USDA Natural Resources Conservation Service

Ecological site R067BY009CO
Siltstone Plains

Last updated: 9/08/2023
Accessed: 05/19/2024

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.

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 Siltstone Plains Ecological Site Description was developed from an earlier version (2004, revised 2007) which was based on input from the Natural Resource Conservation Service (NRCS) (formerly Soil Conservation Service) and historical information obtained from the Siltstone Plains 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

The Siltstone Plains Ecological Site is a run-off site on less than six percent slopes. It is deeper than 40 inches to bedrock, and it has less than 15 percent rock fragments on the surface or in the subsoil. The site is not dominated by sandy surface or subsurface textures, and does not have visible salts in the soil profile or at the surface. It does have calcium carbonates at the surface.

Associated sites

R067BY036CO	**Overflow** This ecological site is commonly adjacent.

R067BY039CO	**Shallow Siltstone** This ecological site is commonly adjacent.
R067BY002CO	**Loamy Plains** This ecological site is commonly adjacent.

Similar sites

R067BY002CO	**Loamy Plains** This ecological site does not have calcium carbonates at the surface.

Table 1. Dominant plant species

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

Physiographic features

This site occurs on fans, footslopes, or toeslopes of the Chalk Bluffs escarpments.

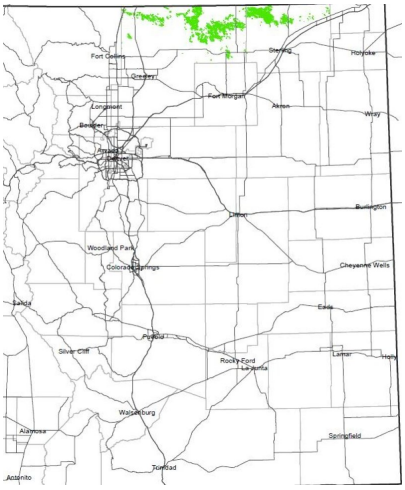


Figure 2. The distribution of the Siltstone Plains site in MLRA 67B.

Table 2. Representative physiographic features

Landforms	(1) Fan
Runoff class	Negligible to medium
Flooding frequency	None
Ponding frequency	None
Elevation	1,158–1,707 m
Slope	0–6%
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) CHEYENNE WELLS [USC00051564], Cheyenne Wells, CO
- (2) FLAGLER 1S [USC00052932], Flagler, CO
- (3) FT MORGAN [USC00053038], Fort Morgan, CO
- (4) KIT CARSON [USC00054603], Kit Carson, CO
- (5) SPRINGFIELD 7 WSW [USC00057866], Springfield, CO
- (6) GREELEY UNC [USC00053553], Greeley, CO
- (7) LIMON WSMO [USW00093010], Limon, CO
- (8) BRIGGSDALE [USC00050945], Briggsdale, CO
- (9) NUNN [USC00056023], Nunn, CO
- (10) BRIGHTON 3 SE [USC00050950], Brighton, CO
- (11) BYERS 5 ENE [USC00051179], Byers, CO

Influencing water features

There are no water features that influence the vegetation or management of the site.

Soil features

The soils on this site are very deep, well drained soils that formed from slope alluvium. They typically have a moderate to moderately rapid permeability class. The available water capacity is typically moderate, but ranges from low to high. Available water is the portion of water in a soil that can be readily absorbed by plant roots. This is the amount of water released between the field capacity and the permanent wilting point. As fineness of texture increases, there is a general increase in available moisture storage from sands to loams and silt loams. 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 loam or silt loam. The surface layer ranges from a depth of 4 to 7 inches thick. The subsoil and underlying material have a similar range in texture as the surface layer. 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.

Surface soil structure is typically granular, and structure below the surface is subangular blocky to massive. Soil structure describes the manner in which soil particles are aggregated and defines the nature of the system of pores and channels in a soil. Together, soil texture and structure help determine the ability of the soil to hold and conduct the water and air necessary for sustaining life.

Major soil series correlated to this ecological site include: Mitchell.

Other soil series that have been correlated to this site, but may eventually be re-correlated include: Keota.

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) Alluvium
Surface texture	(1) Loam (2) Silt loam
Drainage class	Well drained
Permeability class	Moderate to moderately rapid
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	12.7–30.48 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)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–2%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The information in this ESD, including the state-and-transition model diagram (STM), was developed using archeological and historical data, professional experience, and scientific studies. The information is representative of a dynamic set of plant communities that represent the complex interaction of several ecological processes. The plant composition has been determined by study of rangeland relic areas, areas protected from excessive disturbance, seasonal use pastures, short duration or time-controlled grazing strategies, and historical accounts.

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.

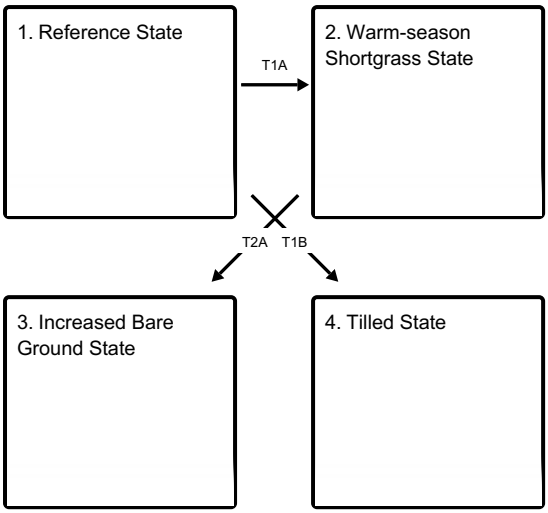
Eastern Colorado was strongly affected by extended drought conditions in the “Dust Bowl” period of the 1930’s, with recurrent drought cycles in the 1950s and 1970s. Extreme to exceptional drought conditions have re-visited the area from 2002 to 2012, with brief interludes of near normal to normal precipitation years. Long-term effects of these latest drought events have yet to be determined. Growth of native cool-season plants begins about April 1 and continues to mid-June. Native warm-season plants begin growth about May 1 and continue to about August 15. Regrowth of cool-season plants occurs in September in most years, depending on the availability of moisture.

Grazing by large herbivores, without adequate recovery periods causes western wheatgrass and green needlegrass to decrease, and blue grama and buffalograss to increase. Blue grama and buffalograss may eventually form a sod-like appearance. Fourwing saltbush and winterfat decrease in frequency and production. American vetch and other highly palatable forbs also decrease. Fendler threeawn, annuals, and bare ground increase under heavy, continuous grazing, excessive defoliation, or long-term non-use. Areas of this ecological site have been tilled and used for crop production, and converted to suburban residence and small acreages, especially near the larger communities.

The Siltstone Plains Ecological Site is characterized by four states: Reference, Warm-Season Shortgrass, Increased *Bare Ground*, and Tilled. The Reference State is characterized by cool-season midgrass (western wheatgrass, green needlegrass) and warm-season 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), annual grasses, and annual forbs. The Tilled State has been mechanically disturbed by equipment and includes either a variety of reseeded warm and cool-season grasses (Seeded Community) or early successional plants as well as annual grasses and forbs (Go-Back Community).

State and transition model

Ecosystem states

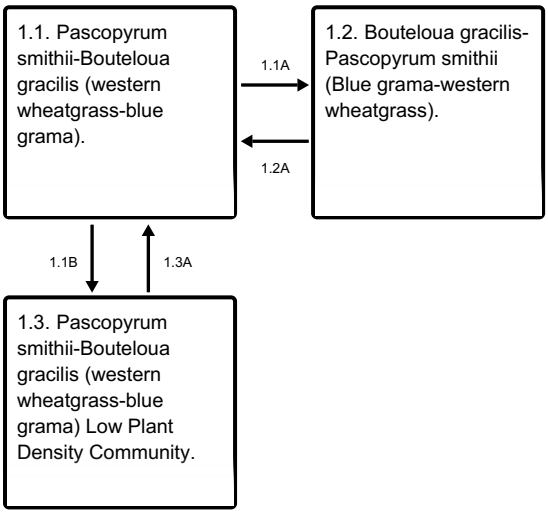


T1A - Excessive grazing. Lack of fire.

T1B - Tillage.

T2A - Excessive grazing. Lack of fire.

State 1 submodel, plant communities



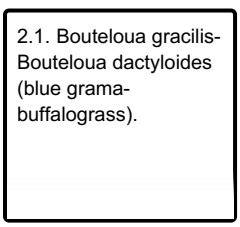
1.1A - Excessive grazing. Lack of fire.

1.1B - Non-use. Lack of fire.

1.2A - Prescribed grazing. Prescribed fire.

1.3A - Prescribed grazing. Prescribed fire.

State 2 submodel, plant communities



State 3 submodel, plant communities

3.1. Aristida purpurea (Fendler threeawn) Increased Bare Ground Community.

State 4 submodel, plant communities

4.1. Bromus tectorum-Aristida purpurea (cheatgrass-Fendler threeawn) Go-Back Community.

4.2. Seeded Plant Community

State 1
Reference State

The Reference State is characterized by three plant community phases. The plant communities and various successional stages between them represent the natural range of variability due to the disturbance regimes that occur on the site.

Dominant plant species

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

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

This is the interpretive plant community. This plant community evolved with grazing by large herbivores, is well suited for grazing by domestic livestock, and can be found on areas that are properly managed with prescribed grazing. The reference plant community consists mainly of cool-season mid grasses and warm-season short grasses. The principal mid grasses are western wheatgrass and green needlegrass. Blue grama is the dominant shortgrass. Grasses and grass-likes of secondary importance are buffalograss, needle and thread, Indian ricegrass, little bluestem, prairie junegrass, and sun sedge. Major forbs and shrubs include American vetch, scarlet globemallow, dotted gayfeather, fourwing saltbush, and winterfat. The reference plant community is about 70-85 percent grasses and grass-likes, 5-15 percent forbs and 10-15 percent shrubs by air-dry weight. This is a sustainable plant community in terms of soil stability, watershed function, and biological integrity. Litter is properly distributed with little movement. Decadence and natural plant mortality is very low. Community dynamics, nutrient cycle, water cycle, and energy flow are functioning properly. This community is resistant to many disturbances except excessive grazing, tillage, and development into urban or other uses. Total annual production, during an average year, ranges from 500 to 1,700 pounds per acre air-dry weight and averages 1,200 pounds. These production figures are the fluctuations expected during favorable, normal, and unfavorable years.

Dominant plant species

- fourwing saltbush (*Atriplex canescens*), shrub
- winterfat (*Krascheninnikovia lanata*), 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	370	1054	1491
Forb	62	135	207
Shrub/Vine	129	157	207
Total	**561**	**1346**	**1905**

Figure 10. Plant community growth curve (percent production by month). CO6701, Cool-season/warm-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	28	15	12	10	5	0	0

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

Key species such as green needlegrass, western wheatgrass, American vetch, fourwing saltbush, and winterfat have been reduced. Blue grama and buffalograss have increased in abundance, and are beginning to take on a sod appearance. Sand dropseed, Fendler threeawn, sixweeks fescue, bottlebrush squirreltail, and hairy goldaster have also increased. This plant community is at risk of losing green needlegrass, western wheatgrass, American vetch, fourwing saltbush, and winterfat. Once these key species are completely removed and other plants have increased, it will take a long time to bring them back by management alone. Substantial increases in money and other resources will be required to replace the lost species in a shorter period of time. Total aboveground carbon has been reduced due to decreases in forage and litter production. Loss of rhizomatous wheatgrass, nitrogen fixing forbs, the shrub component, and increased warm-season short grasses has begun to alter the biotic integrity of this community. Water and nutrient cycles are at risk of becoming impaired. Total annual production, during an average year, ranges from 200 to 1,100 pounds per acre air-dry weight and averages 800 pounds.

Dominant plant species

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

Figure 11. 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

Community 1.3
Pascopyrum smithii-Bouteloua gracilis (western wheatgrass-blue grama) Low Plant Density Community.

This plant community occurs when grazing is removed for long periods of time in the absence of fire. Plant composition is similar to the reference plant community, however, individual species production and frequency will be lower. Much of the nutrients are tied up in standing dead canopy and increased litter. The semiarid environment and the absence of animal traffic to break down litter slow nutrient recycling. Increased standing dead canopy limits sunlight from reaching plant crowns. Many plants, especially bunchgrasses (green needlegrass, blue grama), exhibit increased mortality. Increased litter and absence of grazing animals reduces seed germination and establishment. In advanced stages, plant mortality can increase and erosion may eventually occur if bare ground increases. Once this happens it will require increased energy input in terms of practice cost and management to bring back. Total annual production ranges from 300 to 1,300 pounds per acre air-dry weight and averages 850 pounds during an average year.

Dominant plant species

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

Figure 12. Plant community growth curve (percent production by month). CO6703, Cool-season/warm-season codominant, excess litter; MLRA-67B; upland fine textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	20	25	15	15	10	5	0	0

Pathway 1.1A
Community 1.1 to 1.2

Excessive grazing and reduced fire frequency shifts this plant community to the 1.2 community. Recurring spring seasonal grazing will decrease cool-season plants. Recurring summer grazing decreases warm-season plants and tends to increase cool-season plants over time.

Pathway 1.1B
Community 1.1 to 1.3

Non-use and lack of fire moves this community to the 1.3 community. Plant decadence and standing dead plant material impede energy flow.

Pathway 1.2A
Community 1.2 to 1.1

Grazing with adequate recovery periods, proper stocking, and prescribed fire return this plant community back to the reference community.

Conservation practices

Prescribed Burning
Prescribed Grazing

Pathway 1.3A
Community 1.3 to 1.1

The return of grazing with adequate recovery periods and normal fire frequency facilitate recovery to the reference plant community. This change can occur in a relatively short time frame.

Conservation practices

Prescribed Burning
Prescribed Grazing

State 2
Warm-season Shortgrass State

This state is characterized by a vegetation shift to a shortgrass dominated community. 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 of this site.

Dominant plant species

- broom snakeweed (*Gutierrezia sarothrae*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- blue grama (*Bouteloua gracilis*), grass
- buffalograss (*Bouteloua dactyloides*), grass

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

Most of the key grass, forb, and shrub species are absent. Western wheatgrass may persist in trace amounts, though greatly reduced in vigor and not readily seen. Blue grama and buffalograss dominate the community with a tight “sodbound” appearance. Fendler threeawn, sand dropseed, sixweeks fescue, and hairy goldaster have increased. This plant community is resistant to change due to grazing tolerance of buffalograss and blue grama. A significant amount of production and diversity has been lost from this community when compared to the reference plant community. Loss or major reduction of cool-season grasses, shrub component, and nitrogen fixing forbs have negatively impacted energy flow and nutrient cycling. Water infiltration is reduced significantly due to the massive shallow root system “root pan”, characteristic of blue grama and buffalograss. Soil loss may be obvious where flow paths are connected. Production ranges from 100 to 800 pounds of air-dry vegetation per acre per year and averages 600 pounds.

Dominant plant species

- broom snakeweed (*Gutierrezia sarothrae*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- blue grama (*Bouteloua gracilis*), grass
- buffalograss (*Bouteloua dactyloides*), grass

Figure 13. 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

Litter levels are extremely low. Erosion is evident and flow paths are continuous. Rills may occur on steeper slopes. Wind scoured areas may be apparent on knolls or unprotected areas. The nutrient cycle, water cycle, and overall energy flow are greatly impaired. Organic matter and carbon reserves are greatly reduced.

Dominant plant species

- broom snakeweed (*Gutierrezia sarothrae*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- ring muhly (*Muhlenbergia torreyi*), grass

Community 3.1
Aristida purpurea (Fendler threeawn) Increased Bare Ground Community.

This plant community develops with excessive defoliation and lack of fire. Fendler threeawn is the dominant species. Blue grama may persist in localized areas. Introduced annuals such as burningbush and Russian thistle are present. Introduced species such as field bindweed can also be present, especially on prairie dog towns. Total annual production can vary from 50 to 200 pounds of air-dry vegetation per acre and averages 100 pounds during a normal year.

Dominant plant species

- broom snakeweed (*Gutierrezia sarothrae*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), other herbaceous

Figure 14. 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 4
Tilled State

The Tilled State is the result of the site being tilled (farmed). An ecological threshold has been crossed due to complete removal of vegetation and years of soil tillage. Physical, chemical, and biological soil properties have been dramatically altered.

Dominant plant species

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

Community 4.1
Bromus tectorum-Aristida purpurea (cheatgrass-Fendler threeawn) Go-Back Community.

Go-back land occurs where the soil has been tilled and abandoned. All native plants have been eliminated and the soil structure degraded. A plowpan or compacted layer is formed. Residual synthetic chemicals often remain from past farming operations and erosion processes are active. Over time, early successional annuals and perennials begin to cover the soil surface. Burningbush, Russian thistle, and cheatgrass are examples of some early annuals which begin to establish. These areas will soon become dominated by red threeawn. Eventually, sand dropseed, and ring muhly, will begin to establish. Organic matter has left the system through decomposition and erosion. Erosion can be accelerated if ground cover is lacking. In some instances, when this soil is tilled and abandoned, secondary succession leads to an Indian ricegrass dominated plant community.

Dominant plant species

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

Community 4.2
Seeded Plant Community

This community results from tillage and is seeded to adapted native plant species. A seed mixture of grasses, forbs, and shrubs can be used to accomplish various management objectives. This plant community can vary considerably.

Transition T1A
State 1 to 2

Excessive grazing and lack of fire shifts this state across an ecological threshold to the Warm-season Shortgrass Dominant State.

Transition T1B
State 1 to 4

Tillage of this ecological site will cause an immediate transition across an ecological threshold to the Tilled State. This transition can occur from any plant community and is irreversible.

Transition T2A
State 2 to 3

Long-term, excessive grazing and lack of fire shifts this state to the Increased *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				942–1143	
	western wheatgrass	PASM	*Pascopyrum smithii*	336–471	–
	blue grama	BOGR2	*Bouteloua gracilis*	336–404	–
	green needlegrass	NAVI4	*Nassella viridula*	202–269	–
	buffalograss	BODA2	*Bouteloua dactyloides*	13–67	–
	Grass, perennial	2GP	*Grass, perennial*	13–67	–
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	13–40	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	13–27	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	13–27	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–13	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–13	–
	ring muhly	MUTO2	*Muhlenbergia torreyi*	0–13	–
	squirreltail	ELELE	*Elymus elymoides ssp. elymoides*	0–13	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–13	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–13	–
	needleleaf sedge	CADU6	*Carex duriuscula*	0–13	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	0–13	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–13	–
Forb					
2				67–202	
	American vetch	VIAM	*Vicia americana*	13–67	–
	Forb, perennial	2FP	*Forb, perennial*	13–67	–
	purple prairie clover	DAPU5	*Dalea purpurea*	13–27	–
	lacy tansyaster	MAPIP4	*Machaeranthera pinnatifida ssp. pinnatifida var. pinnatifida*	13–27	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	13–27	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–13	–
	largeflower Townsend daisy	TOGR	*Townsendia grandiflora*	0–13	–
	crownleaf evening	OECO2	*Oenothera coronopifolia*	0–13	–

	primrose				
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–13	–
	New Mexico groundsel	PANEM	*Packera neomexicana var. mutabilis*	0–13	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–13	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–13	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–13	–
	threadleaf ragwort	SEFLF	*Senecio flaccidus var. flaccidus*	0–13	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–13	–
	dotted blazing star	LIPU	*Liatris punctata*	0–13	–
	fernleaf biscuitroot	LODI	*Lomatium dissectum*	0–13	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–13	–
	textile onion	ALTE	*Allium textile*	0–13	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–13	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–13	–
	twogrooved milkvetch	ASBI2	*Astragalus bisulcatus*	0–13	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–13	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–13	–
Shrub/Vine					
3				135–202	
	fourwing saltbush	ATCA2	*Atriplex canescens*	135–202	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	27–94	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	13–40	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–13	–
	soapweed yucca	YUGL	*Yucca glauca*	0–13	–
	spreading buckwheat	EREF	*Eriogonum effusum*	0–13	–
	rubber rabbitbrush	ERNAN5	*Ericameria nauseosa ssp. nauseosa var. nauseosa*	0–13	–
	spinystar	ESVIV	*Escobaria vivipara var. vivipara*	0–13	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–13	–

Animal community

WILDLIFE INTERPRETATIONS:

The variety of grasses, forbs, and shrubs on this ecological site in the various plant communities provides habitat for a wide range of wildlife species. Historic large grazers that influenced these plant communities were bison, elk, and pronghorn. Changes over time have resulted in the loss of bison, the reduction in elk numbers, and pronghorn population swings. Domestic grazers now 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 plant community to other communities on this ecological site may result in dramatic species shifts in the bird community. Because of a lack of permanent water, fish and many amphibians are not expected on this ecological site. Mule and white-tailed deer may use this ecological site, however the shrub cover is too low to expect more than occasional use. The gray wolf and wild bison used this ecological site in historic times. The wolf is thought to be extirpated from Eastern Colorado. Bison in the area are domesticated.

1.1 Reference Plant Community

Prairie dogs support a high amount of wildlife diversity for their now reduced acreage. Species such as ferruginous hawks, burrowing owls, mountain plovers, western rattlesnake, and black-footed ferret occur in association with prairie dog towns.
Pronghorns are the most abundant ungulate on this site, followed by mule deer. This site also supports a high diversity of migratory grassland birds including grasshopper sparrow, McCown's longspur, chestnut-collared longspur, and loggerheaded shrike among others. The loamier soils support many reptile species that may use the site to meet all or parts of their life requisites. Pollinating insects are attracted to the forbs expected in this plant community. Various species of beetles and grasshoppers are also present.

1.2 Community
This community is very similar to the reference community; therefore the value for wildlife is not significantly different. Wildlife species using this this plant community would be the same.

1.3 Community
The wildlife species found here, will be similar to those in the reference community.

2.1 Community
This community has reduced wildlife species diversity due to the loss of taller structure grasses and shrubs and reduced forb diversity. Pronghorns and swift fox continue to use this community. Grassland songbird species that need taller structure like grasshopper sparrows are absent, but short-structure species like horned lark and longspurs will be present. If prairie dogs are present, ferruginous hawks, burrowing owls, and mountain plover may occur.

3.1 Community
The loss of perennial forbs, combined with the increase in bare ground will result in a change in wildlife species when compared with the reference plant community. Western rattlesnake and other reptiles are still be found here. Swainson’s hawks continue to be found here as it is easy to spot prey in this community. Black-tailed prairie dogs and their obligate species are also present.

4.1 Community
The wildlife species found here will be similar to the 3.1 community.

4.2 Community (Adapted Seed Mixes)
Wildlife use of tilled and replanted fields is dependent on the plant species used in the planted seed mix. Many of these sites currently support plains sharp-tailed grouse, ring-necked pheasant, grasshopper sparrow, and other upland bird species. Purpose of the seeding determines the usability for wildlife. If wildlife use is a primary concern, then seed mixes must be formulated to meet species specific habitat requirements.

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).

Plant Community (PC) Production (lbs./acre) and Stocking Rate (AUM/acre)

Reference PC - (1200) (0.33)

1.2 PC - (800) (0.22)

2.1 PC - (600) (0.16)

1.3 PC - (850) (*)

All stocking rates for grazing plans should be determined on-site.

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.

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 varies from moderate to high depending on ground cover. In many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where short grasses form a strong sod and dominate the site. 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)

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 Association LandtypeLandtype 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, percent 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.

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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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Acknowledgments

Program Support:
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Josh Saunders, Rangeland Management Specialist-QC, NRCS Fort Morgan, CO
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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:** None

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2. **Presence of water flow patterns:** Typically none. If present, water flow patterns are on steeper slopes following intense storms, short, and not connected.

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3. **Number and height of erosional pedestals or terracettes:** None

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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. Extended drought can cause bare ground to increase upwards to 10-20 percent with bare patches reaching upwards to 6-12 inches in diameter.

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5. **Number of gullies and erosion associated with gullies:** None

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None

---

7. **Amount of litter movement (describe size and distance expected to travel):** Litter should be uniformly distributed with little movement.

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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 5-6 in interspace at soil surface.

---

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Average SOM is 1-2 percent. A-horizon ranges from 0-9 inches. Soils are typically deep, light brownish gray, medium sub-angular blocky structure.

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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: Cool-season mid rhizomatous >

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

    Other: Warm-season mid bunchgrass > warm-season forbs > cool-season forbs > 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 short and mid bunchgrass mortality and decadence during and following drought.

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14. **Average percent litter cover (%) and depth (in):** Litter cover during and following extended drought ranges from 15-

25 percent.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 500 lbs./ac. low precip years; 1200 lbs./ac. average precip years; 1700 lbs./ac. above average precip years. After extended drought or the first growing season following wildfire, production may be significantly reduced by 300 – 500 lbs./ac. or more.

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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, burningush, 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.
