USDA Natural Resources
Conservation Service

Ecological site R078CY095TX
Clay Flat 23-30" PZ

Last updated: 9/15/2023
Accessed: 04/29/2024

General information

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

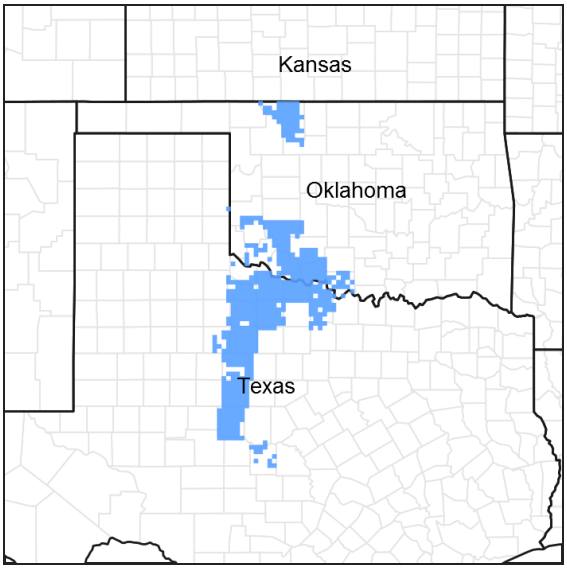


Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 078C–Central Rolling Red Plains, Eastern Part

MLRA 78C is characterized by moderately dissected, rolling plains with prominent ridges and valleys and numerous terraces adjacent to dissecting streams. Loamy and clayey soils are generally deep, well drained, and developed in calcareous and gypsiferous sediments of Permian age.

LRU notes

NA

Classification relationships

This ecological site is correlated to soil components at the Major Land Resource Area (MLRA) level which is further described in USDA Ag Handbook 296.

Ecological site concept

These sites occur on relatively flat, tight clay soils. Reference vegetation consists of midgrasses and forbs with few woody species. The site is quite droughty and the shrink-swell characteristics of the soil produce a gilgai micro-relief

with micro-highs and micro-depressions adding diversity to the plant community. Deep cracks, which form when the soils are dry, limit the plant community to those species that can tolerate frequent root pruning. In the absence of fire or other brush management, the site may transition to a woody state dominated mesquite and or juniper.

Similar sites

R078AY117TX	**Clayey Upland 25-28" PZ** Similar species and production. Similar position on the landscape.
R078BY071TX	**Clay Flat 19-26" PZ** The Clay Flat site has finer textured soils with the signature grass of tobosa.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The Clay Flat 23-30” PZ was formed in calcareous, clayey sediments that are several feet thick. These soils are on nearly level to gently sloping valley fill, alluvial plains in wide valleys, wide divides or mesas, or plane surfaces of uplands. Slopes range from 0 to 3 percent with the majority under 2 percent. Weathered bedrock of shale or limestone occurs between 30 and 80 inches in most pedons. Clay content of the particle-size control section ranges from 40 to 60 percent. In undisturbed areas there is gilgai micro relief with micro-knolls 4 to 12 inches higher than micro-depressions. There are cracks 2 to 7 cm wide that extend from the surface to a depth of more than 50 cm when the soil is dry. Cracks remain open from 150 to 210 cumulative days during most years. Slickensides begin at a depth of 15 to 24 inches. Elevation ranges from 1000 to 2750 feet.

Table 2. Representative physiographic features

Landforms	(1) Alluvial plain > Plain (2) Alluvial plain > Valley flat
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	305–838 m
Slope	0–3%
Water table depth	183 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 78C lies within the subtropical sub-humid climate regime, which typically has dry winters with hot and not as humid summers. This regime is characterized by rapid changes in temperature; marked extremes, both daily and annual; and rather erratic rainfall.

This region lies in the path of polar air masses that move down from the north during the winter. With the passage of cold fronts during the fall and winter, abrupt temperature drops sometimes occur. While the area is subject to a wide range of temperature, winters are generally mild. Low humidity and good wind movements characterize the summers.

Wind speeds average more than eleven miles an hour with prevailing southern winds. Rather strong winds can occur in all months of the year. While strong gusty winds occur, severe dust storms are rare.

Normal rainfall averages 23 to 30 inches a year but distribution of rainfall patterns are so erratic short dry periods are common. The majority of the rainfall occurs as showers, rather than general rain events between March and November. Dry periods of three to four weeks can be expected during this time as well. Even if these dry conditions occur, complete crop failures seldom results.

Table 3. Representative climatic features

Frost-free period (characteristic range)	172-205 days
Freeze-free period (characteristic range)	194-225 days
Precipitation total (characteristic range)	660-737 mm
Frost-free period (actual range)	156-206 days
Freeze-free period (actual range)	191-231 days
Precipitation total (actual range)	660-737 mm
Frost-free period (average)	187 days
Freeze-free period (average)	210 days
Precipitation total (average)	686 mm

Climate stations used

- (1) HAMMON 3 SSW [USC00343871], Elk City, OK
- (2) ALTUS IRIG RSCH STN [USC00340179], Elmer, OK
- (3) LAKE KEMP [USC00414982], Seymour, TX
- (4) HASKELL [USC00413992], Haskell, TX
- (5) MERKEL 12 SW [USC00415852], Merkel, TX

Influencing water features

None.

Wetland description

NA

Soil features

Soils are mapped for each county within the MLRA. Mapunits are representations of the major soil series component(s) and named accordingly. Each Mapunit is spatially represented on a digital soils map as polygons of different shapes and sizes. Within these Mapunits, there are often minor soil series components included. These minor components are soils that occur within a Mapunit polygon but are of small extent (15% or less of the Mapunit area). However, it is difficult to separate these minor soils spatially due to the scale of soil mapping.

Ecological sites are correlated at the component level of the soil survey. Therefore, a single Mapunit may contain multiple Ecological Sites just as it may contain multiple soil components. This is important to understand when investigating soils and Ecological Sites. A soil survey Mapunit may be correlated to a single Ecological Site based on the major component; however, there may be inclusional areas of additional Ecological Sites which are correlated to the minor components of that particular soil Mapunit.

Representative soil components for this site include:
Leeray, Stamford, Treadway, Tillman and Tobosa.

The soils in Clay Flat 23-30” PZ are moderately to very deep and well drained. Permeability is very slow. Runoff is low on slopes less than 1 percent, medium on 1 to 3 percent slopes and high on 3 to 5 percent slopes. Water enters to soil rapidly when it is dry and cracked, and very slowly when it is moist.

These soils formed in calcareous, clayey sediments that are several feet thick. Weathered bedrock of shale or limestone occurs between 30 and 80 inches in most pedons. Clay content of the particle-size control section ranges from 40 to 60 percent. In undisturbed areas there is gilgai micro relief with micro-knolls 4 to 12 inches higher than micro-depressions. There are cracks 2 to 7 cm wide that extend from the surface to a depth of more than 50 cm when the soil is dry. Cracks remain open from 150 to 210 cumulative days during most years. Slickensides begin at a depth of 15 to 24 inches.

Table 4. Representative soil features

Parent material	(1) Alluvium–shale and siltstone
Surface texture	(1) Clay (2) Clay loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Very slow
Soil depth	71–203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	8.64–17.78 cm
Calcium carbonate equivalent (0-101.6cm)	0–40%
Electrical conductivity (0-101.6cm)	0–16 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–20
Soil reaction (1:1 water) (0-101.6cm)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–1%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The information contained in the State and Transition Diagram (STD) and the Ecological Site Description was developed using archeological and historical data, professional experience, and scientific studies. The information presented is representative of a very complex set of plant communities. Not all scenarios or plants are included. Key indicator plants, animals and ecological processes are described to inform land management decisions.

The reference plant community of the Clay Flat 23-30” PZ Ecological Site is assumed to be a Midgrass Prairie Community (1.1). The vegetation developed under the influence of the prevailing climate, frequent fires and periodic herbivory by bison, pronghorn antelope, deer and insects. Before European settlement in the 1800s frequent wildfires kept woody and forb species at low levels. Historians postulate that fires, set either by American Indians or lightning, re-occurred at four to six-year intervals on the eastern part of the Texas Rolling Plains (Frost 1998). The prevailing climate and frequent, intense fires likely were more influential in shaping the plant community into an open Midgrass Prairie Community (1.1) than intermittent heavy grazing by bison and pronghorns and periodic droughts.

The site is quite droughty and the shrink-swell characteristics of the soil produce a gilgai micro-relief with micro-highs and micro-depressions adding diversity to the plant community. Deep cracks, which form when the soils are dry, limit the plant community to those species that can tolerate frequent root pruning. Sideoats grama, vine mesquite, tobosa blue grama and buffalograss, dominated the Midgrass Prairie Community (1.1) making up

approximately 45 to 55 percent of the total herbage production. Tobosa and curly mesquite were common on the western and southern portion of the MLRA where annual precipitation averages less than 25 inches annually. Sideoats grama, vine mesquite, and buffalograss were the primary dominants in the northern portion. The frequent fires favored grasses, especially tobosa, over woody plants and forbs.

The Midgrass Prairie Community (1.1) was relatively stable and resilient within the climate, soil and fire regime until settlement. Settlement by Europeans in mid to late 1800s brought elimination of the bison herd, removal of the American Indian and a large increase of livestock. The development of the windmill and barbed wire fencing in the 1880s brought about overstocking of cattle, sheep and goats throughout the region (Archer 1994 and Smeins, et al. 1997).

Long-term overgrazing of the Clay Flat site causes a reduction of the more palatable grasses and forbs and an increase in less palatable grasses and forbs. When retrogression is cattle induced, vine mesquite, sideoats grama and other palatable grasses and preferred forbs decrease in the plant community. Tobosa and curlymesquite are the primary increasers on the western and southern portions of the MLRA, while buffalograss, silver bluestem and white tridens are the primary increasers in northern and eastern portions. Total herbage production declines as shrubs, shortgrasses and forbs replace the midgrasses. There is a concomitant decline in vegetative ground cover, mulch and soil organic matter. The shift in plant cover and decline in soil properties favors woody plant encroachment. This, along with the reduction in intensity and frequency of fires, allows invasion of species from adjacent sites or the increase of more grazing resistant endemic species.

Under continuous overgrazing by livestock the Midgrass Prairie Community transitions into a Mixed-Grass Prairie Community (1.2) with invading woody species. Tobosa is persistent where it occurs, but shortgrasses generally begin to dominate primary production in this phase. The encroaching woody species also contribute an increasing percentage of the annual production. With proper grazing and periodic prescribed burning, the Mixed-Grass Prairie Community can be maintained or the retrogression reversed. If however, it is continually overgrazed and fire is excluded as a disturbance, the process of succession proceeds toward woody plant dominants and replacement of the more preferred grasses with less preferred species. As grass cover declines, litter and soil organic matter decline and bare ground, erosion and other desertification processes increase. Increasing woody dominants are primarily mesquite and pricklypear. When the woody plant community is well established and exceeds 15 percent canopy, grazing management strategies, such as periodic rests from grazing, generally will not restore the community to grassland. When this threshold occurs, the site has transitioned into a new state, the Shrubland State (2) and a new plant community, the Shortgrass/Mixed-Brush Community (2.1).

In the absence of fires and the occurrence of periodic droughts, the mesquite, lotebush and pricklypear continue to increase in size and density regardless of grazing management. Initially, the grassland component is a mixture of curly mesquite, buffalograss, white tridens, tobosa and low quality forbs. With continued livestock abuse, these species are largely replaced by low quality species such as three-awns, red grama, whorled dropseed and annuals. Tobosa is persistent where it occurs. Cool season species, such as Texas wintergrass and winter annuals, particularly annual brome and annual broomweed increase. Once woody plant cover exceeds 35 to 40 percent, forage production becomes limited, being generally made up of unpalatable shrubs, tobosa, shortgrasses, forbs and annuals. This community is recognized as a Shrub/Shortgrass/Annuals Community (2.2). Production varies greatly from season to season, depending on timing and amount of precipitation. Wet winters and springs bring on cool-season annuals such as annual bromegrass, annual broomweed and mustards. Extended wet spells induce increases in Texas wintergrass.

During the retrogression process, desertification, including erosion, continues in the interspaces until maximum ground cover by woody species is approached. The microclimate becomes drier as interception losses increase with canopy cover. Once canopy cover reaches potential, however, the hydrologic processes, energy flow and nutrient cycling stabilize under the shrubland environment (Thurow 1991). In this state, the site is poor range for livestock and low quality deer habitat providing only cover and low quality browse and forbs.

Major expense and energy are required to restore Shrub/Shortgrass/Annuals Community (2.2) to a Grassland State (1.1 or 1.2). Generally mechanical or herbicidal treatments and range planting followed by grazing deferment, prescribed grazing and prescribed burning is required for the site to approach the historic climax community. Care must be exercised in using mechanical treatments that require re-seeding because annuals such as annual broomweed can reduce seeding success and persist for several years. The restoration process may take several years before the site reaches potential grassland production.

The Clay Flat site was sometimes cultivated for food, fiber and hay, creating a Cultivated State (3.1). Although some grain and winter cereal crops are planted today, most of the fields in the site are used as permanent pasture or game food plots. Adapted annuals, adapted perennials or native perennials should be used. Some areas originally planted to crops have been abandoned and let “go back” to native range without cultural or management inputs, creating a unique plant community expressing itself in the process of secondary ecological succession, depending upon the degree of soil degradation. Such areas generally re-establish naturally with species from adjacent areas. If the woody invaders are not controlled periodically with brush management, such as Individual Plant Treatment (IPT), woody species will eventually dominate the site through secondary succession.

State and Transition Diagram:
A State and Transition Diagram for the Clay Flat (R078CY095TX) site is depicted below. Thorough descriptions of each state, transition, and pathway follow the model. Experts base this model on available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge increases. Plant communities will differ across the MLRA because of the natural variability in weather, soils, and aspect. The Reference Plant Community is not necessarily the management goal; other vegetative states may be desired plant communities as long as the Range Health assessments are in the moderate and above category.

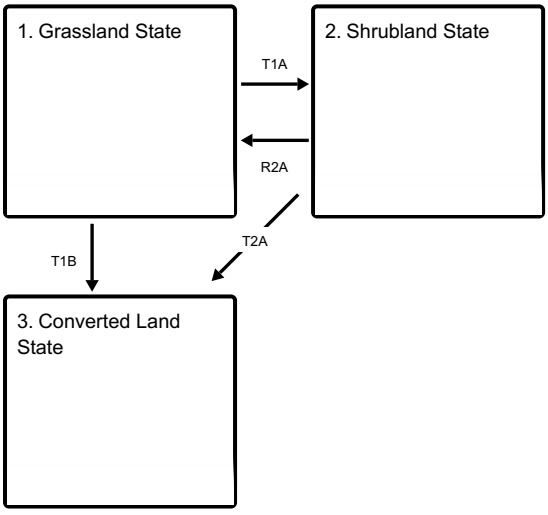
The biological processes on this site are complex. Therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Composition by dry weight and percent canopy cover are provided to describing the functional groups. Most observers find it easier to visualize or estimate percent canopy for woody species (trees and shrubs).

The following diagram suggests some pathways that the vegetation on this site might take. There may be other states not shown on the diagram. This information is intended to show what might happen in a given set of circumstances. It does not mean that this would happen the same way in every instance. Local professional guidance should always be sought before pursuing a treatment scenario.

State and transition model

Ecosystem states



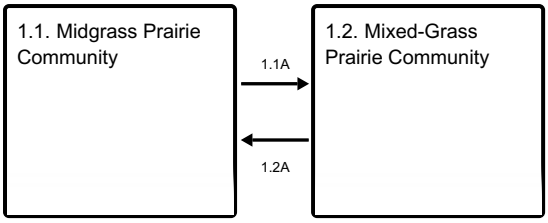
T1A - Absence of disturbance and natural regeneration over time, may be coupled with excessive grazing pressure

T1B - Extensive soil disturbance followed by seeding

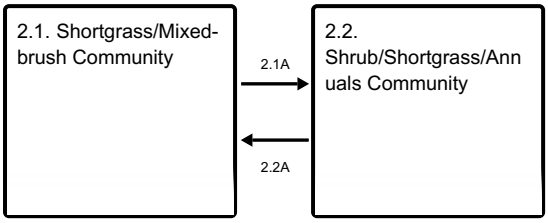
R2A - Adequate rest from defoliation and removal of woody canopy, followed by reintroduction of historic disturbance regimes

T2A - Extensive soil disturbance followed by seeding

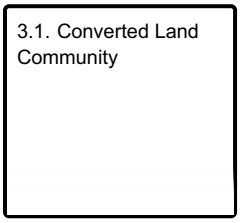
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Grassland State

The reference plant community for this site was a fire induced mixed-grass prairie. Woody species made up less than 1 percent of the herbage production. Tobosa, being tolerant of repeated fires made up as much as 30 percent composition in the western and southern portion of the area, but decreased in dominance from west to east and was often not present. Other desirable midgrasses made up 25 to 35 percent of the composition. Shortgrasses accounted for 30 to 35 percent of the production. Texas wintergrass and western wheatgrass were important parts of the cool season component. Smaller components of forbs, shrubs, and trees were also found. The Mixed-Grass Community (1.2) is a mid and shortgrass prairie being invaded by woody and unpalatable herbaceous species that have been held at low densities by repeated fires and competition from a vigorous grass component. Shrubby species increased in density because long-term overgrazing by livestock reduced grass cover, caused a reduction of soil cover and reduced fine fuel for fire. The more palatable climax grasses and forbs decrease in density and vigor and are replaced by less palatable or more grazing resistant species.

Community 1.1
Midgrass Prairie Community

Figure 8. 1.1 Midgrass Prairie Community

The reference plant community for this site was a fire induced mixed-grass prairie. Woody species made up less than 1 percent of the herbage production. Tobosa, being tolerant of repeated fires made up as much as 30 percent composition in the western and southern portion of the area, but decreased in dominance from west to east and was often not present. Sideoats grama, silver bluestem, vine mesquite, white tridens and alkali sacaton made up 25 to 35 percent of the composition. Buffalograss, blue grama and curly mesquite were common shortgrasses accounting for 30 to 35 percent of the production. Texas wintergrass and western wheatgrass were important parts of the cool season component. Forbs included Indian rushpea, western ragweed, heath aster, trailing ratany and catclaw sensitivebriar. Shrubs included pricklypear, and lotebush. Mesquite was probably also present but kept as scattered multi-stemmed shrubs by the repeated wildfires. The Midgrass Prairie Community (1.1) produces as much as 2500 pounds herbage in good moisture years and 1000 pounds or less in dry years. Annual production declines from east to west due to the decline in precipitation amounts. Grasses contribute up to 95 percent of the total annual production. The mixed-grasses aided in the infiltration of rainfall into the moderately permeable soil and reduced runoff. Litter and organic matter buildup was limited by the dry climate. The Midgrass Prairie Community furnished good habitat for grass eating type animals such as bison, pronghorn antelope, horses and cattle. The reference plant community can be maintained with proper stocking and prescribed burning that closely duplicates the pre-settlement fire regime. The decision as to the kind of livestock and numbers stocked is dependent on the current annual forage production and competition from other herbivores. With continuous overgrazing, decrease in intensity and frequency of fires and no brush management this plant community transitions into the Mixed-Grass Prairie Community (1.2).

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1065	1917	2662
Forb	56	101	140
Tree	–	–	–
Shrub/Vine	–	–	–
Total	**1121**	**2018**	**2802**

Figure 10. Plant community growth curve (percent production by month). TX2275, Midgrass Prairie Community. Warm-season native grassland with some cool-season grass component..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	1	5	15	25	20	5	5	15	8	1	0

Community 1.2
Mixed-Grass Prairie Community

Figure 11. 1.2 Mixed-Grass Prairie Community

The Mixed-Grass Prairie Community (1.2) is a mid and shortgrass dominated prairie being invaded by woody and

unpalatable herbaceous species that have been held at low densities by repeated fires and competition from a vigorous grass component. Shrubby species increased in density because long-term overgrazing by livestock reduced grass cover, caused a reduction of soil cover and reduced fine fuel for fire. Changes in plant composition of the reference community occurred because of selective grazing and differential response of plants to defoliation. The more palatable grasses and forbs decrease in density and vigor and are replaced by less palatable or more grazing resistant species. Periodic long-term drought, and possibly climate change, interacts with overgrazing and reduction in frequency and intensity of fires to bring about this change. The encroaching woody species are generally less than four feet tall and subject to control by prescribed burning in conjunction with proper stocking and prescribed grazing management. The woody canopy varies between 5 and 15 percent depending on length and severity of overgrazing, time since burned and availability of invading specie propagules. Typically, mesquite, lotebush and pricklypear are early and persistent increasers. Redberry juniper often invades from this site in the southern portion. The preferred midgrasses are being replaced by the more grazing resistant tobosa, silver bluestem, curly mesquite and buffalograss. Sideoats grama, blue grama and vine mesquite persist in this phase, but at lesser densities. Most of the perennial forbs found in the historic climax also remain in this plant community. Annual primary production is reduced slightly in relation to the reference community, ranging from 700 to 2000 pounds per acre depending on precipitation amounts and the soil series. Grasses remain the dominant producers of forage. With livestock induced retrogression plant cover, litter and mulch decrease and bare ground increases exposing the soil to some erosion. There could be some mulch and litter movement during rainstorms, but due to gentle slopes little soil movement takes place in this vegetation phase. Unless proper grazing and prescribed burning are initiated at this stage, the invading species continue to increase in size and density. When the canopy of the woody plants becomes dense enough (15 %) and tall enough (> 4 feet) to suppress grass growth and resist fire damage, a threshold in ecological succession is crossed. This threshold can also occur when the fine fuel load provided by grasses is too low to effectively control the brush with prescribed burning. Once this threshold is passed, the Mixed-Grass Prairie Community (1.2) transitions into the Shortgrass/Mixed-brush Community (2.1), a stable plant community state in which normal range management practices, such as proper grazing and prescribed burning, cannot reverse the trend toward woody plant dominance. The transition to the Shortgrass/Mixed-brush Community can be reversed with proper stocking, prescribed grazing and prescribed burning before the threshold is breached. Most Mixed-Grass Prairie Communities found on the Clay Flat Ecological Site today are the result of brush management and prescribed grazing being applied to once brush infested areas of the site.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	538	1166	1793
Shrub/Vine	67	146	224
Tree	34	73	112
Forb	34	73	112
Total	**673**	**1458**	**2241**

Figure 13. Plant community growth curve (percent production by month). TX2284, Mixedgrass Prairie with Forbs . Warm-season rangeland with some cool-season species along with some shrubs and trees component..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	5	15	25	20	4	5	15	5	2	1

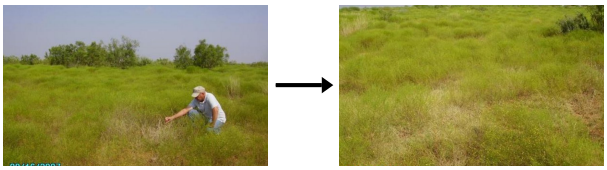
Pathway 1.1A
Community 1.1 to 1.2

Midgrass Prairie Community

Mixed-Grass Prairie Community

With continuous overgrazing, decrease in intensity and frequency of fires and no brush management the Midgrass Prairie Community transitions into the Mixed-Grass Prairie Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1



Mixed-Grass Prairie Community

Midgrass Prairie Community

The HCPC can be restored from the Mixed-Grass Prairie Community with prescribed grazing and prescribed burning that closely duplicates the pre-settlement fire regime.

Conservation practices

Prescribed Burning
Prescribed Grazing

State 2
Shrubland State

The Shortgrass/Mixed-brush Community (2.1) supports a 15 to 35% percent woody plant canopy of Mixed-brush dominated by mesquite. In this phase there is a continued decline in diversity of the grassland component and an increase in woody canopy and cool season component. All, except the more palatable woody species, have increased in size and density. Remnants of climax grasses and forbs and unpalatable invaders occupy the interspaces between shrubs. Characteristic grasses are buffalograss, curly mesquite, three-awn, white tridens, silver bluestem, vine mesquite and Texas wintergrass. Typical forbs include basketflower, filaree, flax wild onion, heath aster, verbena and annual broomweed. Mesquite dominates the Shrub/Shortgrass/Annuals Community (2.2) throughout the MLRA. Redberry juniper is common in the southern portion of the MLRA. Common understory shrubs are pricklypear, lotebush, and tasajillo. Remnants of grazing resistant grasses, forbs and unpalatable invaders occupy the interspaces between shrubs. Characteristic grasses are buffalograss, curly mesquite, three-awn, white tridens, silver bluestem, Texas wintergrass, red grama, annual brome and tobosa in the western portion of the MLRA.

Community 2.1
Shortgrass/Mixed-brush Community

Figure 14. 2.1 Shortgrass/Mixed-brush Community

The Shortgrass/Mixed-brush Community (2.1) supports a 15 to 35% percent woody plant canopy of Mixed-brush dominated by mesquite. It is the result of selective overgrazing by livestock and deer and the differential response

of plants to defoliation over a long period of time. Fire has also been reduced as a disturbance factor because of suppression and a decrease in fine fuel available for hot fires. In this phase there is a continued decline in diversity of the grassland component and an increase in woody canopy and cool season component. Plant composition and production shifts toward the non-grass component because selective grazing reduces preferred species. All, except the more palatable woody species, have increased in size and density. Many of the climax shrubs are present. Typically, mesquite, pricklypear, and lotebush are increasing in density and frequency in this plant type. Remnants of climax grasses and forbs and unpalatable invaders occupy the interspaces between shrubs. Characteristic grasses are buffalograss, curly mesquite, three-awn, white tridens, silver bluestem, vine mesquite and Texas wintergrass. Typical forbs include basketflower, filaree, flax wild onion, heath aster, verbena and annual broomweed. Total plant production ranges from 500 to 1500 pounds per acre, depending on precipitation. The deeper rooting shrubs are able to increase production if erosion has not depleted the soil. However, only about 50 percent of annual production comes from the grassland component. As the grassland vegetation declines, more soil is exposed leading to erosion. Higher interception losses by the increasing woody canopy combined with evaporation and runoff can reduce the effectiveness of rainfall. Soil litter, organic matter and soil structure decline within the interspaces but soil conditions improve under the woody plant cover. Some soil loss can occur during heavy rainfall events. Browsing animals such as goats and deer can find fair food value, but preferred browse diversity is low. Forage quantity and quality for cattle is low and declining. Unless brush management and good grazing management are applied at this stage, the transition toward the Shrub/Shortgrass/Annuals Community (2.2) will continue. The trend cannot be reversed with good grazing management alone. Woody species will eventually dominate the site.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	308	616	925
Tree	112	224	336
Shrub/Vine	84	168	252
Forb	56	112	168
Total	**560**	**1120**	**1681**

Figure 16. Plant community growth curve (percent production by month). TX2285, Shortgrass/Mixedbrush Community. Shortgrasses, annual grasses and shrubs dominate the plant community..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3	6	15	24	18	3	5	15	7	2	1

Community 2.2
Shrub/Shortgrass/Annuals Community

Figure 17. 2.2 Shrub/Shortgrass/Annuals Community

The Shrub/Shortgrass/Annuals Community (2.2) is the result of many years of overgrazing, lack of periodic fires

and little brush management. Mesquite dominates the Shrub/Shortgrass/Annuals Community throughout the MLRA. Redberry juniper is common in the southern portion of the MLRA. Common understory shrubs are pricklypear, lotebush, and tasajillo. Remnants of grazing resistant grasses, forbs and unpalatable invaders occupy the interspaces between shrubs. Characteristic grasses are buffalograss, curly mesquite, three-awn, white tridens, silver bluestem, Texas wintergrass, red grama, annual brome and tobosa in the western portion of the MLRA. Typical forbs include basketflower, flax, wild onion, heath aster, verbena, silverleaf nightshade and annual broomweed. Filaree, little barley, Japanese brome and mustards grow profusely during wet springs. Grasses and forbs make up 25 percent or less of the annual herbage production. With continued heavy grazing and no brush control, the shrub cover can approach 75 percent with the shrub interspaces limited to bare ground, depaupered shortgrasses, cool season grasses and annuals. Initially, the shrub canopy acts to intercept rainfall and increase evapotranspiration losses, creating a more xeric microclimate. Soil fauna and organic mulch are reduced exposing more soil surface to erosion in the few interstitial spaces. The exposed soil crusts and erodes readily. However, within the woody canopy hydrologic and ecological processes stabilize. Soil organic matter and mulch also begin to increase eventually stabilize (Thurow 1991). Unless erosion has been severe in the retrogression process, the Shrub/Shortgrass/Annuals Community will eventually approach or exceed reference community biomass production under the current climate. The Shrub/Shortgrass/Annuals Community (2.2) provides good cover for wildlife, but only limited and variable preferred forage, or browse, is available for livestock or wildlife. Restoration to a grassland or early shrubland type is generally recommended. Alternatives for restoration include brush control and range planting to return the shrubland to grassland. Proper stocking, prescribed grazing and prescribed burning would then be necessary to maintain the desired community.

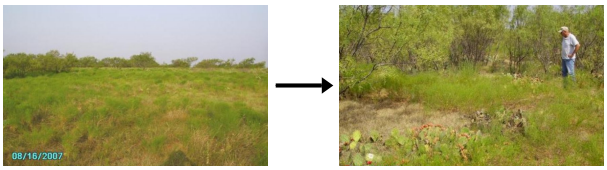
Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	538	874	1211
Grass/Grasslike	224	364	504
Forb	90	146	202
Tree	45	73	101
Total	**897**	**1457**	**2018**

Figure 19. Plant community growth curve (percent production by month). TX2278, Mixed-Brush/Annuals/Cool-season Grasses. Warm-season mixed-brush species, shortgrasses, and cool-season annuals..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	4	12	17	21	16	3	4	12	5	2	1

Pathway 2.1A
Community 2.1 to 2.2



Shortgrass/Mixed-brush Community

Shrub/Shortgrass/Annuals Community

Unless brush management and good grazing management are applied at this stage, the transition toward the Shrub/Shortgrass/Annuals Community (2.2) from the Shortgrass/Mixed-brush Community (2.1) will continue. The trend cannot be reversed with good grazing management alone. Woody species will eventually dominate the site.

Pathway 2.2A
Community 2.2 to 2.1

Shrub/Shortgrass/Annuals Community

Shortgrass/Mixed-brush Community

Alternatives for restoration include brush control and range planting to return back to the Shortgrass/Mixed-brush Community. Proper stocking, prescribed grazing and prescribed burning would then be necessary to maintain the desired community.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing
Range Planting

State 3
Converted Land State

The Clay Flat Ecological Site is sometimes cultivated and planted to crops. The crusting and cracking of exposed soil on this site make it difficult to re-vegetate. When cropping is abandoned the site should be re-vegetated with adapted native plant mixtures, which reference community species. Cultivation and erosion may have reduced soil productivity but near climax forage production may be obtained with a native plant mix that approximates reference species composition. Introduced species often require more care, but can also be productive as pasture.

Community 3.1
Converted Land Community

The Clay Flat Ecological Site is sometimes cultivated and planted to crops. The crusting and cracking of exposed soil on this site make it difficult to re-vegetate. Technical advice as to adapted crops, cropping systems, production, and cultivation practices are available from local NRCS or Extension Service offices. When cropping is abandoned the site should be re-vegetated with adapted native plant mixtures, which include reference community species. Cultivation and erosion may have reduced soil productivity but near reference forage production may be obtained with a native plant mix that approximates reference community species composition. Introduced species often require more care, but can also be productive as pasture. In any case brush management is required to prevent brush invasion from adjacent areas. Weedy grasses, forbs and shrubs will be the first species in secondary succession if fields are abandoned and let re-vegetate naturally. They often persist for many years. Even without grazing, woody species will encroach and eventually dominate unless brush management practices and prescribed burning are applied.

Figure 20. Plant community growth curve (percent production by month). TX2252, Small Grains. Cool-season small grain crops..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5	5	10	10	5	0	0	0	20	25	15	5

Figure 21. Plant community growth curve (percent production by month). TX2264, Warm-season Pasture Grasses. warm-season pasture grasses having nutrient management, pest management, and prescribed grazing..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	5	12	25	20	5	5	14	8	2	1

Transition T1A
State 1 to 2

When the canopy of the woody plants becomes dense enough (15 %) and tall enough (> 4 feet) to suppress grass growth and resist fire damage, a threshold in ecological succession is crossed. This threshold can also occur when the fine fuel load provided by grasses is too low to effectively control the brush with prescribed burning. Once this threshold is passed, the Mixed-Grass Prairie Community (1.2) transitions into the Shortgrass/Mixed-brush Community (2.1), a stable plant community state in which normal range management practices, such as proper grazing and prescribed burning, cannot reverse the trend toward woody plant dominance.

Transition T1B
State 1 to 3

The Grassland State may also transition into the Converted Land State. With the implementation of various conservation practices such as Crop Cultivation, Plowing, Range Planting, Pasture Planting, Pest Management, Nutrient Management, and Prescribed Grazing, the Coverted Land Community may be cultivated for crops, planted into permanent native or introduced pastureland grass species or let abandoned with existing native species.

Restoration pathway R2A
State 2 to 1

Alternatives for restoration include brush control and range planting to return the Shrubland to Grassland State. Proper stocking, prescribed grazing and prescribed burning would then be necessary to maintain the desired community.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing
Range Planting

Transition T2A
State 2 to 3

The Shrubland State may also transition into the Converted Land State. With the implementation of various conservation practices such as Crop Cultivation, Plowing, Range Planting, Pasture Planting, Pest Management, Nutrient Management, and Prescribed Grazing, the Coverted Land Community may be cultivated for crops, planted into permanent native or introduced pastureland grass species or let abandoned with existing native species.

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Midgrasses**			673–1681	
	tobosagrass	PLMU3	*Pleuraphis mutica*	0–841	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	336–420	–
	vine mesquite	PAOB	*Panicum obtusum*	336–420	–
2	**Midgrasses**			112–280	
	silver beardgrass	BOLAT	*Bothriochloa laguroides ssp. torreyana*	0–280	–
	alkali sacaton	SPAI	*Sporobolus airoides*	0–280	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–280	–
	Drummond's	SPCOD3	*Sporobolus compositus var.*	0–280	

	Drummond's dropseed	SPCOD3	*Sporobolus compositus var. drummondii*	0–280	–
	white tridens	TRAL2	*Tridens albescens*	0–280	–
3	**Shortgrasses**			224–560	
	blue grama	BOGR2	*Bouteloua gracilis*	112–280	–
	curly-mesquite	HIBE	*Hilaria belangeri*	112–280	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–168	–
4	**Shortgrasses**			56–140	
	purple threeawn	ARPU9	*Aristida purpurea*	0–140	–
	Wright's threeawn	ARPUW	*Aristida purpurea var. wrightii*	0–140	–
	Hall's panicgrass	PAHA	*Panicum hallii*	0–140	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	0–140	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–140	–
	slim tridens	TRMUM	*Tridens muticus var. muticus*	0–140	–
5	**Cool-season grasses**			56–140	
	sedge	CAREX	*Carex*	0–140	–
	Texas wintergrass	NALE3	*Nassella leucotricha*	0–140	–
	western wheatgrass	PASM	*Pascopyrum smithii*	0–140	–
Forb					
6	**Forbs**			56–140	
	Drummond's onion	ALDR	*Allium drummondii*	0–140	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–140	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–140	–
	Indian rushpea	HOGL2	*Hoffmannseggia glauca*	0–140	–
	trailing krameria	KRLA	*Krameria lanceolata*	0–140	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	0–140	–
	prairie spiderwort	TROC	*Tradescantia occidentalis*	0–140	–
	vervain	VERBE	*Verbena*	0–140	–
Shrub/Vine					
7	**Shrubs/Vines**			0–28	
	Christmas cactus	CYLE8	*Cylindropuntia leptocaulis*	0–28	–
	pricklypear	OPUNT	*Opuntia*	0–28	–
	honey mesquite	PRGL2	*Prosopis glandulosa*	0–28	–
	lotebush	ZIOB	*Ziziphus obtusifolia*	0–28	–

Animal community

Many types of wildlife use the Clay Flat Ecological Site. Bison and pronghorn antelope utilized the site prior to European settlement. Grassland insects, reptiles, birds and mammals frequent the site, either as their base habitat or from the adjacent sites. Small mammals include many kinds of rodents, jackrabbit, cottontail rabbit, raccoon, skunk, opossum and armadillo. Predators include coyote, fox and bobcat. Game birds, songbirds, and birds of prey were indigenous or frequent users. Most are still plentiful although bison and pronghorn antelope are no longer present. Deer, turkey and quail particularly favor the habitat provided by the Mixed-Grass Prairie (1.2) and Shortgrass/Mixed-brush (2.1) communities. In the 21st century these communities are generally found where brush control/management has been applied to convert shrubland communities to grassland. Continued brush management in conjunction with proper stocking and prescribed grazing are necessary to maintain these plant communities.

The site in Midgrass Prairie (1.1) state is very suited to primary grass eaters such as cattle. As retrogression occurs and woody plants invade it becomes better habitat for a mixture of cattle, sheep, goats, deer and other wildlife because of the browse and cool season grasses. The site is not well suited for browsers such as goats and deer because of the limited good browse and forb species. The poor soil-plant–water relationships and cracking of the clay soil when dry limit diversity of the flora and consequently animal species. Any livestock should be stocked in proportion to the available grass, forb and browse forage, keeping deer competition for forbs and browse in mind. If the animal numbers are not kept in balance with herbage and browse production through grazing management and good wildlife population management, the late advanced Shrub/Shortgrass/Annuals Community will have little to offer as habitat except cover. Cropland in grain crops, pasture or seeded to wildlife food plots enhance the landscape as wildlife habitat.

Hydrological functions

The Clay Flat Ecological Site is a clayey upland with nearly level to gentle slopes. Runoff is low on slopes less than 1 percent, medium on 1 to 3 percent slopes and high on 3 to 5 percent slopes. The soils develop large deep cracks when dry. Water enters to soil rapidly when it is dry and cracked, and very slowly when it is moist. Most soils are more than 40 inches deep. They are slow to take up water and droughty during the summer months. These conditions act to reduce the diversity of the flora endemic to the site.

Under reference condition, the grassland vegetation intercepted and utilized much of the incoming rainfall in the soil profile. Only during extended rains or heavy thunderstorms was there much runoff. Litter and soil movement was slight. Standing plant cover litter and soil organic matter decrease and surface runoff increases as the Midgrass Prairie Community (1.1) transitions to the Mixed-Grass Community (1.2). These processes continue in the interstitial spaces in the Shortgrass/Mixed-brush Community (2.1) phase. Evaporation and interception losses are higher, resulting in less moisture reaching the soil. If overgrazing continues, the plant community deteriorates further and desertification processes continue. The deeper-rooted woody plants are able to extract water from greater depths than grasses, so less water will be available for down-slope movement. The woody plants compete for moisture with the remaining grasses and forbs further reducing ground cover in openings. Decreased litter and more bare ground allow erosion from soils in openings between trees. As the Shrub/Shortgrass/Annuals Community (2.2) matures the hydrological processes, nutrient cycling and energy flow stabilize within the woody plant canopy (Thurow 1991).

Recreational uses

The Clay Flat site, in conjunction with adjacent upland and bottomland sites provide diverse scenic beauty and many opportunities for recreation and hunting. The Site is well suited for many outdoor recreational uses including recreational hunting, hiking, camping, equestrian and bird watching.

Wood products

Posts, fire wood and specialty wood products can be made from mesquite.

Other products

Seeds can be harvested from many HCPC plants for commercial sale. Grasses and forbs are sometimes harvested by the dried-plant industry for sale in dried flower arrangements. Honeybees are utilized to harvest honey from the many flowering plants, such as mesquite and pricklypear.

Other information

None.

Inventory data references

Information presented has been derived from the revised Clay Flat Range Site PE 32-36, an undated NRCS draft Ecological Site Description for Clay Flat PE 31-44 78C , literature, personal experience, field observations and

personal contacts with range-trained personnel. Photos by: J.L. Schuster.

Special thanks to the following for assistance and guidance with development of this ESD: Reggie Quiett NRCS Vernon, TX, Danny Lamberth NRCS Haskell, Texas, Ronald Hilliard NRCS Oklahoma, Mark Moseley NRCS, San Antonio, Texas and Justin Clary NRCS Temple, Texas.

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Approval

Bryan Christensen, 9/15/2023

Acknowledgments

Site Development and Testing Plan
Future work, as described in a Project Plan, to validate the information in this Provisional Ecological Site Description is needed. This will include field activities to collect low, medium and high intensity sampling, soil correlations, and analysis of that data. Annual field reviews 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.
Annual reviews of the Project Plan are to be conducted by the Ecological Site Technical Team.

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)	Lem Creswell, Zone RMS, NRCS, Weatherford, Texas.
Contact for lead author	817-596-2865

Date	10/01/2007
Approved by	Bryan Christensen
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

2. **Presence of water flow patterns:** Deposition or erosion is uncommon under normal rainfall but may occur during intense rainfall events.

3. **Number and height of erosional pedestals or terracettes:** Pedestals or terracettes would have been uncommon for this site when occupied by the natural HCPC.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Expect no more than 20% bare ground randomly distributed throughout.

5. **Number of gullies and erosion associated with gullies:** Few or none. Any gullies would be vegetated and stable.

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

7. **Amount of litter movement (describe size and distance expected to travel):** None to slight. Under normal Rainfall, little litter movement should be expected. However litter of all sizes may move long distances under intense storm events.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil surface is resistant to erosion. Stability class range is expected to be 5 to 6.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** 0 to 48 " thick with colors from brown to dark reddish brown clay with generally subangular blocky structure. SOM is approximately 1 to 6%. See Soil survey for specific soil.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The savannah of trees, shrubs, vines, grasses, and forbs with adequate litter and little bare ground provides for maximum infiltration and little runoff under normal rainfall events.

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

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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: Warm-season midgrasses >>

    Sub-dominant: Warm-season shortgrasses >

    Other: Cool-season grasses = Forbs > Shrubs > Trees

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** There should be little mortality or decadence for any functional groups.

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14. **Average percent litter cover (%) and depth (in):** Dominant litter is herbaceous.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 1000 - 2500 lbs/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:** Japanese brome, lotebush, mesquite, pricklypear, broomweed, johnsongrass.

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17. **Perennial plant reproductive capability:** All perennial plants should be capable of reproduction except during periods of prolonged drought conditions, heavy natural herbivory, or intense wildfires.
