USDA Natural Resources
Conservation Service

Ecological site R053AE074MT
Claypan (Cp) (Legacy) RRU 53AE

Last updated: 6/14/2023
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.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

This ecological site occurs on level to sloping glaciated plains, stream terraces and fans. Slopes vary from 0-15%, but are usually less than 8%. This site occurs on all exposures. Elevations normally vary from 2000 to 4000 feet.

Table 2. Representative physiographic features

Landforms	(1) Terrace (2) Fan (3) Plain
Flooding frequency	None
Ponding frequency	None
Elevation	572–1,463 m
Slope	1–15%
Aspect	Aspect is not a significant factor

Climatic features

A semi-arid, temperate climate characterizes the Glaciated Plains. The predominance of cool season species has evolved to take advantage of the precipitation regime that peaks in late spring-early summer (June). Seventy-five percent of the annual precipitation usually falls as steady, soaking, frontal system rains. Summer rains usually come with thunderstorms. Precipitation is the most important factor influencing production (Heitschmidt et al 2005). Severe drought occurs on average in two out of every ten years (Cooper, et al., 2001).

Table 3. Representative climatic features

Frost-free period (average)	129 days
Freeze-free period (average)	104 days
Precipitation total (average)	305 mm

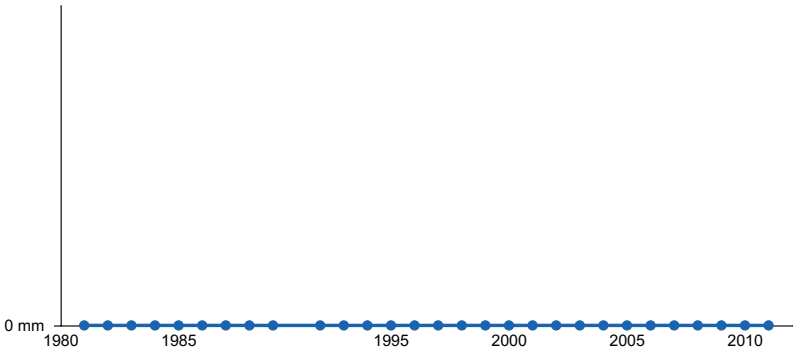


Figure 1. Annual precipitation pattern

Influencing water features

Soil features

These deep and very deep, well drained soils formed in glacial till. Soils occupy glacial uplands. The surface layer varies from 2-8” in depth, and has a clay loam to fine sandy loam texture. The B horizon is characterized by a hard argillic horizon (6-10’’ thick), which restricts root penetration. The argillic layer has strong columnar structure. Salt accumulations are often visible in the lower part of the B horizon. These soils are usually very hard when dry and very sticky when wet.
Permeability is very slow. Soil ph varies from 6.6 – 9.0. This site is characterized by the following soil components: Creed, Gerdrum, Elloam and Thoeny.

Table 4. Representative soil features

Surface texture	(1) Loam (2) Fine sandy loam (3) Clay loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Very slow
Soil depth	51–183 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	10.16–12.7 cm
Calcium carbonate equivalent (0-101.6cm)	0–10%
Electrical conductivity (0-101.6cm)	0–8 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	5–13
Soil reaction (1:1 water) (0-101.6cm)	6.6–7.8
Subsurface fragment volume <=3" (Depth not specified)	5–15%
Subsurface fragment volume >3" (Depth not specified)	0–2%

Ecological dynamics

This site developed through time under the influence of climate, geological materials, fire, plants and animals. Research consistently shows that precipitation is the principal factor altering productivity on ecological sites in the Northern Great Plains (Heitschmidt et al. 2005). The same authors concluded that grazing reduces herbage standing crop, whereas its effects on above ground net primary production varies with timing of grazing and precipitation events, along with the functional and structural composition of the plant community.

It is theorized that these lands burned on a natural interval of 10-12 years (Frost 1998). However, environmental characteristics of this site limit herbage production and subsequent fuel accumulation. Therefore, in comparison to other upland ecological sites, the role of natural fire is probably less significant in the development of this site.

The resultant historic climax plant community (HCPC) is the basis for plant community interpretations. The HCPC has been determined by evaluating rangeland relic areas, and other areas protected from excessive disturbance.

The HCPC is comprised of a mixture of cool and warm season grasses and shrubs. About 85% of the annual production is from grasses and sedges, most of which is produced during the cool season. Forbs and shrubs contribute 5 and 10%, respectively, to total annual production. Total vegetative production averages 900 lbs/ac in normal years, 500 lbs/ac in “unfavorable” years, and 1200 lbs/ac in “favorable” years.

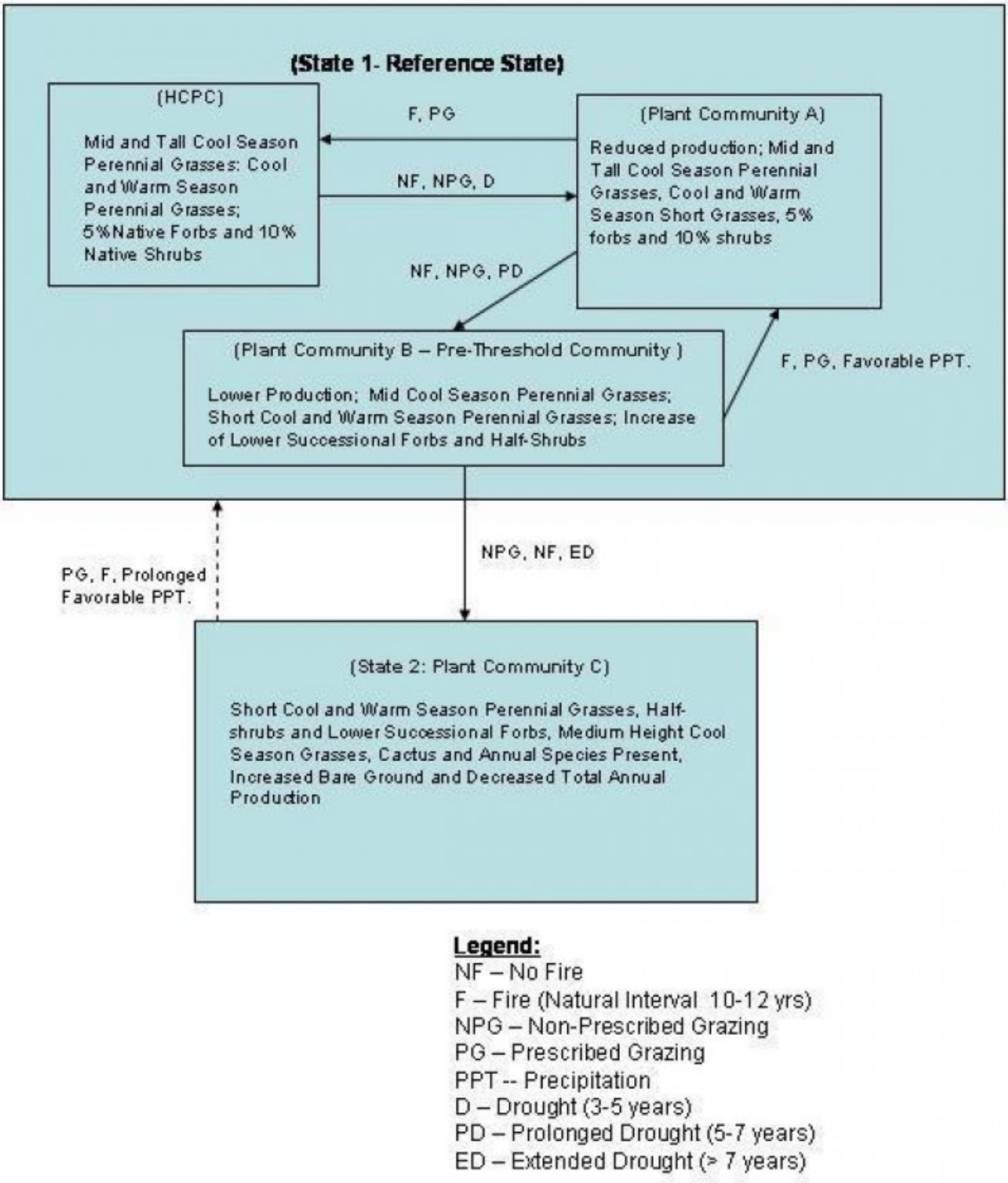
This site is moderately resilient to disturbance because soil characteristics limit plant growth. Departures from the HCPC generally result from management actions, drought, and/or a change in the natural fire regime. The site is considered fragile in the sense that vegetative vigor and composition will rapidly decline in the absence of prescribed grazing and during prolonged drought. With favorable precipitation and/or prescribed grazing treatments, the plant community can return to the HCPC. However, succession may be slow. Trends in plant community dynamics, states, transitional pathways, and thresholds have been evaluated and determined through experience and research.

Successional pathways of the Claypan 10-14” p.z. ecological site cannot be satisfactorily described using traditional theories of plant succession leading to a single climax community (Briske et al. 2005). As the HCPC regresses to an early seral state, it is theorized that a threshold is crossed somewhere within the mid-seral state. Plant communities occurring below this threshold are in a steady state. Succession back to the HCPC does not occur within a reasonable length of time, and/or without a large input of energy.

Three plant communities and the successional pathways that commonly occur within the Reference State (State #1) are shown in the following diagram. In addition, the transition from State #1 to State #2 and a representative plant community in the latter state are also illustrated. Ecological processes are discussed in the plant community descriptions following the diagram.

State and transition model

Claypan MLRU 52XA, 52XB, 53AY



Legend:
NF – No Fire
F – Fire (Natural Interval 10-12 yrs)
NPG – Non-Prescribed Grazing
PG – Prescribed Grazing
PPT -- Precipitation
D – Drought (3-5 years)
PD – Prolonged Drought (5-7 years)
ED – Extended Drought (> 7 years)

State 1
State #1: Historic Climax Plant Community (HCPC)

Community 1.1
State #1: Historic Climax Plant Community (HCPC)

Western/thickspike wheatgrass, bluebunch wheatgrass and green needlegrass are common cool season mid grasses on this ecological site. Alkali sacaton, a tall warm season grass occurs on this site in the eastern glaciated plains. These high-successional grasses account for about 75% of total plant production in the HCPC. Needleandthread, another cool season mid grass is common and tends to replace the green needlegrass when it is stressed by lack of moisture, grazing or etc. About 10% of the total production is comprised of a mix of warm and cool season short grasses and grasslike plants. These species include: blue grama, sandberg bluegrass, plains reedgrass, prairie junegrass, needleleaf sedge, and threadleaf sedge. American vetch, a cool season, nitrogen-fixing legume is one of the most important members of the forb community. White and purple prairie clover are important warm season legumes. Additional nitrogen is fixed by lower successional legumes (milkvetches, scurfpeas, and prairie thermopsis). Onion, hoods phlox, scarlet globemallow, wooly plantain, and biscuitroot often occur in the HCPC. The latter group contains a mix of warm and cool season species whose relative occurrence on the site is largely influenced by the timing and amount of precipitation. Forbs contribute about 5% of the total annual production. Nuttall saltbush, greasewood and silver sagebrush are the most important browse species occurring on this site. While the former two species make their major growth and flower during the cool season, silver sagebrush is a warm season species. Shrubs such as big sagebrush and pricklypear cactus may occur in some areas. Fringed sagebrush, a half-shrub may also be found in the HCPC. Shrubs normally make up about 10% of the total annual production. Broom snakeweed, annual bromes, and annual forbs are not a part of the HCPC. Their presence indicates possible ecological deterioration, or downward trend. Trend is difficult to interpret because large areas of bare ground between plants are fairly common. Total annual production within the HCPC averages 900 lbs/ac during normal years. Thus production is 300 lbs/ac higher than it is on the Dense Clay 10-14” p.z. ecological site, and 400 lbs/ac less than on the Clayey 10-14” p.z. ecological site. Production declines as the HCPC regresses from the HCPC to lower successional communities. Regression may result from grazing management strategies that do not allow adequate recovery periods between grazing events, drought, and/or the disruption of the normal fire sequence. The above disturbances favor the replacement of green needlegrass, bluebunch wheatgrass, and western/thickspike wheatgrass by needleandthread, blue grama, sandberg bluegrass, prairie junegrass, hairy goldenaster, and hoods phlox. Nuttall saltbush may also be replaced by broom snakeweed, fringed sagewort, etc. Cheatgrass and Japanese brome may invade the site. As the result of these vegetative changes, there is less litter to protect the soil and less infiltration. Hydrologic cycles are impaired when plant communities are unable to effectively use precipitation. Plant basal cover varies from 7-20%. Litter varies from 40-50%, and bare ground ranges from 25-45%. Thus, surface runoff and erosion are potential concerns on the Claypan 10-14” p.z. ecological site. Runoff and soil erosion increase as the HCPC regresses to earlier seral states.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	476	857	1143
Shrub/Vine	56	101	135
Forb	28	50	67
Tree	1	1	1
Total	**561**	**1009**	**1346**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0%
Grass/grasslike foliar cover	0%
Forb foliar cover	0%
Non-vascular plants	0-1%
Biological crusts	0-1%
Litter	15-40%

Surface fragments >0.25" and <=3"	0-1%
Surface fragments >3"	0-1%
Bedrock	0-1%
Water	0%
Bare ground	10-20%

Table 7. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	1-5%
Grass/grasslike basal cover	10-15%
Forb basal cover	1-2%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 8. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	15-25%	20-30%
>0.15 <= 0.3	–	35-45%	35-45%	45-55%
>0.3 <= 0.6	–	45-55%	20-30%	20-30%
>0.6 <= 1.4	–	5-15%	10-20%	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 1.2
Plant Community A (State #1)

*Successional Pathway from HCPC to Plant Community A: Non-prescribed grazing, drought and/or a cessation of the natural fire regime will cause regression from HCPC to Community A. Plant Community A (State #1): Total annual production is about 80% of the HCPC. Western and thickspike wheatgrasses, and green needlegrass still contribute approximately 60% of the annual production. However, they are less vigorous and individual plant growth is reduced from what it is in the HCPC. The short grass production increases in comparison to the HCPC. Plant height and plant litter are reduced while bare ground increases. Surface runoff and soil temperature increases, infiltration decreases, and shallow-rooted short grasses and sedges gain a competitive advantage over medium height, deep-rooted cool season perennial grasses. They are able to compete more successfully with the mid-grasses because of the ability of relatively shallow root systems to utilize shallowly penetrating moisture, characteristic of this site. Total shrub production continues to represent about 5% of total annual production. However, vigor of the prairie clovers and American vetch has decreased relative to the vigor of hoods phlox and

other low-successional forbs. Total shrub production remains at about 10% of the total annual production. *Successional Pathway from Community A to HCPC: Favorable growing conditions, the implementation of prescribed grazing, or periodic fire will move Plant Community A to the HCPC. This succession can occur within a couple of years. *Successional Pathway from Community A to Plant Community B: Community A will regress to Community B under non-prescribed grazing, prolonged drought, or an extended period without fire. The rate of regression varies with the kind, intensity, frequency, and duration of the disturbances. Severe drought may cause retrogression within a couple years.

Community 1.3
Plant Community B (State #1)

This Community is dominated by a mix of medium and short grasses. Blue grama, threadleaf sedge, needleandthread and sandberg bluegrass increased in the community by replacing some of the mid grasses. However, western and thickspike wheatgrass and green needlegrass continue to contribute nearly 50% of the total annual production. In comparison to Community A, the short grasses contain more blue grama, a warm season species. Sand dropseed and tumblegrass may also begin to appear in the community. Warm season forbs increase and replace American vetch and other high-successional forbs. The warm season half-shrub, fringed sagewort, increases in production. Pricklypear cactus and broom snakeweed are conspicuous in this community. Annual production is 40-60% of potential for the site. Plant species in this community tend to exhibit more salt tolerant characteristics than the species found in the HCPC or Community A. Infiltration is moderately reduced due to adverse changes in plant community composition and/or distribution. The amount of bare ground is moderately higher than expected for this site (bare ground = 45-60%). In comparison to the HCPC, total plant cover varies from 30-40%. Litter is reduced to 10-15%, which is moderately less, relative to site potential and weather. Active rill formation is slight at infrequent intervals, mostly in exposed areas. Water flow patterns match what is expected for the site, erosion is minor with some instability and deposition (USDI and USDA 2000). Plant community B is called the “pre-threshold community”. It is critical that this community be recognized and strategies implemented to prevent further regression. Although this community can improve to either Community A or HCPC through successional processes, further disturbance will result in regression to a lower state. Once Community B regresses to a lower state, normal successional processes are restricted. *Successional Pathways from Community B to Community A and HCPC The Claypan 10-14” p.z. ecological site is resilient within the Reference State. Prescribed grazing and/or a period of favorable precipitation will induce succession from Community B Community A within a reasonable time frame. *Transition From Community B to State #2 (Community C) However, Community B is much less resistant to perturbations than Community A. Lower production, lower vegetative cover, less litter, and increased bare ground contribute to increase Community B’s susceptibility to disturbance. Extended drought and non-prescribed grazing can lead to further retrogression (State 2). The threshold separating Communities B and C appears to be the functional threshold, below which the type, amount, and pattern of vegetation is often inadequate to prevent accelerated soil erosion.

State 2
Plant Community C (State #2)

Community 2.1
Plant Community C (State #2)

Plant Community C is characterized by a significant reduction in species composition by weight of medium-height, cool season grasses. Wheatgrasses contribute about 25% of total annual growth. Plants produce few seed heads and are low in vigor. This community is dominated by low-successional grasses and sedges. Blue grama, prairie junegrass, other short grasses, sedges and clubmoss contribute about 50% of the total annual production. Clubmoss cover is usually most severe on soils with loamy A and E horizons. Broom snakeweed, fringed sagewort and pricklypear cactus are conspicuous in the community. Japanese brome, cheatgrass, annual forbs (fanweed and pepperweed), and curlycup gumweed will be present. Total annual production is reduced about 75% from levels in the HCPC. Percent composition of forbs and shrubs are highly variable from place to place and from year to year in this community. Variability is apparent in productivity and occurrence of individual species. Litter cover averages about 10%, which is a large reduction relative to site potential. Water flow patterns are numerous and there is moderate active pedestalling. In communities that are not characterized with clubmoss, bare ground is moderately to much higher than expected. There is moderate soil loss or degradation in interspaces with some degradation beneath plant canopies. Compared to the HCPC, there has been a structural shift from medium height to short

grasses, and a functional shift from cool to warm season plants. Reproductive capability of cool season plants is greatly reduced relative to recent climatic conditions. (Insert Plant Community C photo) *Transition from State #2 to higher seral state (State #1): Plant community C is a steady state. It is resistant to significant succession. Blue grama, other short grasses, sedges and clubmoss form a competitive community. The adverse soil conditions and a theorized inadequate seed bank of species found in State #1 greatly restrict potential for succession to State #1. When clubmoss cover is more than 20-25%, succession is not expected to occur within a reasonable length of time. However, significant succession may occur with the combination of prescribed grazing, implementation of the natural fire regime, and an extended period of favorable moisture. This potential is depicted with the dashed line in the state and transition diagram. In comparison to more common ecological sites with moderately deep to deep soils (ie, Loamy 10-14" p.z., Clayey 10-14" p.z., and Sandy 10-14" p.z.), annual production on a Claypan 10-14" p.z. ecological site is about 30% less. Therefore, vegetation response to mechanical treatments and range seeding will be less than the response expected on the higher producing sites (NRCS Conservation Practice Standard 548-1).

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Native perennial grasses**			202–404	
	tufted wheatgrass	ELMA7	*Elymus macrourus*	101–202	–
	western wheatgrass	PASM	*Pascopyrum smithii*	101–202	–
2	**Native perennial grasses**			50–605	
	green needlegrass	NAVI4	*Nassella viridula*	101–202	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	101–202	–
	alkali sacaton	SPAI	*Sporobolus airoides*	50–101	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	50–101	–
3	**Native perennial grasses and grasslikes**			1–101	
	Grass, perennial	2GP	*Grass, perennial*	1–22	–
	blue grama	BOGR2	*Bouteloua gracilis*	1–22	–
	threadleaf sedge	CAFI	*Carex filifolia*	1–22	–
	plains reedgrass	CAMO	*Calamagrostis montanensis*	1–22	–
	squirreltail	ELELE	*Elymus elymoides ssp. elymoides*	1–22	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	1–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	1–22	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	1–22	–
Forb					
4	**Native perennial forbs**			10–50	
	American vetch	VIAM	*Vicia americana*	10–50	–
5	**Native perennial forbs**			20–50	
	white prairie clover	DACA7	*Dalea candida*	10–50	–
	purple prairie clover	DAPU5	*Dalea purpurea*	10–50	–
6	**Native perennial forbs**			1–50	
	Forb, perennial	2FP	*Forb, perennial*	1–6	–
	pussytoes	ANTEN	*Antennaria*	1–6	–
	aster	ASTER	*Aster*	1–6	–
	milkvetch	ASTRA	*Astragalus*	1–6	–
	bastard toadflax	COUM	*Comandra umbellata*	1–6	

	bastard toadflax	COUM	*Comandra umbellata*	1–6	–
	spiny phlox	PHHO	*Phlox hoodii*	1–6	–
	scurfpea	PSORA2	*Psoralidium*	1–6	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	1–6	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	1–6	–
Shrub/Vine					
7	**Native shrubs and half-shrubs**			1–101	
	silver sagebrush	ARCA13	*Artemisia cana*	1–50	–
	big sagebrush	ARTR2	*Artemisia tridentata*	1–50	–
	Nuttall's saltbush	ATNU2	*Atriplex nuttallii*	6–50	–
	greasewood	SAVE4	*Sarcobatus vermiculatus*	1–50	–
	prairie sagewort	ARFR4	*Artemisia frigida*	1–17	–
	Shrub, broadleaf	2SB	*Shrub, broadleaf*	1–17	–
8	**Native shrubs and half-shrubs**			1–2	
	plains pricklypear	OPPO	*Opuntia polyacantha*	1–2	–

Animal community

Livestock Management

The Claypan 10-14” p.z. ecological site is suited for livestock grazing. However, prescribed grazing management is needed. Forage production is somewhat limited by soil characteristics. Many species occurring in State #1 are palatable to livestock, which makes the communities susceptible to heavy stocking and season long grazing. The cool season medium height grasses are generally selectively grazed, giving the short grasses a competitive advantage. Grazing during early spring may result in soil compaction. Any additional factor reducing infiltration and increasing runoff on this site is a management concern. Shorter grazing periods and adequate periods of rest following grazing are needed to facilitate plant regrowth and accumulate litter.

This ecological site has a component of shortgrass species, as do most other sites in the northern mixed prairie. The shortgrasses usually increase with grazing pressure and decrease with deferment or prescribed grazing. However, succession is not guaranteed in the Northern Great Plains. Sampling four-year old ungrazed exclosures and grazed areas with 35% utilization, Vogel and Van Dyne (1966) found essentially the same basal cover of grasses, sedges, forbs, litter and bare soil on protected and grazed sites. They concluded that four years was too short of a time for cover to change significantly. Hofmann and Ries (1989) observed similar results following a four-year study in North Dakota. Even after 41 years of exclosure, changes in species composition can be relatively small when the site is in the dry, low production portion of northern mixed prairie (Brand and Goetz, 1986). They concluded that site characteristics limited the development of potential vegetation with the exclusion of grazing, but the potential impacts of prescribed grazing on succession were not discussed. The Clay Pan 10-14” p.z. ecological site is not as productive as the sites evaluated by Vogel and Van Dyne, Hofmann and Ries, or by Brand and Goetz. Therefore, range managers should recognize the environmental limitations of this site. Prescribed grazing management is always a good recommendation. Furthermore, chiseling of these soils is common in Phillips County and can be very successful given the right conditions.

Wildlife Interpretations

The HCPC associated with this ecological site provides diverse and valuable wildlife habitat. This site often occurs as a mosaic with other ecological sites, thus creating “ecotones” that serve as a magnet for many species of wildlife. Antelope and mule deer prefer grazing this site because of the Nuttall saltbush and diversity of forage species. However, the landscape does not provide thermal and escape cover. The bare ground limits the potential of the site for upland birds and for ground-nesting birds.

This ecological site becomes less valuable for deer and antelope when plant diversity declines with regression. For example, the disappearance of either the tall cool season grasses or warm season grass would shorten the length

of the “green forage” season. The increase of blue grama, clubmoss, hoods phlox, etc. is also associated with the loss of palatable forbs. These changes tend to adversely impact foraging opportunities for deer, antelope, upland birds, etc. Community C has very little value for most wildlife species because of insufficient vegetative structural diversity, residual grass carry-over and litter cover.
Plant Preferences by Animal Kind

Refer to NRCS Field Office Technical Guide, Section IIE, General Information, for tables displaying plant preferences by livestock and wildlife.

Hydrological functions

Water is the main factor limiting vegetative production on this site. Soil components in this ecological site are normally classed into Hydrologic Group D. These soils have a medium to very high runoff potential, with hydrologic runoff curves of 89 to 80. Field investigations are needed to adjust the runoff curves when plant communities deteriorate from the HCPC. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff.

Recreational uses

This site provides hunting opportunities for upland game species.

Wood products

This site has no significant value for wood products.

Other products

None

Other information

This site ecological site is not highly resistant to disturbances. Species diversity is adversely affected by season long continuous grazing and by heavy stocking. Medium height grasses are replaced by short grasses. The number of structural/functional groups is reduced with regression from the HCPC. The amount of solar energy that is captured and converted to carbohydrates for plant growth is reduced in State #2. A reduction in total vegetative growth results in less potential vegetation that can be transformed into litter. Litter reductions result in less infiltration, and more runoff and soil erosion.

Inventory data references

SCS-Range-417 #503 1991 MT Phillips

ECS-1
Modified Double Sampling

USDA-SCS-MT 1981 Technical Range Site Description

Other references

Brand, M.D. and H. Goetz. 1986. Vegetation of exclosures in Southwestern North Dakota. J. Range Manage. 39:434-437.

Briske, D. D., S. D. Fuhlendorf, and F. E. Smeins, 2005. State-and-transition models, thresholds, and rangeland health: a synthesis of ecological concepts and perspectives.
Rangeland Ecol. Manage 58:1-10.

Frost, C. C. 1998. Presettlement fire frequency regimes of the United States: a first approximation. Pages 70-81. in

Teresa L. Pruden and Leonard A. Brennan (eds.). Fire in ecosystem management: shifting paradigm from suppression to prescription. Tall Timbers Fire Ecology Conference Proceedings. No. 20. Tall Timbers Research Station, Tallahassee, FL.

Heitschmidt, R. K., K. D. Klement, and M. R. Haferkamp. 2005. Interactive effects of drought and grazing on Northern Great Plains rangelands. Rangeland Ecol. Manage. 58:11-19.

Hofmann, L. and R.E. Ries. 1989. Animal performance and plant production from continuously grazed cool-season reclaimed and native pastures. J. Range Manage. 42:248-251.

USDA and USDI. 2000. Interpreting indicators of rangeland health. Technical Reference 1734-6.

Vogel, W.G. and G.M. Van Dyne. 1966. Vegetation responses to grazing management on a foothill sheep range. J. Range Manage. 19:80-85.

Contributors

JL, MR, JS, RB, GS
John Lacey, Maxine Rasmussen, Jon Siddoway, Rick Bandy, Greg Snell

Approval

Kirt Walstad, 6/14/2023

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)	Dr. John Lacey, Maxine Rasmussen, Jon Siddoway & Rick Bandy
Contact for lead author	
Date	03/30/2005
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills should not be present in HCPC. If in plant community A on slopes > 15%, careful examination will yield slight evidence of rills that are less than ½ inch deep, linear, but short in length. If in plant community B on slopes > 15%, rills would be visible, ½ inch deep or more, linear, rarely exceeding 1 foot in length. Distance between rills is irregular.

---

2. **Presence of water flow patterns:** Water flow patterns should not be observable in HCPC. If in plant community A, careful examination will yield short discontinuous water flow patterns. If in plant community B, water flow patterns would be visible as long (more than 1feet) and continuous across the landscape.

---

3. **Number and height of erosional pedestals or terracettes:** Pedestals or terracettes would essentially be nonexistent in HCPC. If in plant community A, careful examination on slopes > 8% yield occasional pedestals and terracettes approximately ¼ inch above the soil surface. If in plant community B, pedestals and terracettes are frequent and ½ - ¾ inch above the soil surface.

---

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Less than 10-20% of the soil surface should be bare in HCPC. Bare ground should be less than 2" in diameter. If in plant community A, 20-45% of the soil surface can be exposed. If in plant community B, 45-60% of the soil surface can be exposed.

---

5. **Number of gullies and erosion associated with gullies:** Gullies are not evident in any of the State 1 reference plant communities.

---

6. **Extent of wind scoured, blowouts and/or depositional areas:** Wind scoured, blowouts and/or depositional areas are not evident in any of the State 1 reference plant communities.

---

7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement is not expected with HCPC. If in plant community A, careful examination will yield some fine litter movement for a short distance. If in plant community B, litter, both fine and coarse, movement is visible, especially on slopes > 8%, but the distance moved is less than 1 foot.

---

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class anticipated to be 5 or 6 under plant canopy.

---

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The light gray to grayish brown clay surface layer is 2 - 8" deep. The surface texture ranges from loam, fine sandy loam and clay loam. Soil organic matter is usually 1-2%.

---

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** In HCPC, 40-50% plant canopy and 40-70% basal cover with small gaps between plants should reduce raindrop impact and slow overland flow, providing increased time for infiltration to occur. Healthy, deep rooted native grasses enhance infiltration and reduce runoff. Infiltration rate is slow. If in plant community A, 15-30% plant canopy and 20-35% basal cover with moderate gaps between plants will intensify raindrop impact and increase overland flow, causing decreased time for infiltration. If in plant community B, 10-20% plant canopy and 10-20% basal cover with sizeable gaps between plants, amplifies raindrop impact and increases overland flow. The site tends to be more xeric as runoff increases.

---

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer or soil surface crusting should be evident in any of the State 1 plant communities. Restrictive, very hard claypan begins at 2 - 8 inches.

---

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: HCPC: Tall and mid-stature, cool season bunch grasses = mid-stature, cool season rhizomatous grasses > short cool season bunch grasses > shrubs > forbs. Plant community A: Mid-stature, cool season rhizomatous grasses > tall and mid-stature, cool season bunch grasses >short stature, warm season rhizomatous > shrubs > forbs.

    Sub-dominant: Plant community B: Mid-stature, cool season rhizomatous grasses Short warm season perennial grasses > tall and mid-stature, cool season bunch grasses >forbs>shrubs.

    Other:

    Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Plant mortality and decadence very low in HCPC and Plant community A. In periods of drought, shrubs would exhibit decadence in the state 1 reference communities.

---

14. **Average percent litter cover (%) and depth (in):** Litter cover is in contact with soil surface. Litter decreases in Plant community A to 20-30% and depth is reduced to 0.25 inch. Litter decreases to less than 10-15% in Plant community B and is immeasurable.

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 500 - 1200 #/acre from Plant community B to HCPC in the State 1 reference community.

---

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:** Blue grama, prairie junegrass, needleleaf sedge, curly cup gumweed, Sandberg bluegrass, fringed sagewort, plains prickly pear, broom snakeweed, dense clubmoss.

---

17. **Perennial plant reproductive capability:** All species are capable of reproducing in HCPC and Plant community A. In Plant community B, plant seedlings will be weighed in favor of marginal and undesirable species. Replacement of desirable species will be very few.
