USDA Natural Resources Conservation Service

# Ecological site R086AY010TX
# Northern Blackland

Last updated: 9/21/2023
Accessed: 04/23/2024

## 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.

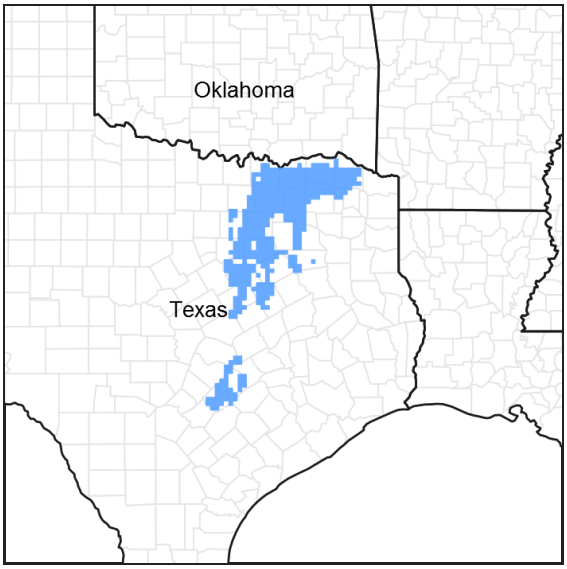



**Figure 1. Mapped extent**

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): 086A–Texas Blackland Prairie, Northern Part

MLRA 86A, The Northern Part of Texas Blackland Prairie is entirely in Texas. It makes up about 15,110 square miles (39,150 square kilometers). The cities of Austin, Dallas, San Antonio, San Marcos, Temple, and Waco are located within the boundaries. Interstate 35, a MLRA from San Antonio to Dallas. The area supports tall and mid-grass prairies, but improved pasture, croplands, and urban development account for the majority of the acreage.

## Classification relationships

USDA-Natural Resources Conservation Service, 2006.
-Major Land Resource Area (MLRA) 86A

## Ecological site concept

The Blackland ecological site is a true tallgrass prairie. Reference sites show an intact grass community with small clumped dispersal of woody species. The soils are moderately deep to very deep, richly black in color, and characterized by their shrink-swell nature. The sites are widely distributed across the uplands and terraces throughout the region.

## Associated sites

| | |
|---|---|
| R086AY008TX | **Northern Eroded Blackland**<br>The Eroded Blackland site is often adjacent to the Blackland site. It differs from the site by having extensive erosion indicated by a partial or lost A horizon, active rills and/or gullies, and lower production. |
| R086AY012TX | **Loamy Bottomland**<br>The Northern Blackland site is often upslope from the Loamy Bottomland site. It differs from the Loamy Bottomland site by its position on uplands, high shrink-swell properties, and having clay soils and higher runoff. |
| R086AY013TX | **Clayey Bottomland**<br>The Northern Blackland site is often upslope from the Clayey Bottomland site. It differs from the Clayey Bottomland site by its position on uplands, lack of high shrink-swell and hydric soil properties, and having clay soils and higher runoff. |
| R086AY001TX | **Northern Chalky Ridge**<br>The Chalky Ridge site is often upslope from the Blackland. It differs from the site by having shallow soils and low soil fertility. |
| R086AY003TX | **Northern Claypan Prairie**<br>The Claypan Prairie site is often adjacent to the Blackland. It differs from the site by having a fine sandy loam surface soil layer over clay subsoils. |

## Similar sites

| | |
|---|---|
| R086AY011TX | **Southern Blackland**<br>The Southern Blackland site is similar to the Northern Blackland site by having similar physiographic features and representative soil features. It differs from the site by receiving less effective precipitation. |
| R086AY008TX | **Northern Eroded Blackland**<br>The Eroded Blackland site is similar to the Blackland site by having similar soil types and topography. It differs from the site by having extensive erosion indicated by a partial or lost A horizon, active rills and/or gullies, and lower production. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | Not specified |
| Shrub | Not specified |
| Herbaceous | (1) *Andropogon gerardii*<br>(2) *Tripsacum dactyloides* |

## Physiographic features

These are uplands and terraces with nearly level to moderate slopes. Slope gradients range from 0 to 8 percent but are usually less than 5 percent. There is no flooding or ponding with a low to high runoff, greatly depending on soil saturation and slope.

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Plains > Terrace<br>(2) Plains > Ridge |
| Runoff class | Low to high |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 300–600 ft |
| Slope | 0–5% |
| Water table depth | 60–80 in |
| Aspect | Aspect is not a significant factor |

**Table 3. Representative physiographic features (actual ranges)**

| | |
|---|---|
| Runoff class | Not specified |
| Flooding frequency | Not specified |
| Ponding frequency | Not specified |
| Elevation | Not specified |
| Slope | 0–8% |
| Water table depth | Not specified |

## Climatic features

The climate for MLRA 86A is humid subtropical and is characterized by hot summers, especially in July and August, and relatively mild winters. Tropical maritime air controls the climate during spring, summer and fall. In winter and early spring, frequent surges of Polar Canadian air cause sudden drops in temperatures and add considerable variety to the daily weather. When these cold air masses stagnate and are overrun by moist air from the south, several days of cold, cloudy, and rainy weather follow. Generally, these occasional cold spells are of short duration with rapid clearing following cold frontal passages. The summer months have little variation in day-to-day weather except for occasional thunderstorms that dissipate the afternoon heat. The moderate temperatures in spring and fall are characterized by long periods of sunny skies, mild days, and cool nights. The average relative humidity in mid-afternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 75 percent of the time during the summer and 50 percent in winter. The prevailing wind direction is from the south and highest wind speeds occur during the spring months. Rainfall during the spring and summer months generally falls during thunderstorms, and fairly large amounts of rain may fall in a short time. High-intensity rains of short duration are likely to produce rapid runoff almost anytime during the year. The predominantly anticyclonic atmospheric circulation over Texas in summer and the exclusion of cold fronts from North Central Texas result in a decrease in rainfall during midsummer. The amount of rain that falls varies considerably from month-to-month and from year-to-year.

**Table 4. Representative climatic features**

| | |
|---|---|
| Frost-free period (average) | 231 days |
| Freeze-free period (average) | 257 days |
| Precipitation total (average) | 43 in |

## Climate stations used

- (1) LAKE TAWAKONI [USC00414980], Point, TX
- (2) LAVON DAM [USC00415094], Wylie, TX
- (3) MCKINNEY [USC00415766], McKinney, TX
- (4) DALLAS FT WORTH AP [USW00003927], Dallas, TX
- (5) RICHARDSON [USC00417588], Plano, TX
- (6) WAXAHACHIE [USC00419522], Waxahachie, TX
- (7) WILLS POINT [USC00419800], Wills Point, TX
- (8) HILLSBORO [USC00414182], Hillsboro, TX
- (9) SULPHUR SPRINGS [USC00418743], Sulphur Springs, TX
- (10) CORSICANA [USC00412019], Corsicana, TX
- (11) GREENVILLE KGVL RADIO [USC00413734], Greenville, TX
- (12) JOE POOL LAKE [USC00414597], Dallas, TX
- (13) KAUFMAN 3 SE [USC00414705], Kaufman, TX
- (14) NAVARRO MILLS DAM [USC00416210], Frost, TX

## Influencing water features

The site has a water table that can exist at a depth of 60 inches in the soil profile.

## Wetland description

Wetlands are not associated with this site.

## Soil features

The site consists of moderately deep to very deep, moderately well to well drained soils that are slow to very slowly permeable. The upland soils formed in calcareous marl and marine sediments, high in smectitic clays. The terrace soils formed in clayey alluvial sediments. A few of the upland soils may have weathered and soft bedrock at a depth of more than 24 inches below the soil surface. The majority of this site is used for cropland due to the very deep, highly productive soils. There are some areas that are used for pasture or rangeland.

In a representative profile, the surface layer is black clay about 24 inches thick. The clay extends below 24 inches and to depths of more than 80 inches. The subsoil is clay that grades from very dark gray to light olive brown as depth increases. Available water capacity to a depth of 60 inches is moderate, and shrink swell potential is very high.

The dominant associated soil series for the Blackland ecological site includes:
Altoga, Branyon, Burleson, Chatt, Dalco, Deport, Fairlie, Heiden, Houston Black, and Leson.

**Table 5. Representative soil features**

| | |
|---|---|
| Parent material | (1) Residuum–mudstone<br>(2) Alluvium |
| Surface texture | (1) Clay<br>(2) Gravelly<br>(3) Stony |
| Family particle size | (1) Clayey |
| Drainage class | Moderately well drained to well drained |
| Permeability class | Slow to very slow |
| Soil depth | 24–80 in |
| Surface fragment cover <=3" | 0–10% |
| Surface fragment cover >3" | 0–4% |
| Available water capacity (0-40in) | 4–11 in |
| Calcium carbonate equivalent (0-40in) | 2–35% |
| Electrical conductivity (0-40in) | 0–4 mmhos/cm |
| Sodium adsorption ratio (0-40in) | 0–12 |
| Soil reaction (1:1 water) (0-40in) | 5.6–8.4 |
| Subsurface fragment volume <=3" (Depth not specified) | 0–10% |
| Subsurface fragment volume >3" (Depth not specified) | 0–10% |

## Ecological dynamics

Introduction – The Northern Blackland Prairies are a temperate grassland ecoregion contained wholly in Texas, running from the Red River in North Texas to San Antonio in the south. The region was historically a true tallgrass prairie named after the rich dark soils it was formed in. Other vegetation included deciduous bottomland woodlands

along rivers and creeks.

Background – Natural vegetation on the uplands is predominantly tall warm-season perennial bunchgrasses with lesser amounts of midgrasses. This tallgrass prairie was historically dominated by big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), eastern gamagrass (*Tripsacum dactyloides*), and little bluestem (*Schizachyrium scoparium*). Midgrasses such as sideoats grama (*Bouteloua curtipendula*), Virginia wildrye (*Elymus virginicus*), Florida paspalum (*Paspalum floridanum*), Texas wintergrass (*Nassella leucotricha*), hairy grama (*Bouteloua hirsuta*), and dropseeds (Sporobolus spp.) are also abundant in the region. A wide variety of forbs add to the diverse native plant community. Mottes of live oak (*Quercus virginiana*) and hackberry (Celtis spp.) trees are also native to the region. In some areas, cedar elm (*Ulmus crassifolia*), eastern red cedar (*Juniperus virginiana*), and honey locust (*Gleditsia triacanthos*) are abundant. In the Northern Blackland Prairie oaks (Quercus spp.) are common increasers, but in the Southern Blackland Prairie oaks are less prevalent. Junipers are common invaders, particularly in the northern part of the region.

During the first half of the nineteenth century, row crop agriculture lead to over 80 percent of the original vegetation lost. During the second half, urban development has caused even an even greater decline in the remaining prairie. Today, less than one percent of the original tallgrass prairie remains. The known remaining blocks of intact prairie range from 10 to 2,400 acres. Some areas are public, but many are privately owned and have conservation easements.

Current State – Much of the area is classified as prime farmland and has been converted to cropland. Most areas where native prairie remains have histories of long-term management as native hay pastures. Tallgrasses remain dominant when haying of warm-season grasses is done during the dormant season or before growing points are elevated, meadows are not cut more than once, and the cut area is deferred from grazing until frost.

Due to the current-widespread farming, the Northern Blackland Prairie is still relatively free from the invasion of brush that has occurred in other parts of Texas. In contrast, many of the more sloping have experienced heavy brush encroachment, and the continued increase of brush encroachment is a concern. The shrink-swell and soil cracking characteristics of the soils favor brush species with tolerance for soil movement.

Current Management – Rangeland and pastureland are grazed primarily by beef cattle. Horse numbers are increasing rapidly in the region, and in recent years goat numbers have increased significantly. There are some areas where dairy cattle, poultry, goats, and sheep are locally important. Whitetail deer, wild turkey, bobwhite quail, and dove are the major wildlife species, and hunting leases are a major source of income for many landowners in this area.

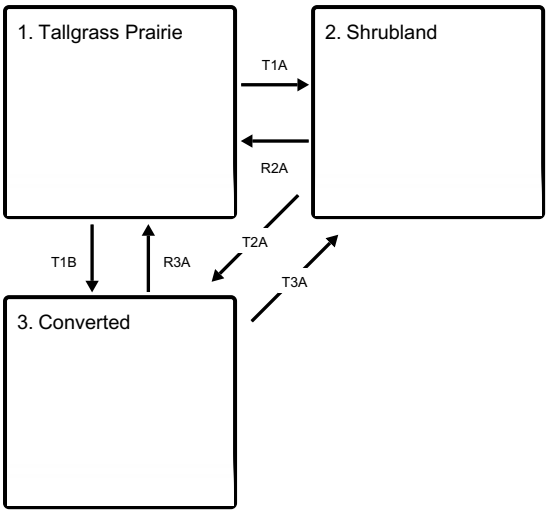
Introduced pasture has been established on many acres of old cropland and in areas with deeper soils. Coastal bermudagrass (*Cynodon dactylon*) and kleingrass (*Panicum coloratum*) are by far the most frequently used introduced grasses for forage and hay. Hay has also been harvested from a majority of the prairie remnants, where long-term mowing at the same time of year has possibly changed the relationships of the native species. Cropland is found in the valleys, bottomlands, and deeper upland soils. Wheat (Triticum spp.), oats (Avena spp.), forage and grain sorghum (Sorghum spp.), cotton (Gossypium spp.), and corn (*Zea mays*) are the major crops in the region.

Fire Regimes – The prairies were a disturbance-maintained system. Prior to European settlement (pre-1825), fire and infrequent, but intense, short-duration grazing by large herbivores (mainly bison and to a lesser extent pronghorn antelope) were important natural landscape-scale disturbances that suppressed woody species and invigorated herbaceous species (Eidson and Smeins 1999). The herbaceous prairie species adapted to fire and grazing disturbances by maintaining below-ground penetrating tissues. Wright and Bailey (1982) report that there are no reliable records of fire frequency occurring in the Great Plains grasslands because there are no trees to carry fire scars from which to estimate fire frequency. Because prairie grassland is typically of level or rolling topography, a natural fire frequency of 5 to 10 years seems reasonable.

Disturbance Regimes - Precipitation patterns are highly variable. Long-term droughts, occurring three to four times per century, cause shifts in species composition by causing die-off of seedlings, less drought-tolerant species, and some woody species. Droughts also reduce biomass production and create open space, which is colonized by opportunistic species when precipitation increases. Wet periods allow tallgrasses to increase in dominance. These natural disturbances cause shifts in the states and communities of the ecological sites.

## State and transition model

**Ecosystem states**




**T1A** - No fire, no brush management, improper grazing management, drought

**T1B** - Brush management, crop cultivation, pasture planting, nutrient management, pest management

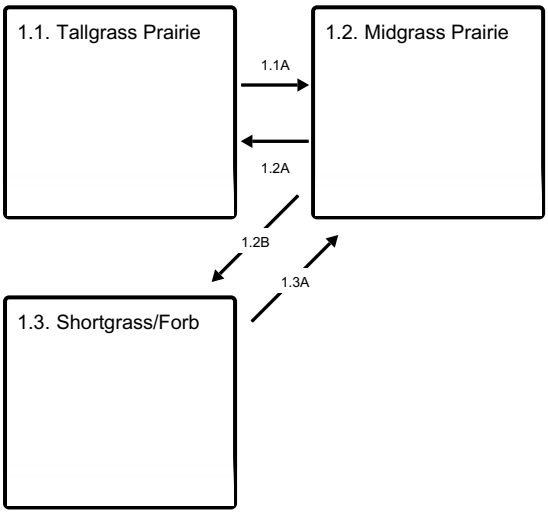
**R2A** - Fire, brush management, proper grazing, range planting

**T2A** - Brush management, crop cultivation, pasture planting, nutrient management, pest management

**R3A** - Fire, brush management, proper grazing, range planting

**T3A** - No fire, no brush management, heavy continuous grazing, no pest management

**State 1 submodel, plant communities**



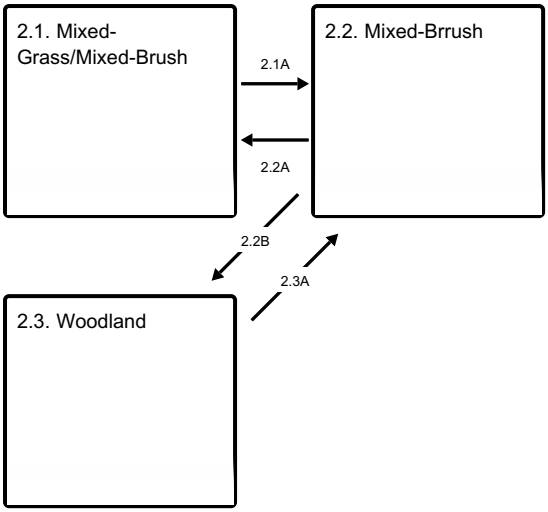

**1.1A** - No fire, no brush management, improper grazing management, drought

**1.2A** - Fire, brush management, proper grazing

**1.2B** - No fire, no brush management, improper grazing management, drought

**1.3A** - Fire, brush management, proper grazing

**State 2 submodel, plant communities**



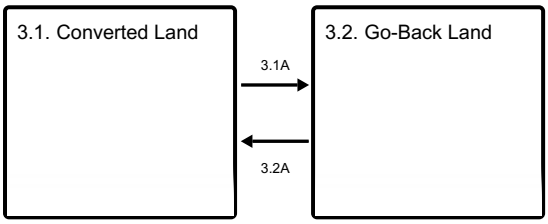

**2.1A** - No fire, no brush management, improper grazing management, drought

**2.2A** - Fire, brush management, proper grazing, range planting

**2.2B** - No fire, no brush management, improper grazing management, drought

**2.3A** - Fire, brush management, proper grazing, range planting

**State 3 submodel, plant communities**




**3.1A** - No fire, no brush management, heavy continuous grazing, no pest management

**3.2A** - Fire, brush management, proper grazing, pest management

## State 1
## Tallgrass Prairie

Three communities exist in the Grassland State: the 1.1 Tallgrass Prairie Community, the 1.2 Midgrass Prairie Community, and the 1.3 Shortgrass/Forbs Community. Community 1.1 is characterized by tallgrasses dominating the understory and comprising greater than 50 percent of the annual production, with woody cover less than 10 percent. Community 1.2 is characterized by midgrasses and forbs combining for greater than 50 percent of the annual production, with woody cover between 10 and 35 percent. Community 1.3 is characterized by shortgrasses and forbs totaling greater than 50 percent of the annual production with 10 to 35 percent woody cover.

## Community 1.1
## Tallgrass Prairie

The Tallgrass Prairie Plant Community (1.1) is the reference community. It is characterized by deeper soils dominated by warm-season, perennial tallgrasses, with warm-season, perennial midgrasses filling most of the remaining species composition. The warm-season, perennial forb component varies between 5 and 15 percent depending on climatic patterns and local precipitation. Woody species make up a minor component of the community, five percent, even in the mid-term absence of fire (15 to 25 years). Indiangrass, big bluestem, eastern gamagrass, switchgrass, and little bluestem dominate the site. Other important grasses are sideoats grama, Florida paspalum, Virginia wildrye, silver bluestem (*Bothriochloa laguroides*), Texas wintergrass, and Texas cupgrass (*Eriochloa sericea*). Forbs commonly found on the site include: Engelmann's daisy (*Engelmannia peristenia*), Maximilian sunflower (*Helianthus maximiliani*), blacksamson (*Echinacea angustifolia*), button snakeroot (*Eryngium yuccifolium*), halfshrub sundrop ( *Calylophus serrulatus*), sensitive-briar (Mimosa spp.), and yellow neptunia (*Neptunia lutea*). Typical, but infrequent shrub and tree species include species of oak, hackberry, and elm (Ulmus spp.), along with bumelia (Sideroxylon spp.) and coralberry (*Symphoricarpos orbiculatus*). The reference grassland community will transition to a midgrass dominated community under the stresses of improper grazing. The first species to decrease in dominance will be the most palatable and/or least grazing tolerant grasses and forbs (e.g. eastern gamagrass, switchgrass, Indiangrass, big bluestem, and Engelmann's daisy). This will initially result in an increase in composition of little bluestem. If improper grazing management continues, little bluestem will decrease and midgrasses such as silver bluestem and sideoats grama will increase in composition. Less palatable forbs will increase at this stage. This plant community has very little bare ground. Plant basal cover and litter make up almost 100 percent ground cover. Infiltration is rapid and runoff is very low when the soils are dry and open. Once soils have swelled to the point of sealing shut, infiltration is slow and runoff can occur. Soils are high in organic matter and the heavy plant cover contributes to increasing organic matter and soil building. The nearly level areas have gilgai. Sloping soils also have gilgai which create microridges and valleys extending up and down the slopes. Soil erosion is very low if tallgrasses and the water trapping gilgai are present. As much as six inches of water could be temporarily trapped in these gilgai microreliefs before runoff begins. Plowing removes the gilgai; it may take 20 years or more after plowing stops for the gilgai to reform.

**Table 6. Annual production by plant type**

| Plant Type | Low (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Grass/Grasslike | 4000 | 5200 | 6400 |
| Forb | 750 | 975 | 1200 |
| Shrub/Vine | 250 | 325 | 400 |
| **Total** | **5000** | **6500** | **8000** |

## Community 1.2
## Midgrass Prairie

The Midgrass Prairie Plant Community (1.2) is the result of improper cattle grazing management or improper haying practices over a long period of time. Tallgrasses in the reference community decrease in vigor and production, allowing midgrasses and forbs to increase to the point that they make up more than 50 percent of species composition. Indigenous or invading woody species may increase on the site depending on fire and brush control

methods. In the Tallgrass Prairie Plant Community (1.1), repeated fires and competition from a vigorous grass component keep woody canopy cover low. When the Midgrass Prairie Plant Community (1.2) is continually overgrazed and fire is excluded, the community crosses a threshold to a state that is dominated by woody plants, the Mixed-Grass/Mixed-Brush Plant Community (2.1). Important grasses include: little bluestem, sideoats grama, silver bluestem, paspalums, Texas wintergrass, and tridens (Tridens spp.). Some of the reference perennial forbs persist, but less palatable forbs will increase. Woody canopy may be as high as 35 percent, depending on the type of grazing animal, fire interval, brush control, and/or availability of increaser shrub species. Numerous shrub and tree species will encroach because overgrazing by livestock has reduced grass cover, exposed more soil, and reduced grass fuel for fire. Typically, trees such as oak, elm, and hackberry will increase in size, while other woody species such as bumelia, coralberry, and honey locust will increase in density. Aggressive, introduced pasture species may begin to invade the Midgrass Prairie Plant Community (1.2), particularly if they have been seeded in nearby pastures. These include introduced grasses such as dallisgrass (*Paspalum dilatatum*), common bermudagrass (*Cynodon dactylon*), and Johnsongrass (*Sorghum halepense*). Heavy continuous grazing will reduce plant cover, litter, and mulch. Bare ground will increase and expose the soil to crusting and erosion. Some mulch and litter movement may occur during rainstorms, but little soil movement occurs due to gentle slopes in this vegetation type. Litter and mulch will move off site as plant cover declines. Increasing woody dominants are hackberry, elm, juniper, and honey locust. Once shrubs reach a height of about three feet, they become more resistant to being killed by fires. When woody species exceed 35 percent canopy cover, the site crosses a threshold (T1A) into the Shrubland State (2) and the Mixed-Grass/Mixed-Brush Plant Community (2.1). Canopy cover drives the transitions between community and states because of the influence of shade and interception of rainfall. Species composition by weight remains an important descriptor of the herbaceous community and of the community as a whole. Woody species are included in species composition for the site. Until the Midgrass Prairie Plant Community (1.2) crosses the threshold into the Grass/Mixed-Brush Plant Community (2.1), this community can be managed back toward the reference community (1.1) through the use of cultural practices including prescribed grazing, prescribed burning, and strategic brush control. It may take several years to achieve this state, depending upon climate and the aggressiveness of the manager. Once woody species begin to establish, returning fully to the reference community is difficult, but it is possible to return to a similar plant community. If improper grazing management continues but shrubs are held in check through fire, brush control, browsing, or mowing, the Midgrass Prairie Plant Community will transition (1.2B) to the Shortgrass/Forb Plant Community (1.3). Tallgrasses will continue to decrease in species composition, and midgrasses will begin to decrease. Grazing-resistant shortgrasses and forbs will represent more of species composition. These species may increase in production due to release from competition with more robust grasses or increase in relative composition due to the loss of tall and midgrasses.

**Table 7. Annual production by plant type**

| Plant Type | Low (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Grass/Grasslike | 2600 | 3150 | 3700 |
| Forb | 450 | 675 | 900 |
| Shrub/Vine | 450 | 675 | 900 |
| **Total** | **3500** | **4500** | **5500** |

## Community 1.3
## Shortgrass/Forb

The Shortgrass/Forb Plant Community (1.3) is the result of improper cattle grazing management or improper haying practices over a long period of time. Midgrasses in the Midgrass Prairie Plant Community (1.2) decrease in vigor and production, allowing shortgrasses and forbs to increase to the point that they make up more than 50 percent of species composition. Indigenous or invading woody species may increase on the site depending on fire and brush control methods. However, this community tends to occur on areas where some form of brush control is in place, either mowing, or heavy browsing due to animals being forced to a low quality diet. This community often occurs in pastures with abusive horse grazing. Important grasses include vine mesquite (*Panicum obtusum*), low panicums (Panicum spp.), and threeawns (Aristida spp.). Grazing-resistant, introduced species can make up a substantial portion of species composition. Few reference community perennial forbs persist, but less palatable forbs will increase such as broomweed (*Amphiachyris dracunculoides*), croton (Croton spp.), and silverleaf nightshade (*Solanum elaeagnifolium*). Woody canopy may be as high as 35 percent, depending on the type of grazing animal, fire interval, brush control, and/or availability of increaser shrub species, but tends to be lower. Heavy continuous grazing will reduce plant cover, litter, and mulch. Bare ground will increase and expose more soil to crusting and erosion. Increasing woody dominants are hackberry, elm, juniper, and honey locust. Once shrubs reach a height of about three feet, they become more resistant to being killed by fires. When woody species exceed 35 percent canopy cover, the site crosses a threshold (T1A) into the Shrubland State (2). Until the Shortgrass/Forb Plant Community (1.3) crosses the threshold into the Shrubland State, this community can be managed back toward the Midgrass Prairie Plant Community (1.2) through the use of cultural practices including prescribed grazing, prescribed burning, and strategic brush control. It may take several years to achieve this state, depending upon climate and the aggressiveness of the manager. Seeding of desirable native species can accelerate this process.

**Table 8. Annual production by plant type**

| Plant Type | Low (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Grass/Grasslike | 1550 | 2100 | 2700 |
| Shrub/Vine | 600 | 800 | 1100 |
| Forb | 350 | 600 | 700 |
| **Total** | **2500** | **3500** | **4500** |

## Pathway 1.1A
## Community 1.1 to 1.2

The Tallgrass Prairie Plant Community will shift to the Midgrass Prairie Plant Community when there is continued growing-season stress on reference grass species. These stresses include improper grazing management that creates insufficient critical growing-season deferment, excess intensity of defoliation, repeated, long-term growing-season defoliation, long-term drought, and/or other repeated critical growing-season stress. Increaser species (midgrasses and woody species) are generally endemic species released by disturbance. Woody species canopy exceeding 20 percent and/or dominance of tallgrasses falling below 50 percent of species composition indicate a transition to the Midgrass Prairie Plant Community. The reference community can be maintained through implementation of brush management combined with properly managed grazing that provides adequate growing-season deferment to allow establishment of tall grass propagules and/or the recovery of vigor of stressed plants.

The driver for community shift 1.1A for the herbaceous component is improper grazing management. The driver for the woody component is lack of fire and/or brush control.

### Pathway 1.2A
### Community 1.2 to 1.1

The Midgrass Prairie Plant Community will return to the Tallgrass Prairie Plant Community under grazing management that provides sufficient critical growing season deferment in combination with proper grazing intensity as long as the seedbank or seed source is still present. Favorable moisture conditions will facilitate or accelerate this transition. The understory component may return to dominance by tallgrasses in the absence of fire or brush control. However, reduction of the woody component to reference conditions of 10 percent or less canopy cover will require inputs of fire or brush control.

### Pathway 1.2B
### Community 1.2 to 1.3

The Midgrass Prairie Plant Community will shift to the Shortgrass/Forb Plant Community when there is continued growing season stress on reference and midgrass species. This transition usually results from heavy, long-term continuous (or growing season long) grazing. Other stresses include: insufficient critical growing season deferment, excess defoliation intensity, improper haying, and/or long-term drought. Increaser species include grazing tolerant or unpalatable grasses and forbs. Shortgrasses and forbs exceeding 50 percent of species composition indicate a transition to the Shortgrass/Forb Plant Community. Transition to the Shortgrass/Forb Plant Community usually requires brush control in some form, either through browsing, mowing, or herbicide. Without brush control, woody species canopy will exceed 35 percent, indicating a shift across a threshold to the Shrubland State.

### Pathway 1.3A
### Community 1.3 to 1.2

The Shortgrass/Forb Plant Community will return to the Midgrass Prairie Plant Community under grazing management that provides sufficient critical growing season deferment in combination with proper grazing intensity. This will require the recovery of the vigor of stressed individual midgrass plants, plants remaining in the seedbank, and/or introduction of reference plant seeds. Favorable moisture conditions will facilitate or accelerate this transition. The understory component may return to dominance by midgrasses in the absence of fire or brush control. However, without brush control the site will eventually cross the threshold to the Shrubland State. Proper grazing management may be combined with fire and/or brush management to create a shift towards or maintain the reference community.

## State 2
## Shrubland

The Shrubland State has three communities: 2.1 Mixed-Grass/Mixed-Brush Community, 2.2 Mixed-Brush Community, and 2.3 Woodland Community. The 2.1 community has a woody species overstory canopy of 35 to 50 percent, the 2.2 community over 50 percent, and the 2.3 community has a closed canopy. As tree and brush canopy increases, the herbaceous understory production decreases due to lack of light availability.

### Community 2.1
### Mixed-Grass/Mixed-Brush

The Mixed-Grass/Mixed-Brush Plant Community (2.1) presents a 35 to 50 percent woody plant canopy, with, hackberry, elm, honey locust, or juniper as dominant woody species. This community can occur as a result of continuous improper grazing management combined with lack of fire or brush control. It can also occur where there has been proper grazing management without brush control or fire. Improper grazing management speeds the process. Although it is rarely found, it is possible for the herbaceous component to include substantial production from tallgrasses. Sideoats grama and other reference community (1.1) midgrasses decrease, but still remain the dominant component of composition, while shortgrasses such as buffalograss (*Bouteloua dactyloides*) increase. Remnants of the reference community (1.1) grasses and forbs along with unpalatable invaders occupy the interspaces between shrubs. Cool-season species such as Texas wintergrass and sedges (Carex spp.), plus other

grazing-resistant reference (1.1) species, can be found under and around woody plants. Plant vigor and productivity of the grassland component is reduced due to grazing pressure and competition for sunlight, nutrients, and water from woody plants. Common herbaceous species include: threeawns, dropseeds, and dotted gayfeather (*Liatris punctata*). Tumblegrass (*Schedonnardus paniculatus*), Texas grama (*Bouteloua rigidiseta*), western ragweed (*Ambrosia psilostachya*), Indian paintbrush (Castilleja spp.), Texas bluebonnet (*Lupinus texensis*), curly-mesquite (*Hilaria belangeri*), and annual species are persistent increasers until shrub density reaches maximum canopy. As the grassland vegetation declines, more soil is exposed, leading to crusting and erosion. In this vegetation type, erosion can be severe. Higher rainfall interception losses by the increasing woody canopy combined with evaporation and runoff can reduce the effectiveness of rainfall. 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 rainfall events. Annual primary production is approximately 2,000 to 4,500 pounds per acre. In this plant community, annual production is balanced between herbaceous plants and woody species, with herbaceous production still the dominant component of annual production. Browsing animals such as goats and deer can find fair food value if browse plants have not been grazed excessively. Forage quantity and quality for cattle is low. Unless brush management and good grazing management are applied at this stage, woody species canopy will exceed 50 percent, causing the community to convert to the Mixed-Brush Community (2.2). The trend cannot be reversed with proper grazing management alone.

**Table 9. Annual production by plant type**

| Plant Type | Low (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Shrub/Vine | 800 | 1300 | 1800 |
| Grass/Grasslike | 800 | 1300 | 1800 |
| Forb | 400 | 650 | 900 |
| **Total** | **2000** | **3250** | **4500** |

## Community 2.2
## Mixed-Brrush

The Mixed-Brush Plant Community (2.2) has 50 to 80 percent woody canopy cover and is the result of many years of improper grazing, lack of periodic fires, and/or a lack of proper brush management. Reference community woody species or increasers such as honey locust and/or juniper dominate the Mixed-Brush Community (2.2). The site can now have the appearance of a dense shrubland or savannah of interspersed shrubland and grassland areas. Common understory shrubs are pricklypear (Opuntia spp.), prairie rose (*Rosa setigera*), and sumac (Rhus spp.). With continued lack of brush control, the trees and shrubs can exceed 80 percent canopy cover, which indicates the transition to the Woodland Community (2.3). Remnant midgrasses and opportunistic shortgrasses, annuals, and perennial forbs occupy the woody plant interspaces. Characteristic shortgrasses are curly-mesquite, buffalograss, and tumblegrass. Texas wintergrass and annuals are found in and around tree/shrub cover. Grasses and forbs make up 50 percent or less of the annual herbage production. Common forbs include dotted gayfeather, halfshrub sundrop, croton, western ragweed, verbena (Verbena spp.), snow-on-the-prairie (*Euphorbia bicolor*), Mexican sagewort (*Artemisia ludoviciana* ssp. mexicana), and sensitive-briar. 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 of the soil surface to erosion in interspaces. The exposed soil crusts readily. However, within the woody canopy, hydrologic processes stabilize and soil organic matter and mulch begin to increase and eventually stabilize under the shrub canopy. The Mixed-Brush Plant Community (2.2) can provide good cover habitat for wildlife, but only limited forage or browse is available for livestock or wildlife. At this stage, highly intensive restoration practices are needed to return the shrubland to grassland. Alternatives for restoration include: brush control and range planting, with proper stocking; prescribed grazing; and prescribed burning following restoration to maintain the desired community.

**Table 10. Annual production by plant type**

| Plant Type | Low (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Shrub/Vine | 900 | 1350 | 1800 |
| Grass/Grasslike | 375 | 560 | 750 |
| Forb | 225 | 340 | 450 |
| **Total** | **1500** | **2250** | **3000** |

## Community 2.3
## Woodland

The Woodland Community (2.3) has more than 80 percent woody canopy cover as the result of lack of periodic fires, and/or a lack of proper brush management. Reference community woody species or increasers, such as honey locust and/or juniper, dominate the Woodland Community (2.3) with little herbaceous understory. The site has the appearance of a dense shrubland or forest. Herbaceous understory plants are limited to shade-tolerant grasses, sedges, and forbs. Under the woody canopy, hydrologic processes stabilize and soil organic matter and mulch begin to increase and eventually stabilize under the shrub canopy. The Woodland Community (2.3) can provide good habitat for wildlife that favor forest habitat. Highly intensive restoration practices are needed to return the woodland to grassland. Alternatives for restoration include: brush control and range planting, prescribed grazing, and prescribed burning following restoration to maintain the desired community.

**Table 11. Annual production by plant type**

| Plant Type | Low (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Shrub/Vine | 1800 | 2700 | 3600 |
| Forb | 150 | 225 | 300 |
| Grass/Grasslike | 50 | 75 | 100 |
| **Total** | **2000** | **3000** | **4000** |

## Pathway 2.1A
## Community 2.1 to 2.2

Without fire (natural or human-caused) and/or brush control, woody density and canopy cover will increase in the Grass/Mixed-Brush Plant Community until it converts into the Mixed-Brush Plant Community. Improper grazing management and/or long-term drought (or other growing season stress) will accelerate this transition. Woody species canopy exceeding 50 percent indicates this transition. Herbaceous understory may be similar to any of the Grassland State Plant Communities. Improper grazing or other long-term growing season stress can increase the composition of shortgrasses and low-growing (or unpalatable) forbs in the herbaceous component. Even with proper grazing, in the absence of fire the woody component will increase to the point that the herbaceous component will decline in production and shift in composition toward sedges, grasses, and forbs suited to growing in shaded conditions with reduced available soil moisture.

## Pathway 2.2A
## Community 2.2 to 2.1

Brush management and/or fire can reduce the woody component below the transition level of 50 percent brush canopy. Continued fire and/or brush management will be required to maintain woody density and canopy below 50 percent. If the herbaceous component has transitioned to shortgrasses and low forbs, proper grazing management (combined with favorable moisture conditions and adequate seed source) will be necessary to facilitate the shift of the understory component to a midgrass-dominated Grass/Mixed-Brush Plant Community. Range planting may accelerate the transition of the herbaceous community, particularly when combined with favorable growing conditions. Range planting is more commonly associated with restoration efforts associated with Restoration Pathway R2A.

### Pathway 2.2B
### Community 2.2 to 2.3

Without fire (natural or human-caused) and/or brush control, woody density and canopy cover will increase in the Mixed-Brush Plant Community until it converts into the Woodland Plant Community. Woody species canopy exceeding approaching closed canopy (greater than 80 percent) and a decline of herbaceous understory species composition of less than 20 percent indicate this transition. Herbaceous understory will be sparse and comprised of sedges, grasses, and forbs suited to growing in shaded conditions with reduced available soil moisture.

### Pathway 2.3A
### Community 2.3 to 2.2

Brush management and/or fire can reduce the woody component below the transition level of 80 percent woodland canopy. Fire may not be a practical management tool due to the large size of the trees present in this community. However, catastrophic wildfire or fire may open the canopy to allow grasses and forbs to reestablish. Continued fire and/or brush management will be required to maintain woody density and canopy below 80 percent. Range planting may accelerate the transition of the herbaceous community, particularly when combined with favorable growing conditions. Range planting is more commonly associated with restoration efforts associated with Restoration Pathway R2A. Transition pathway 2.3A is more likely to accompany small fires or tree disease than be a part of a management plan.

## State 3
## Converted

Two communities exist in the Converted State: 3.1 Converted Land Community and the 3.2 Go-Back Land Community. The 3.1 Community is characterized by agricultural production. The site may be planted to improved pasture for hay or grazing. The site may otherwise be planted to row crops. The 3.2 community represents an agricultural state that has not been managed. The land is colonized by first successional species.

### Community 3.1
### Converted Land

The Converted State (3) occurs when the prairie, either the Grassland State (1) or Shrubland State (2), is plowed for planting to cropland, hayland, tame pasture, or use as non-agricultural land. The Converted State includes cropland, tame pasture, and go-back land. Agronomic practices are used to convert rangeland to the Converted State and to make changes between the communities in the Converted State. Many or all native species are replaced by seeding crops or introduced species into the plowed soil. The native component of the prairie is usually lost in this state, and even with reseeding, the ecological processes defining the past states of the site can be permanently changed. Common introduced species include coastal Bermudagrass and kleingrass, which are used in hayland and tame pastures. Wheat, oats, forage sorghum, grain sorghum, cotton, and corn are the major crop species. Cropland and tame pasture require repeated and continual inputs of fertilizer and weed control to maintain the Converted State. Without agronomic inputs, the site will eventually return to either the Grassland or Shrubland State. Weed and shrub control will be required because seeds remain in the soil or are transported to the site.

Return to native prairie communities in the Grassland State is more likely to be successful if soil chemistry and structure have not been severely altered. Preservation of favorable soil microbes increases the likelihood of a return to reference conditions. Restoration to native prairie will require seedbed preparation and seeding of native species. Without active restoration the site is not likely to return to reference conditions due to the presence of introduced forbs and grasses. Protocols and plant materials for restoring prairie communities are a developing portion of restoration science.

### Community 3.2
### Go-Back Land

Without agronomic inputs, the site will eventually return to either the Grassland or Shrubland State. The site is considered go-back land when active management for pasture ceases. Heavily disturbed soils usually return to the Shrubland State but could return to a Grassland State if shrub seeds are not present. Long-term cropping creates changes in soil chemistry, microflora and structure that make restoration to the reference state very difficult and/or expensive. Moreover, the residual seedbank is usually depleted depending upon the length of time the site has been in the converted state. Restoration to near native prairie is possible. It will nearly always require seedbed preparation, suppression of shrubs and seeding of native species. Otherwise, it would take a very long time to reestablish from natural processes. Protocols and plant materials for restoring prairie communities are a developing portion of restoration science.

### Pathway 3.1A
### Community 3.1 to 3.2

The driver for this transition is lack of agricultural management. Without practices to suppress forbs and woody species, the land will eventually grow first successional species. Annual forbs and grasses are common colonizers and first provide ground cover and soil stability. Eventually, woody species will encroach and begin rapid expansion.

### Pathway 3.2A
### Community 3.2 to 3.1

The driver for this transition is a reestablishment of agricultural management. Depending on what the Go-Back Land looks like depends on the prescription. Proper grazing, brush management, herbicides, and/or fire are all potential practices the landowner can use to create more agricultural production on the site.

### Transition T1A
### State 1 to 2

The Grassland State is resistant to shrub dominance. However, shrubs make up a portion of the plant community in the Grassland State, therefore propagules are present. Even with proper grazing and favorable climate conditions, lack of fire or brush control for 15 to 25 years will allow woody species to increase in canopy to reach the 35 percent threshold level. Improper grazing management, prolonged drought, and a warming climate will provide a competitive advantage to shrubs which will accelerate this process. This transition can occur from any of the Grassland State Communities. The driver for this threshold change is the lack of brush control.

### Transition T1B
### State 1 to 3

The transition to the Converted State from the Grassland State occurs when the prairie is plowed for planting to cropland or hayland. The threshold for this transition is the plowing of the prairie soil and removal of the prairie plant community. The Converted State includes cropland, tame pasture, and go-back land. The site is considered go-back land during the period between cessation of active cropping, fertilization, and weed control and the return to States 1 or 2. Agronomic practices are used to convert rangeland to the Converted State and to make changes between the communities in the Converted State. The driver for these transitions is management’s decision to farm the site.

### Restoration pathway R2A
### State 2 to 1

Restoration of the Shrubland State to the Grassland State requires substantial energy input. Mechanical or herbicidal brush control treatments can be used to remove woody species. A long-term prescribed fire program may sufficiently reduce brush density to a level below the threshold of the Grassland State, particularly if the woody component is dominated by species that are not re-sprouters. However, fire may not be sufficient to remove mature trees. A mixed program consisting of mechanical, chemical, and fire measures may be used. Brush control in combination with prescribed fire, proper grazing management, and favorable growing conditions may be the most economical means of creating and maintaining the desired plant community. If remnant populations of tallgrasses, midgrasses, and desirable forbs are not present at sufficient levels, range planting will be necessary to restore the reference plant community. Depending on the understory community and inputs of seed, the restoration pathway can result in return to any of the Grassland State Communities. The driver for this restoration pathway is brush control.

### Transition T2A
### State 2 to 3

The transition to the Converted State from the Shrubland State (T2A) occurs when the prairie is plowed for planting to cropland or hayland. The size and density of brush in the Shrubland State will require heavy equipment and energy-intensive practices (e.g. rootplowing, raking, rollerchopping, or heavy disking) to prepare a seedbed. The threshold for this transition is the plowing of the prairie soil and removal of the prairie plant community. The Converted State includes cropland, tame pasture, and go-back land. The site is considered “go-back land” during the period between cessation of active cropping, fertilization, and weed control and the return to the “native” states. Agronomic practices are used to convert rangeland to the Converted State and to make changes between the communities in the Converted State. The driver for these transitions is management’s decision to farm the site.

### Restoration pathway R3A
### State 3 to 1

Restoration from the Converted State can occur in the short-term through active restoration or over the long-term due to cessation of agronomic practices. Cropland and tame pasture require repeated and continual inputs of fertilizer and weed control to maintain the Converted State. If the soil chemistry and structure have not been overly disturbed (which is most likely to occur with tame pasture) the site can be restored to the Grassland State. Heavily disturbed soils are more likely to return to the Shrubland State. Without continued disturbance from agriculture the site can eventually return to either the Grassland or Shrubland State. The level of disturbance while in the converted state determines whether the site restoration pathway is likely to be R3A (a return to the Grassland State) or T3A (a return to the Shrubland State). Return to native prairie communities in the Grassland State is more likely to be successful if soil chemistry and structure are not heavily disturbed. Preservation of favorable soil microbes increases the likelihood of a return to reference conditions. Converted sites can be returned to the Grassland State through active restoration, including seedbed preparation and seeding of native grass and forb species. Protocols and plant materials for restoring prairie communities are a developing part of restoration science. The driver for both of these restoration pathways is the cessation of agricultural disturbances.

### Transition T3A
### State 3 to 2

Transition to the Shrubland State (2) occurs with the cessation of agronomic practices. The site will move from the Go-Back Land Community when woody species begin to invade. After shrubs and trees have established over 35 percent, and reached a height greater than three feet, the threshold has been crossed. The driver for the change is lack of agronomic inputs, improper grazing, no brush management, and no fire.

## Additional community tables

**Table 12. Community 1.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Lb/Acre) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Grass/Grasslike** | | | | | |
| 1 | **Tallgrasses** | | | 2500–4000 | |
| | big bluestem | ANGE | *Andropogon gerardii* | 2000–3375 | |

| | | | | | |
|---|---|---|---|---|---|
| | big bluestem | ANGE | *Andropogon gerardii* | 2000–3275 | – |
| | eastern gamagrass | TRDA3 | *Tripsacum dactyloides* | 2000–3275 | – |
| | Indiangrass | SONU2 | *Sorghastrum nutans* | 1250–2000 | – |
| | switchgrass | PAVI2 | *Panicum virgatum* | 1000–1750 | – |
| 2 | **Tall/Midgrasses** | | | 1500–2400 | |
| | sideoats grama | BOCU | *Bouteloua curtipendula* | 1200–2000 | – |
| | little bluestem | SCSCS | *Schizachyrium scoparium var. scoparium* | 1200–2000 | – |
| | Florida paspalum | PAFL4 | *Paspalum floridanum* | 1200–2000 | – |
| | silver beardgrass | BOLAT | *Bothriochloa laguroides ssp. torreyana* | 750–1400 | – |
| | Virginia wildrye | ELVI3 | *Elymus virginicus* | 750–1400 | – |
| | sedge | CAREX | *Carex* | 500–800 | – |
| | cylinder jointtail grass | COCY | *Coelorachis cylindrica* | 500–800 | – |
| | fall witchgrass | DICO6 | *Digitaria cognata* | 500–800 | – |
| | marsh bristlegrass | SEPA10 | *Setaria parviflora* | 500–800 | – |
| | Drummond's dropseed | SPCOD3 | *Sporobolus compositus var. drummondii* | 500–800 | – |
| | Silveus' dropseed | SPSI2 | *Sporobolus silveanus* | 500–800 | – |
| | white tridens | TRAL2 | *Tridens albescens* | 500–800 | – |
| | longspike tridens | TRST2 | *Tridens strictus* | 500–800 | – |
| | panicgrass | PANIC | *Panicum* | 500–800 | – |
| | vine mesquite | PAOB | *Panicum obtusum* | 500–800 | – |
| | Texas cupgrass | ERSE5 | *Eriochloa sericea* | 500–800 | – |
| | Texas wintergrass | NALE3 | *Nassella leucotricha* | 500–800 | – |
| | prairie Junegrass | KOMA | *Koeleria macrantha* | 400–700 | – |
| | plains lovegrass | ERIN | *Eragrostis intermedia* | 400–700 | – |
| | purple threeawn | ARPU9 | *Aristida purpurea* | 400–700 | – |
| **Forb** | | | | | |
| 3 | **Forbs** | | | 750–1200 | |
| | Maximilian sunflower | HEMA2 | *Helianthus maximiliani* | 750–1200 | – |
| | Engelmann's daisy | ENPE4 | *Engelmannia peristenia* | 750–1200 | – |
| | button eryngo | ERYU | *Eryngium yuccifolium* | 500–900 | – |
| | blacksamson echinacea | ECAN2 | *Echinacea angustifolia* | 500–900 | – |
| | beardtongue | PENST | *Penstemon* | 500–900 | – |
| | coastal indigo | INMI | *Indigofera miniata* | 400–750 | – |
| | dotted blazing star | LIPU | *Liatris punctata* | 400–750 | – |
| | sensitive plant | MIMOS | *Mimosa* | 400–750 | – |
| | yellow puff | NELU2 | *Neptunia lutea* | 400–750 | – |
| | vetch | VICIA | *Vicia* | 400–750 | – |
| | scurfpea | PSORA2 | *Psoralidium* | 400–750 | – |
| | snoutbean | RHYNC2 | *Rhynchosia* | 400–750 | – |
| | fuzzybean | STROP | *Strophostyles* | 400–750 | – |
| | beeblossom | GAURA | *Gaura* | 400–750 | – |
| | prairie clover | DALEA | *Dalea* | 400–750 | – |

| | | | | | |
|---|---|---|---|---|---|
| | bundleflower | DESMA | *Desmanthus* | 400–750 | – |
| | ticktrefoil | DESMO | *Desmodium* | 400–750 | – |
| | prairie acacia | ACANH | *Acacia angustissima var. hirta* | 400–750 | – |
| | yellow sundrops | CASE12 | *Calylophus serrulatus* | 400–750 | – |
| | Indian paintbrush | CASTI2 | *Castilleja* | 400–750 | – |
| | American star-thistle | CEAM2 | *Centaurea americana* | 400–750 | – |
| | partridge pea | CHFA2 | *Chamaecrista fasciculata* | 400–750 | – |
| | croton | CROTO | *Croton* | 250–500 | – |
| | ragweed | AMBRO | *Ambrosia* | 250–500 | – |
| | milkweed | ASCLE | *Asclepias* | 250–500 | – |
| | purple poppymallow | CAIN2 | *Callirhoe involucrata* | 250–500 | – |
| | larkspur | DELPH | *Delphinium* | 250–500 | – |
| | snow on the prairie | EUBI2 | *Euphorbia bicolor* | 250–500 | – |
| | vervain | VERBE | *Verbena* | 250–500 | – |
| | skullcap | SCUTE | *Scutellaria* | 250–500 | – |
| | woolly plantain | PLPA2 | *Plantago patagonica* | 250–500 | – |
| | prairie parsley | POLYT | *Polytaenia* | 250–500 | – |
| | Chalk Hill hymenopappus | HYTE2 | *Hymenopappus tenuifolius* | 250–500 | – |
| **Shrub/Vine** | | | | | |
| 4 | **Shrubs/Vines/Trees** | | | 250–400 | |
| | common hackberry | CEOC | *Celtis occidentalis* | 150–300 | – |
| | elm | ULMUS | *Ulmus* | 150–300 | – |
| | bully | SIDER2 | *Sideroxylon* | 100–175 | – |
| | coralberry | SYOR | *Symphoricarpos orbiculatus* | 100–175 | – |

## Animal community

The animal community in the Blackland differs depending on what state the site is currently in. Northern Bobwhite prefer the reference state. They require dense bunchgrasses for nesting and cover. As the site transitions into State 2, white-tailed deer will become more prevalent. Deer are woodland and edge species, with their primary diet consisting of browse. Mourning dove need open areas with semi-clear ground and forbs with desirable seed sources. Go-back land and communities with shortgrasses and forbs provide the best habitat for dove.

## Hydrological functions

Rills and gullies are rare in the reference state. This site has potential for gullies to heal when in functioning condition. Drainage ways should be vegetated and stable. Water flow patterns are very short (less than two feet) if visible. Pedestals or terracettes do not occur in the reference community. Bare ground is essentially non-existent. Soils on this site are permeable when dry, infiltration is rapid, and runoff is slight. When soils are wet and have sealed over, soils are impermeable, infiltration is slow to very slow, and runoff is likely. Soils on this site have high shrink-swell values. This site has slowly permeable soils. Due to density of vegetation, even on sloping sites, small to medium-sized litter will move very little during intense storms. The soil surface under reference conditions is highly resistant to erosion; the soil stability class range is expected to be six. This prairie site is dominated by tallgrasses and forbs having adequate litter and little bare ground which can provide for maximum infiltration and little runoff under normal rainfall events. The nearly level areas have a microrelief of knolls and depressions called gilgai. Sloping soils also have gilgai, which create microridges and valleys extending up and down the slopes. Soil erosion is very low if the tall grasses and the water trapping gilgai are present. Gilgai develops pools of standing water during wet weather. As much as six inches of water can be temporarily trapped in these gilgai microreliefs before runoff begins.

## Recreational uses

Recreational uses include recreational hunting, hiking, camping, equestrian, and bird watching.

## Wood products

Honey mesquite, eastern red cedar, and some oak are used for posts, firewood, charcoal, and other specialty wood products.

## Other products

Jams and jellies are made from many fruit-bearing species, such as agarito. Seeds are harvested from many reference plants for commercial sale. Many grasses and forbs are harvested by the dried-plant industry for sale in dried flower arrangements. Honeybees are utilized to harvest honey from many flowering plants.

## Inventory data references

These site descriptions were developed as part a Provisional Ecological Site project using historic soil survey manuscripts, available site descriptions, and low intensity field traverse sampling. Future work to validate the information is needed. This will include field activities to collect low, medium, and high-intensity sampling, soil correlations, and analysis of that data. A final field review, peer review, quality control, and quality assurance review of the will be needed to produce the final document.

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## Approval

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## Rangeland health reference sheet

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

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| 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:** Some water flow patterns are normal for this site due to landscape position and slope but should be vegetated and stable.

3. **Number and height of erosional pedestals or terracettes:** None.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not**

**bare ground):** Bare ground is essentially nonexistent.

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5. **Number of gullies and erosion associated with gullies:** No gullies should be present. Drainageways should be stable and covered with vegetation.

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

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7. **Amount of litter movement (describe size and distance expected to travel):** This site has slowly permeable soils. Due to density of vegetation, even on sloping sites, small to medium-sized litter will move very little during intense storms.

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

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Greater than 60 inches thick. Colors range from black to very dark brown and moderately fine to medium subangular blocky structure. SOM 1 to 3 percent.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** This prairie site is dominated by tallgrasses and forbs having adequate litter and little bare ground which can provide for maximum infiltration and little runoff under normal rainfall events.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None.

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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 tallgrasses >>

    Sub-dominant: Warm-season midgrasses >

    Other: Forbs > Cool-season midgrasses > Trees > Shrubs/Vines

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Grasses and forbs due to their growth habit will exhibit some mortality and decadence, though very slight. Open spaces from disturbance are quickly filled by new plants through seedlings and reproductive reproduction (tillering).

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

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 5,000 pounds per acre during below average moisture years to 8,000 pounds per acre above average moisture years.

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:** Potential invasive species include yellow bluestems, Bermudagrass, mesquite, elm, huisache, and eastern red cedar.

17. **Perennial plant reproductive capability:** All perennial plants should be capable of reproducing except during periods of prolonged drought conditions.