USDA Natural Resources Conservation Service

Ecological site R078CY096TX
Clay Loam 23-30" PZ

Last updated: 9/15/2023
Accessed: 05/06/2024

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.

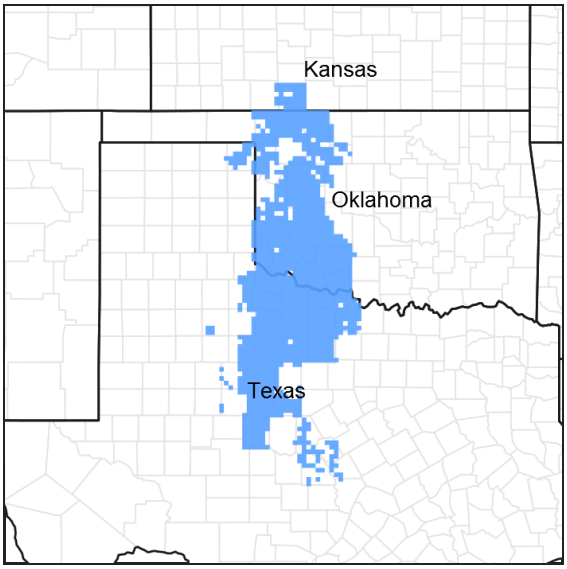


Figure 1. Mapped extent

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 deep clay loam soils. The reference vegetation consists of midgrasses and forbs with few woody species. Without brush management or prescribed fire, woody species may encroach on the site and begin

to dominate the ecological functions. Under prolonged abusive grazing, the midgrass species will be reduced and shortgrass and annual forbs may increase substantially.

Associated sites

R078CY110TX	**Sandy Loam 23-31" PZ** Adjacent to site.
R078CY099TX	**Draw 23-30" PZ** Often runs through the clay loam site and serves as a drainage down slope.

Similar sites

R078BY072TX	**Clay Loam 19-26" PZ** Clay Loam site in 78B

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Bouteloua curtipendula* (2) *Panicum obtusum*

Physiographic features

These soils are located on nearly level to gently sloping soils on alluvial plains, Paleo terraces and broad flat plains. Slopes range from 0 to 12 percent but mainly less than 3 percent. Elevation ranges from 1,000 to 2,500 feet.

Table 2. Representative physiographic features

Landforms	(1) Plains > Plain (2) Plains > Paleoterrace
Runoff class	Low to very high
Flooding frequency	None
Ponding frequency	None
Elevation	305–762 m
Slope	0–12%
Water table depth	102–203 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. May is the wettest month and December is the driest. Effective precipitation is low due to high temperatures, amounts received and intensity.

Table 3. Representative climatic features

Frost-free period (characteristic range)	161-200 days
Freeze-free period (characteristic range)	190-222 days
Precipitation total (characteristic range)	660-711 mm
Frost-free period (actual range)	146-204 days
Freeze-free period (actual range)	182-231 days
Precipitation total (actual range)	635-762 mm
Frost-free period (average)	183 days
Freeze-free period (average)	209 days
Precipitation total (average)	686 mm

Climate stations used

- (1) WILMORE 16SE [USC00148914], Coldwater, KS
- (2) ANSON 3ESE [USC00410268], Anson, TX
- (3) LAKE KEMP [USC00414982], Seymour, TX
- (4) HAMMON 3 SSW [USC00343871], Elk City, OK
- (5) MUTUAL [USC00346139], Mutual, OK
- (6) ABILENE RGNL AP [USW00013962], Abilene, TX
- (7) HOBART MUNI AP [USW00093986], Hobart, OK
- (8) FREDERICK [USC00343353], Frederick, OK
- (9) MUNDAY [USC00416146], Munday, TX
- (10) VERNON [USC00419346], Vernon, 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:
Abilene, Aspermont, Frankirk, Hollister, Rotan, Rowena, Sagerton, and Tillman.

The soils found in the Clay Loam 23-30" PZ ecological site consists of deep to very deep, well drained, loam, silty clay loam, or clay loam surface layers. They are moderately to slowly permeable soils. Solum thickness exceeds 40 inches. Runoff is negligible to medium on slopes less than 1 percent, very low to high on 1 to 3 percent slopes, and medium to high on 3 to 5 percent slopes. Drainage is slow. Natural fertility and organic matter content ranges from medium to high. The plant zone is normally deeper than 60 inches for most soils. As grass cover deteriorates and surface is exposed there is a distinct tendency for a thick crust to form, causing susceptibility to increased erosion during heavy storms.

Table 4. Representative soil features

Parent material	(1) Alluvium–claystone
Surface texture	(1) Clay loam (2) Silty clay loam (3) Loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Moderately slow to moderate
Soil depth	102–203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	8.38–20.07 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–12
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–12%
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 Loam Ecological Site in MLRA (Major Land Resource Area) 78C is a Midgrass Prairie Community (1.1) with an occasional woody plant and a good variety of forbs. Pre-settlement disturbances included grazing or browsing by endemic pronghorn antelope, deer and migratory bison, severe droughts and frequent fires. Wildfires are thought to have occurred at 4 to 6 years intervals in this region (Frost 1998). The frequent fires, weather patterns and relatively frequent droughts favored grasses over woody plants. There were also a wide variety of forbs present. Sideoats grama and vine-mesquite were the dominant species throughout the MLRA contributing as much as 40 percent of the annual herbaceous production. Other characteristic grasses in the historic climax community include Arizona cottontop, tobosa, Texas wintergrass and western wheatgrass. Buffalograss was the most common shortgrass making up as much as 25 percent of plant composition. Tobosa was often important in the western and drier portion of the MLRA. Occasionally, wet winters and springs

cause an abundance of cool-season annuals. See the Plant Composition and Annual Production Table below for estimated composition of the assumed historic climax species.

The Midgrass Prairie Community (1.1) is relatively stable and resilient within the climate, grazing and fire regimes until settlement in the late 1800's brought animal husbandry and fencing. Following this settlement, overstocking with domesticated livestock was almost universal. As overgrazing occurred on the Clay Loam site, there was a reduction of palatable midgrasses, a reduction in intensity and frequency of fires and, consequently, a decline in mulch and soil organic matter. The frequency and intensity of fires was reduced because of less fire fuel and fire suppression. As regression occurred due to continued overgrazing, the midgrasses gave way to blue grama, buffalograss and Texas wintergrass.

The shift in plant cover and decline in soil properties favored woody plant encroachment. The woody and herbaceous invaders were generally endemic species released from competition and fire suppression. These woody species were endemic to the region, but not necessarily native to this site. In the resulting Mixed-grass Prairie Community (1.2), the more palatable midgrasses gave way to less palatable or more grazing resistant, midgrasses and shortgrasses. Midgrasses, especially sideoats grama and vine-mesquite, still dominated annual herbage production, but the encroaching woody species increased in the proportion of production compared to the Midgrass Prairie Community (1.1).

When the Mixed-grass Prairie Community (1.2) is continually overgrazed and fire is excluded, ecological succession transitions the plant community into one that is dominated by woody plants. This process is amplified by droughts that occur at approximately 20-year intervals in the region. More grazing resistant grasses such as buffalograss, tobosa, blue grama and Texas wintergrass and less palatable forbs begin replacing the midgrasses. As the midgrass cover declines, litter, mulch and soil organic matter decline and bare ground, erosion and other desertification processes increase. The microclimate in the grassland areas becomes more arid. Increasing woody dominants are primarily mesquite, pricklypear and lotebush. Proper stocking or rest from grazing and prescribed burning will generally not restore the grassland community when the woody plant community exceeds 10 to 15 percent canopy on this site and/or the plants reach fire resistant age (two years) and/or size (about four feet in height). The plant community transitions into the Shortgrass/Mixed-brush Community (2.1). This threshold also marks the beginning of a new state; the Shrubland State (2), in which woody species dominate the site.

Mesquite generally dominates the Shortgrass/Mixed-brush Community (2.1). Mesquite is sometimes limited by high calcareous soil conditions. Redberry juniper often invades on the western side of the MLRA. The grass component is a mixture of low palatability midgrasses, shortgrasses and low quality forbs. With continued livestock overgrazing, the palatable midgrasses are replaced by grazing resistant shortgrasses, such as buffalograss, white tridens, meadow dropseed, western ragweed and alkali sacaton. Cool-season grasses such as Texas wintergrass and annual brome also increase, especially during wet cycles. Exposed soil in open spaces crusts readily, subjecting the site to erosion.

During this stage, the process of retrogression can be reversed. Relatively inexpensive brush control practices and prescribed grazing management that sets up the application of prescribed burning is needed. If these practices are not applied and overgrazing continues, the woody canopy will continue to increase in dominance and ground cover and a woody-plant dominated community; the Mixed–brush/Shortgrasses/Annuals Community (2.2) occurs. Once the brush canopy exceeds 30 to 35 percent, annual production for the understory becomes limited and is generally made up of unpalatable shrubs, grasses and forbs within tree/shrub interspaces. Brushy species such as mesquite, prickly pear, and lotebush dominate production. Shortgrasses, cool-season grasses and annuals persist, but in weakened condition.

Until maximum canopy cover by woody species is reached, erosion continues in the interspaces. Considerable litter and soil movement occurs from exposed soil during heavy rains. The exposed soil crusts readily, creating opportunity for further soil and wind erosion. Interception losses increase with canopy cover and reduce the amount of soil moisture available for herbaceous production. Once canopy cover reaches potential however, the hydrologic processes, energy flow and nutrient cycling stabilize.

Major high cost and high energy accelerated management practices are required to restore the Mixed–brush/Shortgrasses/Annuals Community (2.2) back to the Grassland State. Generally, mechanical or herbicidal brush management practices such as aerial spraying, dozing and/or individual plant treatments (IPT) along with other conservation practices such as range planting, grazing deferment, prescribed grazing and prescribed burning

are necessary for the ecological site to return to a grassland state. Regular maintenance practices will be required to maintain the grassland state.

The soils of the Clay Loam Ecological Site were formed from calcareous materials and are generally deep clay loams that are calcareous to the surface. The soils have favorable plant-soil-moisture relationships and high calcium content enables the site to produce quality forage plants. The site responds to good grazing management and is moderately resilient.

The Clay Loam site is suited primarily for range, but many acres have been put under cultivation. The soils on the flatter areas are arable. Many acres previously cultivated for crops have been returned to native or introduced grass species and are managed as pasture or range.

State and Transition Diagram:
A State and Transition Diagram for the Clay Loam (R078CY096TX) 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.

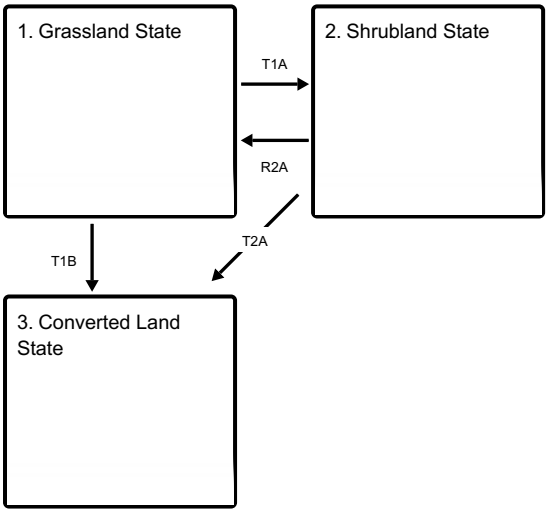
The biological processes on this site are complex. Therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every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



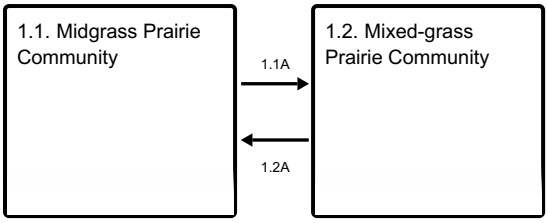
T1A - Absence of disturbance and natural regeneration over time, may be coupled with excessive grazing pressure

T1B - Extensive soil disturbance followed by seeding

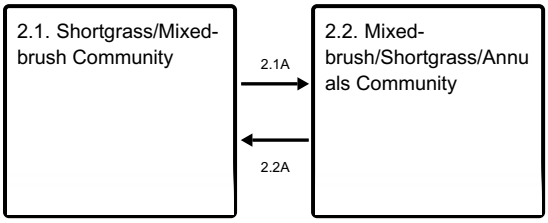
R2A - Adequate rest from defoliation and removal of woody canopy, followed by reintroduction of historic disturbance regimes

T2A - Extensive soil disturbance followed by seeding

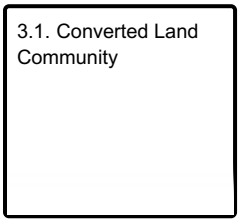
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Grassland State

The Midgrass Prairie Community (1.1) is the interpretive plant community for the Clay Loam Ecological Site. Herbivory by migrating bison and indigenous antelope and deer influenced the plant composition and structure, but not as much as frequent and intense wild fires, which limited woody species encroachment. Hackberry and elm trees were widely scattered in protected areas, but probably made up less than one percent of the plant canopy. Shrubs were typical but infrequent. Vine-mesquite occupied favorable micro-sites and was locally dominant. Sideoats grama was the dominant or co-dominant grass throughout the site. Tobosa was present in significant amounts in the drier, western portion of the MLRA. Blue grama and buffalograss were the most common shortgrasses. Forbs were also found on the site. The Mixed-grass Prairie Community (1.2) is a mixed midgrass and shortgrass dominated grassland being encroached by indigenous or invading woody species that had been held at low densities by repeated fires and competition from a vigorous grass component. The preferred midgrasses, such as sideoats grama and vine-mesquite, are being replaced by the more grazing resistant midgrasses and shortgrasses such as buffalograss and tobosa. Numerous brushy species, including mesquite and pricklypear, are encroaching. The woody canopy varies between 5 and 15 percent and woody species are generally less than three feet tall. Most of the historic perennial forbs persist, but less palatable weedy species increase in the composition.

Community 1.1
Midgrass Prairie Community

The Midgrass Prairie Community (1.1) is the interpretive plant community for the Clay Loam Ecological Site. It developed along with the soils under a dry, sub-humid climate with hot dry summers and mild winters. Herbivory by migrating bison and indigenous antelope and deer influenced the plant composition and structure, but not as much as frequent and intense wild fires, which limited woody species encroachment. Hackberry and elm trees were widely scattered in protected areas, but probably made up less than one percent of the plant canopy. Lotebush, yucca, ephedra, fourwing saltbush, sumac, greenbriar, catclaw acacia were typical, but infrequent, shrubs. Vine-mesquite occupied favorable micro-sites and was locally dominant. Sideoats grama was the dominant or co-dominant grass throughout the site. Also occurring on the site, but in smaller amounts were Arizona cottontop, western wheatgrass and Texas wintergrass. Tobosa was present in significant amounts in the drier, western portion of the MLRA. Blue grama and buffalograss were the most common shortgrasses. A few of the many forbs found on the site include Engelmann daisy, dalea, prairie clover, dotted gayfeather, greenthread, catclaw sensitivebriar, heath aster, western ragweed, broom snakeweed and bundleflower. It is estimated that the Midgrass Prairie Community (1.1) produced

from 1000 to 3000 pounds of biomass annually, depending upon the soils and the amount of precipitation. Grasses produced as much as 95 percent of the annual production. The vegetation of the site was seasonally well balanced because of the presence of cool-season species, which tended to increase during wet years. A good cover of grasses and mulch aided in the infiltration of rainfall into the moderately permeable soil and reduced runoff. Little runoff occurred during historic condition except during intense storms from steeper slopes. The Midgrass Prairie Community furnished good habitat for grazing type wildlife such as bison and pronghorn antelope and, in recent times, cattle. Historically, bison preferred the Clay Loam site. It was close to streams or traversed by drainage ways, and received extra grazing. Livestock now often abuses it unless good grazing management is practiced. This plant community is productive, resilient and recovers well under good grazing management. However, with continuous overgrazing, decrease in intensity and frequency of fires and no brush management, this plant community transitions into a 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	1054	2130	3194
Forb	56	112	168
Tree	11	22	34
Shrub/Vine	11	22	34
Total	**1132**	**2286**	**3430**

Figure 9. 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 10. 1.2 Mixed-grass Prairie Community

The Mixed-grass Prairie Community (1.2) is the result of overgrazing by livestock over a long period of time. It is a mixed midgrass and shortgrass dominated grassland being encroached by indigenous or invading woody species that had been held at low densities by repeated fires and competition from a vigorous grass component. The preferred midgrasses, such as sideoats grama and vine-mesquite, are being replaced by the more grazing resistant midgrasses and shortgrasses such as buffalograss and tobosa. Numerous brushy species, including mesquite and pricklypear, are encroaching because overgrazing by livestock has reduced grass cover, exposed more soil and reduced fine fuel for fire. In this plant community type, the increasing woody species are generally less than three feet tall and still subject to suppression. The woody canopy varies between 5 and 15 percent depending on impact of grazing on herbaceous species, time since burned and availability of invading species. Typically mesquite, pricklypear, lotebush and western ragweed increase in density. Littleleaf sumac, wolfberry, broom snakeweed and

catclaw acacia also increase. Important grasses are sideoats grama, vine-mesquite, meadow dropseed, threeawns, cane or silver bluestem and Texas wintergrass. Most of the historic perennial forbs persist, but less palatable weedy species increase in the composition. If overgrazing by livestock continues, sideoats grama, Arizona cottontop and vine-mesquite will begin giving way to blue grama, buffalograss and Texas wintergrass. Tobosa is often a major increaser in the western portion of the MLRA. Annual primary production has decreased to 500 to 2,500 pounds per acre, depending on precipitation and the soil series. The reduction is due to less plant density and vigor, smaller plant structure and the shift to shallower rooting species. Forage production is predominantly grass. Heavy continuous grazing has reduced plant cover, litter and mulch and has increased bare ground slightly exposing the soil to some erosion because the exposed soil crusts readily. There could be some mulch and litter movement during rainstorms but due to gentle slopes and soil condition only moderate soil movement would take place in this vegetation type. Unless proper grazing and prescribed burning are initiated at this stage, the woody species continue to increase in maturity, size and density. When the canopy of the woody plants becomes dense enough (15-20 % canopy) and big enough (greater than four feet) to suppress grass growth and resist fire damage, a threshold in ecological succession is reached. The Mixed-grass Prairie Community (1.2) becomes the Shortgrass/Mixed-brush Community (2.1). Once this vegetation type occurs, range management practices such as proper grazing and prescribed burning, cannot reverse the trend toward woody plant dominance. Brush control practices, such as individual plant treatment and prescribed burning accompanied by proper grazing, are necessary to maintain this vegetation type or to return the community back to grassland.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	448	1345	2242
Shrub/Vine	56	168	280
Tree	28	84	140
Forb	28	84	140
Total	**560**	**1681**	**2802**

Figure 12. Plant community growth curve (percent production by month). TX2276, Mid/Shortgrasses with Forbs. Warm-season mid and shortgrasses, cool-season grasses, and forbs..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	2	4	8	25	25	14	6	8	5	2	1

Pathway 1.1A
Community 1.1 to 1.2

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

The reference community 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 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 Mixed-brush/Shortgrass/Annuals Community (2.2) throughout the MLRA. Common understory shrubs are pricklypear, lotebush, and tasajillo. Remnants of grazing resistant climax grasses, forbs and unpalatable invaders occupy the interspaces between shrubs. Characteristic grasses are buffalograss, curly mesquite, three-awn, white tridens, silver bluestem, Texas wintergrass, and red grama.

Community 2.1
Shortgrass/Mixed-brush Community

Figure 13. 2.1 Shortgrass/Mixed-brush Community

The Shortgrass/Mixed-brush Community (2.1) is a 15 to 35 percent woody plant canopy of Mixed-brush species. Mesquite is the dominant overstory. Pricklypear and lotebush are the most common shrubs. Redberry juniper may also invade and become dominant. The Shortgrass/Mixed-brush Community 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 paucity of fine fuel available for hot fires. With or without livestock grazing, there is a continued decline in diversity of the grassland component and an increase in woody and cool season species. With grazing, annual herbage production is reduced in the grassland component due to decline in soil structure and organic matter. Plant composition and production shifts toward the non-grass component as selective grazing reduces preferred species. All, except the more palatable woody species, have increased in size and density. Mesquite is an early increaser throughout the MLRA. Many of the historic climax shrubs are present. Typically, pricklypear, lotebush, littleleaf sumac and broom snakeweed are increasing in density and frequency in this vegetation type. Remnants of grasses and forbs and unpalatable invaders occupy the interspaces between trees and shrubs. Cool-season grasses such as Texas wintergrass and annual brome, plus other grazing resistant historic species, can be found under and around woody plants. Because of grazing pressure and competition for nutrients and water from the woody plants the grassland component shows general lack of plant vigor and productivity. Common herbaceous species include white tridens, three-awns, sand and meadow dropseed and prairie coneflower. Buffalograss, western ragweed and tobosa are persistent until shrub density reaches maximum canopy. As the grassland vegetation declines, more soil is exposed leading to erosion on steeper slopes. The effectiveness of rainfall has been reduced. The increasing woody canopy causes higher interception losses coupled with higher evaporation and runoff. Soil 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. Total plant production declines somewhat, being approximately 800 to 2,800 pounds per acre, depending on precipitation. The deeper rooting shrubs are able to increase vegetative growth if erosion has not depleted the soil. Generally, only about 50 percent of annual production comes from the grassland component. Browsing animals such as goats and deer can find fair food value, if browse plants have not been overgrazed continuously. Forage quantity and quality for cattle is low. Unless brush management and good grazing management are applied at this stage, the transition toward the Mixed-brush/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	493	1110	1726
Shrub/Vine	179	404	628
Tree	135	303	471
Forb	90	202	314
Total	**897**	**2019**	**3139**

Figure 15. Plant community growth curve (percent production by month). TX2277, Shortgrasses/Mixed-Brush Community. Shortgrasses, annual grasses, and forbs..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	2	5	8	24	25	12	7	10	5	2	0

Community 2.2
Mixed-brush/Shortgrass/Annuals Community

Figure 16. 2.2 Mixed-brush/Shortgrass/Annuals Community

The Mixed-brush/Shortgrass/Annuals Community is essentially a dense shrubland. It is the collective result of many years of overgrazing, lack of periodic fires and little brush management. Mesquite, and sometimes redberry juniper, dominates the Mixed-brush/Shortgrass/Annuals Community. Common understory shrubs are pricklypear, broom snakeweed, sumac, lotebush, yucca and wolfberry. With continued heavy grazing and no brush control, the trees and shrubs can approach 70 percent woody plant cover. Cool-season grasses, short-grasses and low quality annual and perennial forbs occupy the woody plant interspaces. Characteristic grasses are meadow and sand dropseed and three-awns. Alkali sacaton is common in depressions and salt spots. Texas wintergrass and cool-season annuals are found in and around tree/shrub cover. Grasses and forbs make up 25 percent or less of the annual herbage production. Forbs commonly found in this community include dotted gayfeather, western ragweed, prairie coneflower, and curlycup gumweed. Cool-season annuals such as filaree, little barley, Japanese brome and mustards grow profusely during wet springs. Initially, the shrub canopy acts to intercept rainfall and increase evapotranspiration losses, creating a more xeric microclimate. Soil fauna and organic mulch are reduced. More soil surface is exposed to erosion in the spaces between plants. The exposed soil crusts and readily erodes. However, within the woody canopy hydrologic and ecological processes stabilize. Soil organic matter and mulch also begin to increase and eventually stabilize. Unless erosion has been severe in the retrogression process, the Mixed-brush/Shortgrass/Annuals Community will eventually approach or exceed reference community total biomass production under the current climate. The Mixed-brush/Shortgrass/Annuals Community (2.2) provides cover for wildlife, but only limited and variable preferred forage, or browse, is available for livestock or wildlife. 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	729	1457	1821
Grass/Grasslike	280	560	701
Forb	45	112	140
Tree	45	112	140
Total	**1099**	**2241**	**2802**

Figure 18. 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

Mixed-brush/Shortgrass/Annuals Community

Unless brush management and good grazing management are applied at this stage, the transition toward the Mixed-brush/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

Mixed-brush/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 Loam Ecological Site, with its productive soils, is often cultivated and planted to crops. When cropping is abandoned the site should be re-vegetated with adapted native plant mixtures, which include historic climax 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 community species composition. Introduced species often require more care, but can also be productive as pasture.

Community 3.1
Converted Land Community

The Clay Loam Ecological Site, with its productive soils, is often cultivated and planted to crops. Technical advice as to adapted crops, cropping systems, production, and cultivation practices are available from local NRCS or Extension Service offices. When abandoned from cropping, 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 historic 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. If fields are abandoned and left to re-vegetate naturally, weedy grasses, forbs and shrubs will be the first species in secondary succession. Even without grazing, woody species will encroach and eventually dominate unless brush management practices such as individual plant treatments (IPT) and prescribed burning are applied.

Figure 19. 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 20. 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 (15-20%) and tall enough (> 4 feet) to suppress grass growth and resist fire damage, a threshold in ecological succession is crossed from the Grassland State to Shrubland State. 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**			785–1569	
	vine mesquite	PAOB	*Panicum obtusum*	336–673	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	336–673	–
	Arizona cottontop	DICA8	*Digitaria californica*	112–224	–
2	**Midgrasses**			112–224	
	silver beardgrass	BOLAT	*Bothriochloa laguroides ssp. torreyana*	112–224	–
	tobosagrass	PLMU3	*Pleuraphis mutica*	112–224	–
	large-spike bristlegrass	SEMA5	*Setaria macrostachya*	112–224	–
	alkali sacaton	SPAI	*Sporobolus airoides*	112–224	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	112–224	–
	white tridens	TRAL2	*Tridens albescens*	112–224	–
	slim tridens	TRMU	*Tridens muticus*	112–224	–
3	**Shortgrasses**			448–785	
	buffalograss	BODA2	*Bouteloua dactyloides*	336–560	–
	blue grama	BOGR2	*Bouteloua gracilis*	112–224	–
	fall witchgrass	DICO6	*Digitaria cognata*	112–224	–
	Hall's panicgrass	PAHA	*Panicum hallii*	112–224	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	112–224	–
	threeawn	ARIST	*Aristida*	112–224	–
4	**Cool-season grasses**			112–224	
	Texas wintergrass	NALE3	*Nassella leucotricha*	112–224	–
	western wheatgrass	PASM	*Pascopyrum smithii*	112–224	–
5	**Grasslike species**			0–1	
	sedge	CAREX	*Carex*	0–1	–

Forb					
6	**Forbs**			56–168	
	onion	ALLIU	*Allium*	56–168	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	56–168	–
	milkvetch	ASTRA	*Astragalus*	56–168	–
	rose heath	CHER2	*Chaetopappa ericoides*	56–168	–
	springparsley	CYMOP2	*Cymopterus*	56–168	–
	prairie clover	DALEA	*Dalea*	56–168	–
	larkspur	DELPH	*Delphinium*	56–168	–
	Engelmann's daisy	ENPE4	*Engelmannia peristenia*	56–168	–
	beeblossom	GAURA	*Gaura*	56–168	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	56–168	–
	hoary false goldenaster	HECA8	*Heterotheca canescens*	56–168	–
	Indian rushpea	HOGL2	*Hoffmannseggia glauca*	56–168	–
	trailing krameria	KRLA	*Krameria lanceolata*	56–168	–
	flax	LINUM	*Linum*	56–168	–
	dotted blazing star	LIPU	*Liatris punctata*	56–168	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	56–168	–
	globemallow	SPHAE	*Sphaeralcea*	56–168	–
	greenthread	THELE	*Thelesperma*	56–168	–
	spiderwort	TRADE	*Tradescantia*	56–168	–
	vervain	VERBE	*Verbena*	56–168	–
Shrub/Vine					
7	**Shrubs/Vines**			11–34	
	fourwing saltbush	ATCA2	*Atriplex canescens*	11–34	–
	jointfir	EPHED	*Ephedra*	11–34	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–34	–
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	11–34	–
	pricklypear	OPUNT	*Opuntia*	11–34	–
	honey mesquite	PRGL2	*Prosopis glandulosa*	11–34	–
	littleleaf sumac	RHMI3	*Rhus microphylla*	11–34	–
Tree					
8	**Trees**			0–1	
	hackberry	CELTI	*Celtis*	0–1	–
	elm	ULMUS	*Ulmus*	0–1	–

Animal community

Many types of wildlife use the Clay Loam 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. Bison and pronghorn antelope, however, are no longer present. White-tailed deer utilize the Clay Loam site in its various states. Deer, turkey and quail particularly favor the habitat provided by the Mixed-Grass (1.2) and Shortgrass/Mixed-Brush (2.1) plant communities.

The site is well suitable for production of livestock, including cattle, sheep and goats. The site in reference condition 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. Although sheep and goats are seldom pastured in the MLRA anymore, 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 2.2 Mixed-brush/Shortgrasses/Annuals Community will have little to offer as habitat except cover. Cropland in grain crops, pasture or seeded to wildlife food plots can enhance the landscape as wildlife habitat.

Hydrological functions

The Clay Loam Ecological Site is a moderately fine textured upland with nearly level to gentle slopes. Most soils are more than 20 inches deep. They are slow to take up water and droughty during the summer months. Runoff is slow due to gentle slopes. However, soil crusting can cause erosion from bare ground on steeper slopes.

Under reference condition, the grassland vegetation intercepted and utilized much of the incoming rainfall in the soil solum. Only during extended rains or heavy thunderstorms was there much runoff. Litter and soil movement was slight. Standing plant cover, duff and 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, however, 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. Once the Mixed-brush/Shortgrasses/Annuals Community (2.2) canopy surpasses 50 percent the hydrology and ecological processes, nutrient cycling and energy flow, stabilize within the woody plant canopy.

Recreational uses

The Clay Loam Site is well suited for many outdoor recreational uses including recreational hunting, hiking, camping, equestrian and bird watching. This site along with adjacent upland sites and Loamy Bottomland site also provide diverse scenic beauty and many opportunities for recreation and hunting.

Wood products

Posts and specialty wood products can be made from juniper, mesquite and many shrubs. Mesquite is used for firewood.

Other products

Seeds are harvested from many HCPC plants for commercial sale. Grasses and forbs are 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.

Other information

None.

Inventory data references

Information presented has been derived from the revised Clay Loam Range Site PE 31-44, an undated NRCS draft Ecological Site Description for Clay Loam 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 NRCS personnel for assistance and guidance with development of this ESD: Reggie Quiett NRCS, Vernon, Texas, 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	10/22/2007
Approved by	Bryan Christensen

Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

2. **Presence of water flow patterns:** Water flow patterns are common and follow old stream meanders. Deposition or erosion is uncommon for normal rainfall but may occur during intense rainfall events.

3. **Number and height of erosional pedestals or terracettes:** None to slight. Uncommon for this site.

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:** Some gullies may be present on side drains into perennial and intermittent streams. Gullies should 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):** Under normal rainfall, little litter movement should be expected, however, litter of all sizes may move long distances depending on obstructions 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 8 inches thick dark grayish brown fine sandy loam with weak granular structure. SOM is approximately 1-6%. See soil survey for specific soils information.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The grassland cover of mid and short grasses plus litter provided excellent soil protection and infiltration. Little runoff occurred except under heavy 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.

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 shortgrasses >>

    Sub-dominant: Warm-season midgrasses >> Cool-season grasses >

    Other: Forbs > Grass-likes > Shrubs > Trees

    Additional:

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 group.

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

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 1000 - 3000 lbs/acre

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:** Honey mesquite, prickly pear, bermudagrass, johnsongrass.

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