Ecological site R056BY101MN
Shallow Marsh

Last updated: 9/04/2024
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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): 056B–Glacial Lake Agassiz, Tallgrass Aspen Parklands

MLRA 56B is part of the glacial Lake Agassiz basin, which formed as the lake receded. Most of the area is glaciolacustrine sediments overlying till. This MLRA is entirely in Minnesota and makes up about 4,664 square miles (12,079 square kilometers). It is bordered by beaches and a lake plain on the west (MLRA 56A), by a till plain on thesouth (MLRA 102A), and by a lake plain and till plain on the east (MLRA 88). (United States Department of Agriculture, Agriculture Handbook 296)

Classification relationships

Level IV Ecoregions of the Conterminous United States: 48a Glacial Lake Agassiz Basin; 48b Beach Ridges and Sand Deltas; and 48d Lake Agassiz Plains.

MLRA 56B (United States Department of Agriculture, Agriculture Handbook 296, 2022).

Ecological site concept

The Shallow Marsh ecological site is most commonly located in deep depressions on lake plains, till-floored lake plains, and isolated areas of till plains. It also occurs in depressions and oxbows on flood plains. The slope is less than 2 percent. The common feature of soils in this site is frequent seasonal inundation. Some are in deep depressions and potholes that are ponded through much of the growing season, and some are on flood plains with frequent, long or very long flooding. The soil is very deep and very poorly drained. The site is very poorly drained; under normal climatic conditions, it is ponded for long periods during the growing season. Typically, the depth of ponding is less than 3 feet in the spring and less than 1.5 feet in late summer. Where flooding occurs, it is generally ranges from none to very frequent and of very long duration.

Associated sites

R056BY087MN	**Limy Subirrigated** This site is somewhat poorly drained and occurs on flats adjacent to Shallow Marsh sites. The soils are highly calcareous in the upper part of the subsoil; redoximorphic features at a depth of 18 to 30 inches. All textures are included in the site.
R056BY094MN	**Loamy** This site occurs on nearby uplands. The surface layer and subsoil layers form a ribbon 1 to 2 inches long. It is >30 inches to redoximorphic features.
R056BY095MN	**Subirrigated** This site is somewhat poorly drained and occurs on flats adjacent to Shallow Marsh sites. The soils are non-effervescent to a depth >16 inches; redoximorphic features at a depth of 18 to 30 inches. All textures are included in the site.

R056BY096MN	**Subirrigated Sands** This site occurs on nearby uplands. The upper 20 inches does not form a ribbon. Redoximorphic features occur between 30 and 40 inches.
R056BY102MN	**Wet Meadow** This site is in shallow depressions, on low-lying flats, and on floodplains. It is poorly drained - a seasonal high water table is typically within a depth of 1.5 feet during the months of April through June; in depressions, it is frequently ponded (typically <1.5) from April into July. It typically has redoximorphic features within a depth of 18 inches. Some soils are highly calcareous. It is non-saline to slightly saline (E.C. <8). All textures are included in this site.
R056BY088MN	**Loamy Overflow** This site occurs on floodplain terraces. The surface and subsoil layers form a ribbon 1 to 2 inches long. It is deeper than 30 inches to redoximorphic features.
R056BY084MN	**Clayey** This site occurs on nearby uplands. The subsoil layers form a ribbon >2 inches long. It is >30 inches to redoximorphic features.
R056BY090MN	**Sands** This site occurs on nearby uplands. Between a depth of 10 and 20 inches, the soil does not form a ribbon. It is >40 inches to redoximorphic features.

Similar sites

R056BY102MN	**Wet Meadow** This site is in shallow depressions, on low-lying flats, and on floodplains. It is poorly drained - a seasonal high water table is typically within a depth of 1.5 feet during the months of April through June; in depressions, it is frequently ponded (typically <1.5) from April into July. It typically has redoximorphic features within a depth of 18 inches. Some soils are highly calcareous. It is non-saline to slightly saline (E.C. <8). All textures are included in this site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Carex* (2) *Ranunculus*

Physiographic features

This site typically occurs in deep depressions on lake plains, till-floored lake plains, and isolated areas of till plain; It also occurs in depressions and oxbows on flood plains. Slope is less than 2 percent.

Table 2. Representative physiographic features

Landforms	(1) Lake plain > Depression (2) Till plain > Depression (3) Flood plain
Runoff class	Very low
Flooding duration	Very long (more than 30 days)
Flooding frequency	None to very frequent
Ponding duration	Long (7 to 30 days) to very long (more than 30 days)
Ponding frequency	Frequent
Elevation	229–451 m
Slope	0–2%
Ponding depth	0–30 cm
Water table depth	0–25 cm

Aspect	Aspect is not a significant factor

Climatic features

About 70 percent of the rainfall comes from high-intensity, convective thunderstorms during the growing season. Winter precipitation accounts for about 15 percent of the annual precipitation.

Table 3. Representative climatic features

Frost-free period (characteristic range)	103-108 days
Freeze-free period (characteristic range)	133-136 days
Precipitation total (characteristic range)	559-584 mm
Frost-free period (actual range)	102-110 days
Freeze-free period (actual range)	132-137 days
Precipitation total (actual range)	559-610 mm
Frost-free period (average)	106 days
Freeze-free period (average)	135 days
Precipitation total (average)	584 mm

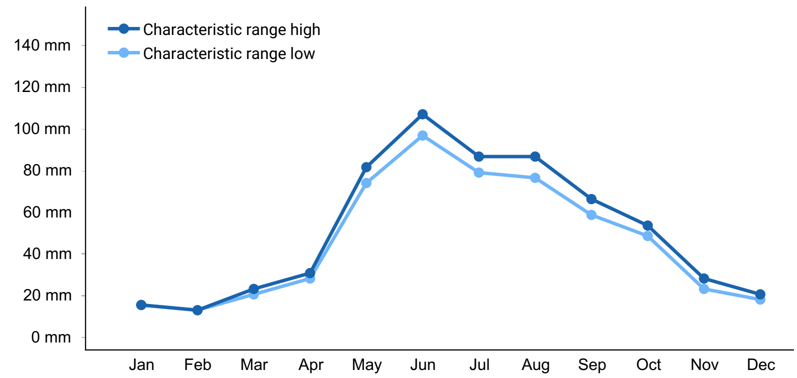


Figure 1. Monthly precipitation range

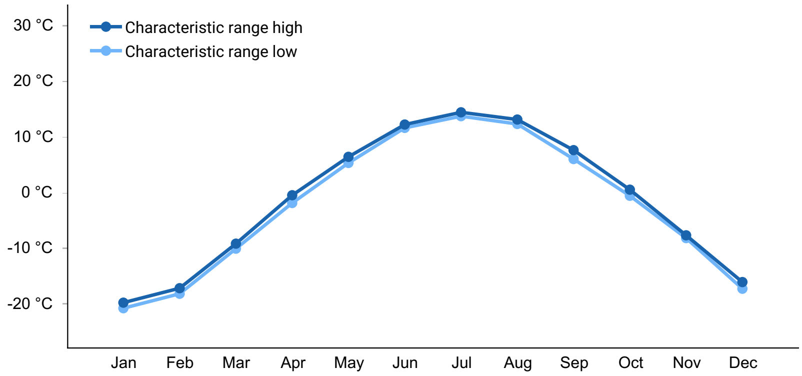


Figure 2. Monthly minimum temperature range

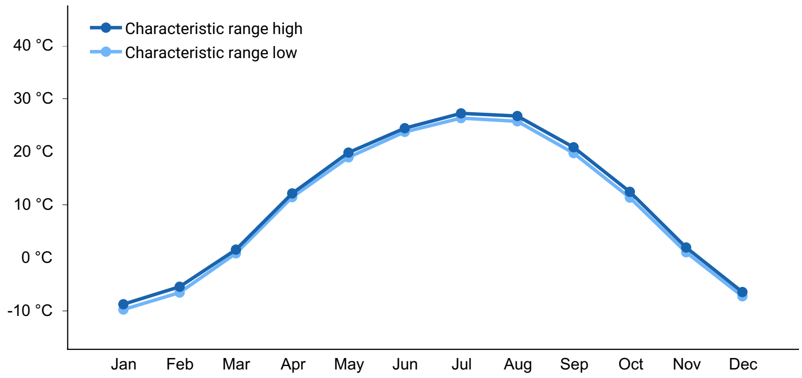


Figure 3. Monthly maximum temperature range

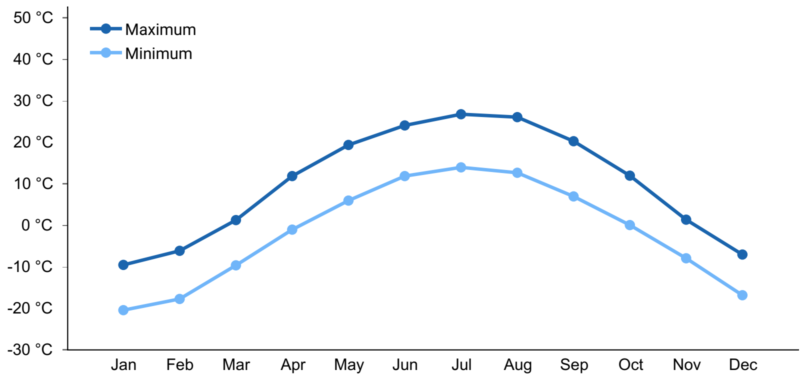


Figure 4. Monthly average minimum and maximum temperature

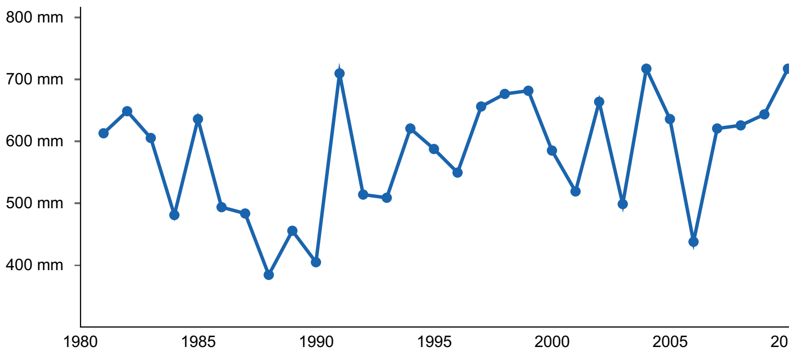


Figure 5. Annual precipitation pattern

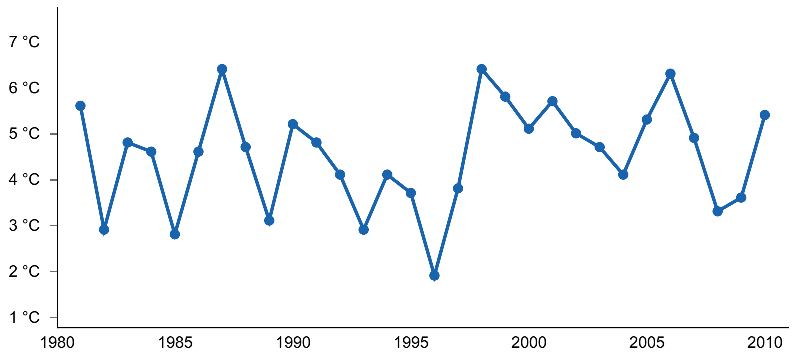


Figure 6. Annual average temperature pattern

Climate stations used

- (1) GOODRIDGE 12 NNW [USW00004994], Grygla, MN
- (2) AGASSIZ REFUGE [USC00210050], Grygla, MN
- (3) RED LAKE FALLS [USC00216787], Red Lake Falls, MN

- (4) CROOKSTON NW EXP STN [USC00211891], Crookston, MN
- (5) HALLOCK [USC00213455], Hallock, MN

Influencing water features

This site is very poorly drained. Under normal climatic conditions, it is inundated for very long periods (>30 days) during the growing season. Some soils in this site have endosaturation (apparent water table) and others have episaturation (perched water table above a subsoil layer with low or moderately low saturated hydraulic conductivity). Water tables in endosaturated soils typically range from 1.5 feet above to 10 inches below the surface during most of the growing season. The depth of ponding on episaturated soils, typically, is less than 3 feet in the spring and less than 1.5 feet in late summer. Surface water may not be evident in late summer; but saturation is generally within a depth of 10 inches during this time.

Water on the site is typically received from upland runoff, but on flood plains it is from stream overflow. Soils occurring on flood plains have frequent, long or very long flooding. Surface infiltration ranges from very slow to very rapid. Saturated hydraulic conductivity ranges from low to very high. These typically are flow-through wetlands but can also be recharge wetlands.

Wetlands receive water from different sources including ground water movement. Recharge wetlands have groundwater flow predominantly away from the wetland moving toward or into a flowthrough or discharge wetland basin. Flowthrough wetlands have groundwater flowing away from the wetland basin but is balanced with water flowing into the basin.

Water loss is primarily through evapotranspiration and lateral movement into (and evaporation from) adjacent soils. During periods of drought or extreme wetness, water table fluctuations will also have an impact on depth of ponding, especially in sandy soils. During periods of drawdown (e.g. prolonged drought), soil and water chemistry may significantly impact the soil/water/vegetation dynamics of the site (see Site Development and Testing Plan).

Fluctuations in specific conductance are less pronounced during average or normal water conditions than during periods of excessive water depth or extreme drought. The approximate normal and extreme range in specific conductance (micromhos/cm3) of surface water in plant communities that are indicators of differences in average salinity are as follows:

Plant Community Normal Range (micromhos/cm3) Electroconductivity (dS/m)
Fresh <40 - 500 0.5
Slightly brackish 500 - 2,000 0.5 to 2.0
Moderately brackish 2,000 - 5,000 2.1 to 5.0
Brackish 5,000 - 15,000 5.1 to 15.0
Sub-saline 15,000 - 45,000 15.1 to 45.0
Saline 45,000 -100,000 > 45.0

Wetland description

Wetland Description: Cowardin, et al., 1979
System: Palustrine
Subsystem: N/A
Class: Persistent Emergent Wetland
Sub-class: Seasonally Flooded or Saturated

Soil features

Soils associated with Shallow Marsh ES include mineral and organic soils. They are in the Mollisol, Vertisol, Inceptisol, Entisol, and Histosol orders. Soils on this site were developed under wetland vegetation associated with very long periods of inundation. They formed in glaciolacustrine sediments and local alluvium from till and glaciolacustrine sediments. A few inches of organic materials are common on the surface of mineral soils that have never been cultivated.

The common feature of soils in this site is frequent seasonal inundation (typically extends into mid-summer or longer). Some are in deep depressions and potholes that are ponded through much of the growing season. The soils are very deep and very poorly drained. Since hydrology (surface and sub-surface) is the primary factor used in identifying this site, all textures are included. Therefore, soil physical properties associated with texture vary widely. The dark-colored surface soil typically is more than 7 inches thick and generally more than 20 inches thick; however, soils with thin topsoil layers (<7 inches thick) also occur.

This site should show no evidence of rills, wind-scoured areas, or pedestaled plants. The soil surface is stable and intact. Sub-surface soil layers are non-restrictive to root penetration, but in some soils water movement downward is slowed. These soils are not susceptible to water erosion. Inundated water conditions strongly influence the soil/water/plant relationship.

Major mineral soil series correlated to the Shallow Marsh site are: Clearwater, Rauville, Roliss, Smiley, and Venlo. Very poorly drained phases of the Augsburg, Borup, Colvin, Cormant, Percy, and Rosewood are also included in the site. Major organic soils and mineral soils with a histic epipedon currently included in this site are Berner, Cathro, Deerwood, Dora, Hamre, Haug, Markey, Northwood, Rifle, Seelyeville, and Wildwood (see Site Development and Testing Plan below). Also, currently included in the site is the Southam soil which has nearly continuous ponding (3 to >5 feet deep).

Access Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx) for specific local soils information.

Table 4. Representative soil features

Parent material	(1) Organic material (2) Till (3) Glaciolacustrine deposits
Surface texture	(1) Mucky (2) Loam (3) Fine sandy loam
Drainage class	Very poorly drained
Permeability class	Moderately slow to rapid
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	16.51–34.8 cm
Soil reaction (1:1 water) (0-25.4cm)	5.6–7.8
Subsurface fragment volume <=3" (0-101.6cm)	0–11%
Subsurface fragment volume >3" (0-101.6cm)	0–2%

Ecological dynamics

This ecological site description is based on nonequilibrium ecology and resilience theory and utilizes a State-and-Transition Model (STM) diagram to organize and communicate information about ecosystem change as a basis for management. The ecological dynamics characterized by the STM diagram reflect how changes in ecological drivers, feedback mechanisms, and controlling variables can maintain or induce changes in plant community composition (phases and/or states). Weather variables that dramatically change water depths and water chemistry, coupled with the application of various management actions, impact the ecological processes which influence the competitive interactions thereby maintaining or altering plant community structure. Due to these climatic and management factors, species composition within Plant Community Phases and States can be highly variable.

Drainage/Hydrological Manipulation: Hydrological manipulation (surface or tile drainage, pumping, surface water diversion, etc.) modifies this ecological site. For more detailed information on drainage/hydrological manipulation of the site, see the “Hydrology Functions” section of this document.

MLRA 56 has a wide variation of Shallow Marsh sites mainly driven by differences in water source and water chemistry. The Shallow Marsh ecological sites in the Sheyenne Delta region of the MLRA are driven by ground water fluctuations and are mainly freshwater. Shallow Marsh ecological sites in the northwestern portions of the MLRA are driven by highly saline ground water and can become very brackish dependent upon runoff from snowmelt and rainfall. Water in Shallow Marsh ecological sites in the northeast region is derived from runoff, stream flow, and groundwater sources, it has circumneutral pH (6.0–8.0) and high mineral and nutrient content. Refer to Site Development and Testing Plan section at end of this document.

This site developed under Northern Great Plains climatic conditions which included frequent droughts and wide fluctuations in temperature and precipitation which can result in both short-term and long-term changes in water levels and water chemistry (e.g. alkalinity/salinity). Unlike adjoining upland ecological sites, which are strongly influenced by grazing and fire, the primary ecological drivers for the Shallow Marsh ecological sites are hydrology and water chemistry. Hydrology is mainly a factor of landscape position, including the size of the contributing watershed, connectivity to other basins, ground water movement, and whether the basin has an outlet. Water chemistry is influenced by soil chemistry and whether the site is a recharge or flowthrough site.

Shallow Marsh ecological sites are highly influenced by water levels, including saturated soil, water movement, and water chemistry (i.e. recharge and flowthrough hydrology). Water levels, including soil saturation, influence fire effectiveness and livestock use. Water levels also influence exotic species invasion. As Shallow Marsh sites drawdown (drying and losing soil moisture), they transition to functioning similar to Wet Meadow ecological sites and can increase in salinity/alkalinity. Salt and grazing tolerant foxtail barley can dominate the site during the drawdown phase. Extended periods of drawdown accompanied by grazing may cause this site to function similar to a Saline Lowland or other upland ecological sites. Many factors will dictate the speed of exotic species invasion including duration of drawdown phase, management of the sites during the drawdown phase, change in soil chemistry, and availability of exotic species seed or plants parts. Exotic species invasion usually begins to occur on adjacent Wet Meadow ecological sites, within or between basins, and then moves into the Shallow Marsh ecological site. During extended periods of drawdown, presence of exotic species adjacent to the site and lack of fire or heavy continuous livestock grazing can speed up the invasion of foxtail barley and cool-season exotic grasses such as quackgrass and barnyard grass or forbs such as Canada thistle or sow thistle. Extended periods of drawdown will also allow upland invasive species, such as leafy spurge and Russian olive, to invade the site.

Once the site is invaded, increased water depth can inundate exotic species to a depth above plant height, causing considerable mortality, allowing restoration from the State 2: Native/Invaded State to the State 1: Reference State. Salt accumulation will be difficult to reverse back to levels prior to extended periods of drawdown and may take extended periods of inundation. In addition, exotic grasses (e.g. quackgrass) and foxtail barley can tolerate extended periods of inundation or saturation, which may never totally drown out along the outer margins of the adjacent Wet Meadow or Saline Lowland ecological sites. The continued presence of cool-season exotic grasses will cause this site to transition from State 1: Reference State and State 2: Native/Invaded State as water levels naturally fluctuate.

During extended periods of drawdown, heavy continuous grazing without adequate recovery periods following each grazing occurrence favors foxtail barley (e.g. Community Phase 2.2). During periods of normal water level, extended periods of no use or no fire often favor exotic species such as reed canarygrass (e.g. Community Phase 2.1) or hybrid cattail. Annual cropping of the site or adjacent upland sites increases nutrient and sediment movement into this ecological site favoring hybrid cattail (State 3.0).

At times, particularly during periods of soil saturation with little standing water, Shallow Marsh sites may be susceptible to pugging damage or hummocking of the soil by livestock walking on the site. Pugging is a form of soil compaction due to livestock activity which damages the soil structure. It can seal the soil surface which reduces infiltration and exacerbates waterlogging of the topsoil. The micro-topography created by pugging generally supports plants of more well drained conditions (e.g. adjacent uplands) and is often associated with an increase in weedy species. This can lead to a significant reduction in herbage production and utilization.

Five vegetative states have been identified for the site (Reference, Native/Invaded, Invaded, Go-Back, and cropland). Within each state, one or more community phases have been identified. These community phases are named based on the more dominant water phases and visually conspicuous species and have been determined by study of historical documents, relict areas, scientific studies, and ecological aspects of plant species and plant communities. However, this ecological site is quite dynamic due to wide variations in water depth, water chemistry, and other environmental factors. Management factors are also widely variable. As a result, the species composition and productivity of all states and community phases can vary considerably. Transitional pathways and thresholds have been determined through similar methods.

State 1: Reference State represents the natural range of variability that dominated the dynamics of this ecological site prior to European influence when the primary disturbance mechanisms for this site included water level fluctuations. Periodic fire and grazing by large herding ungulates were not a major disturbance mechanism. Spring snowmelt runoff and rainfall events, coupled with subsurface groundwater movement, dictated the dynamics that occurred within the natural range of variability. Due to those variations, the Reference State is thought to have shifted temporally and spatially between four Plant Community Phases.

Water level fluctuations and water chemistry are the present-day primary disturbances. However, during drawdown phases, livestock grazing and a lack of fire impact this ecological site. Because of the changes in these and other environmental factors, the Reference State is becoming increasingly rare. Once adjacent upland ecological sites are converted to cropland, the Reference State can no longer exist due to sedimentation and increased nutrient loading to the site. The presence of exotic species on the site precludes it from being placed in the Reference State. It must then be placed in one of the other states, most commonly State 2: Native/Invaded State (T1A).

State 2: Native/Invaded State: Colonization of the site by exotic species results in a transition from State 1: Reference State to State 2: Native/Invaded State (T1A). This transition is probably inevitable; it often results from colonization by exotic species or their hybrids, commonly hybrid cattail or exotic strains/hybrids of reed canarygrass. Three community phases have been identified for this state. The exotic species/hybrids can be expected to increase. Hybrid cattail and exotic strains/hybrids of reed canarygrass tend to form virtual monocultures and, as such, plants more desirable to wildlife and livestock decline.
Maintenance of communities on the periphery of the wetland (e.g. Wet Meadow ecological site, adjacent upland sites) are critical to the ecological integrity/functioning of the wetland ecosystem. If a buffer zone (50 feet minimum) is not maintained, an increase in eutrophication, sedimentation rate, and invasion by exotic species can be expected. For more information on buffer widths please refer to the Gilbert et.al. (2006) in the references section.

To slow or limit the invasion of these exotic species and their hybrids, it is imperative that managerial options (e.g. prescribed grazing, prescribed burning, maintaining intact buffers) be carefully constructed and evaluated with respect to that objective. If management does not include measures to control or reduce these exotic cool-season grasses, the transition to State 3: Invaded State should be expected (T2A).

State 3: Invaded State: The threshold for this state may be reached when hybrid cattail or the exotic strains/hybrids of reed canarygrass exceed 30% of the plant community and native plants represent less than 40% of the community. One plant community phase has been identified for this state. This state is typically dominated by hybrid cattail or exotic strains/hybrids of reed canarygrass. These species typically form virtual monocultures; as a result, plant diversity is low and habitat suitability for some wildlife species is low as well (e.g. hybrid cattail dominated wetlands may not provide waterfowl habitat but may provide white-tailed deer winter habitat).

A restoration pathway to State 1: Reference State may be accomplished with the implementation of a successful wetland restoration or seeding, increased water regime, vegetative chemical treatment, and/or sediment/nutrient removal (R3A). However, it has been difficult and perhaps expensive. A failed wetland restoration or seeding will lead to State 2: Native/Invaded State (R3B).

State 4: Go-Back State often results following cropland abandonment during periods of extended below average precipitation or drought and consists of only one plant community phase which often is composed of a variety of annual forbs, grasses, spike rushes, etc. including noxious weeds (e.g. Canada thistle) which may need control. Over time, the site will likely become dominated by exotic strains or hybrids of reed canarygrass and/or hybrid cattail. Cessation of annual cropping followed by a successful wetland restoration/planting with prescribed burning and vegetative management may lead to State 2: Native/Invaded State (R4A). A failed wetland restoration/seeding with no use and no fire will likely lead to State 3: Invaded State R4B).

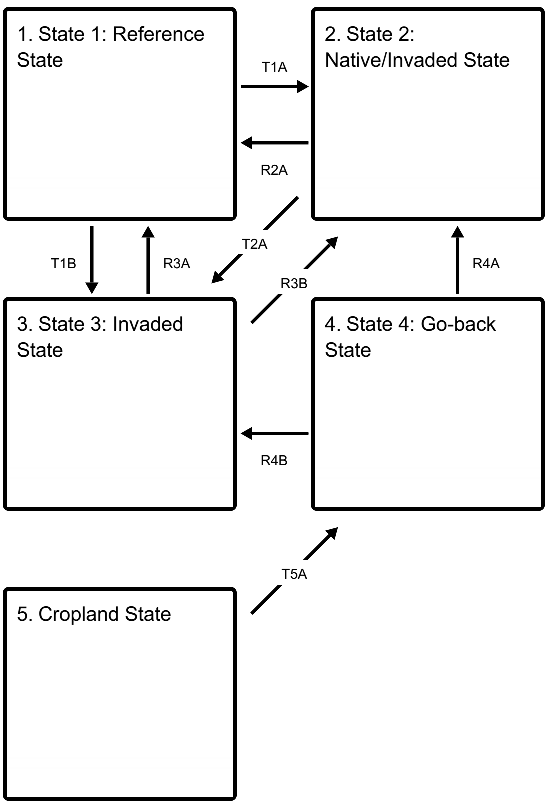
State 5: Cropland State results from planting and production of annual crops. This plant community is most commonly associated with cropped fields. Soil conditions can be quite variable on the site, in part due to variations in the management/cropping history (e.g. development of tillage induced compaction, erosion, fertility, herbicide/pesticide carryover). Thus, soil conditions should be assessed when considering restoration techniques.

The following state and transition model diagram illustrate the common states, community phases, community pathways, transition and restoration pathways that can occur on the site. These are the most common plant community phases and states based on current knowledge and experience; changes may be made as more data are collected. Pathway narratives describing the site's ecological dynamics reference various water regimes and are influenced by management practices (e.g. prescribed grazing, prescribed burning, brush management, herbaceous weed treatment) which, if properly designed and implemented, will positively influence plant community competitive interactions. The design of these management practices will be site specific and should be developed by knowledgeable individuals, based upon management goals, a resource inventory, and supported by an ongoing monitoring protocol.

Due to variations in management, climate, and other factors, the botanical composition within Plant Community Phases and States can be highly variable. The sites are dominantly driven by water depth and water chemistry (local and regional). When the management goal is to maintain an existing plant community phase, modification of existing management to ensure native species have the competitive advantage may be required. To restore a previous state, or restore to another phase within the same state, water depth and water chemistry may need to be modified, which is rarely available to managers except under hydrological restoration applications. Whether using prescribed grazing, prescribed burning, or a combination of both with or without additional practices, the timing and method of application needs to favor the native species over the exotic species. Adjustments to account for variations in annual growing conditions and implementing an ongoing monitoring protocol to track changes and adjust management inputs to ensure desired outcome will be necessary. The plant community phase composition table(s) has been developed from the best available knowledge including research, historical records, clipping studies, and inventory records. As more data are collected, plant community species composition and production information may be revised.

State and transition model

Ecosystem states



T1A - Invasion by exotic plants, no-use no fire, heavy season-long grazing, decrease in water depth

T1B - Tillage with increased eutrophication and sedimentation

R2A - Increased water depth.

T2A - Tillage with increased eutrophication and sedimentation

R3A - Successful wetland restoration or seeding, increased water depth, chemical treatment and/or sediment/nutrient removal, with successful buffer or upland restoration

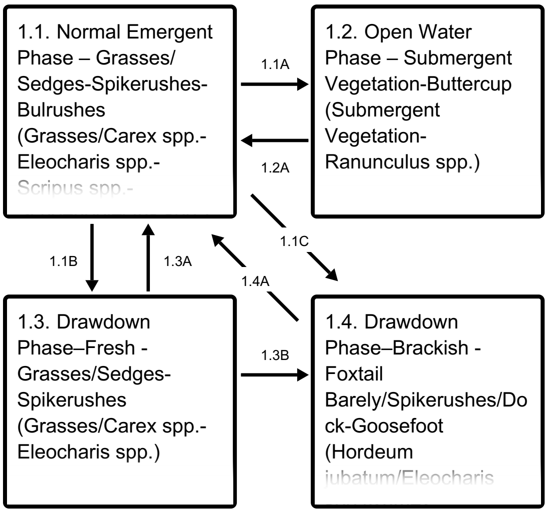
R3B - Successful wetland restoration or seeding, increased water depth, chemical treatment and/or sediment/nutrient removal, with successful buffer or upland restoration

R4A - Cessation of annual cropping, successful wetland restoration/seeding, prescribed fire, vegetation management

R4B - Cessation of annual cropping, failed wetland restoration/seeding, no-use and no fire

T5A - Cessation of annual cropping

State 1 submodel, plant communities



1.1A - Increase in water depth, above average precipitation

1.1B - Drawdown phase, below average precipitation, fresh

1.1C - Drawdown phase, below average precipitation, more brackish

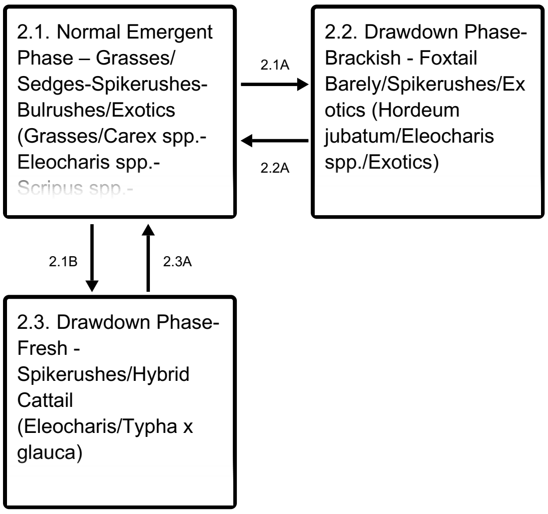
1.2A - Drawdown phase, below average to average precipitation

1.3A - Average to above average precipitation, increase in water depth

1.3B - Season-long grazing, no change in precipitation

1.4A - Average to above average precipitation with increased water depth above plant height to cause plant mortality

State 2 submodel, plant communities



2.1A - Heavy season-long grazing, drawdown phase, saline soils (discharge site)

2.1B - Heavy season-long grazing, drawdown phase, non-saline (recharge/flowthrough site)

2.2A - Prescribed grazing, increase in water depth

2.3A - Prescribed grazing, increase in water depth

State 3 submodel, plant communities

3.1. Hybrid Cattail or Reed Canarygrass (Typha x glauca or Phalaris arundinacea)

State 4 submodel, plant communities

4.1. Annual/Pioneer Perennial/Exotics

State 1
State 1: Reference State

This state represents the natural range of variability that dominated the dynamics of this ecological site prior to European settlement. Historically the primary disturbance mechanisms for this site in the reference condition were large fluctuations of the water table, water levels, soil saturation, and water chemistry (e.g. brackishness/salinity/alkalinity). Periodic fire and grazing by large herding ungulates were also historical disturbances that influenced this site but to a much lesser degree. Climate, weather, and drawdown events, combined with the timing of fires and grazing, dictated the dynamics that occurred within the natural range of variability. Presently, the main disturbances are climate, weather events, water level fluctuations, lack of fire, concentrated livestock grazing, and agronomic activities on adjacent ecological sites (e.g. tillage, fertilizer and herbicide use, drainage). The Reference State is composed of four community phases. These phases are largely due to weather and climate factors resulting in considerable fluctuations in water levels and water chemistry (e.g. brackishness). Brackishness, along with water depth, is also a major factor influencing vegetation of the site. Brackishness can be natural due to the type of hydrology and soils of the site. Exotic perennial species do not exist in this state. .

Characteristics and indicators. (i.e. characteristics and indicators that can be used to distinguish this state from others). Exotic species and hydrologic manipulation would not be present on this site when it is in State 1: Reference State.

Resilience management. (i.e. management strategies that will sustain a state and prevent a transition). If intact, the reference state should be managed with current disturbance regimes which has permitted the site to remain in reference condition as well as maintaining the quality and integrity of associated ecological sites. Maintenance of the reference state is contingent upon a monitoring protocol to guide management.

Dominant plant species

- common rivergrass (*Scolochloa festucacea*), grass
- fowl mannagrass (*Glyceria striata*), grass
- American sloughgrass (*Beckmannia syzigachne*), grass
- slimstem reedgrass (*Calamagrostis stricta*), grass
- wheat sedge (*Carex atherodes*), other herbaceous
- common threesquare (*Schoenoplectus pungens*), other herbaceous
- bur-reed (*Sparganium*), other herbaceous
- common spikerush (*Eleocharis palustris*), other herbaceous
- spotted water hemlock (*Cicuta maculata*), other herbaceous
- water knotweed (*Polygonum amphibium*), other herbaceous

Community 1.1
Normal Emergent Phase – Grasses/ Sedges-Spikerushes-Bulrushes (Grasses/Carex spp.-

Eleocharis spp.-Scripus spp.- Schoenoplectus spp.)

This community phase was historically the most dominant both temporally and spatially. Botanical composition can be quite variable due to variations in water chemistry and other factors. It is often dominated by tall and mid, cool-season graminoids along with sedges, spikerushes and bulrushes. The dominant grass species include common rivergrass (aka whitetop), mannagrass (i.e. American mannagrass, fowl mannagrass), slimstem reedgrass, bluejoint and American sloughgrass. Wheat sedge is the primary sedge; bulrushes may include common threesquare (may become dominant in brackish waters); and spikerush includes common spikerush and needle spikerush. Common forbs include bur-reed (mostly broadfuit bur-reed), spotted water hemlock, hemlock water parsnip, water knotweed, and common bladderwort. Moss (Drepanocladus spp.) often covers much of the soil surface during drawdown phase. Bulrushes, such as hardstem, river, or softstem bulrush may also be present in the transition zone to Deep Marsh ecological sites. Fowl bluegrass, northern reedgrass, and prairie cordgrass along with various forbs and sedges occur in the transition zone to Wet Meadow ecological sites. Annual production can be quite variable but may range from 5800-7800 pounds per acre with graminoids and forbs contributing 95% and 5% of the production, respectively. This is the reference plant community phase and is described in the “Plant Community Composition and Group Annual Production” portion of this ecological site description.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	6176	7229	8305
Forb	325	381	437
Total	**6501**	**7610**	**8742**

Community 1.2
Open Water Phase – Submergent Vegetation-Buttercup (Submergent Vegetation-Ranunculus spp.)

This community phase occurs when increased precipitation or other factors cause the water levels to increase in depth for a sufficient period of time for the site to become dominated by open water submergent species such as buttercup (e.g. yellow water buttercup, longbeak buttercup). With a decrease in water levels (e.g. return to average precipitation/runoff), the plant community should return to Community Phase 1.1. Annual production can be quite variable due to wide variations in water chemistry, hydrology, and other factors.

Community 1.3
Drawdown Phase–Fresh - Grasses/Sedges-Spikerushes (Grasses/Carex spp.-Eleocharis spp.)

This community phase occurs during prolonged dry periods or other factors leading to decreased water depth and more brackish conditions. Woolly sedge, spikerush (e.g. common spikerush, needle spikerush), slimstem reedgrass, and other sedges from the adjacent, drier sites encroach onto the site. An increase in species characteristic of more brackish conditions can also be expected. With an increase in water depth (e.g. return to average precipitation) the plant community will readily return to Community Phase 1.1. Annual production can be quite variable due to wide variations in water chemistry, hydrology, and other factors.

Community 1.4
Drawdown Phase–Brackish - Foxtail Barely/Spikerushes/Dock-Goosefoot (Hordeum jubatum/Eleocharis spp./Rumex spp./Chenopodium spp.)

This community phase occurs on some wetland soils during a drawdown phase causing more brackish conditions, perhaps coupled with heavy season-long grazing. This leads to a marked increase in foxtail barley, spikerush (e.g. common spikerush, needle spikerush), speedwell, dock (e.g. golden dock, western dock) and goosefoot (e.g. red goosefoot). American sloughgrass, knotweeds, and cinquefoils can also be common associates of this community phase. Annual production and the extent of bare ground can be quite variable. With continued heavy season-long grazing, increased soil compaction may result in high amounts of bare ground or in the colonization of exotic forbs and grasses. If this occurs, the site will likely begin transition to State 2: Native/Invaded State or State3: Invaded State.

Pathway 1.1A
Community 1.1 to 1.2

Community Phase 1.1 to 1.2 occurs with above average precipitation or other factors causing an increase in water depth sufficient to shift the vegetation from a diverse mixture of grasses, sedges, spikerushes, and bulrushes to one with more extensive open water supporting buttercup.

Pathway 1.1B
Community 1.1 to 1.3

Community Phase 1.1 to 1.3 occurs with below average precipitation or other factors causing a drawdown phase with the fresh-water, shifting the vegetation to woolly sedge, spikerush, and slimstem reedgrass.

Pathway 1.1C
Community 1.1 to 1.4

Community Phase 1.1 to 1.4 occurs during a drawdown phase with the water becoming more brackish. This shifts the dominant vegetation from a diverse mixture of grasses, sedges, spikerushes and bulrushes, to foxtail barley, spikerush, and dock.

Pathway 1.2A
Community 1.2 to 1.1

Community Phase Pathway 1.2 to 1.1 occurs during times of below average precipitation or other conditions that result in a drawdown phase or drop in water levels sufficient to cause a shift in the vegetation from submergent species such as buttercup to a diverse mixture of grasses, sedges, spikerushes and bulrushes.

Pathway 1.3A
Community 1.3 to 1.1

Community Phase Pathway 1.3 to 1.1 occurs during times of above average precipitation leading to an increase in water depth sufficient to cause a shift in the dominant vegetation from woolly sedge, spikerush, and slimstem reedgrass to a diverse mixture of grasses, sedges, spikerushes and bulrushes.

Pathway 1.3B
Community 1.3 to 1.4

Community Phase Pathway 1.3 to 1.4 occurs with heavy season-long grazing leading to a change from grasses, woolly sedge, spikerush, and slimstem reedgrass to one dominated by foxtail barley, spikerush, dock, and goosefoot.

Pathway 1.4A
Community 1.4 to 1.1

Community Phase Pathway 1.4 to 1.1 occurs with above average precipitation or other factors causing an increase in water depth sufficient to shift the vegetation from foxtail barley and associates to a diverse mixture of grasses, sedges, spikerushes and bulrushes.

State 2
State 2: Native/Invaded State

This state is characterized by the colonization and establishment of minor amounts of exotic plants. Reed canarygrass is native to North America, but exotic strains (largely Eurasian) have been widely introduced and, along with their hybrids, can be quite invasive. Hybrid cattail, the hybrid between narrowleaf cattail and broadleaf cattail is also a common exotic. Canada thistle is also known to invade the site during dry periods. Although the site is still dominated by native plants, an increase in exotic plants can be expected. Unless a prescribed grazing and/or prescribed burning program is implemented, or an increase in water depth drowns out exotic species, a transition to

State 3: Invaded State can be expected.

Characteristics and indicators. The presence of trace amounts of exotic species/hybrids (e.g. cattail, reed canarygrass) indicates a transition from State 1 to State 2.

Resilience management. Implementation of management techniques and monitoring procedures designed to limit or control exotic species/hybrids.

Dominant plant species

- fowl mannagrass (*Glyceria striata*), grass
- common rivergrass (*Scolochloa festucacea*), grass
- slimstem reedgrass (*Calamagrostis stricta*), grass
- American sloughgrass (*Beckmannia syzigachne*), grass
- reed canarygrass (*Phalaris arundinacea*), grass
- foxtail barley (*Hordeum jubatum*), grass
- curly dock (*Rumex crispus*), other herbaceous
- oakleaf goosefoot (*Chenopodium glaucum*), other herbaceous
- wheat sedge (*Carex atherodes*), other herbaceous
- needle spikerush (*Eleocharis acicularis*), other herbaceous
- bur-reed (*Sparganium*), other herbaceous
- spotted water hemlock (*Cicuta maculata*), other herbaceous
- common bladderwort (*Utricularia macrorhiza*), other herbaceous

Community 2.1
Normal Emergent Phase – Grasses/ Sedges-Spikerushes-Bulrushes/Exotics (Grasses/Carex spp.-Eleocharis spp.-Scripus spp.- Schoenoplectus spp./Exotics)

This is the wetter community phase of State 2: Native/Invaded State. This community is similar to Community Phase 1.1. However, exotic species such as exotic strains/hybrids of reed canarygrass or hybrid cattail, curly dock, narrowleaf dock, oakleaf goosefoot, marshpepper knotweed, spotted ladysthumb, and others are now minor components of the community. Annual production can be quite variable due to wide variations in water chemistry, hydrology, and other factors.

Community 2.2
Drawdown Phase-Brackish - Foxtail Barely/Spikerushes/Exotics (Hordeum jubatum/Eleocharis spp./Exotics)

This is the drier, brackish community phase in State 2: Native/Invaded State. It is dominated by foxtail barley in association with spikerush, dock, and various native forbs such as water knotweed, Mexican dock, curlytop knotweed, Pursh seepweed, goosefoot, and others. Exotic plants may include exotic strains/hybrids of reed canarygrass as well as hybrid cattail, curly dock, narrowleaf dock, oakleaf goosefoot, marshpepper knotweed, spotted ladysthumb, and others which are now minor components of the community. Absinthium (aka wormwood) may also become prominent if the basin dries-up. Annual production and the extent of bare ground can be quite variable.

Community 2.3
Drawdown Phase-Fresh - Spikerushes/Hybrid Cattail (Eleocharis/Typha x glauca)

This is the drier, fresher community phase in State 2: Native/Invaded State. It is dominated by spikerushes and hybrid cattail. Swamp ragwort, burningbush, cocklebur, pale smartweed, and other rather weedy forbs are also common. Exotic strains/hybrids of reed canarygrass may also become minor components of the community. Absinthium (aka wormwood), Canada thistle, and sow thistle may also become prominent if the basin dries-up.

Pathway 2.1A
Community 2.1 to 2.2

Community Phase Pathway 2.1 to 2.2 occurs with heavy, season-long grazing coupled with a drawdown phase and saline soils (discharge site). As the pathway progresses, native plant diversity declines while foxtail barley, spikerush, sedges, knotweed, dock, and exotic forbs increase.

Pathway 2.1B
Community 2.1 to 2.3

Community Phase Pathway 2.1 to 2.3 occurs heavy-season-long grazing coupled with a drawdown phase and non-saline soils (recharge/flowthrough site). As the pathway progresses the site becomes more dominated by spikerushes and hybrid cattail.

Pathway 2.2A
Community 2.2 to 2.1

Community Phase Pathway 2.2 to 2.1 occurs with the implementation of prescribed grazing with the return to near normal precipitation resulting in increased water depth. This leads to a shift from foxtail barley, spikerush, dock, and exotic forbs to one of a diverse mixture of grasses, sedges, spikerushes, and bulrushes along with exotic grasses and exotic forbs.

Pathway 2.3A
Community 2.3 to 2.1

Community Phase 2.3 to 2.1 occurs with the implementation of prescribed grazing with the return to near average precipitation resulting in increased water depth. This leads to increasing prevalence of emergent species such as bulrushes, spikerushes, and sedges.

State 3
State 3: Invaded State

This state occurs when the site becomes dominated by exotic plants. Common exotics of the site include exotic strains/hybrids of reed canarygrass or hybrid cattail. Canada thistle may also invade the site during dry periods. Once the state is established, restoration efforts have proven difficult (see Restoration R3A).

Characteristics and indicators. (i.e. characteristics that can be used to distinguish this state from others). This site is characterized by exotic species/hybrids dominating the site and controlling the ecological processes (i.e. approximately 30 to 40%).

Resilience management. Once established, reed canarygrass and hybrid cattail are very resilient and will withstand grazing, haying pressure, and non-use.

Dominant plant species

- reed canarygrass (*Phalaris arundinacea*), grass
- hybrid cattail (*Typha ×glauca*), other herbaceous

Community 3.1
Hybrid Cattail or Reed Canarygrass (Typha x glauca or Phalaris arundinacea)

Hybrid cattail or exotic strains/hybrids of reed canarygrass often dominate State 3: Invaded State. Whether hybrid cattail or reed canarygrass dominate the site is largely determined by which species propagules (presence/abundance) are present on the site. Diversity plummets with dominance by either of these species, as both form monotypic stands. Hybrid cattail is the hybrid of narrowleaf cattail and broadleaf cattail. The hybrid is also known to backcross with the broadleaf cattail. It is widely regarded as aggressive or invasive and typically forms monotypic stands. It is particularly adapted to nutrient enriched habitats with high sedimentation (i.e. associated with tillage, siltation, drainage). Reed canarygrass is native to North America, but exotic strains have repeatedly been introduced over the years. These exotic strains and their hybrids are regarded as aggressive or invasive, often forming monotypic stands. Reed canarygrass and hybrid cattail are highly adaptive and managerial efforts to control them has been difficult (see Restoration R3A). Annual production can be quite variable due to wide variations in water chemistry, hydrology, and other factors.

State 4
State 4: Go-back State

This state is highly variable depending on the level and duration of disturbance related to the T5A pathway. In this MLRA, the most probable origin of this state is plant succession following crop abandonment. This plant community will initially include a variety of annual forbs and grasses, some of which maybe noxious weeds.

Characteristics and indicators. Tillage has destroyed the native plant community, altered soil structure and biology, increased eutrophication, reduced soil organic matter, and results in the formation of a tillage induced compacted layer which is restrictive to root growth. Noxious weeds, if present, will need to be managed.

Dominant plant species

- reed canarygrass (*Phalaris arundinacea*), grass
- American sloughgrass (*Beckmannia syzigachne*), grass
- foxtail barley (*Hordeum jubatum*), grass
- curly dock (*Rumex crispus*), other herbaceous
- hybrid cattail (*Typha ×glauca*), other herbaceous
- Canada thistle (*Cirsium arvense*), other herbaceous
- field sowthistle (*Sonchus arvensis*), other herbaceous
- goosefoot (*Chenopodium*), other herbaceous

Community 4.1
Annual/Pioneer Perennial/Exotics

This community phase may be quite variable in composition. Vegetation is generally a mix of pioneer species, both native and exotic, as well as some native and exotic perennials such as foxtail barley, reed canarygrass, slough grass, spikerush, speedwell, dock, goosefoot, knotweeds, hybrid cattail, water horehound, field sowthistle, and others. Absinthium and Canada thistle are known to be present during extended drawdown periods. Annual production can be quite variable due to wide variations in water chemistry, hydrology, and other factors.

State 5
Cropland State

Cropland State results from planting and production of annual crops. This plant community is most commonly associated with cropped fields. Soil conditions can be quite variable on the site, in part due to variations in the management/cropping history (e.g. development of tillage induced compaction, erosion, fertility, herbicide/pesticide carryover). Thus, soil conditions should be assessed when considering restoration techniques..

Dominant plant species

- corn (*Zea*), other herbaceous
- soybean (*Glycine*), other herbaceous

Transition T1A
State 1 to 2

This is the transition from the State 1: Reference State to State 2: Native/Invaded State resulting from the colonization and establishment of exotic plants, often exotic strains of reed canarygrass or hybrid cattail. Canada thistle is also known to invade the site during dry periods. Heavy season-long grazing, prolonged periods of no use and no fire, and a decrease in the water regime of the site are often involved with this transition. Excessive litter accumulation provides conditions favorable to hybrid cattail or exotic strains/hybrids of reed canarygrass which can quickly spread to form virtual monocultures. As a result, the transition to State 3: Invaded State can be expected.

Constraints to recovery. (i.e. variables or processes that preclude recovery of the former state). Restoration to State 1 is dependent upon hydrology, condition of adjacent upland ecological sites (i.e. cropland), and abundance of exotic species.

Transition T1B
State 1 to 3

This is the transition from State 1: Reference State to State 3: Invaded State. Although the State 3: Invaded State often forms via State 2: Native/Invaded State, this direct transition to State 3: Invaded State can occur with tillage of the Shallow Marsh ecological site or adjacent upland with an associated increase in eutrophication and sedimentation resulting in vegetation dominance by hybrid cattail or exotic strains/hybrids of reed canarygrass.

Constraints to recovery. Restoration to State 1 is dependent upon hydrology, condition of adjacent upland ecological sites (i.e. cropland), and abundance of exotic species.

Restoration pathway R2A
State 2 to 1

This restoration pathway from State 2: Native/Invaded State to State 1: Refence State is initiated by an increase in water depth sufficient to drown out invasive exotic species. Success of this pathway is dependent upon the invasive species present in State 2 Native/Invaded State. Hybrid cattail and reed canary grass will likely persist with increased water levels, whereas foxtail barley, dock, or Canada and sow thistle will drown out.

Context dependence. (i.e. factors that cause variations in plant community shifts, restoration likelihood, and contribute to uncertainty). Hydrological restoration/management to remove exotic species/hybrids which may necessitate chemical control. Adjacent upland ecological sites will need to remain intact or reseeded to native species in order to prevent sedimentation and nutrient loading to Shallow Marsh ecological site. Prescribed grazing techniques may provide a short-term reduction in reed canarygrass density; however, a combination of mowing and prescribed burning may be more effective than prescribed grazing alone.

Transition T2A
State 2 to 3

The transition from State 2: Native/Invaded State to State 3: Invaded State can occur with tillage within the site or on adjacent upland sites resulting in an increase in eutrophication and sedimentation leading to a dominance of hybrid cattail or exotic strains/hybrids of reed canarygrass. Studies indicate that a threshold may exist in the transition to this Native/Invaded State on some upland ecological sites when Kentucky bluegrass exceeds 30% of the plant community and native grasses represent less than 40% of the plant community composition. Similar thresholds may exist for exotic strains of reed canarygrass and hybrid cattail on this site. Constraints to recovery. Restoration to State 2 is dependent upon hydrology and abundance of exotic species/hybrids.

Constraints to recovery. Restoration to State 2 is dependent upon hydrology and abundance of exotic species/hybrids.

Restoration pathway R3A
State 3 to 1

This restoration pathway from State 3: Invaded State to State 1: Reference State can rarely be accomplished. The likelihood of a successful wetland restoration through hydrological restoration, seeding, increased water regime, chemical treatment, and/or sediment/nutrient removal is limited due the persistence of exotic invasive species such as hybrid cattail or reed canarygrass. A successful upland restoration is also needed to reduce the likelihood of exotic species invasion or continued sedimentation or nutrient loading. It is more likely that a wetland restoration effort that is considered to be successful will eventually end up in State 2.

Context dependence. Reed canarygrass and hybrid cattail are difficult to control, largely due to vigorous spreading rhizomes, high seed production, and a large seed bank. Various control techniques may show signs of success but are often short-term with vegetation reverting within a few years. Adjacent upland ecological sites will need to remain intact or reseeded to native species in order to prevent sedimentation and nutrient loading to the Shallow Marsh ecological site. Prescribed grazing (e.g. heavy seasonal), high-intensity burns, and herbicides have shown some success in reducing the dominance by reed canarygrass. However, within several years the vegetation often reverts. Herbicides can be effective in reducing or eliminating hybrid cattail and can be followed by reseeding (or plugging) desirable species. Prescribed burning has also been effective during dry periods where fire temperatures may kill rhizomes and seeds. Although expensive, mechanical removal of the substrate has also been an effective technique.

Restoration pathway R3B
State 3 to 2

This restoration pathway from State 3: Invaded State to State 2: Native/Invaded State results from a failed restoration or seeding, increased water regime, chemical treatment, and/or sediment/nutrient removal with failed buffer or upland restoration.

Context dependence. Reed canarygrass and hybrid cattail are difficult to control, largely due to vigorous spreading rhizomes, high seed production, and a large seed bank. Various control techniques may show signs of success but are often short-term with vegetation reverting within a few years. Prescribed grazing (e.g. heavy seasonal), high-intensity burns, and herbicides have shown some success in reducing the dominance by reed canarygrass. However, within several years the vegetation often reverts. Herbicides can be effective in reducing or eliminating hybrid cattail and can be followed by reseeding (or plugging) desirable species. Prescribed burning has also been effective during dry periods where fire temperatures may kill rhizomes and seeds. Although expensive, mechanical removal of the substrate has also been an effective technique.

Restoration pathway R4A
State 4 to 2

This restoration pathway from State 4: Go-Back State to State 2: Native/Invaded State results from cessation of annual cropping, successful wetland restoration/seeding/plugging, prescribed burning, and vegetation management.

Context dependence. If manipulated, hydrology needs to be restored. Elevated soil nitrogen levels and sedimentation have been shown to benefit reed canarygrass and hybrid cattail. Sedimentation may need to be removed to preexisting conditions. A successful range planting will include proper seedbed preparation, weed control (both prior to and after the planting), selection of adapted native species representing functional/structural groups inherent to the State 1, and proper seeding technique. Management (e.g. prescribed grazing, prescribed burning) during and after establishment must be applied in a manner that maintains the competitive advantage for the seeded native species.

Restoration pathway R4B
State 4 to 3

This restoration pathway from State 4: Go-Back State to State 3: Invaded State results from cessation of annual cropping followed by a failed wetland restoration/seeding with no use and no fire.

Context dependence. Failure to restore hydrology and failed range plantings can result from many causes, both singularly and in combination, including: drought, poor seedbed preparation, improper seeding methods, seeded species not adapted to the site, insufficient weed control, herbicide carryover, poor seed quality (purity & germination), improper management.

Restoration pathway T5A
State 5 to 4

This transition from any plant community to State 4: Go-Back State. Most commonly, it is associated with the cessation of cropping without the benefit of restoration efforts, resulting in a “go-back” situation. Soil conditions can be quite variable on the site, in part due to variations in the management/cropping history, such as development of a tillage induced compacted layer, erosion, fertility (degree of eutrophication), and sedimentation herbicide/pesticide carryover. Thus, soil conditions should be assessed when considering restoration techniques.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)

Grass/Grasslike					
1	**Grasslikes**			2287–3811	
	wheat sedge	CAAT2	*Carex atherodes*	1524–3049	–
	woolly sedge	CAPE42	*Carex pellita*	152–1143	–
	smoothcone sedge	CALA12	*Carex laeviconica*	152–1143	–
	Sartwell's sedge	CASA8	*Carex sartwellii*	76–381	–
	softstem bulrush	SCTA2	*Schoenoplectus tabernaemontani*	76–381	–
	hardstem bulrush	SCAC3	*Schoenoplectus acutus*	0–381	–
	chairmaker's bulrush	SCAM6	*Schoenoplectus americanus*	0–381	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	76–381	–
	spikerush	ELEOC	*Eleocharis*	76–229	–
	rush	JUNCU	*Juncus*	0–229	–
2	**Grasses**			1905–3049	
	common rivergrass	SCFE	*Scolochloa festucacea*	762–2668	–
	northern reedgrass	CASTI3	*Calamagrostis stricta ssp. inexpansa*	381–1524	–
	American mannagrass	GLGR	*Glyceria grandis*	381–1143	–
	fowl mannagrass	GLST	*Glyceria striata*	76–762	–
	American sloughgrass	BESY	*Beckmannia syzigachne*	0–381	–
	shortawn foxtail	ALAE	*Alopecurus aequalis*	0–381	–
	prairie cordgrass	SPPE	*Spartina pectinata*	0–381	–
3	**Other Native Grasses**			0–381	
	saltgrass	DISP	*Distichlis spicata*	0–381	–
	scratchgrass	MUAS	*Muhlenbergia asperifolia*	0–381	–
Forb					
4	**Forbs**			0–381	
	Forb (herbaceous, not grass nor grass-like)	2FORB	*Forb (herbaceous, not grass nor grass-like)*	76–381	–
	American water horehound	LYAM	*Lycopus americanus*	76–229	–
	smooth joyweed	ALPAP	*Alternanthera paronychioides var. paronychioides*	76–229	–
	northern water plantain	ALTR7	*Alisma triviale*	76–152	–
	Indianhemp	APCA	*Apocynum cannabinum*	76–152	–
	swamp milkweed	ASIN	*Asclepias incarnata*	76–152	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	76–152	–
	curlytop knotweed	POLA4	*Polygonum lapathifolium*	76–152	–
	cinquefoil	POTEN	*Potentilla*	76–152	–
	buttercup	RANUN	*Ranunculus*	76–152	–
	arumleaf arrowhead	SACU	*Sagittaria cuneata*	76–152	–
	marsh skullcap	SCGA	*Scutellaria galericulata*	76–152	–
	marsh fleabane	SECO2	*Senecio congestus*	76–152	–
	giant goldenrod	SOGI	*Solidago gigantea*	76–152	–
	broadfruit bur-reed	SPEU	*Sparganium eurycarpum*	76–152	–
	New England aster	SYNO2	*Symphyotrichum novae-angliae*	76–152	–
	broadleaf cattail	TYLA	*Typha latifolia*	76–152	–

	rough bugleweed	LYAS	*Lycopus asper*	76–152	–
	knotweed	POLYG4	*Polygonum*	76–152	–
	swamp smartweed	POHY2	*Polygonum hydropiperoides*	76–152	–
	western dock	RUAQ	*Rumex aquaticus*	76–152	–
	blazing star	LIATR	*Liatris*	0–152	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	0–152	–
	pale dock	RUAL4	*Rumex altissimus*	0–152	–
	hemlock waterparsnip	SISU2	*Sium suave*	0–76	–
	hedgenettle	STACH	*Stachys*	0–76	–
	white panicle aster	SYLA6	*Symphyotrichum lanceolatum*	0–76	–

Inventory data references

This is a provisional ecological site, and as such no field plots were inventoried for this project. MLRA 56 was split into 2 MLRAs 56A and 56B with Agricultural Handbook 296 (2022). All information was taken from original MLRA 56 ecological site descriptions in which MLRA 56B was part of. Future field verification is needed to refine the plant communities and ecological dynamics described in this ecological site description.

Site Development and Testing Plan
• Further investigation is need on organic soils (fens and bogs) included in this site. The hydrology and plant communities may warrant a separate ecological site and STM. Total extent of organic soils currently in Shallow Marsh ecological site in MLRA 56 is >180,000 acres. MLRA map units needing investigation are:
- Berner muck, dense till, 0 to 1 percent slopes (map unit 21by1)
- Berner, Cathro and Haug soils, ponded, 0 to 1 percent slopes (map unit 21bxb)
- Cathro muck, dense till, 0 to 1 percent slopes (map unit 21bxg)
- Deerwood muck, dense till, 0 to 1 percent slopes (map unit 21bxd)
- Haug muck, 0 to 1 percent slopes (map unit 21bxx)
- Haug muck, silty till, 0 to 1 percent slopes (map unit 2ql1s)
- Northwood muck, 0 to 1 percent slopes (map unit prp0)
- Northwood muck, 0 to 1 percent slopes, very stony (map unit 2sw89)
- Northwood muck, dense till, 0 to 1 percent slopes (map unit 21bxh)
- Northwood muck, marl subsoil, 0 to 1 percent slop (map unit 2ql2j)
- Rosewood, Strathcona, and Berner soils, 0 to 1 percent slopes (map unit 2sw8t)

• Further investigation is needed on the influence of water chemistry on the soil/water/plant dynamics of this site. Currently wetlands with fresh water and those with brackish water are both included in the Shallow Marsh site. During the drawdown phase, in particular, the chemistry of both water and soil will likely significantly impact the plant community. Soils with some accumulation of carbonates and/or salts are included in this site; however, these accumulations are more typical of discharge wetlands which are not considered the central concept of Shallow Marsh. Calciaquolls form where soil water movement is more upward than downward, creating the layer of carbonate accumulation near the surface. It is believed the duration of ponding on the Typic Calciaquolls included in this site is significantly longer now than when these soils were forming. Extensive cultivation of the surrounding uplands contributes to more runoff into these wetlands now than under prairie conditions. In addition, periodic cultivation of the wetland soils likely has altered soil structure significantly – slowing infiltration. A separate ecological site may be needed to adequately address the brackish water/discharge wetland areas included in this site.
• Further investigation is needed on soils with nearly continuous, deep ponding (Southam series). The hydrology and plant community on this site is likely not well-represented by the Shallow Marsh site. A Deep Marsh ecological site may need to be developed.
• Further investigation is needed on the wide range of landforms and soil textures (and associated properties) and their relationship to hydrology/plant dynamics.
• Further investigation is needed on areas of this site associated with flood plains. Rauville (major and minor components) and minor components of Ludden soils occur in on flood plains and in oxbows of streams and rivers. A separate ecological site for these soils may be useful. The impact of occasional or frequent flooding on these areas needs evaluation.

• Further evaluation and refinement of the State-and-Transition model may be needed to identify disturbance driven dynamics. Additional states and/or phases may be required to address grazing response.
• Further documentation may be needed for plant communities in all states. Plant data has been collected in previous range-site investigations, including clipping data; however, this data needs review. If geo-referenced sites meeting Tier 3 standards for either vegetative or soil data are not available, representative sites will be selected for further investigation.
• Site concepts will be refined as the above noted investigations are completed.
• The long-term goal is to complete an approved, correlated Ecological Site Description as defined by the National Ecological Site Handbook.

Other references

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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	11/21/2024
Approved by	Suzanne Mayne-Kinney
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:

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17. **Perennial plant reproductive capability:**
