Ecological site F134XY014AL
Northern Non-Acid Floodplain - PROVISIONAL

Accessed: 04/23/2024

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): 134X–Southern Mississippi Valley Loess

The Southern Mississippi Valley Loess (MLRA 134) extends some 500 miles from the southern tip of Illinois to southern Louisiana. This MLRA occurs in Mississippi (39 percent), Tennessee (23 percent), Louisiana (15 percent), Arkansas (11 percent), Kentucky (9 percent), Missouri (2 percent), and Illinois (1 percent). It makes up about 26,520 square miles. Landscapes consist of highly dissected uplands, level to undulating plains, and broad terraces that are covered with a mantle of loess. The soils, mainly Alfisols, formed in the loess mantle. Stream systems of the MLRA typically originate as low-gradient drainageways in the upper reaches that broaden rapidly downstream to wide, level floodplains with highly meandering channels. Alluvial soils are predominantly silty where loess thickness of the uplands are deepest but grade to loamy textures in watersheds covered by thin loess. Underlying the loess mantle are Tertiary deposits of unconsolidated sand, silt, clay, gravel, and lignite. Crowley's Ridge, Macon Ridge, and Lafayette Loess Plains are discontinuous, erosional remnants that run north to south in southeastern Missouri - eastern Arkansas, northeastern Louisiana, and south-central Louisiana, respectively. Elevations range from around 100 feet on terraces in southern Louisiana to over 600 feet on uplands in western Kentucky. The steep, dissected uplands are mainly in hardwood forests while less sloping areas are used for crop, pasture, and forage production (USDA-NRCS, 2006).

East of the MS River, this site extends from Wickliffe, Kentucky southward to Vicksburg, Mississippi. West of the MS River, the site is restricted to the southern portions of Crowley's Ridge from about Forrest City to Helena, Arkansas and the extreme northern portion of Crowley's Ridge (including the Commerce Hills, Hickory Ridge, and a series of smaller hills) in the Missouri "Bootheel".

Classification relationships

All or portions of the geographic range of this site falls within a number of ecological/land classifications including:
-NRCS Major Land Resource Area (MLRA) 134 – Southern Mississippi Valley Loess
-Environmental Protection Agency's Level IV Ecoregion: Bluff Hills, 74a (Griffith et al., 1998; Woods et al., 2002; Chapman et al., 2002; Chapman et al., 2004; Woods et al., 2004; Daigle et al., 2006)
-231H - Coastal Plains-Loess section of the USDA Forest Service Ecological Subregion (McNab et al., 2005)
-LANDFIRE Biophysical Setting 45-46-4713270 and NatureServe Ecological System CES203.481 East Gulf Coastal Plain Northern Loess Bluff Forest (LANDFIRE, 2009; NatureServe, 2013)
-LANDFIRE Biophysical Setting 4513220 and NatureServe Ecological System CES203.079 Southern Crowley's Ridge Mesic Loess Slope Forest and Crowley's Ridge Mesic Loess Slope Forest, respectively (LANDFIRE, 2008; NatureServe, 2011)
-Western Mesophytic Forest Region - Mississippi Embayment Section - Loess Hills (Braun, 1950)

Ecological site concept

The Northern Non-acid Floodplain is characterized by deep, moderately well to well drained soils that formed in thick silty alluvium. This site occurs along stream courses and on broader floodplains and alluvial fans that drain areas of very deep loess deposits (greater than 10 feet thick), primarily the Loess Hills and its transition to the Loess

Plains. Soils have reactions that range from moderately acid to mildly alkaline and are subject to flooding during winter to early spring. Flood duration is brief along the stream corridors of the Loess Hills but may extend to longer periods on broader floodplains of larger creeks and medium-sized rivers. Slopes range from 0 to 2 percent. Soils of this site are highly productive, and the natural vegetation is rich in species that have an affinity for moist environments (i.e., mesophytes). Composition often consists of American sycamore, American beech, tuliptree, sweetgum, sugar maple, eastern cottonwood, Shumard's oak, northern red oak, willow oak, bitternut hickory, black walnut, northern hackberry, sugarberry, elm, ash, pawpaw, ironwood, hophornbeam, spicebush, red buckeye, and giant cane.

Associated sites

F134XY001TN	**Northern Deep Loess Backslope Mesophytic Forest** The Northern Deep Loess Backslope site adjoins the N. Non-acid Floodplain site along the footslope position. Deep loess deposits on the backslopes directly influence soil reaction and natural fertility of this site.
F134XY015AL	**Northern Non-Acid Moderately Wet Floodplain - PROVISIONAL** This site occurs on slightly wetter (somewhat poorly drained) and lower positions where the nonacid soils co-occur.
F134XY016AL	**Northern Non-Acid Wet Floodplain - PROVISIONAL** This site occupies the lowest and wettest situations within nonacid floodplains and alluvial fans.

Similar sites

F134XY101MS	**Southern Rolling Plains Loess Drainways - PROVISIONAL** This site is the southern counterpart to this site, the Northern Non-acid Floodplain.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The distribution of the Northern Non-acid Floodplain is primarily restricted to areas of MLRA 134 that drain uplands supporting the thickest loess deposits. This area includes much of the Loess Hills proper and the transition zone of the Loess Hills (EPA Level IV Ecoregion: 74a) and Loess Plains (EPA Ecoregion: 74b).

Physiographic features of the site include narrow drainageways, moderately broad to broad floodplains, and alluvial fans. Of the varying geomorphologic characteristics, the narrow drainageways of the Loess Hills best represents the site's ecological properties. Here, the rich alluvial soils coupled with the moist ravines and sinuous valleys create an incredible medium for supporting a rich bottomland hardwood community. Within the Loess Hills, the site's distribution is best described as a highly dendritic network of small, first-order to third-order streams. Landform position of the most incised ravines is probably best referred to as toe slopes.

Alluvial fans of this site are fairly common, but they are mostly restricted to the interface of the Loess Hills and the edge or boundary of the Southern Mississippi Valley Alluvium (MLRA 131A). Formation of this landform is generally the result of "water reworked" loess deposited onto the floodplain from the mouths of narrow draws and valleys of the steep, loess-covered slopes. This pattern occurs east of the Mississippi River and along portions of Crowley's Ridge.

The broader floodplains of this site generally occur along larger stream courses within the Loess Hills and where rivers and streams flowing to the Mississippi River have formed gaps through the hills.

Table 2. Representative physiographic features

Landforms	(1) Drainageway (2) Flood plain (3) Alluvial fan
Flooding duration	Long (7 to 30 days)
Flooding frequency	None to frequent
Ponding frequency	None
Elevation	260–550 ft
Slope	0–3%
Ponding depth	0 in
Water table depth	17–42 in
Aspect	Aspect is not a significant factor

Climatic features

This site falls under the Humid Subtropical Climate Classification (Koppen System). The average annual precipitation for this site increases north to south from 48 to 57 inches (1,219 to 1,448 millimeters). Maximum precipitation occurs in winter and spring and precipitation decreases gradually throughout the summer, except for a moderate increase in midsummer. Rainfall occurs primarily as high-intensity, convective thunderstorms, but moderate-intensity tropical storms can produce large amounts of rainfall during winter in the southern part of the area (USDA-NRCS, 2006). Snowfall generally occurs in the northern part of the area. Accumulations are generally less than 12 inches (31 centimeters) and generally melt within 3 to 5 days. South of Memphis, winter precipitation sometimes occurs as freezing rain and sleet. The average annual temperature is 57 to 62 degrees F (13.9 to 18.1 degrees C), increasing from north to south. The freeze-free period averages 226 days and ranges from 196 to 253 days, increasing in length from north to south.

The broad geographic distribution of this site north to south naturally includes much climatic variability with areas farther south having a longer growing season and increased precipitation. These climatic factors likely lead to important differences in overall plant productivity and key vegetation components between the southern and northern portions of this site. As future work proceeds, the current distribution of the Northern Wet Loess Interfluve, as indicated in this report, will likely be revised with a “central” site interjected between the northern and southern extremes.

Table 3. Representative climatic features

Frost-free period (average)	200 days
Freeze-free period (average)	226 days
Precipitation total (average)	54 in

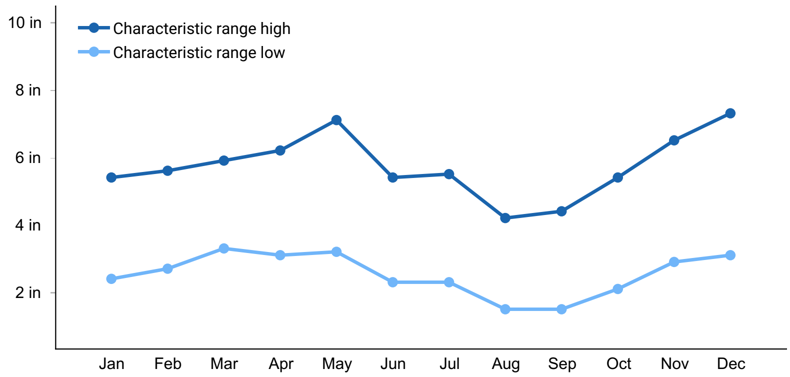

Figure 1. Monthly precipitation range

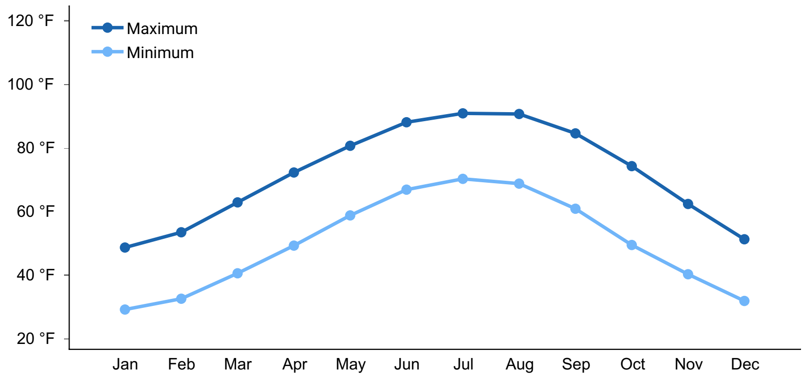

Figure 2. Monthly average minimum and maximum temperature

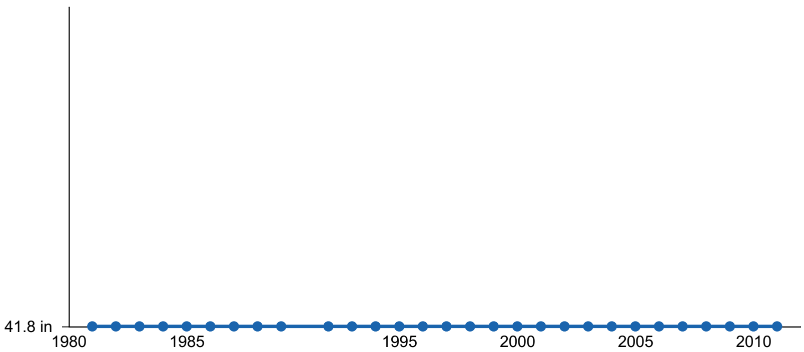

Figure 3. Annual precipitation pattern

Climate stations used

- (1) JONESBORO 2 NE [USC00033734], Jonesboro, AR
- (2) BARDWELL 2 E [USC00150402], Bardwell, KY
- (3) CHARLESTON [USC00221606], Charleston, MS
- (4) RIPLEY [USC00407710], Ripley, TN
- (5) MEMPHIS INTL AP [USW00013893], Memphis, TN
- (6) ADVANCE 1 S [USW00093825], Advance, MO
- (7) MADISON 1 NW [USC00034528], Forrest City, AR
- (8) HERNANDO [USC00223975], Hernando, MS
- (9) LEXINGTON [USC00225062], Lexington, MS
- (10) MALDEN MUNI AP [USC00235207], Malden, MO
- (11) COVINGTON 3 SW [USC00402108], Covington, TN
- (12) DYERSBURG III GOLF [USW00003809], Dyersburg, TN
- (13) GREENWOOD LEFLORE AP [USW00013978], Carrollton, MS
- (14) MEMPHIS [USW00093839], Millington, TN
- (15) MARIANNA 2 S [USC00034638], Marianna, AR
- (16) BATESVILLE 2 SW [USC00220488], Batesville, MS
- (17) GRENADA [USC00223645], Grenada, MS
- (18) SENATOBIA [USC00227921], Coldwater, MS
- (19) NEWBERN [USC00406471], Newbern, TN
- (20) UNION CITY [USC00409219], Union City, TN
- (21) CAPE GIRARDEAU MUNI AP [USW00003935], Chaffee, MO
- (22) HELENA [USC00033242], Helena, AR
- (23) WYNNE [USC00038052], Wynne, AR
- (24) VICKSBURG MILITARY PK [USC00229216], Vicksburg, MS
- (25) YAZOO CITY 5 NNE [USC00229860], Yazoo City, MS

Influencing water features

This site occurs within floodplains of small to large stream systems. Overland flooding occurs over a large percentage of the site's distribution. Flood duration is highly variable and directly dependent upon stream size and watershed position. Narrow floodplains of small streams are typically "flashy" and may flood occasionally to frequently but flood duration is generally brief. Sites associated with larger streams and large drainage basins may flood frequently with much longer flood duration. However, regardless of flood frequency and duration, the soils of this site are well drained to moderately well drained and are not hydric. On floodplains of larger stream systems, the water table may fluctuate between 1.5 to 2.5 feet of the surface for much of the time during winter and early in spring in most years. Of note, very little if any vegetation on these soils classify as wetland obligates. Although this site receives surface flooding, most of the vegetation would be considered facultative wetland and/or no wetland status.

Soil features

Please note that the soils listed in this section of the description may not be all inclusive. There may be additional soils that fit the site's concepts. Additionally, the soils that provisionally form the concepts of this site may occur elsewhere, either within or outside of the MLRA and may or "may not" have the same geomorphic characteristics or support similar vegetation. Some soil map units and soil series included in this "provisional" ecological site were used as a "best fit" for a particular soil – landform catena during a specific era of soil mapping, regardless of the origin of parent material or the location of MLRA boundaries. Therefore, the listed soils may not be typical for MLRA 134 or a specific location, and the associated soil map units may warrant further investigation in a joint ecological site inventory – soil survey project. When utilizing this provisional description, the user is encouraged to verify that the area of interest meets the appropriate ecological site concepts by reviewing the soils, landform, vegetation, and physical location. If the site concepts do not match the attributes of the area of interest, please review the Similar or Associated Sites listed in the Supporting Information section of this description to determine if another site may be a better fit for your area of interest.

The soils of this site are very deep, well drained to moderately well drained that formed in silty alluvium. These level to nearly level soils are on flood plains along streams in the Southern Mississippi Valley Loess (MLRA 134) and on alluvial fans along the edge of the Southern Mississippi Valley Alluvium (MLRA 131A). They are subject to flooding during winter and early in spring, have slow runoff, and are moderately permeable. Slopes range from 0 to 2 percent. A key property of these soils is that reactions commonly ranges from moderately acid to slightly alkaline in all horizons. Higher pH of these soils are hypothesized to support greater plant productivity than their acid, floodplain counterparts.

Principal soils of this site include Morganfield (Coarse-silty, mixed, active, nonacid, thermic Typic Udifluvents) and Adler (Coarse-silty, mixed, superactive, thermic Fluvaquentic Eutrudepts). Morganfield soils are well drained and do not have aquic conditions within a depth of 40 inches of the soil surface. These soils often occur on smaller streams and relatively "high up" within watersheds of the dissected Loess Hills. When they co-occur with Adler soils, Morganfield is generally on higher positions of the floodplain. Adler soils are moderately well drained and have mottles with chroma of 2 at a depth of less than 20 inches. In watersheds of deep loess, Adler is often found on broader floodplains and also forms the principal soils of many alluvial fans (USDA-NRCS, 2016).

A secondary soil of this site consists of the Riedtown series (Coarse-silty, mixed, active, thermic Fluvaquentic Eutrudepts). Riedtown soils are moderately well drained. Diagnostic horizons and features recognized consist of an ochric epipedon with a depth of about 7 inches (Ap horizon) with reactions that ranges from strongly acid to neutral. A cambic horizon is present that extends from about 7 to 80 inches (Bw, B/Eb1, B/Eb2, Bgb1, Bgb2). Reactions throughout the cambic horizon range from medium acid to moderately alkaline. Depth to a buried soil ranges from 20 to 40 inches. Fluvaquentic Eutrochrepts features consist of mottles with chroma of 2 or less within 24 inches of the surface (Bw horizon). Riedtown soils are of minor extent, having been mapped in two Mississippi counties: Hinds and Madison.

Table 4. Representative soil features

Surface texture	(1) Silt loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Moderate
Soil depth	80 in

Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	8.7 in
Electrical conductivity (0-40in)	0–1 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.2–7
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

A suite of distinct ecological sites are currently recognized in the northern section of the Loess Hills (includes Crowley's Ridge). Each site is largely defined by the landscape position in which it occurs: summits or ridgetops, steep to nearly vertical backslopes, and narrow drainageways. This ecological site, the Northern Non-acid Floodplain, is entirely restricted to the lowest position on the landscape, the narrow to moderately broad floodplains. Unlike the other two sites, the non-acid floodplain extends slightly beyond the dissected landscape of the hills and includes alluvial fans and broader floodplains of the Loess Hills and portions of the Loess Plains. This ecological site is provisionally separated from similar floodplain sites that have acid soils. It is hypothesized that the "non-acid" soils of this site may be more productive than their acidic counterparts.

The composition and structure of the pre-settlement plant community of this site is largely unknown. Tree species lists of the Loess Hills were provided in the early state geologic reports (e.g., Hilgard, 1860; Loughridge, 1888; Call, 1891; Holmes and Foster, 1908), but even those reports focused on the steep, inaccessible slopes and small reserves that had yet to be cleared. Even with a paucity of information, there is one species present on this site that provides some clues as to the plausible historical plant community: giant cane (*Arundinaria gigantea*). Cane grows readily on this site and historically, extended from the drains or bottoms to the summits of the Loess Hills (Hilgard, 1860; Loughridge, 1888; Shull, 1921). The sheer presence of this species alone in the historic community suggests disturbance beyond flooding alone. Fire may have been an important disturbance factor in the pre-settlement bottomland community (see Gagnon and Platt, 2008; Gagnon, 2009), which suggests that the structure of this site may have been more open. However, any vestige of that system is long past. Those areas that have been allowed to revert naturally are now best characterized as closed-canopied, bottomland hardwoods.

The principal land use of this site, today, is agriculture production. The fertile soils of the broader floodplains and alluvial fans are almost exclusively cropland. Timber production is mostly restricted to the narrower drainageways of the Loess Hills. There are a few areas that have been set aside in the public and/or private interest (e.g., parks, refuges, natural areas, and forest preserves), and those areas are now heavily forested. With no example of the pre-settlement plant community remaining intact, reference conditions of this site have been arbitrarily chosen to reflect the native plant species that most frequently occur and that influence the overall structure and characteristics of maturing stands. Locations that offer an opportunity to examine "surrogate" reference conditions are relegated to those public and private land holdings.

Many of the oldest stands support a broad range of hardwoods that includes species occurring on adjoining ecological sites, such as the backslopes and summits within the Loess Hills. A large percentage of the components occurring within the protected ravines and drainageways are mesophytes but a number of oak species occur as well. Farther south, loblolly pine (*Pinus taeda*) becomes an additional component; however the presence of this species is almost always an indicator of former land-use impacts. In fact, pine was never associated with the historic forest community of the Loess Hills and was noted as invading or colonizing abandoned farmland (Holmes and Foster, 1908).

Areas of former cropland and pastureland that are now in hardwood forests have produced several timber harvests since initial abandonment. On the most favorable sites, potential productivity (i.e., site index) of individual trees can be impressive. Site indices (represents 50 years of growth; cottonwood, 30 years) of green ash, cottonwood, cherrybark, sweetgum, sycamore, and tuliptree reportedly approach heights of 105, 130, 120, 120, 130, and 125 feet, respectively (Broadfoot, 1976).

A major concern over current and future forests of this site pertain to the prevailing practice of harvesting superior quality trees of select species and leaving behind unhealthy, defective trees and unmarketable species (i.e., high-grading). This practice has led to shifts in species composition and threatens the overall health and quality of affected stands (Hodges, 1995).

Plant communities of this site face additional threats, some of which are newly emerging. Invasive exotic plants are a persistent threat that competes with native species for nutrients and space. Forests are particularly susceptible to exotic plant invasions following a disturbance, whether the disturbance is from natural causes or human-induced. Some of the more notable and problematic exotic plants observed on this site include privet (Ligustrum spp.), Japanese honeysuckle (*Lonicera japonica*), multiflora rose (*Rosa multiflora*), and Nepalese browntop (*Microstegium vimineum*).

Following this narrative, a “provisional” state and transition model is provided that includes the “perceived” reference state and several alternative (or altered) vegetation states that have been observed and/or projected for the Northern Deep Loess Summit ecological site. This model is based on limited inventories, literature, expert knowledge, and interpretations. Plant communities will differ across MLRA 134 due to natural variability in climate, soils, and physiography. Depending on objectives, the reference plant community may not necessarily be the management goal.

The environmental and biological characteristics of this site are complex and dynamic. As such, the following diagram suggests pathways that the vegetation on this site might take, given that the modal concepts of climate and soils are met within an area of interest. Specific locations with unique soils and disturbance histories may have alternate pathways that are not represented in the model. This information is intended to show the possibilities within a given set of circumstances and represents the initial steps toward developing a defensible description and model. The model and associated information are subject to change as knowledge increases and new information is garnered. This is an iterative process. Most importantly, local and/or state professional guidance should always be sought before pursuing a treatment scenario.

State and transition model

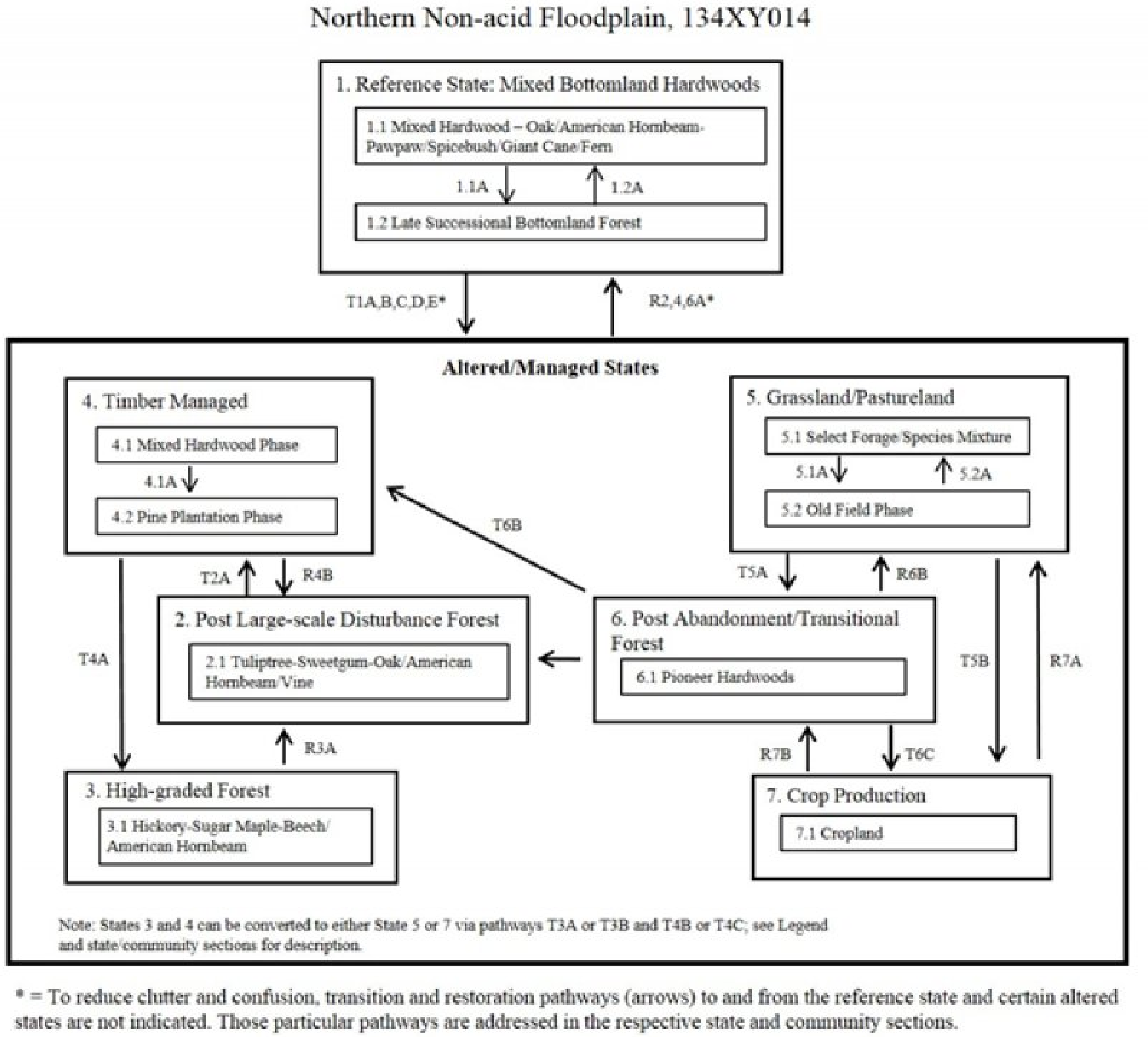

Figure 5. STM - Northern Non-acid Floodplain

Pathway	Process/Stressor
1.1A	natural succession over time; disturbance minimal, gap-scale
1.2A	large gap- to incomplete stand-scale disturbance (wind, ice, "possible" low- to mixed-severity fire, uneven-aged management – group selection harvests)
T1A, R3A, R4B, T6A	large-scale stand initiating disturbance (wind, ice, replacement fire, clearcut; State 2)
T1B, T4A	repeated select harvest (high-grading) (State 3)
T1C	beginning point uneven-aged stand; goal of oak/mixed hardwood management; timber stand improvements; group selection; competitor control – herbicide and mechanical; or conversion to pine monoculture (T1C only) (State 4)
T1D, T3A, T4B, 5.2A, R6B, R7A	mechanical removal of vegetation; herbicide application; seedbed preparation; planting desired species at appropriate rate (State 5)
T1E, T3B, T4C, T5B, T6C,	mechanical removal of vegetation; preparation for cultivation (State 7)
T2A, T6B	beginning point even-aged stand; establishment of hardwood regeneration (potential planting; competitor control – herbicide/mechanical; TSI); or conversion to pine monoculture (State 4)
R2A, R4A, R6A	natural succession over time (> 50 yrs); may require exotic plant control, reestablishment of missing species, TSI, and implemented disturbance regimes (e.g., group selection, fire) (State 1)
4.1A	conversion to pine monoculture
5.1A	grazing and/or mowing/haying cessation, natural succession
T5A, R7B	natural succession (< 30 yrs) (State 6)

Figure 6. Legend - Northern Non-acid Floodplain

State 1
Mixed Bottomland Hardwoods

The pre-settlement plant community of this ecological site was largely removed more than 150 years ago, and the fertile and moist alluvial fans, bottoms, and drainageways of this site were among the first to have been converted (Hodges, 1995). There are no extant examples of that community. Early descriptions of the forests of the Loess Hills emphasized the heavy presence of cane throughout the bottoms and steep backslopes (e.g., Hilgard, 1860; Loughridge, 1888). Since dense cane growth appears to require some form of disturbance (e.g., fire and/or canopy gaps), the pre-settlement community of this site may have been much more open than what is experienced today (see Gagnon and Platt, 2008; Gagnon, 2009). Heineke (1987) suggested that the forests of the Loess Hills had an open physiognomy, which is unlike the dense, closed-canopied forests of today. The natural fertility and moisture retention of the deep non-acid soils of this site foster tremendous plant production. Without disturbance, dense woody regrowth on this site leads to closed-canopy conditions and high shade. Following decades of land-use impacts, the plant community that returned in those areas initially set aside for protection 50 to 80 years ago (e.g., parks, natural areas, and refuges) are often comprised of a large mesophyte component in addition to a number of oak species. Cane is still an important component of the understory but its occurrence is usually represented by single stems beneath high shade and not the dense stands (brakes) that was historically reported. Without a model of the pre-settlement forest to follow, reference conditions of this site reflect conditions of maturing stands observed within public lands and/or private reserves. Two community phases are currently recognized within the reference state. They are distinguished from one another based on the degree of successional stage (development); level or intensity of disturbance; and relative proportion of shade-tolerant vs. shade-intolerant species present in local stands.

Community 1.1
Mixed Hardwood – Oak/American Hornbeam-Pawpaw/Spicebush/Giant Cane/Fern

This community phase represents the successional stage, composition, and structural complexity of stands supporting perceived reference conditions. Historically, this phase may have been more open with a dense presence of cane. Today, this community is representative of the maturing stands (often >70 years) found within protected areas. Overstory composition of the rich drainageways and floodplains within and along the margins of the Loess Hills consists of American sycamore (*Platanus occidentalis*), American beech (*Fagus grandifolia*), tuliptree (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), sugar maple (*Acer saccharum* to the north; A. floridanum to the south), eastern cottonwood (*Populus deltoides*), cherrybark oak (*Quercus pagoda*), Shumard's oak (*Q. shumardii*), northern red oak (*Q. rubra*), willow oak (*Q. phellos*), water oak (*Q. nigra*), swamp chestnut oak (*Q. michauxii*), bitternut hickory (*Carya cordiformis*), black walnut (*Juglans nigra*), elm (Ulmus spp.), ash (Fraxinus spp.), sugarberry (*Celtis laevigata*), northern hackberry (*C. occidentalis*), and occasionally butternut (*J. cinerea*).

The subcanopy or mid-story stratum is often represented by American hornbeam (*Carpinus caroliniana*), hophornbeam (*Ostrya virginiana*), pawpaw (*Asimina triloba*), and flowering dogwood (*Cornus florida*). Vegetation characteristic of the small to tall shrub strata include spicebush (*Lindera benzoin*), pawpaw (*Asimina triloba*), red buckeye (*Aesculus pavia*), giant cane (*Arundinaria gigantea*), and strawberry bush (*Euonymus americanus*). The ground layer stratum supports a broad array of herbaceous and woody vine species including Canadian wood nettle (*Laportea canadensis*), jumpseed (*Polygonum virginianum*), snakeroot (Sanicula sp.), mayapple (*Podophyllum peltatum*), crossvine (*Bignonia capreolata*), greenbrier (*Smilax rotundifolia*), Virginia creeper (*Parthenocissus quinquefolia*), broad beech fern (*Phegopteris hexagonoptera*), Christmas fern (*Polystichum acrostichoides*), sedges (Carex spp.), and occasional dense, monotypic stands of horsetail (*Equisetum hyemale*). The fertile, moist soils of this site provide an incredible medium for supporting a number of mesophytes and facultative mesophytes including sweetgum, tuliptree, beech, maple, sycamore, cottonwood, and ash. These species often respond quickly to disturbance and may dominate canopy openings. As individual stands increase in age, the canopy associates that appear to have a tougher time competing in this environment are the oaks. Oak seedlings (< 2 feet tall) are occasional to common components of the ground flora, but there is an alarming paucity of oaks at the taller sapling and small tree strata. Overall, oak recruitment in this phase appears to be poor. Regeneration and continuation of oak likely require disturbances extending beyond the gap-scale, possibly requiring incomplete-stand to stand-initiating disturbances coupled with forces that control potential competitive exclusion of oaks by faster growing shade-intolerant associates. Without reoccurring disturbances that promote oak reproduction and regeneration, this phase will naturally transition to a more shade-tolerant, late successional stage. Prior to reaching that stage, oak break-up, resulting in broader canopy openings, may be rapidly colonized by shade-intolerant hardwoods such as tuliptree, sweetgum, and ash with a concomitant release and expansion of a shade-tolerant understory.

Community 1.2
Late Successional Bottomland Forest

This community phase represents a later successional stage of this ecological site and is characterized by the dominance and prevalence of shade-tolerant species throughout midstory and understory strata. Recognition of this phase is mainly due to a trend occurring in many older stands that have been protected from large, reoccurring disturbances. In these stands, shade-tolerant trees often occupy important positions in the midstory and understory where they occur as seedlings, saplings, and subcanopy trees. Understories dominated by shade tolerant species are sometimes devoid of shade-intolerant species, with the exception of recent germinations and small seedlings (< 1 feet in height). Disturbances occurring within the community are mainly in the form of smaller, gap-scale openings resulting in the deaths of individual trees and/or small groups of canopy/subcanopy trees (e.g., windthrow events). Gaps of insufficient size ultimately favor “ingrowth” of live canopy trees or canopy accession of shade-tolerant species (Oliver and Larson, 1990). An interpretation of these observations is that future overstory recruitment will largely come from the advancement of smaller, shade-tolerant components. Without the requisite processes for retaining oaks and other shade-intolerant species, slow decline and eventual disappearance of some species may occur at the stand level. Although no examples of this phase have been documented and studied, composition of late successional stands is projected to include a greater abundance of American beech and sugar maple at the canopy and understory strata along with potential associates of sweetgum, ash, and bitternut hickory. Additional components expected to thrive or persist include American hornbeam, hophornbeam, flowering dogwood, pawpaw, red buckeye, and spicebush. The understory species that may be negatively impacted is likely to be cane. Important, shade-intolerant components of Phase 1.1 will likely decrease in abundance in the late successional stage but may not disappear entirely at the stand level. Large canopy gaps are anticipated to reset conditions for faster growing shade-intolerants such as tuliptree and sweetgum; the former is expected to persist as an important canopy component given its rapid response to disturbance and greater longevity. However, larger-scale disturbances (e.g., incomplete stand- to stand-initiating) on a more frequent rotation may be required for greater oak regeneration and persistence of cane. Even then, proliferation of shade-tolerant species and the presence of fast-growing hardwoods may still present recruitment challenges for oaks (Johnson et al., 2009). A community phase pathway (pathway 1.2A below) is recognized for creating conditions more suitable for shade-intolerant species, but the complications just mentioned may require stand initiating disturbances and pro-active management specifically designed for oak recruitment.

Pathway 1.1A
Community 1.1 to 1.2

This pathway represents a natural increase in shade-tolerant, late successional species (i.e., increased mesophication) over a long period of time. Disturbance is light, infrequent, and localized – the result of single tree senescence or small group windthrow. The abundance and importance of shade intolerant species (e.g., oaks) declines, overall.

Pathway 1.2A
Community 1.2 to 1.1

This pathway involves larger gap- to incomplete stand-scale disturbances resulting in a reduction of late successional dominance in the overstory and permitting opportunity for shade-intolerant species to resume position in the stand. Potential disturbances include those induced by wind, ice, low to mixed severity fire, and forest management (e.g., group selection harvests, basal area reduction harvests). Species benefitting from this level of disturbance include tuliptree, sweetgum, white ash, and other shade-intolerant hardwoods. Restoring the oak component, however, may be more problematic. If oaks were rare in the late successional stand, their regeneration in the recovering gaps will also be rare and most likely, nonexistent. Achieving successful oak recruitment ultimately depends upon the presence of advanced oak regeneration prior to the disturbance. Management recommendations for oak recruitment may include timber stand improvement (TSI), planting, and mechanical and chemical treatment of oak competition. Finding the appropriate approach for a given stand and environment necessitates close consultation with trained, experienced, and knowledgeable professionals. It is strongly urged and advised that professional guidance from a forester be secured and a well-designed silvicultural plan developed in advance of any work conducted.

State 2
Post Large-scale Disturbance Forest

This state is characterized by the regeneration or regrowth of a pre-existing forest stand following a major, stand-replacing disturbance. Scale of the disturbance is at the stand level and is greater than one acre in size (Johnson et al., 2009). Potential types of disturbances include catastrophic windstorms, wildfire, silvicultural clearcuts, and particularly destructive ice storms. The resulting, even-aged stand (or single-cohort) is set on a new course of development, which is highly dependent upon several critical factors including: the composition and structure of the stand prior to the disturbance; the degree or intensity of the disturbance; size and configuration of the disturbed area; and distance to seed sources. Composition and condition of the forest stand prior to a major disturbance may dictate, in large part, future composition of the regenerating stand. Although colonization by new species is expected soon after the disturbance, many of the pre-existing overstory components are anticipated to occupy position in the new, developing stand – their presence arising mainly from stump or root sprouts, advance regeneration, and germination from the seed bank (Oliver and Larson, 1990).

Community 2.1
Tuliptree – Sweetgum – Oak/American hornbeam/Vine

Soon after overstory removal, numerous species may colonize large openings and influence the dynamics of the site. Initial colonizers are often forbs, graminoids, and vines that may have existed in the seed bank, were forest floor components prior to disturbance, or transported into the site via wind and/or animals. Overstory species anticipated to occur during the stand-initiation stage include tuliptree, sweetgum, American sycamore, eastern cottonwood, ash, oaks, hickory, elm, walnut, hackberry, sugarberry, boxelder, along with the residual shade-tolerant species of sugar maple, beech, American hornbeam, and hophornbeam. For stands that were highly altered prior to the disturbance (e.g., high-graded), intensive management may be necessary in order to establish a desired composition. Management actions may include controlling undesirable species mechanically and chemically and planting the desired species.

State 3
High-graded/Grazed Forest

Forests in this state have undergone repeated select harvests over time. Actions leading to this condition consist of removing the largest and healthiest individuals of the most desirable species and leaving low-quality trees (damaged and deformed) and undesirable species. This action, conducted repeatedly, can cause tremendous shifts in species composition and can decrease the vigor and health of the residual stand. Without implementing carefully prescribed management actions, species composition of extreme high-graded stands may remain in a highly altered condition for many decades, even after large, stand-replacing disturbances resets “successional opportunity.” Today, this vegetation state probably represents the conditions of many forest stands throughout the distribution of this site. Local stands in which desirable species such as oaks, tuliptree, walnut, etc. were repeatedly targeted often results in sites with proportionally more hickory, maple, and beech. Stands where hickory was also targeted often support maple, hophornbeam, and disproportionate numbers of other components such as boxelder, hackberry, and sugarberry.

Community 3.1
Hickory-Sugar Maple-Beech/ American Hornbeam

Under high-grading practices, species typically left or avoided during harvests often include hickory, sugar maple, beech, and practically the entire understory. This has resulted in canopies largely comprised of the preceding species along with a dense understory of American hornbeam and hophornbeam. Noticeable characteristics of this condition are a conspicuous reduction of oaks and other valuable hardwoods.

State 4
Timber Managed

Two timber management phases are recognized to represent the range of management options and outcomes. The first phase focuses on the broad range of hardwoods supported on this site, and the second represents conversion to a pine monoculture (or plantation).

Community 4.1
Mixed Hardwood Phase

This phase represents the prevailing compositional diversity of hardwood species occurring on this site. Components of the system that are often in greatest demand are the oaks. Oaks that respond incredibly well on this site include cherrybark, Shumard’s, northern red, swamp chestnut, willow, water, and occasionally white oak. However, managing for oaks alone on this highly productive site may be time, labor, and cost prohibitive. Managing for a mixed diversity of hardwoods (including oaks) is the option representative of this management phase. In addition to oaks, species responding well on this site include tuliptree, sweetgum, ash, elm, walnut, sycamore, and cottonwood. There are a variety of silvicultural methods for achieving this management state including both uneven-aged approaches (e.g., group selection) and even-aged actions (e.g., clearcut). Finding the appropriate approach for a given stand and environment necessitates close consultation with trained, experienced, and knowledgeable forestry professionals. If there is a desire to proceed with this state, it is strongly urged and advised that professional guidance be secured and a well-designed silvicultural plan developed in advance of any work conducted.

Community 4.2
Pine Monoculture

This phase represents site conversion to a pine monoculture. However, this management option should be relegated to the southern extent of this ecological site in Mississippi. The northern portions of this site are probably best suited to hardwood production. Although pines grow well, the moist, fertile characteristics of the alluvial, non-acid soils tend to foster a rapid response of fast growing hardwoods such as cottonwood, tuliptree, and sweetgum. Competition from these and other hardwoods is likely to be severe.

Pathway 4.1A
Community 4.1 to 4.2

This pathway represents the conversion of the former mixed hardwood forest to a pine monoculture or plantation (Phase 4.3). This action requires mechanical removal of all hardwoods, site preparation, herbicide treatment of root sprouts, and planting in pine; loblolly pine should be the preferred species given the productivity of the site.

State 5
Grassland/Pastureland

This state is representative of sites that have been converted to and maintained in pasture and forage cropland, typically a grass – legume mixture. For pastureland, planning or prescribing the intensity, frequency, timing, and duration of grazing can help maintain desirable forage mixtures at sufficient density and vigor (USDA-NRCS, 2010; Green et al., 2006). This state or land use is probably the most infrequent of all management options on this site.

Community 5.1
Select Forage/Species Mixture

This community phase represents commonly planted forage species on pasturelands, haylands, and open grasslands. The suite of plants established on any given site may vary considerably depending upon purpose, management goals, and usage (e.g., horses vs. cattle). Most systems include a mixture of grasses and legumes that provide forage throughout the growing season. Cool season forage may include tall fescue (*Schedonorus arundinaceus*), orchardgrass (*Dactylis glomerata*), white clover (*Trifolium repens*), and red clover (*T. pratense*), and warm season forage often consists of bermudagrass (*Cynodon dactylon*), bahiagrass (*Paspalum notatum*), and annual lespedeza (Kummerowia spp.). Several additional plants and/or species combinations may be present depending on the objectives and management approaches of the land manager/owner. Maintaining the select suite of plants for any length of time is improbable in most situations. Both native and non-native plant species will gradually propagate newly established and renovated pastureland and hayland. Over time, a very diverse mixture of species will become established on most sites; some of these may be noxious and highly undesirable.

Community 5.2
Old Field Phase

This phase represents the succession of pastureland and/or open grassland to “old field” conditions. The stage of this phase is the transitional period between a predominantly open, herbaceous field and the brushy stage of a newly initiated stand of trees. Structurally, this phase is characterized as a complex consisting of newly colonized tree seedlings, scattered small saplings, shrubs, and a persistent herbaceous component. Duration of this phase is short-lived and depending on former management, use, and impacts, may last from 3 to 5 years and possibly up to 8 on severely degraded sites. On many old field sites, the early pioneer woody species may consist of black locust, followed by scattered stems of sycamore, tuliptree, sweetgum, elm, hackberry, sugarberry, honeylocust (*Gleditsia triacanthos*), and boxelder. Shrubs are frequently represented by winged sumac (*Rhus copallinum*), smooth sumac (*R. glabra*), elderberry (Sambucus canadensis), and blackberry. Herbaceous species may consist of tall fescue, bermudagrass, goldenrod (Solidago spp.), ticktrefoil (Desmodium spp.), dallisgrass (*Paspalum dilatatum*), Carolina horsenettle (*Solanum carolinense*), among many others.

Pathway 5.1A
Community 5.1 to 5.2

When all management activities are discontinued (e.g., grazing, mowing, etc.), natural succession of the once managed site leads to the “old field” stage.

Pathway 5.2A
Community 5.2 to 5.1

This pathway represents renovation of the old field condition back to pastureland, forage production, or open grassland. Management activities likely include mechanical removal of the larger, woody vegetation followed by herbicide treatment and establishment of desired seeding mixtures.

State 6
Post Abandonment/Transitional Forest

This state represents a return to forest conditions following the abandonment of pastureland/grassland and cropland management. The developmental stage of this state follows the “old field” condition and begins at canopy closure of the new forest stand. This initiates the stem exclusion period whereby establishment of additional canopy species becomes exceedingly difficult without active management (Oliver and Larson, 1990). Composition of the resulting forest will vary considerably depending on the amount of time the site was previously managed; the intensity of former land use practices; the condition of the land prior to abandonment; and the source and distance of the nearest seed sources. Some pioneer species of the new stand may dominate early on but will be replaced by competitors within the community as the stand matures. Competitive interactions are intense at this stage.

Community 6.1
Pioneer Hardwoods

A broad mixture of hardwood species are anticipated to comprise the overstory early on including sycamore, elm, hackberry, sugarberry, boxelder, tuliptree, sweetgum, and likely a few important oak species. As the stand matures, shifts in species dominance and codominance often occur. The components that may increase in importance include tuliptree, sweetgum, ash, elm, oaks, and hickory. However, the presence of oak and hickory may be a special case that depends on nearest seed sources and disturbances at sufficient intensity and frequency to aid their competitive placement in the maturing stand.

State 7
Crop Production

Immediately upon settlement, the fertility of the soils led to rapid land clearing and crop production. Today, crops that are often established include corn, soybean, small grains, and cotton.

Community 7.1
Cropland

Corn, soybean, small grains, and cotton.

Transition T1A
State 1 to 2

This pathway represents a large-scale, stand replacing disturbance, which may be caused by a catastrophic windstorm (e.g., straight-line winds, tornado), ice storm, severe fire, or a silvicultural clearcut. For this stressor to occur, most or all of the overstory must be removed or destroyed. A few residual trees may persist, but overall, the disturbance must be intensive enough, at least one acre or larger (Johnson et al., 2009), that a new, even-aged stand is created.

Transition T1B
State 1 to 3

Repeated selective harvesting or high-grading of stands over time can cause shifts in species composition, structure, and overall health of affected stands. High-grading occurs when the most desirable trees of select species are repeatedly removed leaving behind inferior, low quality stems and undesirable species.

Transition T1C
State 1 to 4

This pathway consists of prescribed silvicultural activities specifically designed to meet stand compositional and production objectives. Activities may include release cuttings through a combination of low and high thinning, mechanical and chemical control of competition, and artificial regeneration (i.e., planting) of sites with low oak presence. A variety of silvilcultural methods may be employed including group selection, single tree selection harvests (all classes/condition; avoid “high-grading”), or even-age management (clearcut). The final option of this pathway is the conversion of the former hardwood forest to a pine monoculture or plantation (Phase 4.2). This action requires mechanical removal of all hardwoods, site preparation, herbicide treatment of root sprouts, and planting in pine; loblolly pine should be the preferred species given the productivity of the site.

Transition T1D
State 1 to 5

Actions required to convert forests to grassland or forage production include forest clearing, stump removal, herbicide application, seedbed preparation, and the establishment of desired plants.

Transition T1E
State 1 to 7

Actions include mechanical removal of vegetation and stumps; herbicide treatment of residual plants; and preparation for crop establishment.

Restoration pathway R2A
State 2 to 1

This pathway represents a return to reference conditions through natural succession, if the disturbance occurred within a reference community. Depending upon objectives and stand condition, management activities to aide recovery may include exotic species control and silvicultural treatment that benefits oak regeneration and establishment (e.g., TSI practices such as crop tree release, low thinning, and cull removal).

Transition T2A
State 2 to 4

This pathway represents the development of an even-aged stand that is prescribed to meet compositional and production objectives, which may be either hardwood management or pine monoculture.

Restoration pathway R3A
State 3 to 2

This pathway represents a large-scale, stand replacing disturbance, which may be caused by a catastrophic windstorm (e.g., straight-line winds, tornado), ice storm, severe fire, landslide, or a silvicultural clearcut. For this stressor to occur, most or all of the overstory must be removed or destroyed. A few residual trees may persist, but overall, the disturbance must be intensive enough, at least one acre or larger (Johnson et al., 2009), that a new, even-aged stand is created.

Transition T3A
State 3 to 5

Actions include forest clearing, stump removal, herbicide application, seedbed preparation, and the establishment of desired plants.

Transition T3B
State 3 to 7

Actions include mechanical removal of vegetation and stumps; herbicide treatment of residual plants; and preparation for cultivation or orchard establishment.

Restoration pathway R4A
State 4 to 1

Natural succession over a period of time may transition a former timber-managed stand (Phase 4.1) to one supporting reference conditions. Based on observations of some reference stands, a period greater than 50 years may be required. Some question remains whether a return to reference conditions will occur in every situation, especially since some components may have been selectively culled from the stand. Management activities to aide recovery may include exotic species control and silvicultural treatment.

Restoration pathway R4B
State 4 to 2

This pathway represents a large-scale, stand-initiating disturbance, which effectively removes most or all of the pre-existing overstory. Disturbances may include a catastrophic windstorm, severe wildfire, slope failure or landslide, and silvicultural management (even-aged). If the disturbance is a prescribed management action, method of harvest will depend upon current timber objectives and future stand composition and production goals.

Transition T4A
State 4 to 3

Repeated selective harvesting or high-grading of stands over time can cause shifts in species composition, structure, and overall health of affected stands. High-grading occurs when the most desirable trees of select species are repeatedly removed leaving behind inferior, low quality stems and undesirable species. (Pathway pertains to Community Phase 4.1).

Transition T4B
State 4 to 5

Actions include forest clearing, stump removal, herbicide application, seedbed preparation, and the establishment of desired plants.

Transition T4C
State 4 to 7

Actions include mechanical removal of vegetation and stumps; herbicide treatment of residual plants; and preparation for cultivation or orchard establishment.

Transition T5A
State 5 to 6

Abandonment of grassland/pastureland management and allowing natural succession to proceed beyond the old field stage to canopy closure of the young, developing forest stand.

Transition T5B
State 5 to 7

Actions include mechanical removal of vegetation and stumps; herbicide treatment of residual plants; and preparation for crop establishment.

Restoration pathway R6A
State 6 to 1

This pathway represents natural succession back to perceived reference conditions. The period required for this transition to take place likely varies by location and is dependent upon local site conditions. Ages extrapolated from reference stands on a few protected sites (e.g., parks, refuges, etc.) suggest that a return interval to reference conditions may require more than 50 years; some of the examined stands have been protected for at least 75 years. In some cases, a return to the reference state may not be possible without considerable management effort. That effort may involve exotic species control and the reestablishment of components considered characteristic of the reference state.

Transition T6A
State 6 to 2

This pathway represents a large-scale, stand replacing disturbance, which may be caused by a catastrophic windstorm (e.g., straight-line winds, tornado), ice storm, severe fire, landslide, or a silvicultural clearcut.

Transition T6B
State 6 to 4

This pathway represents prescribed management strategies for transitioning an abandoned forest state to one that meets compositional and production objectives. Managing for mixed hardwood production (Phase 4.1) may require exotic species control and general timber stand improvement practices. The final option of this pathway is the conversion of the former hardwood forest to a pine monoculture or plantation (Phase 4.2).

Restoration pathway R6B
State 6 to 5

Actions include forest clearing, stump removal, herbicide application, seedbed preparation, and the establishment of desired plants.

Transition T6C
State 6 to 7

Actions include mechanical removal of vegetation and stumps; herbicide treatment of residual plants; and preparation for cultivation.

Restoration pathway R7A
State 7 to 5

Seedbed preparation and establishment of desired forage/grassland mixture.

Restoration pathway R7B
State 7 to 6

Abandonment of cropland/orchard production and allowing natural succession to proceed to canopy closure of the young, developing forest stand.

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:**

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:**