habitat for limited populations of wild turkey. Several species of lizards and snakes inhabit this site. Maintaining adequate woody vegetation for travel lanes and escape cover is necessary for maximum wildlife populations. When practicing brush management, the maintenance of a well-planned brush pattern can enhance the site for most animals and songbirds. This usually requires that 25 to 35 percent of the area be maintained in woody vegetation.

Hydrological functions

The primary soil series associated with the Shallow Savannah ecological site is Basehor. It is classified as a hydrologic group D soil. The major hazard on this site is its susceptibility to rill and small gully erosion, especially on the steeper slopes. Please refer to the NRCS National Engineering Handbook Section 4 (NEH-4) for runoff quantities and hydrologic curves when making hydrology determinations.

Recreational uses

The Shallow Savannah ecological site provides for a variety of outdoor activities including camping, hunting, bird watching, hiking, and outdoor/wildlife photography. There are a variety of flowering plants in bloom throughout the growing season that provide much aesthetic appeal to the landscape. Recreation can be a valued use, but there are site considerations such as steep, rocky, and rough terrain.

Wood products

A mature overstory can provide a limited amount of timber and firewood, though due to access issues and the limited supply, harvest may not be economically feasible.

Other products

No appreciable other products.

Other information

Site Development and Testing Plan: Future work is needed to validate the information in this Provisional Ecological Site Description. Additional data collection and evaluation may also be needed to develop this ESD to the Approved, then Correlated level. This could include field activities to collect low, medium, and high intensity sampling, soil correlations, and analysis of that data. Field reviews of the project plan should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document.

Inventory data references

Historical accounts and data are supplemented by expert opinions from resource professionals.

Other references

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Contributors

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Approval

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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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Date	11/30/2024
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** **None. Rills are not expected on this site.**

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2. **Presence of water flow patterns:** **Typically, none. Water flow patterns are not expected on this site except on slopes exceeding 20 percent. When present, water flow patterns will be rare, short (less than 12 inches or 30 cm), narrow (less than 6 inches or 15 cm wide), and disrupted by perennial vegetation.**

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3. **Number and height of erosional pedestals or terracettes:** **Typically, none. Pedestals or terracettes are not expected on the site, except on slopes exceeding 15 percent. On these steeper slopes, bunch grasses may occasionally be pedestalled (average of 2 or less per square meter), with no exposed roots. Drought, wildfire, and prescribed burns should not increase the incidence of pedestals.**

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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 5 percent or less. Bare ground is exposed mineral soil that is not covered by vegetation (basal and/or foliar canopy), 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:** None. Gullies are not expected on this site.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None. Wind scoured and/or depositional areas are not expected on this site.

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7. **Amount of litter movement (describe size and distance expected to travel):** Typically, none. Litter movement is not expected on this site except on slopes exceeding 15 percent and due to high intensity storms. In this case, fine litter movement will be short distances of 6 to 12 inches (15 to 30 cm) and be associated with water flow patterns.

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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 stability ratings will be 5 to 6, typically 6. High root content and organic matter will be present in the soil surface.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The surface horizon (A) typically ranges from 4 to 8 inches thick. Soil colors in the surface horizon are typically dark grayish brown (hue: 10YR, value: 4, chroma: 2) or very dark grayish brown (hue: 2.5Y, value: 3, chroma: 2) when moist and light grayish brown (hue: 10YR, value: 4, chroma: 2) or grayish brown (hue: 2.5Y, value: 5, chroma: 2) when dry. Soil structure in the upper horizon ranges from weak fine granular to moderate medium granular. See Official Soils Descriptions (OSD) for additional details. The Basehor and Vinland soil series are correlated to this site.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** A plant community composed of 70 percent grasses and grass-likes, 10 percent forbs, and 20 percent shrubs and trees will optimize infiltration on the site. Infiltration can be adversely impacted by the invasion of Kentucky bluegrass, smooth brome, tall fescue, and trees when present above 10 percent (subdominant designation).

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

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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: Phase 1.1: 1. Native, perennial, warm-season, mid grass (2 species minimum): little bluestem, sideoats grama, composite dropseed, purple lovegrass. 2. Native, perennial, warm-season, tall grass (2 species minimum): big bluestem, Indiangrass, switchgrass. Phase 1.2: 1. Native, perennial, warm-season, mid grass (3 species minimum): little bluestem, composite dropseed, sideoats grama, purple lovegrass. Phase 1.3: 1. Native, perennial, warm-season, short grass (1 species minimum): blue grama, hairy grama. 2. Native, deciduous trees (2 species minimum): American elm, hickory, bur oak, and other deciduous trees that vary from location to location.

Sub-dominant: Phase 1.1: 1. Native, perennial, cool-season grass (2 species minimum): western wheatgrass, prairie junegrass, porcupinegrass, needleandthread, Scribner rosette grass. 2. Native, deciduous trees (2 species minimum): American elm, hickory, bur oak, and other deciduous trees that vary from location to location. 3. Shrubs (2 species minimum): leadplant, smooth sumac, jersey tea, coralberry, prairie rose, western snowberry or other shrubs that vary from location to location. Phase 1.2: 1. Native, perennial, warm-season, tall grass (2 species minimum): big bluestem, Indiangrass, eastern gamagrass, switchgrass. 2. Native, perennial, warm-season, short grass (1 species minimum): blue grama, hairy grama. 3. Native, deciduous trees (2 species minimum): American elm, hickory, bur oak, and other deciduous trees that vary from location to location. 4. Shrubs (2 species minimum): leadplant, smooth sumac, jersey tea, coralberry, prairie rose, western snowberry or other shrubs that vary from location to location. Phase 1.3: 1. Shrubs (2 species minimum): leadplant, smooth sumac, jersey tea, coralberry, prairie rose, western snowberry or other shrubs that vary from location to location. 2. Native, perennial, cool-season grass (2 species minimum): porcupinegrass, Canada wildrye, prairie junegrass, western wheatgrass, Scribner rosette grass, fall rosette grass.

Other: Minor - Phase 1.1: 1. Native, perennial, warm-season, short grass: blue grama, hairy grama. 2. Native forbs: Nuttall's sensitive briar, roundhead lespedeza, sunflowers, and other forbs that vary from location to location. Minor - Phase 1.2: 1. Native, perennial, cool-season grass: porcupinegrass, Canada wildrye, prairie junegrass, western wheatgrass, Scribner rosette grass, fall rosette grass. 2. Native forbs: forbs present vary from location to location. 3. Grass-likes: sedges. Minor - Phase 1.3: 1. Native, perennial, warm-season, tall grass: big bluestem, Indiangrass, eastern gamagrass, switchgrass. 2. Native, perennial, warm-season, mid grass (2 species minimum): little bluestem, composite dropseed, sideoats grama, purple lovegrass. 3. Non-native, cool-season grass: Kentucky bluegrass, smooth brome, tall fescue. 4. Native forbs: forbs present vary from location to location. 5. Grass-likes: sedges. Trace - Phase 1.1: 1. Grass-likes: sedges. Trace - Phase 1.2: 1. Non-native or naturalized, cool-season grass.

Additional: The Reference Community (1.1) includes eight F/S groups. These groups in order of abundance are native, perennial, warm-season, mid grass; native, perennial, warm-season, tall grass; native, perennial, cool-season grass; native, deciduous trees; shrubs; native, perennial, warm-season, short grass; forbs; grass-likes. The Degraded Native Grass Community (1.2) includes nine F/S groups. These groups in order of abundance are native, perennial, warm-season, mid grass; native, perennial, warm-season, tall grass; native, perennial, warm-season short grass; native, deciduous trees; shrubs; native, perennial, cool-season grass; forbs; grass-likes; nonnative, cool-season grass. The At-Risk Community (1.3) includes nine F/S groups. These groups in order of abundance are native, perennial, warm-season, short grass; native, deciduous trees; shrubs; native, perennial, cool-season grass; native, perennial, warm-season, tall grass; native, perennial, warm-season, mid grass; non-native, cool-season grass; forbs; grass-likes.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence): There is a diverse mixture of age classes among the plants. A few (less than 3 percent) dead centers may occur in bunch grasses. Shrubs and trees may show some dead branches (less than 5 percent) as plants age.**

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14. **Average percent litter cover (%) and depth (in): Plant litter cover is evenly distributed throughout the site and is expected to be 50 to 70 percent and at a depth of 0.5 to 1.0 inches (1.25 to 2.50 cm). Kentucky bluegrass excessive litter can negatively impact the functionality of this site.**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production): Production is shown in air dry values. Representative Value (RV) = 1,800 pounds per acre. Low production years = 1,500 pounds per acre. High production years = 2,300 pounds per acre.**

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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: **No non-native invasive species are present. Kentucky bluegrass, smooth brome, silver bluestem, Caucasian bluestem, tall fescue, eastern red cedar, honey locust, rough leaf dogwood, buckbrush, smooth sumac, musk thistle, common mullein, and annual brome are known invasives that have the potential to be dominant or co-dominant on the site. Consult the state noxious weed and state watch lists for potential invasive species on each ecological site. NOTE: Invasive plants (for the purposes of the IIRH protocol) are plant species that are typically not found on the ecological site or should only be in trace or minor categories under the natural disturbance regime and have the potential to become a dominant or co-dominant species on the site if their establishment and growth are not actively controlled by natural disturbances or management interventions. Species listed characterize degraded states AND have the potential to become a dominant or co-dominant species.**

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17. **Perennial plant reproductive capability:** **All perennial species exhibit high vigor relative to climatic conditions. Perennial grasses should have vigorous rhizomes or tillers; vegetative and reproductive structures are not stunted. All perennial species should be capable of reproducing annually.**
