USDA Natural Resources Conservation Service

Ecological site R067BY036CO
Overflow

Last updated: 12/05/2024
Accessed: 05/21/2025

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

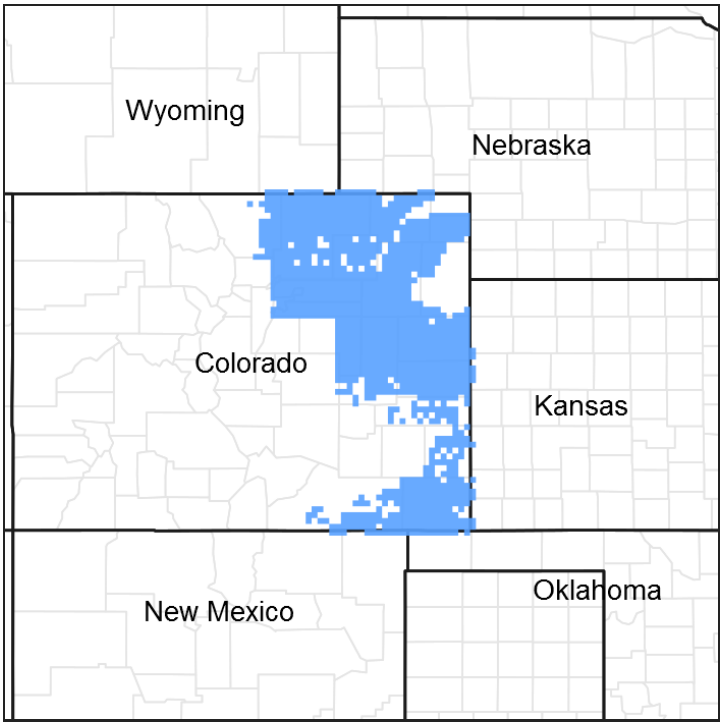


Figure 1. Mapped extent

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 Overflow Ecological Site was developed from an earlier version (2004, revised 2007). This earlier version was based on input from the Natural Resources Conservation Service (formerly Soil Conservation Service) and historical information obtained from the Overflow 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 Overflow Ecological Site is a run-on site that has no redoximorphic mottles and a water table deeper than four feet. It is subject to flooding but but doesn't have sandy subsoil textures.

There are no visible salts in the soil subsurface or on the surface.

Associated sites

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

Similar sites

R067BY037CO	**Saline Overflow** This ecological site has visible salts on the surface or in the soil profile.

Table 1. Dominant plant species

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

Physiographic features

This site occurs on the floodplains of ephemeral or intermittent streams, but may also occur on drainageways or draws that may or may not have a channel. These sites receive water from channel flooding or from runoff from surrounding areas during precipitation events.

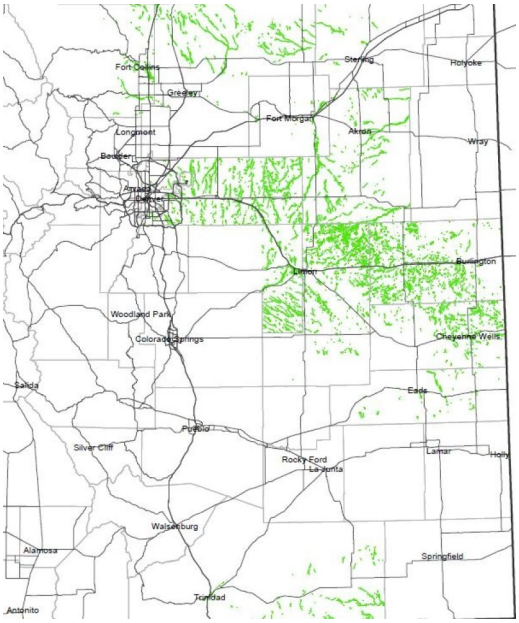


Figure 2. The distribution of the Overflow site in MLRA 67B.

Table 2. Representative physiographic features

Landforms	(1) Flood plain (2) Drainageway (3) Draw
Runoff class	Low to medium
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	Rare to frequent
Ponding frequency	None
Elevation	1,036–1,829 m
Slope	0–3%

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

Influencing water features

There are no water features affecting this ecological site.

Soil features

The soils on this site are very deep, well drained soils that formed from alluvium. They typically have a moderate to moderately slow permeability class, but can range to slow. The available water capacity is typically moderate to high. 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, but may include clay loam. The surface layer ranges from 3 to 15 inches thick. The subsoil is typically loam or clay loam, but may include silt loam. Some subsoil horizons may be stratified with varying textures. Soils in this site typically are leached of free carbonates at the surface, but some soils may range from 0 to 34 inches. These soils are susceptible to erosion by water and wind. The potential for erosion increases where vegetative cover is inadequate. Channel cutting, deposition, and removals may occur adjacent to ephemeral or intermittent streams.

Major soil series correlated to this ecological site include: Goshen, Haverson, Lohmiller, Manzanst, Paoli, Rago (occasional overflow), Sampson, and Table Mountain.

Other soil series that have been correlated to this site, but may eventually be re-correlated include: Clayey Alluvial Land and Loamy Alluvial Land.

*Feature listed in “( )” relates to the flooding frequency of the soil.

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

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 to 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 (3) Clay loam
Drainage class	Well drained
Permeability class	Slow to moderate
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	15.24–30.48 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)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–15%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The Overflow Ecological Site is characterized by four states: Reference, Warm-Season Shortgrass, Increased *Bare Ground*, and Tilled. The Reference State is characterized by cool-season mid-rhizomatous (western wheatgrass) and bunchgrass (green needlegrass). 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 and cool-season short bunchgrass (Fendler threeawn, squirreltail), annual grasses (sixweeks fescue, annual barley), and

forbs (hairy goldenaster). Common annual invasives (cheatgrass, Russian thistle), and perennial invasives (bindweed) may also occur. The Tilled State has been mechanically disturbed by equipment and includes either a variety of reseeded warm- and cool-season grasses or early successional plants as well as annual grasses and forbs.

Grazing by large herbivores, without adequate recovery periods following each grazing occurrence, causes blue grama and buffalograss to increase. Blue grama and buffalograss may eventually form a sod-bound appearance. Cool-season grasses such as western wheatgrass and green needlegrass decrease in frequency and production. Key shrubs such as fourwing saltbush and winterfat also decrease in frequency and production, as do American vetch and other highly palatable forbs. Fendler threeawn, annuals, and bare ground increases under heavy, continuous grazing, excessive defoliation, or long-term non-use. Areas of this ecological site have been tilled and used for crop production. Other areas of this ecological site have been converted to small acreages, especially near the larger communities.

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

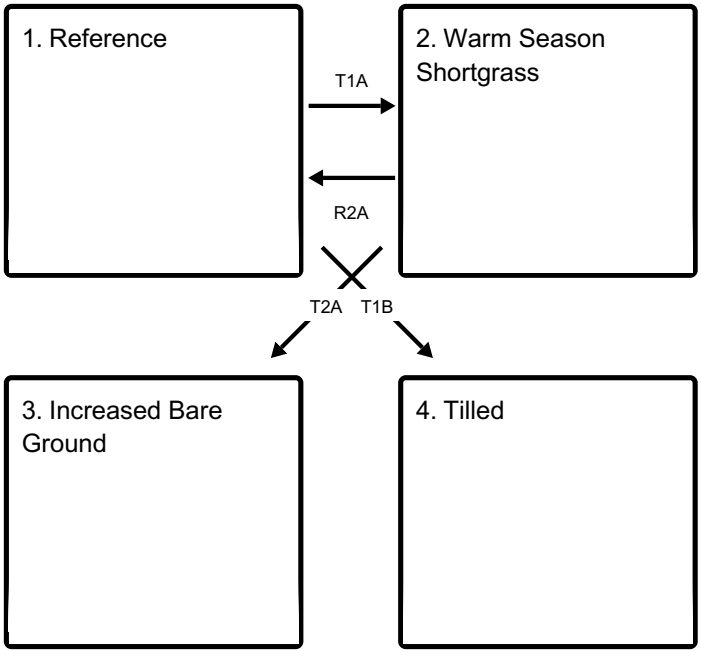
large migratory herbivores (Stewart, 2002). The impact of fire over the past 100 years has been relatively insignificant due to the human control of wildfires and the lack of acceptance of prescribed fire as a management tool.

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.

State and transition model

Ecosystem states



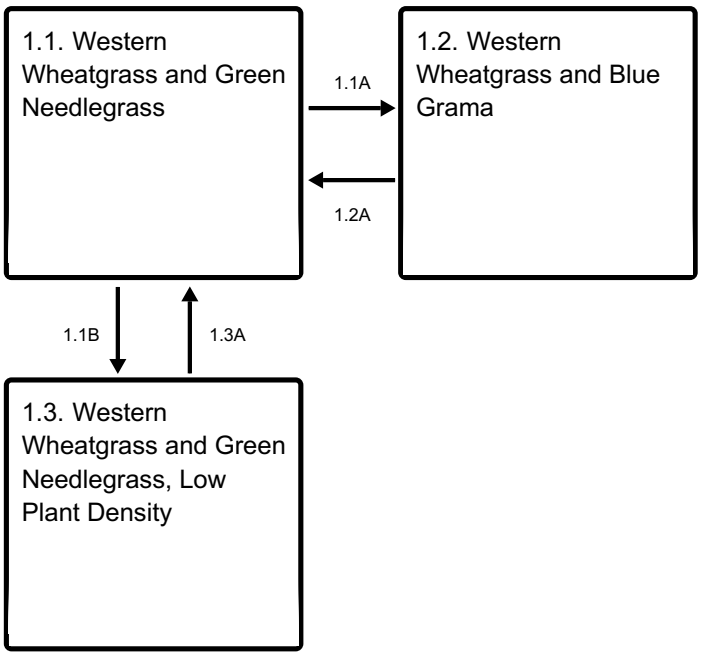
T1A - Excessive grazing. Lack of fire.

T1B - Mechanical tillage.

R2A - Prescribed grazing. Prescribed fire.

T2A - Excessive grazing. Lack of fire.

State 1 submodel, plant communities



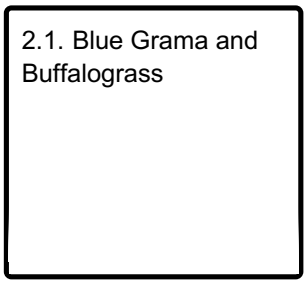
1.1A - Excessive grazing. Lack of fire.

1.1B - Non-use. Lack of fire.

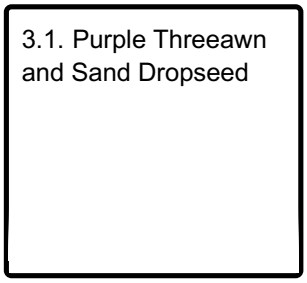
1.2A - Prescribed grazing. Prescribed fire.

1.3A - Prescribed grazing. Prescribed fire.

State 2 submodel, plant communities



State 3 submodel, plant communities



State 4 submodel, plant communities

4.1. Cheatgrass, Russian Thistle, and Burningbush, Go-Back Land	4.2. Seeded

State 1
Reference

The Reference state is characterized by three plant communities. These plant communities, and the various successional stages between them, represent the natural range of variability within the Reference state.

Dominant plant species

- fourwing saltbush (*Atriplex canescens*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- western wheatgrass (*Pascopyrum smithii*), grass
- green needlegrass (*Nassella viridula*), grass

Community 1.1
Western Wheatgrass and Green Needlegrass

This community evolved with grazing by large herbivores and is well suited for grazing by domestic livestock. The potential vegetation is about 75 to 90 percent grasses and grass-like plants, 5 to10 percent forbs and 5 to 5 percent woody plants. Major grasses include western wheatgrass, green needlegrass, big bluestem, and switchgrass. Other grasses occurring on this community include blue grama, buffalograss, Canada wildrye, and Indiangrass. Major forbs and shrubs include American vetch, upright prairie coneflower, fourwing saltbush, and winterfat. This plant community is diverse, stable, and productive. It is well suited to carbon sequestration, water yield, wildlife use by many species, livestock use, and is aesthetically pleasing. Community dynamics, nutrient cycle, water cycle, and energy flow are functioning properly. Plant litter is properly distributed with very little movement off-site and natural plant mortality is very low. This community is resistant to many things except heavy, continuous grazing, plowing' and development into urban or other uses. Total annual production ranges from 1200 to 2800 pounds of air-dry vegetation per acre with a Representative Value of 2000 pounds. These production figures are the fluctuations expected during favorable, normal, and unfavorable years due to the timing and amount of precipitation and temperature. Total annual production should not be confused with species productivity, which is annual production and variability by species throughout the extent of the community phase.

Dominant plant species

- fourwing saltbush (*Atriplex canescens*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- western wheatgrass (*Pascopyrum smithii*), grass
- green needlegrass (*Nassella viridula*), grass

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1177	1849	2522
Shrub/Vine	84	224	364
Forb	84	168	252
Total	**1345**	**2241**	**3138**

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
Western Wheatgrass and Blue Grama

Western wheatgrass, green needlegrass, and fourwing saltbush have decreased. Big bluestem, switchgrass, Indiangrass, Canada wildrye, and American vetch have been reduced and may be missing from the plant community. Blue grama and buffalograss have increased in abundance. Sand dropseed, purple threeawn, sixweeks fescue, hairy goldenaster, and plains pricklypear have also increased. This plant community is at risk of losing key species that were present in the Reference Plant Community. Once these species are removed and other plants have increased, it will take significant time to bring them back through proper grazing management. Total aboveground carbon has been reduced due to decreases in forage and litter production. Reduction of rhizomatous wheatgrass, nitrogen fixing forbs, shrub component and increased warm-season shortgrasses has begun to alter the biotic integrity of this community. Water and nutrient cycles are at risk of becoming impaired. Total annual production varies from 400 to 1200 pounds of air-dry vegetation per acre and averages 800 pounds during a normal year.

Dominant plant species

- fourwing saltbush (*Atriplex canescens*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- western wheatgrass (*Pascopyrum smithii*), grass
- blue grama (*Bouteloua gracilis*), 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
Western Wheatgrass and Green Needlegrass, Low Plant Density

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, in time, individual species production and frequency are lower. Much of the nutrients are tied up in excessive litter. The semiarid environment and the absence of animal traffic impairs nutrient cycling. Increased aboveground litter limits sunlight from reaching plant crowns. Many plants, especially bunchgrasses die. Increased litter and absence of grazing or fire reduce seed germination and establishment. This plant community will change rapidly with prescribed grazing or prescribed fire. In advanced stages, plant mortality can increase and erosion may eventually occur if bare ground increases. Once this happens, an ecological threshold has been crossed, and it will require increased energy input in terms of practice cost and management to restore the Reference Plant Community. Total annual production varies from 800 to 2200 pounds of air-dry vegetation per acre and averages 1500 pounds during a normal year.

Dominant plant species

- fourwing saltbush (*Atriplex canescens*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- western wheatgrass (*Pascopyrum smithii*), grass
- green needlegrass (*Nassella viridula*), 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 toward the 1.2 Community. Extended drought accelerates this transition. Recurring spring seasonal grazing decreases cool-season plants and increases warm-seasons. Recurring summer grazing decreases warm-seasons increases cool-seasons. Biotic integrity is altered and the water & nutrient cycles become impaired.

Pathway 1.1B
Community 1.1 to 1.3

Non-use and lack of fire causes the Reference Plant Community to shift to the 1.3 Community. Plant decadence and standing dead plant material impede energy flow. Water and nutrient cycles are impaired.

Pathway 1.2A
Community 1.2 to 1.1

Grazing that allows for adequate recovery opportunity between grazing events, proper stocking rates, and prescribed fire shift this community back to the Reference Community. Drought followed by a return of normal precipitation may cause western wheatgrass to increase, more closely resembling the Reference Plant Community.

Conservation practices

Prescribed Burning
Prescribed Grazing

Pathway 1.3A
Community 1.3 to 1.1

The return of grazing with adequate recovery opportunity and normal fire frequency will return this community to the Reference Community. This change can occur in a relatively short time frame with the return of these disturbances.

Conservation practices

Prescribed Burning
Prescribed Grazing

State 2
Warm Season Shortgrass

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 characteristics) 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 development of a shallow root system (aka root-pan), and subsequent changes in hydrology and nutrient cycling. The loss of functional/structural groups such as cool-season bunchgrasses, forbs, and shrubs reduces the biodiversity and productivity of this site.

Dominant plant species

- plains pricklypear (*Opuntia polyacantha*), shrub
- blue grama (*Bouteloua gracilis*), grass
- buffalograss (*Bouteloua dactyloides*), grass

Community 2.1
Blue Grama and Buffalograss

Most, if not all of the key grass, forb, and shrub species are absent. Western wheatgrass may persist in trace amounts, greatly reduced in vigor and not readily seen. Blue grama and buffalograss dominate the community with a tight “sod-bound” structure. Purple 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 production and diversity has been lost when compared to the Reference Plant Community. Loss of cool-season midgrasses, warm-season tallgrasses, the 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. It will take a very long time to restore this plant community back to the Reference Plant Community. Prescribed grazing management with adequate recovery opportunity and proper stocking, together with appropriate accelerating practices, will be necessary for restoration. Renovation is very costly. Production ranges from 200 to 900 pounds of air day vegetation per acre per year and averages 650 pounds in a normal year.

Dominant plant species

- plains pricklypear (*Opuntia polyacantha*), 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

An ecological threshold has been crossed. Litter levels are extremely low due to reduced production. Increased bare ground can cause erosion, off-site runoff, and deposition when rainfall events are intense. The nutrient cycle, water cycle, and overall energy flow are greatly impaired. Organic matter and carbon reserves are greatly reduced.

Dominant plant species

- plains pricklypear (*Opuntia polyacantha*), shrub
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- sand dropseed (*Sporobolus cryptandrus*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), other herbaceous

Community 3.1
Purple Threeawn and Sand Dropseed

Purple threeawn is the dominant species with sand dropseed present in lesser amounts. Blue grama and buffalograss may persist in localized areas. Introduced annuals such as burningbush, Russian thistle, cocklebur, and sunflower are present. Field bindweed can also be present, especially on prairie dog towns. Total annual production varies from 0 to 200 pounds of air-dry vegetation per acre and averages 100 pounds during a normal year.

Dominant plant species

- plains pricklypear (*Opuntia polyacantha*), shrub
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- sand dropseed (*Sporobolus cryptandrus*), 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

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

Dominant plant species

- cheatgrass (*Bromus tectorum*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), other herbaceous

Community 4.1
Cheatgrass, Russian Thistle, and Burningbush, Go-Back Land

Go-back land is created when the soil is tilled or farmed (sod-busted) and abandoned. All of the native plants are eliminated, soil organic matter is reduced, soil structure is degraded, and a plowpan or compacted layer is formed. Residual synthetic chemicals often remain from past farming operations and erosion processes may be active. With minor soil loss, the process of developing soil and vegetation will start. This is a very slow process. Re-seeding can expedite this process. Due to accelerated erosion another ecological site may evolve through secondary successional processes. Over time, burningbush, Russian thistle, and cheatgrass begin to establish. The plant community in time will become dominated by purple threeawn. Eventually, early successional perennials may begin to establish.

Dominant plant species

- cheatgrass (*Bromus tectorum*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), other herbaceous

Community 4.2
Seeded

This plant community can vary considerably depending upon the amount of soil erosion, the species seeded, and post-seeding management.

Transition T1A
State 1 to 2

Excessive grazing and lack of fire shifts this plant community across an ecological threshold to the Warm-Season Shortgrass State.

Transition T1B
State 1 to 4

Tillage causes an immediate transition across an ecological threshold to the Tilled State. This transition can occur from any plant community and it is irreversible.

Restoration pathway R2A
State 2 to 1

Long-term prescribed grazing that incorporates adequate recovery periods, proper stocking, and prescribed fire restore this state to the Reference State, assuming an adequate seed or vegetative source is available. This restoration may require substantial time depending on the proximity to seed source and remnant species present.

Conservation practices

Prescribed Burning
Prescribed Grazing

Transition T2A
State 2 to 3

Long-term, heavy continuous grazing without adequate recovery periods and lack of fire cause a shift across an ecological threshold to the Increase *Bare Ground* State. Erosion, loss of organic matter and carbon reserves, and flooding are concerns. Non-native exotic plants such as field bindweed and knapweeds are likely to invade.

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				1681–2018	
	western wheatgrass	PASM	*Pascopyrum smithii*	785–897	–
	green needlegrass	NAVI4	*Nassella viridula*	336–560	–
	switchgrass	PAVI2	*Panicum virgatum*	224–448	–
	big bluestem	ANGE	*Andropogon gerardii*	224–448	–
	blue grama	BOGR2	*Bouteloua gracilis*	112–224	–
	Indiangrass	SONU2	*Sorghastrum nutans*	112–224	–
	Canada wildrye	ELCA4	*Elymus canadensis*	22–157	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–112	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–112	–
	Grass, perennial	2GP	*Grass, perennial*	22–112	–
	little bluestem	SCSC	*Schizachyrium scoparium*	22–112	–
	buffalograss	BODA2	*Bouteloua dactyloides*	22–67	–
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	22–45	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–22	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–22	–

	sixweeks fescue	VUOC	*Vulpia octoflora*	0–22	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–22	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–22	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–22	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	0–13	–
Forb					
2				112–224	
	Forb, perennial	2FP	*Forb, perennial*	22–112	–
	American vetch	VIAM	*Vicia americana*	22–45	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	22–45	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–45	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–22	–
	Carolina larkspur	DECAV2	*Delphinium carolinianum ssp. virescens*	0–22	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–22	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–22	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–22	–
	prairie groundsel	PAPL12	*Packera plattensis*	0–22	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–22	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–22	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–22	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–22	–
	Missouri milkvetch	ASMI10	*Astragalus missouriensis*	0–22	–
	narrowleaf milkvetch	ASPE5	*Astragalus pectinatus*	0–22	–

	false boneset	BREU	*Brickellia eupatorioides*	0–22	–
Shrub/Vine					
3				112–336	
	fourwing saltbush	ATCA2	*Atriplex canescens*	112–336	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	22–112	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	22–67	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–22	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–22	–
	rubber rabbitbrush	ERNAN5	*Ericameria nauseosa ssp. nauseosa var. nauseosa*	0–22	–

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. Bison are no longer widely distributed in 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. The occasional wetland or spring found on this site provides essential seasonal water needed for reproductive habitat by some reptiles and amphibians. Because of a lack of permanent water, fish are not common.

1.1 Reference Plant Community: Western Wheatgrass, Green Needlegrass, Big Bluestem, Fourwing Saltbush

Pronghorn 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. Reptiles using this community include prairie rattlesnake. Swift fox also use this community, especially for denning activities.

1.2 Community: Increased Blue Grama, Decreased Big Bluestem, Decreased Western Wheatgrass

This community is very similar to the Reference Community therefore the value for wildlife is not significantly different.

1.3 Community: Excessive Litter, Increased Standing Dead Canopy

The wildlife species found here are similar to those in the Reference Community.

2.1 Community: Blue Grama, Buffalograss

The loss of tall structure grasses and reduced forb diversity affects the diversity of wildlife species using this community. Pronghorn use this community but it has reduced forage value. Swift fox continue to use these areas due to decreased visual obstruction. Grassland birds preferring shorter structure grasses are also found, and these include horned lark, McCown's and chestnut collared longspurs, and loggerheaded shrike among others. If prairie dogs are present, ferruginous hawks, burrowing owls, and mountain plover may be as well.

3.1 Community: Fendler Threeawn, Annual Grasses/Forbs, *Bare Ground*

Wildlife species using this this community is similar to those using the 2.1 Community. Black-tailed prairie dogs and their obligate species may use the plant community.

4.1 Community: Fendler Threeawn, Annual Grasses & Forbs

This community is very similar to the Increased *Bare Ground* Community and the value for wildlife is not significantly different. Wildlife values change over time, as plant succession progresses from annuals and bare ground after plow-out, to early successional perennials (Fendler threeawn, sand dropseed, etc.).

4.2 Seeded Plant Community

Wildlife use of tilled and replanted fields is dependent on the plant species used in the planted seed mix.

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).

Western Wheatgrass, Green Needlegrass, Big Bluestem, Fourwing Saltbush Plant Community (Reference Plant Community) - (2000) (0.55)

Increased Blue Grama, Decreased Big Bluestem, Decreased Western Wheatgrass Community - (800) (0.22)

Blue Grama/Buffalograss Community - (650) (0.18)

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

An on-site inventory is required prior to developing 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 and D. Infiltration is moderate and runoff potential for this site varies from moderate to high depending on soil hydrologic group and 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 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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Acknowledgments

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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, Ben Berlinger, Daniel Nosal
Contact for lead author	Harvey Sprock, Area Rangeland Management Specialist, Greeley, CO
Date	11/19/2004

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 water flow patterns are present, they are 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 to 3 inches in diameter. Extended drought can cause bare ground to increase upwards to 10 to 20 percent with bare patches reaching upwards to 6 to12 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

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7. **Amount of litter movement (describe size and distance expected to travel):** Minimal and short. Extreme flooding events causes litter to be displaced or captured.

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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 to 6 in interspace at soil surface. Soil surface is stabilized by decomposing organic matter.

Biological crusts (lichens, algae, cyanobacteria, mosses) may be present on or just below 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 2 to 4 percent. Soils are typically deep and well drained. Surface texture ranges from loam to silt loam. A-horizon ranges from 0 to 7 inches in depth with a pale brown color. Structure is weak medium sub-angular blocky to strong fine granular.

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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 grass = warm-season tall bunchgrass >

    Sub-dominant: Cool-season mid bunchgrasses > shrubs >

    Other: Warm-season short bunchgrass = warm-season mid bunchgrass = leguminous forbs = other forbs > warm-season short stoloniferous grass

    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.

14. **Average percent litter cover (%) and depth (in):** Litter cover during and following extended drought ranges from 25 to 35 percent.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 1200 lbs./ac. low precipitation years; 2000 lbs./ac. average; 2800 lbs./ac. above average. After extended drought or the first growing season following wildfire, production may be significantly reduced by 500 – 1000 lbs./ac. or more.

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 the reference plant community. Cheatgrass, Russian thistle, burningbush, and other non-native annuals may invade following extended drought or fire, assuming a seed source is available.

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