USDA Natural Resources Conservation Service

Ecological site R081BY334TX
Loamy Bottomland 19-23 PZ

Last updated: 9/19/2023
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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.

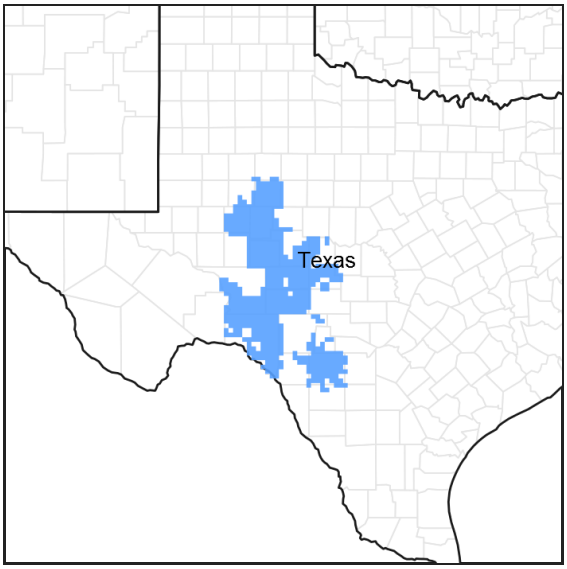


Figure 1. Mapped extent

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): 081B–Edwards Plateau, Central Part

This area is entirely in south-central Texas. It makes up about 11,125 square miles (28,825 square kilometers). The towns of Fredericksburg, Junction, Menard, Rocksprings, and Sonora are in this MLRA. Interstate 10 crosses the middle part of the area. A few State parks and State historic sites are in this MLRA.

Classification relationships

USDA-Natural Resources Conservation Service, 2006.
-Major Land Resource Area (MLRA) 81B

Ecological site concept

Loamy Bottomlands occupy the lowest setting on the landscape. They are comprised of flood plains formed from loamy alluvium. Flooding can occur on these sites.

Associated sites

R081BY325TX	**Clay Loam 19-23 PZ** The Clay Loam site may be encountered upslope.

Similar sites

R081BY333TX	**Loamy 19-23 PZ** The Loamy site does not have a flooding potential.

Table 1. Dominant plant species

Tree	(1) *Quercus virginiana* (2) *Celtis laevigata var. reticulata*
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Panicum virgatum*

Physiographic features

This site occurs on bottomlands and in valleys along major streams and tributaries. Slopes are level to nearly level and rarely exceed two percent except on stream banks and other natural breaks in the landscape. The site receives additional water as off-flow from uphill sites and from upstream flooding.

Table 2. Representative physiographic features

Landforms	(1) Plateau > Flood plain (2) River valley > Flood plain
Runoff class	Very low to medium
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	Occasional to frequent
Ponding frequency	None
Elevation	305–808 m
Slope	0–2%
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding duration	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	0–3%

Climatic features

The climate in the MLRA 81B is subtropical subhumid on the eastern portion and subtropical steppe on the western portion of the MLRA. Winters are dry, and the summers are hot and humid. The precipitation increases from west to east and the temperatures increase from north to south. The area usually receives 65 to 70 percent sunshine each year. The majority of the rainfall occurs during the warm months of April to October. Most precipitation comes from thunderstorms that vary in the amount of water received and the areas covered. Spring is characterized by fluctuating patterns, but mild temperatures prevail. July and August are relatively dry and hot with little weather variability day-to-day. As summer progresses through fall, an increase of precipitation usually occurs in the eastern portions while a decrease of precipitation occurs to the west. Winter temperatures are mild, but polar Canadian air

masses bring rapid drops in temperature. These cold spells last 2 or 3 days. Prevailing winds are southerly with March and April the windiest months.

Table 4. Representative climatic features

Frost-free period (characteristic range)	210-270 days
Freeze-free period (characteristic range)	240-290 days
Precipitation total (characteristic range)	483-610 mm
Frost-free period (actual range)	210-270 days
Freeze-free period (actual range)	240-290 days
Precipitation total (actual range)	483-635 mm
Frost-free period (average)	230 days
Freeze-free period (average)	260 days
Precipitation total (average)	559 mm

Climate stations used

- (1) OZONA [USC00416734], Ozona, TX
- (2) CARTA VALLEY [USC00411492], Rocksprings, TX
- (3) ELDORADO [USC00412809], Eldorado, TX
- (4) SONORA [USC00418449], Sonora, TX
- (5) BIG LAKE 2 [USC00410779], Big Lake, TX

Influencing water features

Bottomland sites can be flooded occasionally to frequently for varying duration throughout the year. Hydric soils can occur in areas therefore an onsite inspection is required to determine wetland status.

Wetland description

Onsite determination is required.

Soil features

These are deep moderately permeable, bottomland soils formed from calcareous alluvial material. Gravel and cobbles may occur in the soils on this site. Water intake is moderate and water holding capacity is high with good inherent fertility. This site is highly productive due to soil characteristics and outside water flooding and upslope overflow. Soil series correlated to this site include: Dev, Frio, and Rioconcho.

Table 5. Representative soil features

Parent material	(1) Alluvium–limestone
Surface texture	(1) Silty clay loam (2) Very gravelly loam
Family particle size	(1) Fine (2) Loamy-skeletal
Drainage class	Moderately well drained to well drained
Permeability class	Slow to moderately rapid
Soil depth	152–203 cm
Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0–1%

Available water capacity (0-101.6cm)	4.06–20.07 cm
Calcium carbonate equivalent (0-101.6cm)	1–90%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	7.4–8.4
Subsurface fragment volume <=3" (10.2-101.6cm)	5–65%
Subsurface fragment volume >3" (10.2-101.6cm)	0–25%

Ecological dynamics

Loamy Bottomlands are typically found in narrow bands in valleys along perennial streams and their tributaries. The reference plant community is a hardwood woodland with tallgrass understory adjacent the watercourse and mixed-grass savannah with a mixture of mid and tall grasses away from the stream. Historically, the Loamy Bottomland evolved under grazing by white-tailed deer and occasional migratory bison. Grazing by wild animals was probably not as influential in shaping the reference vegetation, as were the intense and frequent fires. Fires would occur at 7 to 12-year intervals, killing all except protected trees along the stream terraces and scattered trees or mottes on the outlying bottomland. The deep fertile soils, frequent growing season flooding and runoff from adjacent uplands allowed development of the more mesic mixed tallgrass/midgrass woodland complex. A mixture of tallgrasses, typically big bluestem (*Andropogon gerardii*) and Indiangrass (Sorgastrum nutans), and midgrasses, typically sideoats grama (*Bouteloua curtipendula*) and little bluestem (*Schizachyrium scoparium*) dominate the open grassland from near the stream outward. Forbs, vines, and shrubs are common throughout the woodland and grassland, but were generally held to low densities by frequent wildfires. The riparian vegetation immediately adjacent the stream is dominate by open stands of hardwood trees with occasional breaks in the canopy and an understory of shade tolerant cool-season grasses and forbs. Tallgrasses, typically switchgrass (*Panicum virgatum*) and wildryes (Elymus spp.), dominate the interspaces along the stream bank.

The Mixed-Grass Hardwood Complex Community (1.1) is relatively resilient within the climate, soil, grazing, and fire regime until European settlement and the arrival of animal husbandry. Large numbers of free roaming horses and cattle added to the impact of grazing by endemic game during the early and mid-1800’s. Although the bison had been mostly extirpated by 1860’s, cattle and horse populations continued to increase. With the introduction of barbed wire fencing and windmills during the 1880’s, cattle and sheep grazing became even more extensive. By the drought of the 1890’s, much of the Edwards Plateau was overgrazed. Because of the proximity to permanent water, bottomlands received heavy grazing use and manipulation by settlers. The sites provided lumber, firewood, and water for the pioneers and much of it was deforested.

As overgrazing occurred on the Mixed-Grass Hardwood Complex Community (1.1), there was a reduction of the palatable tallgrasses, forbs, and cool-season components. Continued overgrazing causes a decline in litter, mulch, and organic matter which causes a reduction in intensity and frequency of fires. The shift in plant cover and decline in soil properties favors woody plant encroachment. The early woody and grassland vegetation increasers are generally endemic species released from competition. As the result of overgrazing, the Mixed-Grass Hardwood Complex Community (1.1) regresses to a Midgrass Hardwood Complex Community (1.2). In this phase, midgrasses such as little bluestem, sideoats grama, white tridens (*Tridens albescens*), and low-palatability forbs began replacing the preferred tallgrasses and forbs. Grasses still dominate primary production, but the encroaching woody species contribute an increasing amount.

If the Midgrass Hardwood Complex Community (1.2) is continually overgrazed and fire is excluded, the process of succession proceeds toward woody plant domination. The more preferred tallgrasses, midgrasses, and shortgrasses that are either less palatable or more resistant to grazing, will be replaced. As grass cover declines, litter and soil organic matter decline and bare ground, erosion and other desertification processes increase. The

microclimate in the grassland areas becomes more arid. The site becomes more susceptible to erosion during floods.

When the woody plant cover reaches 35 to 40 percent, applying proper grazing and prescribed burning generally will not restore the grassland community. The presence of woody plants and decline in herbaceous growth prevents fine fuel build up, reducing the ability of fires to control woody species. When this threshold is crossed, the plant community transitions into a woodland state, the Bottomland Hardwood Community (2.1). In this woodland state, woody plants dominate production and depress herbaceous vegetation through shading and competition for water and nutrients.

Continued overgrazing by livestock causes the palatable midgrasses and the more preferred forbs to decline further. They are replaced by less palatable, more shade-tolerant midgrasses, shortgrasses, forbs, and a cool-season species. Ground cover, litter, and mulch are further reduced in the open grassland and interspaces in the woodland allowing previously suppressed plants to increase or invade from adjacent uphill sites. Ashe juniper (*Juniperus ashei*) and mesquite (*Prosopis glandulosa*) are common invaders, eventually becoming dominant understory species. Condalia (Condalia spp.), algerita (Mahonia trifoliata), and pricklypear (Opuntia spp.) also invade. With less herbaceous cover and litter, soil organic matter and structure decline leading to less productive soil, less water holding capacity, less infiltration and more susceptible to erosion. During the transition from grassland to dense woodland, the site is vulnerable to litter and soil movement during flooding events.

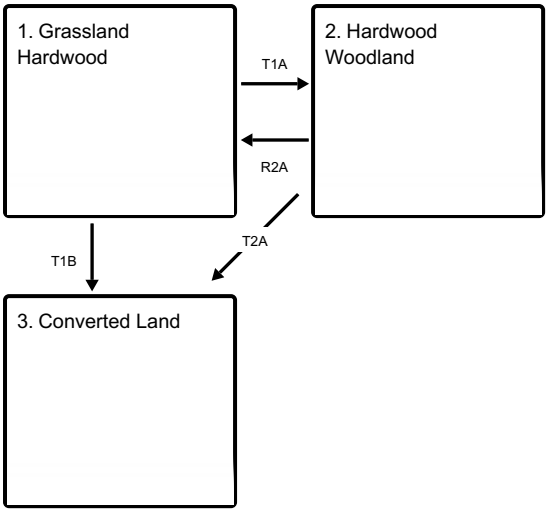
Oaks (Quercus spp.), pecan (*Carya illinoinensis*), hackberry (Celtis spp.), and elms (Ulmus spp.) dominate the hardwood overstory, eventually creating over 50 percent canopy, especially near the watercourse. Ashe juniper, mesquite, and western soapberry (*Sapindus saponaria* var. drummondii) are the most aggressive invaders, often forming almost closed canopies under the hardwood overstory. Midgrasses and cool-season grasses and forbs are in weakened condition due to shading and competition for moisture and nutrients. Without management intervention, woody cover can exceed 90 percent and primary production is from low-quality trees, shrubs, forbs, and grasses. Desertification, including erosion, continues in the interspaces until maximum ground cover by woody species is approached. Once canopy cover reaches the maximum potential, the hydrologic processes, energy flow, and nutrient cycling stabilize under the woodland environment. In this condition, the woodland community is stable but provides only poor forage for livestock and low-quality deer habitat.

Major expense and energy are required to restore the Hardwood Woodland Community (2.1) to the reference plant community. Generally, broadcast treatments, such as dozing or aerial spraying and replanting followed by grazing deferment, prescribed grazing and prescribed burning, are essential for the site to return to the reference community. Soil and streambank erosion during the retrogression process may preclude complete return.

During the settlement period of the 1800’s, the timber was cut for fuel and lumber and the site cultivated for food and fiber crops. Cultivation and cropping along with pasture planting creates a Converted Land State (3), greatly influenced by energy inputs by the land manager. Food and fiber crops were produced on many acres of the site for many years, generally depleting the soil of nutrients. During the last few decades, many acres of the Loamy Bottomland site have been converted from row crops to permanent pasture, creating a Pastureland Community. Some of the cropland has just been abandoned, left idle and let go back to native range. Those idled lands, and pastures that have not been maintained with proper grazing and brush management, are in various stages of re-infestation with invading species. The abandoned cropland areas are commonly called the Abandoned Land Community or Go Back Land Community (3.2).

State and transition model

Ecosystem states



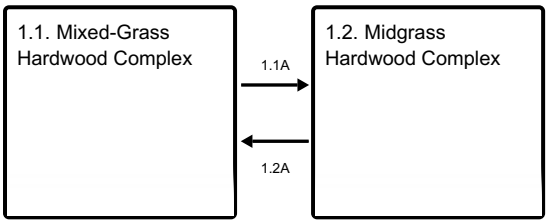
T1A - Absence of disturbance and natural regeneration over time, may be coupled with excessive grazing pressure

T1B - Extensive soil disturbance followed by seeding

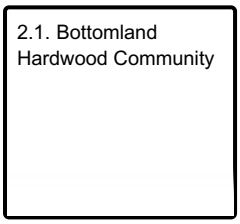
R2A - Reintroduction of historic disturbance return intervals

T2A - Extensive soil disturbance followed by seeding

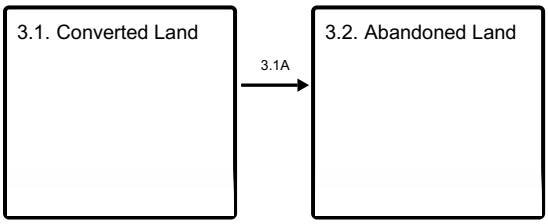
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Grassland Hardwood

Dominant plant species

- live oak (*Quercus virginiana*), tree
- netleaf hackberry (*Celtis laevigata var. reticulata*), tree
- little bluestem (*Schizachyrium scoparium*), grass
- switchgrass (*Panicum virgatum*), grass

Community 1.1

Mixed-Grass Hardwood Complex

Figure 8. 1.1 Mixed-Grass Hardwood Complex Community

The Mixed-Grass Hardwood Complex Community (1.1) supported hardwood woodland species along the edge of the watercourse and a mixture of tall and midgrasses, forbs, and shrubs on the adjacent terraced grassland. Pecan, live oak (*Quercus virginiana*), hackberry, elm, black willow (*Salix nigra*), western soapberry, and American sycamore (*Platanus occidentalis*) can be found along the stream bank and first bottom area, where recurring fires keep the woody species in check. Typical shrubs and vines found in this community include bumelia (*Sideroxylon lanuginosum*), elbowbush (Foresteria pubescens), wolfberry (Lycium spp.), grape (Vitis spp.), and greenbriar (Smilax spp.). Woody species decrease in density and canopy cover as the distance from the stream bank increases, taking on a savannah structure. This grassland woodland pattern varies depending on soil series, herbivory, and fire frequency. Fire is postulated to have occurred at 7 to 12-year intervals in this region. Tallgrasses, shrubs, and forbs thrived in the interspaces and beneath the trees, creating a complex pattern of grassland and woodland. A mixture of little bluestem, big bluestem, Indiangrass, switchgrass (*Panicum virgatum*), Eastern gamagrass (*Tripsacum dactyloides*), sideoats grama (*Bouteloua curtipendula*), and wildrye (Elymus spp.) dominate the grassland. Bundleflower (Desmanthus spp.), Engelmann's daisy (*Engelmannia peristenia*), hairy tubetongue (*Justicia pilosella*), and dalea (Dalea spp.) are important forbs. Numerous other perennial forbs, grasses, shrubs, and woody vines contribute to the excellent diversity of the understory vegetation. Switchgrass and Eastern gamagrass, along with numerous sedges (Carex spp.), spikerushes (Eleocharis spp.), flatsedges (Cyperus spp.), and shrub species, occurr along the streambank. These species have a positive effect on streambank stabilization during flooding events. The deep fertile soils and runoff from adjacent uplands and occasional flooding cause this site to be more productive than the surrounding ecological sites. Primary above ground production is mostly from the grassland component, ranging from 2,000 to 4,500 pounds per acre annually, depending on soils and summer growing season precipitation.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1793	2914	4035
Tree	224	364	504
Forb	112	182	252
Shrub/Vine	112	183	252
Total	**2241**	**3643**	**5043**

Figure 10. Plant community growth curve (percent production by month). TX3628, Grassland Hardwood Complex Community. Warm-season grassland influenced by tree shading and additional water from runoff and flooding..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	3	5	10	20	15	5	3	15	12	5	4

Community 1.2
Midgrass Hardwood Complex

Figure 11. 1.2 Midgrass Hardwood Complex Community

The Midgrass Hardwood Complex Community (1.2) reflects the effects of heavy abusive grazing on the more palatable species and the result of the suppression of fires. Excessive defoliation is detrimental to the more palatable tallgrasses and forbs and allows more grazing resistant midgrasses to increase. The defoliation also reduces standing foliage and litter, thereby creating bare ground susceptible to invasion of woody species previously repressed by competition or fires. Less preferred indigenous and invading woody plants increase in density and stature. The more palatable tall and midgrasses are being replaced by subdominants such as tall dropseed (*Sporobolus compositus* var. compositus), feathery bluestems (Bothriochloa spp.), bristlegrass (Setaria spp.), Texas wintergrass, less palatable forbs, and annuals. Mesquite, juniper, wolfberry, and algerita are common woody invaders. The hardwood trees, especially western soapberry, elm, and hackberry, also increase in density. Annual forage production is not significantly affected, but primary production is shifting to less palatable or more grazing resistant grasses and woody plants. Annual primary production ranges from 2,000 to 4,000 pounds per acre annually with 65 percent or more being produced by the grassland component. Nutrient cycling and water use are shifting toward the deeper-rooted woody perennials. Soil organic matter and litter are slightly less than in reference conditions. The grazing disturbance reduces ground cover, litter, and soil organic matter exposing soil to erosion. The transition to the woodland state can be reversed by implementing moderately intensive management practices like prescribed grazing and prescribed burning until the woody component reduces burning effectiveness. The threshold for this transition is generally between 30 and 40 percent woody plant cover. Burning effectiveness declines when there is not enough fine fuel produced by the grassland component to control or suppress the invading species. Once that threshold is breached, the Midgrass Hardwood Complex Community transitions to the Bottomland Hardwood Community (2.1).

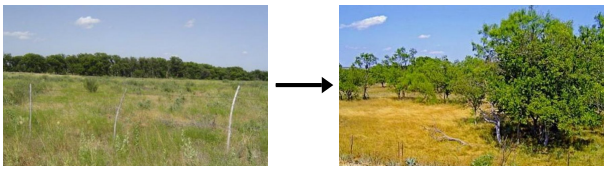
Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1345	2018	2690
Tree	448	673	897
Shrub/Vine	336	504	673
Forb	112	168	224
Total	**2241**	**3363**	**4484**

Figure 13. Plant community growth curve (percent production by month). TX3628, Grassland Hardwood Complex Community. Warm-season grassland influenced by tree shading and additional water from runoff and flooding..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	3	5	10	20	15	5	3	15	12	5	4

Pathway 1.1A
Community 1.1 to 1.2



Mixed-Grass Hardwood Complex

Midgrass Hardwood Complex

With heavy abusive grazing, no fire, no brush management, and invasion of brush species, the Mixed-grass Hardwood Complex Community shifts to the Midgrass Hardwood Complex Community.

Pathway 1.2A
Community 1.2 to 1.1

Midgrass Hardwood Complex

Mixed-Grass Hardwood Complex

Prescribed grazing, prescribed burning, brush management, and IPT are several conservation practices that can assist in reverting back to the Mixed-grass Hardwood Complex Community.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

State 2
Hardwood Woodland

Dominant plant species

- pecan (*Carya illinoinensis*), tree
- oak (*Quercus*), tree

Community 2.1
Bottomland Hardwood Community

Figure 14. 2.1 Bottomland Hardwood Community

Continued livestock grazing causes a shift from the Midgrass Hardwood Community (1.2) with 15 to 35 percent woody cover to a Bottomland Hardwood Community (2.1) having over 40 percent woody plant cover. During this retrogression process, there is a considerable decline in the grassland component compared to the reference community. With decreasing amounts of grass in the tree interspaces, there is a corresponding decrease in ground cover, litter, mulch, and soil organic matter. Soil structure deteriorates, and the exposed soil is subject to crusting and erosion. Considerable litter and soil losses occur during flooding events. With time and no tree or shrub control, the community will approach 100 percent canopy cover, especially along the watercourse. Pecan, oaks, hackberry and elms dominate the overstory. Pecan groves with inclusions of oaks, hackberry, and elm are typical on first and second terraces. Juniper, western soapberry, and mesquite often form dense thickets in the grassland areas, and over time in the woodland areas. As further succession takes place under continued overgrazing, shortgrasses and low-quality grasses and forbs replace the midgrasses. There is a major increase in undesirable woody shrubs such as algerita, condalia, and pricklypear (Opuntia spp). Texas wintergrass, three-awns (Aristida spp.), Hall's panicum (*Panicum hallii*), and buffalograss are common shortgrasses. Common forbs include aster (Aster spp.), ruellia (Ruellia spp.), croton (Croton spp.), broomweed (Gutierrezia spp.), Western ragweed, and prairie coneflower (*Ratibida columnifera*). Without major brush management and grazing management practices, the Bottomland Hardwood Community (2.1) cannot be reversed into a grassland state. The site will continue transition toward a dense woodland until plant community stabilizes with the climate and soil. The Bottomland Hardwood Community (2.1) represents a plant community without the disturbance of periodic fires. Without manipulation by humans it will remain a bottomland hardwood community having unique ecological processes. Without excessive grazing use by livestock or wildlife, it will proceed with woodland-based soil development, nutrient cycling, energy flow, and hydrologic functions. This community can provide unique woodland products and values. Although Bottomland Hardwood Community (2.1) provides good cover for wildlife, continued overgrazing by livestock or deer will cause the site to provide only limited preferred forage or browse for livestock or wildlife. Restoration will be necessary to regain livestock or wildlife values. Alternatives for restoration include, tree removal, brush management, and revegetation to return vegetation back to near reference condition followed by grazing management and prescribed fire to maintain the desired community.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	1121	1681	2242
Grass/Grasslike	560	841	1121
Shrub/Vine	448	673	897
Forb	224	336	448
Total	**2353**	**3531**	**4708**

Figure 16. Plant community growth curve (percent production by month). TX3630, Bottomland Hardwood Community. Warm season grassland influenced by tree shading and additional water from runoff and flooding..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	3	10	15	20	18	5	4	10	7	4	2

State 3
Converted Land

Dominant plant species

- kleingrass (*Panicum coloratum*), grass
- Bermudagrass (*Cynodon dactylon*), grass

Community 3.1
Converted Land

Many acres have been converted to cropland and pastureland in the past. Historically, most were cut for timber, posts, poles, or firewood. Cropping small acreages is still practiced for grain, hay, or winter small grain, either for

livestock grazing, grain harvesting, or planting for wildlife food plots. Irrigation is practiced where water is available. Abandoned cropland areas, or cleared areas, are often seeded to introduced species, such as bermudagrass (Cynodon spp.) or Kleingrass (*Panicum coloratum*). Herbage production on those seeded to adapted introduced grasses or native grasses reach peak production within a few years, if a full stand is established. In this case, herbage production will equal reference conditions if species such as big bluestem or switchgrass are seeded. The practice of including adapted legumes or other forbs will enhance productivity and usefulness, especially for wildlife. Irrigation will boost forage production where available. Invasion of the seeded fields by brush species such as mesquite, pricklypear (Opuntia spp.), condalia (Condalia spp.), willow baccharis (Baccharis spp.), Texas persimmon and juniper are common. Drought and reduced soil cover due to cropping or grazing coupled with a nearby seed source trigger the invasions. The shrubs are established by seeds brought in by animals, water, or wind. The invading brush must be controlled with grazing management, prescribed burning, or other brush management methods. Many fields, however, have been abandoned and let go back to native range or planted to introduced grasses for pasture.

Figure 18. Plant community growth curve (percent production by month). TX3600, Cool Season Crops. Cool season species are planted in the fall for winter and spring growth. Species include wheat and oats..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5	5	10	10	5	0	0	0	20	25	15	5

Figure 19. Plant community growth curve (percent production by month). TX3601, Warm Season Crops. Warm season species are planted in early spring. Their peak growth is in late May with a lesser peak in September. Forage and Grain sorghum that are planted during the warm season months..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	20	25	20	10	10	5	2	0	0

Figure 20. Plant community growth curve (percent production by month). TX3613, Reclaimed Land. Reclaimed Land seeded with native or introduced species..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	3	5	13	22	15	5	3	15	7	5	4

Community 3.2
Abandoned Land

Figure 21. 3.2 Abandoned Land Community

Abandoned or go back land is a local name used to describe cropland fields that have been abandoned and are undergoing secondary succession. Many areas of Loamy Bottomland cleared of timber and cultivated by settlers in conjunction with the associated uplands. The abandoned cropland will be invaded by brush from the adjacent rangelands. The initial composition of abandoned fields are annual, biennial, and weak perennial grasses and forbs. The species depends on the seed source from adjacent rangeland or flood deposition. Willow baccharis, mesquite,

Texas persimmon, and juniper are common early invaders. The rate of succession depends on grazing management and drought frequency. Without grazing management and brush management, brush species such as mesquite and juniper will dominate before a reference grass community can be established. Brush management and grazing management are required if the goal is restoration of the reference community. Without management inputs to control woody plants, most of the herbage produced in early stages of succession is from annual grasses and forbs, while in the latter stages of succession by woody invaders.

Table 9. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	740	1356	1973
Forb	404	740	1076
Shrub/Vine	135	247	359
Tree	67	123	179
Total	**1346**	**2466**	**3587**

Figure 23. Plant community growth curve (percent production by month). TX3619, Midgrass/Mixedbrush Community. Midgrass and Mixedbrush summer growth with some cool season grass growth..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	3	7	13	20	15	7	5	10	7	5	5

Pathway 3.1A
Community 3.1 to 3.2

Abusive grazing, no fires, no brush management, no pasture/cropland management, abandonment, and idled land shifts the community from Converted Land Community to Abandoned Land Community.

Transition T1A
State 1 to 2

Heavy abusive grazing, no brush management, and no fires contribute to the shift from the Grassland Hardwood State to the Hardwood Woodland State.

Transition T1B
State 1 to 3

Brush management, pasture planting, range planting, and crop cultivation speeds up the shift from the Grassland Hardwood State to the Converted Land State.

Restoration pathway R2A
State 2 to 1

Prescribed grazing, brush management, IPT, range planting, and prescribed burning are various conservation practices to revert back to Grassland Hardwood State from the Hardwood Woodland State.

Conservation practices

Brush Management
Prescribed Burning
Range Planting
Native Plant Community Restoration and Management
Prescribed Grazing

Transition T2A
State 2 to 3

Brush Management, pasture planting, range planting, and crop cultivation can shift from the Hardwood Woodland State to the Converted Land State.

Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
0	**Tallgrass**			224–504	
1	**Tallgrasses**			336–757	
	big bluestem	ANGE	*Andropogon gerardii*	336–757	–
	switchgrass	PAVI2	*Panicum virgatum*	336–757	–
	Indiangrass	SONU2	*Sorghastrum nutans*	336–757	–
	eastern gamagrass	TRDA3	*Tripsacum dactyloides*	336–757	–
2	**Midgrasses**			560–1261	
	sideoats grama	BOCU	*Bouteloua curtipendula*	560–1261	–
	plains lovegrass	ERIN	*Eragrostis intermedia*	560–1261	–
	Texas cupgrass	ERSE5	*Eriochloa sericea*	560–1261	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	560–1261	–
	white tridens	TRAL2	*Tridens albescens*	560–1261	–
3	**Midgrasses**			224–504	
	beardgrass	BOTHR	*Bothriochloa*	224–504	–
	green sprangletop	LEDU	*Leptochloa dubia*	224–504	–
	large-spike bristlegrass	SEMA5	*Setaria macrostachya*	224–504	–
	southwestern bristlegrass	SESC2	*Setaria scheelei*	224–504	–
	Drummond's dropseed	SPCOD3	*Sporobolus compositus var. drummondii*	224–504	–
4	**Shortgrasses**			112–252	
	threeawn	ARIST	*Aristida*	112–252	–
	buffalograss	BODA2	*Bouteloua dactyloides*	112–252	–
	grama	BOUTE	*Bouteloua*	112–252	–
	fall witchgrass	DICO6	*Digitaria cognata*	112–252	–
	curly-mesquite	HIBE	*Hilaria belangeri*	112–252	–
	Hall's panicgrass	PAHA	*Panicum hallii*	112–252	–
5	**Cool-season grasses**			336–757	
	sedge	CAREX	*Carex*	336–757	–
	flatsedge	CYPER	*Cyperus*	336–757	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	336–757	–
	Canada wildrye	ELCA4	*Elymus canadensis*	336–757	–
	spikerush	ELEOC	*Eleocharis*	336–757	–
	Virginia wildrye	ELVI3	*Elymus virginicus*	336–757	–

	threeflower melicgrass	MENI	*Melica nitens*	336–757	–
	Texas wintergrass	NALE3	*Nassella leucotricha*	336–757	–
	western wheatgrass	PASM	*Pascopyrum smithii*	336–757	–
	Texas bluegrass	POAR	*Poa arachnifera*	336–757	–
Forb					
6	**Forbs**			112–252	
	Indian mallow	ABUTI	*Abutilon*	112–252	–
	prairie acacia	ACAN	*Acacia angustissima*	112–252	–
	leather flower	CLEMA	*Clematis*	112–252	–
	prairie clover	DALEA	*Dalea*	112–252	–
	zarzabacoa comun	DEIN3	*Desmodium incanum*	112–252	–
	bundleflower	DESMA	*Desmanthus*	112–252	–
	Engelmann's daisy	ENPE4	*Engelmannia peristenia*	112–252	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	112–252	–
	Gregg's tube tongue	JUPI5	*Justicia pilosella*	112–252	–
	dotted blazing star	LIPU	*Liatris punctata*	112–252	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	112–252	–
	narrowleaf Indian breadroot	PELI10	*Pediomelum linearifolium*	112–252	–
	snoutbean	RHYNC2	*Rhynchosia*	112–252	–
	wild petunia	RUELL	*Ruellia*	112–252	–
	awnless bushsunflower	SICA7	*Simsia calva*	112–252	–
	globemallow	SPHAE	*Sphaeralcea*	112–252	–
	vervain	VERBE	*Verbena*	112–252	–
Shrub/Vine					
7	**Shrubs/Vines**			112–252	
	eastern redbud	CECA4	*Cercis canadensis*	112–252	–
	stretchberry	FOPU2	*Forestiera pubescens*	112–252	–
	desert-thorn	LYCIU	*Lycium*	112–252	–
	plum	PRUNU	*Prunus*	112–252	–
	littleleaf sumac	RHMI3	*Rhus microphylla*	112–252	–
	gum bully	SILA20	*Sideroxylon lanuginosum*	112–252	–
	grape	VITIS	*Vitis*	112–252	–
	common pricklyash	ZAAM	*Zanthoxylum americanum*	112–252	–
Tree					
8	**Trees**			224–504	
	pecan	CAIL2	*Carya illinoinensis*	224–504	–
	hackberry	CELTI	*Celtis*	224–504	–
	walnut	JUGLA	*Juglans*	224–504	–
	Texas mulberry	MOMI	*Morus microphylla*	224–504	–
	American sycamore	PLOC	*Platanus occidentalis*	224–504	–
	cottonwood	POPUL	*Populus*	224–504	–
	honey mesquite	PRGL2	*Prosopis glandulosa*	224–504	–
	oak	QUERC	*Quercus*	224–504	–

	live oak	QUVI	*Quercus virginiana*	224–504	–
	black willow	SANI	*Salix nigra*	224–504	–
	western soapberry	SASAD	*Sapindus saponaria var. drummondii*	224–504	–
	elm	ULMUS	*Ulmus*	224–504	–

Animal community

This site is used to produce domestic livestock and to provide habitat for native wildlife. Cow-calf operations are the primary livestock enterprise, although stocker cattle are also grazed. Sheep, Angora goats, and Spanish goats were formerly raised in large numbers. Sheep are still present in reduced numbers, while meat goats are now present in fairly high numbers. Boer goats have been introduced, either purebred or crossed with Spanish goats, to obtain a larger meat animal. Reports indicate that Boers do not browse as heavily as earlier breeds.

Sustainable stocking rates have declined drastically over the past 100 years due to deterioration of the reference plant community. An assessment of vegetation is needed to determine the site's current carrying capacity. Calculations used to determine livestock stocking rate should be based on forage production remaining after determining use by resident wildlife, then refined by frequent careful observation of the plant community's response to animal foraging.

A large diversity of wildlife is native to this site. In the reference plant community, migrating bison, grazing primarily during wetter periods, pronghorn, white-tailed deer and turkey were the more predominant herbivore species. With the subsequent transformation of the plant community, due primarily to the influence of man and climate change, the kind and proportion of wildlife species have been altered.

Except for a few domestic herds, bison have been eliminated. With the eradication of the screwworm fly, increase in woody vegetation and man-suppressed natural predation, deer numbers have increased and are often in excess of carrying capacity. Where deer numbers are excessive, overbrowsing and overuse of preferred forbs causes deterioration of the plant community. Progressive management of deer populations through hunting can keep populations in balance and provide an economically important ranching enterprise. Achieving a balance between brushy cover and more open plant communities on this and adjacent sites is important to deer management. Competition among deer, sheep, and goats must be a consideration in livestock and wildlife management to prevent damage to the plant community.

Various species of exotic wildlife have been introduced on the site, including deer such as axis, sika, fallow, and red; antelope such as sable, oryx, blackbuck, and nilgai, and sheep such as barbados (mouflon) and aoudad with various degrees of success. Their numbers must be included along with livestock and native wildlife, primarily white-tailed deer, in any management plan. Feral hogs may feed on the site. They can be damaging to the plant community if their numbers are not managed. Smaller mammals include many kinds of rodents, jackrabbit, cottontail, raccoon, ringtail, skunk, and armadillo. Mammalian predators include coyote, red fox, gray fox, bobcat, and mountain lion. Wolves were common in earlier times, bears resided in some areas, and an occasional jaguar or ocelot was encountered. Many species of snakes and lizards are native to the site.

Many species of birds are found on this site including game birds, songbirds, and birds of prey. Major game birds that are economically important are turkey, bobwhite quail, scaled (blue) quail and mourning dove. Turkeys prefer plant communities with substantial amounts of shrubs and trees interspersed with grassland. Quail prefer a combination of low shrubs, bunch grass (critical for nesting cover), bare ground, and low successional forbs. The different species of songbirds vary in their habitat preferences. Habitat on this site that provides a large diversity of grasses, forbs, and shrubs will support a good variety and abundance of songbirds. Birds of prey are important to keep the numbers of rodents, rabbits, and snakes in balance. Different species of raptors benefit from a diverse plant community as well.

Hydrological functions

The hydrology functions according to the existing plant community and its management. The water cycle functions most effectively when the site is dominated by mid and tall bunchgrasses. Rapid rainfall infiltration, high soil organic matter, good soil structure, and good porosity exist with a good cover of bunchgrass. Quality of surface runoff is high with low erosion and sedimentation levels. The higher infiltration rates facilitate water movement to deeper root

zones and below, contributing to the recharge of aquifers and sustained streamflow.

In case of loss of bunchgrass and ground cover, the hydrologic cycle is impaired. Infiltration is decreased and runoff is increased due to poor ground cover, rainfall splash, soil capping, low organic matter, and poor structure. Some infiltration can still occur due to surface cracking of the soil when dry. A sparse ground cover combined with heavy rainfall contributes to increased frequency of flooding in a watershed, accelerated soil erosion, poor surface runoff, and increased sedimentation.

As the site becomes dominated by woody species the water cycle is further altered. An increase of woody species is matched by a decline in grass cover, duplicating some of the results of heavy abusive grazing. Increased interception of rainfall by tree canopies and its subsequent evaporation reduces the amount of water reaching the surface. The funneling effect of the canopy produces higher stemflow, concentrating more soil moisture at tree bases. Increased transpiration reduces deep percolation. Brush management combined with good grazing management can help restore the natural hydrology of the site.

Recreational uses

The site is well suited for many outdoor recreational uses including recreational hunting, hiking, camping, and bird watching.
Most streams associated with the site provide water related recreational opportunities. The site, along with adjacent upland sites, provides diverse scenic beauty and many opportunities for recreating.

Wood products

Many kinds of lumber and wood products are made from the trees of the site. Bald cypress lumber is especially prized for its strength and durability. Pecan, juniper, mesquite, and oak are used for lumber, furniture, firewood, and charcoal.

Other products

Pecan production is often a profitable commercial enterprise. Seeds are harvested from many native 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 flowering plants.

Inventory data references

Five records were used from Crockett County. Information presented was derived from the revised Loamy Bottomland Range Site, literature, limited NRCS clipping data (417s), field observations, and personal contacts with range-trained personnel. Photos by J. L. Schuster.

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Rangeland health reference sheet

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

Author(s)/participant(s)	Joe Franklin, Zone RMS, NRCS, San Angelo, TX
Contact for lead author	325-944-0147
Date	12/15/2005
Approved by	Bryan Christensen
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None. Minimal evidence of past or present formation of rills except after recent floods.

2. **Presence of water flow patterns:** Few. Old water patterns are stable. Any formed after flooding stabilizing.

3. **Number and height of erosional pedestals or terracettes:** None to uncommon. Minimal pedestals or terracettes due to erosion except after recent flood.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Less than 10 percent bare ground. Small and non-connected areas except after recent flood.

5. **Number of gullies and erosion associated with gullies:** None to uncommon due to recent flood. Drainages are represented as stable channels. No signs of erosion and vegetation is common.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None to uncommon. Wind erosion hazard of soil is slight.

7. **Amount of litter movement (describe size and distance expected to travel):** Minimal movement of the litter for short distances during normal rainfall. Extensive movement of all classes of litter during extensive flooding.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Erosion stability values estimated at 4 to 6. Water erosion hazard of soil is moderate.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soils are grayish-brown silty clay loam to 50 inches, structure is fine granular and SOM is high.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The reference community provides good plant distribution and provides excellent infiltration. Under normal rainfall, runoff is essentially nil but when rainfall exceed sites ability to hold water the runoff is free of erosive action.

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

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

    Dominant:

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

    Other: Trees Shrub/Vines = Forbs = Warm-season shortgrasses

Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal. Grasses will almost always show some mortality and decadence, especially during drought conditions.

14. **Average percent litter cover (%) and depth (in):** Interspaces between plant canopies essentially covered with various sizes of litter and mulch.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 2,000 pounds per acre in years with below average moisture, 3,200 pounds per acre in average years and 4,500 pounds per acre in above average moisture years. Site may receive extra moisture from upslope sites and be highly productive in wet years.

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Mesquite, juniper, prickly pear, juniper, tobosagrass, whitebrush, salt cedar, baccharis, pecan, hackberry.

17. **Perennial plant reproductive capability:** Good. All species should be capable of reproducing except during periods of prolonged drought, heavy natural herbivory or intense fires. Recovery from these disturbances will take 2 to 5 years.