USDA Natural Resources Conservation Service

Ecological site R058AC042MT
Sandy (Sy) RRU 58A-C 11-14" p.z.

Last updated: 6/14/2023
Accessed: 05/03/2024

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.

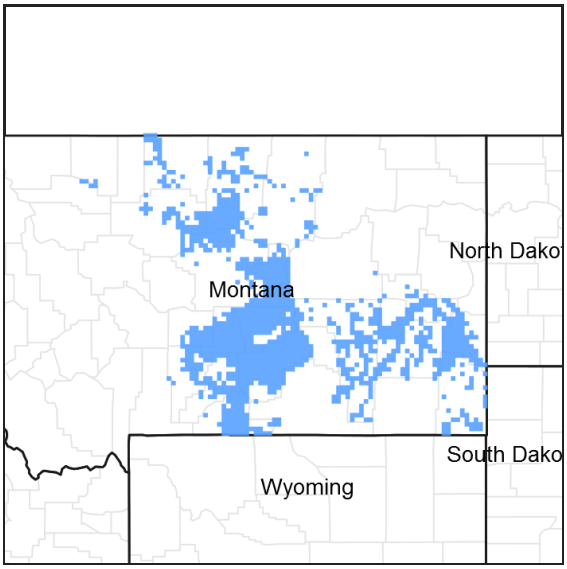


Figure 1. Mapped extent

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.

Associated sites

R058AC040MT	**Silty (Si) RRU 58A-C 11-14" p.z.**

Similar sites

R058AC040MT	**Silty (Si) RRU 58A-C 11-14" p.z.** The Silty site occupies similar landscape positions, differing mainly by texture.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Calamovilfa longifolia*

Physiographic features

Table 2. Representative physiographic features

Landforms	(1) Alluvial fan (2) Terrace (3) Plain
Flooding frequency	None
Ponding frequency	None
Elevation	686–1,372 m
Slope	0–15%
Ponding depth	0 cm
Water table depth	152 cm
Aspect	Aspect is not a significant factor

Climatic features

Major Land Resource Area (MLRA) 58AC in Montana is considered to have a continental climate characterized by cold winters, hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are typical. The climate is the result of this MLRA's location in the geographic center of North America. There are few natural barriers on the northern Great Plains and the winds move freely across the plains and account for rapid changes in temperature. Seasonal precipitation is often limiting for plant growth. Annual fluctuations in species composition and total production are typical depending on the amount and timing of rainfall.
Temperatures can be very extreme in this part of Montana. Summer daytime temperatures are typically quite warm, generally averaging in the mid to upper 80º's F for July and August. Summertime temperatures will typically reach in the 100º's F at some point during the summer, and can reach 90º F any month between May and September. Conversely, winter temperatures can be cold, averaging in the mid teens to mid 20º's F for December and January. There will typically be several days of below zero temperatures each winter. It is not uncommon for temperatures to reach 30–40º F below zero, or even colder, most any winter.

Spring can be windy throughout this MLRA, with winds averaging over 10 mph about 15 percent of the time. Speeds of 50 mph or stronger can occasionally occur as a weather system crosses this part of Montana.

The majority of the rangeland in MLRA 58AC is within the 11 to 14 inch Mean Annual Precipitation (MAP) range. During an average year, 70 to 75 percent of the annual precipitation falls between April and September, which are the primary growing season months.

Snowfall is not heavy in the area, averaging 28 total inches in the Yellowstone Valley. Heavy snowfall occurs infrequently, usually late in the winter or early spring. Snow cover is typically 1 to 3 inches.

The frost-free (32º F.) season averages about 105 to 145 days each year in the uplands, to nearly 170 days along the Yellowstone River Valley.

For local climate station information, refer to http://www.wcc.nrcs.usda.gov/cgibin/state.pl?state=mt.

Table 3. Representative climatic features

Frost-free period (average)	135 days
Freeze-free period (average)	155 days
Precipitation total (average)	356 mm

Influencing water features

Soil features

These soils are coarse to fine sandy loams more than 20 inches deep. They are well drained, permeability is mostly moderate to moderately rapid, and effective rooting depth is greater than 20 inches. Available water holding

capacity to 40 inches is mainly over 4 inches.

Table 4. Representative soil features

Surface texture	(1) Coarse sandy loam (2) Fine sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate to moderately rapid
Soil depth	51–183 cm
Surface fragment cover <=3"	0–5%
Available water capacity (0-101.6cm)	10.16–22.86 cm

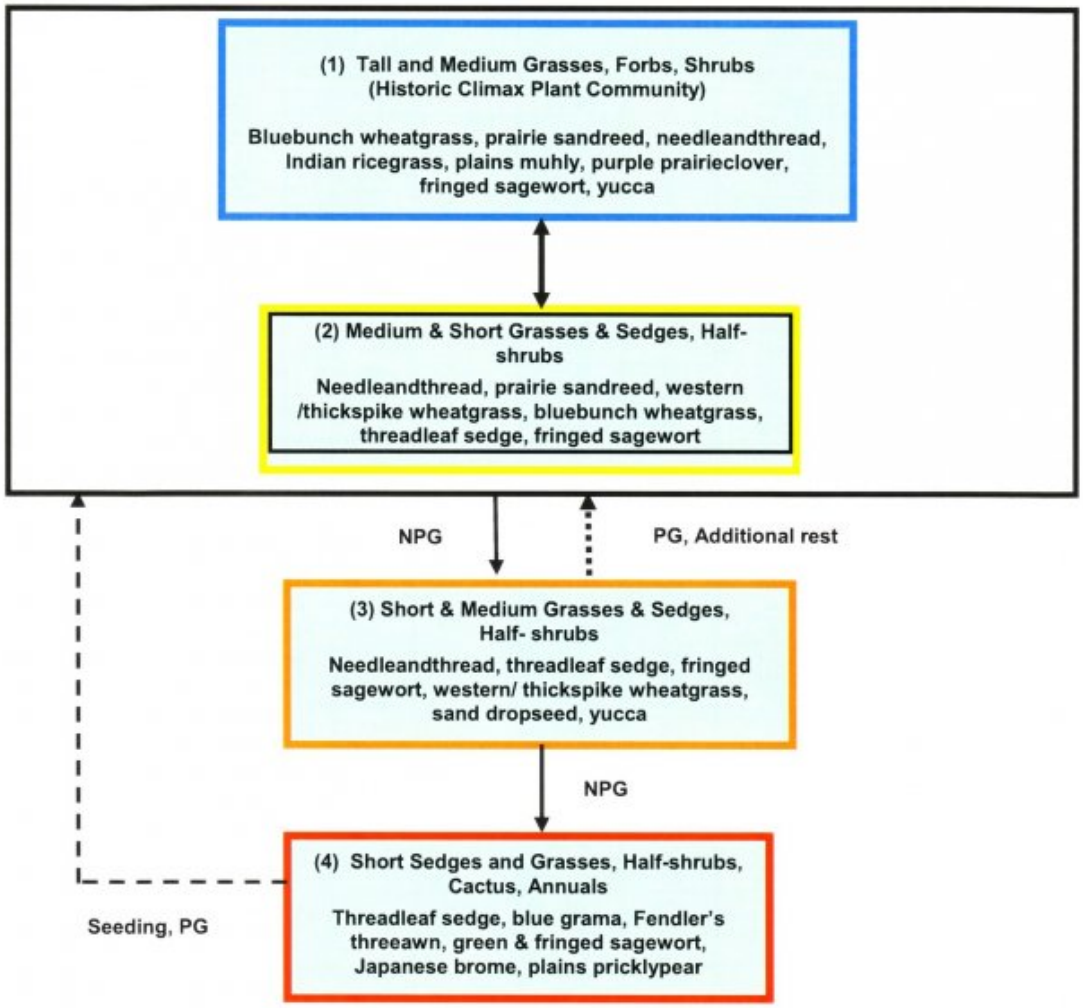
Ecological dynamics

The following are descriptions of several plant communities that may occupy this site:

State and transition model

MLRA: 58AC – Sedimentary Plains, Central
R058AC042MT

5c. Plant Communities and Transitional Pathways (diagram)



Smaller boxes within a larger box indicate that these communities will normally shift among themselves with slight variations in precipitation and other disturbances. Moving outside the larger box indicates the community has crossed a threshold (heavier line) and will require intensive treatment to return to Community 1 or 2. Dotted lines indicate a reduced probability for success. Yellow boxes indicate caution that the community may be in danger of crossing a threshold. Orange boxes represent communities that have crossed over thresholds from the HCPC and may be difficult to restore with grazing management alone. Red boxes represent communities that have severely shifted away from the HCPC and probably cannot be restored without mechanical inputs.

NOTE: Not all species present in the community are listed in this table. Species listed are representative of the plant functional groups that occur in the community.

PG = Prescribed Grazing: Use of a planned grazing strategy to balance animal forage demand with available forage resources. Timing, duration, and frequency of grazing are controlled and some type of grazing rotation is applied to allow for plant recovery following grazing.

NPG = Non-Prescribed Grazing: Grazing which has taken place that does not control the factors as listed above, or animal forage demand is higher than the available forage supply.

Fire: Prescribed fire or non-prescribed wildfire.

Matted: > 50% cover

State 1
Plant Community 1: Tall and Medium Grass/ Forbs/ Shrubs (HCPC)

Community 1.1
Plant Community 1: Tall and Medium Grass/ Forbs/ Shrubs (HCPC)

Figure 2. 58AC Plant Community 1

The physical aspect of this site in Historic Climax is that of a level to undulating grassland dominated by warm and cool-season grasses, with forbs and shrubs occurring in small percentages. Approximately 80 – 90% of the annual production is from grasses and sedges, 1 – 10% from forbs, and 1 – 5% is from shrubs and half-shrubs. Canopy cover of shrubs is 0 – 5%. Dominant species include bluebunch wheatgrass, prairie sandreed, Indian ricegrass, needleandthread, and plains muhly, and short grasses and sedges (sand dropseed, threadleaf sedge). There are abundant forbs (prairie clovers, dotted gayfeather) which occur in smaller percentages. Shrubs and half-shrubs occur occasionally. This plant community is well adapted to the Northern Great Plains climatic conditions. The diversity in plant species and presence of tall, deep-rooted perennial grasses allows for drought tolerance. Plants on this site have strong, healthy root systems that allow production to increase significantly with favorable moisture conditions. Abundant plant litter is available for soil building and moisture retention. Plant litter is properly distributed with very little movement off-site and natural plant mortality is very low. This plant community provides for soil stability and a functioning hydrologic cycle.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1457	1614	1849
Forb	90	179	191
Shrub/Vine	73	90	101
Total	**1620**	**1883**	**2141**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0-10%
Grass/grasslike foliar cover	70-85%
Forb foliar cover	1-5%
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 7. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	1-4%
Grass/grasslike basal cover	5-15%
Forb basal cover	1-4%
Non-vascular plants	0%
Biological crusts	0-1%
Litter	50-70%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	10-20%

Table 8. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	–	–
>0.15 <= 0.3	–	–	–	–
>0.3 <= 0.6	–	–	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	1-5%
>4 <= 12	–	0-10%	70-85%	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

State 2
Plant Community 2: Medium and Short Grasses and Sedges/ Half-shrubs

Community 2.1
Plant Community 2: Medium and Short Grasses and Sedges/ Half-shrubs

Figure 4. 58AC Sandy Plant Community 2

This community occurs due to minor climate shifts or slight variations in soils and/or topography or disturbance, including non-prescribed grazing. Dominant species include prairie sandreed and needleandthread. Western or thickspike wheatgrass, sand dropseed, threadleaf sedge and green and fringed sagewort tend to become a slightly larger part of the plant community. The more palatable grasses (bluebunch wheatgrass, Indian ricegrass, plains muhly) will still be present but in smaller amounts. Palatable and nutritious forbs will be replaced by less desirable and more aggressive species. Yucca may become more common. Grass biomass production and litter become reduced on Community 2 as the taller grasses become less prevalent, increasing evaporation and reducing moisture retention. Additional open space in the community can result in undesirable invader species. These plant communities provide for moderate soil stability

State 3
Plant Community 3: Short and Medium Grasses and Sedges/ Half-shrubs

Community 3.1
Plant Community 3: Short and Medium Grasses and Sedges/ Half-shrubs

Figure 5. 58AC Sandy Plant Community 3

This is a disturbance induced community, with dominant species including needleandthread, western or thickspike wheatgrass, threadleaf sedge, sand dropseed and blue grama. Forbs and green and fringed sagewort tend to make up a larger part of the plant community. There may still be remnant amounts of some of the late-seral species such as bluebunch wheatgrass or prairie sandreed present. Palatable forbs will be mostly absent. Yucca or other shrubs may increase.

State 4
Plant Community 4: Short Sedges and Grasses/ Half-Shrubs/ Cactus/ Annual Grasses

Community 4.1
Plant Community 4: Short Sedges and Grasses/ Half-Shrubs/ Cactus/ Annual Grasses

This community is the result of continual adverse disturbances. Dominants include threadleaf sedge, blue grama, and other short grasses. A remnant of the potential plant community may remain, especially needleandthread, but in much smaller proportions. Species that are un-palatable become more common, including Fendler’s threeawn, green and fringed sagewort, broom snakeweed, annual bromes, six-weeks fescue, and plains pricklypear. Plant Communities 3 and 4 are much less productive than Plant Communities 1 or 2, and have lost many of the attributes of a healthy rangeland. The loss of deep perennial root systems reduces total available moisture for plant growth. Reduction of plant litter will result in higher surface soil temperatures and increased evaporation losses. Annual species are often aggressive and competitive with seedlings of perennial plants. This community can respond positively to improved grazing management but it will take additional inputs to move it towards a community similar in production and composition to that of Plant Community 1 or 2.

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 grasses**			1296–1713	
	prairie sandreed	CALO	*Calamovilfa longifolia*	243–1392	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	163–1070	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	163–428	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	81–321	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	90–214	–
	western wheatgrass	PASM	*Pascopyrum smithii*	81–214	–
	tufted wheatgrass	ELMA7	*Elymus macrourus*	81–214	–
2	**Native grasses**			1–214	
	Grass, perennial	2GP	*Grass, perennial*	1–108	–
	blue grama	BOGR2	*Bouteloua gracilis*	1–108	–
	threadleaf sedge	CAFI	*Carex filifolia*	1–108	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	1–108	–
	Sandberg bluegrass	POSE	*Poa secunda*	1–108	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	1–108	–
3	**Native grasses**			1–3	
	Fendler's threeawn	ARPUF	*Aristida purpurea var. fendleriana*	1–3	–
Forb					
4	**Native forbs**			16–214	
	Forb, perennial	2FP	*Forb, perennial*	16–108	–
	common yarrow	ACMI2	*Achillea millefolium*	16–108	–
	rockcress	ARABI2	*Arabis*	16–108	–
	tarragon	ARDR4	*Artemisia dracunculus*	16–108	–
	milkvetch	ASTRA	*Astragalus*	16–108	–
	bastard toadflax	COUM	*Comandra umbellata*	16–108	–
	white prairie clover	DACA7	*Dalea candida*	16–108	–
	purple prairie clover	DAPU5	*Dalea purpurea*	16–108	–
	annual buckwheat	ERAN4	*Eriogonum annuum*	16–108	–
	buckwheat	ERIOG	*Eriogonum*	16–108	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	16–108	–
	Lewis flax	LILE3	*Linum lewisii*	16–108	–
	dotted blazing star	LIPU	*Liatris punctata*	16–108	–
	desertparsley	LOMAT	*Lomatium*	16–108	–
	beardtongue	PENST	*Penstemon*	16–108	–
	spiny phlox	PHHO	*Phlox hoodii*	16–108	–
	scurfpea	PSORA2	*Psoralidium*	16–108	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	16–108	–

	manyflowered aster	SYERP2	*Symphyotrichum ericoides var. pansum*	16–108	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	16–108	–
	American vetch	VIAM	*Vicia americana*	16–108	–
5	**Native forbs (toxic properties)**			1–3	
	twogrooved milkvetch	ASBI2	*Astragalus bisulcatus*	1–3	–
	larkspur	DELPH	*Delphinium*	1–3	–
	locoweed	OXYTR	*Oxytropis*	1–3	–
	deathcamas	ZIGAD	*Zigadenus*	1–3	–
Shrub/Vine					
6	**Native shrubs and half-shrubs**			1–108	
	Shrub, broadleaf	2SB	*Shrub, broadleaf*	1–108	–
	silver sagebrush	ARCA13	*Artemisia cana*	1–108	–
	prairie sagewort	ARFR4	*Artemisia frigida*	1–108	–
	rubber rabbitbrush	ERNAN5	*Ericameria nauseosa ssp. nauseosa var. nauseosa*	1–108	–
	creeping juniper	JUHO2	*Juniperus horizontalis*	1–108	–
	skunkbush sumac	RHTR	*Rhus trilobata*	1–108	–
	prairie rose	ROAR3	*Rosa arkansana*	1–108	–
	soapweed yucca	YUGL	*Yucca glauca*	1–108	–
7	**Native shrubs and half-shrubs**			1–3	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	1–3	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	1–3	–

Animal community

Livestock Grazing Interpretations:

Managed livestock grazing is suitable on this site as it has the potential to produce an abundance of high quality forage. This is often a preferred site for grazing by livestock, and animals tend to congregate in these areas. In order to maintain the productivity of this site, grazing must be managed carefully on adjoining sites with less production to be sure livestock drift onto the Sandy site is not excessive. Management objectives should include maintenance or improvement of the plant community. Shorter grazing periods and adequate re-growth after grazing are recommended for plant maintenance and recovery. Heavy stocking and season-long use of this site can be detrimental and will alter the plant community composition and production over time.

Whenever Plant Community 2 (medium and short grasses and sedges) occurs, grazing management strategies need to be implemented to avoid further deterioration. This community is still stable, productive, and healthy provided it receives proper management. This community will respond fairly quickly to improved grazing management, including increased growing season rest of key forage plants. Grazing management alone can usually move this community back towards the potential community.

Plant Communities 3 and 4 have substantially reduced forage production, and a high percentage of aggressive, non-palatable species. Once these plant communities become established, it will be much more difficult to restore the site to a community that resembles the potential with grazing management alone. Additional growing season rest is often necessary for re-establishment of the desired species and to restore the stability and health of the site. Seeding may be necessary to restore desirable native perennial species.

Wildlife Interpretations:

The Sandy ecological site occurs over large acreages on the Northern Great Plains except where it is fragmented by conversion to cropland, which is significant in many areas. Habitat fragmentation of this site has contributed to the decline of some “area sensitive” wildlife species, particularly such ground-nesting birds as the grasshopper sparrow. This site is home to a diverse native wildlife complex resulting from the varied habitat structure provided by a mixture of grasses, forbs, and shrubs. Historically, huge herds of migratory bison and pronghorn as well as large numbers of sharp-tailed grouse were probably the dominant “game” species in addition to a wide variety of ground-nesting songbirds, waterfowl and shorebirds, small mammals and mammalian predators. Grazing patterns, topographic diversity, extensive acreages, and interspersion with other ecological sites make this type very important to numerous wildlife species. Small mammal diversity and abundance is high which, in turn, supports a varied raptor population. Invasive plant species such as leafy spurge, Canada thistle and several knapweeds are contributing to a loss of biodiversity within this ecological site. Wildlife water requirements are provided by springs and seeps, intermittent and perennial streams, and in modern times, numerous artificial ponds and livestock pipelines. These areas are locally important for northern leopard frogs, tiger salamanders and a number to toad species, all of which feed on a variety of insects. Grazing, fire, drought cycles, and insect population fluctuations create a shifting mosaic of wildlife habitats across this site.

Plant Community 1: Tall and Medium Grasses/ Forbs/ Shrubs (HCPC):

The diversity of plant species and life forms provides feeding substrate for a variety of beneficial pollinating insects. Numerous warm and cool water fish species inhabit the intermittent and perennial streams associated with this community. Northern pike, lake chub, carp, a variety of suckers and walleye are examples. Common reptile and amphibian species include tiger salamanders in ponds and stock tanks, Woodhouse’s toad, western chorus frogs, short-horned lizards, bull snake and rattlesnake, and three species of garter snakes. The diversity of grass stature and life forms, along with scattered shrubs and a variety of forbs, provides habitat for many bird species including the upland sandpiper, sharp-tailed grouse, loggerhead shrike, grasshopper and savanna sparrow, chestnut-collared longspur, and western meadowlark. This community is especially favorable for ground-nesting birds because of the abundant residual plant material and litter available for nesting, escape, and thermal cover. Diverse prey populations are available for raptors such as ferruginous and Swainson’s hawks. The predominance of grasses plus a diversity of forbs, shrubs and half-shrubs in this community favors grazers and mixed feeders such as bison, pronghorn and elk. Complex plant structural diversity and litter cover provide habitat for a wide array of small mammals (both seed eaters, i.e. deer mice and herbivores, i.e. voles and jackrabbits) and neotropical migratory birds.

Plant Community 2: Medium and Short Grasses and Sedges/ Half-shrubs:

The partial loss of structural diversity makes this plant community somewhat less attractive to the variety of wildlife species using the HCPC. Insects still find a wide variety of plant species to utilize. A decrease in residual plant material and litter cover is usually associated with degradation of the HCPC, which makes this community less attractive for amphibians and ground-nesting birds. The reduction in Indian ricegrass decreases seed supplies for both birds and small mammals. Pronghorn make considerable use of this type because of forb and half-shrub availability in the generally open landscape.

Plant Community 3: Short and Medium Grasses and Sedges / Half-shrubs:

Insect diversity is reduced and grasshopper infestations may increase because of better breeding conditions on the warmer, drier soil surface. Likewise, generally drier conditions reduce habitat value for amphibians. Ground-nesting birds are adversely affected by the loss of residual cover and surface litter. Small mammal diversity is reduced with the loss of varied habitat structure. The seed-eating deer mouse may increase and herbivores, such as voles, decrease.

Plant Community 4: Short Sedges and Grasses/ Half-shrubs/ Cactus/ Annual Grasses:

Harmful insects, such as grasshoppers, can breed very successfully on the hot, dry soil surface. Habitat conditions for most wildlife species are very poor, reflecting the lack of structural diversity, residual cover and litter cover. Mountain plovers and horned larks may nest on the open soil surface.

Hydrological functions

The soils associated with this ecological site are generally in Hydrologic Soil Group B. The infiltration rates for these soils will normally be moderate to moderately rapid. The runoff potential for this site is low, depending on slope and ground cover/health. Runoff curve numbers generally range from 65 to 83.

Other information

The following is an example of how to calculate the recommended stocking rate. This example does not use production estimates from this specific ecological site. You will need to adjust the annual production values and run the calculations using total annual production values from the ecological sites encountered on each individual ranch/pasture. Before making specific recommendations, an on-site evaluation must be made.

Example of total annual production amounts by type of year:
Favorable years = 2200 lbs/acre
Normal years = 1480 lbs/acre
Unfavorable years = 1200 lbs/acre

It is recommended that on slopes of 30% or less, stocking rate should be derived from the total annual production pounds minus 500 pounds for residual dry matter and 25% harvest efficiency. On slopes over 30%, stocking rate is derived from total annual production pounds minus 800 pounds for residual dry matter and 25% harvest efficiency. Refer to the NRCS National Range and Pasture Handbook for a list of Animal Unit Equivalents.

Sample Calculations using Favorable Year production amounts:

< 30% slopes: AUM/AC = [(2200-500)(0.25)]/915 lbs/month for one AU = 0.46 AUM/AC
AC/AUM = (1.0 AU)/(0.46AUM/AC) = 2.2 AC/AUM

> 30% slopes: AUM/AC = [(2200-800)(0.25)]/915 lbs/month for one AU = 0.38 AUM/AC
AC/AUM = (1.0 AU)/(0.38 AUM/AC) = 2.6 AC/AUM

NOTE: 915 lbs/month for one Animal Unit is used as the baseline for maintenance requirements. This equates to 30 lbs/day of air-dry forage (1200 lb cow at 2.5% of body weight).

Inventory data references

Supporting Data for Site Development:
NRCS Production & Composition Record for Native Grazing Lands (Range-417): 5

BLM Soil & Vegetation Inventory Method (SVIM) Data: 2

NRCS Range Condition Record (ECS-2): 25

NRCS Range/Soil Correlation Observations & Soil 232 notes: 25

Ecological Site Reference: NRCS 417 No.: Golden Valley County 520

Field Offices where this site occurs within the state:

Big Sandy
Big Timber
Billings
Chinook
Columbus
Crow Agency
Fort Belknap
Hardin

Harlowton
Joliet
Lewistown
Malta
Roundup
Stanford
White Sulphur Springs
Winnett

Other references

Site Documentation:

Authors:
Original: NRCS, 1983

Revised: Matthew J. Ricketts, Robert E. Leiland, Rhonda Sue Noggles, Peter O. Husby, 2003

Contributors

MJR, REL, RSN, POH
RSN

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)	Loretta Metz
Contact for lead author	
Date	04/10/2005
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Minor rills (less than 0.5 to 1.0 inches in depth; less than 2.5 feet long) may be present in the reference state when slopes are greater than 8%. Plant community 2 has more rills than Plant community 1.

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2. **Presence of water flow patterns:** Water flow patterns are generally not evident in Plant community 1 in the reference state. Following heavy thunderstorms, or on slopes over 8%, short (less than 6.0 feet long) flow patterns may be apparent.

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3. **Number and height of erosional pedestals or terracettes:** These should not be evident in the reference state.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is less than 20% in the reference state. In HCPC, bare ground should not exceed 12%.

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5. **Number of gullies and erosion associated with gullies:** Gully erosion is not evident in the reference state.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** These are uncommon, but may certainly occur in the reference state. Size and extent vary too greatly to describe an “average” situation.

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement varies by size and depth of litter. In the reference state, litter should be coarse, anywhere from 1.5 inches up to 4 inches in length, and will not move more than a couple of inches from where it originated. Winds may move less persistent litter farther than water will move it.

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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 values of 2-3 in plant interspaces. Stability values of 3-5 under plant canopies and at plant bases.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Granular structure, light brown to dark brown color, A-horizon is approximately 2-10 inches in depth. Organic matter in A-horizon approximately 1-4%.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Deep-rooted native perennial grasses optimize infiltration and runoff. Grasses should be spaced approximately 2-4 feet apart in the reference state.

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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 present in the reference state.

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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: cool season, mid-height, native perennial bunchgrasses > warm season, mid- and short- height native perennial bunchgrasses >> native forbs > native shrubs.

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Plant mortality is very low; decadence is minimal except in prolonged periods of drought.

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):** 1445 – 1910 #/acre.

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:** plains pricklypear, broom snakeweed, cheatgrass, Japanese brome, fringed sagewort, threadleaf sedge, blue grama, etc.

17. **Perennial plant reproductive capability:** This is not impaired in the reference state. Except in extended periods of drought, plants are able to reproduce sexually or vegetatively.