

# Ecological site R087BY007TX Loamy Bottomland

Last updated: 9/21/2023  
Accessed: 05/07/2024

## General information

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



Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

## MLRA notes

Major Land Resource Area (MLRA): 087B–Texas Claypan Area, Northern Part

This area is in northeastern Texas (79 percent) and southeastern Oklahoma (21 percent). It makes up about 4,480 square miles (11,610 square kilometers). The towns of Greenville, Sulphur Springs, Paris, Mount Vernon, Canton, and Athens, Texas, and Durant, Oklahoma, are in this MLRA. Interstates 30 and 20 and Highways 69, 70, 80, and 82 cross the area. The Caddo National Grasslands is in the north end of the area.

## Classification relationships

USDA-Natural Resources Conservation Service, 2006.  
-Major Land Resource Area (MLRA) 87B

## Ecological site concept

The Loamy Bottomlands have soils that are very deep loams and are associated with flooding regimes. The loamy-textured soils allow the water to drain faster than the Clayey Bottomlands, and therefore do not stay inundated as long.

## Associated sites

R087BY002TX	Claypan Savannah
R087BY003TX	Sandy Loam
R087BY005TX	Deep Sand

## Similar sites

R087AY011TX	Loamy Bottomland
-------------	------------------

Table 1. Dominant plant species

Tree	(1) <i>Quercus nigra</i>
Shrub	Not specified
Herbaceous	(1) <i>Carex</i> (2) <i>Elymus virginicus</i>

## Physiographic features

This site is nearly level to gently sloping and occurs along rivers and streams. Flooding occurs frequently on the sites.

Table 2. Representative physiographic features

Landforms	(1) Plains > Flood plain
Runoff class	Negligible to high
Flooding duration	Brief (2 to 7 days) to long (7 to 30 days)
Flooding frequency	Frequent
Ponding frequency	None
Elevation	76–229 m
Slope	0–1%
Water table depth	0–30 cm
Aspect	Aspect is not a significant factor

## Climatic features

The average annual precipitation is 47 inches in most of this area, but it can be higher or lower depending on the exact location. Most of the rainfall occurs in spring and winter. The average annual temperature is 62 to 66 degrees F. The freeze-free period averages 235 days and frost-free period averages 210 days.

Table 3. Representative climatic features

Frost-free period (average)	210 days
Freeze-free period (average)	235 days
Precipitation total (average)	1,194 mm

## Climate stations used

- (1) LAKE FORK RSVR [USC00414976], Quitman, TX
- (2) MT VERNON [USC00416119], Mount Vernon, TX
- (3) BOSWELL 1 S [USC00340980], Boswell, OK

- (4) EMORY [USC00412902], Emory, TX
- (5) MT PLEASANT [USC00416108], Mount Pleasant, TX
- (6) DURANT [USC00342678], Durant, OK
- (7) CLARKSVILLE 2NE [USC00411772], Clarksville, TX
- (8) PARIS [USC00416794], Paris, TX
- (9) BONHAM 3NNE [USC00410923], Bonham, TX
- (10) DENISON DAM [USC00412394], Cartwright, TX

## Influencing water features

This site is adjacent to rivers and streams. It receives overflow from watercourses and runoff from higher adjacent sites.

## Wetland description

All soils in this site are hydric and may be wetlands, but onsite delineations are required to make certain.

## Soil features

The soils of this site are very deep, somewhat poorly drained, loamy textured, and moderately permeable. They usually receive extra water as overflow from watercourses or as runoff from adjacent higher sites. They are, however, better drained than the Clayey Bottomland sites. The plant-soil-water-air relationship is very favorable for plant growth. These factors, together with the natural fertility of the soil, favor high yields of good quality forage. Nahatche is the representative soil correlated to this ecological site. Other soils correlated to this site include: Ambia, Manco, Nahatche, Okay, and Oklared.

**Table 4. Representative soil features**

Parent material	(1) Alluvium–sandstone and shale
Surface texture	(1) Loam
Family particle size	(1) Loamy
Drainage class	Somewhat poorly drained
Permeability class	Moderate
Soil depth	203 cm
Available water capacity (0-101.6cm)	10.16–15.24 cm
Calcium carbonate equivalent (0-101.6cm)	0–5%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–10
Soil reaction (1:1 water) (0-101.6cm)	5.6–7.8

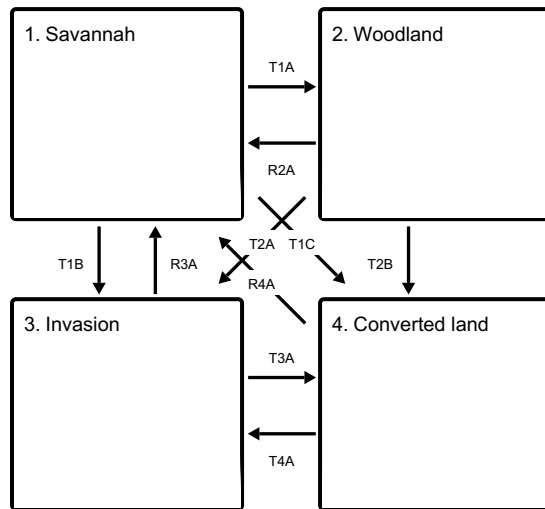
## Ecological dynamics

Natural fertility, presence of shade, proximity to water, and nutritious forage make this site a preferred grazing area. The wet nature of the site protects it from grazing at times, but during dry conditions it is often the first site to be overused. Virginia wildrye (*Elymus virginicus*), eastern gamagrass (*Tripsacum dactyloides*), switchcane (*Arundinaria gigantea*), switchgrass (*Panicum virgatum*), and sedges (*Carex* spp.) decrease in abundance and are replaced by dallisgrass (*Paspalum dilatatum*), common Bermudagrass (*Cynodon dactylon*), and carpetgrass (*Axonopus fissifolius*) as abusive grazing continues. Shrubs and hardwood saplings invade the site in the absence of proper grazing management and brush management. Prolonged mismanagement or abandonment allows the site to become a hardwood forest dominated by water oak (*Quercus nigra*), willow oak (*Quercus phellos*), overcup

oak (*Quercus lyrata*), and cedar elm (*Ulmus crassifolia*) on non-calcareous sites or green ash (*Fraxinus pennsylvanica*), cottonwood (*Populus* spp.), pecan (*Carya illinoensis*), cedar elm, and sugarberry (*Celtis laevigata*) on calcareous sites.

## State and transition model

### Ecosystem states



**T1A** - Heavy continuous grazing, no brush management, no fire

**T1B** - Invasion by invasive introduced species

**T1C** - Brush management, crop cultivation, pasture planting

**R2A** - Brush management, prescribed grazing, fire

**T2A** - Invasion by invasive introduced species

**T2B** - Brush management, crop cultivation, pasture planting

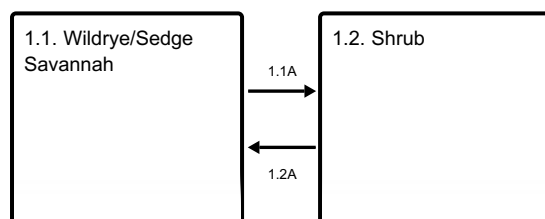
**R3A** - Brush management, invasive species control, range planting, prescribed grazing

**T3A** - Brush management, crop cultivation, pasture planting

**R4A** - Brush management, invasive species control, range planting, prescribed grazing

**T4A** - Invasion by invasive introduced species

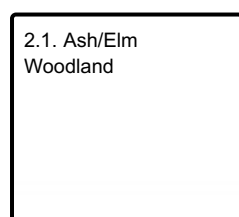
### State 1 submodel, plant communities



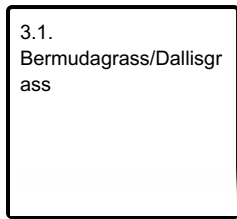
**1.1A** - Heavy continuous grazing, no brush management, no fire

**1.2A** - Brush management, prescribed grazing, fire

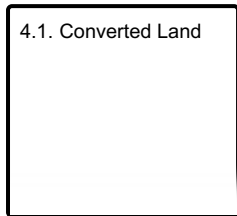
### State 2 submodel, plant communities



### State 3 submodel, plant communities



### State 4 submodel, plant communities



## State 1 Savannah

Two communities exist in the Savannah State: the 1.1 Wildrye/Sedge Savannah Community and the 1.2 Shrub Community. Community 1.1 is characterized by tall and midgrass dominating the understory, with 20 percent woody cover by ash and elm. Community 1.2 is characterized by an increase in shade tolerant grasses and 20 to 40 percent canopy cover of woody species.

### Community 1.1 Wildrye/Sedge Savannah

The reference plant community of this site is a savannah. Oak, elm, hackberry, cottonwood, ash, black willow (*Salix nigra*), pecan, and other large trees provide about a 20 percent canopy. The overstory canopy is denser immediately adjacent to the watercourse. The understory may include hawthorn (*Crataegus* spp.), greenbriar (*Smilax* spp.), Alabama supplejack (*Berchemia scandens*), peppervine (*Ampelopsis arborea*), grape (*Vitis* spp.), trumpet creeper (*Parthenocissus* spp.), and honeysuckle (*Lonicera japonica*). Sedges, Virginia wildrye, switchcane, broadleaf woodoats (*Chasmanthium latifolium*), and rustyseed paspalum (*Paspalum langei*) in shaded and wet areas dominate the herbaceous plant community. Various combinations of beaked panicum (*Panicum anceps*), switchgrass, Indiangrass, big bluestem (*Andropogon gerardii*) little bluestem (*Schizachyrium scoparium*), eastern gamagrass, vine mesquite (*Panicum obtusum*), and Florida paspalum (*Paspalum floridanum*) may dominate drier, open areas. Continuous yearlong grazing for a succession of years will tend to move the reference herbaceous plant community towards a herbaceous community of common Bermudagrass, dallisgrass, Vasey's grass (*Paspalum urvillei*), carpetgrass, giant ragweed (*Ambrosia trifida*), and annual sumpweed (*Iva annua*). Prescribed grazing may shift this herbaceous community back towards the reference herbaceous species. Continuous yearlong grazing with no weed or brush management or abandoning the site for several years will tend to move towards a shrub-sapling community. Once woody shrubs and saplings invade the site, brush management in some form must be used to move back toward the Savannah State. Prescribed burning is not a viable management tool on this site due to excess fine fuel moisture.

### Community 1.2 Shrub

The plant community develops in the absence of proper grazing management and mechanical or chemical brush control treatments. It is usually the result of abandonment following cropping or yearly continuous grazing. Trees and shrubs begin to replace the grassland component of the savannah community. In addition to the naturally occurring cedar elm, water oak, hackberry, pecan, cottonwood, and green ash - honey locust (*Gleditsia triacanthos*), Chinese tallow (*Sapium sebiferum*), and eastern persimmon (*Diospyros virginiana*) increase in density and canopy coverage (20 to 40 percent). Species whose seeds are windblown (elm, cottonwood, ash) or animal dispersed (persimmon, pecan, Chinese tallow) are the first to colonize and dominate the site. Remnants of Virginia wildrye and eastern gamagrass may still occur but the herbaceous component of the community becomes dominated by lesser producing grasses and forbs. Shade-tolerant species such as broadleaf woodoats, longleaf woodoats

(*Chasmanthium sessiliflorum*), Cherokee sedge (*Carex cherokeensis*), ironweed (*Veronia baldwinii*), buttercup (*Ranunculus* spp.), and goldenrod (*Solidago* spp.) are the most abundant species as canopy cover increases. Prescribed burning is not a viable option for returning this community to a savannah due to the moisture content and lack of quantity of the herbaceous fine fuel. Mechanical or chemical brush control as well as prescribed grazing must be applied to move this vegetative state back towards the reference plant community.

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

The Wildrye/Sedge Savannah will transition to the Shrubland Community when continued heavy grazing pressure, no brush management, and/or field abandonment continues. The transition is evident when woody species canopy cover exceeds 20 percent and grasses shift composition to more shade-tolerant species.

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

Restoration back to the Wildrye/Sedge Community requires brush management and prescribed grazing. Mechanical or chemical controls can be used to remove the woody species and shrubs. Prescribed grazing may require destocking and/or deferment.

## **State 2** **Woodland**

One community exists in the Woodland State, the Ash/Elm Woodland Community. It is characterized by shade tolerant grasses and an overstory canopy of 40 to 80 percent.

### **Community 2.1** **Ash/Elm Woodland**

This plant community is a closed overstory (40 to 80 percent) woodland dominated by green ash, cedar elm, overcup oak, water oak, willow oak, pecan, cottonwood, sycamore (*Plantanus occidentalis*), and black willow. Understory shrubs and sub-shrubs include yaupon, farkleberry (*Vaccinium arboreum*), possumhaw (*Ilex decidua*), American beautyberry (*Callicarpa americana*), and hawthorn (*Crataegus* spp.). Woody vines also occur and include Alabama supplejack (*Berchemia scandens*), poison ivy (*Toxicodendron radicans*), grape (*Vitis* spp.), greenbrier (*Smilax* spp.), trumpet creeper, Virginia creeper (*Parthenocissus quinquefolia*), and peppervine (*Ampelopsis arborea*). The herbaceous understory is composed of shade-tolerant species including longleaf woodoats, broadleaf woodoats, sedges, ironweed, and ice plant (*Verbesina lindheimeri*). Switchcane, eastern gamagrass, and goldenrod may occur in small amounts. Prescribed fire is not a viable treatment option for conversion of this site back to a semblance of the Wildrye/Sedge Savannah because of lack of fine fuel and high fine fuel moisture. Chemical brush control on a large scale is not a treatment option, however, individual plant treatment with herbicides on small acreages may be a viable option. Mechanical treatment of this site, along with seeding, is the most viable treatment option although probably not economical.

## **State 3** **Invasion**

One community exists in the Invasion State, the Bermudagrass/Dallisgrass Community. It is characterized by an invasion by tame pasture grasses. The invasive species may have been planted for agriculture purposes or they may have invaded from nearby pastures.

### **Community 3.1** **Bermudagrass/Dallisgrass**

The herbaceous community is dominated by common Bermudagrass, dallisgrass, Vasey's grass, carpetgrass, giant ragweed, and annual sumpweed. White clover (*Trifolium repens*), vetch (*Vicia sativa*), and annual ryegrass (*Lolium multiflorum*) may also occur. This community develops from years of heavy continuous grazing. Prescribed grazing may shift this community back towards the Wildrye/Sedge Savannah Community, but total restoration may not be

possible as invasive species are hard to control.

## **State 4**

### **Converted land**

The Converted Land State contains one community, the 4.1 Converted Land Community. The state is characterized by the land manager farming crops or planted grasses.

### **Community 4.1**

#### **Converted Land**

Conversion of this site to cropland (primarily cotton) occurred from the middle 1800's to the early 1900's. Some remains in cropland today, typically cotton (*Gossypium* spp.), corn (*Zea mays*), sorghum (*Sorghum* spp.), and soybeans (*Glycine max*). Ditching, land leveling, and levee construction has significantly changed the topography and hydrology on many acres of this site. While restoration of this site to a semblance of the reference plant community is possible with seeding and prescribed grazing, complete restoration of the reference community in a reasonable time is very unlikely. Following crop production, this site is often planted to native or introduced grasses and legumes for livestock grazing or hay production. Typical species planted include improved Bermudagrass varieties, bahiagrass, switchgrass, dallisgrass, eastern gamagrass, annual ryegrass (*Lolium multiflorum*), and white clover. Many of the introduced species (bahiagrass, Bermudagrass, and dallisgrass) are invasive - moving by wind, water, and animals. Once established, they are extremely difficult to remove and will hinder the reestablishment of native species. The establishment and maintenance of these species requires cultivation, fertilization, weed control, and prescribed grazing management.

#### **Transition T1A**

##### **State 1 to 2**

The Savannah State will transition to the Woodland State when continued heavy grazing pressure, no brush management, and/or field abandonment continues. The transition is evident when woody species canopy cover exceeds 40 percent and grasses shift composition to more shade-tolerant species.

#### **Transition T1B**

##### **State 1 to 3**

The Savannah State will transition to the Invasion State when continuous, yearlong heavy grazing occurs, coupled with the invasion of species like Bermudagrass and Dallisgrass.

#### **Transition T1C**

##### **State 1 to 4**

The transition to the Converted State occurs when the site is plowed for planting crops or pasture. The driver for the transition is the land manager's decision to farm the site.

#### **Restoration pathway R2A**

##### **State 2 to 1**

Restoration back to the Savannah State requires substantial energy inputs. Brush management and prescribed grazing will be needed to shift the community back to the reference state. Mechanical or chemical controls can be used to remove the woody overstory species back below 20 percent. Prescribed grazing may require destocking and/or deferment to manage the understory grasses back to those found in the reference community.

#### **Transition T2A**

##### **State 2 to 3**

The Woodland State will transition to the Invasion State when invasion by species like Bermudagrass and Dallisgrass occur. These species will invade from nearby pastures and compete with native vegetation.

## **Transition T2B**

### **State 2 to 4**

The transition to the Converted State occurs when the site is plowed for planting crops or pasture. The driver for the transition is the land manager's decision to farm the site.

## **Restoration pathway R3A**

### **State 3 to 1**

Restoration back to the Savannah State requires substantial energy inputs. If woody species are present, chemical or mechanical brush management will be required. Range planting may be required if invasive species have taken over completely. Total restoration back to the reference community may not be possible due to the challenge of completely removing invasive species from the community.

## **Transition T3A**

### **State 3 to 4**

The transition to the Converted State occurs when the site is plowed for planting crops or pasture. The driver for the transition is the land manager's decision to farm the site.

## **Restoration pathway R4A**

### **State 4 to 1**

The restoration to State 1 can occur when the land manager ceases agronomic practices. Range planting of native species found in the reference community will be required to bring back a similar community as the State 1 plant composition. The extent of previous soil disturbances will determine how much seedbed preparation will be needed, as well as the ability to be restored. Proper grazing and brush management will be required to ensure success.

## **Transition T4A**

### **State 4 to 3**

The Converted Land State will transition to the Invasion State when continued heavy grazing pressure, no brush management, and/or field abandonment occurs. The transition is evident when forbs, shrubs, and woody species begin to limit the production of planted crops or pasture grasses.

## **Additional community tables**

### **Animal community**

Historically, the Loamy Bottomland site provided habitat to bison, deer, turkey, migratory birds and large predators such as wolves, coyotes, mountain lions, and black bear. White-tailed deer, turkey, fox and gray squirrels, coyotes, bobcats, and migratory birds find suitable habitat in these savannahs today. The favorable moisture regime of this site attracts many species of wildlife during the hot dry summer months when the quality and quantity of forages on upland sites may be lacking. Where old mast producing oaks and pecan trees are present, this site provides habitat for deer, turkey, squirrels, and ducks - especially during the winter. As the savannah transitions through the various vegetative states, the quality of the habitat may improve for some species and decline for others. Management must be applied to maintain a plant community in optimum habitat quality for the desired animal species.

### **Hydrological functions**

Peak rainfall periods occur in May and June from frontal passage thunderstorms and in September and October from tropical systems as well as frontal passages. Rainfall amounts may be high (three to five inches per event) and events may be intense. The site is subject to erosion along adjacent stream banks where adequate herbaceous cover is not maintained and on heavy use areas such as roads and livestock trails. Extended periods (60 days) of little to no rainfall during the growing season are common. The site may be periodically inundated from overflow water from adjacent watercourses and may be ponded or saturated for long periods. This site may be a wetland or contain wetland inclusions as oxbows or stream meanders.



## Recreational uses

Hunting, camping, bird watching, and equestrian are popular activities.

## Wood products

Water oak and willow oak provides material for hardwood flooring, plywood, veneer, and cross-ties. Green ash is used for bats, tool handles, and furniture. Post oak and water oak are used for firewood. Rattan is used for furniture.

## Other products

Fruit from blackberries, grapes, and plums and nuts from pecans are harvested.

## Inventory data references

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

## Other references

1. Archer, S. 1994. Woody plant encroachment into southwestern grasslands and savannas: rates, patterns and proximate causes. In: Ecological implications of livestock herbivory in the West, pp. 13-68. Edited by M. Vavra, W. Laycock, R. Pieper. Society for Range Management Publication, Denver, CO.
2. Archer, S. and F.E. Smeins. 1991. Ecosystem-level Processes. Chapter 5 in: Grazing Management: An Ecological Perspective. Edited by R.K. Heitschmidt and J.W. Stuth. Timber Press, Portland, OR.
3. Bestelmeyer, B.T., J.R. Brown, K.M. Havstad, R. Alexander, G. Chavez, and J.E. Herrick. 2003. Development and use of state-and-transition models for rangelands. *J. Range Manage.* 56(2): 114-126.
4. Brown, J.R. and S. Archer. 1999. Shrub invasion of grassland: recruitment is continuous and not regulated by herbaceous biomass or density. *Ecology* 80(7): 2385-2396.
5. Foster, J.H. 1917. Pre-settlement fire frequency regions of the United States: a first approximation. Tall Timbers Fire Ecology Conference Proceedings No. 20.
6. Gould, F.W. 1975. The Grasses of Texas. Texas A&M University Press, College Station, TX. 653p.
7. Hamilton, W. and D. Ueckert. 2005. Rangeland Woody Plant Control: Past, Present, and Future. Chapter 1 in: Brush Management: Past, Present, and Future. pp. 3-16. Texas A&M University Press.
8. Scifres, C.J. and W.T. Hamilton. 1993. Prescribed Burning for Brush Management: The South Texas Example. Texas A&M University Press, College Station, TX. 245 p.
9. Smeins, F., S. Fuhlendorf, and C. Taylor, Jr. 1997. Environmental and Land Use Changes: A Long Term Perspective. Chapter 1 in: Juniper Symposium 1997, pp. 1-21. Texas Agricultural Experiment Station.
10. Stringham, T.K., W.C. Krueger, and P.L. Shaver. 2001. State and transition modeling: and ecological process approach. *J. Range Manage.* 56(2):106-113.
11. Texas Agriculture Experiment Station. 2007. Benny Simpson's Texas Native Trees (<http://aggie-horticulture.tamu.edu/ornamentals/natives/>).
12. Texas A&M Research and Extension Center. 2000. Native Plants of South Texas (<http://uvalde.tamu.edu/herbarium/index.html>).
13. Thurow, T.L. 1991. Hydrology and Erosion. Chapter 6 in: Grazing Management: An Ecological Perspective. Edited by R.K. Heitschmidt and J.W. Stuth. Timber Press, Portland, OR.
14. USDA/NRCS Soil Survey Manuals counties within MLRA 8BA.
15. USDA, NRCS. 1997. National Range and Pasture Handbook.
16. USDA, NRCS. 2007. The PLANTS Database (<http://plants.usda.gov>). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.
17. Vines, R.A. 1984. Trees of Central Texas. University of Texas Press, Austin, TX.
18. Vines, R.A. 1977. Trees of Eastern Texas. University of Texas Press, Austin, TX. 538 p.
19. Wright, H.A. and A.W. Bailey. 1982. Fire Ecology: United States and Southern Canada. John Wiley & Sons, Inc.

## Contributors

Mike Stellbaur  
Tyson Hart

## Approval

Bryan Christensen, 9/21/2023

## 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)	
Contact for lead author	
Date	05/07/2024
Approved by	Bryan Christensen
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

## Indicators

1. **Number and extent of rills:**

---

2. **Presence of water flow patterns:**

---

3. **Number and height of erosional pedestals or terracettes:**

---

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

---

5. **Number of gullies and erosion associated with gullies:**

---

6. **Extent of wind scoured, blowouts and/or depositional areas:**

---

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

---

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

values):

---

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

---

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

---

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

---

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:

Other:

Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

---

14. **Average percent litter cover (%) and depth ( in):**

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

---

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:**

---

17. **Perennial plant reproductive capability:**

---