USDA Natural Resources Conservation Service

Ecological site R102BY019SD
Closed Depression

Last updated: 2/01/2024
Accessed: 05/12/2025

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): 102B–Till Plains

The Till Plains (102B) is located within the Western Lake Section of the Central Lowland Province of the Interior Plains. It is entirely in South Dakota, encompassing 2,215 square miles (Figure 1). The elevation ranges from 1,140 to 1,880 feet. The MLRA is characterized by glaciated, nearly level to hilly plains populated by stagnation and end moraines, glacial outwash terraces, and floodplains as the major landforms. The dominant parent materials are silty drift, glacial till, glacial outwash, and alluvium. (USDA-NRCS, 2006)

The dominant soil order in this MLRA is Mollisols. The soils in the area dominantly have a mesic temperature regime, a udic ustic moisture regime and mixed or smectitic mineralogy. They generally are very deep, well drained to poorly drained, and clayey or loamy. This area is in the western area of the tall grass prairie and supports big bluestem (Andropogon gerardi), little bluestem (Schizachyrium scoparium), Indiangrass (Sorghastrum nutans), porcupine grass (Hesperostipa spartea), and green needlegrass (Nassella viridula) as the dominant native species. Cattails (Typha), prairie cordgrass (Spartina pectinate), bulrush (Cyperaceae) and reed canarygrass (Phalaris arundinacea) are commonly found on the poorly drained soils. (USDA-NRCS, 2006).

Classification relationships

Hierarchical Framework Relationships:

Major Land Resource Area (MLRA): Till Plains (102B) (USDA-NRCS, 2006)

USFS Subregions: North Central Glaciated Plains Section (251B); Outer Coteau des Prairies (251Bb); Yankton Hills and Valleys (251Bf); Northwest Iowa Plains (251Bd); (Cleland et al., 2007).

US EPA Level IV Ecoregion: Prairie Coteau (46k); James River Lowland (46n); Loess Prairies (47a); Big Sioux Basin (46m) - (USEPA, 2013)

Ecological site concept

The Closed Depression ecological site typically occurs in slight depressions on nearly level slopes in the upland areas. Soils are poorly drained and may have a claypan (columnar structure) within six inches of the soil surface or an abrupt texture change within 12 inches of the soil surface. Permeability is very slow due to the claypan (columnar structure) or the clayey subsoil and the site may pond water four to eight weeks in the spring of the year. Ponded water conditions, very slow permeability and/or a natric horizon strongly influences the soil-water-plant relationship. The natric horizon in the subsoil typically has a Sodium Absorption Ratio (SAR) greater than 13 or an Exchangeable Sodium Percentage (ESP) greater than 15.

Vegetation in the Reference State includes western wheatgrass and common spikerush. The site my become degraded due to change in disturbance regime, and vegetation may shift to community dominated by foxtail barley,

inland saltgrass, and bareground.

Associated sites

R102BY010SD	**Loamy** These sites occur on upland areas. The soils are well drained and have less than 40 percent clay in the surface and subsoil. The central concept soil series are Egan and Wentworth, but other series are included.
R102BY020SD	**Loamy Overflow** These sites occur in upland swales. The Soils are moderately well drained, which have water flow into and over or through the site. The central concept soil series are Trent and Viborg, but other series are included.

Similar sites

R102BY004SD	**Wet Meadow** The Wet Meadow site occurs in a similar landscape position and does not have a claypan (columnar structure) within 6 inches of the soil surface. The Wet Meadow site will have more wetland species and more cordgrass than the Closed Depression site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Eleocharis palustris*

Physiographic features

This site typically occurs on nearly level depressions on upland areas.

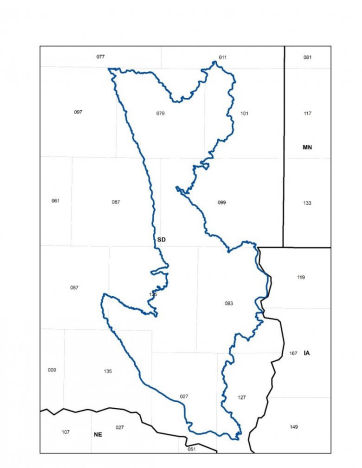


Figure 1. Site Distribution Map for the Closed Depression site in MLRA 102B.

Climatic features

Major Land Resource Area 102B is considered to have a continental climate with cold winters and relatively hot summers, low to moderate humidity, light rainfall, and much sunshine. Extremes in temperature may also abound. The climate is the result of the location of this MLRA near the geographic center of North America. There are few natural barriers on the Northern Great Plains and air masses move freely across the plains and account for rapid changes in temperature.

Annual precipitation typically ranges from 24 to 26 inches per year. The average annual temperature is about 46°F.

January is the coldest month with average temperatures ranging from about 14°F (Wentworth 2 WNW, South Dakota, to about 18°F (Canton 4 WNW, SD). July is the warmest month with temperatures averaging from about 72°F (Wentworth 2 WNW, SD), to about 73°F (Canton 4 WNW, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 57°F. This large annual range attests to the continental nature of the climate of this area. Hourly winds are estimated to average about 11 miles per hour (mph) annually, ranging from about 13 mph during the spring to about 10 mph during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 mph.

Growth of cool-season plants begins in early to mid-March, slowing or ceasing in late June. Warm-season plants begin growth about mid-May and continue to early or mid-September. Green-up of cool-season plants may occur in September and October when adequate soil moisture is present.

Table 2. Representative climatic features

Frost-free period (characteristic range)	124-127 days
Freeze-free period (characteristic range)	138-140 days
Precipitation total (characteristic range)	660 mm
Frost-free period (actual range)	123-128 days
Freeze-free period (actual range)	137-141 days
Precipitation total (actual range)	660-686 mm
Frost-free period (average)	126 days
Freeze-free period (average)	139 days
Precipitation total (average)	660 mm

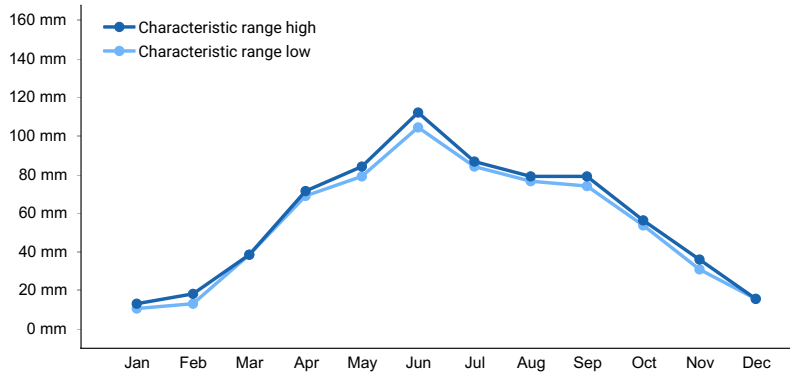


Figure 2. Monthly precipitation range

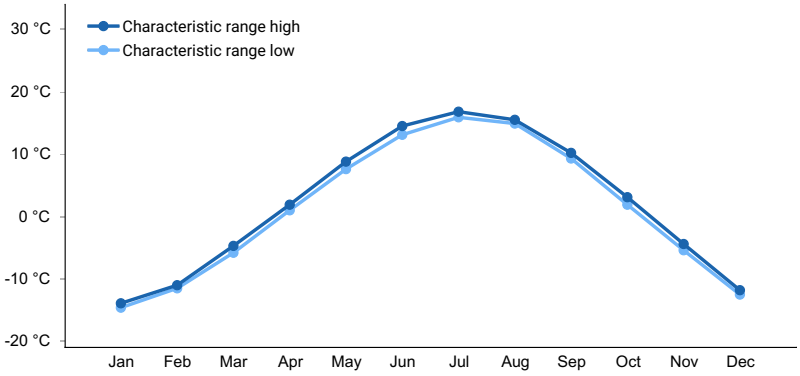


Figure 3. Monthly minimum temperature range

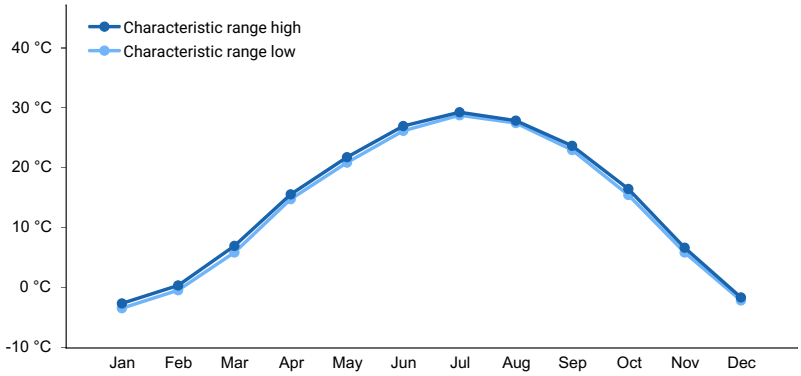


Figure 4. Monthly maximum temperature range

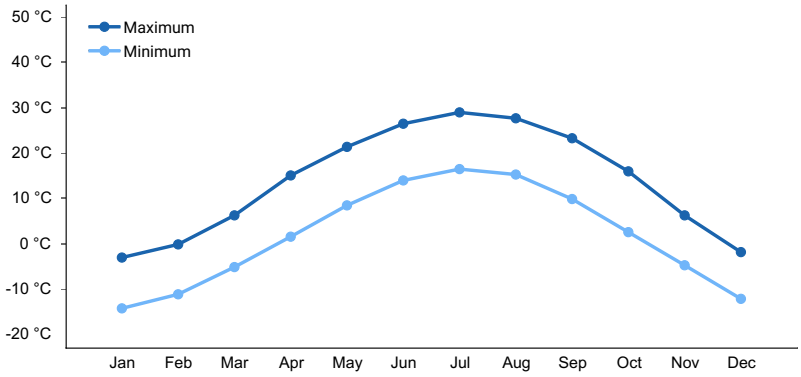


Figure 5. Monthly average minimum and maximum temperature

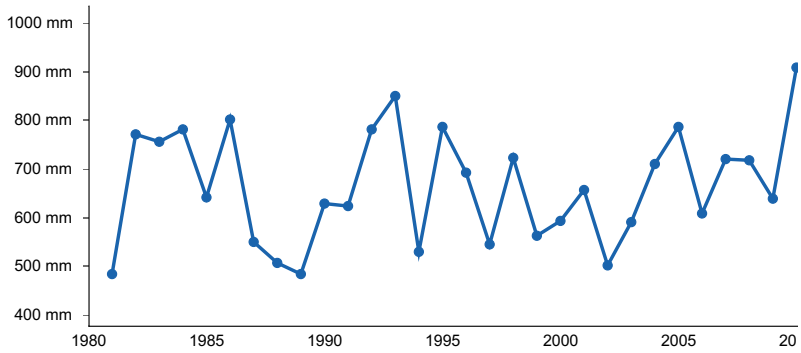


Figure 6. Annual precipitation pattern

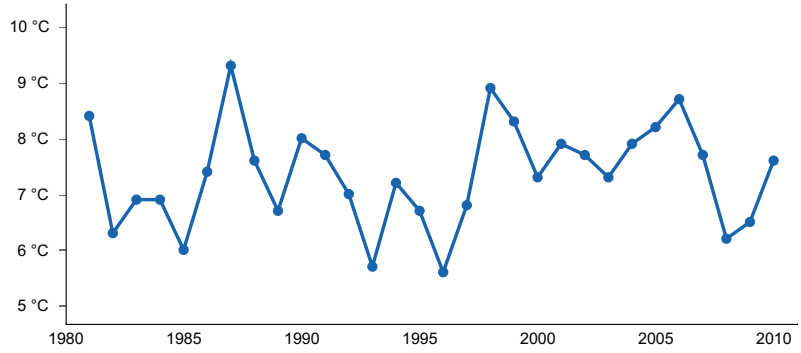


Figure 7. Annual average temperature pattern

Climate stations used

- (1) WENTWORTH 2.5 WNW [USC00399042], Wentworth, SD
- (2) MADISON 2SE [USC00395090], Madison, SD
- (3) MONTROSE 8N [USC00395738], Montrose, SD

- (4) CANTON [USC00391392], Canton, SD
- (5) CENTERVILLE 6 SE [USC00391579], Beresford, SD

Influencing water features

No riparian features are directly associated with this site.

Soil features

The Closed Depression site typically occurs in slight depressions on nearly level slopes in the upland areas. Soils are poorly drained and may have a claypan (columnar structure) within six inches of the soil surface. The central concept soil series is Hoven. Note: This ecological site description will only be used for minor soil components in MLRA 102B.

Ecological dynamics

The information in this Ecological Site Description, including the state-and-transition model (STM), was developed based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

The site which is located in the Till Plains Region developed under Northern Great Plains climatic conditions and included natural influence of large herding herbivores and occasional fire. Changes will occur in the plant communities due to weather fluctuations and management actions. Under adverse impacts, a relatively rapid decline in vegetative vigor and composition can occur. Under favorable conditions the site has the potential to resemble the Reference State. Interpretations for this site are based primarily on the 1.1 Reference Plant Community Phase. This community phase and the Reference State have been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts also have been considered. Plant community phases, states, transitional pathways, and thresholds have been determined through similar studies and experience.

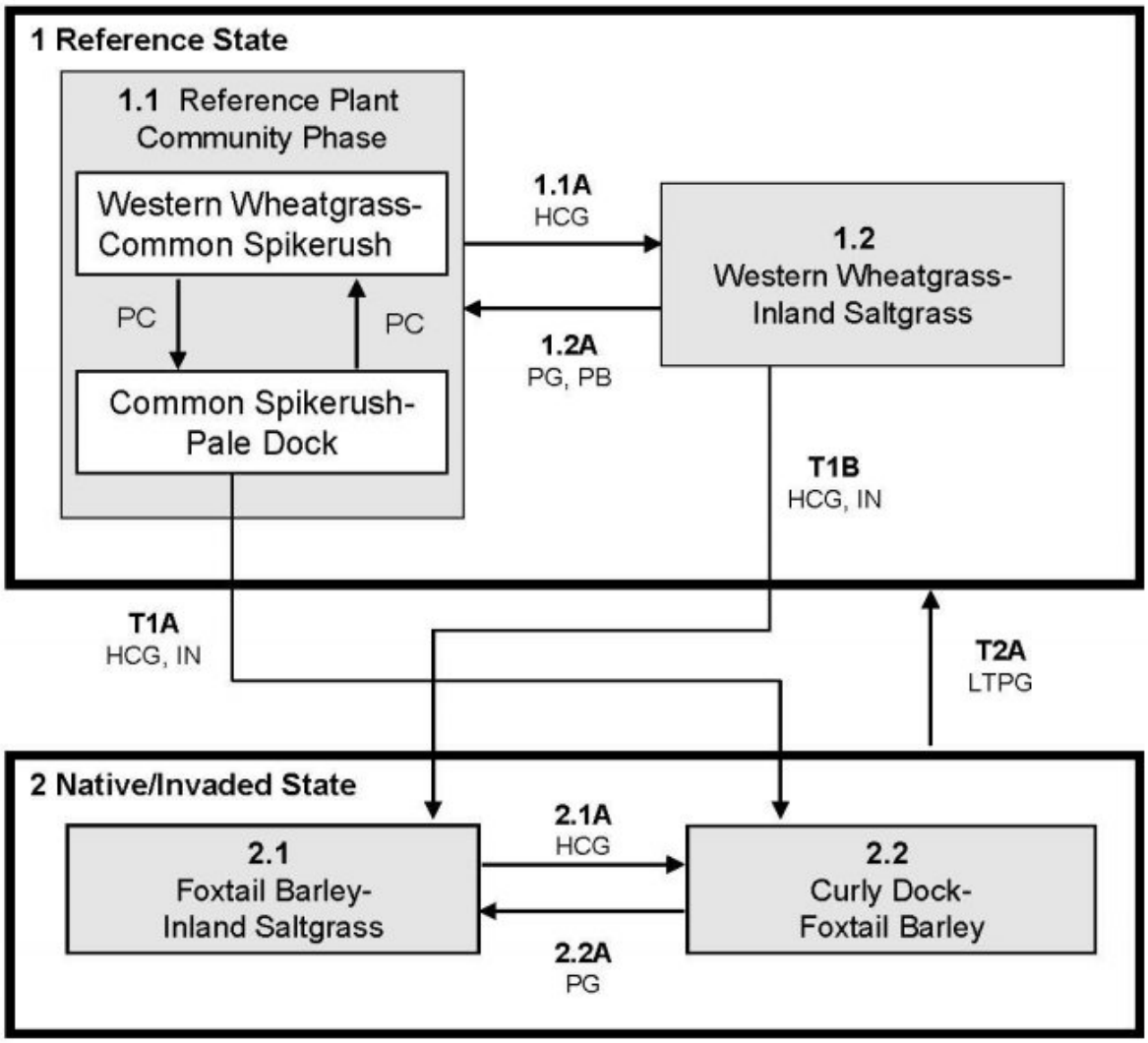
This site is very sensitive to precipitation fluctuations from year to year. With above average precipitation the site becomes very wet, leading to a much different plant community than what would be present with average to below average precipitation. In dry years, plant density becomes very low. The two plant communities influenced strongly by precipitation alone, Western Wheatgrass-Common Spikerush Plant Community Subphase and Common Spikerush-Pale Dock Plant Community Subphase make up the natural fluctuation of what could be considered the 1.1 Reference Plant Community Phase.

Following the state-and-transition diagram are narratives for each of the described states and community phases. These may not represent every possibility, but they are the most prevalent and repeatable states and community phases. The associated plant composition tables have been developed from the best available knowledge at the time of this revision. As more data are collected, some of these community phases and states may be revised or removed, and new ones may be added. The main purpose for including the descriptions here is to capture the current knowledge and experience at the time of this revision.

The following is a diagram that illustrates the common plant community phases that can occur on the site and the transition and community pathways between them. The ecological processes will be discussed in more detail in the plant community descriptions following the diagram.

State and transition model

Closed Depression – R102BY019SD



LEGEND
Closed Depression – R102BY019SD

HCG – Heavy, continuous grazing
IN – Invasion
LTPG – Long-term prescribed grazing
PB – Prescribed burning
PC – Precipitation cycles
PG – Prescribed grazing

Figure 8. State-And-Transition Model and Legend for the Closed Depression site in MLRA 102B.

Code	Process
T1A	Heavy, continuous grazing, invasion
T1B	Heavy, continuous grazing, invasion
1.1A	Heavy, continuous grazing
1.2A	Prescribed grazing, prescribed burning
2.1A	Heavy, continuous grazing
2.2A	Prescribed grazing
T2A	Long-term prescribed grazing

Figure 9. Matrix for the Closed Depression site in MLRA 102B.

State 1
Reference State

The Reference State represents the natural range of variability that dominated the dynamics of this ecological site (ES). This state was dominated by cool-season grasses, with warm-season grasses being subdominant. Before European settlement in North America, the primary disturbance mechanisms for this site in the Reference condition included periods of below and above average precipitation, periodic fire, and herbivory by insects and large ungulates. Timing of fires and herbivory coupled with weather events dictated the dynamics that occurred within the natural range of variability. Wheatgrass species can decline and a corresponding increase in foxtail barley (*Hordeum jubatum*), short, warm-season grasses and forbs would will occur. Under extended periods of disturbance, the main change is a reduction in vigor and production and an increase in bare ground and forb composition. Interpretations are based primarily on the 1.1 Reference Plant Community Phase, which are also considered to be climax. This plant community evolved with grazing by large herbivores and occasional fire, as well as, periodic flooding and drying, and can be maintained with prescribed grazing, prescribed burning, or areas receiving occasional short periods of rest or deferment. This plant community phase has two sub-phases, just referred to as plant communities here. These sub-phases are mainly driven by precipitation and flooding and drying sequences.

Community 1.1
Reference Community

Community Sub-phase 1.1 Western Wheatgrass-Common Spikerush – Interpretations are based primarily on the 1.1 Western Wheatgrass-Common Spikerush Plant Community Sub-phase (this is also considered to be Reference). Following several years of above average precipitation, the plant community stabilizes and becomes dominated with perennial grasses such as western wheatgrass and common spikerush. Other grasses and grass-likes present include Nuttall's alkaligrass (*Puccinellia nuttalliana*), sedge (Carex), rush (Juncus), slender wheatgrass (Elymus trachcaulus). The occurrence of forbs will be considerably lower, including some species such as American licorice (*Glycyrrhiza lepidota*), curlytop knotweed (*Polygonum lapathifolium*), Pennsylvania smartweed (*Polygonum pensylvanicum*), Pursh seepweed (*Suaeda calceoliformis*), and western dock (*Rumex aquaticus*). The plant community is made up of about 80 to 90 percent grasses and grass-likes, and about 10 to 20 percent forbs. Community Subphase 1.1 Common Spikerush-Pale Dock – Interpretations are based primarily on the 1.1 Common Spikerush-Pale Dock Plant Community Subphase (this is also considered to be climax). This plant community often occurs after a period of higher precipitation that follows an extended dry cycle. Grasses and grass-likes commonly occurring include common spikerush, sedge, rush, foxtail barley, western wheatgrass, and bluegrasses. The forbs commonly found include pale dock, western dock, mint (Mentha), Pursh seepweed, lambsquarters (*Chenopodium album*), knotweed (Polygonum), evening-primrose (Oenothera), buttercup (Ranunculus), and New England aster (*Symphyotrichum novae-angliae*). The plant community is made up of about five to 10 percent grasses, 30 to 40 percent grass-likes, and about 50 to 60 percent forbs. Precipitation cycles will shift this community between the 1.1 Western Wheatgrass-Common Spikerush Plant Communtity Subphase and the 1.1 Common Spikerush-Pale Dock Plant Communtity Subphase. After several years of above average precipitation, the plant community stabilizes and perennial grasses and western wheatgrass will dominate the site with few grass-likes and forbs; and in the instance of higher precipitation received after extended years of drought, there will be an increase in the grass-likes and forbs components.

Community 1.2
Western Wheatgrass-Inland Saltgrass

This plant community is the result of heavy, continuous grazing. Repeated defoliation depletes stored carbohydrates resulting in weakening and eventual death of the most palatable grasses. Lack of litter and reduced plant vigor result in higher soil temperatures, poor water infiltration rates, high evapotranspiration, and increased percolation of the high water table, which increases salt concentrations on the surface. This gives inland saltgrass (*Distichlis spicata*) and other salt tolerant species a competitive advantage over less tolerant species. Inland saltgrass drastically increases and competes with western wheatgrass as the dominant species. Other grass and grass-like species present include Nuttall's alkaligrass, plains bluegrass (*Poa arida*), common spikerush, needle Spikerush (*Eleocharis acicularis*), and other sedges (Cyperaceae) and rushes (Juncaceae). Early cool-season grasses including foxtail barley, fowl bluegrass (*Poa palustris*), and Kentucky bluegrass (Poa Pratensis) begin to invade. Forbs that will invade are curly dock (*Rumex crispus*) and cocklebur (Xanthium). Common forbs to the site include lambsquarters, Pennsylvania smartweed, curlytop knotweed, plantain (Plantago), and povertyweed (*Iva axillaris*). This plant community is relatively stable and well adapted to increased salinity. Plant vigor, litter, frequency, and production have decreased. The biological integrity, water, and nutrient cycles of this plant

community are becoming impaired. This plant community is less productive than the 1.1 Reference Plant Community Phase.

Pathway 1.1A
Community 1.1 to 1.2

Heavy, continuous grazing (grazing at full to heavy levels for extended portions of the growing season without adequate recovery periods) will shift this community to the 1.2 Western Wheatgrass-Inland Saltgrass Plant Community.

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing, and/or prescribed burning returned to normal disturbance regime levels and frequencies, or periodic light to moderate grazing will convert this plant community to the 1.1 Reference Plant Community Phase.

State 2
Native Invaded State

This state represents the range of variability that exists with reduced vigor and production of the dominant species as a result of grazing-induced disturbance and the introduction of non-native species. This state is dominated by cool-season grasses. It can be found on areas that are impacted by extended periods of heavy, continuous grazing. Grazing tolerant species become dominant, and non-native species are present.

Community 2.1
Foxtail Barley-Inland Saltgrass

This plant community developed with heavy, continuous grazing where adequate recovery periods between grazing events were not allowed. Patches of inland saltgrass sod are typical and foxtail barley and fowl bluegrass are well distributed throughout the community. Nuttall's alkaligrass and western wheatgrass have been greatly reduced in production and vigor, but may persist in remnant amounts. This plant community is resistant to change due to the grazing tolerance of inland saltgrass and increased surface salts. A significant amount of production and diversity has been lost when compared to the 1.1 Reference Plant Community Phase. Loss of key cool-season grasses and increased bare ground have negatively impacted energy flow and nutrient cycling. Water infiltration is reduced significantly due to the massive shallow root system "root pan," characteristic of inland saltgrass and increased bare ground. It will take a long time to bring this plant community back to the Reference State (State 1) with management alone. Renovation (mechanical and chemical inputs) is typically not effective due to high salt content of the soil and saltgrass persistence.

Community 2.2
Curly Dock-Foxtail Barley

This plant community can be reached with heavy, continuous grazing coupled with compaction due to grazing when the soil is saturated. This plant community can also result from long-term ponding and occasional subsequent drying, as when this site is developed for a water source. The dominant vegetation includes pioneer annual grasses, forbs, invaders, and early successional biennial and perennial species. Grasses may include foxtail barley, which may become dominant, along with fowl bluegrass, Nuttall's alkaligrass, and western wheatgrass. The dominant forbs include curly dock, curlycup gumweed (*Grindelia squarrosa*), kochia (*Bassia scoparia*), cocklebur, and other early successional salt tolerant species. The community is susceptible to non-native species due to severe soil disturbances and the relatively high percent of bare ground. This plant community is resistant to change as long as soil disturbance or severe vegetation defoliation persist, thus holding back secondary plant succession. Secondary succession is highly variable, depending upon availability and diversity of a viable seed bank of higher successional species within the existing plant community and neighboring plant communities.

Pathway 2.1A
Community 2.1 to 2.2

Heavy, continuous grazing which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or during periods of below normal precipitation shifts this community to the 2.2 Curly Dock-Foxtail Barley Plant Community Phase.

Pathway 2.2A
Community 2.2 to 2.1

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing will convert this plant community to the 2.1 Foxtail Barley-Inland Saltgrass Plant Community Phase.

Transition T1A & T1B
State 1 to 2

Heavy, continuous grazing (stocking levels well above carrying capacity for extended portions of the growing season, and often at the same time of year each year, typically beginning early in the season) and invasion of non-native plant species will convert the 1.1 Common Spikerush-Pale Dock Plant Communtity Subphase within the Reference State (State 1) to the 2.2 Curly Dock-Foxtail Barley Plant Community Phase within the Native/Invaded State (State 2). Heavy, continuous grazing (stocking levels well above carrying capacity for extended portions of the growing season, and often at the same time of year each year, typically beginning early in the season) and invasion of non-native plant species will convert the 1.2 Western Wheatgrass-Inland Saltgrass Plant Community Phase within the Reference State (State 1) to the 2.1 Foxtail Barley-Inland Saltgrass Plant Community Phase within the Native/Invaded State (State 2).

Restoration pathway T2A
State 2 to 1

Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) may lead the Native/Invaded State (State 2) over a threshold to the Reference State (State 1).

Additional community tables

Other information

Ecological Site Correlation Issues and Questions:

• Note: the R102BY019SD Closed Depression ecological site description was established to be used for minor components only in MLRA 102B.
• Note: Worthing silty clay loam, 0 to 1 percent slopes (national symbol 2tlch) is currently a MLRA 55C map unit and has a minor component of Hoven (Closed Depression ESD). This MLRA map unit is currently used in MLRA 53C, 55C, 102B and 102C. The Hoven soil does not exist and should not be used in MLRA 102B and 102C. A future project will be needed to split correlate and designate the correct MLRA map unit for each MLRA.
• Note: Worthing silty clay loam, ponded, 0 to 1 percent slopes (national symbol 2tlcj) is currently a MLRA 55C map unit and has a minor component of Hoven (Closed Depression ESD). This MLRA map unit is currently used in MLRA 53C, 55C and 102B. The Hoven soil does not exist and should not be used in MLRA 102B A future project will be needed to split correlate and designate the correct MLRA map unit for each MLRA.
• Reference and alternative states within the state and transition model are may not be fully documented and may require additional field sampling for refinement.

Inventory data references

There is no NRCS clipping data and other inventory currently available for this site. Information presented here has been derived using field observations from range-trained personnel. Those involved in developing this site include: Stan Boltz, Range Management Specialist, NRCS; and Bruce Kunze, Soil Scientist, NRCS.

Data Source Sample Period State County
None

Other references

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USDA, NRCS. National Soil Information System, Information Technology Center, Fort Collins, CO. http://nasis.nrcs.usda.gov

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Approval

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This Provisional Ecological Site concept has passed both Quality Control and Quality Assurance processes. It was officially approved for publication by David Kraft as of 11/12/2020.

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)	
Contact for lead author	
Date	05/12/2025
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:**

17. **Perennial plant reproductive capability:**