USDA Natural Resources
Conservation Service

Ecological site R053AE078MT
Shallow Clay (Swc) (Legacy) RRU 53AE

Last updated: 6/14/2023
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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.

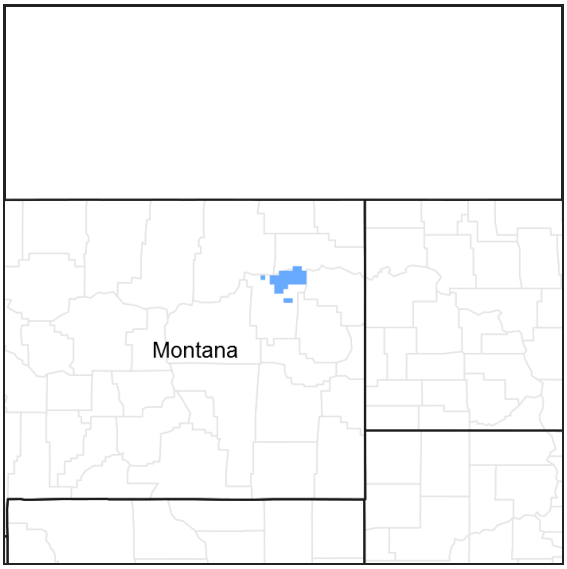


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

This ecological site occurs on rolling or strongly dissected uplands with shale outcrops. Soils generally have a clay loam to clay surface layer, subsoil, and shale bedrock at a depth of 10 to 20 inches. Slopes usually range from 15 to 35%, but can be less than 15%, and can occasionally reach 60%. Elevations normally vary from 2,200 to 3,500 feet.

Table 2. Representative physiographic features

Landforms	(1) Plain (2) Hill (3) Ridge
Flooding frequency	None
Ponding frequency	None

Elevation	572–1,158 m
Slope	0–60%
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)	123 days
Freeze-free period (average)	142 days
Precipitation total (average)	356 mm

Influencing water features

Soil features

These shallow, well drained soils formed in material weathered from clay shale. The soils occupy upland positions. Clay shale bedrock is at a depth of 10 to 20 inches. The surface texture is clay or silty clay. Subsoil textures are usually silty clay. Permeability is very slow. Soil ph varies from 6.6 – 8.4. This site is characterized by the following soil components: Lisam, Neldore, and Yawdim.

Table 4. Representative soil features

Surface texture	(1) Clay loam (2) Clay (3) Silty clay
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Very slow
Soil depth	25–51 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	3.81–7.62 cm
Calcium carbonate equivalent (0-101.6cm)	0–5%
Electrical conductivity (0-101.6cm)	0–8 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–13
Soil reaction (1:1 water) (0-101.6cm)	5.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	6–19%

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 on upland ecological sites consistently shows that precipitation is the principal factor altering productivity (Heitschmidt et al. 2005). The same authors concluded that grazing reduces herbage standing crop, whereas its effects on aboveground net primary production vary with timing of grazing and precipitation events, along with the functional and structural composition of the plant community. Prior to the arrival of European man, these lands may have burned every 10-12 years (Frost 1998).

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 10% and 5%, respectively, to total annual production. Total vegetative production averages 1000 lbs/ac in normal years, 700 lbs/ac in “unfavorable” years, and 1300 lbs/ac in “favorable” years.

This site is resistant to disturbance, especially when late-successional plants dominate the site. 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 with continued adverse impacts. Plant communities that retain a high percentage of late successional species are highly resilient. With favorable precipitation and/or prescribed grazing treatments these plant communities can return to the HCPC. In contrast, significant succession is unusual within early-seral communities.

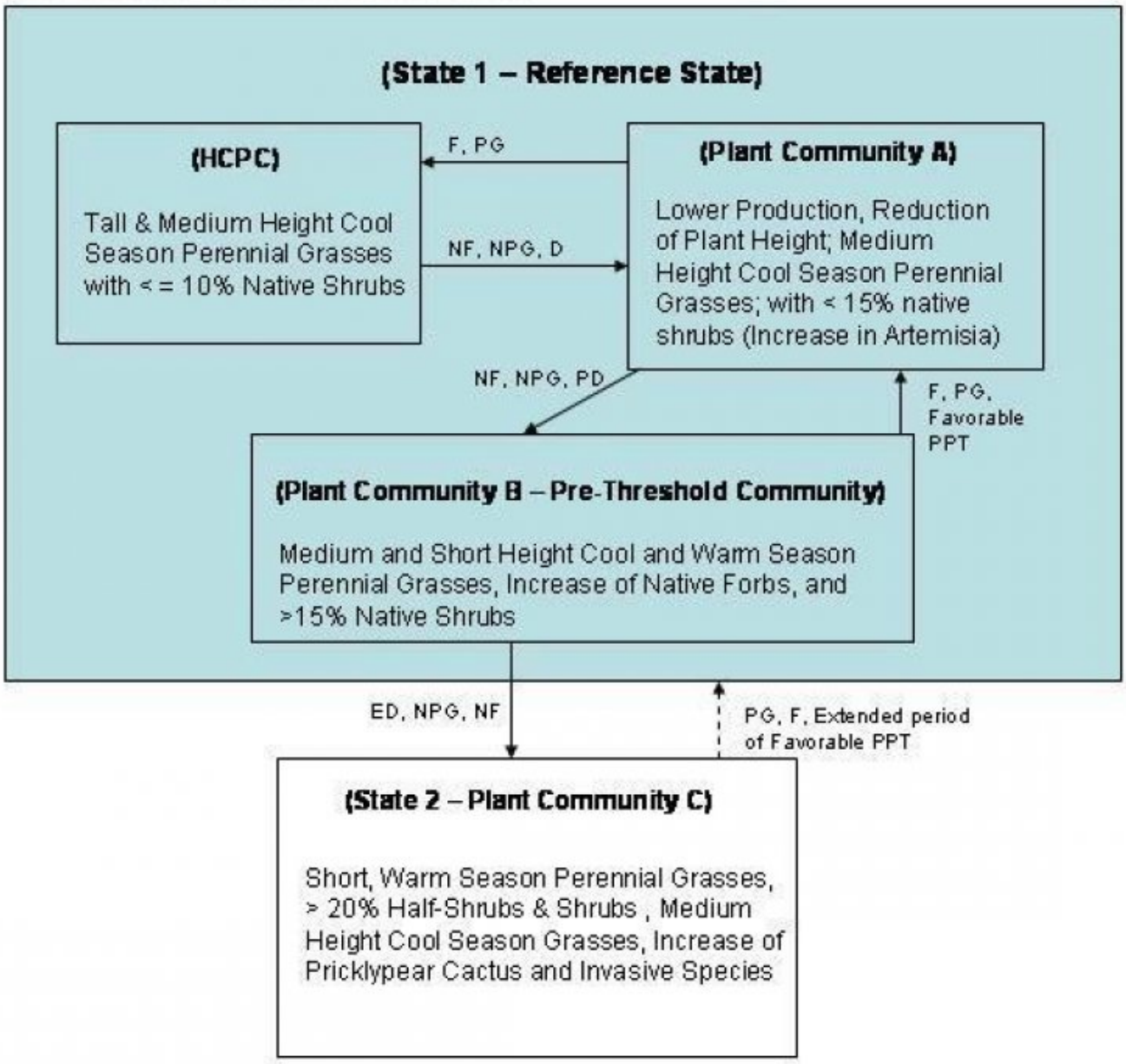
State and Transition Diagram

Successional pathways of Shallow Clay 10-14” p.z. ecological sites 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. The transition from State #1 to State #2 and a plant community representative of State #2 are also illustrated. Ecological processes are discussed in the plant community descriptions that follow the diagram.

State and transition model

Shallow Clay MLRU 52XA, 52XB, 53AY



Legend:

NF – No Fire
F – Fire (natural interval 10-12 years)
NPG – Non-prescribed Grazing
PG – Prescribed Grazing
PPT -- Precipitation
D – Drought (3-5 years)
PD – Prolonged Drought (5-7 years)
ED – Extended Drought (> 7years)

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

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

The cool season western wheatgrass and green needlegrass are the dominant plants on this ecological site. They account for about 75% of the total annual production in the HCPC. Drought and non-prescribed grazing reduces the competitiveness of the dominant species, and allows lower successional grasses (plains reedgrass, prairie junegrass, needleandthread, sandberg bluegrass, and blue grama) to increase on the site. Plains muhly, a palatable, warm season, short grass may occur in this community. About 10% of the total production is made by a mix of warm and cool season short grasses and sedges. Forbs contribute about 5% of the total annual production. Two warm season legumes (purple and white prairie clover) and a cool season legume (American vetch) are important components of the HCPC. They fix nitrogen, and are highly palatable forage for livestock and many species of wildlife. Three additional legumes (milkvetch, scurfpea and prairie thermopsis) also occur in the community however their value as forage plants is much lower. Onion, hoods phlox, buckwheat, hoods phlox, scarlet globemallow and biscuitroot may occur as small percentages of the total annual production. 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. Nuttall saltbush and winterfat are two common shrubs on this site. Both species make most of their growth during the cool part of the growing season, and are excellent browse for grazing animals. Silver sagebrush, big sagebrush, fringed sagebrush, rubber rabbitbrush, prairie rose, and pricklypear cactus may occur as small percentages of the total annual production. 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. Total annual production averages 1000 lbs/ac during normal years. However, production declines as the site 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 regime. The above disturbances favor the replacement of green needlegrass and western wheatgrass by blue grama, sandberg bluegrass, prairie junegrass, scarlet globemallow, onion, and hoods phlox. Nuttall saltbush may also be replaced by broom snakeweed, fringed sagewort, etc. Cheatgrass and Japanese brome may colonize the site as it further deteriorates from the HCPC and associated plant communities. As a result of these vegetative changes, there is less litter to protect the soil and infiltration is reduced. Hydrologic cycles are impaired when plant communities are unable to effectively use precipitation. Plant basal cover averages 25%. Litter varies from 50-60%, and bare ground averages 10%. Thus, runoff and erosion are not major concerns in the HCPC on the shallow clay ecological site. Runoff and soil erosion normally 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	673	953	1233
Shrub/Vine	90	112	146
Forb	22	56	78
Total	**785**	**1121**	**1457**

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	50-60%
Surface fragments >0.25" and <=3"	0-1%
Surface fragments >3"	0-1%
Bedrock	0-1%

Water	0%
Bare ground	0-10%

Table 7. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	1-5%
Grass/grasslike basal cover	15-20%
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%	10-20%	20-30%
>0.15 <= 0.3	–	35-45%	35-45%	45-55%
>0.3 <= 0.6	–	45-55%	35-45%	20-30%
>0.6 <= 1.4	–	5-15%	0-10%	–
>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): Non-prescribed grazing and drought reduce plant height and plant litter. Total annual production is about 80% of the production found in HCPC. Surface runoff and soil temperature increases and infiltration decreases. Shallow-rooted short grasses (sandberg bluegrass, blue grama, and prairie junegrass) and sedges gain a competitive advantage over medium height, deep-rooted cool season perennial grasses (bluebunch wheatgrass, green needlegrass and western wheatgrass). 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. Western wheatgrass, little bluestem, green needlegrass and bluebunch wheatgrass contribute about 60% of the total annual production. Vigor of these high-successional grasses has declined, and individual plant growth is reduced from what it is in the HCPC. Production of the short grasses increases relative to their percentage contribution in the HCPC. Although a few annual forbs are present on disturbed areas, the forb component continues to contribute about 10% of the total annual production. Fringed sagewort and silver sagebrush increased at the expense of nuttall saltbush and winterfat. Therefore, total shrub production is 5-10% of total annual production. Most of the species characteristic in the HCPC community are present in Community A. Therefore, it is highly resilient and resistant to change. Trend is

influenced by the interaction of climatic factors and livestock grazing management practices. *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 is possible 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 lacking a natural fire regime. The rate of regression varies with the intensity of the disturbances. Severe drought may cause retrogression within a couple years.

Community 1.3
Plant Community B (State #1)

Plant Community B (State #1): This Community is dominated by a mix of medium and short height, cool and warm season grasses. Western wheatgrass, green needlegrass, and bluebunch wheatgrass represent from 40-50% of total annual production. Blue grama, threadleaf sedge, sandberg bluegrass and other low successional grasses expanded their influence in the community. Total annual production is about 75% of the production in Community A, or about 50% of what it was in the HCPC. Prairie thermopsis, hoods phlox, wild onion, western yarrow, and scarlet globemallow increased and now contribute about 15% of the total annual production. The density of fringed sagewort and broom snakeweed (warm season half-shrubs) increased relative to their presence in the higher successional communities. Pricklypear cactus is usually present in this community. Total annual production averages 550 lbs/ac. In comparison to the HCPC, total plant cover and amount of litter declines. A disproportionate amount of litter that is on the ground is material from lower successional plants. Bare ground increases to about 20%. Plant community B is called the “pre-threshold community”. It is critical that this community be recognized and strategies implemented to prevent further regression. Compared to the HCPC, water flow patterns are more numerous than expected, there is slight to moderate active pedestalling, there is more bare ground than expected, there is moderate movement of smaller size litter deposits into depressions or against obstructions, infiltration is slightly to moderately decreased due to the shift toward more short grasses in the plant community. The reproductive capabilities of green needlegrass and western wheatgrass are somewhat limited relative to recent climatic conditions (USDI and USDA 2000). Bluebunch wheatgrass often persists as no more than remnant plants in this Community. Community B is less resilient and much less resistant to change than Community A. Once Community B regresses to a lower state, normal successional processes are less likely to occur in a timely fashion. *Successional Pathways from Community B to Community A: Community B is fairly resilient, and it does not persist in a steady state. Prescribed grazing and/or a period of favorable precipitation will usually induce succession from Community B to Community A (Branson and Miller 1981). *Transition from Community B (State 1) to State #2: Community B is much less resistant to change than Community A. Lower production, lower vegetative cover, less litter, and increased bare ground increases Community B’s susceptibility to disturbance. Extended drought and non-prescribed grazing can cause regression to State #2.

State 2
Plant Community C (State #2)

Community 2.1
Plant Community C (State #2)

Plant Community C (State #2): This plant community is dominated by blue grama and other short warm season perennial grasses. Prairie junegrass, sandberg bluegrass and other cool season short grasses are also common. Western wheatgrass persists as slender stalks, with minimal seed production. Low-successional grasses and sedges contribute about 50% of the total annual production. Fringed sagewort, broom snakeweed and Nuttall saltbush contribute more than 20% of the total annual production. Low successional forbs also contribute about 20% of the production. Broom snakeweed and pricklypear cactus are conspicuous in the community. Total annual production averages about 400 lbs/ac, a 25% reduction from Community B. Litter cover averages about 15%. Water flow patterns are numerous and there is moderate active pedestalling. Bare ground is moderately to much higher than expected. 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 mid height cool season grasses is greatly reduced relative to recent climatic conditions. *Transition from State #2 to Reference State (State #1): Prescribed grazing reduces the probability of further regression in this State, but it does not ensure significant succession to State #1. Succession from State #2 to State #1 may occur with prescribed grazing combined with an extended period of favorable precipitation. This potential succession is depicted with a “dashed” arrow in the state

and transition diagram. Succession can also be induced by mechanical treatments and range seeding.

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**			112–336	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	56–168	–
	western wheatgrass	PASM	*Pascopyrum smithii*	56–168	–
2	**Native perennial grasses**			1–953	
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	1–560	–
	little bluestem	SCSC	*Schizachyrium scoparium*	56–392	–
	green needlegrass	NAVI4	*Nassella viridula*	112–336	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	1–336	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	1–56	–
3	**Native perennial grasses and grasslikes**			1–112	
	Grass, perennial	2GP	*Grass, perennial*	1–22	–
	blue grama	BOGR2	*Bouteloua gracilis*	1–22	–
	needleleaf sedge	CADU6	*Carex duriuscula*	1–22	–
	threadleaf sedge	CAFI	*Carex filifolia*	1–22	–
	plains reedgrass	CAMO	*Calamagrostis montanensis*	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**			11–56	
	American vetch	VIAM	*Vicia americana*	11–56	–
5	**Native perennial forbs**			22–112	
	white prairie clover	DACA7	*Dalea candida*	11–56	–
	purple prairie clover	DAPU5	*Dalea purpurea*	11–56	–
6	**Native perennial forbs**			1–45	
	Forb, perennial	2FP	*Forb, perennial*	1–17	–
	common yarrow	ACMI2	*Achillea millefolium*	1–17	–
	onion	ALLIU	*Allium*	1–17	–
	aster	ASTER	*Aster*	1–17	–
	milkvetch	ASTRA	*Astragalus*	1–17	–
	bastard toadflax	COUM	*Comandra umbellata*	1–17	–
	spiny phlox	PHHO	*Phlox hoodii*	1–17	–
	scurfpea	PSORA2	*Psoralidium*	1–17	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	1–17	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	1–17	–
Shrub/Vine					

7	**Native shrubs and half-shrubs**			11–56	
	silver sagebrush	ARCA13	*Artemisia cana*	11–56	–
	Nuttall's saltbush	ATNU2	*Atriplex nuttallii*	11–56	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	11–56	–
8	**Native shrubs and half-shrubs**			1–34	
	Shrub, broadleaf	2SB	*Shrub, broadleaf*	1–17	–
	prairie sagewort	ARFR4	*Artemisia frigida*	1–17	–
	big sagebrush	ARTR2	*Artemisia tridentata*	1–17	–
9	**Native shrubs and half-shrubs**			1–17	
	greasewood	SAVE4	*Sarcobatus vermiculatus*	1–17	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–1	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–1	–

Animal community

Livestock Management

The Shallow Clay 10-14” p.z. ecological site is fairly productive and is suited for livestock grazing. However, prescribed grazing management is needed. This site is often associated with slopes that may be susceptible to erosion. Species composition is favorable to livestock, and is 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 also result in soil compaction. Any additional factors reducing infiltration and increasing runoff on this site are management concerns. Shorter grazing periods developed in conjunction with adequate periods of deferment to facilitate regrowth, replenish carbohydrate pools, and accumulate litter on the soil surface are recommended.

This ecological site, as do most other sites in the northern mixed prairie, has a short grass component. The short grasses usually increase with grazing and decrease with protection or prescribed grazing. However, succession in direct response to a change in grazing pressure 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 shallow clay 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. While a prescribed grazing system is always a good recommendation, it may not guarantee significant succession.

This ecological site is suited for prescribed grazing by livestock. Because of the terrain, and propensity of shrubs, this site may be more compatible for sheep, rather than cattle grazing. Although poisonous plants are not normally a problem, death camas and other forbs may cause losses if livestock are grazing in early spring, before there is adequate growth of suitable forage plants.

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 to attract many species of wildlife. Antelope and mule deer prefer grazing this site because of the Nuttall saltbush and other shrubs. When this site occurs in the landscape as a mosaic with other sites, thermal and escape cover are provided for many species of wildlife.

This ecological site becomes less valuable for deer and antelope when plant diversity declines with regression. For example, the disappearance of the bluebunch wheatgrass, green needlegrass, western wheatgrass, and the reduction of Nuttall saltbush would shorten the length of the “green forage” season. The increase of blue grama, hoods phlox etc. is associated with the loss of palatable forbs. These changes also adversely impact foraging opportunities for deer, antelope, upland birds, etc. Because of insufficient vegetative structural diversity, residual grass carry-over and litter cover, the value of the plant community found in State #2 is greatly reduced for wildlife habitat.

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 very high runoff potential, with hydrologic runoff curves of 89 to 80. Field investigations are needed to adjust the curves when plant communities deteriorate from the HCPC. Areas with ground cover less than 50% have the greatest potential for reduced infiltration and higher runoff.

Recreational uses

This site provides hunting opportunities for upland game species. Outdoor enthusiasts may also appreciate the serenity and openness of this site.

Wood products

This site has no significant value for wood products.

Other information

This 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 1 1991-1992 MT Phillips
(Note: regarded with skepticism; SI=66%; production=520 lbs/ac, of which 180 lbs were forbs)

ECS-1
Modified Double Sampling 8 2002-2004 MT Phillips, Blaine, Valley, Roosevelt, Daniels

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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.

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.

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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 or in plant community A. In plant community B, rills would be visible, ½ inch deep or more, linear, rarely exceeding 1 foot in length. Distance between rills is irregular.

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2. **Presence of water flow patterns:** Water flow patterns should not be present in HCPC or in plant community A. In plant community B, water flow patterns would be visible as long (more than 1feet) and continuous across the landscape.

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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 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.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 5-10% of the soil surface could be bare in HCPC and in plant community A. If in plant community B, 10-20% of the soil surface can be exposed.

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5. **Number of gullies and erosion associated with gullies:** Active gullies should not be present. Existing gullies should be “healed” with a good vegetative cover in all State 1 reference plant communities.

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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.

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement is not expected with HCPC and plant community A., In plant community B, litter, both fine and coarse, movement is visible, into depressions or against natural obstacles.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class anticipated to be 5 or 6 in HCPC and in plant community A. Stability class would decrease to 4 in plant community B.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The surface layer is usually 0-4” deep and typically have clay, clay loam, and silty clay textures. Surface color ranges from light brownish gray to dark grayish brown. Soil organic matter ranges from 0.5 – 1%

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** In HCPC and Plant community A, 50-60% plant canopy and 65-90% 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 very slow. If in plant community B, 30-40% plant canopy and 65-80% basal cover with large gaps between plants, amplifies raindrop impact and increases overland flow. The site tends to be more xeric as runoff increases.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer should be evident in any of the State 1 plant communities.
    Clay shale bedrock begins at 10 to 20 inches below the surface.

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

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

Sub-dominant: Plant community B: Short warm season rhizomatous grasses = short cool season bunch grasses > mid-stature, cool season rhizomatous grasses > forbs > shrubs.

Other:

Additional:

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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 all state 1 reference plant communities. In periods of drought, shrubs would exhibit decadence in the state 1 reference communities.

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14. **Average percent litter cover (%) and depth (in):** Litter cover is in contact with soil surface. Litter decreases in Plant community B to 30-40% and depth is immeasurable.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 600 - 1100 #/acre.

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Blue grama, prairie junegrass, needleleaf sedge, plains prickly pear, broom snakeweed.

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17. **Perennial plant reproductive capability:** All species have a somewhat restricted ability to reproduce 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.
