USDA Natural Resources Conservation Service

Ecological site R084AY075OK
Sandy Loam Savannah

Last updated: 9/21/2023
Accessed: 05/10/2025

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): 084A–North Cross Timbers

MLRA 84A “North Cross Timbers” is characterized by rolling to hilly uplands with oak trees, bedrock outcrops, and narrow stream valleys. It is believed that the Cross Timbers ecosystem is one the least disturbed forest types remaining in the Eastern US. Major rivers in this MLRA include the Verdigris River in Kansas and the Arkansas, Cimarron, and South Canadian Rivers in Oklahoma. The western parts of this MLRA are underlain by sandstone and shale of Permian age, while the eastern parts are underlain by sandstone and shale of Pennsylvanian age. There are also occurrences of Pleistocene age stream terraces along the rivers.

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.

Level IV EPA Ecoregions 27o “Crosstimbers Transition”, 29a “Northern Crosstimbers”, and 29h “Northwestern Crosstimbers”.

Ecological site concept

These sites occur over sandstone and shale parent material on gently sloping to moderately steep ridge crests and side slopes. The reference vegetation is tallgrass prairie species with an overstory of Post Oak and Blackjack Oak averaging 30 percent canopy, creating a savannah mosaic ecotype. This plant community is disturbance driven and requires periodic fire to maintain the savannah community. When fire is removed from the system, the site is at risk of encroachment of woody species and buildup of leaf litter, altering the plant community and driving it towards a woodland system with little understory production.

Associated sites

R084AY018OK	**Deep Sand Savannah** Savannah site over deep sand. Lower landscape positions.
R084AY088OK	**Shallow Savannah** Many times intermingled with Sandy Savannah. Shallow soils, less productive.

Similar sites

R084AY018OK	**Deep Sand Savannah** Savannah site over deep sand. Lower landscape positions.
R084AY088OK	**Shallow Savannah** Many times intermingled with Sandy Savannah. Shallow soils, less productive.

Table 1. Dominant plant species

Tree	(1) *Quercus stellata* (2) *Quercus marilandica*
Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii* (2) *Schizachyrium scoparium*

Physiographic features

This site occurs on very gently sloping to moderately steep ridge crest and side slopes in the Cross Timbers. Slopes range from1 to 25 percent but are typically 5 to 15 percent.

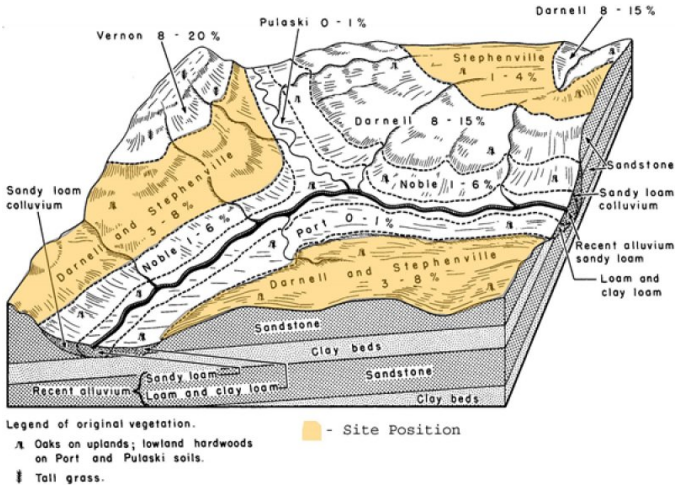


Figure 2. Sandy Savannah Block Diagram

Table 2. Representative physiographic features

Landforms	(1) Hills > Hill (2) Hills > Cuesta
Runoff class	Medium to high

Elevation	500–1,500 ft
Slope	5–15%
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Low to very high
Elevation	Not specified
Slope	1–25%

Climatic features

Climate is moist sub-humid with annual precipitation ranging from 30 to 45 inches. There will be noticeable differences in precipitation and temperatures from north to south and east to west. The most intense rainfall occurs in late spring and early summer while warm season vegetation is growing rapidly. Frost free and freeze free days increase from north to south. Precipitation increases from west to east.

Table 4. Representative climatic features

Frost-free period (characteristic range)	166-191 days
Freeze-free period (characteristic range)	196-209 days
Precipitation total (characteristic range)	37-42 in
Frost-free period (actual range)	166-195 days
Freeze-free period (actual range)	193-229 days
Precipitation total (actual range)	34-45 in
Frost-free period (average)	179 days
Freeze-free period (average)	205 days
Precipitation total (average)	40 in

Climate stations used

- (1) SEDAN [USC00147305], Sedan, KS
- (2) BARTLESVILLE F P FLD [USW00003959], Bartlesville, OK
- (3) PAWHUSKA [USC00346935], Pawhuska, OK
- (4) BARNSDALL [USC00340535], Barnsdall, OK
- (5) MANNFORD 6 NW [USC00345522], Cleveland, OK
- (6) BRISTOW [USC00341144], Bristow, OK
- (7) CHANDLER [USC00341684], Chandler, OK
- (8) NORMAN 3SSE [USC00346386], Norman, OK
- (9) ADA [USC00340017], Ada, OK
- (10) SEMINOLE [USC00348042], Seminole, OK
- (11) CHICKASHA EXP STATION [USC00341750], Chickasha, OK
- (12) ANADARKO 3 E [USC00340224], Anadarko, OK
- (13) LINDSAY 2 W [USC00345216], Lindsay, OK
- (14) DUNCAN [USC00342660], Duncan, OK
- (15) STILLWATER 5 WNW [USW00053927], Stillwater, OK

Influencing water features

These upland site is not associated with any wetland or riparian system.

Wetland description

NA

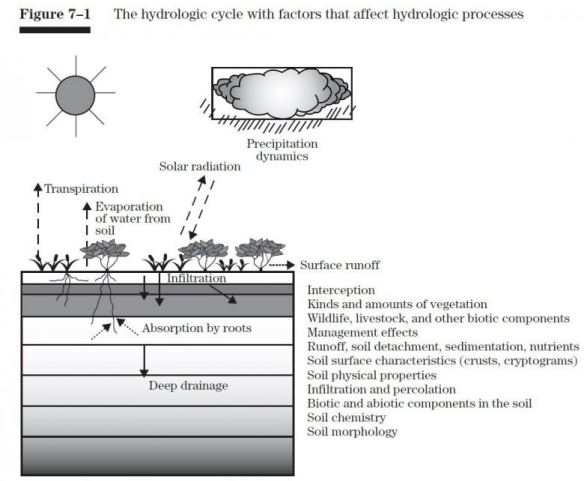


Figure 9.

Soil features

Representative soils: Bartlesville,Littleaxe, Newalla, Niotaze, Stephenville, and Konowa.

These are deep to moderately deep, permeable, medium textured soils formed over sandstone and shale. These particular soils are very susceptible to severe water and wind erosion unless good cover is maintained.

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

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

Table 5. Representative soil features

Parent material	(1) Residuum–sandstone and shale
Surface texture	(1) Fine sandy loam (2) Loamy fine sand
Drainage class	Somewhat poorly drained to excessively drained
Permeability class	Very slow to moderately rapid
Depth to restrictive layer	24 in
Soil depth	24 in
Surface fragment cover <=3"	0–10%
Surface fragment cover >3"	0–10%
Available water capacity (0-40in)	2–6.1 in
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0–8

Soil reaction (1:1 water) (0-40in)	5.5–7.5
Subsurface fragment volume <=3" (Depth not specified)	0–60%
Subsurface fragment volume >3" (Depth not specified)	0–21%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	Not specified
Soil depth	Not specified
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-40in)	Not specified
Electrical conductivity (0-40in)	Not specified
Sodium adsorption ratio (0-40in)	Not specified
Soil reaction (1:1 water) (0-40in)	4.5–8.4
Subsurface fragment volume <=3" (Depth not specified)	Not specified
Subsurface fragment volume >3" (Depth not specified)	Not specified

Ecological dynamics

The reference state is an oak savannah interspersed with tallgrasses, forbs and shrubs. The vegetation is predominately tallgrasses and midgrasses, consisting of big bluestem, little bluestem, Indiangrass and switchgrass. Secondary grasses include purpletop, sand lovegrass, purple lovegrass, sand dropseed Canada wildrye and Virginia wildrye. Overstory trees of post oak, blackjack oak and various species of hickory formed a canopy of approximately 15 to 20 percent. However, it is important to note that woody canopy has always varied from 70+ to <10 in a mosaic pattern.Common species of shrubs are smooth sumac, skunkbush, and leadplant. Major legumes include Illinois bundleflower, sessile tickclover, Illinois tickclover, catclaw sensitivebrier, Virginia tephrosia, slender lespedeza, Steuve's lespedeza and roundhead lespedeza.

Grazing and fire are critical elements in maintaining a balance of vegetation types. Without periodic burning, woody plants gradually thicken, further reducing the amount of herbaceous vegetation in the understory. The estimated historical fire return in 2-5 years (Frost 1998). The lack of fire has changed much of the historical ecosystem. On some savannah locations, tree canopies have thickened to the point that only sparse amounts of shade tolerant herbaceous plants remain in the understory. Long term overgrazing by domestic animals, primarily cattle, usually results in a decrease of the tallgrasses and more cattle-palatable forbs and shrubs. These plants are gradually replaced by less palatable plants for domestic grazing stock, but not necessarily less desirable plants for other management goals.

In other areas, eastern redcedar has invaded the site. These evergreen trees can form an understory component of varying heights and density, but if left unchecked eastern redcedar will eventually completely overtake the site rendering it unproductive and uninhabitable for most animal and bird species. Considerations should be taken regarding removal eastern redcedar before or during canopy thinning treatments to avoid a surge after thinning.

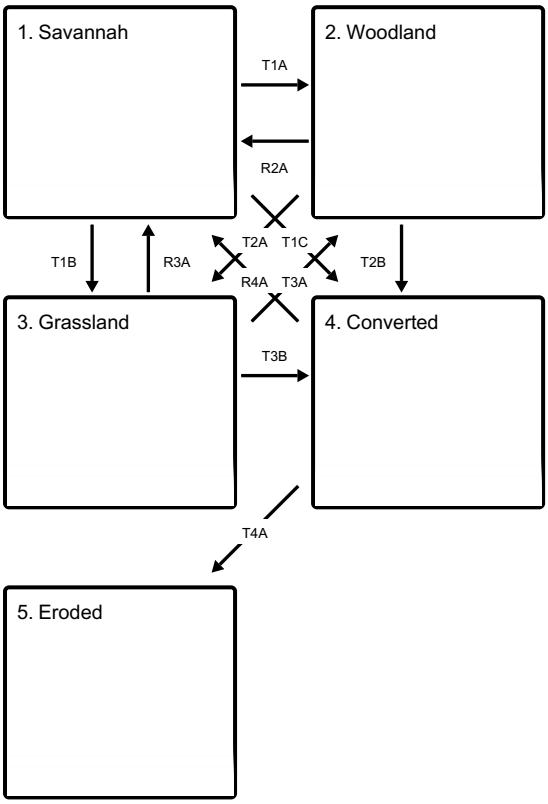
Variations in the timing and intensity of fire can produce different effects on both structure and amount of both

woody and herbaceous vegetation. Summer burns, especially in July and August, have the ability to cause changes in woody structure and composition. Late winter and spring fires tend to be effective in keeping smaller woody plants and seedlings in check, but have only minor effects on more mature woody species. Heavy grazing reduces fuel load and, therefore, minimizes the intensity and the effectiveness of fires.

A large number of acres of Sandy Loam Savannah sites have had an attempt at clearing woody species through chemical herbicide use. Mid-century use of 2,4,5-T and other similar chemicals led to large areas of timber kill. However, many of these areas re-sprouted into thicker and denser "scrub oak" mottes. More recently, tebuthiuron pellets have been used in attempts to open up more grazable acres for cattle production. Some have had success, however, many times the canopy release leads to secondary invasions by eastern redcedar, sericea lespedeza, and broomsedge bluestem. Careful planning and consideration should be used before attempting chemical application in the cross timbers.

State and transition model

Ecosystem states



T1A - No brush management, No fire

T1B - Chemical brush management, Prescribed burning

T1C - Land clearing, Tillage, Seeding

R2A - Selective thinning, Prescribed burning, Prescribed grazing

T2A - Chemical brush management, Prescribed burning, Prescribed grazing

T2B - Land clearing, Tillage, Seeding

R3A - Prescribed burning 4 year+ return, Prescribed grazing

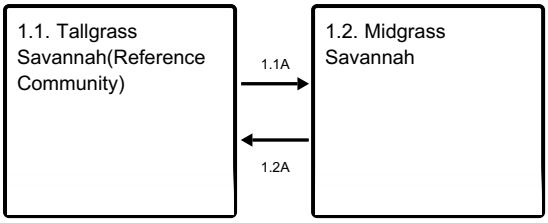
T3A - No fire, No brush management

T3B - Tillage, Seeding

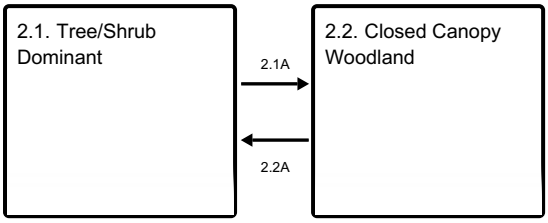
R4A - Range planting, Prescribed burning 4+ year interval

T4A - Soil erosion

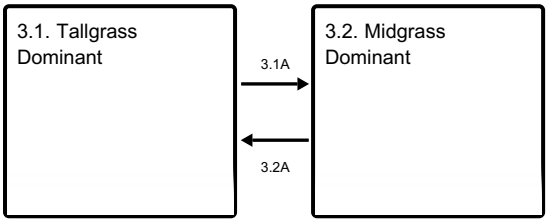
State 1 submodel, plant communities



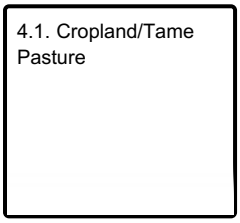
State 2 submodel, plant communities



State 3 submodel, plant communities



State 4 submodel, plant communities



State 1
Savannah

This is the Reference state for this ecological site. It represents the historical variability of plant communities on this site under the natural disturbance regime.

Characteristics and indicators. This ecological state consists of native grasses and forbs with an overstory of oak trees. The average canopy coverage of tree species ranges from 15-30%.

Resilience management. This state requires periodic fire every 2-5 years to maintain the relationship between woody and herbaceous species.

Dominant plant species

- post oak (*Quercus stellata*), tree
- blackjack oak (*Quercus marilandica*), tree
- black hickory (*Carya texana*), tree
- winged sumac (*Rhus copallinum*), shrub
- coralberry (*Symphoricarpos orbiculatus*), shrub
- big bluestem (*Andropogon gerardii*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- goldenrod (*Solidago*), other herbaceous
- sunflower (*Helianthus*), other herbaceous

Community 1.1
Tallgrass Savannah(Reference Community)

The general aspect of the vegetation is an oak savannah. The major plants are tallgrasses and midgrasses with a scattered overstory of trees. Big bluestem, little bluestem, Indiangrass and switchgrass are the dominant grasses and comprise 50 to 60 percent of the vegetation by weight. Secondary grasses include purpletop, sand lovegrass, purple lovegrass, sand dropseed Canada wildrye and Virginia wildrye. Post oak, blackjack oak and hickory are the major trees. Common species of shrubs are smooth sumac, skunkbush, and leadplant. Combined woody species form an overstory of about 20 to 40 percent. The site supports a large number of forbs and legumes. Major legumes include Illinois bundleflower, sessile tickclover, Illinois tickclover, catclaw sensitivebrier, Virginia tephrosia, slender lespedeza, Stuves' lespedeza and roundhead lespedeza. More abundant forbs are Maximilian sunflower, hairy sunflower, pale echinacea, fringeleaf ruellia, heathaster and several species of goldenrod. Over the years this plant community has been maintained by periodic fires and moderate grazing.

Resilience management. This community relies on periodic fire every 2-5 years in order to maintain the structure and composition of species. Abusive grazing practices can both alter herbaceous species composition and reduce fuel loads needed for effective use of fire. Without fire, woody species can dominate the site reducing hydrological function and energy flow on the site.

Dominant plant species

- post oak (*Quercus stellata*), tree
- blackjack oak (*Quercus marilandica*), tree
- black hickory (*Carya texana*), tree
- coralberry (*Symphoricarpos orbiculatus*), shrub
- smooth sumac (*Rhus glabra*), shrub
- big bluestem (*Andropogon gerardii*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- goldenrod (*Solidago*), other herbaceous
- sunflower (*Helianthus*), other herbaceous

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	2089	2972	3854
Tree	811	903	1046
Forb	200	400	550
Shrub/Vine	100	125	150
Total	**3200**	**4400**	**5600**

Figure 11. Plant community growth curve (percent production by month). OK0003, Warm season tallgrasses, forbs, and a few woody species.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	2	6	9	21	24	14	6	11	4	2	1

Community 1.2
Midgrass Savannah

Within this community phase, the more palatable tallgrasses and forbs have decreased. They have been replaced by species such as tall dropseed, silver bluestem, and sideoats grama. The less palatable annual forbs, such as broomweed and western ragweed have increased also. Total herbaceous production may remain the same as the reference community, however, the composition has been altered significantly. In this community, midgrass species are roughly equal to tallgrass species in composition by weight.

Resilience management. The communities of the reference state are quite resilient. However, without periodic fire, this community may be at risk of transitioning to a woody state. Abusive grazing practices may also contribute to this risk by reducing fuel loads need to produce an effective fire.

Figure 12. Plant community growth curve (percent production by month). OK0003, Warm season tallgrasses, forbs, and a few woody species.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	2	6	9	21	24	14	6	11	4	2	1

Pathway 1.1A
Community 1.1 to 1.2

Tallgrass Savannah(Reference Community) **Midgrass Savannah**

Abusive grazing practices which exceed carrying capacity without adequate rest/recovery will result in a quick reduction of tall grass species and palatable forbs. Without some type of rest for these plants, constant defoliation will reduce the vigor creating an opportunity for less palatable plants to out-compete them for resources.

Context dependence. While drought can exacerbate this pathway, it is often grazing that is the main driver.

Pathway 1.2A
Community 1.2 to 1.1

Midgrass Savannah

Tallgrass Savannah(Reference Community)

Through a properly implemented prescribed grazing system that includes a balanced stocking rate and some degree of growing season rest, this community phase may be reverted to the reference plant community. The length of deferment and time required for this restoration is dependent upon length of abusive grazing, precipitation and management system used.

State 2
Woodland

This vegetative state is composed of an overstory of trees and shrubs that will slowly eliminate most herbaceous vegetation from the plant community if left unchecked.

Characteristics and indicators. The major species are post oak and black jack oak. Woody species that were historically suppressed by fire have increased. These include hackberry, elms and greenbriar.

Resilience management. There is a high potential for encroachment by eastern redcedar in this ecological state if proper management is not applied.

Dominant plant species

- post oak (*Quercus stellata*), tree
- blackjack oak (*Quercus marilandica*), tree
- American elm (*Ulmus americana*), tree
- black hickory (*Carya texana*), tree
- eastern poison ivy (*Toxicodendron radicans*), shrub
- Virginia creeper (*Parthenocissus quinquefolia*), shrub
- coralberry (*Symphoricarpos orbiculatus*), shrub
- saw greenbrier (*Smilax bona-nox*), shrub
- sedge (*Carex*), grass
- poverty oatgrass (*Danthonia spicata*), grass
- purpletop tridens (*Tridens flavus*), grass
- wildrye (*Elymus*), grass
- goldenrod (*Solidago*), other herbaceous
- crownbeard (*Verbesina*), other herbaceous

Community 2.1
Tree/Shrub Dominant

This plant community is a moderately closed oak savannah with an understory of mid and tallgrasses. The absence of fire has allowed woody species to increase in abundance. The overstory tree canopy ranges from 40 to 60 percent. The competition from the increased canopy has led to a decrease in herbaceous understory plants. Little bluestem is the dominant grass in the understory. Other grasses include big bluestem, Indiangrass, switchgrass, purpletop, purple lovegrass, Scribners' panicum, Virginia wildrye and Canada wildrye. More abundant legumes are slender lespedeza. Illinois tickclover, catclaw sensitivebrier, trailing wildbean and showy partridgepea. Hairy sunflower, heathaster, western ragweed, fleabane and goldenrods are the more common forbs. Woody species that were historically suppressed by fire have increased, including hackberry and elm species. Low growing woody species such as buckbrush, flameleaf sumac, blackberry and greenbriar have increased and are common on the site.

Figure 13. Plant community growth curve (percent production by month). OK0006, MLRA 84A, Oak/Cedar. Mature oak overstory .

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	3	5	10	18	25	10	5	8	5	4	5

Community 2.2
Closed Canopy Woodland

This plant community is characterized by oak trees and other trees forming an overstory canopy of 65 to 85 percent. Understory vegetation is sparse and composed primarily of shade tolerant grasses, forbs and low growing woody species. Grasses and grasslike plants include Scribners panicum, Virginia wildrye, sedges, arrowfeather threeawn, fringeleaf paspalum, little bluestem, broomsedge bluestem and purpletop. Major forbs include goldenrods, pussytoes, heathaster, blue aster, sageworts, tickclovers, lespedezas and showy partridgepea. Woody plants in the understory include blackberry, buckbrush, eastern redcedar, redbud and seedlings and immature plants of blackjack, post oak, elm and hackberry.

Figure 14. Plant community growth curve (percent production by month). OK0006, MLRA 84A, Oak/Cedar. Mature oak overstory .

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	3	5	10	18	25	10	5	8	5	4	5

Pathway 2.1A
Community 2.1 to 2.2

Tree/Shrub Dominant **Closed Canopy Woodland**

In the absence of fire or brush managment, the trees and shrubs in this plant community will continue to out-compete the herbaceous vegetation for sunlight and resources. With time, it will become a closed canopy woodland community.

Pathway 2.2A
Community 2.2 to 2.1

Closed Canopy Woodland | Tree/Shrub Dominant

Through a program of brush management and prescribed fire, the closed canopy plant community can be reverted to the tree/shrub dominant community. This pathway can be accomplished by opening the canopy and allowing more sunlight to reach the soil surface. Special consideration should be taken if eastern redcedar is present in high amounts in the understory as they will be very competitive once the canopy is opened.

State 3
Grassland

In this state, the shallow savannah has been transitioned to an open grassland dominated by tallgrasses and forbs.

Characteristics and indicators. This state has very low canopy of trees due to chemical and/or mechanical brush management.

Resilience management. Without proper management, this state may return to a savannah state within a short time. It is important to note that maintaining this state will require significant inputs and the transition may take many years. A large number of acres of Sandy Loam Savannah sites have had an attempt at clearing woody species through chemical herbicide use. Mid-century use of 2,4,5-T and other similar chemicals led to large areas of timber kill. However, many of these areas resprouted into thicker and denser "scrub oak" mottes. More recently, tebuthiuron pellets have been used in attempts to open up more grazable acres for cattle production. Some have had success, however, many times the canopy release leads to secondary invasions by eastern redcedar, sericea lespedeza, and broomsedge bluestem. Careful planning and consideration should be used before attempting chemical application in the cross timbers.

Dominant plant species

- little bluestem (*Schizachyrium scoparium*), grass
- big bluestem (*Andropogon gerardii*), grass
- broomsedge bluestem (*Andropogon virginicus*), grass

Community 3.1
Tallgrass Dominant

This community is dominated by tallgrass species such as little bluestem, big bluestem, switchgrass, and indiangrass. Some perenial forbs may persist, depending on the herbicide used on the oak trees. Grazing management plays a key role in the maintenance of this plant community. If tebuthiuron pellets are used to control woody species, it is important to remember that there is a period of years following treatment that it is inadvisable to burn. Therefore special caution should be taken when stocking pastures to ensure that the tallgrass community remains dominant. Other invaders such as sericia lespedeza and eastern redcedar also thrive once released from the oak canopy.

Figure 15. Plant community growth curve (percent production by month). OK0009, Native Warm-Season Grasses. The growing season for warm season(C4) grasses in this region runs from last frost to first frost with peak production from mid April through mid July. The curve listed below is intended to be a representative of normal growing conditions. The monthly production pecentages can vary from year to year deopending upon temperature and rainfall variatioins..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	9	25	28	15	5	10	5	0	0

Community 3.2
Midgrass Dominant

This community is dominated by less palatable midgrass species. Abusive grazing has resulted in the decline of palatable tallgrasses and forbs. Little bluestem will persist, along with dropseed species, silver bluestem, native lovegrasses, sideoats grama, and broomsedge bluestem(in eastern portions of MLRA). Annual forbs increase in abundance. Total site production may be similar to community 3.1 but composition has changed significantly.

Figure 16. Plant community growth curve (percent production by month). OK0009, Native Warm-Season Grasses. The growing season for warm season(C4) grasses in this region runs from last frost to first frost with peak production from mid April through mid July. The curve listed below is intended to be a representative of normal growing conditions. The monthly production pecentages can vary from year to year deopending upon temperature and rainfall variatioins..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	9	25	28	15	5	10	5	0	0

Pathway 3.1A
Community 3.1 to 3.2

Tallgrass Dominant | Midgrass Dominant

Abusive grazing practices exceeding carrying capacity without adequate rest/recovery can push this tallgrass dominated plant community towards a community that is dominated by less palatable midgrass species.

Pathway 3.2A
Community 3.2 to 3.1

Midgrass Dominant | Tallgrass Dominant

Through a properly implemented prescribed grazing system that includes some degree of growing season rest, this community phase may be reverted to the reference plant community. The length of deferment and time required for this restoration is dependent upon precipitation and management system used.

State 4
Converted

This state is the result of a change in land use. Native vegetation has been tilled and crops or introduced perennial vegetation has been planted.

Resilience management. This state is not likely to return to reference conditions due to the alteration of soil structure, chemistry and hydrology. However, if abandoned, the site may become invaded by woody species and transition to something similar to the woodland state.

Dominant plant species

- Bermudagrass (*Cynodon dactylon*), grass

Community 4.1
Cropland/Tame Pasture

With brush management, tillage, seeding and/or sprigging, this site can support a variety of native and non-native plant communities. Good grazing management and, occasionally, reseeding may be needed to re-establish and maintain desired plant communities. Once tillage has occured, physical and biological soil properties have been significantly altered. The return of this state to the reference state may not be achievable. However, range seeding, prescribed fire and proper grazing management can restore a plant community similar the the reference state.

State 5
Eroded

This state is the result of water erosion over bare soil.

Characteristics and indicators. Most of the "A" horizon of the soil profile has been displaced. The remaining subsoil is very low in fertility. Some native grasses and forbs will persist in this state, however, production is greatly reduced.

Resilience management. Site specific evaluations are required on eroded soils in order to determine what restoration options are feasible.

Dominant plant species

- silver beardgrass (*Bothriochloa laguroides*), grass
- threeawn (*Aristida*), grass

Transition T1A
State 1 to 2

In the absence of fire or brush management, this savannah state will transition to a woodland state of tree/shrub dominance.

Constraints to recovery. Overall woody infestation level and time since fire will determine level of restoration needed.

Transition T1B
State 1 to 3

Through intensive chemical brush management, the savannah state may be transitioned to a grassland state dominated by tallgrasses or midgrasses with very few trees and shrubs. It is important to note that maintaining this state will require significant inputs.

Context dependence. A large number of acres of Sandy Loam Savannah sites have had an attempt at clearing woody species through chemical herbicide use. Mid-century use of 2,4,5-T and other similar chemicals led to large areas of timber kill. However, many of these areas resprouted into thicker and denser "scrub oak" mottes. More recently, tebuthiuron pellets have been used in attempts to open up more grazable acres for cattle production. Some have had success, however, many times the canopy release leads to secondary invasions by eastern redcedar, sericea lespedeza, and broomsedge bluestem. Careful planning and consideration should be used before attempting chemical application in the cross timbers.

Conservation practices

Brush Management

Transition T1C
State 1 to 4

Through land clearing tillage and seeding the sandy savannah site may be converted to cropland or tame pasture

Context dependence. Once tillage has occurred, physical and biological soil properties have been significantly altered. The return of this state to the reference state may not be achievable.

Conservation practices

Land Clearing

Restoration pathway R2A
State 2 to 1

Implementing a brush management plan that includes mechanical thinning and the use of prescribed fire can restore the woodland state to an open canopy savannah state. Fire alone can help restore the site, however, this may take many years to accomplish.

Context dependence. Overall woody encroachment level and time since fire have an impact on restoration efforts.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

Transition T2A
State 2 to 3

Through intensive chemical brush management, the woodland state may be transitioned to a grassland state dominated by tallgrasses or midgrasses with very few trees and shrubs. It is important to note that maintaining this state will require significant inputs. A large number of acres of Sandy Loam Savannah sites have had an attempt at clearing woody species through chemical herbicide use. Mid-century use of 2,4,5-T and other similar chemicals led to large areas of timber kill. However, many of these areas resprouted into thicker and denser "scrub oak" mottes. More recently, tebuthiuron pellets have been used in attempts to open up more grazable acres for cattle production. Some have had success, however, many times the canopy release leads to secondary invasions by eastern redcedar, sericea lespedeza, and broomsedge bluestem. Careful planning and consideration should be used before attempting chemical application in the cross timbers.

Transition T2B
State 2 to 4

Through land clearing tillage and seeding the sandy savannah site may be converted to cropland or tame pasture land use.

Constraints to recovery. Once tillage has occurred, physical and biological soil properties have been significantly altered. The return of this state to the reference state may not be achievable.

Conservation practices

Land Clearing

Restoration pathway R3A
State 3 to 1

This state may be restored to the savannah state with the exclusion of chemical brush management.

Context dependence. A prescribed fire program must be implemented to control resprouting woody species and maintain an open savannah canopy. Otherwise, the site could transition to the woody dominated state. This restoration may take many years.

Conservation practices

Prescribed Burning
Prescribed Grazing

Transition T3A
State 3 to 2

In the absence of fire or brush management, this grassland state will transition to a woodland state of tree/shrub dominance.

Transition T3B
State 3 to 4

Through tillage and seeding the grassland state may be converted to cropland or tame pasture land use.

Constraints to recovery. Once tillage has occurred, physical and biological soil properties have been significantly altered. The return of this state to the reference state may not be achievable.

Restoration pathway R4A
State 4 to 1

The potential for this converted state to revert to another state varies greatly from site to site. It is dependent upon multiple factors including length of time in production, soil integrity, planned restoration methods, and precipitation patterns. The return of soil properties to reference condition may not be achievable, post cultivation. Introduced pasture species are also very difficult to eradicate once established. Consult with local conservationists to develop a site specific restoration plan.

Transition T4A
State 4 to 5

If this ecological site is subjected to soil disturbances such as land clearing, ripping, or plowing that leave large amounts of exposed soil, the site may become very susceptible to water erosion. Once the "A" horizon has been displace through erosion, this site has transitioned to an Eroded Sate.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tallgrasses**			746–1375	
	big bluestem	ANGE	*Andropogon gerardii*	543–1000	–
	switchgrass	PAVI2	*Panicum virgatum*	102–188	–
	Indiangrass	SONU2	*Sorghastrum nutans*	102–188	–
2	**Little Bluestem**			678–1250	
	little bluestem	SCSC	*Schizachyrium scoparium*	679–1250	–
3	**Mid/Shortgrasses**			305–563	
	dropseed	SPORO	*Sporobolus*	102–188	–
	purpletop tridens	TRFL2	*Tridens flavus*	68–125	–
	beaked panicgrass	PAAN	*Panicum anceps*	68–125	–
	sand lovegrass	ERTR3	*Eragrostis trichodes*	68–125	–
	purple lovegrass	ERSP	*Eragrostis spectabilis*	34–63	–
	cylinder jointtail grass	COCY	*Coelorachis cylindrica*	34–63	–
	broomsedge bluestem	ANVI2	*Andropogon virginicus*	34–63	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	34–63	–
	arrowfeather threeawn	ARPUP4	*Aristida purpurascens var. purpurascens*	20–38	–
	marsh muhly	MURA	*Muhlenbergia racemosa*	20–38	–
	splitbeard bluestem	ANTE2	*Andropogon ternarius*	20–38	–
	green sprangletop	LEDU	*Leptochloa dubia*	14–25	–
	hairawn muhly	MUCA2	*Muhlenbergia capillaris*	14–25	–
	bearded skeletongrass	GYAM	*Gymnopogon ambiguus*	14–25	–
	blue grama	BOGR2	*Bouteloua gracilis*	14–25	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	14–25	–
	churchmouse threeawn	ARDI4	*Aristida dichotoma*	7–13	–
	gummy lovegrass	ERCU	*Eragrostis curtipedicellata*	7–13	–
	nimblewill	MUSC	*Muhlenbergia schreberi*	7–13	–
	puffsheath dropseed	SPNE2	*Sporobolus neglectus*	7–13	–
4	**Cool-Season Grassses**			360–666	

	Virginia wildrye	ELVI3	*Elymus virginicus*	102–188	–
	Canada wildrye	ELCA4	*Elymus canadensis*	68–125	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	34–63	–
	Texas bluegrass	POAR	*Poa arachnifera*	34–63	–
	sedge	CAREX	*Carex*	34–63	–
	slimleaf panicgrass	DILI2	*Dichanthelium linearifolium*	34–63	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	34–63	–
	roundseed panicgrass	DISPS3	*Dichanthelium sphaerocarpon var. sphaerocarpon*	20–38	–
Forb					
5	**Forbs**			125–344	
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	50–138	–
	compassplant	SILA3	*Silphium laciniatum*	50–138	–
	ashy sunflower	HEMO2	*Helianthus mollis*	25–69	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	25–69	–
	muck sunflower	HESI2	*Helianthus simulans*	25–69	–
	cobaea beardtongue	PECO4	*Penstemon cobaea*	25–69	–
	prairie fleabane	ERST3	*Erigeron strigosus*	25–69	–
	pitcher sage	SAAZG	*Salvia azurea var. grandiflora*	25–69	–
	bluejacket	TROH	*Tradescantia ohiensis*	25–69	–
	Baldwin's ironweed	VEBA	*Vernonia baldwinii*	20–55	–
	button eryngo	ERYU	*Eryngium yuccifolium*	20–55	–
	pale purple coneflower	ECPA	*Echinacea pallida*	20–55	–
	flowering spurge	EUCO10	*Euphorbia corollata*	20–55	–
	Appalachian mountainmint	PYFL	*Pycnanthemum flexuosum*	20–55	–
	rough coneflower	RUGR	*Rudbeckia grandiflora*	15–41	–
	fringeleaf wild petunia	RUHU	*Ruellia humilis*	15–41	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	15–41	–
	devil's bite	LISC2	*Liatris scariosa*	15–41	–
	tall thoroughwort	EUAL3	*Eupatorium altissimum*	15–41	–
	butterfly milkweed	ASTU	*Asclepias tuberosa*	15–41	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	15–41	–
	pussytoes	ANTEN	*Antennaria*	10–28	–
	common yarrow	ACMI2	*Achillea millefolium*	10–28	–
	soft agrimony	AGPU	*Agrimonia pubescens*	10–28	–
	whorled milkweed	ASVE	*Asclepias verticillata*	10–28	–
	Deane's milkvetch	ASDE	*Astragalus deanei*	10–28	–
	licorice bedstraw	GACI2	*Galium circaezans*	10–28	–
	cudweed	GNAPH	*Gnaphalium*	10–28	–
	Nuttall's prairie parsley	PONU4	*Polytaenia nuttallii*	10–28	–
	hairy hawkweed	HILO2	*Hieracium longipilum*	10–28	–
	showy goldenrod	SOSP2	*Solidago speciosa*	10–28	–
	browneyed Susan	RUTR2	*Rudbeckia triloba*	10–28	–

	blackeyed Susan	RUHI2	*Rudbeckia hirta*	5–14	–
6	**Legumes**			75–206	
	partridge pea	CHFA2	*Chamaecrista fasciculata*	25–69	–
	white prairie clover	DACA7	*Dalea candida*	25–69	–
	purple prairie clover	DAPUP	*Dalea purpurea var. purpurea*	25–69	–
	Illinois bundleflower	DEIL	*Desmanthus illinoensis*	25–69	–
	sessileleaf ticktrefoil	DESE	*Desmodium sessilifolium*	25–69	–
	roundhead lespedeza	LECA8	*Lespedeza capitata*	25–69	–
	tall lespedeza	LEST5	*Lespedeza stuevei*	25–69	–
	slender lespedeza	LEVI7	*Lespedeza virginica*	25–69	–
	Virginia tephrosia	TEVI	*Tephrosia virginiana*	25–69	–
	violet lespedeza	LEVI6	*Lespedeza violacea*	20–55	–
	blue wild indigo	BAAUM	*Baptisia australis var. minor*	15–41	–
	Atlantic pigeonwings	CLMA4	*Clitoria mariana*	10–28	–
Shrub/Vine					
7	**Shrubs**			100–150	
	leadplant	AMCA6	*Amorpha canescens*	33–50	–
	Jersey tea	CEHE	*Ceanothus herbaceus*	33–50	–
	dwarf chinquapin oak	QUPR	*Quercus prinoides*	33–50	–
	winged sumac	RHCO	*Rhus copallinum*	33–50	–
	smooth sumac	RHGL	*Rhus glabra*	33–50	–
	skunkbush sumac	RHTR	*Rhus trilobata*	33–50	–
	Carolina rose	ROCA4	*Rosa carolina*	33–50	–
	blackberry	RUBUS	*Rubus*	33–50	–
	saw greenbrier	SMBO2	*Smilax bona-nox*	33–50	–
	coralberry	SYOR	*Symphoricarpos orbiculatus*	33–50	–
	western poison ivy	TORY	*Toxicodendron rydbergii*	33–50	–
	grape	VITIS	*Vitis*	33–50	–
Tree					
8	**Trees**			600–800	
	post oak	QUST	*Quercus stellata*	462–615	–
	blackjack oak	QUMA3	*Quercus marilandica*	185–246	–
	black hickory	CATE9	*Carya texana*	92–123	–
	bitternut hickory	CACO15	*Carya cordiformis*	46–61	–
	shagbark hickory	CAOV2	*Carya ovata*	46–61	–
	eastern redbud	CECA4	*Cercis canadensis*	28–37	–
	common hackberry	CEOC	*Celtis occidentalis*	28–37	–
	American elm	ULAM	*Ulmus americana*	28–37	–
	Oklahoma plum	PRGR	*Prunus gracilis*	28–37	–
	white ash	FRAM2	*Fraxinus americana*	28–37	–
	eastern redcedar	JUVI	*Juniperus virginiana*	18–25	–
	common persimmon	DIVI5	*Diospyros virginiana*	18–25	–

Table 9. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
post oak	QUST	*Quercus stellata*	Native	–	10–25	–	–
blackjack oak	QUMA3	*Quercus marilandica*	Native	–	10–25	–	–
black hickory	CATE9	*Carya texana*	Native	–	1–10	–	–

Animal community

This plants on this site have value for grazing cattle. They also provide cover and food for many species of wildlife including whitetail deer and bobwhite quail. Coyote, red fox, squirrel, cottontail rabbit, opossum and raccoon are common. Numerous song birds and woodpeckers may be found on the site.

Hydrological functions

These upland sites may shed some water via runoff during heavy rain events. The presence of good ground cover and deep rooted grasses can help facilitate infiltration and reduce sediment loss. As ground cover decreases, sediment loss may increase.

Many of these soils maintain a shallow water table during the dormant season when water remains perched over the sandstone or shale bedrock. This water may discharge downslope at areas of exposed bedrock.

In the woody state, trees and shrubs may intercept a majority of the rainfall. There may be some enter the soil through stemflow, however, much of the moisture is intercepted in the canopy and lost via evaporation. This can alter the overall cycling of water and other nutrients.

Recreational uses

Hunting, Camping, Hiking, Bird watching, Photography, Horseback Riding.

Wood products

There is not much "marketable" timber on these sites. Some areas are sources for firewood.

Other products

NA

Other information

NA

Inventory data references

Clipping data and other observations on file in the Oklahoma NRCS State Office:
Suite 206
100 USDA
Stillwater, Oklahoma 74074

The original information presented here was derived from field observations of Dr. Jack Eckroat, in the summer of 2007, correlated to office files and old Rangesite Technical Descriptions (1961 USDA/SCS). Species compositions are as complete as possible. Production will vary by species from within years, from year to year, and from site to site.

Range-417 collections and NRI data were used to validate production and species estimates.

Type locality

Location 1: Osage County, OK	
General legal description	Osage County, Oklahoma; 14 miles northeast of Pawhuska; about 2,300 feet south and 650 feet east of the NW corner of Sec. 23, T. 27 N, R. 10 E

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Contributors

Edits by Colin Walden, Soil Survey Region 9, Stillwater, OK
Dr. Jack Eckroat, Grazing Lands Specialist, NRCS, Oklahoma

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 Site Technical Team.

Rangeland health reference sheet

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

Author(s)/participant(s)	Colin Walden, Brandon Reavis
Contact for lead author	100 USDA Suite 206 Stillwater, Oklahoma 740740
Date	05/28/2020
Approved by	Bryan Christensen
Approval date	
Composition (Indicators 10 and 12) based on	Foliar Cover

Indicators

1. **Number and extent of rills:** No rills present due to adequate ground cover.

2. **Presence of water flow patterns:** Very few water flow patterns. Only in understory following intense storms.

3. **Number and height of erosional pedestals or terracettes:** No pedestals or terracettes present on site.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** There is some variability, but it should average less than 10% bare ground on this site. Bare areas are small and not connected.

5. **Number of gullies and erosion associated with gullies:** No gully erosion on site.

6. **Extent of wind scoured, blowouts and/or depositional areas:** No wind erosion on site.

7. **Amount of litter movement (describe size and distance expected to travel):** Uniform distribution of litter. Litter rarely

moves >6 inches on flatter slopes and may be as much as doubled on steeper slopes, then only during high intensity storms.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Average of stability scores 5 or better.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Ap horizon: 0 to 16 inches; light brown loamy fine sand, single grained structure.
   Bt horizon: 16 to 36 inches; reddish brown sandy loam, reddish brown medium prismatic structure.

   Refer to description for specific component sampled.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Infiltration and runoff are not affected by any changes in plant community composition and distribution. (Tallgrass/ Tree dominant).

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** There is no compaction layer.

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Foliar cover : Tree = Tallgrasses

    Sub-dominant: Little Bluestem

    Other: Mid/Short = Forb+Legume , Shrub

    Additional: Tree species should be predominately oak and hickory

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** There may be some plant mortality and decadence on the perennial grasses, especially in the absence of fire and herbivory, but usually <5%.

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14. **Average percent litter cover (%) and depth (in):** Litter should cover 50-75% of the area between plants with accumulations of no more than 1 inch deep.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Normal production is 2500 – 5000 pounds per year.

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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: eastern redcedar, elm, hackberry, greenbriar, privet, sericea lespedeza and non-natives (introduced species).

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17. **Perennial plant reproductive capability:** All plants capable of reproducing every year. Seed stalks, stalk length and seedheads are numerous.
