

Ecological site R085AY187TX

Steep Rocky 30-38" PZ

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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): 085A–Grand Prairie

The Grand Prairie MLRA is characterized by predominately loam and clay loam soils underlain by limestone and shale. Topography transitions from steeper ridges and summits of the Lampasas Cut Plain on the southern end to the more rolling hills of the Fort Worth Prairie to the north. The Arbuckle Mountain area in Oklahoma is also within this MLRA.

Classification relationships

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

Ecological site concept

These sites occur over steep, shallow, rocky soils over limestone. Stones and boulders cover much of the soils surface and rock ledges are common. The reference vegetation includes native tall and midgrasses with scattered forbs and oak trees. The woody canopy is less than 30% under reference conditions. However, without periodic fires or other brush management, woody species may increase and dominate the site.

Associated sites

R085AY182TX	Low Stony Hill 30-38" PZ The Low Stony Hill site frequently occur downslope from the Steep Rocky site. It differs from the site by having a slope <12% and only 10 to 20% of surface rock fragments being >3 inches in size.
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Similar sites

R085AY182TX	Low Stony Hill 30-38" PZ The Low Stony Hill site is similar to Steep Rocky in that both sites have similar soils and species composition. Sites with >12 percent slope are classified as Steep Rocky while sites with under 12 percent slope are Low Stony Hill.
R085AY186TX	Steep Adobe 30-38" PZ The Steep Adobe site is similar to Steep Rocky in that both sites are located on similar topography and are underlain by limestone. It differs from Steep Rocky by its lighter-colored loamy soils, lower fertility, and occurrence away from larger streams and rivers.

Table 1. Dominant plant species

Tree	(1) <i>Quercus fusiformis</i>
Shrub	Not specified
Herbaceous	(1) <i>Schizachyrium scoparium</i>

Physiographic features

This site occurs on interfluves and crests of hillslopes in the Grand Prairie. Characteristic of this site are outcrops of massive indurated limestone. Slopes may be up to 40 percent.

Table 2. Representative physiographic features

Landforms	(1) Hills > Ridge (2) Hills > Hill (3) Hills > Hillslope
Runoff class	High to very high
Elevation	152–579 m
Slope	12–40%
Aspect	Aspect is not a significant factor

Climatic features

The climate is subhumid subtropical and is characterized by hot summers 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. The average first frost should occur around November 5 and the last freeze of the season should occur around March 19.

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 possible during the summer and 50 percent in winter. The prevailing wind direction is from the south and highest windspeeds occur during the spring months.

Approximately two-thirds of annual rainfall occurs during the April to September period. Rainfall during this period generally falls during thunderstorms, and fairly large amounts of rain may fall in a short time. The driest months are usually July and August.

Table 3. Representative climatic features

Frost-free period (characteristic range)	194-208 days
Freeze-free period (characteristic range)	216-243 days
Precipitation total (characteristic range)	813-965 mm
Frost-free period (actual range)	190-209 days
Freeze-free period (actual range)	209-245 days
Precipitation total (actual range)	787-991 mm
Frost-free period (average)	201 days
Freeze-free period (average)	230 days
Precipitation total (average)	889 mm

Climate stations used

- (1) BENBROOK DAM [USC00410691], Fort Worth, TX
- (2) CLEBURNE [USC00411800], Cleburne, TX

- (3) WHITNEY DAM [USC00419715], Clifton, TX
- (4) DENTON MUNI AP [USW00003991], Ponder, TX
- (5) DECATUR [USC00412334], Decatur, TX
- (6) EVANT 1SSW [USC00413005], Evant, TX
- (7) BROWNWOOD 2ENE [USC00411138], Early, TX
- (8) LAMPASAS [USC00415018], Lampasas, TX

Influencing water features

Due to the steep slopes and rocky surface of these sites, the shed water rapidly to lowland sites. They are not associated with wetlands.

Wetland description

NA

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

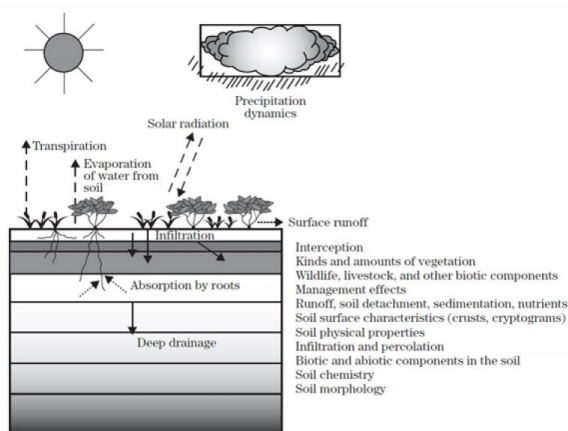


Figure 8.

Soil features

Representative soil components for this ecological site include: Eckrant and Tarrant

The site is characterized by very shallow and shallow to indurated limestone bedrock, interbedded with marl and chalk. These well drained soils formed in residuum derived from limestone with a high concentration of cobbles or stones.

Table 4. Representative soil features

Parent material	(1) Residuum–limestone (2) Residuum–mudstone
Surface texture	(1) Very cobbly clay (2) Cobbly clay (3) Stony clay
Drainage class	Well drained
Permeability class	Moderately slow to slow
Soil depth	10–51 cm
Surface fragment cover <=3"	2–20%
Surface fragment cover >3"	15–60%
Available water capacity (0-101.6cm)	0–2.54 cm

Calcium carbonate equivalent (0-101.6cm)	0–40%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–2
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	5–20%
Subsurface fragment volume >3" (Depth not specified)	25–80%

Ecological dynamics

Steep Rocky 30-38" PZ is a live oak savannah ecological site. The reference plant community for the Steep Rocky site is a fire-influenced mosaic of tallgrass and oak plant communities, interspersed with a high diversity of perennial forbs and midgrasses due to terrain. Grass-dominated areas make up 65% or more of the area and mix with groups (mottes) of oak trees (10-20% of the area) to create a mosaic of grass and shrub communities. Improper grazing will result in a reduction of tallgrasses and an increase in composition of midgrasses, unpalatable forbs, and woody species. The steeper portions of this site receive limited grazing from large ungulates (cattle) due to its slope and surface rockiness. However, smaller ruminants (goats, deer, and pronghorn) graze this site.

Continued degradation of the site will result in the site crossing a threshold to a shrubland community characterized by invasive shrubs, mid and shortgrasses, and unpalatable forbs. Bare ground, erosion, and water flow patterns will increase. Forage production will decline. Over time the size and amount of eroded areas will increase as the A horizon erodes.

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/or 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.

Natural vegetation on the uplands is predominantly tall warm-season perennial bunchgrasses with lesser amounts of midgrasses and shortgrasses. This site occurs as a rocky inclusion within the tallgrass prairie that makes up most of MLRA 85. MLRA 85 was historically dominated by big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), and little bluestem (*Schizachyrium scoparium*). Midgrasses such as sideoats grama (*Bouteloua curtipendula*), 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. Scattered live oak and hackberry (*Celtis* spp.) trees are also native to the region. The intermittent bottomlands also contain hardwoods including several species of oak (*Quercus* spp.), elm (*Ulmus* spp.), and native pecan (*Carya illinoensis*) trees.

The northernmost portion of the Grand Prairie MLRA is still relatively free from the widespread invasion of brush that has occurred in other parts of the state, including the southern part of the MLRA. Juniper (cedar) (*Juniperus* spp.), honey mesquite (*Prosopis glandulosa*), pricklypear (*Opuntia* spp.), and scrub oak (*Quercus sinuata* var. *breviloba*) have increased to the point of dominance in some locations, especially on shallow, rocky slopes.

Pre-settlement influences included grazing or browsing by endemic pronghorn antelope, and deer, severe droughts, and infrequent, catastrophic fires. Wright and Bailey (1982) reported that there are no reliable records of fire frequency in the Great Plains grasslands because there are no trees to carry fire scars from which to estimate fire frequency. A natural fire frequency of 7 to 10 years seems reasonable for surrounding prairie. Due to its slope and rockiness, the Steep Rocky site burned infrequently. Natural fires were catastrophic fires limited to years with excess fuel loads and/or severe fire conditions. They generally occurred when shrub canopy reached a level sufficient to carry crown fires. Even then, fires tended to be limited to mosaics due to the pattern of the vegetation and occurrence of rock outcrops. Fires exhibited different dynamics on heavily wooded north slopes versus more

sparsely vegetated south slopes.

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 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. The Steep Rocky site does not lend itself to cultivation.

Rangeland Health Reference Worksheets have been posted for this site on the Texas NRCS website (www.tx.nrcs.usda.gov) in Section II of the eFOTG under (F) Ecological Site Descriptions (ESDs).

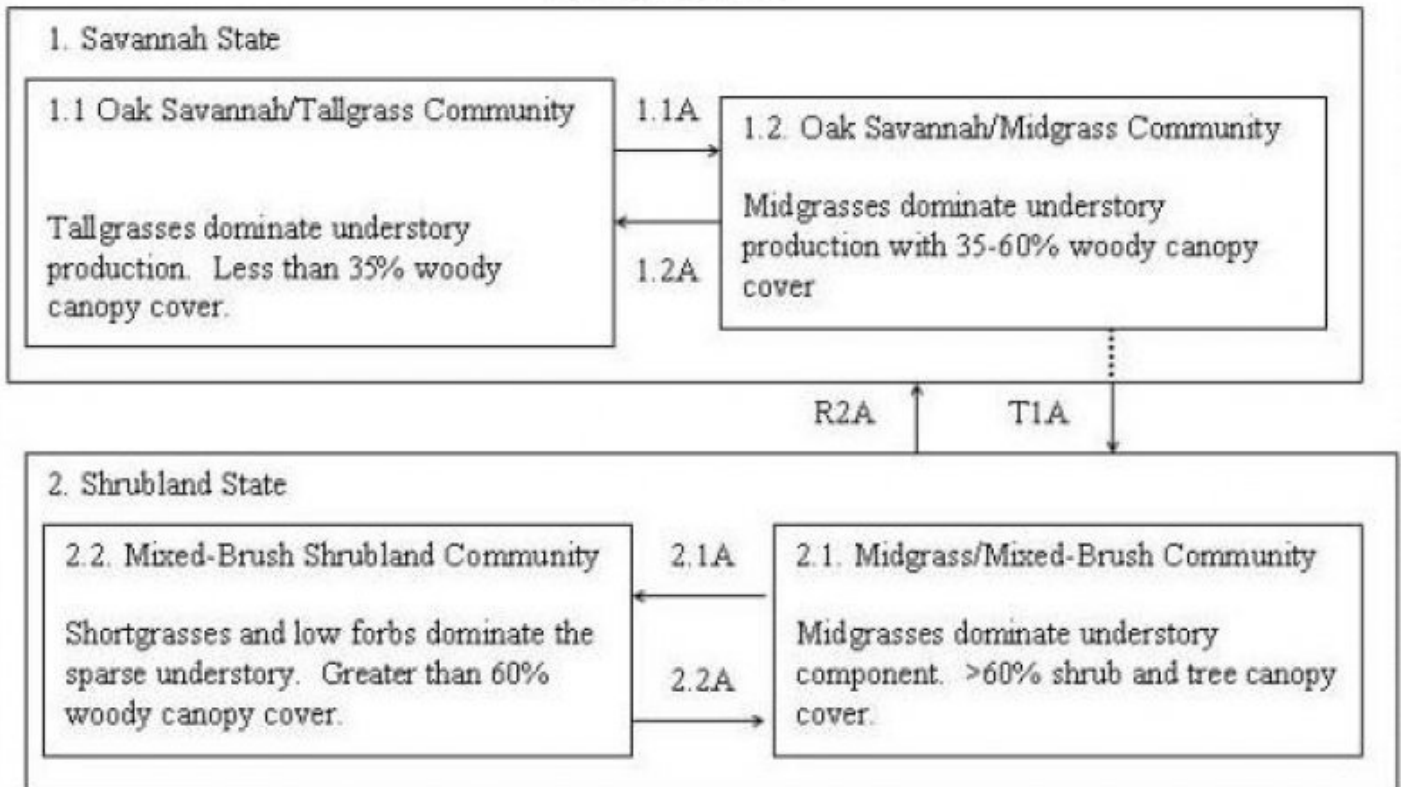
Plant Communities and Transitional Pathways

A state and transition model for the Steep Rocky ecological site is depicted in Figure 1. Thorough descriptions of each state and associated transition and of each plant community and associated pathway follow the model. This model is based on the available experimental research, field observations, and interpretations by experts, but is likely to change as knowledge increases.

Plant community dynamics vary across the MLRA reflecting the range of variability in conditions (precipitation, elevation, aspect, and soils) and each plant community reflects that natural variability over space and time. ESDs attempt to communicate highly complex biological processes in a land management context. ESDs do not attempt to describe the specific attributes exhibited for each state or community; rather they describe representative values that are important to ecological dynamics.

State and transition model

Steep Rocky 30-38" PZ
R085XY187TX



Legend

- 1.1A Improper Grazing Management, No Fire, No Brush Management, Drought
- 1.2A Proper Grazing Management, Prescribed Burning, Brush Management
- T1A Improper Grazing Management, No Fire, No Brush Management, Drought
- R2A Proper Grazing, Brush Management, Prescribed Burning
- 2.1A Improper Grazing Management, No Fire, No Brush Management, Drought
- 2.2A Proper Grazing, Prescribed Burning, Brush Management, Range Planting

State 1

Savannah State - Reference

Dominant plant species

- Texas live oak (*Quercus fusiformis*), tree
- little bluestem (*Schizachyrium scoparium*), grass

Community 1.1

Oak Savannah/Tallgrass Community



Figure 9. 1.1 Oak Savannah/Tallgrass Community

The Oak Savannah/Tallgrass Community (1.1) is the reference community and is characterized as a live oak savannah with 30 to 35 percent woody species canopy cover. Live oak dominates the overstory. Texas oak (*Quercus buckleyi*), scrub oak (*Quercus sinuata* var. *breviloba*), sumacs (*Rhus* spp.), elm (*Ulmus* spp.), and hackberry (*Celtis* spp.) can also be important overstory species. Both percent species composition by weight and percent canopy cover are used in this ESD. Most observers find it easier to visualize or estimate percent canopy for woody species (trees and shrubs). 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. Calculating similarity index requires use of species composition. Little bluestem dominates the herbaceous component of the site. Other important grasses are sideoats grama, big bluestem, Indiangrass, green sprangletop (*Leptochloa dubia*), tall grama (*Bouteloua hirsuta* var. *pectinata*), slim tridens (*Tridens muticus*), tall dropseed (*Sporobolus compositus*), and silver bluestem (*Bothriochloa laguroides*). Forbs commonly found on the site include Maximilian sunflower (*Helianthus maximiliani*), awnless bushsunflower (*Simsia calva*), Engelmann's daisy (*Engelmannia peristenia*), dotted gayfeather (*Liatris punctata*), and halfshrub sundrop (*Calylophus serrulatus*), and bundleflowers (*Desmanthus* spp.). Other shrub and tree species found in community (1.1) include eastern redbud (*Cercis canadensis*), species of cherry (*Prunus* spp.), bumelia (*Sideroxylon* spp.), elbowbush (*Forestiera pubescens*), and saw greenbrier (*Smilax bona-nox*). Ashe's juniper (*Juniperus ashei*) was historically restricted to rocky ledges and shelves, where it was protected from fire. Prior to settlement, this site functioned as a shifting mosaic with shrub-dominated areas expanding until a catastrophic fire killed woody species and opened areas for grasses and forbs. The site would recover to a grassland savannah until woody species encroached during longer fire-free periods. After 15-25 years without a fire regime, the site would cross the threshold between the Savannah State to the Shrubland State. This shifting mosaic would continue in a long term cycle. The reference savannah community will transition to the Oak Savannah/Midgrass Community (1.2) with lack of fire, lack of brush control, long-term drought, repeated, long-term growing season defoliation, and/or other repeated critical growing season stresses. The first species to decrease in dominance will be the grasses and forbs with the least shade tolerance and highest moisture requirements (i.e. Indiangrass, big bluestem, and Engelmann's daisy). This will initially result in an increase in composition of little bluestem. As shrub canopy cover increases, little bluestem will decrease and shade and drought tolerant midgrasses and forbs will increase in composition. The soil surface of this site is characterized by stones and boulders covering 30 to 65 percent of the soil surface. Bare soil composes 10 percent or less of the ground cover. Plant basal cover and litter make up the remainder of the ground cover. The site is well drained with high infiltration and low runoff, despite the steep slope. The shrub canopy will intercept much of the rainfall. Although the stones and boulders on the soil surface increase runoff and lead to the development of water flow patterns, runoff is eventually intercepted by plants within the site. Soils are high in organic matter and the heavy plant cover contributes to increasing organic matter and soil building.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1681	2102	2522
Shrub/Vine	336	420	504
Forb	224	280	336
Total	2241	2802	3362

Figure 11. Plant community growth curve (percent production by month). TX6020, Tallgrass Oak Savannah Community. The plant community is a fire climax savannah composed of warm-season perennial tallgrasses and scattered post oaks..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	2	18	23	17	6	4	16	6	3	2

Community 1.2 Oak Savannah/Midgrass Community



Figure 12. 1.2 Oak Savannah/Midgrass Community

The Oak Savannah/Midgrass Community Phase (1.2) typically results from lack of fire over a long period of time (transition 1.1A). During this period, indigenous or invading woody species increase on the site. The site will return to the Oak Savannah/Tallgrass Plant Community (1.1) when brush control (albeit infrequent due to slope) and/or repeated fires allow competition from a vigorous grass component to dominate open savannah areas while shrubs dominate mottes and constitute 35 percent or less woody canopy cover (transition 1.2A). When the Oak Savannah/Midgrass Community (1.2) is continually overgrazed and fire is excluded, the community crosses a threshold (T1A) to a state that is dominated by woody plants, the Mixed-Brush/Midgrass Community (2.1). Important grasses are little bluestem, sideoats grama, silver bluestem, tall dropseed, and Texas cupgrass (*Eriochloa sericea*). More grazing-resistant shortgrasses and less palatable forbs begin replacing the midgrasses. Some of the perennial forbs persist, but less palatable forbs will increase. Woody canopy varies between 35 and 60 percent, depending on the severity of grazing, fire interval, and availability of increaser shrub species. Numerous shrub and tree species will continue to increase because shrub canopy intercepts rainfall and creates drier growing conditions for understory species, reducing their vigor and competitiveness. Typically, trees such as oak (*Quercus* spp.), elm, hackberry, and ash (*Fraxinus* spp.) will increase in size, while other tree and shrub species such as bumelia, sumac (*Rhus* spp.), elbowbush, agarito (*Mahonia trifoliolata*), honey mesquite, juniper, and pricklypear (*Opuntia* spp.) will increase in density. The composition of hardwood species tends to increase on north and east aspects while west and south aspects favor softwood species. To control woody species populations, prescribed grazing (browsing) and fire can be used to control smaller shrubs and trees, and mechanical removal of larger shrubs and trees may be necessary in older stands. The time frame for woody species to dominate a healthy community is unknown, but reference sites indicate re-growth of woody species reached 75 percent canopy cover in about 25 years. Fire and brush control are difficult to use on this site. Examples exist of restoration using strategic burning with small fires. Chemical control may require hand spraying or aerial application to create openings in a closed shrub canopy. It may take several years to achieve change, depending upon growing conditions and the

aggressiveness of treatment. Large scale fires historically burned this site only during hot, dry, windy conditions. Large scale prescribed fires require careful fuel management and generally involve burning this site at the same time as surrounding more productive sites with plentiful fine fuels. The transition 1.1A will result in an increase in bare ground, shrub density, and length of water flow patterns, in addition to decreased infiltration. Heavy continuous grazing will reduce plant cover, litter, and mulch. Litter and mulch will move off site as plant cover declines. Ashe's juniper is a particularly aggressive shrub on this site. Once the midgrasses decrease below 25 percent of composition, woody species cover exceeds 60 percent canopy cover, and the woody plants within the grassland portion of the savannah reach fire-resistant size (about 3 feet in height), the site crosses a threshold into the Shrubland State (2) and the Mixed-Brush/Midgrass Plant Community (2.1). Until the Oak Savannah/Midgrass Plant Community (1.2) crosses the threshold (T1A) into the Mixed-Brush/Midgrass Community (2.1), this community can be managed back toward the reference community (1.1) through the use of cultural practices including strategic burning and strategic brush control. Once invasive woody species become established, returning fully to the reference is difficult, but it is possible to return to a similarly functioning plant community. The risk of soil erosion under shrub canopy is much less than deeper sites due to shallow soil depths. The large fragments that cover 35 – 65 percent of the soil surface provide numerous interruptions to waterflow that reduces the opportunity for soil to flow off site. Unlike sites with deeper soils, changing management practices (improving grazing management and controlling brush) can create sufficient change in growing conditions for the site to follow restoration pathway R2A to the Savannah State within a reasonable time frame.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	538	897	1211
Shrub/Vine	538	897	1211
Forb	269	448	605
Total	1345	2242	3027

Figure 14. Plant community growth curve (percent production by month). TX6021, Tall & Midgrass/Oak Savannah Community. The tallgrasses will start to disappear and be replaced by midgrasses. Invader brush species appears and becomes established..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	2	18	23	17	6	4	16	6	3	2

Pathway 1.1A Community 1.1 to 1.2



Oak Savannah/Tallgrass Community



Oak Savannah/Midgrass Community

The Oak Savannah/Tallgrass Plant Community will shift to the Oak Savannah/Midgrass Plant Community when there is continued growing season stress on palatable grass species. These stresses include: lack of fire, lack of brush control, long-term drought and/or other repeated critical growing season stress. Increaser species (midgrasses and woody species) are generally endemic species released from competition as vigor of tallgrasses declines. Woody species canopy exceeding 35% and/or dominance of tallgrasses falling below 50% of species composition indicate a transition to the Oak Savannah/Midgrass Plant Community. Presettlement, this site was dependent on fire to maintain the savannah's balance of grass and shrubs. Currently, fire and/or brush management are required to maintain the reference community. Due to the infrequent and irregular nature of fire presettlement, one can theorize the site transitioned between the two communities within the Savannah State, and even across the threshold to the Shrubland State, under natural influences. This site would be less stable than the surrounding prairie sites. The driver for this transition is increasing canopy cover of woody species. Contemporarily this transition is often driven by introduction and expansion of invasive shrubs. Cattle grazing management tends to

not drive this transition, as the site is not well suited to cattle grazing due to steepness and rockiness. Examples exist of Steep Rocky sites that were overgrazed by cattle, particularly less steep slopes and areas when access to more favorable sites was limited. The driver for community shift 1.1A for the herbaceous component is improper grazing management on sites with grazing. On ungrazed or lightly grazed sites increased competition from invader midgrasses and forbs and increasing shrub cover drive herbaceous shifts. The driver for the woody component is lack of fire and/or brush control.

Pathway 1.2A Community 1.2 to 1.1



Oak Savannah/Midgrass
Community

Oak Savannah/Tallgrass
Community

The Oak Savannah/Midgrass Plant Community will return to the Oak Savannah/Tallgrass 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 35% or less canopy cover will require inputs of fire and/or brush control. Due to the steepness of the site, brush control may be limited to hand work or chemical control using aerial or all-terrain vehicle (ATV) application because site conditions hinder use of heavy machinery. The driver for community shift 1.2A for the herbaceous component is proper grazing management. The driver for the woody component is fire and/or brush control. Brush control can also benefit tallgrasses and drive community shift 1.2A for the herbaceous community.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

State 2 Shrubland State

Dominant plant species

- Texas live oak (*Quercus fusiformis*), tree
- Ashe's juniper (*Juniperus ashei*), tree
- Texas wintergrass (*Nassella leucotricha*), grass

Community 2.1 Mixed-Brush/Midgrass Community



Figure 15. 2.1 Mixed-Brush/Midgrass Community

The Mixed-Brush/Midgrass Community (2.1) presents a 60 percent woody plant canopy, with live oak as the dominant species within the oak mottes and honey mesquite and juniper invading the former grassland areas. The community loses its savannah appearance with invasive shrubs beginning to fill the open grassland portion of the savannah. The oak mottes remain, but are no longer the only areas with trees. This community type is the result of lack of fire and accompanying increase in shrub canopy cover. Alternatively, groups of Ashe's juniper can replace oak mottes. Much of MLRA 85 was cleared of hardwoods around 1900. Hardwood species were also impacted by overgrazing by sheep and goats in the early 1900s. After the hardwoods were harvested, re-growth was primarily by juniper. These dense juniper stands are commonly referred to locally as "old growth cedar" or "cedar brakes". These juniper stands can occur in either the Mixed-Brush/Midgrass community (2.1) or Mixed-Brush Shrubland community (2.2) depending on the composition of the understory. Canopy cover of these juniper stands can reach 80 percent. Once juniper stands have become dense and extensive, it is difficult to reestablish oaks. Although difficult, managers can restore the grassland openings within the shrubs through properly executed brush management. The degree of treatment depends upon practicability. The success of reestablishment of desirable native grasses and forbs is dependant upon soil being left when juniper are removed. Brush removal that leaves the thin layer of soil can increase the likelihood of success of reseeding efforts. Reclamation success is often dependant on the skill of those removing brush. The slope of this site makes restoration a difficult practice and often limits the size of restoration operations. 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 such as sumac. Unpalatable forbs such as western ragweed (*Ambrosia psilostachya*) increase in species composition. Annual herbage production decreases 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 northern portion. Ashe's juniper occurs mostly in the southern portion, but can be found throughout the MLRA. Many of the reference community (1.1) shrubs are still present. Sideoats grama and other reference community (1.1) midgrasses decrease to the point that grasses no longer form the dominant component. Shortgrasses/grasslikes such as low panicums (*Panicum* spp.) and threeawns (*Aristida* spp.) increase. Remnants of the reference community (1.1) grasses and forbs along with unpalatable invaders occupy the interspaces between trees and shrubs. Cool-season species such as Texas wintergrass (*Nassella leucotricha*) and sedges (*Carex* spp.) can be found under and around woody plants. Plant vigor and productivity of the grassland component is reduced due to competition for nutrients and water from woody plants. Common herbaceous species include tall grama, and Mexican sagewort (*Artemisia ludoviciana* ssp. *mexicana*). Buffalograss (*Bouteloua dactyloides*), western ragweed, 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. Due to the shallow depth to limestone bedrock and steep slope, erosion can be severe. Higher rainfall interception losses by the increasing woody canopy combined with increased 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. Soil loss can occur during rainfall events. Excessive grazing by other 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 threeawns and cedar sedge (*Carex planostachys*). Grasses and forbs make up as little as 5 percent of annual biomass production. Excessive cattle grazing tends to create a different response and structure to the community than does excessive deer or goat grazing. Excessive cattle grazing tends to

accelerate 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 growth that grows below the browse line on larger shrubs and trees. While large trees will continue 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. Annual primary production is approximately 700 to 2000 pounds per acre. In this plant community, annual production is balanced between herbaceous plants and woody species. 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 proper grazing management are applied at this stage, understory composition will continue to shift towards shortgrasses and unpalatable forbs, causing the community to convert to the Mixed-Brush Shrubland Community (2.2). Aggressive shrubs (such as juniper) can facilitate this shift even under proper grazing management.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	392	560	1121
Grass/Grasslike	275	392	785
Forb	118	168	336
Total	785	1120	2242

Figure 17. Plant community growth curve (percent production by month). TX6022, Oak/Juniper/Midgrass Community. Consists of midgrasses with ten to twenty percent canopy of woody plants..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3	8	20	25	19	5	3	10	4	1	1

Community 2.2 Mixed-Brush Shrubland Community



Figure 18. 2.2 Mixed-Brush Shrubland Community

The Mixed-Brush Shrubland Community (2.2) is the result of many years of improper grazing management, lack of periodic fires, and/or lack of proper brush management. Oaks, honey mesquite, and/or juniper dominate the Mixed-Brush Shrubland Community (2.2), which has greater than 60 percent woody canopy cover and little or low understory production. It is now essentially a dense shrubland with remnant grasses, sedges, and forbs under the canopy and within interspaces. As brush canopy increases, annual production for the understory declines to very low levels, due to shading, competition for nutrients, and interception of rainfall by the shrub canopy. Most of the remaining understory is shade tolerant, grazing tolerant, and/or unpalatable. Common understory shrubs are pricklypear, agarito, sumacs, and elbowbush. Grazing pressure generally becomes less of a factor once the

community has reached this stage, particularly if junipers have replaced shrubs with browsing value. Canopy cover will increase until the site is covered with a dense stand of brush. Juniper stands may become so dense as to provide little wildlife browsing or cover. Reference sites demonstrate that the Steep Rocky site is highly resilient when brush control is accompanied by favorable growing conditions. Because soils on this site are shallow to very shallow even at reference conditions, erosion is not severe under shrub canopy. Additionally 35-65 percent of the soil surface is covered with large fragments (stones, boulders, and limestone outcrops) which create favorable microsites for seed germination in the spaces between the rocks. If remnant plants are present, aggressive tallgrasses such as big bluestem, little bluestem, and Indiangrass reestablish and increase following brush control or fire accompanied by grazing deferment. Remnant grasses are protected between the rocks so that once the overstory is removed, they can express themselves. Cleared sites frequently re-grow to dense juniper stands that can reach 75 percent cover in approximately 25 years unless juniper control measures are taken. These dense stands of juniper can reach 80 percent canopy cover with an understory that is primarily cedar sedge with trace amounts of reference community species. The shrub canopy acts to intercept rainfall and increase evapotranspiration losses and interception losses, creating a more xeric microclimate. Soil fauna and organic mulch are reduced, exposing more of the soil surface to erosion in interspaces. The percent of exposed limestone bedrock increases with erosion. 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 Shrubland 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 grassland. Alternatives for restoration include: brush control and range planting, proper stocking, prescribed grazing, and prescribed burning following restoration to maintain the desired community.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	314	549	785
Forb	67	118	168
Grass/Grasslike	67	118	168
Total	448	785	1121

Figure 20. Plant community growth curve (percent production by month). TX6023, Oak/Juniper/Mesquite Complex. Oak/Juniper/Mesquite complex having greater than twenty percent woody canopy dominated by juniper and mesquite..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3	8	20	25	19	5	3	10	4	1	1

Pathway 2.1A Community 2.1 to 2.2



Mixed-Brush/Midgrass Community



Mixed-Brush Shrubland Community

Without fire (natural or human-caused) and/or brush control, woody density and canopy cover will increase in the Mixed-Brush/Midgrass Plant Community until it converts into the Mixed-Brush Shrubland Plant Community. Improper grazing management and/or long-term drought (or other growing season stress) will accelerate this transition. Due to the shallow nature of the soils, woody species (particularly live oak and juniper) may die off under severe drought conditions. This may facilitate a transition back to the Savannah State by providing canopy openings for grass cover to increase when favorable growing conditions return. While woody species canopy may continue to increase, the indicator for this transition is the change of the understory from domination by midgrasses to a sparse understory of shortgrasses and unpalatable forbs. There may be areas under dense shrub cover with almost no understory. Improper grazing management or other long-term growing season stress can decrease the

composition of midgrasses and palatable forbs in the herbaceous component. Even without 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. The driver for community shift 2.1A is lack of fire and/or brush control.

Pathway 2.2A Community 2.2 to 2.1



Mixed-Brush Shrubland
Community



Mixed-Brush/Midgrass
Community

Brush management and/or fire can create great openings in the canopy so that remnant midgrasses and shade intolerant forbs can increase in vigor and composition. Large groups of dense forbs may remain with stands of good herbaceous growth in the openings of shrub canopy. Continued fire and/or brush management will be required to maintain openings in the canopy. Fire management is challenging on this site, particularly on steeper slopes, which may burn only during wildfire conditions. Prescribed fire requires special precautions and prudence due to difficulty in both carrying a fire and controlling the fire once moving. This site is usually in small spot treatments or burned along with adjacent ecological sites. If the herbaceous component has transitioned to shortgrasses and low forbs, proper grazing management (combined with favorable moisture conditions) will be necessary to facilitate the shift of the understory component to the midgrass-dominated Mixed-Brush/Midgrass Plant Community. Range planting may accelerate the transition of the herbaceous community, particularly when combined with favorable growing conditions. However, range planting is very difficult on the Steep Rocky site and will be limited to hand seeding of small areas or ATV broadcasting due to the steepness and rockiness of the site. Range planting is more commonly associated with restoration efforts associated with Restoration Pathway R2A. The driver for community shift 2.2A is fire and/or brush control.

Conservation practices

Brush Management
Prescribed Burning

Transition T1A State 1 to 2

While the Savannah State has some resistance to shrub dominance, long-term lack of fire or brush control will allow brush to dominate the site even under proper grazing management. Shrubs make up a portion of the plant community in this state, therefore propagules are present. The mean fire return interval to maintain the Savannah State is 5-10 years. Even with proper grazing management and favorable climate conditions, lack of fire for 15-25 years will allow woody species to increase in canopy to reach the 60% threshold level. An infusion of invasive species (i.e. juniper or mesquite) will speed up the process. Improper grazing management, prolonged drought, and a warming climate will provide a competitive advantage to shrubs which will accelerate this process. Tallgrasses will decrease to less than 5% species composition. This transition can occur from any of the Grassland State Communities. The driver for Transition T1A is lack of fire and/or brush control. The Grassland State is always at risk for this transition because woody species are present in the grassland plant community. Introduction of aggressive woody invader species (i.e. juniper) increase the risk that this state transition will occur and accelerate the rate at which it is likely to occur.

Restoration pathway R2A State 2 to 1

Restoration of the Shrubland State to the Savannah 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 Savannah State, particularly if the woody

component is dominated by species that are not re-sprouters. Brush control in combination with prescribed fire, proper grazing, 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, propagules from adjacent sites are frequently necessary to restore reference community species. Range planting will be limited to hand or ATV broadcasting due to the steepness and rockiness of the site. The driver for Restoration Pathway R2A is fire and/or brush control combined with restoration of the herbaceous community and proper grazing management. Restoration may require aggressive treatment of invader species.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	Tallgrass			504–1177	
	little bluestem	SCSC	<i>Schizachyrium scoparium</i>	504–1177	–
2	Midgrass			252–588	
	sideoats grama	BOCU	<i>Bouteloua curtipendula</i>	252–588	–
3	Tallgrasses			336–785	
	big bluestem	ANGE	<i>Andropogon gerardii</i>	224–673	–
	Indiangrass	SONU2	<i>Sorghastrum nutans</i>	112–560	–
4	Mid/Shortgrasses			168–392	
	cane bluestem	BOBA3	<i>Bothriochloa barbinodis</i>	0–336	–
	tall grama	BOHIP	<i>Bouteloua hirsuta</i> var. <i>pectinata</i>	0–336	–
	silver beardgrass	BOLAT	<i>Bothriochloa laguroides</i> ssp. <i>torreyana</i>	0–336	–
	composite dropseed	SPCOC2	<i>Sporobolus compositus</i> var. <i>compositus</i>	0–336	–
	slim tridens	TRMU	<i>Tridens muticus</i>	0–336	–
	slim tridens	TRMUE	<i>Tridens muticus</i> var. <i>elongatus</i>	0–336	–
	green sprangletop	LEDU	<i>Leptochloa dubia</i>	0–336	–
	Texas wintergrass	NALE3	<i>Nassella leucotricha</i>	0–168	–
	fall witchgrass	DICO6	<i>Digitaria cognata</i>	0–168	–
	plains lovegrass	ERIN	<i>Eragrostis intermedia</i>	0–168	–
	Texas cupgrass	ERSE5	<i>Eriochloa sericea</i>	0–168	–
	sedge	CAREX	<i>Carex</i>	0–112	–
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0–112	–
	Wright's threeawn	ARPUW	<i>Aristida purpurea</i> var. <i>wrightii</i>	0–112	–
	Reverchon's bristlegrass	SERE3	<i>Setaria reverchonii</i>	0–112	–
Forb					
5	Forbs			168–392	
	awnless	SICA7	<i>Simsia calva</i>	0–392	–

	bushsunflower				
	bundleflower	DESMA	<i>Desmanthus</i>	0–392	–
	Engelmann's daisy	ENPE4	<i>Engelmannia peristenia</i>	0–392	–
	Maximilian sunflower	HEMA2	<i>Helianthus maximiliani</i>	0–392	–
	dotted blazing star	LIPU	<i>Liatris punctata</i>	0–392	–
	coastal indigo	INMI	<i>Indigofera miniata</i>	0–336	–
	trailing krameria	KRLA	<i>Krameria lanceolata</i>	0–336	–
	sensitive plant	MIMOS	<i>Mimosa</i>	0–336	–
	smartweed leaf-flower	PHPO3	<i>Phyllanthus polygonoides</i>	0–336	–
	scurfpea	PSORA2	<i>Psoralegium</i>	0–336	–
	snoutbean	RHYNC2	<i>Rhynchosia</i>	0–336	–
	milkpea	GALAC	<i>Galactia</i>	0–336	–
	Dakota mock vervain	GLBIB	<i>Glandularia bipinnatifida</i> var. <i>bipinnatifida</i>	0–336	–
	ticktrefoil	DESMO	<i>Desmodium</i>	0–336	–
	fuzzybean	STROP	<i>Strophostyles</i>	0–336	–
	vetch	VICIA	<i>Vicia</i>	0–336	–
	prairie clover	DALEA	<i>Dalea</i>	0–336	–
	Forb, annual	2FA	<i>Forb, annual</i>	0–280	–
	Cuman ragweed	AMPS	<i>Ambrosia psilostachya</i>	0–280	–
	white sagebrush	ARLUM2	<i>Artemisia ludoviciana</i> ssp. <i>mexicana</i>	0–280	–
	stork's bill	ERODI	<i>Erodium</i>	0–280	–
	plantain	PLANT	<i>Plantago</i>	0–280	–
	blazingstar	MENTZ	<i>Mentzelia</i>	0–280	–
Tree					
6	Trees			168–392	
	Texas live oak	QUFU	<i>Quercus fusiformis</i>	168–392	–
	bastard oak	QUSIB	<i>Quercus sinuata</i> var. <i>breviloba</i>	0–336	–
	Texas red oak	QUBU2	<i>Quercus buckleyi</i>	0–336	–
Shrub/Vine					
7	Shrubs/Vines/Trees			84–196	
	elm	ULMUS	<i>Ulmus</i>	0–196	–
	hackberry	CELTI	<i>Celtis</i>	0–196	–
	ash	FRAXI	<i>Fraxinus</i>	0–196	–
	Ashe's juniper	JUAS	<i>Juniperus ashei</i>	0–140	–
	algerita	MATR3	<i>Mahonia trifoliolata</i>	0–140	–
	plum	PRUNU	<i>Prunus</i>	0–140	–
	bully	SIDER2	<i>Sideroxylon</i>	0–140	–
	saw greenbrier	SMBO2	<i>Smilax bona-nox</i>	0–140	–
	Eve's necklacepod	STAF4	<i>Styphnolobium affine</i>	0–140	–
	black prairie clover	DAFR2	<i>Dalea frutescens</i>	0–140	–
	stretchberry	FOPU2	<i>Forestiera pubescens</i>	0–140	–
	Mexican buckeye	UNSP	<i>Ungnadia speciosa</i>	0–140	–
	Texas yucca	YURU	<i>Yucca rupicola</i>	0–140	–

Animal community

This site provides habitat for a great variety of wildlife. Deer may use the savannah areas and the edges of the shrub mottes. Dove and quail also inhabit this site. Turkey and squirrel from adjacent bottomlands frequent this site and feed extensively on acorns and other mast. Many songbirds and small animals feed, nest, and raise their young on the site; among these is the golden cheeked warbler.

Hydrological functions

Site-specific data indicated that rills, if present, are very short (<5 feet). Some gullies may be present on side drains into perennial and intermittent streams. Gullies are vegetated and stable. Water flow patterns are common but are short (5-10 feet) due to interruption by rocks or plant bases. Deposition or erosion is uncommon for normal rainfall conditions but may occur during intense rainfall events. Pedestals or terracettes are uncommon for this site. Even under normal rainfall conditions, litter movement would be expected. Under moderate rain events, litter will move across large fragments and outcrops until interrupted by plants and large rocks. Litter of all sizes may move long distances during intense storm events due to the steepness of the site. Soil surface is resistant to erosion; stability class range is expected to be 4-6 where large fragments permit sampling. The understory of tallgrasses, midgrasses, and forbs creates adequate litter and includes little bare ground, which provides for maximum infiltration and little runoff under normal rainfall events.

Recreational uses

Recreational uses include recreational hunting, hiking, camping, equestrian, and bird watching. In the fall, this site usually produces a pleasing show of colors.

Wood products

Honey mesquite, eastern redcedar, 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 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, such as honey mesquite.

Inventory data references

Information presented was derived from the revised Steep Rocky Range Site, NRCS clipping data, literature, field observations, and personal contacts with range-trained personnel.

Reviewers:

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Approval

Bryan Christensen, 9/21/2023

Acknowledgments

Site Development and Testing Plan:

Future work, as described in a Project Plan, to validate the information in this Provisional Ecological Site Description is needed. This will include field activities to collect low, medium and high intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document. Annual reviews of the Project Plan are to be conducted by the Ecological

Rangeland health reference sheet

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

Author(s)/participant(s)	Lem Creswell, Zone RMS, NRCS, Weatherford, Texas
Contact for lead author	817-596-2865
Date	04/14/2008
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:** Water flow patterns are common and follow old stream meanders. Deposition or erosion is uncommon for normal rainfall but may occur during intense rainfall events.

3. **Number and height of erosional pedestals or terracettes:** Pedestals or terracettes would have been uncommon for this site.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Expect no more than 30% bare ground randomly distributed throughout in small and non-connected areas.

5. **Number of gullies and erosion associated with gullies:** Some gullies may be present on side drains into perennial and intermittent streams. Gullies should be vegetated and stable.

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

7. **Amount of litter movement (describe size and distance expected to travel):** Under normal rainfall, little litter movement should be expected; however, litter of all sizes may move long distances during intense storm events. Minimal and short.

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 5-6.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface is 0-4 inches of pale brown gravelly loam, moderately fine and very fine subangular blocky and granular structure on the surface. SOM is approximately 0-3%. See soil survey for specific soils.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The savannah of tallgrasses, midgrasses, 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):** No evidence of compaction.

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 > Trees >

Other: Cool-season grasses > Forbs > Shrubs

Additional:

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.

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

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 1500-3500 pounds per acre

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Ashe Juniper, Honey mesquite, Prickly pear, Bermudagrass, Johnsongrass, King Ranch bluestem

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

of prolonged drought conditions, heavy herbivory, and intense wildfires.
