USDA Natural Resources Conservation Service

Ecological site R073XY120KS
Clay Terrace

Last updated: 10/03/2019
Accessed: 05/13/2025

General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

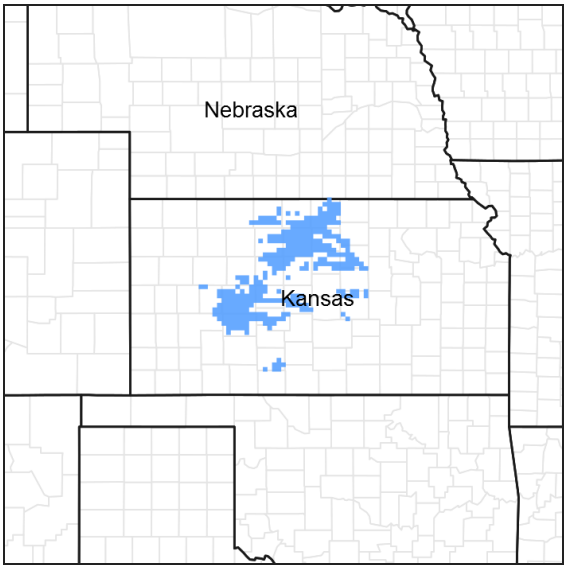


Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 073X–Rolling Plains and Breaks

This ESD is located in the Rolling Plains and Breaks Major Land Resource Area (MLRA) 73 of the Central Great Plains Winter Wheat and Range Region of the United States. MLRA 73 is in Kansas (78 percent) and Nebraska (22 percent). It makes up about 21,485 square miles (13,750,400 acres). The towns of Hays, Great Bend, and Dodge City, Kansas, and Alma, Curtis, Holdrege, and McCook, Nebraska are in this MLRA. The MLRA is bisected by Interstate 70. The Platte River is at the northern edge of the area, and the Arkansas River is at the southern edge.

Classification relationships

Major land resource area (MLRA): 073-Rolling Plains and Breaks

Ecological site concept

The soils characteristic of this site formed in alluvium on stream terraces or flood plains. The Clay Terrace site is characterized by soils with greater than 40 percent clay in the surface.

Associated sites

R073XY108KS	**Loamy Floodplain** The Loamy Floodplain ecological site is on similar landforms and has less than 35 percent clay in the particle-size control section.
R073XY118KS	**Blue Shale** The Blue Shale ecological site are on adjacent uplands and are underlain by clayey shales.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The western half of MLRA 73 and areas along the Arkansas River have remnants of the Tertiary river-laid sediments washed out onto the plains from erosion of the prehistoric Rocky Mountains in Colorado. In the valley of the Arkansas River, the wind reworked these sediments, forming a hummocky dune surface of eolian sand. A loess mantle occurs on the higher ground in the western half of the area. The Tertiary-age Ogallala and White River Formations cover Cretaceous Pierre Shale in the northern part of the area. The Ogallala Formation consists of loose to well cemented sand and gravel, and the White River Formation consists of ashy claystone and sandstone. Pierre Shale and Niobrara Chalk are at the surface in the valleys of the Republican, Smoky Hill, and Saline Rivers. Fort Hays limestone of the Niobrara Formation and Blue Hill shale of the Carlile Formation are at the surface in the valleys of the Saline and Smoky Hill Rivers. Shale can be seen exposed in the eastern half of this MLRA, in Kansas. Quaternary and more recent sand and gravel partially cover the shale in the river valleys.

The Clay Terrace site is located on nearly level to gently sloping alluvial benches, terraces, or fans. Although flooding is rare, additional water run-in is received from adjacent uplands. This site consists of deep, moderately well drained soils. These soils formed in alluvium on stream terraces or flood plains. The surface layer textures are silty clay.

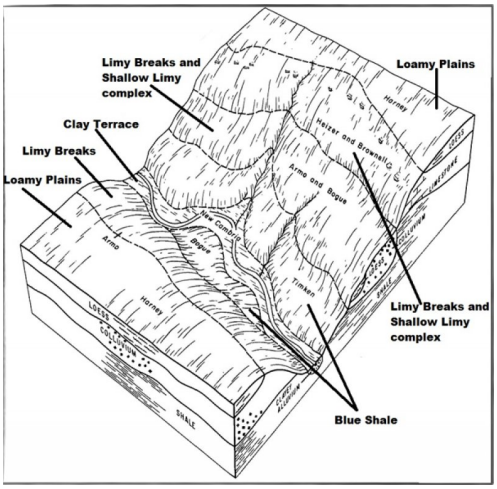


Figure 2. MLRA 73 ESD block diagram.

Table 2. Representative physiographic features

Landforms	(1) Stream terrace (2) Flood plain (3) Fan
Flooding duration	Extremely brief (0.1 to 4 hours)
Flooding frequency	None to very rare
Ponding frequency	None

Elevation	488–853 m
Slope	0–5%
Ponding depth	0 cm
Water table depth	178 cm

Climatic features

For MLRA 73 the average annual precipitation is 19 to 30 inches (48 to 76 centimeters). Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The maximum precipitation occurs from the middle of spring to the early autumn months. Precipitation in winter occurs as snow. The annual snowfall ranges from about 17 inches (45 centimeters) in the southern part of the area to 24 inches (60 centimeters) in the northern part. The average annual temperature is 48 to 56 degrees F (9 to 14 degrees C). The freeze-free period averages 180 days and ranges from 145 to 210 days, increasing in length from northwest to southeast. The following weather data originated from weather stations chosen across the geographical extent of the ecological site, and will likely vary from the data for the entire MLRA. The climate data derives from the Natural Resources Conservation Service (NRCS) National Water and Climate Center. The data-set is from 1981-2010.

Table 3. Representative climatic features

Frost-free period (average)	161 days
Freeze-free period (average)	185 days
Precipitation total (average)	686 mm

Climate stations used

- (1) BELOIT [USC00140693], Beloit, KS
- (2) GREAT BEND [USC00143218], Great Bend, KS
- (3) HAYS 1 S [USC00143527], Hays, KS
- (4) MANKATO [USC00144982], Mankato, KS
- (5) CEDAR BLUFF DAM [USC00141383], Ogallah, KS
- (6) LINCOLN 1 SE [USC00144712], Lincoln, KS
- (7) LARNED [USC00144530], Larned, KS

Influencing water features

This site is made up of alluvial soils that have a water table greater than 6 feet from the surface. Fluctuations with this water table occur and there could be times throughout the year that it is less than 6 feet from the surface. Water influences this site due to landform position. This site is adjacent to streams and is in a water-receiving position.

Figure 7–1 The hydrologic cycle with factors that affect hydrologic processes

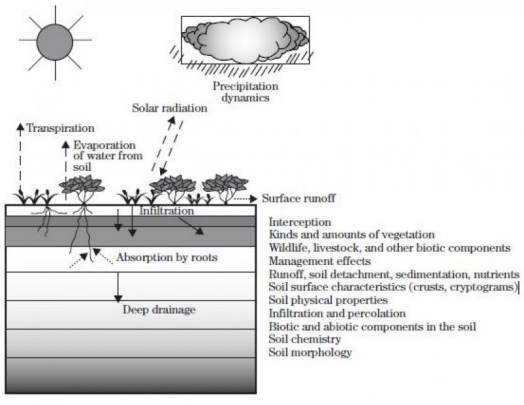


Figure 7. Fig.7-1 from National Range and Pasture Handbook.

Soil features

The soils on this site are deep and are moderately well drained. The parent material is alluvium formed on stream terraces or flood plains. The surface soil is from 6 to 14 inches thick, generally is dark colored, and has a silty clay texture. The underlying material is dark colored and also has a silty clay texture. Carbonates (slight effervescence) occur throughout the profile. The content of organic matter is estimated at 2-4 percent in the surface horizon. Available water capacity ranges from low to moderate. Flooding is very rare to frequent and runoff is low.

The major soil series correlated to this ecological site is New Cambria.

These attributes represent 0-40 inches in depth or to the first restrictive layer.

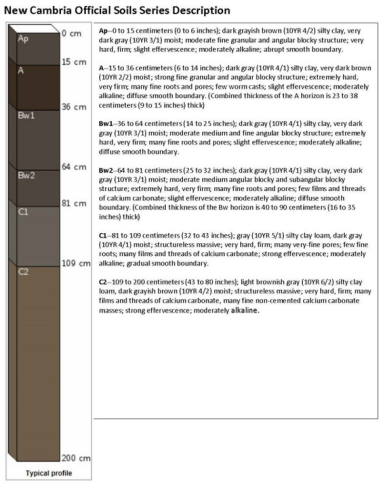


Figure 8. Official Series Description of New Cambria.

Table 4. Representative soil features

Surface texture	(1) Silty clay
Family particle size	(1) Clayey
Drainage class	Moderately well drained
Permeability class	Moderate
Soil depth	102–152 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	36.73–37.95 cm
Calcium carbonate equivalent (0-101.6cm)	3–10%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	7.7–8
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The grasslands of Major Land Resource Area (MLRA) 73, the Rolling Plains and Breaks, is located in south-central Nebraska and central Kansas. It evolved under sub-humid (20-40 inch precipitation range) climates, characterized by much the same weather extremes of temperatures, rainfall, and snowfall we are familiar with today. As a result of glacial activity and other natural forces, then and later, plants have migrated from their places of origin, so that today MLRA 73 grasslands are simple-to-complex mixtures of perennial grasses and forbs, plus a few native annuals and biennials. Species composition has been modified by the introduction of Kentucky bluegrass and cool-season annual and perennial grasses, particularly Japanese brome (Launchbaugh and Owensby, 1978).

Through the ages to modern times, wildfires – many started by lightning, but most by primitive people – influenced development of fire-tolerant grasses and suppressed woody vegetation (Sauer, 1950). Certain woody plants, however, always were present as natural components of some grasslands. Browsing by animals and frequent prairie fires were largely responsible for maintaining “normal” amounts of woody species (Dyksterhuis, 1958). In primitive time, numerous large herbivores subjected herbaceous vegetation to grazing stress. After the last glacial retreat, bison emerged as the major dominant large grazer, although the prairies and plains simultaneously supported many pronghorn antelope, elk, deer, prairie dogs, rabbits, rodents, and insects. And each exerted grazing pressures on the vegetation (Launchbaugh and Owensby, 1978). There is little doubt that during and long before Spanish explorations into this area, most of the grassland was used almost continuously throughout the year by one roving herd of buffalo after another and other grazing animals (early exploration accounts reviewed by Dary in 1974; diaries of early Kansas residents cited by Choate and Fleharty in 1975). Grazing and trampling by bison and their associates were often intensive, as was uncontrolled grazing by livestock in the late 1800s after most of the wild grazers had been eliminated.

The plant communities for the Clay Terrace ecological site are dynamic due to the complex interaction of many ecological processes. The interpretive plant community for this site is the Reference Plant Community. The Reference Community has been determined by the study of rangeland relic areas, areas protected from excessive disturbance, areas under long term rotational grazing strategies, literature of plant communities from the early 1900s, and local expertise. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts have also been used.

This ecological site is made up of a Grassland State, a Woody State, and a Tillage State. The Grassland State is characterized by non-broken land (no tillage), warm-season bunchgrasses, sod forming grasses, forbs, and shrubs. The Woody State is characterized by a community made up of eastern redcedar, Siberian elm, Russian Olive, honeylocust, and cottonwood with few remnant native grasses making up the understory and forbs. The Tillage State has been mechanically disturbed (broken) by equipment and includes either a variety of reseeded warm-season bunch and sod-forming grasses or early successional plants to include the latter as well as annual grasses and forbs.

Vegetation changes are expected within this ecological site and will be dependent on the site's geographical location inside Major Land Resource Area (MLRA) 73. Variation in precipitation east and west is not as affected as is temperature north and south. The northern part of MLRA 73 is characterized by cooler temperatures and shorter growing season in respect to the southern end. As a result, cool-season bunchgrasses, and sod-formers proliferate. Growth of native cool-season plants begins about April 15, and continues to about June 15. Native warm-season plants begin growth about May 15, and continue to about August 15. Green-up of cool-season plants may occur in September and October if adequate moisture is available (weather data from National Climate Data Center, 1980-2010).

The Clay Terrace ecological site developed with occasional fires as part of the ecological processes. Historically, it is believed that the fires were infrequent, randomly distributed, and started by lightning at various times throughout the season when thunderstorms were likely to occur. It is also believed that pre-European inhabitants may have used fire as a management tool for attracting herds of large migratory herbivores (bison, elk, deer, and pronghorn). The impact of fire over the past 100 years has been relatively insignificant due to the human control of wildfires and the lack of acceptance of prescribed fire as a management tool in the sub-humid, High Plains and Smoky Hills area.

The degree of herbivory (feeding on herbaceous plants) has a significant impact on the dynamics of the site. Historically, periodic grazing by herds of large, migratory herbivores was a primary influence. Secondary influences of herbivory by species such as prairie dogs, grasshoppers, gophers, and root-feeding organisms impacted the

vegetation historically, and continue to this day.

The management of herbivory by humans through grazing of domestic livestock and/or manipulation of wildlife populations has been a major influence on the ecological dynamics of the site. This management, coupled with the High Plains and Smoky Hills climate, largely dictates the plant communities for the site.

Drought cycles were part of the natural range of variability within the site and historically have had a major impact upon the vegetation. The species composition changes according to the duration and severity of the drought cycle (Albertson and Weaver, 1940).

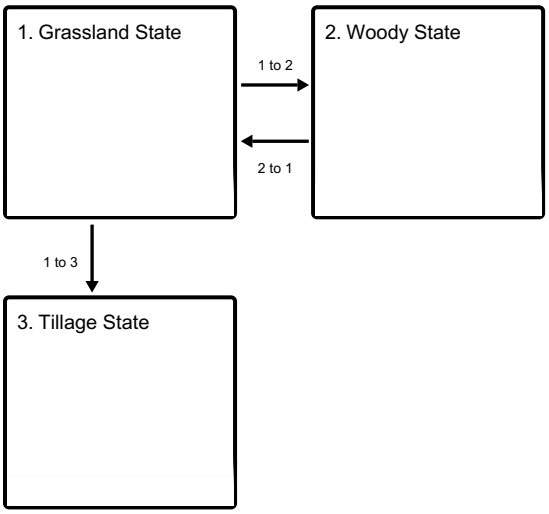
This site appears on nearly level bottomland adjacent to streams in the area. It is seldom found as extensive areas but rather occurs as isolated pockets. Management of this ecological site by itself is difficult.

The general response of this site to long-term continuous grazing pressure is to gradually lose the vigor and reproductive potential of the tallgrass species, and shift the plant community toward mid- and shortgrasses.

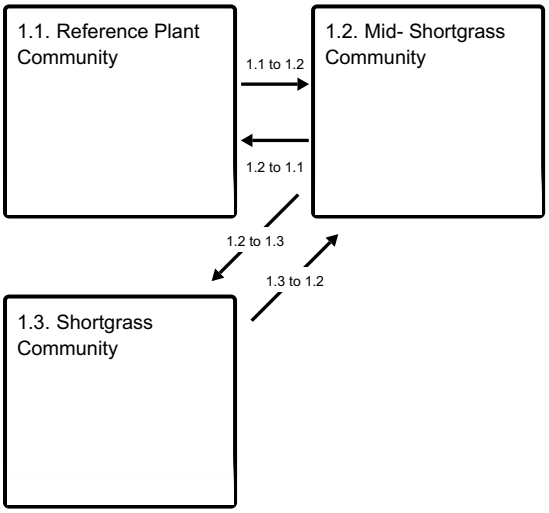
The following diagram illustrates pathways that the vegetation on this site may take from the Reference Plant Community as influencing ecological factors change. There may be other states or plant communities not shown in the diagram, as well as noticeable variations within those illustrated and described in the following sections.

State and transition model

Ecosystem states



State 1 submodel, plant communities



State 2 submodel, plant communities

2.1. Tree and Shrub Community

State 3 submodel, plant communities

3.1. Reseed Community

3.2. Go-back Community

State 1
Grassland State

The Grassland State is supported by empirical data, historical data, local expertise, and photographs. This state is defined by three native plant communities that are a result of periodic fire, drought, and grazing. These events are part of the natural disturbance regime and climatic process. The Reference Plant Community consists of both warm- and cool-season, tall- and midgrasses, forbs, shrubs. The Mid-Shortgrass Plant Community consists of cool- and warm-season mid- and shortgrasses, forbs, and shrubs, and/or woody species. Community 3 consists of shortgrasses, forbs, and annuals.

Community 1.1
Reference Plant Community

The Reference Plant Community serves as the basis for all other interpretations. The potential vegetation of this site is a mixed grass prairie. This community includes approximately 88 percent grasses and grass-like plants, 10 percent forbs, and 2 percent trees, shrubs, and cacti. Tallgrasses dominate the site and comprise 40% of the total annual production produced. The tallgrasses include big bluestem, switchgrass, Indiangrass, composite dropseed, and sand dropseed. The midgrasses make up 23% of the plant community and include little bluestem and sideoats grama. The cool-season grasses western wheatgrass, Canada wildrye, and sedges comprise 15% of the plant community. Blue grama and buffalograss are shortgrasses that make up 10%. The Reference Plant Community has a diverse forb population that makes up 10 percent of the total annual production per ac/yr while shrubs and cacti make up 2 percent. Prescription grazing that allows for adequate recovery periods after each grazing event and a forage and animal balance will maintain the biotic integrity of this plant community. Spring grazing and summer deferment will reduce the cool-season component of this plant community and increase the warm-season component and palatable shrubs. Spring deferment and summer grazing will increase the cool-season component and decrease the warm-season component of this plant community. The Reference Plant Community is diverse and productive. The abundance and diversity of vegetation found on this site allows for excellent capture and storage of precipitation and increased infiltration rates. Plant litter, lack of large areas of bare ground, and a shrub component of less than 5 percent canopy cover will promote the proper function of the water and nutrient cycles. Decomposition of roots, high infiltration rates, and high litter cover allow for the proper function of the nutrient cycle in the Reference Plant Community. Total annual production ranges from 2,500 to 4,500 pounds of air-dried vegetation per acre per year and will average 3,500 pounds.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2466	3452	4439
Forb	280	392	504
Shrub/Vine	56	78	101
Total	**2802**	**3922**	**5044**

Community 1.2
Mid- Shortgrass Community

This plant community developed under heavy, continuous season-long grazing. The dominant Reference Plant Community species were not given adequate rest and recovery during the growing season. Big bluestem, switchgrass, Indiangrass, sideoats grama, and other desirable species lose productive capacity through loss of vigor and reproductive potential. Forb diversity is reduced. A decrease in tallgrass production and density is indicative of changes leading to a major shift in the plant community. This community phase marks a shift in plant composition from a tall- and midgrass community to a mid- and shortgrass plant community. Tallgrasses, such as big bluestem, Indiangrass, and switchgrass, are decreasing in vigor with continued defoliation. Tallgrasses are being replaced by grasses such as western wheatgrass, blue grama, and buffalograss. Timing of defoliation (grazing, wildfire, hail, etc.) will have an impact on the proportions of species within the plant community. Due to the decrease in plant litter, organic matter, and biomass, effective precipitation is reduced, causing a decline in production compared to the Reference Plant Community. Rangeland health on this site is affected by less efficient nutrient cycling, the biotic integrity of the site, as well as hydrologic cycle disturbance. Total annual production ranges from 1,500 to 2,500 pounds of air-dried vegetation per acre per year and will average 2,000 pounds.

Figure 10. Plant community growth curve (percent production by month). KS7307, Western Wheatgrass, Buffalograss, Blue Grama. Reference community phase growth curve is generalized in order to capture both warm and cool season species. .

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	10	23	25	25	10	5	0	0	0

Community 1.3
Shortgrass Community

Buffalograss and little barley dominate the Shortgrass Community phase. The key warm- and cool-season midgrasses, such as western wheatgrass, little bluestem, and sideoats grama are absent or in remnant amounts only. Threeawns, annuals, and broom snakeweed are secondary species. This state marks a shift from the western wheatgrass, buffalograss, blue grama community to a shortgrass-dominated community of buffalograss and little barley. Remnant midgrasses such as little bluestem and sideoats grama have reduced vigor. This reduction is due in part to continuous defoliation and inadequate rest and recovery. Remnant tallgrass species will no longer be present. A significant amount of production and diversity has been lost when compared to the Reference Plant Community. Loss of cool-season grasses and desirable forbs have negatively impacted the plant community. Soil loss is obvious where flow paths are connected. The plant community lacks diversity. Due to the decrease in plant litter and biomass the effective precipitation is reduced, causing a decline in total annual production. Soil health is affected as a result of inefficient nutrient, mineral, and hydrology cycles. Total annual production ranges from 600 to 1,500 pounds of air-dried vegetation per acre per year.

Figure 11. Plant community growth curve (percent production by month). KS7308, Buffalograss, Ragweed, Little Barley.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	15	35	30	10	5	0	0	0

Pathway 1.1 to 1.2
Community 1.1 to 1.2

Long-term (>10 years) management that includes repetitive heavy use (grazing/defoliation) during the growing season, lack of rest, and recovery of the grazed key forage species, no prescribed fires, and/or no forage and animal balance may contribute to the cause of shift between community phases.

Pathway 1.2 to 1.1
Community 1.2 to 1.1

Management incorporating long-term (>10 years) prescription grazing that includes a forage and animal balance, prescription fires at a frequency of 1 in 7 years, and providing adequate rest and recovery periods of the key forage species during the growing season. Shifts in community phases are reversible through succession, natural disturbances, short-term climatic variations, and use of practices such as grazing management.

Pathway 1.2 to 1.3
Community 1.2 to 1.3

Long-term (>10 years) management without a forage and animal balance, an absence of brush maintenance or removal, consistently grazing during the summer months, no prescription fires, and continuous grazing without adequate recovery periods between grazing events. These types of management scenarios will convert Community 2 to a community of shortgrasses, forbs, and annuals.

Pathway 1.3 to 1.2
Community 1.3 to 1.2

Management that incorporates long-term (~10 years) prescription grazing, a forage and animal balance, brush management, adequate rest and recovery of the key forage species, and prescription fires will favor this plant community to restore Community Phase 2.

State 2
Woody State

This state is dominated by a tree and/or shrub plant community. The increase and spread of trees results from an absence of fire. 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 tends to hinder the establishment of most woody species, and favors forbs and grasses. However, it should be pointed out that not all unburned areas have a woody plant invasion. Hydrologic function is affected by the amount of vegetative cover. 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 dynamic property changes affected include biological activity, infiltration rates, and soil fertility. 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. In some locations the use of chemicals as a brush management tool may be desirable to initiate and accelerate this transition. Birds, small mammals, and livestock are instrumental in the distribution of seed and accelerating the spread of most tree and shrubs common to this site. The speed of encroachment varies considerably and can occur on both grazed and non-grazed pastures. Many species of wildlife, especially bobwhite quail, turkey, and white-tailed deer benefit from the growth of trees and shrubs for both food and cover. Conversely, the presence of trees is considered detrimental to populations of greater prairie chickens. When management for specific wildlife populations is desirable, these options should be considered in any brush management plan.

Community 2.1
Tree and Shrub Community

This community is dominated by trees with a canopy cover usually greater than 15-20 percent. Trees characterizing this community can include eastern redcedar, Siberian elm, Russian olive, honeylocust, and cottonwood. When tree encroachment occurs on areas that have been subjected to long-term, continuous overgrazing, the associated grasses will usually consist of composite dropseed, purpletop tridens, purple lovegrass, Kentucky bluegrass, and Scribner’s rosette grass. Trees will also invade areas where both grazing and fire have been excluded for many years. A heavy accumulation of plant mulch and litter retarding herbage growth. This provides a favorable habitat for seed germination and establishment of many woody species. Grass yields are significantly reduced, 10 to 30 percent of the total vegetative production, due to the competition from woody species. The combination of less water entering the soil and strong ability by the trees to extract water, means that little water has a chance to drain beneath the root zone. Therefore, invasion of trees and shrubs on large areas that were once primarily grassland

has strong implications for recharge of aquifers. It can be a common occurrence to have seeps and springs stop flowing in conjunction with increases in tree and shrub cover (Thurow and Hester, 1997). In this plant community, the amount of available forage is heavily dependent upon the predominant woody species cover and the kind(s) of livestock and/or wildlife utilizing the site. A prescribed burning program, mechanical brush removal, and periodic rest and recovery accompanied by prescribed grazing can return the plant community to one dominated by grasses and forbs. The time frame will be dependent upon the percentage of canopy cover and remnant native grass population remaining. 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 and mechanical removal as a brush management tool will usually be necessary to reduce fire-resistant woody species populations in order to accelerate the recovery of desired vegetative cover. Some landowners rely on the browsing habits of goats to suppress the woody growth.

State 3
Tillage State

The Tillage State consists of abandoned cropland that has been naturally revegetated (go-back) or planted/seeded to grassland. Many reseeded plant communities were planted with a local seeding mix under the Conservation Reserve Program (CRP) or were planted to a monoculture of sideoats grama. Go-back communities are difficult to define due to the variability of plant communities that can exist. Many of these communities are represented by the genus Aristida (threeawns). This is an alternative state since the energy, hydrologic, and nutrient cycles are altered to that of the Reference State in its natural disturbance regime. 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).

Community 3.1
Reseed Community

This plant community is created when the soil is tilled or farmed (sodbusted), and abandoned. All of the native plants are killed, soil organic matter and carbon reserves are reduced, soil structure is altered, and a plowpan or compacted layer can be observed, limiting water infiltration. Synthetic chemicals may remain as a residual in the soil from farming operations. In early successional stages, this community is not stable. Wind and water erosion is a concern within this plant community. This plant community can vary considerably depending on how eroded the soil was, the species seeded, the stand that was established, how long ago the stand was established, and the management of the stand since establishment. Prescribed grazing that incorporates adequate recovery periods between grazing events and a forage and animal balance is necessary to maintain the health, vigor, and productivity of desirable species. Selection of grass species by grazing animals on seeded rangeland sites can be significantly different from native range sites. Typically there is a reduced production level on seeded sites, compared to native sites with similar species composition. Species diversity is lower, and forb species generally take longer to re-establish. Seeded rangeland should be managed separately due to the natural ecological differences and livestock grazing preference.

Community 3.2
Go-back Community

This plant community originates when the soil is tilled or farmed (sodbusted), and abandoned. Generally land that has been used for purposes other than rangeland or hayland will start to revegetate when left undisturbed. Due to tillage activity there are no native plants, soil organic matter and carbon reserves are reduced, soil structure is altered, and a plowpan or compacted layer can be formed, limiting water infiltration. Many times synthetic chemicals remain as a residual from farming operations. Wind and water erosion is a concern within this plant community. The initial ground cover will primarily consist of kochia, annual bromes, pigweed, foxtail (bristlegrass), Russian thistle, witchgrass, and tumblegrass as well as other annuals. These plants give some protection from erosion and start to rebuild organic matter. The next succession of plants will be grasses such as composite dropseed, threeawn, silver bluestem, and annuals. Eventually, after decades, blue grama, sideoats grama, and buffalograss will come back. These species will not regain in proportions to that of the Reference State plant communities. Soil structure, aggregate stability, and organic matter will also not recover to conditions of the Reference State. Range seeding can accelerate the process of species composition and possibly production, but with high energy expense and

inputs.

Transition 1 to 2
State 1 to 2

The absence of managing woody species are the variables that contribute directly to loss of state resilience and result in shifts between states. This transition involves a change in vegetation type and a canopy cover of greater than 15%. This transition could take generations, and possibly will not occur if there is not a tree-shrub seed source available.

Transition 1 to 3
State 1 to 3

This transition is triggered by a management action as opposed to a natural event. Tillage, or breaking the ground with machinery for crop production, will move the Grassland State to a Tillage State. The resilience of the Reference State has been compromised by the fracturing and blending of the native virgin sod. The energy, hydrologic, and nutrient cycles are altered and vary from that of the Grassland State.

Restoration pathway 2 to 1
State 2 to 1

Restoration efforts will be costly, labor-intensive, and can take many years, if not decades, to return to a Grassland State. Once canopy levels reach greater than 20 percent, estimated cost to remove trees is very expensive and includes high energy inputs. The technologies needed in order to go from an invaded Woody State to a Grassland State include but are not limited to: prescribed burning—the use of fire as a tool to achieve a management objective on a predetermined area under conditions where the intensity and extent of the fire are controlled; brush management—manipulating woody plant cover to obtain desired quantities and types of woody cover and/or to reduce competition with herbaceous understory vegetation, in accordance with overall resource management objectives; prescribed grazing—the controlled harvest of vegetation with grazing or browsing animals managed with the intent to achieve a specified objective. Grazing at an intensity that will maintain enough cover to protect the soil and maintain or improve the quantity and quality of desirable vegetation. When a juniper tree is cut and removed the soil structure, and the associated high infiltration rate may be maintained for over a decade (Hester, 1996). This explains why the area near the dripline usually has substantially greater forage production for many years after the tree has been cut. It also explains why runoff will not necessarily dramatically increase once juniper is removed. Rather, the water continues to infiltrate at high rates into soils previously ameliorated by junipers, thereby increasing deep drainage potential. In rangeland, deep drainage amounts can be 16 percent of the total rainfall amount per year (Thurow and Hester, 1997).

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tallgrasses dominant 40%**			897–1569	
	big bluestem	ANGE	*Andropogon gerardii*	560–981	–
	switchgrass	PAVI2	*Panicum virgatum*	392–588	–
	Indiangrass	SONU2	*Sorghastrum nutans*	78–196	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	17–118	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	17–118	–
2	**Midgrasses subdominant 23%**			504–897	
	sideoats grama	BOCU	*Bouteloua curtipendula*	280–785	–
	little bluestem	SCSC	*Schizachyrium scoparium*	78–196	–
4	**Cool-season grasses subdominant 15%**			280–594	
	western wheatgrass	PASM	*Pascopyrum smithii*	280–594	–
	Canada wildrye	ELCA4	*Elymus canadensis*	78–196	–
	sedge	CAREX	*Carex*	78–196	–
3	**Shortgrasses minor 10%**			168–392	
	blue grama	BOGR2	*Bouteloua gracilis*	112–224	–
	buffalograss	BODA2	*Bouteloua dactyloides*	112–224	–
Forb					
5	**Forbs minor 10%**			196–392	
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–39	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–39	–
	Illinois bundleflower	DEIL	*Desmanthus illinoensis*	0–39	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–39	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–39	–
	dotted blazing star	LIPU	*Liatris punctata*	0–39	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–39	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	0–39	–
	evening primrose	OENOT	*Oenothera*	0–39	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–39	–
	pitcher sage	SAAZG	*Salvia azurea var. grandiflora*	0–39	–
	goldenrod	SOLID	*Solidago*	0–39	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–39	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–39	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–39	–
	spiderwort	TRADE	*Tradescantia*	0–39	–
Shrub/Vine					
6	**Shrubs and Cacti trace 2%**			0–78	
	leadplant	AMCA6	*Amorpha canescens*	0–78	–
	smooth sumac	RHGL	*Rhus glabra*	0–78	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–39	–

Animal community

Wildlife Interpretations

This ecological site is nearly level and has gently undulating lands on smooth alluvial terraces along major streams. Much of this site occurs in narrow bands that facilitate farming, so relatively few areas remain in native vegetation and are used for grazing. Historically, the predominance of grasses and forbs on this site supported grazers and mixed feeders such as bison, elk, mule deer, pronghorn and a variety of grassland-associated birds and small mammals. Due to the heterogeneity inherent in all landscapes, some areas were not grazed uniformly by these historic large herds of grazing animals. This type of grazing enhanced habitat for wildlife by creating a mosaic pattern, or patchiness, of vegetative structural diversity throughout the landscape. Wildlife native to the site depend on a plant community diverse in species and structure. This need is evident in the variability of known habitat requirements of grassland-associated wildlife.

Shrubs such as lead plant and smooth sumac may be present and locally abundant on this site. Shrubs thickets offer escape and thermal cover for several species of wildlife. Since this site is located next to major streams where trees have either historically existed or recently encroached along the drainages, the presence of tall trees makes this site generally unsuitable for prairie chickens and other ground-nesting birds that require large expanses of non-woody habitat. These sites have the potential to become dominated by woody vegetation, dramatically changing the wildlife communities from grassland-associated species to a species composition typical of woodlands.

Woody species, such as those commonly established in tree plantings, provide habitat for mid-sized mammals such as raccoons, opossums, and striped skunks which can be detrimental to ground-nesting birds native to grassland habitats. Trees can also increase the potential for nest parasitism by brown-headed cowbirds when adjacent to grasslands. Trees of sufficient size adjacent to drainages do offer roosting habitat for wild turkeys, and nesting and perching habitat for raptors.

The site's close proximity to permanent or seasonal water in streams generally meets the needs of wildlife requiring open water for drinking. Seasonal pools present during the spring offer breeding habitat for amphibians.

Periodic events such as prolonged drought, wildfire, disease, or high insect numbers will alter plant community diversity and structure and associated wildlife species.

Reference Plant Community (big bluestem, sideoats grama, western wheatgrass, switchgrass)

The high diversity of grasses and forbs in this community provides habitat for a diverse group of insects. Areas with high forb diversity will generally support more insects such as the leaf-hoppers important to young grassland birds. Grasshoppers, associated with grasses, are a critical food source for birds in later stages of development. Ornate box turtles, six-lined racerunners and snakes such as the racer and the gopher snake are common reptiles on this site. Areas with high forb and insect populations, coupled with nearby roost trees, offer suitable brood habitat for wild turkeys. Reference Plant Community sites with taller native warm-season bunchgrasses and openings at ground level offer suitable northern bobwhite quail nesting habitat. Burrowing mammals such as thirteen-lined ground squirrels, and plains pocket gophers are common. Prairie voles and deer mice are common and provide prey for raptors such as red-tailed hawks and great-horned owls throughout the year and prey for northern harriers, rough-legged hawks, and short-eared owls during the winter. Small mammals also provide prey for coyotes and other predators.

Grazing Interpretations

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangelands in this area provide yearlong forage under prescribed grazing for cattle, sheep, horses, and other herbivores. During the dormant period, livestock may need supplementation based on reliable forage analysis.

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.

Hydrological functions

Water is the principal factor limiting forage production on this site. The soils on this site are deep, moderately well drained soils. In many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff.

Recreational uses

The site exhibits some visual contrast and a panoramic view of the wide open spaces cherished by many in the Great Plains states.

Wood products

No appreciable wood products are present on the site.

Other products

Because of the deep fertile soils and gentle slopes of this ecological site, it is continually vulnerable to development for cropland, homesites, roads, and urban uses.

Other information

Site Development and Testing Plan

This site went through the approval process.

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 were used extensively to develop this ecological site description.

NRCS individuals involved in developing the Clay Terrace ESD in 2002 include Darrell Beougher, Jon Deege, Lorne Denetclaw, Sharla Schwien, Joel Willhoft, Dwayne Rice, and Bob Tricks from Kansas; and Nadine Bishop, Kristin Dickinson, Kim Stine, Dana Larson, and Chuck Markley from Nebraska.

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Contributors

Chris Tecklenburg

Approval

David Kraft, 10/03/2019

Acknowledgments

The ecological site development process is a collaborative effort, conceptual in nature, dynamic and is never considered complete. I thank all those who set the foundational work in the early 2000s in regards to this ESD. I thank all those who contributed to the development of this site. In advance, I thank those who would provide insight, comments and questions about this ESD in the future.

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 5-16-2017 David Kraft, John Henry, Doug Spencer and Dwayne Rice Original Authors 2-2005
Contact for lead author	Chris Tecklenburg (chris.tecklenburg@ks.usda.gov)
Date	10/03/2019
Approved by	David Kraft
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** There are no rills or active headcutting present on the site.

2. **Presence of water flow patterns:** There is no evidence of water flow patterns, soil deposition, or erosion on the site.

3. **Number and height of erosional pedestals or terracettes:** There is no evidence of pedestaled plants or terracettes or the site.

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. Cover can be defined as live plants, litter, rocks, moss, lichens, etc.

5. **Number of gullies and erosion associated with gullies:** There are no gullies present on the site.

6. **Extent of wind scoured, blowouts and/or depositional areas:** There is no evidence of wind erosion creating bare areas or denuding vegetation.

7. **Amount of litter movement (describe size and distance expected to travel):** Plant litter is distributed evenly throughout the site.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Plant canopy is sufficient to intercept the majority of raindrops. Soil organic matter is incorporated into aggregates at the surface, and/or adhesion of decomposing organic matter is present, and/or biological crusts are present on the surface. Soil stability scores will range from 5-6.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** OSD from New Cambria series; Ap--0 to 15 centimeters (0 to 6 inches); dark grayish brown (10YR 4/2) silty clay, very dark gray

(10YR 3/1) moist; moderate fine granular and angular blocky structure; very hard, firm; slight effervescence; moderately alkaline; abrupt smooth boundary.

A--15 to 36 centimeters (6 to 14 inches); dark gray (10YR 4/1) silty clay, very dark brown (10YR 2/2) moist; strong fine granular and angular blocky structure; extremely hard, very firm; many fine roots and pores; few worm casts; slight effervescence; moderately alkaline; diffuse smooth boundary. (Combined thickness of the A horizon is 23 to 38 centimeters (9 to 15 inches) thick)

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** There is no negative effect on water infiltration and/or runoff due to plant community composition or distribution. Plant composition and spatial distribution are adequate to prevent any rill formation and/or pedastalling. Plant rooting patterns, litter production, decomposition processes, and spatial distribution are adequate to establish good infiltration and prevent all runoff.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** There is no evidence of compacted soil layers due to animal impact or cultural practices.

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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: Tallgrass dominant 40%; big bluestem 500-875, switchgrass 350-525, Indiangrass 70-175, composite dropseed 15-105, sand dropseed 15-105

    Sub-dominant: Midgrass subdominant 23%; sideoats grama 250-700, little bluestem 70-175
    Cool-season subdominant 15%; western wheatgrass 250-530, Canada wildrye 70-175, sedge 70-175

    Other: Shortgrasses minor 10%; blue grama 100-200, buffalograss 100-200

    Forbs 10%

    Shrubs and Cacti 2%

    Additional: Forbs minor 10%
    Shrubs and cacti trace 2%

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

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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. Plant litter at 45-55% cover, at a depth of .25 of an inch.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 2,500 pounds of production per ac/yr for a below average year, 4,500 pounds of production per ac/yr for an above average year. Relative value is 3,500 pounds of production per ac/yr.

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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:** 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:** The number and distribution of tillers or rhizomes is assessed on perennial plants occupying the evaluation area. No reduction in vigor or capability to produce seed or vegetative tillers given the constraints of climate and herbivory.
