USDA Natural Resources
Conservation Service

Ecological site F123XY002TN
Limestone Flats

Accessed: 09/27/2024

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.

MLRA notes

Major Land Resource Area (MLRA): 123X–Nashville Basin

123—Nashville Basin
This area is entirely in Tennessee (fig. 123-1). It makes up about 5,625 square miles (14,580 square kilometers). The cities of Nashville, Franklin, Hendersonville, Columbia, Murfreesboro, and Shelbyville are in this area.

Physiography
Most of this area is in the Nashville Basin Section of the Interior Low Plateaus Province of the Interior Plains. A small part of the northeast corner and the western and southern fourth of the area are in the Highland Rim Section of the same province and division. Most of the outer part of the Nashville Basin is deeply dissected and consists of steep slopes between narrow, rolling ridgetops and narrow valleys. The inner part of the basin is dominantly undulating and rolling. In many areas the land surface is deeply pitted by limestone sinks, and outcrops of limestone are almost everywhere. Elevation generally is about 650 feet (200 meters), but it is 1,000 to 1,325 feet (305 to 405 meters) on isolated hills and is as low as 450 feet (135 meters) in some of the more deeply cut stream channels.

Geology
The bedrock geology in this area consists of Ordovician limestone exposed by geologic erosion of the top of the Nashville Dome (a high part of the Cincinnati Arch) throughout this area. Sinkholes are common in the limestone and are either open to the subsurface or are covered by soils and colluvium that have collected in the depressions formed on the land surface above the sinkhole. Younger rocks occur as a rim just outside this area. Surficial deposits include loess on the less eroded landforms and alluvium along the rivers and streams.

Source: United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the
Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Classification relationships

Scientific Name: Central Interior Highlands and Appalachian Sinkhole and Depression Pond
Unique Identifier: CES202.018

Possible Association(s)-(field work needed to verify):
Quercus nigra - Quercus (alba, phellos) Floodplain Forest, CEGL004979

Ecological site concept

Central Interior Highlands and Appalachian Sinkhole and Depression Pond, CES202.018:
Summary: This system of ponds and wetlands is found in the Interior Highlands of the Ozark, Ouachita, and Interior

Low Plateau regions, and ranges north from the Southern and Central Appalachians to the northern Piedmont regions. Stands occur in basins of sinkholes or other isolated depressions on uplands. Soils are very poorly drained, and surface water may be present for extended periods of time, rarely becoming dry. Water depth may vary greatly on a seasonal basis and may be a meter deep or more in the winter. Some examples become dry in the summer. Soils may be deep (100 cm or more), consisting of peat or muck, with parent material of peat, muck or alluvium. Ponds vary from open water to herb-, shrub-, or tree-dominated. Tree-dominated examples typically contain Quercus species, Platanus occidentalis, Fraxinus pennsylvanica, Acer saccharinum, or Nyssa species, or a combination of these. In addition, Liquidambar styraciflua may be present in southern examples. Cephalanthus occidentalis is a typical shrub component. The herbaceous layer is widely variable depending on geography. (data source: www.explorer.natureserve.org)

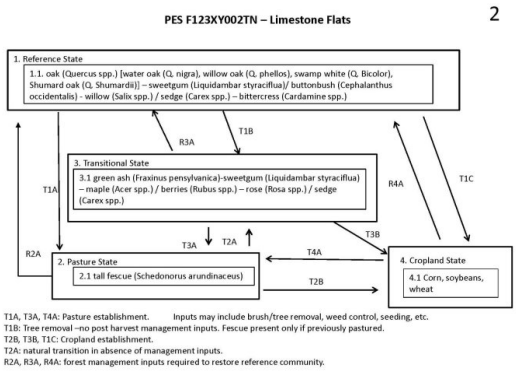

Figure 1.

Table 1. Dominant plant species

Tree	(1) *Quercus* (2) *Liquidambar styraciflua*
Shrub	(1) *Cephalanthus occidentalis* (2) *Salix*
Herbaceous	(1) *Carex* (2) *Cardamine*

Physiographic features

This ecosite is found in basin, hill, plateau, and upland landscapes in MLRA 123. NASIS lists the unique landforms for these mapunits as: depression, flat, hillslope, and stream terrace.

Table 2. Representative physiographic features

Landforms	(1) Depression (2) Flat (3) Stream terrace
Flooding duration	Long (7 to 30 days)
Flooding frequency	None to frequent
Ponding duration	Brief (2 to 7 days) to long (7 to 30 days)
Ponding frequency	None to frequent
Elevation	70–640 m
Slope	0–6%
Ponding depth	0–76 cm
Water table depth	0–130 cm

Aspect	Aspect is not a significant factor

Climatic features

Climate:
The average annual precipitation in this area is 48 to 57 inches (1,220 to 1,450 millimeters). The maximum precipitation occurs in midwinter and early in spring, and the minimum occurs in autumn. Rainfall primarily occurs during high-intensity, convective thunderstorms. Some snow occurs in winter, but it does not remain on the ground for long periods.
The average annual temperature is 56 to 60 degrees F (14 to 16 degrees C). The freeze-free period averages 210 days and ranges from 195 to 230 days. The longer freeze-free periods occur in the southern part of the area.

Source: United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Table 3. Representative climatic features

Frost-free period (average)	170 days
Freeze-free period (average)	194 days
Precipitation total (average)	1,397 mm

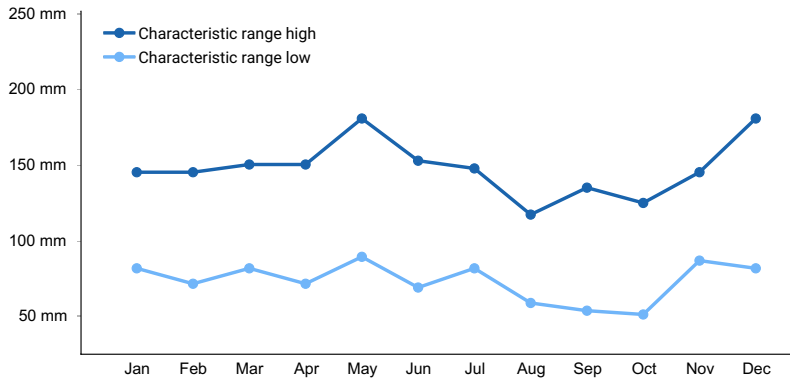

Figure 2. Monthly precipitation range

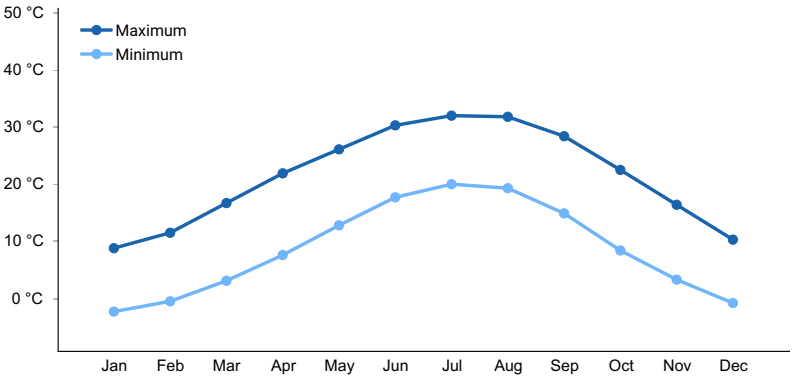

Figure 3. Monthly average minimum and maximum temperature

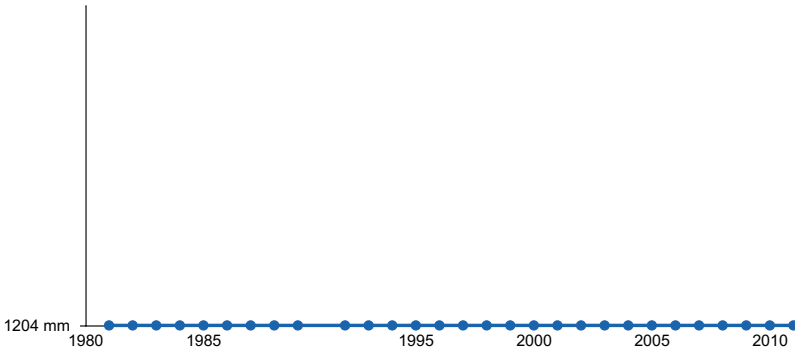

Figure 4. Annual precipitation pattern

Climate stations used

- (1) GAINESBORO [USC00403370], Gainesboro, TN
- (2) FAYETTEVILLE WTP [USC00403074], Fayetteville, TN
- (3) COLUMBIA 3 WNW [USC00401957], Columbia, TN
- (4) NASHVILLE INTL AP [USW00013897], Nashville, TN

Influencing water features

These sites have no influencing riparian or floodplain features.

Soil features

This initial PES grouping are soils found in depressions and flats. This group is moderately deep to deep and have very slow to moderate permeability. Most of the soils in this group are somewhat poorly to poorly drained. Capshaw and Bluestocking are moderately well drained soils and are included in this group until further field work can be conducted.

Future ESD development will likely result this group being split into multiple groups.

Table 4. Representative soil features

Parent material	(1) Alluvium–limestone
Surface texture	(1) Silt loam (2) Silty clay (3) Silty clay loam
Family particle size	(1) Loamy
Drainage class	Poorly drained to moderately well drained
Permeability class	Very slow to moderately rapid
Soil depth	56–152 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	7.87–19.56 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0

Soil reaction (1:1 water) (0-101.6cm)	5.3–6.7
Subsurface fragment volume <=3" (Depth not specified)	0–40%
Subsurface fragment volume >3" (Depth not specified)	0–2%

Ecological dynamics

Provisional Ecological Site (PES): F123XY002TN - Limestone Flats
Major Land Resource Area (MLRA) 123

This PES describes ecological communities likely to be found on soil in the PES soil grouping. Future field work is required to develop detailed and accurate ecological site descriptions (ESDs) that can be used by conservation planners for restoration and planning activities. This PES describes hypotheses based on available data from many different sources and has not been developed using site-specific ecological field monitoring. Future ESD development will result in this initial PES group being split into more refined ecological communities.

Soil series currently included in this project are Agee, Almaville, Bluestocking, Burgin Capshaw, Dowellton, Dunning, Eagleville, Godwin, Lanton, Minter, Norene, Roellen, Tupelo, and Woodmont.

Forest Vegetation as listed in Official Series Descriptions (OSDs):
Agee: Native vegetation was a mixture of canebrakes and hardwood trees including oak, sycamore, sweetgum, maple, willow and ash.
Almaville: Forested areas are chiefly in oaks, gums, hackberry, elms, redcedar, and hickory trees.
Bluestocking: The native vegetation was mixed hardwoods.
Burgin: no OSD found
Capshaw: A few areas are in woodland consisting of oak, hickory, maple, elm, hackberry, beech, dogwood, and red cedar.
Dowellton: Forests are oak, hickory, maple, elm, ash, and hackberry.
Dunning: Native forest is water-tolerant hardwoods such as red maple, sycamore, gums, boxelder, willow, pin oak, water oak, swamp white oak, and cottonwood, interspersed with glades of cane, grass, and sedge.
Eagleville: Native hardwoods including oak, hickory, elm, maple, sycamore, and ash; also much of these areas were in canebrakes in places.
Godwin: Native vegetation was hardwood forest.
Lanton: The original vegetation was hardwood forest.
Minter: Principal vegetation of wooded areas is bald cypress, oak, sweetgum, blackgum, water tupelo, and pine.
Norene: Native vegetation is water-tolerant hardwoods such as water oak, willow oak, American elm, sycamore, hackberry, red maple, sweetgum and eastern cottonwood.
Roellen: The native vegetation was mixed hardwood forest, chiefly of bottomland oaks, sycamore, sweetgum, willow, and green ash.
Tupelo: Forested areas are in oak, hickory, ash, sweetgum, and yellow poplar.
Woodmont: The native vegetation is mixed hardwoods.

Trees listed in NASIS for the mapunits in this PES grouping are as follows:
Agee: cherrybark oak, water oak, sweetgum, sycamore, cottonwood
Almaville: pin oak, southern red oak, loblolly pine
Bluestocking: tulip tree
Burgin: eastern cottonwood, sweetgum, swamp white oak
Capshaw: northern red oak, southern red oak, tulip tree, loblolly pine
Dowellton: water oak, sweetgum, loblolly pine
Dunning: swamp white oak, sweetgum, boxelder, red maple, eastern cottonwood (Dunning-Lindside loamy mapunit: tulip tree, white ash, black walnut)
Eagleville: water oak, swamp white oak, sweetgum, eastern cottonwood, green ash
Godwin: water oak, sweetgum, green ash, eastern cottonwood
Lanton: sweetgum, eastern cottonwood, loblolly pine

Minter: swamp white oak, sweetgum, green ash, overcup oak
Norene: red maple, eastern cottonwood, water oak, American sycamore, loblolly pine
Roellen: water oak, sweetgum, eastern cottonwood, cherrybark oak
Tupelo: swamp white oak, sweetgum, southern red oak, white oak, tulip poplar, American sycamore, loblolly pine
Woodmont: willow oak, cherrybark oak, sweetgum, white oak, tulip tree, shortleaf pine, loblolly pine.

Trees listed for PES map units in the USDA-NRCS Tennessee County Soil Surveys were water oak, willow oak, northern red oak, sweetgum, cherrybark oak, southern red oak, white oak, tulip poplar, American sycamore, eastern cottonwood, American elm, loblolly pine, shortleaf pine, and hackberry. Bottomland oaks (especially water oak), sweetgum, and tulip poplar were the most commonly recorded species for the PES soil group overall.

Only two tree species can be selected for entry into the ESIS database as dominants: however, multiple tree species can be dominant on these sites and it will vary by drainage, aspect, soil depth, seed sources, management, disturbance history, fire regime, micro-topography, etc.

Ecological Dynamics
This PES describes forest communities generally found on limestone flats in the Nashville Basin area of Tennessee. Most mapunits in this initial PES grouping range from somewhat poorly drained to very poorly drained A few mapunits of Capshaw and Bluestocking soils are also included in this group. These soils are moderately well drained and will exhibit more upland vegetation species compared to the poorly drained sites. Future field monitoring of high quality sites is required to develop ecological site descriptions (ESDs) to support future conservation planning. Multiple ESDs will likely be developed from this initial PES group.

State 1. (Reference)
State 1, Phase 1.1: Plant species dominants:
oak (Quercus spp.) [water oak (Q. nigra), willow oak (Q. phellos), swamp white (Q. Bicolor), Shumard oak (Q. Shumardii)] – sweetgum (Liquidambar styraciflua)/ buttonbush (Cephalanthus occidentalis) - willow (Salix spp.) / sedges (Carex spp.) – bittercress (Cardamine spp.)

Trees on these sites will be varied but include a mix of oaks and other hardwoods. Water oak, willow oak, white oak, Shumard oak, swamp white oak, pin oak, cherrybark oak, southern red oak (more common on moderately well drained soils such as Capshaw) and northern red oak are recorded by NRCS on these sites. Other species present may include tulip poplar, sweetgum, eastern cottonwood, green ash, red maple, American elm, hackberry, black gum, and American sycamore. Shrub and vine species are variable and may include dogwood (Cornus spp.), American black elderberry (Sambucus canadensis), and northern spicebush (Lindera benzoin). Buttonbush (Cephalanthus occidentalis) and black willow (Salix nigra) may be components on the wetter sites.

The herbaceous layer will be highly variable. Herbaceous species may include sweet woodreed (Cinna arundinacea), eastern woodland sedge (Carex blanda), Virginia wildrye (Elymus virginicus), violet woodsorrel (Oxalis violacea), bulbous bittercress (Cardamine bulbosa), eastern poison ivy (Campsis radicans), Bidens spp., Pennsylvania bittercress (Cardamine pensylvanica), and Virginia springbeauty (Claytonia virginica). Field verification during ESD development is necessary to better characterize this community.

State 2. Pastureland
State 2, Phase 2.1: Managed Pasture.
Plant species dominants: Schedonorus arundinaceus (tall fescue)

Plant species within pasture phases depend on seeding, management, and concurrent land uses. As with all sites, soil characteristics and management inputs will influence production levels.
Many species of warm-season or cool-season grasses are feasible for these sites. Common forage species include tall fescue, orchard grass, Johnson grass, and timothy. Management of pasture sites should follow conservation planning standards and protocols which will benefit water quality, forage production, and soil health.

Transitioning this state to a reference condition would likely require extensive and long-term timber stand improvement practices including control of non-native vegetation and management for desired native tree, shrub and understory species.

Hydrological modifications such as tiling and draining may be present on these sites.

State 3. Transitional
State 3, Phase 3.1: Plant species dominants: tulip poplar (Liriodendron tulipifera) – sweetgum (Liquidambar styraciflua)/ berries (Rubus spp.) – rose (Rosa spp.) /

Tree species would be dependent upon several factors including severity and duration of disturbance, adjacent plant communities, available seed sources, post-disturbance management (control of invasive plants, grazing, etc.). A wide range of hardwoods is possible and may include tulip poplar, maple, ash, locust, black cherry, elm, and if seed sources are nearby, oaks sweetgum. and hickories. Common shrubs would be berries, roses, and briars. Grasses, forbs and herbs would be highly dependent upon current and previous land use.

Transitioning this state to a reference condition will require timber stand improvement practices to control non-native vegetation and manage for higher quality oak or hickory species. Hydrological modifications such as tiling and ditching may be present on these sites and should be evaluated if restoration to the reference condition is the management goal.

State 4. Croplands
Dependent upon seeding and management. Corn and soybeans are common. Hydrological modifications such as tiling and draining are often present on these sites

Abandonment of cropland would result in weed species taking over the site. Dozens of species are possible depending on the seed sources. Initially annual weeds would predominate followed annual and perennial grasses, shrubs, and finally, pioneer tree species such as pines, eastern red cedar, locusts, maples, ashes, and tulip poplar. Restoration would be required to return this State to a reference community, including oak and hickory regeneration, control of non-native vegetation, and planting of native understory species. Protection from disturbance (grazing) and restoration of the natural hydrology would also be required.

State and transition model

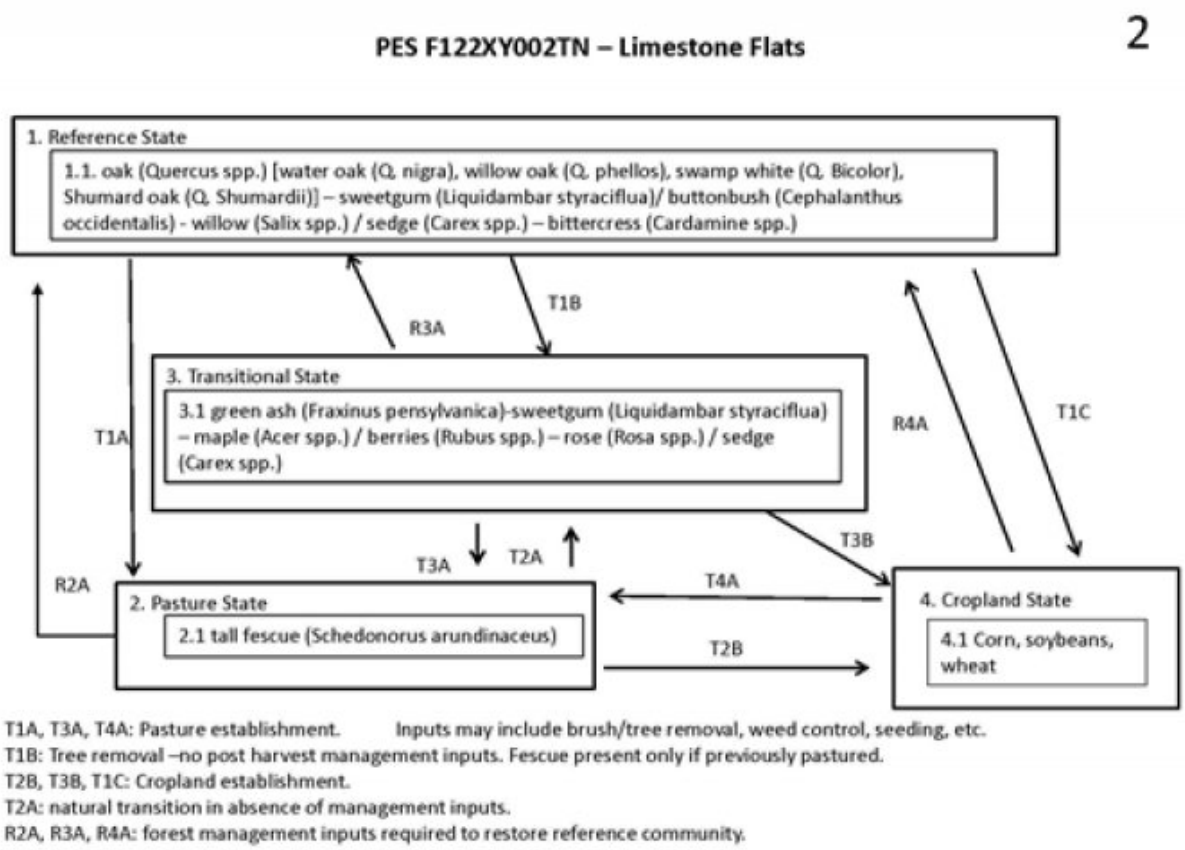

Figure 6. Limestone Flats MLRA 123

State 1
Forestland

This is the natural reference state of mixed oak hardwood forest. Species will vary depending on drainage, topography, and soils.

Community 1.1
Oak Forestland

This reference community is a oak-hickory or mixed oak hardwood forest.

State 2
Pastureland

This site is utilized as pasture and managed as such.

Community 2.1
Managed Pasture

This phase is a managed pasture. Management activities will depend on goals and objective of the landowner. Practices may include brush control, weed treatments, seeding, and fertilizing.

State 3

Transitional

In this STM, this state can be the result of major forest disturbance (logging, storm damage, fire) where the overstory trees have been removed or a natural progression from a managed pasture to an unmanaged pasture. Understory plants will differ

Community 3.1
Transitional (unmanaged) field

This phase is a successional state. In this STM, the transitional state could be either the result of forest disturbance (overstory removal by fire, logging or storm damage) or could be a natural transition from a pasture that is no longer being actively managed for forage.

State 4
Cropland

This is a managed cropland state. Species will be depended upon management objectives. Common crops include corn, soybeans, and tobacco.

Community 4.1
Cropland

This phase is a cropland that would be intensively managed for corn, soybeans, or other cash crops. These sites may have hydrological alterations such as tiling or draining to manage soil moisture.

Transition T1A
State 1 to 2

This is a transition from the oak forest reference state to a managed pastureland.

Transition T1B
State 1 to 3

This transition is from a oak forest to a transitional (successional) state resulting from large scale forest disturbance such as logging, storm damage, or fire. Species will vary depending on seed sources, type and length of disturbance, and previous land use.

Transition T1C
State 1 to 4

Restoration pathway R2A
State 2 to 1

This restoration pathway is from the pasture state to a oak forest. Long-term forest management would be required to accomplish this restoration. Multiple conservation practices would be applicable to this effort. Restoration of hydrology may be necessary and should be considered as part of the management plan.

Conservation practices

Brush Management
Tree/Shrub Site Preparation
Forest Stand Improvement
Invasive Plant Species Control
Forest Management Plan - Written
Forest Management Plan - Applied

Restoration pathway R3A
State 3 to 1

This restoration pathway is from the transitional (abandoned pasture) state to a oak forest. Long-term forest management would be required to accomplish this restoration to a fully functioning oak hardwood forest. Multiple conservation practices would be applicable to this effort. Restoration of hydrology may be necessary and should be considered as part of the management plan.

Conservation practices

Brush Management
Tree/Shrub Site Preparation
Upland Wildlife Habitat Management
Forest Stand Improvement
Invasive Plant Species Control
Forest Management Plan - Written
Forest Management Plan - Applied

Restoration pathway R4A
State 4 to 1

This restoration pathway is from the cropland state to a oak hardwood forest. Long-term forest management would be required to accomplish this restoration to a fully functioning oak forest. Multiple conservation practices would be applicable to this effort. Restoration of hydrology may be necessary and should be considered as part of the management plan.

Conservation practices

Brush Management
Tree/Shrub Site Preparation
Tree/Shrub Establishment
Forest Stand Improvement
Invasive Plant Species Control
Forest Management Plan - Written
Forest Management Plan - Applied

Additional community tables

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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)	
Contact for lead author	
Date	
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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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):**

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

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

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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):**

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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:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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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:**

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17. **Perennial plant reproductive capability:**
