USDA Natural Resources Conservation Service

Ecological site R067BY039CO
Shallow Siltstone

Last updated: 9/08/2023
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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.

MLRA notes

Major Land Resource Area (MLRA): 067B–Central High Plains, Southern Part

MLRA 67B occurs in eastern Colorado and consists of rolling plains and river valleys. Some canyonlands occur in the southeast portion. The major rivers are the South Platte and Arkansas which flow from the Rocky Mountains to Nebraska and Kansas. Other rivers in the MLRA include the Cache la Poudre and Republican and associated tributaries. This MLRA is traversed by Interstate 25, 70 and 76; and U.S. Highways 50 and 287. Major land uses include 54 percent rangeland, 35 percent cropland, and 2 percent pasture and hayland. Urban, developed open space, and miscellaneous land occupy approximately 9 percent. Major Cities in this area include Fort Collins, Greeley, Sterling, and Denver. Other cities include Limon, Cheyenne Wells, and Springfield. Land ownership is mostly private. Federal lands include Pawnee and Comanche National Grasslands (U.S. Forest Service), Sand Creek Massacre National Historic Site (National Park Service), and Rocky Mountain Arsenal National Wildlife Refuge (U.S. Fish & Wildlife Service). State Parks include Cherry Creek and Chatfield Reservoirs, and Barr and Jackson Lakes.

This region is periodically affected by severe drought, including the historic “Dust Bowl” of the 1930s. Dust storms may form during drought years in windy periods. Elevations range from 3,400 to 6,000 feet. The Average annual precipitation ranges from 14 to17 inches per year and ranges from 13 inches to over 18 inches, depending upon location. Precipitation occurs mostly during the growing season, often during rapidly developing thunderstorms. Mean annual air temperature (MAAT) is 48 to 52 degrees Fahrenheit. Summer temperatures may exceed 100

degrees Fahrenheit. Winter temperatures may be sub-zero, and snowfall varies from 20 to 40 inches per year. Snow cover frequently melts between snow events.

LRU notes

Land Resource Unit (LRU) A is the northeast portion of MLRA 67B, to an extent of approximately 9 million acres. Most of the LRU is rangeland, and includes the Pawnee National Grassland. Dryland winter wheat/fallow rotations (that may include dryland corn, sunflowers, and sorghum) are grown in most counties. Irrigated cropland is utilized in the South Platte Valley. Small acreage and urban ownership are more concentrated on the Front Range. This LRU is found in portions of Adams, Arapahoe, Elbert, Kit Carson, Larimer, Lincoln, Logan, Washington, and Weld counties. Other counties include Boulder, Cheyenne, Denver, Jefferson, and Yuma. The soil moisture regime is aridic ustic. The mean annual air temperature (MAAT) is 50 degrees Fahrenheit.

LRU B is in the southeast portion of MLRA 67B (2.6 million acres) and includes portions of Baca, Bent, Cheyenne, Kiowa, Las Animas, and Prowers counties. Most of the LRU remains in rangeland and includes the Comanche National Grassland. On the farmed land, a system of dryland winter wheat/fallow rotations (that may include dryland corn, sunflowers, and sorghum) is implemented. Irrigated cropland is found in the Arkansas Valley. The soil moisture regime is aridic ustic and the MAAT is 52 degrees Fahrenheit.

LRU C occurs in portions of Morgan and Weld counties (approximately 1.2 million acres). Most of LRU C is in rangeland. On the farmed land, a system of dryland winter wheat/fallow rotations (that may include dryland corn, sunflowers, and sorghum) is implemented. The soil moisture regime is ustic aridic and the MAAT is 48 degrees Fahrenheit.

Classification relationships

MLRA 67B is in the Colorado Piedmont and Raton Sections of the Great Plains Province (USDA, 2006). The MLRA is further defined by Land Resource Units (LRUs) A, B, and C. Features such as climate, geology, landforms, and key vegetation further refine these concepts and are described in other sections of the Ecological Site Description (ESD). NOTE: To date, these LRUs are DRAFT.

Relationship to Other Hierarchical Classifications:
NRCS Classification Hierarchy: Physiographic Division, Physiographic Province, Physiographic Section, Land Resource Region, Major Land Resource Area, Land Resource Unit (Fenneman, 1946).
USFS Classification Hierarchy: Domain, Division, Province, Section, Subsection,
Land Type Association: Land Type, Land Type Phase (Cleland et al, 1997).

REVISION NOTES:
The Shallow Siltstone Ecological Site was developed by an earlier version (2004, revised 2007). This earlier version was based on input from Natural Resources Conservation Service (formerly Soil Conservation Service) and historical information obtained from the Shallow Siltstone Range Site descriptions (1975). This ESD meets the Provisional requirements of the National Ecological Site Handbook (NESH). This ESD will continue refinement towards an Approved status according to the NESH.

Ecological site concept

This site is a run-off site with siltstone bedrock within 40 inches of the soil surface.

Associated sites

R067BY009CO	**Siltstone Plains** This ecological site is commonly adjacent.
R067BY002CO	**Loamy Plains** This ecological site is commonly adjacent.
R067BY056CO	**Sandstone Breaks** This ecological site is commonly adjacent.

Similar sites

R067BY060CO	**Limestone Breaks** The Limestone Breaks Ecological Site has limestone bedrock.
R067BY056CO	**Sandstone Breaks** The Sandstone Breaks Ecological Site has sandstone bedrock.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Krascheninnikovia lanata* (2) *Atriplex canescens*
Herbaceous	(1) *Pascopyrum smithii* (2) *Bouteloua gracilis*

Physiographic features

This site occurs on crests, nose slopes, and side slopes of the ridges, and on backslopes and shoulders of the hills associated below the Chalk Bluffs escarpments. It is closely associated with barren exposures of the Brule Formation.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Ridge
Runoff class	Low to high
Flooding frequency	None
Ponding frequency	None
Elevation	1,128–1,768 m
Slope	0–9%
Ponding depth	0 cm
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

Average annual precipitation across the MLRA extent is 14 to 17 inches, and ranges from 13 to over 18 inches, depending on location. Precipitation increases from north to south. Mean Annual Air Temperature (MAAT) is 50 degrees Fahrenheit in the northern part and increases to 52 degrees Fahrenheit in the southern part. Portions of Morgan and Weld counties are cooler and drier, the MAAT is 48 degrees Fahrenheit, and average precipitation is 13 to14 inches per year.

Two-thirds of the annual precipitation occurs during the growing season from mid-April to late September. Snowfall averages 30 inches per year, area-wide, but varies by location from 20 to 40 inches per year. Winds are estimated to average 9 miles per hour annually. Daytime winds are generally stronger than at night, and occasional strong storms may bring periods of high winds with gusts to more than 90 mph. High-intensity afternoon thunderstorms may arise. The average length of the freeze-free period (28 degrees Fahrenheit) is 155 days from April 30th to October to 3rd. The average frost-free period (32 degrees Fahrenheit) is 136 days from May 11th to September 24th. July is the hottest month, and December and January are the coldest months. Summer temperatures average 90 degrees Fahrenheit and occasionally exceed 100 degrees Fahrenheit. Summer humidity is low and evaporation is high. Winters are characterized with frequent northerly winds, producing severe cold with temperatures occasionally dropping to -30 degrees Fahrenheit or lower. Blizzard conditions may form quickly. For detailed information, visit the Western Regional Climate Center website:
Western Regional Climate Center Historical Data Western U.S. Climate summaries, NOAA Coop Stations Colorado http://www.wrcc.dri.edu/summary/Climsmco.html.

Table 3. Representative climatic features

Frost-free period (characteristic range)	119-129 days
Freeze-free period (characteristic range)	134-151 days
Precipitation total (characteristic range)	356-432 mm
Frost-free period (actual range)	102-132 days
Freeze-free period (actual range)	126-156 days
Precipitation total (actual range)	356-432 mm
Frost-free period (average)	121 days
Freeze-free period (average)	142 days
Precipitation total (average)	381 mm

Climate stations used

- (1) BRIGGSDALE [USC00050945], Briggsdale, CO
- (2) GREELEY UNC [USC00053553], Greeley, CO
- (3) NUNN [USC00056023], Nunn, CO
- (4) FLAGLER 1S [USC00052932], Flagler, CO
- (5) FT MORGAN [USC00053038], Fort Morgan, CO
- (6) KIT CARSON [USC00054603], Kit Carson, CO
- (7) BRIGHTON 3 SE [USC00050950], Brighton, CO
- (8) BYERS 5 ENE [USC00051179], Byers, CO
- (9) CHEYENNE WELLS [USC00051564], Cheyenne Wells, CO
- (10) SPRINGFIELD 7 WSW [USC00057866], Springfield, CO
- (11) LIMON WSMO [USW00093010], Limon, CO

Influencing water features

There are no influential water features associated with this ecological site.

Soil features

The soils on this site are shallow to moderately deep, well drained soils that formed from residuum weathered from siltstone. They typically have a moderately rapid to moderately slow permeability class. The soil moisture regime is typically aridic ustic. The soil temperature regime is mesic.

The surface layer of the soils in this site are typically silt loam or loam, but may include silty clay loam. The surface layer ranges from a depth of 3 to 6 inches thick. The subsoil is typically silt loam or loam, but may include very fine sandy loam. Soils in this site typically have free carbonates at the surface, but some soils may be leached to 10 inches. These soils are susceptible to erosion by water and wind. The potential for water erosion accelerates with increasing slope. Exposed areas of siltstone bedrock are inherent to this site.

Major soil series correlated to this ecological site include: Epping and Keota.

Other soil series that have been correlated to this site, but may eventually be re-correlated include: none.

Note: Revisions to soil surveys are on-going. For the most recent updates, visit the Web Soil Survey, the official site for soils information: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.

The attributes listed below represent 0-40 inches in depth or to the first restrictive layer.

Table 4. Representative soil features

Parent material	(1) Residuum–siltstone
Surface texture	(1) Silt loam (2) Loam
Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Soil depth	25–102 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	4.32–21.59 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	7.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–15%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The Shallow Siltstone Ecological Site is characterized by three states: Reference, Warm-Season Shortgrass, and Increased *Bare Ground*. The Reference State is characterized by cool-season mid rhizomatous grass (western wheatgrass) and warm-season short bunchgrass (blue grama). The Warm-season Shortgrass State is characterized by a warm-season short bunchgrass (blue grama) and stoloniferous grass (buffalograss). The Increased *Bare Ground* State is characterized by early successional warm-season bunchgrass (Fendler threeawn), cool-season short bunchgrass (squirreltail), cushion plants, annual grasses, and annual forbs.

Continuous, heavy grazing that does not allow for adequate recovery opportunities between grazing events causes this site to deteriorate. Grasses such as western wheatgrass, little bluestem, sideoats grama, and green needlegrass decrease in both frequency and production. Grasses and grass-likes such as blue grama, buffalograss, and threadleaf sedge increase. If proper recovery periods between grazing events are not allowed during the growing season, blue grama and buffalograss form a dense sod on the flatter areas of the site. Mid- and tallgrasses and palatable forbs and shrubs are eventually removed from the plant community. Cushion plants such as spiny milkvetch (aka mat loco) and creeping nailwort (aka sessile nailwort) in addition to Fendler threeawn, fringed sagebrush, small soapweed, and cheatgrass increase or invade the site. In time, continuous use in combination with heavy stocking results in large amounts of bare ground and cryptogammic crusts.

The degree of grazing has a significant impact on the ecological dynamics of the site. This region was historically occupied by large grazing animals, such as bison, elk, pronghorn, and mule deer. Grazing by these large herbivores, along with climatic and seasonal weather fluctuations, had a major influence on the ecological dynamics of the site. Deer and pronghorn are widely distributed throughout the MLRA. Secondary influences of herbivory by species such as prairie dogs and other small rodents, insects, and root-feeding organisms continues to impact the vegetation.

Historically, grazing patterns by herds of large ungulates were driven by water distribution, precipitation events, drought events, and fire. It is believed that grazing periods would have been shorter, followed by longer recovery periods. These large migrating herds impacted the ecological processes of nutrient and hydrologic cycles, by urination, trampling (incorporation of litter into the soil surface), and breaking of surface crust, (which increases

water infiltration).

Today, livestock grazing, especially beef cattle has been a major influence on the ecological dynamics of the site. Grazing management, coupled with the effects of annual climatic variations, largely dictates the plant communities for the site.

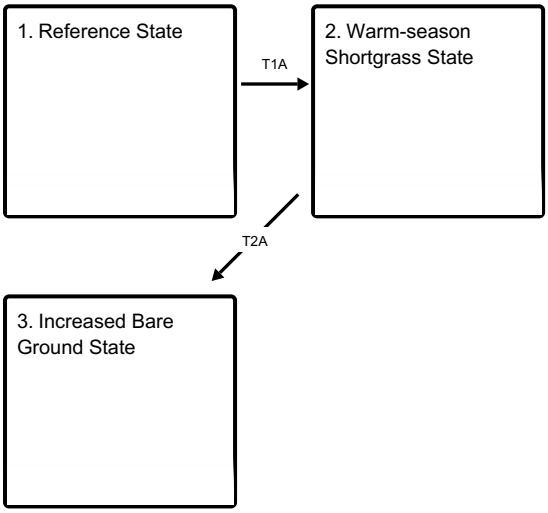
Recurrent drought has historically impacted the vegetation of this region. Changes in species composition vary depending upon the duration and severity of the drought cycle and prior grazing management. Drought events since 2002 have significantly increased mortality of blue grama and buffalograss in some locales.

This site developed with occasional fire as part of the ecological processes. Historic fire frequency (pre-industrial) is estimated at 10 to14 years (Guyette, 2012), randomly distributed, and started by lightning at various times throughout the growing season. Early human inhabitants also were likely to start fires for various reasons (deliberate or accidental). It is believed that fires were set as a management tool for attracting herds of large migratory herbivores (Stewart, 2002). The impact of fire over the past 100 years has been relatively insignificant due to the human control of wildfires and the lack of acceptance of prescribed fire as a management tool.

Mechanical treatment consisting of contour pitting, furrowing, terracing, chiseling, and disking has been practiced in the past. It was theorized that the use of this high-input technology would improve production and plant composition on rangeland. These high-cost practices have shown to have no significant long-term benefits on production or plant composition and have only resulted in a permanently rough ground surface. Prescribed grazing that mimics the historic grazing of herds of migratory herbivores, as described earlier, has been shown to result in desired improvements based on management goals for this ecological site.

State and transition model

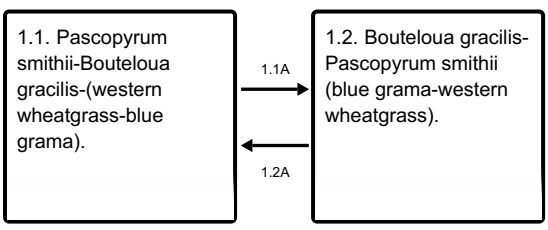
Ecosystem states



T1A - Excessive grazing. Lack of fire.

T2A - Excessive grazing. Lack of fire.

State 1 submodel, plant communities



1.1A - Excessive grazing. Lack of fire.

1.2A - Prescribed grazing. Prescribed fire.

State 2 submodel, plant communities

2.1. Bouteloua gracilis-Bouteloua dactyloides (blue grama-buffalograss).

State 3 submodel, plant communities

3.1. Aristida purpurea-Bromus tectorum (Fendler threeawn-cheatgrass).

State 1
Reference State

The Reference State is characterized by two plant community phases. The plant communities and various successional stages between them represent the natural range of variability applicable to the site.

Dominant plant species

- winterfat (*Krascheninnikovia lanata*), shrub
- fourwing saltbush (*Atriplex canescens*), shrub
- blue grama (*Bouteloua gracilis*), grass
- western wheatgrass (*Pascopyrum smithii*), grass

Community 1.1
Pascopyrum smithii-Bouteloua gracilis-(western wheatgrass-blue grama).

This plant community is the interpretive plant community. This community evolved with grazing by large herbivores and is suited to grazing by domestic livestock. This plant community can be found on areas that are grazed and the grazed plants receive adequate periods of recovery during the growing season. The potential vegetation is about 70-80 percent grasses and grass-likes, 10 -15 percent forbs and 10 -15 percent woody plants. Western wheatgrass and blue grama dominate the community. Other key plants of secondary importance are little bluestem, sideoats grama, green needlegrass, purple prairie clover, winterfat, and fourwing saltbush. Big bluestem and switchgrass may occasionally occur in small amounts. Threadleaf sedge and sun sedge are common. This is a sustainable plant community in terms of soil stability, watershed function, and biological integrity. Litter is properly distributed where vegetative cover is continuous. Some litter movement may occur on steeper slopes. Decadence and natural plant mortality are very low. Community dynamics, nutrient cycle, water cycle, and energy flow are functioning properly. Areas having lost all vegetation, such as livestock and vehicle trails are subject to high erosion rates and extreme runoff depending on storm intensity and duration. This community is resistant to many disturbances except heavy, continuous grazing and development into urban or other uses. Total annual production ranges from 500 to 1,000 pounds of air-dry weight during a normal year and averages 800 pounds.

Dominant plant species

- winterfat (*Krascheninnikovia lanata*), shrub
- fourwing saltbush (*Atriplex canescens*), shrub
- western wheatgrass (*Pascopyrum smithii*), grass
- blue grama (*Bouteloua gracilis*), grass

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	392	673	841
Forb	84	112	140
Shrub/Vine	84	112	140
Total	**560**	**897**	**1121**

Figure 9. Plant community growth curve (percent production by month). CO6708, Warm-season/cool-season codominant; MLRA-67B; upland fine-textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	8	20	35	18	10	5	2	0	0

Community 1.2
Bouteloua gracilis-Pascopyrum smithii (blue grama-western wheatgrass).

This plant community develops with heavy, continuous grazing without adequate recovery periods. Western wheatgrass, little bluestem, sideoats grama, green needlegrass, purple prairie clover, winterfat, and fourwing saltbush have decreased. Blue grama has increased. Big bluestem, Indiangrass, and switchgrass occur in remnant amounts. Hairy grama, sand dropseed, Fendler threeawn, spiny milkvetch (aka mat loco), creeping nailwort (aka sessile nailwort), spiny phlox (aka Hood's phlox), cuman ragweed (aka western ragweed), and soapweed yucca (aka small soapweed) have increased. Plant frequency and vigor have decreased. Reduction of key vegetation species has begun to alter the biotic integrity of this community. Water and nutrient cycles are becoming impaired. Litter levels have been reduced. Flow paths are more apparent. Pedestalled plants may be present. Total annual production ranges from 300 to 700 pounds of air-dry weight during a normal year, and averages 450 pounds.

Dominant plant species

- winterfat (*Krascheninnikovia lanata*), shrub
- fourwing saltbush (*Atriplex canescens*), shrub
- blue grama (*Bouteloua gracilis*), grass
- western wheatgrass (*Pascopyrum smithii*), grass

Figure 10. Plant community growth curve (percent production by month). CO6702, Warm-season dominant, cool-season subdominant; MLRA-67B, upland fine textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	2	15	45	20	15	3	0	0	0

Pathway 1.1A
Community 1.1 to 1.2

Continuous, heavy grazing without adequate recovery periods, and lack of fire shifts this plant community to the 1.2 Community. Extended drought accelerates this process. Recurring spring seasonal grazing decreases cool-season plants. Recurring summer grazing decreases warm-season plants. Biotic integrity is altered and water and nutrient cycles are impaired.

Pathway 1.2A
Community 1.2 to 1.1

Grazing with adequate recovery periods, proper stocking rates, and prescribed fire return this plant community to the Reference Community.

Conservation practices

Prescribed Burning
Prescribed Grazing

State 2
Warm-season Shortgrass State

An ecological threshold has been crossed and a significant amount of production and diversity has been lost when compared to the Reference State. Significant biotic and edaphic (soil characteristic) changes have negatively impacted energy flow and nutrient and hydrologic cycles. This is a very stable state, resistant to change due to the high tolerance of blue grama and buffalograss to grazing. The loss of other functional/structural groups such as cool-season midgrasses, forbs, and shrubs, reduces the biodiversity and productivity.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- blue grama (*Bouteloua gracilis*), grass
- buffalograss (*Bouteloua dactyloides*), grass

Community 2.1
Bouteloua gracilis-Bouteloua dactyloides (blue grama-buffalograss).

Blue grama and buffalograss dominate the community. These species have developed into a sod-bound condition on the flatter slopes. Tall and midgrasses, palatable forbs, and shrubs have been removed. Little bluestem and sideoats grama may remain in remnant amounts. Forbs and shrubs that have increased are spiny phlox (aka Hood's phlox), hairy goldenaster (aka hairy goldaster), prairie sagewort (aka fringed sagebrush), and soapweed yucca (aka small soapweed). Cushion plants such as spiny milkvetch (aka mat loco), and creeping nailwort (aka sessile nailwort) have increased. Threadleaf sedge has also increased. Species diversity and production have been severely reduced. Litter levels are low. Mineral and water cycles are impaired due to the loss of deep-rooted grasses, forbs and shrubs. Soil erosion is a concern on steeper slopes. Flow paths, rills, and early gully formation are more obvious on exposed siltstone areas. Production ranges from 150 to 450 pounds of air-dry vegetation per acre per year and averages 250 pounds.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- blue grama (*Bouteloua gracilis*), grass
- buffalograss (*Bouteloua dactyloides*), grass

Figure 11. Plant community growth curve (percent production by month). CO6707, Warm-season dominant; MLRA-67B; upland fine-textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	3	20	45	20	10	2	0	0	0

State 3
Increased Bare Ground State

An ecological threshold has been crossed and the site is in an extremely degraded condition. Bare ground is a major concern, soil erosion is severe.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- cheatgrass (*Bromus tectorum*), grass
- Russian thistle (*Salsola*), other herbaceous

- burningbush (*Bassia scoparia*), other herbaceous

Community 3.1
Aristida purpurea-Bromus tectorum (Fendler threeawn-cheatgrass).

Bare ground, cushion plants, and cryptogammic crusts have significantly increased. Remnant amounts of blue and hairy grama may still be found in localized areas. Other plants which may be present are Russian thistle, burningbush, Fendler threeawn, cheatgrass, cushion plants such as spiny milkvetch (aka mat loco) and creeping nailwort (aka sessile nailwort), and soapweed yucca (aka small soapweed). Total annual production varies from 25 to 150 pounds of air-dry vegetation per acre per year.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- cheatgrass (*Bromus tectorum*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), other herbaceous

Figure 12. Plant community growth curve (percent production by month). CO6707, Warm-season dominant; MLRA-67B; upland fine-textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	3	20	45	20	10	2	0	0	0

Transition T1A
State 1 to 2

Continuous, heavy grazing without adequate recovery periods and lack of fire shifts this community across an ecological threshold to the Warm-season Shortgrass State.

Transition T2A
State 2 to 3

Heavy, continuous grazing without adequate recovery periods shifts the Warm-season Shortgrass State across an ecological threshold to the Increase *Bare Ground* State. Erosion and loss of organic matter and carbon reserves are concerns.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				628–717	
	blue grama	BOGR2	*Bouteloua gracilis*	224–269	–
	western wheatgrass	PASM	*Pascopyrum smithii*	224–269	–
	little bluestem	SCSC	*Schizachyrium scoparium*	45–135	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	90–135	–
	green needlegrass	NAVI4	*Nassella viridula*	9–63	–
	buffalograss	BODA2	*Bouteloua dactyloides*	9–45	–
	Grass, perennial	2GP	*Grass, perennial*	9–45	–
	big bluestem	ANGE	*Andropogon gerardii*	9–27	–
	switchgrass	PAVI2	*Panicum virgatum*	9–27	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	9–18	–

	sand dropseed	SPCR	*Sporobolus cryptandrus*	9–18	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	9–18	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	9–18	–
	threadleaf sedge	CAFI	*Carex filifolia*	9–18	–
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	9–18	–
	squirreltail	ELELE	*Elymus elymoides ssp. elymoides*	0–9	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–9	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–9	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–9	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–9	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–9	–
	Indiangrass	SONU2	*Sorghastrum nutans*	0–9	–
Forb					
2				90–135	
	Forb, perennial	2FP	*Forb, perennial*	9–45	–
	purple prairie clover	DAPU5	*Dalea purpurea*	9–18	–
	annual buckwheat	ERAN4	*Eriogonum annuum*	0–9	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–9	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–9	–
	dotted blazing star	LIPU	*Liatris punctata*	0–9	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–9	–
	lacy tansyaster	MAPIP4	*Machaeranthera pinnatifida ssp. pinnatifida var. pinnatifida*	0–9	–
	crownleaf evening primrose	OECO2	*Oenothera coronopifolia*	0–9	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–9	–
	white locoweed	OXSE	*Oxytropis sericea*	0–9	–
	alpine feverfew	PAAL6	*Parthenium alpinum*	0–9	–
	New Mexico groundsel	PANEM	*Packera neomexicana var. mutabilis*	0–9	–
	creeping nailwort	PASE	*Paronychia sessiliflora*	0–9	–
	broadbeard beardtongue	PEAN4	*Penstemon angustifolius*	0–9	–
	spiny phlox	PHHO	*Phlox hoodii*	0–9	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–9	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–9	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–9	–
	threadleaf ragwort	SEFLF	*Senecio flaccidus var. flaccidus*	0–9	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–9	–
	stiff greenthread	THFI	*Thelesperma filifolium*	0–9	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–9	–
	American vetch	VIAM	*Vicia americana*	0–9	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–9	–

	tarragon	ARDR4	*Artemisia dracunculus*	0–9	–
	twogrooved milkvetch	ASBI2	*Astragalus bisulcatus*	0–9	–
	spiny milkvetch	ASKE	*Astragalus kentrophyta*	0–9	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–9	–
	narrowleaf milkvetch	ASPE5	*Astragalus pectinatus*	0–9	–
Shrub/Vine					
3				90–135	
	winterfat	KRLA2	*Krascheninnikovia lanata*	27–90	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	18–63	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	9–45	–
	skunkbush sumac	RHTR	*Rhus trilobata*	9–27	–
	golden currant	RIAU	*Ribes aureum*	0–9	–
	wax currant	RICE	*Ribes cereum*	0–9	–
	soapweed yucca	YUGL	*Yucca glauca*	0–9	–
	chokecherry	PRVIV	*Prunus virginiana var. virginiana*	0–9	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–9	–
	rubber rabbitbrush	ERNAN5	*Ericameria nauseosa ssp. nauseosa var. nauseosa*	0–9	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–9	–

Animal community

WILDLIFE INTERPRETATIONS:

The combination of grasses, forbs, and shrubs found on the ecological site provide habitat for numerous wildlife species. Historic large grazers that influenced these communities were bison, elk, mule deer, and pronghorn. Herbivory and soil disturbance by black-tailed prairie dogs influenced ecological processes, supporting unique wildlife species. Bison are no longer widely distributed in their historic range. Prairie dogs occupy a small fraction of their historic range. Pronghorn are the most abundant ungulates using this ecological site, followed by mule deer. Domestic grazers share these habitats with wildlife. The grassland communities of eastern Colorado are home to many bird species. Changes in the composition of the plant community when moving from the Reference Community to other communities on this ecological site may result in species shifts in bird species.

GRAZING INTERPRETATIONS:
The following table lists suggested initial stocking rates for an animal unit (1000-pound beef cow) under continuous grazing (yearlong grazing or growing-season-long grazing) based on normal growing conditions. However, continuous grazing is not recommended. These estimates should only be used as preliminary guidelines in the initial stages of the conservation planning process. Often, the existing plant composition does not entirely match any particular plant community described in this ecological site description. Therefore, field inventories are always recommended to document plant composition, total production, and palatable forage production. Carrying capacity estimates that reflect on-site conditions should be calculated using field inventories.

If the following production estimates are used, they should be adjusted based on animal kind or class and on the specific palatability of the forage plants in the various plant community descriptions. Under a properly stocked, properly applied, prescribed grazing management system that provides adequate recovery periods following each grazing event, improved harvest efficiencies eventually result in increased carrying capacity. See USDA-NRCS Colorado Prescribed Grazing Standard and Specification Guide (528).

The stocking rate calculations are based on the total annual forage production in a normal year multiplied by 25 percent harvest efficiency divided by 912.5 pounds of ingested air-dry vegetation for an animal unit per month (AUM).

Reference PC - (800) (0.22)

1.2 PC - (450) (0.12)

2.1 PC - (250) (0.07)

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangelands in this area provide yearlong forage under prescribed grazing for cattle, sheep, horses and other herbivores.

An on-site inventory is required prior to development of a grazing plan.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group B. Infiltration and runoff potential for this site is moderate depending on ground cover. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff (refer to NRCS Section 4, National Engineering Handbook (USDA–NRCS, 1972–2012) for runoff quantities and hydrologic curves).

Recreational uses

This site provides hunting, hiking, photography, bird watching, and other opportunities. The wide varieties of plants that bloom from spring until fall have an aesthetic value that appeals to visitors.

Wood products

No appreciable wood products are present on the site.

Other products

Site Development and Testing Plan

General Data (MLRA and Revision Notes, Hierarchical Classification, Ecological Site Concept, Physiographic, Climate, and Water Features, and Soils Data):

Updated. All “Required” items complete to Provisional level.

Community Phase Data (Ecological Dynamics, STM, Transition & Recovery Pathways, Reference Plant Community, Species Composition List, Annual Production Table):

Updated. All “Required” items complete to Provisional level.
NOTE: Annual Production Table is from the “Previously Approved” ESD 2004. The Species Composition List is also from the 2004 version, with minor edits. These will need review for future updates at Approved level.

Each Alternative State/Community:

Complete to Provisional level

Supporting Information (Site Interpretations, Assoc. & Similar Sites, Inventory Data References, Agency/State Correlation, References):

Updated. All “Required” items complete to Provisional level.

Livestock Interpretations updated to reflect Total Annual Production revisions in each plant community.

Wildlife interpretations, general narrative, and individual plant communities updated to the Provisional level. Hydrology, Recreational Uses, Wood Products, Other Products, Plant Preferences table, and Rangeland Health Reference Sheet carried over from previously “Approved” ESD 2004.

Reference Sheet

The Reference Sheet was previously approved in 2007.
It will be updated at the next “Approved” level.

“Future work, as described in a project plan, to validate the information in this provisional ecological site description is needed. This will include field activities to collect low and medium intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document.” (NI 430_306 ESI and ESD, April, 2015).

More soils site investigation needed to determine whether the Shallow Siltstone and Siltstone Plains can be combined.

Other information

Relationship to Other Hierarchical Classifications:

NRCS Classification Hierarchy:
Physiographic Divisions of the United States (Fenneman, 1946): Physiographic DivisionPhysiographic ProvincePhysiographic SectionLand Resource RegionMajor Land Resource Area (MLRA)Land Resource Unit (LRU).
USFS Classification Hierarchy:
National Hierarchical Framework of Ecological Units (Cleland et al, 181-200):
DomainDivisionProvinceSectionSubsectionLandtype AssociationLandtypeLandtype Phase.

Inventory data references

NRI: references to Natural Resource Inventory data
Information presented here has been derived from data collection on private and federal lands using:
• Double Sampling (clipped 2 of 5 plots)*
• Rangeland Health (Pellant et al., 2005)
• Soil Stability (Pellant et al., 2005)
• Line Point Intercept : Foliar canopy, basal cover (Forb, Graminoid, Shrub, subshrub, Lichen, Moss, Rock fragments, bare ground, % Litter) (Herrick et al., 2005)
• Soil pedon descriptions collected on site (Schoeneberger et al., 2012)

*NRCS double-sampling method, CO NRCS Similarity Index Worksheet 528(1).
Additional reconnaissance data collection using numerous ocular estimates and other inventory data; NRCS clipping data for USDA program support; Field observations from experienced range trained personnel. Specific data information is contained in individual landowner/user case files and other files located in county NRCS field offices.

Those involved in developing the 2004 site description include: Harvey Sprock, Rangeland Management Specialist, CO-NRCS; Ben Berlinger, Rangeland Management Specialist, CO-NRCS; James Borchert, Soil Scientist, CO-NRCS; Terri Skadeland, Biologist, CO-NRCS.

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Data collection for this ecological site was done in conjunction with the progressive soil surveys within the 67B Central High Plains (Southern Part) of Colorado. It has been mapped and correlated with soils in the following soil surveys: Adams County, Arapahoe County, Baca County, Bent County, Boulder County, Cheyenne County, El Paso County Area, Elbert County, Eastern Part, Kiowa County, Kit Carson County, Larimer County Area, Las Animas County Area, Lincoln County, Logan County, Morgan County, Prowers County, Washington County, Weld County, Northern Part, and Weld County, Southern Part.

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Harvey Sprock, Daniel Nosal
Contact for lead author	Harvey Sprock, Area Rangeland Management Specialist, Greeley, CO
Date	01/12/2005
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Typically none. If present, rills may occur on siltstone outcrop areas.

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2. **Presence of water flow patterns:** Typically none on gentle slopes. Water flow paths associated with siltstone outcrop areas may be connected.

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3. **Number and height of erosional pedestals or terracettes:** Siltstone outcrops may have pedestalled plants.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 3 percent or less bare ground, with bare patches generally less than 2-3 inches in diameter where slopes are gentle. Extended drought can cause bare ground to increase upwards to 10-20 percent with bare patches reaching upwards to 6-12 inches in diameter. A significant amount of exposed siltstone is inherent to steeper slopes and would be considered rock outcrop.

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5. **Number of gullies and erosion associated with gullies:** None to some on steeper slopes.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None to some on exposed slopes.

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter should be uniformly distributed with little movement. On steep slopes or knolls, litter may move from a few inches to 1-2 feet depending on intensity of storm.

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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 rating is anticipated to be 2-4 in the interspaces at soil surface.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Average SOM is 0.5-1 percent. Surface texture is typically a silt loam. A-horizon ranges from 0-5 inches. Soils are shallow, light gray, weak fine crumb grading to weak fine granular structure. Many siltstone chips occur on the surface.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Raindrop impact is reduced by the diverse grass, forb, shrub functional/structural groups and root structure. This slows overland flow and provides increased time for infiltration to occur. Extended drought, wildfire or both may reduce basal density, canopy cover, and litter amounts (primarily from tall, warm-season bunch and rhizomatous grasses), resulting in decreased infiltration and increased runoff on steep slopes following intense rainfall events.

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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):** None

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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: Warm-season short bunchgrass = cool-season mid rhizomatous >

    Sub-dominant: Warm-season mid bunchgrass > cool-season mid and short bunchgrass and grasslikes > shrubs > leguminous forbs >

    Other: Warm-season forbs > cool-season forbs > warm-season tall bunchgrass > warm-season short stoloniferous

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Typically minimal. Expect slight mortality and decadence during and following extended drought.

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14. **Average percent litter cover (%) and depth (in):** 30-45 percent litter cover at 0.25 inch depth on gentle slopes and 5-15 percent on steeper slopes.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 500 lbs./ac. during low precipitation years; 800 lbs./ac. in average years; 1000 lbs./ac. in above average years. After extended drought or the first growing season following wildfire, production may be reduced by 200 – 400 lbs./ac.

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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:** Invasive plants should not occur in reference plant community. Cheatgrass, Russian thistle, burningbush, other non-native annuals may invade following extended drought or fire assuming a seed source is available.

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17. **Perennial plant reproductive capability:** The only limitations are weather-related, wildfire, natural disease, and insects that may temporarily reduce reproductive capability.
