

Ecological site F136XY700NC

Basic Upland Flats and Depressions, Expansive Clay, Seasonally Wet and Dry

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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.

MLRA notes

Major Land Resource Area (MLRA): 136X–Southern Piedmont

This MLRA is on a large piedmont underlain by metamorphic and igneous bedrock. It stretches from north-central Virginia to east-central Alabama, running parallel to the Appalachian highlands to the northwest and the Atlantic coast to the southeast. MLRA 136 has only subtle climatic differences with MLRA 148 (Northern Piedmont), with which it shares a common geologic origin. This adjacent MLRA sits to the north. Along the fall line, it shares a boundary with MLRA 133A (Southern Coastal Plain), MLRA 137 (Carolina and Georgia Sand Hills), and 133C (Gulf Coastal Plain). Here, unconsolidated Coastal Plain sediments intersect the much older Piedmont bedrock. Along its northwestern boundary, it sits adjacent to MLRAs 130B (Southern Blue Ridge), 130A (Northern Blue Ridge), and 128 (Southern Appalachian Ridges and Valleys). These MLRAs are distinguished from the Southern Piedmont by topographic and elevational differences, as well as differences in the age, origin, and degree of metamorphism of the underlying bedrock. Five states are intersected by the MLRA, including North Carolina (29 percent), Georgia (27 percent), Virginia (20 percent), South Carolina (17 percent), and Alabama (7 percent). The MLRA extent makes up about 63,720 square miles (165,034 square kilometers). MLRA PHYSIOGRAPHY The landscape is generally rolling to hilly, with a well-defined drainage pattern. Streams have dissected the original Piedmont plateau, forming narrow ridgetops, somewhat broad interfluves, and short, steep side slopes adjacent to the streams and drainageways. With some exceptions, the valley floors are generally narrow and make up about 10 percent or less of the land area. The associated stream terraces are generally small and of minor extent. The landscape is moderately dissected overall, with isolated erosional remnants (monadnocks) and other areas of high topographic relief interspersed. Over most of the MLRA, elevation ranges from approximately 325 to 1,315 feet (100 to 400 meters), with elevations generally increasing toward the Appalachian Highlands, in the upper Piedmont, and decreasing toward the Coastal Plain, in the lower Piedmont. The major rivers that cross this area en route to the ocean include, from north to south, the James, Roanoke, Cape Fear, Savannah, Altamaha, Chattahoochee, and Alabama Rivers. These rivers typically originate within the Piedmont or in the Blue Ridge. They flow east and south across the Coastal Plain and empty into the Atlantic Ocean or the Gulf of America. MLRA GEOLOGY Precambrian and Paleozoic metamorphic and igneous rocks underlie almost all of this MLRA. The dominant metamorphic rock types include gneiss, schist, slate, argillite, and phyllite, among others. Dominant igneous rock types include granite and other related felsic crystalline rocks. Mafic intrusive rocks, including gabbro, diabase, amphibolite, and other dark colored rocks, underlie a minority of the upland landscape. These mafic intrusions crop out in the form of dikes and sills, and often weather to produce soils high in base cations. The Carolina Slate Belt runs lengthwise through the east-central part of the MLRA, in southern Virginia, North Carolina, South Carolina, and the eastern-most part of the Georgia Piedmont. This region is underlain by fine-grained metasedimentary and metavolcanic rock, which generally weathers to produce soils high in silt. From Virginia to North Carolina, and in a single county in South Carolina, fault-bounded Triassic Basins are scattered amongst the igneous and metamorphic uplands. These basins are underlain by Triassic and Jurassic siltstone, shale, sandstone, and mudstone, which were laid down in response to continental rifting and subsequent erosion during the Mesozoic era. MLRA SOILS The dominant soil orders of the MLRA are Ultisols, Inceptisols, and Alfisols. Ultisols and Alfisols are typically found on more stable landforms, such as interfluves, gentle hillslopes, broad ridgetops, and stream terraces, while Inceptisols are typically found on less stable landforms, including flood plains, steep hillslopes, and narrow ridgetops. Soils of the region predominantly have a thermic temperature regime, a udic moisture regime, and generally have kaolinitic or mixed mineralogy. In the upper Piedmont of Virginia and North Carolina however, soils have a mesic soil temperature regime, as depicted in figure 2. The mesic soil temperature regime portion of the MLRA is oriented from northeast to southwest and occupies approximately 18 percent of the MLRA extent, or 11,729 square miles (30,377 square kilometers). Broadly speaking, soils of the Southern Piedmont uplands are shallow to very deep, well drained, and loamy or clayey. Soils of the river valleys are generally very deep, well to poorly drained, and loamy. Soils tend to be finer-textured than in Coastal Plain regions. MLRA CLIMATE In general, precipitation is evenly distributed throughout the year in this MLRA, with occasional drought-like conditions extending from late summer into autumn. During the growing season, most of the rainfall comes from high-intensity, convective thunderstorms. Significant moisture also comes from the movement of warm and cold fronts across the MLRA from November to April. High amounts of rain can also occur during hurricanes, usually during the months of August through October. Over most of the MLRA, snowfall is typically light, though overall, the mesic soil temperature regime portion of the MLRA features colder temperatures, more snowfall, and a shorter growing season than in the thermic

portion. The cooler climate in this region supports an increase in species with northern or Blue Ridge affinities. Both the mean annual temperature and the length of the freeze-free period increase from north to south and with decreasing elevation from the upper to the lower Piedmont. **MLRA LAND USE AND RESOURCES** Once largely cultivated, much of this region is now planted to loblolly pine or has reverted to successional pine and hardwood forests. The more productive lands support small to medium-size family farms that produce crops and livestock, while the less productive lands have been in forest for some time. Most of the open areas are used for grazing beef cattle, though in years past, dairy cattle were also important to the local economy. The principal crops of the region include corn, soybeans, and small grains. Burley tobacco remains a crop of local importance. Cotton is grown in the thermic soil temperature regime portion of the MLRA. Several major land cover transformations have occurred in the Southern Piedmont over the past several centuries; from open woodlands sculpted by fire, to farmland, to closed forests and planted pine, past land uses have played an outsized role in shaping present-day soils and vegetation patterns in the region. Land-use intensity peaked with the arrival of the industrial revolution, which gradually increased demand for textiles. Cotton became the dominant crop over much of the region. In spite of early successes, two centuries of poor management practices accelerated soil erosion, stripping away the fertility and moisture-supplying capacity of soils. In addition to soil losses in the uplands, legacy sediments derived from the eroded land rapidly accumulated in the river valleys below, often leading to changes in hydrology and flooding frequency. After being stripped of its loamy topsoil, many areas of the Piedmont had been so badly eroded as to render the land unsuitable or economically impractical for agriculture. The effects of erosion were widespread, with cumulative soil loss estimates ranging from 5 to 10 inches on average. The steeper slopes, which had often been cleared and farmed at the height of the Cotton era, generally suffered greater losses. By the 1930's, crop production was in rapid decline in the Southern Piedmont. The loss of soil productivity due to erosion, losses to the cotton boll weevil, development of synthetic fibers, and the onset of the Great Depression all contributed to rapid abandonment of cropland. By 1960, cropland acres had decreased by more than 50 percent in nearly every county in the Southern Piedmont. While crop production is still important today on the more productive lands, those of lower productivity, or those that were subject to severe erosion, were often abandoned some time ago. Typically, they have either reverted to forest, or have been converted to other uses. Although the productivity of soils was greatly reduced through erosion, less intensive land uses such as grazing and forestry were still feasible. These land uses gained popularity as patterns of urban migration, low commodity prices, and other factors gradually made crop production less economical on the marginal lands. In recent years, large-scale adoption of soil conservation practices have led to better outcomes with respect to erosion in much of MLRA, increasing the economic viability and long-term sustainability of Piedmont farms. Despite some success, water erosion remains one of the most important soil resource concerns in the MLRA. Other major resource concerns include increasing conversion of prime farmland and farmland of statewide importance to urban uses. Throughout the MLRA, metropolitan areas are expanding into lands that have historically been used for timber or agriculture. This change in land use is occurring rapidly in the corridor called the Piedmont Crescent, which extends from Atlanta, Georgia, to Raleigh, North Carolina. **HISTORIC VEGETATION COVER** Over most of the Southern Piedmont uplands, the historic oak-hickory, or oak-hickory-pine forest, once covered large portions of the landscape. It was dominated by upland oaks, such as white oak (*Quercus alba*), northern red oak (*Quercus rubra*), and southern red oak (*Quercus falcata*), with a smaller contribution from hickories (*Carya* spp.) and pines. The principal pine species are shortleaf pine (*Pinus echinata*), loblolly pine (*Pinus taeda*), and to the north and west, Virginia pine (*Pinus virginiana*). In the southernmost and easternmost portions of the MLRA, the historic montane longleaf pine forest, dominated by longleaf pine (*Pinus palustris*), shortleaf pine (*P. echinata*), and dry-site oaks, was found on ridgetops and steep south or west-facing slopes. According to historic accounts, forests and woodlands of the past were generally more open and park-like, having been exposed to a more frequent fire regime. Piedmont prairies, likely maintained by Native Americans, were also reportedly common across the landscape, as were fire-maintained canebrakes along the streams (Trimble 1974; Daniels 1987; Griffith et al. 2002; Van Lear et al. 2004; Dearman and James 2019; Schomberg et al. 2020; USDA-NRCS 2022).

LRU notes

MLRA 136 is one of the largest MLRAs in the United States. It has a broad north-south and east-west extent and covers a wide range of elevations. The MLRA is partitioned by the mesic-thermic line, which divides the MLRA into mesic and thermic soil temperature regimes (figure 2.). The mesic soil temperature regime was delineated based on estimates of the native range of loblolly pine, which was historically absent in this part of the MLRA. In addition, this region is said to represent the northern and western limits of cotton production, an important crop to the south and east. ESDs developed for this MLRA were split geographically into mesic and thermic ecological site concepts. Climate variation across the MLRA extent warrants the development of Land Resource Unit (LRU) classifications, to further subdivide the MLRA and support more precise Ecological Site Descriptions.

Classification relationships

APPLICABLE USNVC ASSOCIATIONS Cegl003558 *Quercus stellata* - (*Pinus echinata*) / *Schizachyrium scoparium* - Echinacea laevigata - *Oligoneuron album*; Cegl003711 *Quercus stellata* - (*Pinus echinata*) / *Schizachyrium scoparium* - *Symphyotrichum georgianum*; Cegl003714 *Quercus stellata* - *Quercus marilandica* - *Carya (carolinae-septentrionalis, glabra)* / *Schizachyrium scoparium*; Cegl007403 *Quercus phellos* / *Carex (albolutescens, intumescens, joorii)* / *Climacium americanum* APPLICABLE EPA ECOREGIONS Level III: 45. Piedmont Level IV: 45g. Triassic Basins; 45b Southern Outer Piedmont; 45c Carolina Slate Belt (EPA 2013). APPLICABLE USFS ECOLOGICAL UNITS Domain: Humid Temperate Division: Subtropical Ecological province: 231. Southeastern Mixed Forest Ecological sections: 231I. Central Appalachian Piedmont (Cleland et al. 2007). Based on the USGS physiographic classification system (Fenneman and Johnson 1946), most of MLRA 136 is in the Piedmont Upland section of the Piedmont province, in the Appalachian Highlands division.

Ecological site concept

This ecological site includes seasonally wet and seasonally dry circumneutral soils on upland flats, upland depressions, and at the heads of drainageways, in the thermic soil temperature regime portion of the MLRA. This ecological site is subject to wetting and drying cycles typical of "hydroxeric" conditions, due primarily to shrink-swell clay mineralogy and low relief. These sites are saturated or even ponded during the cooler months, but generally dry out by late spring. Soils on this ecological site are weathered from mafic intrusive rock. They are typically deep, poorly drained Mollisols or Alfisols, which formed in residuum from dark colored rocks high in ferromagnesian minerals. The subsoil has a high clay content and the clay fraction is dominated by 2:1 clay minerals. Base saturation is greater than or equal to 35 percent in the subsoil. A transient water table is present within 12 inches of the soil surface during the cooler months. Nevertheless, these wet conditions are temporary and the vegetation generally has a drier character than would be expected. Seasonally drier examples still, in which the water table remains well below the surface, are covered by PX136X00X710, a similar and often associated ecological site. The reference state supports an open to partially open canopy woodland with a species-rich herbaceous understory. Important canopy species include post oak (*Quercus stellata*), shortleaf pine (*Pinus echinata*), and willow oak (*Quercus phellos*). This ecological site is of small extent due to a unique set of edaphic and hydrologic conditions, but can support a diverse and distinctive herbaceous flora of prairie affinities. It is most common over mafic intrusions in the flatter terrain of Triassic basins, but it can also be found in other settings. Dominant land uses include pasture and hayland, cropland, wildlife habitat, and other land uses meant to conserve threatened plants and animals. Soils are poorly-suited to most building applications or septic system installations because of seasonal wetness and shrink-swell hazard. ES CHARACTERISTICS SUMMARY • Thermic soil temperature regime • Occurs on Piedmont uplands, on upland flats, upland depressions, and at the heads of drainageways • Parent materials: mafic intrusive rock • Base saturation: ? 35 percent in the subsoil • Seasonal high water table: perched, 0 - 12 inches from the soil surface • Soils: deep, poorly drained Mollisols or Alfisols • The subsoil has a high clay content and a high shrink-swell potential

Associated sites

F136XY710NC	Basic Upland Woodland, Expansive Clay, Seasonally Wet and Dry Found in slightly higher and drier landscape positions. Soils have a comparable shrink-swell potential, but the seasonal high water table is deeper (12-40 inches from the soil surface), supporting a relative increase in dry-site species, of which blackjack oak (<i>Quercus marilandica</i>) is most notable.
F136XY720NC	Basic Upland Forest, Moist Found in higher landscape positions. The seasonal high water table is much deeper (? 40 inches from the soil surface, usually deeper). The clay fraction is not dominated by shrink-swell clay minerals, reducing fluctuations in plant available water and allowing moisture-loving plant species to increase in abundance, of which northern red oak (<i>Quercus rubra</i>) is most notable.
F136XY410NC	Triassic Basin Upland Forest, Seasonally Wet Where associated, in the Triassic basins of the northern part of the MLRA, it is typically found in slightly higher landscape positions. Shrink-swell clay minerals do not dominate the clay fraction, reducing fluctuations in plant available water and allowing moisture-loving plant species to increase in abundance. Parent materials are Triassic sedimentary rock, which tend to produce soils that have a lower pH than similar soils weathered from mafic intrusive rock, thus supporting a relative decrease in basic indicator species in the understory.

Similar sites

F136XY200VA	Mesic Temperature Regime, Basic Upland Flats and Depressions, Expansive Clay, Seasonally Wet and Dry The soil temperature regime is mesic, occurring outside of the native range of loblolly pine (<i>Pinus taeda</i>).
F136XY800VA	Acidic Upland Depressions and Heads of Drains, Wet The geomorphic setting is similar, but soils weathered from acidic igneous or metamorphic rock. The subsoil is not dominated by shrink-swell clay minerals and has a base saturation less than 35 percent. Seasonal extremes in plant available water are less pronounced, significantly reducing cover from dry-site species such as post oak (<i>Quercus stellata</i>). These stands are comparatively less diverse.

F136XY710NC	Basic Upland Woodland, Expansive Clay, Seasonally Wet and Dry Soil properties are similar, but the seasonal high water table is deeper (12-40 inches from the soil surface). Cover from dry-site species tends to increase, of which blackjack oak (<i>Quercus marilandica</i>) is most notable.
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Figure 1. EPA level IV ecoregions of the Southern Piedmont (45).

Figure 2. Spatial illustration of soil temperature regimes of the Southern Piedmont.

Figure 3. Spatial extent of this ecological site representing the major areas where this site is important on the landscape.

Table 4. Dominant plant species

Tree	(1) <i>Quercus stellata</i> (2) <i>Pinus echinata</i>
Shrub	(1) <i>Viburnum</i>
Herbaceous	(1) <i>Schizachyrium scoparium</i> (2) <i>Echinacea laevigata</i>

Physiographic features

This ecological site is found on broad upland flats, smooth depressions, and at the heads of drainageways. It is often associated with the flatter terrain of Triassic basins, but it can occur in other settings, though generally those of comparably low relief. It is generally limited in extent to the northern half of the thermic soil temperature regime portion of the MLRA. Representative locations are nearly level, with a representative slope of 2 percent or less and a maximum slope of 3 percent.

The geologic substrate on this ecological site is mafic intrusive rock, such as diabase, gabbro, and other related dark colored rocks high in ferromagnesian minerals. The material was transported upward through fissures in the earth's crust in the form of mafic dikes and sills. These structures cut through the surrounding country rock. As a result, this ecological site often occurs in small patches, and is often adjacent to or surrounded by more acidic soils that formed in Triassic sedimentary rock or felsic crystalline rock.

Figure 1. Typical soil-landscape relationships of the Triassic Basin Soil System, where mafic intrusions are a common occurrence. Picture soils, which formed in mafic intrusive rock, are associated with this ecological site, depicted here on a broad interfluve.

Table 5. Representative physiographic features

Hillslope profile	(1) Summit (2) Toeslope
Landforms	(1) Piedmont > Flat (2) Piedmont > Depression (3) Piedmont > Drainageway
Runoff class	Very high

Flooding frequency	None
Ponding frequency	None
Elevation	220 – 240 m
Slope	0 %
Water table depth	20 – 30 cm
Aspect	Aspect is not a significant factor

Table 6. Representative physiographic features (actual ranges)

Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	200 – 250 m
Slope	0 %
Water table depth	0 – 30 cm

Climatic features

On this ecological site, the average mean annual precipitation is 46 inches. On average, the rainiest months occur in July and August, as well as in March. The driest months occur in April and May, with another dry period occurring from October through February.

Table 7 Representative climatic features

Frost-free period (characteristic range)	170-190 days
Freeze-free period (characteristic range)	200-220 days
Precipitation total (characteristic range)	1,170-1,190 mm
Frost-free period (actual range)	160-200 days

Freeze-free period (actual range)	190-230 days
Precipitation total (actual range)	1,140-1,220 mm
Frost-free period (average)	180 days
Freeze-free period (average)	210 days
Precipitation total (average)	1,170 mm

- (1) OXFORD AG [USC00316510], Oxford, NC
- (2) DURHAM [USC00312515], Durham, NC
- (3) FALLS LAKE [USC00312993], Raleigh, NC
- (4) ROXBORO 7 ESE [USC00317516], Roxboro, NC
- (5) CALHOUN FALLS [USC00381277], Calhoun Falls, SC
- (6) OXFORD 1 E [USC00316507], Oxford, NC
- (7) RALEIGH DURHAM INTL AP [USW00013722], Raleigh, NC

Influencing water features

This ecological site is not influenced by surface water features. A perched water table is present within 12 inches of the surface for some time during the months of November to April.

Wetland description

Under most circumstances, this ecological site would not be expected to meet wetland criteria. Due to unique edaphic factors, it does not typically support hydrophytic vegetation in proportions great enough to satisfy this requirement. If wetland conditions are suspected, a field visit is advisable to make a determination.

Soil features

Soils on this ecological site are typically deep, poorly drained Mollisols or Alfisols. Parent materials are residuum derived from mafic intrusive rock. The subsoil has a high clay content and the clay fraction is dominated by 2:1 clay minerals, namely montmorillonite or others in the smectite group. In representative pedons, subsoil layers have a very plastic, very sticky, and very firm consistence.

Reaction in the subsoil is typically moderately acid to neutral (pH 5.6 to 7.3). In the surface layers, reaction varies with land use and management. Under low input or forested conditions, it generally falls somewhere between pH 5.1 and 7.3. Base saturation is greater than or equal to 35 percent in the subsoil. These soils are typically in a fine particle size family.

As a result of their clay mineralogy, soils on this ecological site are subject to distinct wetting and drying cycles, fluctuations in plant available water, and seasonal periods of soil saturation and anaerobic conditions. Soils dominated by 2:1 clay minerals can store large volumes of water at field capacity. Soil water content can remain high for extended periods, typically during the winter and early spring. However, these clay minerals also hold on to water more tightly when they do dry out, leaving little water available to plants during dry periods.

The result is a water availability dynamic that alternates between being saturated and anaerobic during the cooler months, to being thoroughly parched during warm-season dry spells. These soil properties interact with landscape position and local hydrology to produce a continuum of soil moisture conditions, from predominantly dry to predominantly wet. This ecological site generally covers the wetter of these site conditions, though locally conditions can vary over short distances with microtopography (Buol et al. 2011).

Soils on this ecological site have a seasonal high water table between 0 and 12 inches of the mineral soil surface. The perched water table persists for periods long enough to leave behind redoximorphic features indicative of anaerobic conditions (i.e., iron and manganese depletions).

Soils on this ecological site have a thermic soil temperature regime, which is characterized by a mean annual soil temperature of 15°C to 22°C and a winter to summer temperature differential of 6°C or more in the subsoil.

Modal soil taxa include: Vertic Argiaquolls

Modal soil series include: Picture

Other soils attributed to this ecological site include Iredell Variant.

Figure 8. An illustration of a soil profile belonging to the Picture series, a representative soil series associated with this ecological site.

Figure 9. A soil profile of the Picture series.

Table 8. Representative soil features

Parent material	(1) Residuum – diabase (2) Residuum – gabbro (3) Residuum – amphibolite
Surface texture	(1) Loam (2) Fine sandy loam (3) Sandy loam
Family particle size	(1) Fine
Drainage class	Poorly drained
Permeability class	Very slow
Depth to restrictive layer	120 – 150 cm
Soil depth	120 – 150 cm
Surface fragment cover ≤3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-203.2cm)	17.78 – 22.86 cm
Soil reaction (1:1 water) (0-25.4cm)	5.1 – 7.3

Subsurface fragment volume <=3" (0-203.2cm)	0 – 10 %
Subsurface fragment volume >3" (0-203.2cm)	Not specified

Table 9. Representative soil features (actual values)

Drainage class	Poorly drained
Permeability class	Very slow
Depth to restrictive layer	120 – 2,540 cm
Soil depth	120 – 200 cm
Surface fragment cover <=3"	0 %
Surface fragment cover >3"	0 %
Available water capacity (0-203.2cm)	15.24 – 25.4 cm
Soil reaction (1:1 water) (0-25.4cm)	5.1 – 7.8
Subsurface fragment volume <=3" (0-203.2cm)	0 – 20 %
Subsurface fragment volume >3" (0-203.2cm)	0 %

Ecological dynamics

U.S. National Vegetation Classification (USNVC) associations that are consistent with reference conditions on this ecological site include CEGLO03558 *Quercus stellata* - (*Pinus echinata*) / *Schizachyrium scoparium* - *Echinacea laevigata* - *Oligoneuron album*, CEGLO03711 *Quercus stellata* - (*Pinus echinata*) / *Schizachyrium scoparium* - *Symphytotrichum georgianum*, or CEGLO03714 *Quercus stellata* - *Quercus marilandica* - *Carya (carolinae-septentrionalis, glabra)* / *Schizachyrium scoparium*. Another association, CEGLO07403 *Quercus phellos* / *Carex (albolutea, intumescens, joorii)* / *Climacium americanum* may apply to examples with a slightly longer hydroperiod and with less acute seasonal dryness. This USNVC association is broad however and includes both basic and acidic examples (USNVC 2022).

This ecological site is subject to wetting and drying cycles typical of "hydroxeric" conditions. These conditions include seasonal extremes in plant available water, caused primarily by shrink-swell clay mineralogy and low relief. The shrinking and swelling properties are responsible for fluctuating soil water potentials and cause shearing of the fine roots of woody plants. Layers of dense, plastic clays, which sit below the surface, can behave somewhat like rock, inhibiting root development, perching or ponding water during wet cycles, while simultaneously limiting the infiltration of water, contributing to dry cycles.

These edaphic factors produce a characteristically stunted canopy and create favorable conditions for recurring fires which would have historically helped maintain an open woodland structure. Forest patches associated with this ecological site are usually small and insular, being restricted to areas of mafic geology and unusual edaphic conditions.

Woodlands of this type are known locally by many names, including Piedmont flatwoods, Iredell flatwoods, montmorillonite forests, basic hardpan woodlands, gabbro upland depression forests, diabase barrens, prairie barrens, and vertic diabase woodlands. Regionally and locally, much variability exists between vegetation communities of this type, but all share a relatively open woodland structure, a fluctuating plant available water dynamic, and a predominance of base-loving plants in the understory. This ecological site includes seasonally wetter examples of these woodlands, which have a seasonal high water table within 12 inches of the soil surface. Still, these wet conditions are temporary and in most instances the influence of dry edaphic conditions, which develop over the course of the growing season, are reflected in the character of the vegetation.

MATURE FORESTS

The reference state has an open to partially open canopy structure. The canopy is dominated by dry-site oaks and pines, with variable contribution from bottomland oaks. The understory is characterized by a suite of basic indicator species, including a species-rich herb layer containing plant species that are seldom seen elsewhere in the Southern Piedmont.

In the reference state, dominant canopy species include post oak (*Quercus stellata*), shortleaf pine (*Pinus echinata*), and willow oak (*Quercus phellos*). Other important canopy species include southern shagbark hickory (*Carya carolinae-septentrionalis*), and winged elm (*Ulmus alata*). On some sites, swamp white oak (*Quercus bicolor*) may be present. This species is uncommon over most of the Southern Piedmont, being restricted to bottomlands and wet mafic depressions in the northern part of the MLRA.

Under reference conditions, the subcanopy layer is generally sparse and poorly-developed. Basic indicator species are well-represented, including eastern redcedar (*Juniperus virginiana*), eastern redbud (*Cercis canadensis*), winged elm (*Ulmus alata*), white ash (*Fraxinus americana*), and white fringetree (*Chionanthus virginicus*). Where fire has been excluded, southern sugar maple (*Acer floridanum*) can be abundant. Subcanopy generalists include sweetgum (*Liquidambar styraciflua*) and common persimmon (*Diospyros virginiana*).

In the shrub layer, characteristic basic indicator species include several arrowwood species (*Viburnum* spp.), coralberry (*Symphoricarpos orbiculatus*), and the somewhat less common fragrant sumac (*Rhus aromatica*). Generalists represented in the shrub layer include Carolina rose (*Rosa carolina*) and New Jersey tea (*Ceanothus americanus*).

Species commonly associated with flood plains may be present including possumhaw (*Ilex decidua*) and common winterberry (*Ilex verticillata*). These species are rarely found on uplands, except over circumneutral soils weathered from mafic rock.

The herb layer is diverse and distinctive, especially in areas in which fire has been reintroduced. Numerous species of conservation concern have been documented on this ecological site, some rare or endemic to the region. Most of these species are confined to mafic sites. Some are disjunct species which are more characteristic of the tallgrass prairie of the Midwest. Many of these species produce seed which can lie in wait in the soil seed bank, and sprout only after fire.

Forbs typical of the reference state include prairie rosinweed (*Silphium terebinthinaceum*), stiff goldenrod (*Oligoneuron rigidum* var. *rigidum*), prairie goldenrod (*Oligoneuron album*), button eryngo (*Eryngium yuccifolium*), scaly blazing star (*Liatris squarrosa*), Appalachian blazing star (*Liatris squarrolosa*), obedient plant (*Physostegia virginiana*), smooth purple coneflower (*Echinacea laevigata*), and many others. Characteristic grasses and grass-like plants include little bluestem (*Schizachyrium scoparium*), Indiangrass (*Sorghastrum nutans*), Florida paspalum (*Paspalum floridanum*), poverty oatgrass (*Danthonia spicata*), poverty dropseed (*Sporobolus vaginiflorus*), shortbeard plumegrass (*Saccharum brevibarbe* var. *contortum*), big bluestem (*Andropogon gerardii*), littlehead nutrush (*Scleria oligantha*), and various sedges (*Carex* spp.).

DYNAMICS OF NATURAL SUCCESSION AND FIRE ECOLOGY

Beginning in the early 20th century, a widespread fire suppression campaign resulted in a dramatic decrease in the frequency of fires across the Southeast. These changes gradually altered the vegetation structure and species composition of ecosystems that were dependent on fire for seedling recruitment, reproduction, and maintenance.

On this ecological site, the partially open canopy structure seen in some remnant examples is maintained, at least in part, by extremes in plant water availability. Few tree species are tolerant of alternating periods of soil saturation and the extremely dry soil conditions which develop during the growing season. Further, herbaceous plants are more tolerant of shrinking and swelling cycles that lead to shearing of the fine roots. Still, the natural fire regime would have produced a much more open canopy and understory than is seen in most examples presently, and promoted a dense herbaceous layer that could efficiently carry fire in future burns.

Because these communities are predominantly small-patch and spatially insular, fires would have spread primarily from the surrounding

landscape. In all likelihood, the fire return interval would have largely matched that of the surrounding forests. However, because of extreme fluctuations in soil moisture, the effects of fire would have been greater, presumably maintaining a more open woodland structure than is seen presently. With a dense grassy herb layer, burning would have been more complete and fire more intense than in the current hardwood litter. Under a more regular fire regime, pyrophytic oaks, pines, and other fire-dependent plant species are more competitive. Under these conditions, tree replacement would presumably be less dependent on canopy gaps and more on fire than under fire-suppressed conditions, or compared to the more prevalent oak-hickory forests of the surrounding landscape.

A combination of prescribed burns and selective removals can open up the understory and constrain the growth of fire-intolerant opportunistic species, thereby restoring the health and vigor of forests that evolved under a more regular fire regime (Schafale and Weakley 1990; Oakley et al. 1995; Cowell 1998; Evans et al. 2002; Walker et al. 2009; Boul et al. 2011; Spira 2011; Guyette et al. 2012; Schafale 2012a, 2012b; Stanley et al. 2013; Sigmon-Chatham 2015; Vander Yacht et al. 2020; Greenberg et al. 2021; Spooner et al. 2021).

SPECIES LIST

Canopy layer: *Quercus stellata*, *Pinus echinata*, *Quercus phellos*, *Carya carolinae-septentrionalis*, *Carya tomentosa*, *Carya glabra*, *Quercus alba*, *Ulmus alata*, *Ulmus americana*, *Fraxinus pennsylvanica*, *Gleditsia triacanthos*, *Pinus taeda*, *Quercus shumardii*, *Quercus nigra*,

Subcanopy layer: *Juniperus virginiana*, *Cercis canadensis*, *Acer floridanum*, *Acer rubrum*, *Ulmus alata*, *Fraxinus americana*, *Chionanthus virginicus*, *Liquidambar styraciflua*, *Diospyros virginiana*,

Vines/lianas: *Smilax rotundifolia*, *Smilax bona-nox*, *Smilax tamnoides*, *Campsis radicans*, *Toxicodendron radicans*, *Trachelospermum difforme*, *Parthenocissus quinquefolia*, *Lonicera japonica* (ex.)

Shrub layer: *Viburnum rafinesqueanum*, *Viburnum rufidulum*, *Viburnum prunifolium*, *Viburnum dentatum*, *Symphoricarpos orbiculatus*, *Ilex verticillata*, *Ilex decidua*, *Rosa carolina*, *Vaccinium arboreum*, *Rhus aromatica*, *Rhus copallinum*, *Ceanothus americanus*, *Celtis pumila*, *Crataegus marshallii*, *Crataegus viridis*, *Hypericum virgatum*, *Berberis canadensis*, *Ligustrum sinense* (ex.)

Herb layer - forbs: *Echinacea laevigata*, *Silphium terebinthinaceum*, *Silphium asteriscus* var. *asteriscus*, *Oligoneuron rigidum* var. *rigidum*, *Oligoneuron album*, *Eryngium yuccifolium*, *Liatris squarrosa*, *Liatris squarrulosa*, *Physostegia virginiana*, *Baptisia australis* var. *aberrans*, *Zephyranthes atamasca*, *Solidago nemoralis*, *Scutellaria integrifolia*, *Scutellaria elliptica*, *Marshallia obovata*, *Symphyotrichum georgianum*, *Symphyotrichum parviceps*, *Symphyotrichum depauperatum*, *Coreopsis major*, *Oenothera fruticosa*, *Clematis ochroleuca*, *Ruellia humilis*, *Agalinis purpurea*, *Marshallia legrandii*, *Zizia aurea*, *Asclepias tuberosa*, *Asclepias purpurascens*, *Ionactis linariifolius*, *Salvia urticifolia*, *Parthenium auriculatum*, *Parthenium integrifolium*, *Lotus helleri*, *Helianthus schweinitzii*, *Helianthus strumosus*, *Rudbeckia hirta*, *Lithospermum canescens*, *Nothoscordum bivalve*, *Cirsium carolinianum*, *Cirsium altissimum*, *Tragia urticifolia*, *Lespedeza virginica*, *Lespedeza hirta*, *Matelea decipiens*, *Blephilia ciliata*, *Monarda fistulosa*, *Scutellaria parvula* var. *missouriensis*, *Penstemon pallidus*, *Verbena simplex*, *Phlox* spp., *Eupatorium* spp., *Geranium maculatum*, *Erigeron strigosus*, *Cardamine douglassii*, *Commelina erecta*, *Triosteum angustifolium*,

Herb layer - graminoids: *Schizachyrium scoparium*, *Andropogon gerardii*, *Andropogon ternarius*, *Sorghastrum nutans*, *Paspalum floridanum*, *Piptochaetium avenaceum*, *Danthonia spicata*, *Danthonia sericea*, *Saccharum brevibarbe* var. *contortum*, *Carex* spp. (*complanata*, *caroliniana*, *albolutescens*, *festucacea*, *intumescens*, *normalis*, *louisianica*, *typhina*, *meadii*, *bushii*, *glaucodea*), *Dichanthelium* spp., *Tridens flavus*, *Saccharum alopecuroides*, *Scleria oligantha*, *Panicum anceps*, *Juncus coriaceus*, *Sorghastrum elliottii*, *Panicum philadelphicum*, *Panicum capillare*, *Panicum virgatum*, *Panicum flexile*, *Tripsacum dactyloides*, *Melica mutica*, *Festuca paradoxa*, *Sphenopholis obtusata*, *Aristida oligantha*, *Sporobolus vaginiflorus*, *Sporobolus junceus*,

(I) = introduced

State and transition model

Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 11. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 12. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 13. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 14. Community 2.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Inventory data references

Data collection and analysis of field data will be performed during the Verification Stage of ESD development.

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Approval

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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	08/20/2026
Approved by	
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:
