USDA Natural Resources Conservation Service

Ecological site R086AY008TX
Northern Eroded Blackland

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General information

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

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 Eroded Blackland ecological site is a tallgrass prairie. Reference sites show intact communites of grasses with pockets of woody species interspersed. Biomass productivity is not as high as the Blackland site due to the erosion that has partially, or completely, removed the A horizon.

Associated sites

R086AY013TX	**Clayey Bottomland** The Clayey Bottomland site is frequently adjacent to the site. It differs from the site by its occurrence on floodplains, intact A horizon, and high shrink-swell properties.
R086AY003TX	**Northern Claypan Prairie** The Eroded Blackland site can occur adjacent to the Claypan Prairie site. It differs from the site by having areas with extensive erosion indicated by a partial or lost A horizon, active rills and/or gullies, and lower production.
R086AY010TX	**Northern Blackland** 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.

Similar sites

R086AY010TX	**Northern Blackland** The Blackland site is similar in that both sites have similar soils and topography. It differs from the site by having an intact A horizon, no rills or gullies, and stable, vegetated drainage ways.
R086AY009TX	**Southern Eroded Blackland** The Southern Eroded Blackland site is similar to the Northern Eroded Blackland site by having similar physiographic features and representative soil features. It differs from the Southern Eroded Blackland site by receiving more effective precipitation.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Sorghastrum nutans*

Physiographic features

The site consists of nearly level to gently sloping eroded soils on uplands. The slope gradients range from 1 to 20 percent but are usually less than 12 percent. The runoff class is high to very high. Runoff increases as slope gradient increases.

Table 2. Representative physiographic features

Landforms	(1) Plains > Ridge > Gilgai
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	76–305 m
Slope	1–12%
Water table depth	183–203 cm
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	0–20%
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)	1,092 mm

Climate stations used

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

Influencing water features

This site is not influenced by water from streams.

Wetland description

Wetlands are not associated with this site.

Soil features

The site consists of moderately deep to very deep, well drained soils that are slow to very permeable. These soils

formed in weakly consolidated calcareous marine sediments, high in smectitic clays. As such, these soils are comprised of thin clayey surface layers and subsoils depending on the severity of their erosion. Erosion on the site occurs as gently sloping to rolling upland ridges. Uncultivated areas often have narrow microridges and microvalleys that extend up and down the slope.

In a representative profile the surface layer is dark grayish brown or very dark gray clay about 32 inches thick. The subsoil is grayish brown or light yellowish brown clay. These soils formed in calcareous clayey shale. The available water capacity is low to moderate. Infiltration is rapid when the soil is dry and cracked, but very slow when the soil is wet.

The dominant associated soil series for the Eroded Blackland include: Engle, Ellis, Ferris, Heiden, Houston Black, and Vertel.

Table 5. Representative soil features

Parent material	(1) Residuum–shale
Surface texture	(1) Clay (2) Stony clay (3) Clay loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Slow to very slow
Soil depth	61–203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	7.62–31.5 cm
Calcium carbonate equivalent (0-101.6cm)	0–55%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–12
Soil reaction (1:1 water) (0-101.6cm)	6.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	4–15%
Subsurface fragment volume >3" (Depth not specified)	0–12%

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.

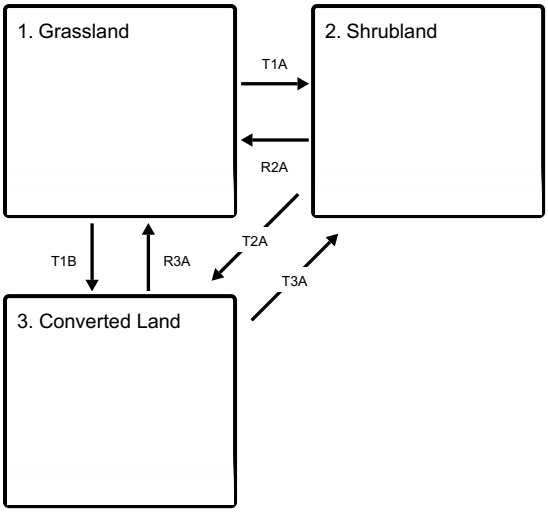
Introduced pasture has been established on many acres of old cropland and in areas with deeper soils. Coastal bermudagrass (*Cynodon dactylon*) and kleingrass (*Panicum coloratum*) are by far the most frequently used introduced grasses for forage and hay. Hay has also been harvested from a majority of 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

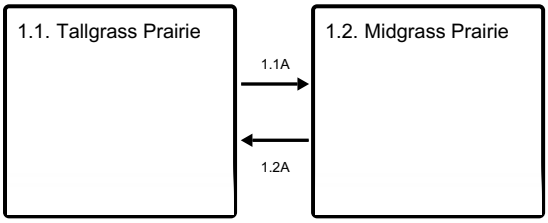
R2A - Fire, brush management, proper grazing, range planting

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

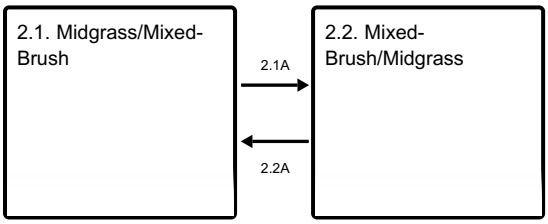
State 1 submodel, plant communities



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

1.2A - Fire, brush management, proper grazing

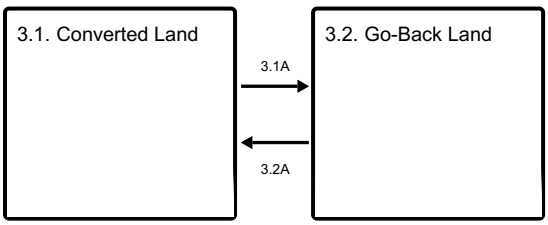
State 2 submodel, plant communities



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

2.2A - No fire, no brush management, improper grazing management, drought Fire, brush management, proper grazing

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
Grassland

Two communities exist in the Grassland State: the 1.1 Tallgrass Prairie Community and the 1.2 Midgrass Prairie Community. Community 1.1 is characterized by tallgrasses dominating the understory and woody species cover less than five percent of the area. Community 1.2 is characterized by my midgrass dominance, but the woody species cover is 5 to 25 percent, with some species attaining heights of three feet.

Community 1.1
Tallgrass Prairie

The Tallgrass Prairie Plant Community (1.1) mosaic includes deeper soils dominated by warm-season, perennial tallgrasses. Warm-season, perennial midgrasses constitute most of the remaining species composition. The warm-season perennial forb component varies from 5 to 15 percent of the community composition depending on climatic patterns and local precipitation. Woody species make up a minor component of the community even in the absence of fire (at least 25 to 50 years). Midgrasses dominate the shallower “eroded” areas. The eroded area, from which the site derives its name, resulted from prehistoric loss of the A horizon. These areas form a mosaic with deeper soils and may range in size from less than 200 to over 1,000 square feet. These areas often appear to be associated with prehistoric water courses. They appear to be associated more with water erosion than with wind erosion, but are probably a result of a combination of both. Little bluestem dominates the site, while other important grasses are Indiangrass, big bluestem, switchgrass, vine mesquite (*Panicum obtusum*), silver bluestem (*Bothriochloa laguroides*), tall dropseed (*Sporobolus compositus*), and Texas wintergrass. Forbs commonly found on the site include Engelmann’s daisy (*Engelmannia peristenia*), Maximilian sunflower (*Helianthus maximiliani*), and halfshrub sundrop (*Calylophus serrulatus*). Typical, but infrequent shrub and tree species found in the reference community (1.1) include species of bumelia (Sideroxylon spp.), elbowbush (*Forestiera pubescens*), hackberry, elm, and live oak. 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 (Indiangrass, big bluestem, Engelmann’s daisy). This will initially result in an increase in composition of little bluestem, which will increase its dominance. 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 of the ground cover.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1905	3138	4259
Forb	224	336	448
Shrub/Vine	112	168	336
Total	**2241**	**3642**	**5043**

Community 1.2
Midgrass Prairie

The Midgrass Prairie Plant Community (1.2) typically results from improper cattle grazing management over a long period of time. Indigenous or invading woody species increase on the site (with or without fire). 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 Midgrass/Mixed-Brush Plant Community (2.1). Important grasses are little bluestem, Indiangrass, big bluestem, vine mesquite, silver bluestem, tall dropseed, Texas wintergrass, and switchgrass. More grazing-resistant shortgrasses, such as Texas wintergrass, and less palatable forbs begin replacing the midgrasses. Some of the reference perennial forbs persist, but less palatable forbs will increase. Woody canopy varies between 5 and 15 percent, depending on the severity of grazing, fire interval, and availability of increaser 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 oaks, elms, hackberry, and hawthorn (Crataegus spp.) will increase in size, while woody species such as bumelia, coralberry (*Symphoricarpos orbiculatus*), elbowbush, and wild plum (Prunus spp.) will increase in density. Brown and Archer (1999) concluded that even with a healthy and dense stand of grasses, woody species will populate the site and eventually dominate the community. To control woody species populations, prescribed grazing and/or browsing and fire can be used to control smaller shrubs and trees. Mechanical removal of larger shrubs and trees may be necessary in older stands. The time frame for woody species to dominate a healthy community with proper grazing management is unknown, but reference sites indicate this will take over 50 years (and possibly hundreds of years). Heavy continuous grazing will reduce plant cover, litter, and mulch. Bare ground will increase and expose the soil to 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 oaks, juniper, and honey mesquite (prosopis glandulosa). Once the tallgrasses have been eliminated from the site, woody species cover exceeds 5 to 25 percent canopy cover, and the plants reach fire-resistant size (about three feet in height). At this point the site crosses a threshold into the Shrubland State (2) and the Midgrass/Mixed-Brush Plant Community (2.1). Until the Midgrass Prairie Plant Community (1.2) crosses the threshold into the Midgrass/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. Potential exists for soils to erode to the point that irreversible damage may occur. If soil-holding herbaceous cover decreases to the point that

soils are no longer stable, the shrub overstory will not prevent erosion of the A and B soil horizons. This is a critical shift in the ecology of the site. Once the A horizon has eroded, the hydrology, soil chemistry, soil microorganisms, and soil physics are altered to the point where intensive restoration is required to restore the site to another state or community. Simply changing management (improving grazing management or controlling brush) cannot create sufficient change to restore the site within a reasonable time frame.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1569	2634	3587
Tree	224	448	673
Forb	224	280	448
Total	**2017**	**3362**	**4708**

Pathway 1.1A
Community 1.1 to 1.2

Tallgrass Prairie **Midgrass Prairie**

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 insufficient critical growing season deferment, excess defoliation intensity, repeated long-term growing season defoliation, and/or long-term drought. Increaser species (midgrasses and woody species) are generally endemic species released from competition. Woody species canopy exceeding 5 percent and/or dominance of tallgrasses falling below 50 percent of species composition indicate a transition to the Midgrass Plant Community. Implementation of managed grazing that provides adequate growing season deferment to allow establishment of tallgrass propagules and/or the recovery of vigor of stressed individual plants. Proper grazing management may be combined with fire and/or brush management to create a shift towards or maintain the reference community.

Pathway 1.2A
Community 1.2 to 1.1

Midgrass Prairie **Tallgrass Prairie**

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. However, reduction of the woody component to reference conditions of five percent or less canopy cover will require inputs of fire or brush control.

State 2
Shrubland

The Shrubland State has two communities: 2.1 Midgrass/Mixed-Brush Community and 2.2 Mixed-Brush/Midgrass Shrubland Community. The 2.1 community has a woody species overstory canopy of 25 to 50 percent and the 2.2 community has a woody canopy cover over 50 percent. As tree and brush canopy increases, the herbaceous understory production decreases due to lack of light availability.

Community 2.1
Midgrass/Mixed-Brush

The Midgrass/Mixed-Brush Plant Community (2.1) presents a 25 to 50 percent woody plant canopy, with cedar elm, juniper, and rarely live oak as the dominant species. This community type is the result of continuous improper grazing management and a lack of fire. In areas where high deer densities occur, heavy browsing can decrease preferred woody plants. There is a continued decline in diversity of the grassland component and an increase in woody species and unpalatable forbs. Once the brush canopy exceeds 30 to 35 percent, annual production for the understory is very limited and is generally made up of unpalatable shrubs, grasses, and forbs within tree and shrub interspaces. Annual herbage production has decreased due to a decline in soil structure and organic matter and has shifted toward the woody component. All unpalatable woody species have increased in size and density. Honey mesquite is an early increaser throughout the MLRA. Redberry juniper (*Juniperus pinchotii*) occurs only in the southern counties of the MLRA and eastern redcedar (*Juniperus virginiana*) occurs only in the north. Ashe juniper (*Juniperus ashei*) occurs mostly in the south, but can be found throughout the MLRA. Typically, agarito (*Mahonia trifoliolata*), pricklypear (Opuntia spp.), and sumac (Rhus spp.) form thickets on this site. Many of the reference (1.1) shrubs are still present. Sideoats grama and other reference (1.1) midgrasses decrease, but still remain the dominant component, while shortgrasses such as buffalograss (*Bouteloua dactyloides*) and Texas wintergrass increase. Remnants of the reference (1.1) grasses and forbs along with unpalatable invaders occupy the interspaces between shrubs. Cool-season species such as Texas wintergrass, 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 nutrients and water from woody plants. Common herbaceous species include threeawns (Aristida spp.), hairy grama (*Bouteloua hirsuta*), and upright prairie coneflower (*Ratibida columnifera*). Buffalograss, western ragweed (*Ambrosia psilostachya*), and curly-mesquite (*Hilaria belangeri*) 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 1,000 to 3,000 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 increase until it exceeds 50 percent, indicating a conversion to the Mixed-Brush/Midgrass Plant Community (2.2). The trend for increased shrub cover cannot be reversed with proper grazing management alone.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	841	1345	1849
Tree	560	785	1009
Forb	280	392	504
Total	**1681**	**2522**	**3362**

Community 2.2
Mixed-Brush/Midgrass

The Mixed-Brush/Midgrass Plant Community (2.2) is the result of many years of improper grazing, lack of periodic fires, and/or a lack of proper brush management. Cedar elm, honey mesquite, and/or juniper dominate the Mixed-Brush/Midgrass Plant Community (2.2), which has greater than 50 percent woody canopy cover. It is now essentially a dense shrubland. Common understory shrubs are tasajillo (*Cylindropuntia leptocaulis*), agarito, sumacs, and elbowbush. With continued heavy cattle grazing and/or browsing and no brush control, the trees and shrubs can exceed 70 percent canopy cover, and potentially reach almost 100 percent cover. Excessive browsing by deer or goats will create a community dominated by large trees. Few remnant midgrasses and opportunistic shortgrasses, annuals, and perennial forbs occupy the woody plant interspaces. Characteristic grasses are curly-mesquite, buffalograss, and fall witchgrass (*Digitaria cognata*). Texas wintergrass and annuals are found in and around tree/shrub cover. Grasses and forbs make up 35 percent or less of the annual herbage production. Common forbs include dotted gayfeather (*Liatris punctata*), orange zexmenia (Wedelia texana), croton (Croton spp.), western ragweed, upright prairie coneflower, Mexican sagewort (*Artemisia ludoviciana*), and sensitive-briar (Mimosa spp.). At its most extreme, this community takes on a woodland appearance: large woody species with understory dominated by low production grasses, sedges, and forbs that have low palatability and high shade tolerance. Excessive cattle grazing tends to create a different response and structure to the community than does excessive deer or goat grazing. Excessive grazing accelerates invasion of shrubs because it creates conditions where young shrubs increase in vigor and size while palatable grasses decrease in vigor and abundance. Excess deer or goat grazing tends to create a dominance of large trees by removing both young shrubs and the young twigs and branches that grow below the browse line on larger shrubs and trees. While large trees will continue to increase in size, they will have very little production below the browse line. The site becomes dominated by large trees with little forage available for livestock or wildlife. Large trees with little understory provide much less soil protection than do dense stands of grass. As soils erode, understory species have reduced potential to revegetate the site. The bare area under the browse line creates a situation that provides poor forage conditions and poor visual cover for wildlife. Even if irreversible soil damage has occurred, it may be possible to remove brush and seed the site to a grassland community. The resulting grassland will not look or function like the reference community (1.1). Instead, it is likely to be dominated by few introduced midgrasses and produce less biomass than the reference community (1.1). However, it is very difficult and expensive to restore the site to reference conditions due to the loss of organic matter, soil horizons, soil microbes, and soil structure. Rangeland health functions will depart substantially from reference conditions. 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 readily forms crusts. 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/Shortgrass Plant Community (2.2) provides good habitat cover 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 a 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 9. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	785	1009	1233
Grass/Grasslike	224	448	673
Forb	112	224	336
Total	**1121**	**1681**	**2242**

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 Midgrass/Mixed-Brush Plant Community until it converts into the Mixed-Brush/Midgrass Plant Community. Improper grazing and/or long-term drought (or other growing season stress) will accelerate this transition. Woody species canopy exceeding 50 percent indicates this transition. 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 shift in composition toward shortgrasses and forbs suited to growing in shaded conditions with little 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 25 percent brush canopy. Continued fire and/or brush management will be required to maintain woody density and canopy below 25 percent. If the herbaceous component has transitioned to shortgrasses and low forbs, proper grazing (combined with favorable moisture conditions) will be necessary to facilitate the shift of the understory component to the midgrass-dominated Midgrass/Mixed-Brush Plant Community. Range planting may accelerate the transition of the herbaceous community, particularly when combined with favorable growing conditions.

State 3
Converted Land

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 Land State (3) occurs when the prairie, either the Grassland State (1) or Shrubland State (2), is

plowed for planting to cropland, hayland, or 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. The site is considered go-back land during period between active management for pasture or cropland and return to a “native” state. Both crop and pasturelands require weed and shrub control because seeds are present on the site, either by remaining in the soil or being transported to the site. Without agronomic inputs the site will eventually return to either the grassland or shrubland state over the long term due to competitive grass, forb, and shrub species sprouting from seeds. These species are often aggressive weed species. Sites can be restored to the Grassland State in the short-term or allowed to return to the Grassland State over the long term. Without active restoration the site is not likely to return to reference conditions due to the introduction of introduced forbs and grasses. 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 (or near reference) conditions. Restoration to native prairie will require seedbed preparation and seeding of native species. Protocols and plant materials for restoring prairie communities is a developing portion of restoration science. Long-term cropping can create changes in soil chemistry, biology, and structure that make restoration to the reference state very difficult and/or expensive. Heavily disturbed soils return to the Shrubland State. These sites will generally become a mesquite thicket with an understory of “weedy” forbs.

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. 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 for 25 to 50 years will allow woody species to increase in canopy to reach the 25 percent threshold level.

Improper grazing, prolonged drought, and warming climate will provide a competitive advantage to shrubs, which will accelerate this process. Tallgrasses will decrease to less than 5 percent species composition.

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.

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 fire sprouters (e.g., Ashe juniper). However, fire may not be sufficient to remove mature trees. 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.

Transition T2A
State 2 to 3

The transition to the Converted State from the Shrubland State 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. 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 25 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 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tallgrasses**			953–2018	
	little bluestem	SCSCS	*Schizachyrium scoparium var. scoparium*	673–1793	–
2	**Tallgrasses**			504–1345	
	big bluestem	ANGE	*Andropogon gerardii*	420–1121	–
	Indiangrass	SONU2	*Sorghastrum nutans*	420–1121	–
	switchgrass	PAVI2	*Panicum virgatum*	224–560	–
3	**Midgrasses**			392–785	
	sideoats grama	BOCU	*Bouteloua curtipendula*	224–560	–
	silver beardgrass	BOLAT	*Bothriochloa laguroides ssp. torreyana*	168–448	–
	vine mesquite	PAOB	*Panicum obtusum*	168–448	–
	Drummond's dropseed	SPCOD3	*Sporobolus compositus var. drummondii*	112–336	–
	Texas wintergrass	NALE3	*Nassella leucotricha*	112–336	–
	panicgrass	PANIC	*Panicum*	112–336	–
4	**Other Grasses**			112–224	
	purple threeawn	ARPU9	*Aristida purpurea*	56–168	–
	sedge	CAREX	*Carex*	56–168	–
	Canada wildrye	ELCA4	*Elymus canadensis*	56–168	–
	Virginia wildrye	ELVI3	*Elymus virginicus*	56–168	–
	plains lovegrass	ERIN	*Eragrostis intermedia*	56–168	–
	Texas cupgrass	ERSE5	*Eriochloa sericea*	56–168	–
	Florida paspalum	PAFL4	*Paspalum floridanum*	56–168	–
	crowngrass	PASPA2	*Paspalum*	56–168	–
	marsh bristlegrass	SEPA10	*Setaria parviflora*	56–168	–
	slim tridens	TRMUE	*Tridens muticus var. elongatus*	56–168	–
	slim tridens	TRMUM	*Tridens muticus var. muticus*	56–168	–
Forb					
5	**Forbs**			168–448	
	Engelmann's daisy	ENPE4	*Engelmannia peristenia*	168–448	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	168–448	–
	ticktrefoil	DESMO	*Desmodium*	112–392	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	112–392	–
	button eryngo	ERYU	*Eryngium yuccifolium*	112–392	–
	yellow sundrops	CASE12	*Calylophus serrulatus*	112–392	–
	partridge pea	CHFA2	*Chamaecrista fasciculata*	112–392	–
	prairie clover	DALEA	*Dalea*	112–392	–

	fuzzybean	STROP	*Strophostyles*	112–392	–
	sensitive plant	MIMOS	*Mimosa*	112–392	–
	yellow puff	NELU2	*Neptunia lutea*	112–392	–
	beardtongue	PENST	*Penstemon*	112–392	–
	coastal indigo	INMI	*Indigofera miniata*	112–392	–
	dotted blazing star	LIPU	*Liatris punctata*	112–392	–
	scurfpea	PSORA2	*Psoralidium*	112–392	–
	snoutbean	RHYNC2	*Rhynchosia*	112–392	–
	vetch	VICIA	*Vicia*	112–392	–
	skullcap	SCUTE	*Scutellaria*	84–224	–
	Texas lupine	LUTE	*Lupinus texensis*	84–224	–
	woolly plantain	PLPA2	*Plantago patagonica*	84–224	–
	prairie parsley	POLYT	*Polytaenia*	84–224	–
	vervain	VERBE	*Verbena*	84–224	–
	larkspur	DELPH	*Delphinium*	84–224	–
	croton	CROTO	*Croton*	84–224	–
	Indian paintbrush	CASTI2	*Castilleja*	84–224	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	84–224	–
	milkweed	ASCLE	*Asclepias*	84–224	–
	purple poppymallow	CAIN2	*Callirhoe involucrata*	84–224	–
	snow on the prairie	EUBI2	*Euphorbia bicolor*	84–224	–
	beeblossom	GAURA	*Gaura*	84–224	–
	Chalk Hill hymenopappus	HYTE2	*Hymenopappus tenuifolius*	84–224	–
Tree					
6	**Trees, Shrubs, Vines**			112–224	
	oak	QUERC	*Quercus*	84–224	–
	live oak	QUVI	*Quercus virginiana*	84–224	–
	elm	ULMUS	*Ulmus*	56–168	–
	hackberry	CELTI	*Celtis*	56–168	–
	hawthorn	CRATA	*Crataegus*	39–112	–
	stretchberry	FOPU2	*Forestiera pubescens*	39–112	–
	plum	PRUNU	*Prunus*	39–112	–
	bully	SIDER2	*Sideroxylon*	39–112	–
	coralberry	SYOR	*Symphoricarpos orbiculatus*	39–112	–

Animal community

The animal community 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

Site-specific information indicated that rills are not common in the reference community. The extent of rills is influenced by length of slope. This site has potential for gullies to heal, but most often the site has 10 to 20 percent of gullies and rills active, even when in functioning condition. Drainage ways should be vegetated and stable. Some water flow patterns are normal due to landscape position and slope but should be vegetated and stable. Occasional low pedestals or terracettes are expected in association with rills and water flow areas. Expect no more than 5 percent bare ground randomly distributed throughout. 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. Soil surface under reference conditions is highly resistant to erosion. 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.

Recreational uses

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

Wood products

Honey mesquite, juniper (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, pricklypear, and wild plum. 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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Contributors

Lem Creswell
Mark Moseley
Tyson Hart

Approval

Bryan Christensen, 9/21/2023

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Reviewers:
Lem Creswell, RMS, NRCS, Weatherford, Texas
Jeff Goodwin, RMS, NRCS, Corsicana, Texas
Maurice Jurena, RSS, NRCS, Caldwell, Texas
Travis Wasier, RSS, NRCS, Caldwell, Texas
Richard Reid, RSS, NRCS, Caldwell, Texas

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, RMS, NRCS, Weatherford, Texas
Contact for lead author	817-596-2865
Date	09/21/2007
Approved by	Bryan Christensen
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are not common on this site. Extent is influenced by length of slope.

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:** Occasional low pedestals or terracettes are expected in association with rills and water flow areas.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Expect no more than 30 percent bare ground randomly distributed throughout.

5. **Number of gullies and erosion associated with gullies:** No gullies should be present on side drains into perennial and intermittent streams. Drainageways 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):** This site has slowly permeable soils. On sloping sites, small to medium-sized litter will move short distances during intense storms.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil surface under reference conditions is resistant to erosion. Soil stability class range is expected to be 3 to 5.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** 40 to 60 inches thick. Colors range from olive gray to dark grayish brown having very fine and moderately fine subangular blocky structure. SOM is 1 to 3 percent.

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

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

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 > Warm-season shortgrasses >

Other: Cool-season grasses > Trees > Forbs > 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 due to their growth habit will exhibit some mortality and decadence, though very slight.

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

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 2,000 to 4,500 pounds per acre.

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Invasives include yellow bluestems, common Bermudagrass, mesquite, elm, huisache, eastern red cedar, Macartney rose.

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17. **Perennial plant reproductive capability:** Under reference conditions, all perennial plants should be capable of reproducing, except during periods of prolonged drought conditions, heavy herbivory, and intense wildfires.
