

## Ecological site R111XD002IN Deep Muck

Last updated: 5/28/2020  
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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): 111X–Indiana and Ohio Till Plain

A PROVISIONAL ECOLOGICAL SITE is a conceptual grouping of soil map unit components within a Major Land Resource Area (MLRA) based on the similarities in response to management. Although there may be wide variability in the productivity of the soils grouped into a Provisional Site, the soil vegetation interactions as expressed in the State and Transition Model are similar and the management actions required to achieve objectives, whether maintaining the existing ecological state or managing for an alternative state, are similar. Provisional Sites are likely to be refined into more precise group during the process of meeting the APPROVED ECOLOGICAL SITE DESCRIPTION criteria.

This PROVISIONAL ECOLOGICAL SITE has been developed to meet the standards established in the National Ecological Site Handbook. The information associated with this ecological site does not meet the Approved Ecological Site Description Standard, but it has been through a Quality Control and Quality Assurance processes to assure consistency and completeness. Further investigations, reviews and correlations are necessary before it becomes an Approved Ecological Site Description.

111D – Indiana and Ohio Till Plain, Western Part. This MLRA occurs in two separate areas. One area is in the west-central part of Indiana (73 percent), and the other is in southwestern Ohio (27 percent). The MLRA makes up 5,355 square miles (13,880 square kilometers). It includes the towns of Crawfordville, Delphi, Frankfort, Lafayette, and Liberty, Indiana, and Hamilton, Lebanon, Middletown, and Wilmington, Ohio. Interstates 65 and 74 cross the part of this area in Indiana, and Interstates 71 and 75 cross the part in Ohio. Shades and Turkey Run State Parks are in the part in Indiana, and Caesar Creek and Hueston Woods State Parks are in the part in Ohio. A small portion of the Wright-Patterson Air Force Base, in Ohio, is in the northern part of the area.

This area is in the Till Plains Section of the Central Lowland Province of the Interior Plains. It is dominated by loess hills and flats that are broken in places by moraines, kames, outwash plains, and stream terraces. Narrow, shallow valleys commonly are along the few large streams in the area. Elevation ranges from 530 to 1,050 feet (160 to 320 meters), increasing gradually from southwest to northeast. Relief is mainly a few meters, but in some areas hills rise as much as 100 feet (30 meters) above the adjoining plains.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Wabash (0512), 68 percent; Great Miami (0508), 15 percent; Middle Ohio (0509), 14 percent; Scioto (0506), 2 percent; and Upper Illinois (0712), 1 percent. Wildcat Creek in Indiana and the Little Miami River in Ohio have been designated as National Wild and Scenic Rivers. Sugar Creek and Walnut Creek occur in the part of the area in northern Indiana, and the Whitewater River is in the part in southeastern Indiana. The Sevenmile, Fourmile, and Great Miami Rivers cross the part of the area in Ohio.

Most of the eastern part of this MLRA is underlain by Late Ordovician shale and limestone. The western part is underlain by shale, siltstone, sandstone, limestone, and dolostone ranging in age from Middle Pennsylvanian to Silurian. Surficial materials include glacial deposits of till, outwash, and lacustrine sediments from Wisconsin and

older glacial periods. A thin or moderately thick mantle of loess overlies much of the area.

## **Classification relationships**

Major Land Resource Area (USDA-Natural Resources Conservation Service, 2006)

USFS Ecological Regions (USDA, 2007):

Sections –Central Till Plains, Beech Maple (222H), Interior Low Plateau-Shawnee Hills (223D), Interior Low Plateau-Bluegrass (223F), Central Till Plains-Oak Hickory (223G), Central Till Plains and Grand Prairies (251D)

Subsections -Bluffton Till Plains (222Ha), Miami-Scioto Plain-Tipton Till Plain (222Hb), Little Miami Old Drift Plain (222Hc), Mad River Interlobate Plains (222Hd), Crawford Uplands (223De), Crawford Escarpment (223Df), Northern Bluegrass (223Fd), Lower Wabash Alluvial Plain (223Gc), Southwest Indiana Glaciated Lowlands (223Ge), Eastern Grand Prairie (253Dd).

NatureServe Systems anticipated (NatureServe, 2011): Agriculture - Cultivated Crops and Irrigated Agriculture, Agriculture - Pasture/Hay, Allegheny-Cumberland Dry Oak Forest and Woodland, Central Interior Acidic Cliff and Talus, Central Interior Highlands Calcareous Glade and Barrens, Central Tallgrass Prairie, Clearcut - Grassland/Herbaceous, Introduced Upland Vegetation – Treed, Managed Tree Plantation, Mississippi River Riparian Forest, North-Central Interior and Appalachian Acidic Peatland, North-Central Interior Beech-Maple Forest, North-Central Interior Dry-Mesic Oak Forest and Woodland, North-Central Interior Dry Oak Forest and Woodland, North-Central Interior Floodplain, North-Central Interior Freshwater Marsh, North-Central Interior Maple-Basswood Forest, North-Central Interior Oak Savanna, North-Central Interior Wet Flatwoods, North-Central Interior Wet Meadow-Shrub Swamp, North-Central Oak Barrens, Northern Atlantic Coastal Plain Hardwood Forest, Ruderal Forest, Ruderal Upland - Old Field, South-Central Interior / Upper Coastal Plain Wet Flatwoods, South-Central Interior Large Floodplain, South-Central Interior Mesophytic Forest, South-Central Interior Small Stream and Riparian, Southern Appalachian Oak Forest, Southern Interior Low Plateau Dry-Mesic Oak Forest, Successional Shrub/Scrub

LANDFIRE Biophysical Settings anticipated (USGS, 2010): Allegheny-Cumberland Dry Oak Forest and Woodland, Bluegrass Savanna and Woodland, Central Interior and Appalachian Floodplain Systems, Central Interior and Appalachian Riparian Systems, Central Interior and Appalachian Shrub-Herbaceous Wetland Systems, Central Interior and Appalachian Swamp Systems, Central Interior Highlands Calcareous Glade and Barrens, Central Interior Highlands Dry Acidic Glade and Barrens, Central Tallgrass Prairie, Great Lakes Coastal Marsh Systems, Mississippi River Alluvial Plain Dry-Mesic Loess Slope Forest, North-Central Interior Beech-Maple Forest, North-Central Interior Dry-Mesic Oak Forest and Woodland, North-Central Interior Dry Oak Forest and Woodland, North-Central Interior Maple-Basswood Forest, North-Central Interior Oak Savanna, North-Central Interior Wet Flatwoods, Paleozoic Plateau Bluff and Talus, Pennyroyal Karst Plain Prairie and Barrens, South-Central Interior Mesophytic Forest, South-Central Interior/Upper Coastal Plain Flatwoods, Southern Appalachian Oak Forest, Southern Interior Low Plateau Dry-Mesic Oak Forest

## **Ecological site concept**

This site is a wetland site formed on very deep (51 to 80+ inches) herbaceous organic soil parent material in depressions on lake and till plains that are very poorly drained.

Fire was the historic disturbance mechanism of the site and was driven by the seasonal presence of water on the site. In the spring and early summer the site is often ponded or flooded to a depth of 30 inches for long stretches of time. The water table recedes as the summer progresses creating a much drier situation that increases the susceptibility of the site to fire. The seasonal flooding and fire return interval of about 15 years created a situation where the site is dominated by herbaceous vegetation.

The characteristic vegetation is herbaceous in nature, mostly dominated by bulrushes and cattails, with a number of sedge species being also being present. Invasive species, specifically phragmites, can invade and come to dominate the site in the absence of management to curtail or prevent its establishment and proliferation. The absence of fire will lead this site to being converted to forest or woodland dominated by wetland or wetland facultative tree species. Currently a large percentage of the site is in agricultural production, notably corn and soybean rotations, after the installation of drainage.

## Similar sites

R111XD020IN	<b>Wet Outwash Mollisol</b> Soil types differ greatly; this on is a mineral parent material (till). Site dominated by prairie grasses.
R111XD007IN	<b>Till Depression Prairie</b> Soil types differ greatly; this on is a mineral parent material (till). Site dominated by prairie grasses.

**Table 1. Dominant plant species**

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) <i>Scirpus</i> (2) <i>Typha latifolia</i>

## Physiographic features

This site is located in the 111D - Indiana and Ohio Till Plain, Western Part MLRA. This site was formed on herbaceous organic material that extends at least 51 inches. It is located in closed depressions on till plains, lake plains, and flood plains.

**Table 2. Representative physiographic features**

Landforms	(1) Depression
Flooding frequency	None
Ponding duration	Brief (2 to 7 days) to very long (more than 30 days)
Ponding frequency	None to frequent
Elevation	143–351 m
Slope	0–2%
Ponding depth	0–76 cm
Water table depth	0–38 cm
Aspect	Aspect is not a significant factor

## Climatic features

The average annual precipitation in this area is 36 to 43 inches (915 to 1,090 millimeters). Most of the rainfall occurs as convective thunderstorms during the growing season. About half or more of the precipitation occurs during the freeze-free period. Snowfall is common in winter. The average annual temperature is 49 to 54 degrees F (10 to 12 degrees C). The freeze-free period averages about 200 days and ranges from 180 to 215 days.

**Table 3. Representative climatic features**

Frost-free period (characteristic range)	131-150 days
Freeze-free period (characteristic range)	171-182 days
Precipitation total (characteristic range)	991-1,092 mm
Frost-free period (actual range)	108-159 days
Freeze-free period (actual range)	169-187 days
Precipitation total (actual range)	991-1,118 mm
Frost-free period (average)	136 days
Freeze-free period (average)	177 days

Precipitation total (average)

1,041 mm

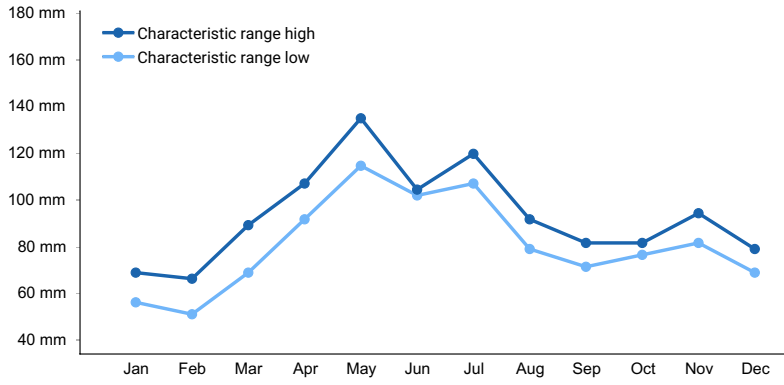


Figure 1. Monthly precipitation range

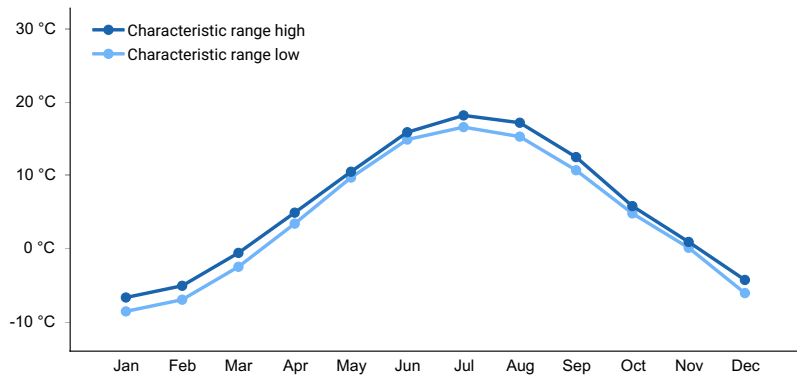


Figure 2. Monthly minimum temperature range

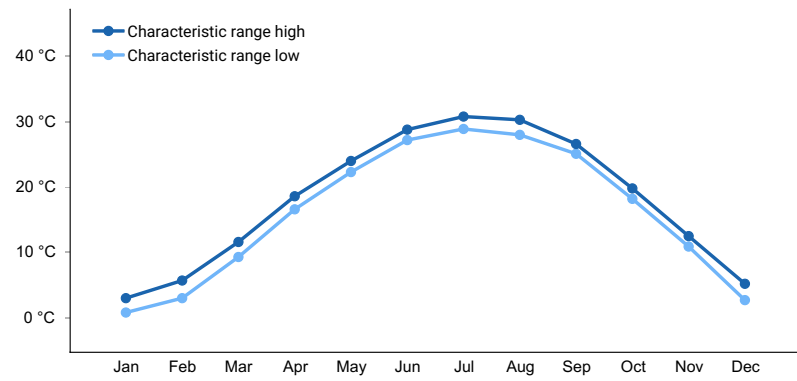


Figure 3. Monthly maximum temperature range

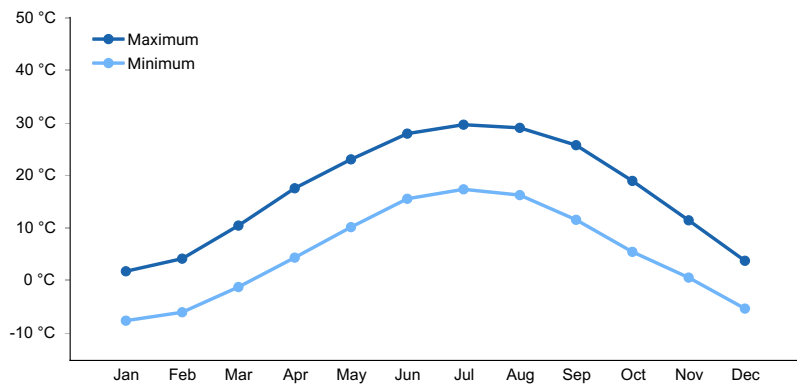


Figure 4. Monthly average minimum and maximum temperature

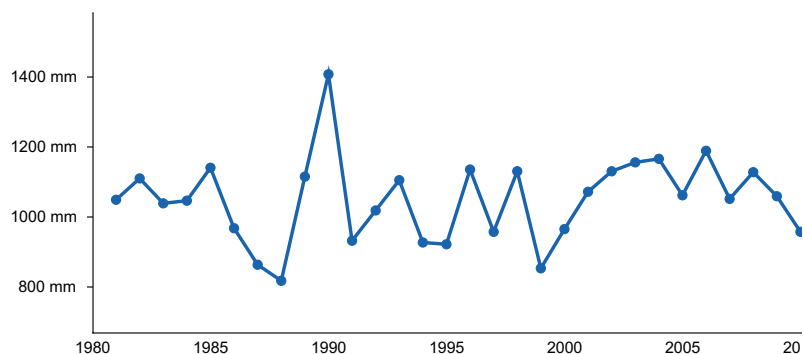


Figure 5. Annual precipitation pattern

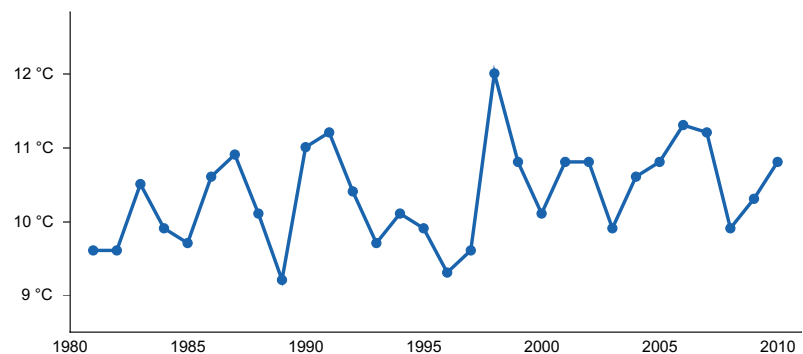


Figure 6. Annual average temperature pattern

### Climate stations used

- (1) DELPHI 2 N [USC00122149], Delphi, IN
- (2) BOSWELL 4WNW [USC00120858], Fowler, IN
- (3) TERRE HAUTE INDIANA ST [USC00128723], Terre Haute, IN
- (4) WABASH [USC00129138], Wabash, IN
- (5) JAMESTOWN 2 E [USC00124356], Lizton, IN
- (6) FAIRFIELD [USC00332651], Hamilton, OH
- (7) WILMINGTON 3 N [USC00339219], Wilmington, OH

### Influencing water features

These wetland systems are groundwater-dependent as well as being, generally, the lowest point in the landscape. Water levels fluctuate seasonally, reaching their peak in spring and lows in late summer. Ponding can occur on the site, generally in the spring, to a depth of 30 inches and can have a very long duration (> 30 days). Water levels typically remain at or near the soils surface throughout the year. The hydrogeographic model classification for this site is ORGANIC SOIL FLATS: Depression, Ground Water Influenced, Pondered; herbaceous. This site has a Cowardin Classification of PEM1Eg; it is a Palustrine system with persistent, emergent vegetation that is seasonally flooded/saturated on organic soil.

### Soil features

The soil series associated with this site are: Houghton. They are very deep, very poorly drained, and moderately slow to moderately rapid permeable soils, with strongly acidic to slightly alkaline soil reaction, that formed in Herbaceous organic material.

Table 4. Representative soil features

Parent material	(1) Herbaceous organic material
Surface texture	(1) Mucky silt loam
Family particle size	(1) Loamy

Drainage class	Very poorly drained
Permeability class	Moderately rapid
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	39.88–40.61 cm
Calcium carbonate equivalent (0-101.6cm)	0–5%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.5–7
Subsurface fragment volume <=3" (Depth not specified)	2–8%
Subsurface fragment volume >3" (Depth not specified)	0%

### Ecological dynamics

The historic plant community of the Deep Muck ecological site is a deep muck wetland. This site is characterized by the soil parent material being composed of herbaceous organic matter to depths of 51-80 inches. The plant community is dominated by bulrush species and cattails. The site is located in closed depressional areas principally associated with glacial lake plains, outwash plains, and till plains. Being the lowest portion of the local landscape, the site is dependent upon groundwater and its fluctuation, which reaches its peak in the spring and low in the late summer. This fluctuation and dominate herbaceous species create a fire dependent system. Replacement fires about every 15 years and seasonal flooding worked in concert to drive the species dominance and richness of the site. Lack of fire for any given time would move this site to one dominated by woody species. Since settlement, most of this site has been converted to agricultural use by drainage installation.

### State and transition model

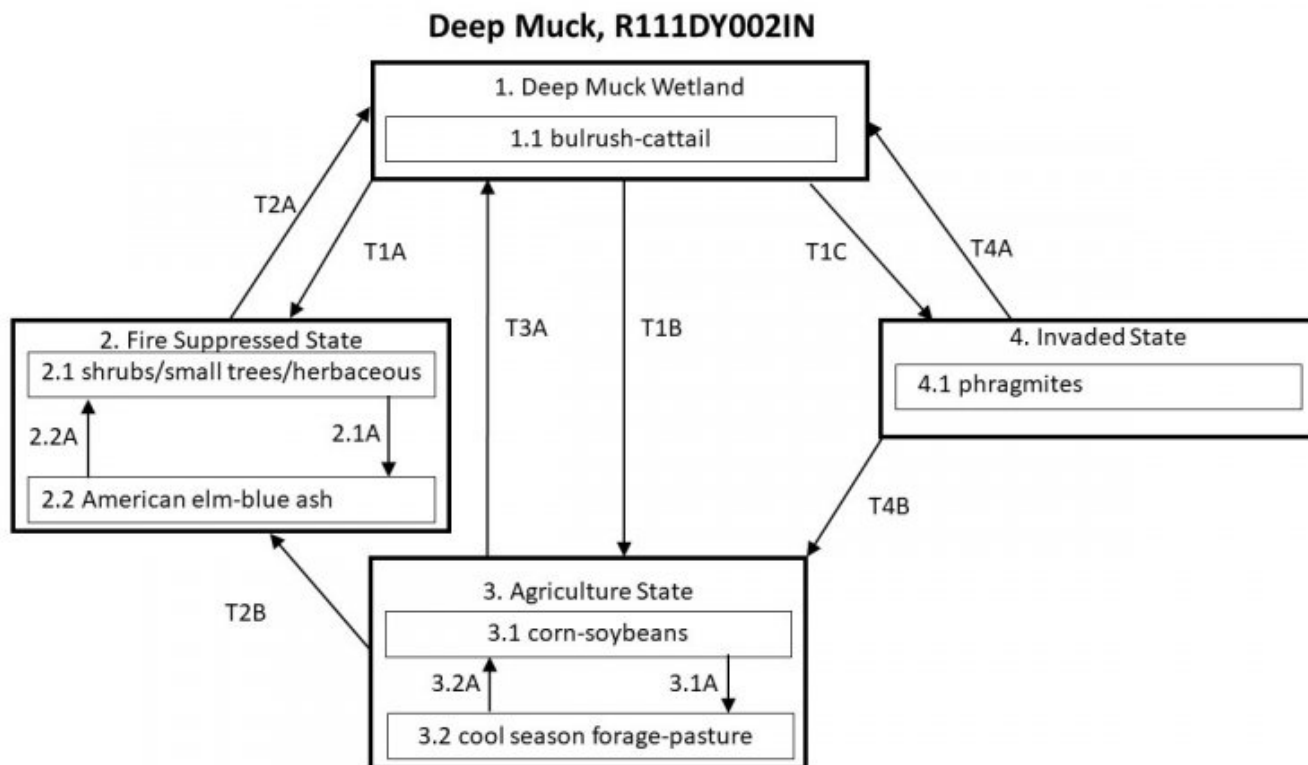


Figure 7. Deep Muck STM

**Deep Muck, R111DY002IN**  
**Diagram Legend**

T1A	No fire, no woody species management
T1B	Drainage, site preparation, planting, management
T1C	Invasion, no management
T2A	Tree removal, planting, fire
T2B	Drainage, site preparation, planting, management
T3A	Drainage removal, planting, fire
T4A	Chemical/mechanical treatment of invasive species, fire
T4B	Drainage, site preparation, planting, management
2.1A	No fire, no woody species management
2.2A	Tree removal, no fire
3.1A	Pasture/forage planting and maintenance
3.2A	Tillage/no-till planting and management of row crops.

Figure 8. Deep Muck Legend

**State 1**  
**Deep Muck Wetland**

This is the reference or diagnostic plant community for this site. In reference conditions, this site was dominated by bulrush and cattails. Sedge species were also a large component of this site along with bluejoint grass. This state was maintained by nearly seasonal flooding and a fire frequency of 15 years. Absence of fire would transition this state to the fire suppressed state, which is dominated by woody species. Shrub or tree removal and the application of fire would transition the site back to this state.

## **Community 1.1**

### **bulrush/cattail**

This is the reference or diagnostic plant community for this site. In reference conditions, this site was dominated by bulrush and cattail. Sedge species were also a large component of this site.

## **State 2**

### **Fire Suppressed State**

This state is characterized by a longer than normal fire return interval or the absence of fire as a disturbance agent. Absence of fire allows for a thick layer of leaf litter to accumulate which suppresses the production of the herbaceous species and allows the woody species to establish and flourish.

## **Community 2.1**

### **shubs/small trees**

This phase is characterized by the establishment and dominance shrubby species and small trees. Common species include dogwood, white sweetmeadow, and willow species.

## **Community 2.2**

### **elm/ash**

This phase is characterized by the establishment and dominance tree species that convert the site to a forest. Common species include American elm, silver maple, and blue ash as dominate.

## **Pathway CP 2.1-2.2**

### **Community 2.1 to 2.2**

Continued absence of fire and/or woody species management will move the site towards phase 2.2.

## **Pathway CP 2.2-2.1**

### **Community 2.2 to 2.1**

Removal of most or all the trees without the application of fire will move the site towards phase 2.1.

## **State 3**

### **Agriculture State**

This site has largely been converted to agricultural use. Most of the historic acres are now in row crop agricultural use. Most common is a corn and soybean rotation of various types. Roughly 14% of the site is not used to grow hay or cool season forage and used for grazing.

## **Community 3.1**

### **corn/soybeans**

This phase is characterized by row crop agriculture of small grains, primarily corn and soybeans.

## **Community 3.2**

### **cool season forage/pasture**

This phase is characterized by forage or grazing agriculture. Different mixes of, generally, cool season grasses and forbs, largely clovers, are grown.

## **Pathway CP 3.1-3.2**

### **Community 3.1 to 3.2**



Planting of cool season pasture/forage species and management to maintain them.

### **Pathway CP 3.2-3.1** **Community 3.2 to 3.1**

Planting, either by conventional or no-till methods, of row crop. Management that keeps the site in row crop production

### **State 4** **Invaded State**

This site is characterized by the establishment of invasive species. Without management the invasive species come to be the dominant species to the exclusion of nearly all other species.

### **Community 4.1** **phragmites**

This phase is characterized by the establishment and eventual dominance of phragmites.

### **Transition T 1-2** **State 1 to 2**

No fire or woody species management will transition this site towards the fire suppressed state. This will result in a loss of herbaceous species production and richness.

### **Transition T 1-2** **State 1 to 2**

No fire or woody species management will transition this site towards the fire suppressed state. This will result in a loss of herbaceous species production and richness.

### **Transition T 1-3** **State 1 to 3**

The installation of drainage either through ditches or field tile or both facilitates the start of the transition to the agriculture state. Planting and management of the selected crop complete the transition.

### **Transition T 1-3** **State 1 to 3**

The installation of drainage either through ditches or field tile or both facilitates the start of the transition to the agriculture state. Planting and management of the selected crop complete the transition.

### **Transition T 1-4** **State 1 to 4**

The establishment of invasive species with out management, to include the use of fire, move the site towards the invaded state. This results in a loss in species richness of the site.

### **Transition T 1-4** **State 1 to 4**

The establishment of invasive species with out management, to include the use of fire, move the site towards the invaded state. This results in a loss in species richness of the site.

### **Restoration pathway R 2-1**

## **State 2 to 1**

Removal of trees and other woody species then planting the site to the desired species. Following these actions with fire will help restore the site to state 1.

## **Restoration pathway R 3-1**

### **State 3 to 1**

Removal of drainage system, site preparation, tree planting, and regular application of fire.

## **Restoration pathway R 4.1**

### **State 4 to 1**

Chemical and mechanical treatment of the invasive species is the first restoration step. Some times biological treatment, to included grazing, can be helpful but is not common in this area. The reapplication of fire after seeding of the appropriate species.

## **Restoration pathway R 4-1**

### **State 4 to 1**

Chemical and mechanical treatment of the invasive species is the first restoration step. Some times biological treatment, to included grazing, can be helpful but is not common in this area. The reapplication of fire after seeding of the appropriate species.

## **Additional community tables**

### **Inventory data references**

Site concept developed through expert opinion, review of the literature, and field work. Field work has included limited field reconnaissance.

### **Other references**

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## Contributors

Tyler Staggs

## Approval

Chris Tecklenburg, 5/28/2020

## 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)	Tyler Staggs
Contact for lead author	
Date	05/03/2024
Approved by	Chris Tecklenburg
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

## Indicators

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

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

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

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

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

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

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

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

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

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

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

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

Dominant:

Sub-dominant:

Other:

Additional:

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

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

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

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if**

their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:

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17. Perennial plant reproductive capability:

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