USDA Natural Resources Conservation Service

Ecological site R067AY120WY
Limy Upland (LiU)

Last updated: 9/07/2023
Accessed: 05/20/2024

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.

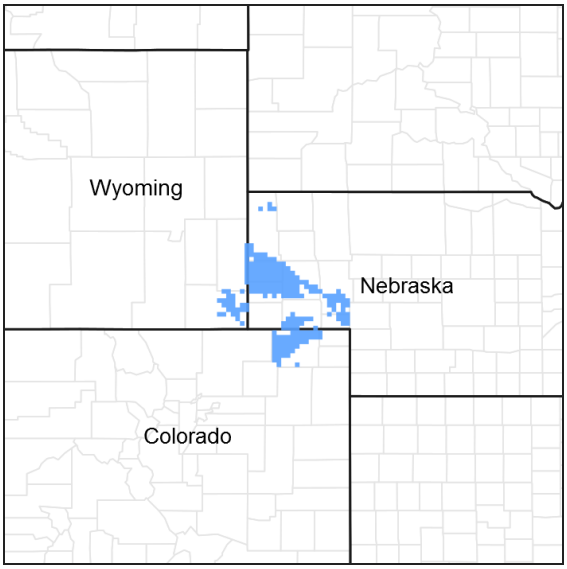


Figure 1. Mapped extent

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): 067A–Central High Plains, Northern Part

MLRA 67A-Central High Plains, Northern Part is located in southeastern Wyoming (58 percent), the southwestern portion of the Nebraska panhandle (38 percent), and extreme northeastern Colorado (4 percent). It is comprised of rolling plains, upland breaks, and river valleys. The major rivers are the North Platte and Laramie. The headwaters of these systems are in the Rocky Mountains. Other tributaries include Crow, Horse, and Lodgepole Creeks. This MLRA is traversed by Interstate 25 and Interstate 80, and by U.S. Highways 26, 30 and 85. Major land uses include rangeland (71 percent), cropland (21 percent), pasture and hayland (1 percent), urban (3 percent), and miscellaneous (4 percent). Cities in this area include Cheyenne, Torrington, and Wheatland, WY; and Kimball, Oshkosh, and Scottsbluff, NE. Land ownership is mostly private. Areas of interest include Scotts Bluff National Monument, Chimney Rock and Fort Laramie National Historic Sites; Hawk Springs, Lake Minatare, and Wildcat Hills State Recreation Areas; Ash Hollow and Guernsey State Parks.

The elevations in MLRA 67A range from approximately 3,300 to 6,200 feet. The average annual precipitation in this area ranges from 13 to17 inches per year, but may increase up to 18 inches per year, in localized areas. Precipitation occurs mostly during the growing season from rapidly developing thunderstorms. Mean annual air temperature ranges from 47 degrees Fahrenheit in the western part to 52 degrees Fahrenheit in the eastern part. Summer temperatures may exceed 100 degrees Fahrenheit. Winter temperatures may drop to sub-zero, and snowfall varies from 20 to 50 inches per year.

Classification relationships

MLRA 67A is in the Western Great Plains Range and Irrigation Land Resource Region. It is in the High Plains Section, of the Great Plains Province, of the Interior Plains (USDA, 2006). MLRA's can be defined by climate, landscapes, geology, and annual precipitation zones (PZ). Other features such as landforms, soil properties, and key vegetation further refine these concepts, and are described at the Ecological Site Description (ESD) level.

Revision Notes:

The Limy Upland Ecological Site Description (ESD) was developed by an earlier version of the Limy Upland (LyU) 12-17" Precipitation Zone ESD (2005, updated 2008). The earlier version of the Limy Upland ESD were based on input from NRCS (formerly Soil Conservation Service) and historical information obtained from the Limy Upland 12-14" Southern Plains (SP) and Limy Upland 15-17" SP Range Site Descriptions (1988). 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 Limy Upland Ecological Site is a run-off site on soils deeper than 20 inches. It has carbonates at or within six inches of the soil surface.

Associated sites

R067AY122WY	**Loamy (Ly)** This ecological site is commonly adjacent.
R067AY162WY	**Shallow (Sw)** This ecological site is commonly adjacent.

Similar sites

R067AY122WY	**Loamy (Ly)** The Loamy Ecological Site does not have carbonates at or within six inches of the soil surface.
R067AY162WY	**Shallow (Sw)** The Shallow Ecological Site has bedrock within 20 inches of the surface.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Krascheninnikovia lanata* (2) *Yucca glauca*
Herbaceous	(1) *Hesperostipa comata* (2) *Bouteloua curtipendula*

Physiographic features

This site occurs on fans or on toeslopes, footslopes, or backslopes below the bluffs, or escarpments of the dissected uplands. It is also found on moderately sloping hillslopes of the uplands.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Fan
Runoff class	Low to high
Flooding frequency	None
Ponding frequency	None

Elevation	1–2 m
Slope	3–20%
Water table depth	203–508 cm
Aspect	Aspect is not a significant factor

Climatic features

Wide fluctuations in precipitation may occur from year to year, as well as occasional periods of drought (longer than one year in duration). Two-thirds of the annual precipitation occurs during the growing season from April to September. The mean annual air temperature (MAAT) ranges from 47 degrees Fahrenheit in the western part to 52 degrees Fahrenheit in the eastern part. Cold air outbreaks from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may also occur in winter and bring rapid rises in temperature. Extreme storms may occur during the winter, but most severely affect ranch operations during the late winter and spring months. High-intensity afternoon thunderstorms may arise in summer. Wind speed averages about 8 miles per hour, ranging from 10 during the spring to 7 during late summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 75 mph. The average length of the freeze-free period (28 degrees Fahrenheit) is 150 days from May 4 to October 1. The average frost-free period (32 degrees Fahrenheit) is 128 days from May 16 to September 21. Growing season increases from west to east (Wyoming to Nebraska). Growth of native cool-season plants begins about April 1 and continues to mid-June. Native warm-season plants begin growth about May 15 and continue to about August 15. Regrowth of cool-season plants occur in September in most years, depending upon moisture.

Table 3. Representative climatic features

Frost-free period (characteristic range)	85-117 days
Freeze-free period (characteristic range)	119-135 days
Precipitation total (characteristic range)	406-432 mm
Frost-free period (actual range)	84-123 days
Freeze-free period (actual range)	116-137 days
Precipitation total (actual range)	356-457 mm
Frost-free period (average)	103 days
Freeze-free period (average)	128 days
Precipitation total (average)	406 mm

Climate stations used

- (1) HARRISBURG 12WNW [USC00253605], Harrisburg, NE
- (2) CHUGWATER [USC00481730], Chugwater, WY
- (3) OLD FT LARAMIE [USC00486852], Yoder, WY
- (4) WHEATLAND 4 N [USC00489615], Wheatland, WY
- (5) KIMBALL 2NE [USC00254440], Kimball, NE
- (6) PHILLIPS [USC00487200], LaGrange, WY
- (7) CHEYENNE [USW00024018], Cheyenne, WY
- (8) SCOTTSBLUFF HEILIG AP [USW00024028], Scottsbluff, NE
- (9) OSHKOSH [USC00256385], Oshkosh, NE
- (10) BRIDGEPORT [USC00251145], Bridgeport, NE

Influencing water features

There are no water features associated with the Limy Upland Ecological Site.

Soil features

The soils on this site are typically deep to very deep but include moderately deep soils. Well drained soils formed from slope alluvium derived from weathered calcareous siltstone or formed from calcareous eolian deposits or loess; the moderately deep soils formed from residuum derived from calcareous sandstone or siltstone. They typically have a moderate to moderately rapid permeability class, but range to moderately slow in some soils. The available water capacity is moderate but may range to high in some soils. 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 very fine sandy loam, silt loam, or loam. The surface layer ranges from a depth of 3 to 12 inches thick. The subsoil is typically very fine sandy loam, silt loam, or loam, but may include silty clay loam. Rock fragments typically account for less than 5 percent of the subsoil. Soils in this site typically have carbonates to the surface or within 6 inches of the surface. These soils are susceptible to erosion by water and wind. The potential for water erosion accelerates with increasing slope.

The surface soil structure is fine to medium granular, and structure below the surface is prismatic and/or subangular blocky. 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.

Major soil series correlated to this ecological site: Buffington, Colby, Glendo, Graystone, Keota, Mitchell, and Sulco.

Other soil series that have been correlated to this site: Angora, Bridget, Cedak, Luman, Norka, Nucla, Selpats, and Ulysses.

The attributes listed below represent 0-40 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.

Figure 8. Mitchell very fine sandy loam, Cheyenne County, NE.

Table 4. Representative soil features

Parent material	(1) Alluvium–calcareous siltstone (2) Loess (3) Eolian deposits
Surface texture	(1) Very fine sandy loam (2) Silt loam (3) Loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate to moderately rapid
Soil depth	51–203 cm

Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	16.26–22.35 cm
Calcium carbonate equivalent (0-101.6cm)	1–15%
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)	0–5%
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/time controlled grazing strategies, and historical accounts.

The Limy Upland ecological site is characterized by four states: Reference, Sod-bound, Increased *Bare Ground*, and Tilled. The Reference State is characterized primarily by warm-season shortgrass (blue grama) and cool-season midgrass (needle and thread). Minor grasses and grass-likes include warm-season midgrasses (little bluestem and sideoats grama), cool-season rhizomatous midgrass (western wheatgrass), and grass-likes (threadleaf sedge). Other minor components include forbs (prairie coneflower, slimflower scurfpea, penstemon, scarlet globemallow, American vetch, and dotted blazing star) and shrubs (winterfat). The Sod-bound State is characterized by a warm-season bunch shortgrass (blue grama) and stoloniferous grass (buffalograss). The Increased *Bare Ground* State is characterized by remnant blue grama and buffalograss, threadleaf sedge, increased annual grasses (sixweeks fescue),forbs (cuman ragweed), annuals, and shrubs (broom snakeweed, fringed sagewort, and pricklypear) Invasives include cheatgrass. The Tilled State has been mechanically disturbed by farming equipment and includes the 4.1 Community, notably with early successional plants (threeawn), annual grasses (sixweeks fescue), and forbs, or reseeded warm and cool-season grasses.

As this site begins to deteriorate from a combination of frequent and severe grazing during the growing season, bunchgrasses such as needle and thread decrease in both frequency and production. Grasses such as blue grama and threadleaf sedge increase. Western wheatgrass and palatable shrubs such as winterfat also begin to decrease. Forbs and shrubs such as hairy false goldenaster, cuman ragweed, and curlycup gumweed increase. Shrubs such as fringed sagewort and broom snakeweed also increase. If continued, the plant community become sod-bound, and all midgrasses may eventually be removed from the plant community. Over the long-term, this continuous use in combination with high stock densities, results in a broken sod, with areas of bare ground developing, and species such as broom snakeweed and annual bromes (cheatgrass), invading. Fendler threeawn, annuals, and bare ground increases under heavy, continuous grazing, excessive defoliation, or long-term non-use.

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.

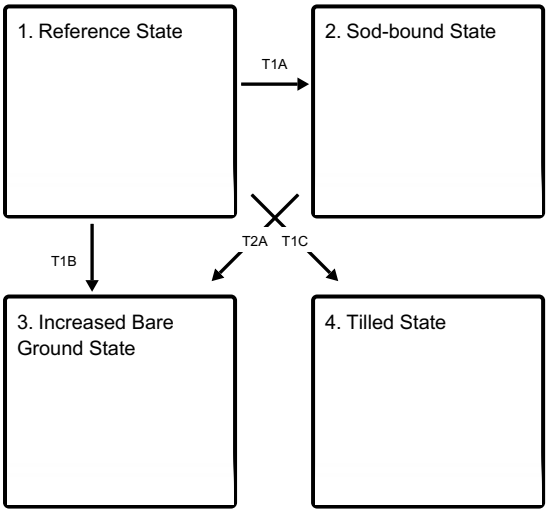
This site developed with occasional fire as part of the ecological processes. Historic fire frequency (pre-industrial) is estimated at 10 to14 years (Guyette, 2012), randomly distributed, and started by lightning at various times throughout the growing season. Early human inhabitants also were likely 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



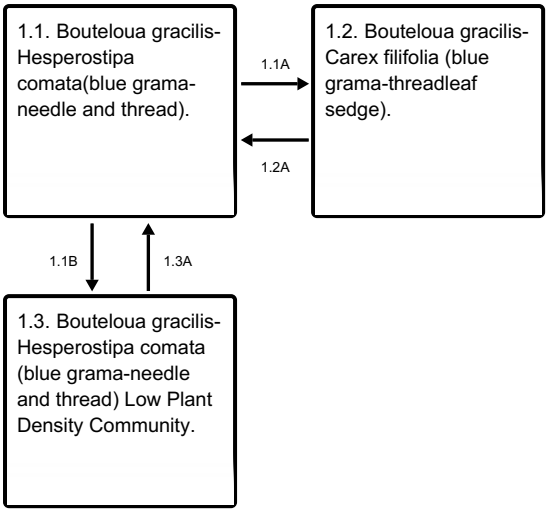
T1A - Excessive grazing. Lack of fire.

T1B - Excessive grazing. Lack of fire.

T1C - Mechanical tillage.

T2A - Excessive grazing. Lack of fire.

State 1 submodel, plant communities



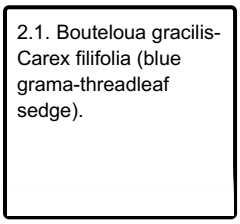
1.1A - Excessive grazing.

1.1B - Non-use. Lack of fire.

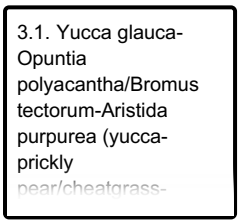
1.2A - Prescribed grazing. Prescribed fire.

1.3A - Prescribed grazing. Prescribed fire.

State 2 submodel, plant communities



State 3 submodel, plant communities



State 4 submodel, plant communities

State 1
Reference State

The Reference State is characterized by three distinct plant community phases. The plant communities, and various successional stages between them represent the natural range of variability within the Reference State.

Dominant plant species

- winterfat (*Krascheninnikovia lanata*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- blue grama (*Bouteloua gracilis*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass

Community 1.1
Bouteloua gracilis-Hesperostipa comata(blue grama-needle and thread).

Figure 9. Limy Upland 12-17" PZ, Cheyenne County, NE

The Reference Plant Community is the interpretive community for this site. It is well adapted to the Northern Great Plains climate. This community developed with grazing by large herbivores and is suited to grazing by domestic livestock. Historically, fires likely occurred infrequently, and were randomly distributed. This plant community can be found on areas where grazed plants receive adequate periods of recovery during the growing season. The potential vegetation consists of about 75 to 90 percent grasses and grass-likes, 5 to 15 percent forbs, and 0 to10 percent woody plants. In the western portion of the MLRA, the plant community consists predominately of cool-season midgrasses, with a significant component of warm-season midgrasses. In the eastern portion of the MLRA, the plant community is predominantly warm-season with a significant cool-season component. The major grasses and grass-likes include needle and thread and blue grama. Minor grasses and grass-likes include little bluestem, sideoats grama, western wheatgrass, and threadleaf sedge. Other minors include forbs such as prairie clovers (purple and white), scarlet globemallow, and American vetch, and shrubs such as winterfat. Plant diversity is high. In the 12 to 14” precipitation zone (PZ), the total annual production (air-dry weight) is about 1,000 pounds per acre during an average year, but ranges from about 600 pounds per acre in unfavorable years to about 1,200 pounds per acre in above-average years. In the 15 to 17” PZ, the total annual production (air-dry weight) is about 1,250 pounds per acre during an average year, but ranges from about 750 pounds per acre in unfavorable years to about 1,750 pounds per acre in above-average years. Community dynamics (nutrient and water cycles and energy flow) are functioning properly. Infiltration rates are moderate, and soil erosion are low. Litter is properly distributed where vegetative cover is continuous. Decadence and natural plant mortality are low. This community is resistant to many disturbances except continuous grazing, tillage or development into urban or other uses.

Dominant plant species

- winterfat (*Krascheninnikovia lanata*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- blue grama (*Bouteloua gracilis*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass

Figure 11. Plant community growth curve (percent production by month). WY1101, 12-14SP Upland sites w/o warm seasons. 12-14" Precipitation Zone, Southern Plains (SP) without warm season (grass) species.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	25	40	15	5	10	0	0	0

Community 1.2
Bouteloua gracilis-Carex filifolia (blue grama-threadleaf sedge).

Grazing-tolerant species such as blue grama and threadleaf sedge begin to increase. Needle and thread, western wheatgrass, and winterfat begin to decrease. Prairie clover species and other palatable forbs such as dotted

gayfeather and penstemon are present in reduced amounts. In the 12 to 14“ PZ, the total annual production (air-dry weight) is about 750 pounds per acre during an average year, but ranges from about 500 pounds per acre in unfavorable years to about 1,000 pounds per acre in above-average years. In the 15 to 17“ PZ, the total annual production (air-dry weight) is about 950 pounds per acre during an average year, but it can ranges from about 600 pounds per acre in unfavorable years to about 1,300 pounds per acre in above-average years. Total aboveground biomass has been reduced. Reduction of rhizomatous wheatgrasses, nitrogen-fixing forbs, and increased warm-season shortgrasses have begun to alter the biotic integrity of this community. Water and nutrient cycles may be impaired. Nearly all plant species typically found in the Reference Plant Community are present and will respond to changes in grazing management.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- blue grama (*Bouteloua gracilis*), grass
- threadleaf sedge (*Carex filifolia*), grass

Figure 12. Plant community growth curve (percent production by month). WY1101, 12-14SP Upland sites w/o warm seasons. 12-14" Precipitation Zone, Southern Plains (SP) without warm season (grass) species.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	25	40	15	5	10	0	0	0

Community 1.3
Bouteloua gracilis-Hesperostipa comata (blue grama-needle and thread) Low Plant Density Community.

This plant community developed under many years of non-use and lack of fire. Plant species resemble the Reference Plant Community however, frequency and production are reduced. Eventually, litter levels can become high enough to cause decadence and mortality of the stand. Bunchgrasses typically develop dead centers and rhizomatous grasses can form small decadent communities due to a lack of impact by grazing animals. Much of the available nutrients are tied up in standing dead plant material and increased amounts of litter. The semiarid environment and the absence of animal traffic to break down litter slows nutrient recycling. Threadleaf sedge has increased. Blue grama is reduced. Noxious weeds may invade if a seed source is readily available. Annual grasses such as sixweeks fescue, and forbs such as cuman ragweed have increased. Pricklypear, broom snakeweed, and fringed sagewort may also increase. Invasive grasses such as cheatgrass tend to encroach under these conditions. Water flow patterns and pedestalling become apparent, especially on steeper slopes. Infiltration is reduced and runoff is increased. In advanced stages of non-use or lack of fire, bare areas increase causing an erosion concern. Plant diversity is moderate to high. In the 12 to 14“ PZ, the total annual production (air-dry weight) is about 800 pounds per acre during an average year, but ranges from about 550 pounds per acre in unfavorable years to about 1,050 pounds per acre in above-average years. In the 15 to 17” PZ, the total annual production (air-dry weight) is about 1,000 pounds per acre during an average year, but ranges from about 650 pounds per acre in unfavorable years to about 1,350 pounds per acre in above-average years.

Dominant plant species

- winterfat (*Krascheninnikovia lanata*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- blue grama (*Bouteloua gracilis*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass

Figure 13. Plant community growth curve (percent production by month). WY1101, 12-14SP Upland sites w/o warm seasons. 12-14" Precipitation Zone, Southern Plains (SP) without warm season (grass) species.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	25	40	15	5	10	0	0	0

Pathway 1.1A
Community 1.1 to 1.2

Heavy, continuous grazing and lack of fire causes this community move to the 1.2 community. Drought accelerates this process. Water and nutrient cycles are impaired.

Pathway 1.1B
Community 1.1 to 1.3

Non-use and lack of fire cause the Reference Plant Community to shift toward the Low Plant Density Plant Community. Plant decadence and standing dead plant material impede energy flow. Initially, excess litter increases. Eventually, native plant density begins to decrease and annuals and introduced species begin to invade. Water and nutrient cycles are impaired.

Pathway 1.2A
Community 1.2 to 1.1

Grazing that allows for adequate recovery between grazing events, proper stocking rates and prescribed fire shift this community back to the Reference Plant Community. Recurrent drought has historically impacted the vegetation of this region. Changes in species composition and production vary depending upon the duration and severity of the drought cycle and prior grazing management.

Conservation practices

Prescribed Burning
Prescribed Grazing

Pathway 1.3A
Community 1.3 to 1.1

The return of grazing with adequate recovery and normal fire frequency shift this plant community toward the Reference Plant Community. This change occurs in a relatively short time frame with the return of these disturbances.

Conservation practices

Prescribed Burning
Prescribed Grazing

State 2
Sod-bound State

An ecological threshold has been crossed and a significant amount of production and diversity has been lost when compared to the Reference State. Significant biotic and soil changes have negatively impacted energy flow, and nutrient and hydrologic cycles. The loss of functional/structural groups such as warm-season midgrasses reduces the biodiversity and productivity of this site. 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 (root pan), and subsequent changes in hydrology and nutrient cycling. The loss of other functional/structural groups such as cool-season bunch and rhizomatous grasses, forbs, and shrubs reduces the biodiversity productivity of this site.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- blue grama (*Bouteloua gracilis*), grass
- threadleaf sedge (*Carex filifolia*), grass

Community 2.1
Bouteloua gracilis-Carex filifolia (blue grama-threadleaf sedge).

The midgrasses and palatable forbs have been eliminated. The dominant species are blue grama, threadleaf sedge, and buffalograss. These species have developed into a sod-bound condition occurring in localized colonies exhibiting a mosaic appearance. Perennial threeawn species such as Fendler threeawn have increased. Forbs such as scarlet globemallow, wild onion, death camas, slim-flower scurfpea, and skeletonplant remain. Forbs and shrubs that continue to increase are Cuman ragweed (western ragweed), hairy false goldenaster, fringed sagewort, and pricklypear. Plant diversity is very low. Energy flow and water and mineral cycles have been negatively affected. Litter levels are very low and unevenly distributed. In the 12 to 14 inch precipitation zone (PZ), the total annual production (air-dry weight) is 500 pounds per acre during an average year, but ranges from 350 pounds per acre in unfavorable years to 650 pounds per acre in above-average years. In the 15 to 17 inch PZ, the total annual production (air-dry weight) is 700 pounds per acre during an average year, but ranges from 500 pounds per acre in unfavorable years to 900 pounds per acre in above-average years. This plant community is extremely resistant to change. Many plant species are missing and a seed source is not readily available. Also, sod-forming grasses tend to maintain themselves due to their resistance to any further overgrazing.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- blue grama (*Bouteloua gracilis*), grass
- threadleaf sedge (*Carex filifolia*), grass

Figure 14. Plant community growth curve (percent production by month). WY1104, 12-14SP upland sites w/ warm. 12-14" Precipitation Zone, Southern Plains (SP) with warm-season (grass) species.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	20	35	30	5	5	0	0	0

State 3
Increased Bare Ground State

The hazard of soil erosion has increased due to the increase of bare ground. Runoff is typically high and infiltration is low. All ecological functions are impaired. An ecological threshold has been crossed. Erosion and loss of organic matter are resource concerns.

Dominant plant species

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

Community 3.1
Yucca glauca-Opuntia polyacantha/Bromus tectorum-Aristida purpurea (yucca-prickly pear/cheatgrass-Fendler threeawn).

The plant composition is made up of annuals with a few species of perennial forbs and grasses that are very tolerant to frequent and severe defoliation. Remnant grasses and grass-likes are blue grama, threadleaf sedge, and threeawn. Annual grasses and forbs such as sixweeks fescue, Russian thistle, burningbush, and cheatgrass have increased or invaded. The dominant forbs include curlycup gumweed, green sagewort, and hairy false goldenaster. Broom snakeweed and pricklypear are increasing. In the 12 to 14 inch PZ, the total annual production (air-dry weight) is 500 pounds per acre during an average year, but ranges from 300 pounds per acre in unfavorable years to 700 pounds per acre in above-average years. In the 15 to 17inch PZ, the total annual production (air-dry weight)

is 650 pounds per acre during an average year, but it ranges from 400 pounds per acre in unfavorable years to 900 pounds per acre in above-average years.

Dominant plant species

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

Figure 15. Plant community growth curve (percent production by month). WY1104, 12-14SP upland sites w/ warm. 12-14" Precipitation Zone, Southern Plains (SP) with warm-season (grass) species.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	20	35	30	5	5	0	0	0

State 4
Tilled State

The Tilled State is the result of mechanical farming operations on the site. An ecological threshold has been crossed due to complete removal of vegetation and soil tillage. Physical, chemical, and biological soil properties have been dramatically altered. There is no restorative pathway known at this time. This state includes the Go-back and Seeded Communities.

Dominant plant species

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

Community 4.1
Salsola-Bassia scoparia/Bromus tectorum-Vulpia octoflora (Russian thistle-burningbush/cheatgrass-six weeks fescue).

Go-back land is created when the soil is tilled or farmed (sodbusted) and abandoned. All of the native plants are removed, soil organic matter is reduced, soil structure is degraded, and a compacted layer (plowpan) is formed. Residual synthetic chemicals may remain from past farming operations, and soil erosion is typically active. This plant community developed where cropland was abandoned, in the past 20 to 50 years, with either no reseeding (tilled and abandoned), or reseeding that was only marginally successful. This plant community is highly variable depending upon the level of soil disturbance and amount of soil loss. Blue grama is typically absent. Go-back land evolves through several plant communities beginning with an early annual plant community, which initiates the revegetation process. Plants such as Russian thistle, burningbush, sixweeks fescue, and other annuals begin to establish. These plants provide some protection from erosion and start to build minor levels of soil organic matter. This early annual plant community lasts for two to several years. Threeawn, sand dropseed, and several other early perennials can dominate the plant community for five to eight years or more. Buffalograss establishes next and dominates for many years. Eventually western wheatgrass, blue grama, and other natives become re-established. Where go-back land has eroded to parent material, the slow process of soil development and re-establishment of vegetation starts. Initial forbs include western stickseed, and Cuman ragweed. Significant shrubs in this community include broom snakeweed and green rabbitbrush. Pricklypear is typically absent. This is a very slow process (100 years or more). A new ecological site may evolve, depending upon the severity of soil and parent material erosion, and parent material.

Dominant plant species

- cheatgrass (*Bromus tectorum*), grass

- sixweeks fescue (*Vulpia octoflora*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), other herbaceous

Community 4.2
Seeded Community

This plant community can vary considerably depending upon the severity of soil erosion, the species seeded (native or introduced), and success of stand establishment. Other factors include management and age of the stand.

Transition T1A
State 1 to 2

Frequent and severe defoliation without adequate recovery periods between grazing events and lack of fire shift this plant community across an ecological threshold to the Sod-bound State. Biotic integrity and hydrologic function are impaired as a result of this transition.

Transition T1B
State 1 to 3

Long-term heavy, continuous, grazing without adequate recovery periods following each grazing event, and lack of fire shift this plant community across an ecological threshold to the Increased *Bare Ground* State. Erosion and loss of organic matter reserves are resource concerns. Non-native plants are likely to invade.

Transition T1C
State 1 to 4

Mechanical tillage of this ecological site causes an immediate transition across an ecological threshold to the Tilled State. This transition can occur from any plant community in this ecological site and is irreversible.

Transition T2A
State 2 to 3

Long-term frequent and severe defoliation without adequate recovery between grazing events and lack of fire will cause a shift across an ecological threshold to the Increased *Bare Ground* State. Erosion and loss of organic matter reserves are resource concerns. Annual plants are likely to increase or invade as a result of this transition.

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				168–336	
	needle and thread	HECO26	*Hesperostipa comata*	112–224	–
	western wheatgrass	PASM	*Pascopyrum smithii*	56–112	–
2	**12"-14"**			168–336	
	sideoats grama	BOCU	*Bouteloua curtipendula*	112–168	–
	little bluestem	SCSC	*Schizachyrium scoparium*	56–168	–
3	**12"-14"**			224–280	
	blue grama	BOGR2	*Bouteloua gracilis*	224–280	–
4	**12"-14"**			112–168	
	threadleaf sedge	CAFI	*Carex filifolia*	112–168	–
	sedge	CAREX	*Carex*	0–56	–

5	**12"-14"**			56–168	
	Grass, perennial	2GP	*Grass, perennial*	0–56	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–56	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–56	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–56	–
	green needlegrass	NAVI4	*Nassella viridula*	0–56	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–56	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–56	–
	threeawn	ARIST	*Aristida*	0–22	–
8	**15"-17"**			211–420	
	needle and thread	HECO26	*Hesperostipa comata*	140–280	–
	western wheatgrass	PASM	*Pascopyrum smithii*	71–140	–
9	**15"-17"**			211–420	
	sideoats grama	BOCU	*Bouteloua curtipendula*	140–211	–
	little bluestem	SCSC	*Schizachyrium scoparium*	71–211	–
10	**15"-17"**			280–351	
	blue grama	BOGR2	*Bouteloua gracilis*	280–351	–
11	**15"-17"**			140–211	
	threadleaf sedge	CAFI	*Carex filifolia*	140–211	–
	sedge	CAREX	*Carex*	0–71	–
12	**15"-17"**			71–211	
	Grass, perennial	2GP	*Grass, perennial*	0–71	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–71	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–71	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–71	–
	green needlegrass	NAVI4	*Nassella viridula*	0–71	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–71	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–71	–
	threeawn	ARIST	*Aristida*	0–28	–
Forb					
6	**12"-14"**			56–168	
	Forb, perennial	2FP	*Forb, perennial*	0–56	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–22	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–22	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–22	–
	milkvetch	ASTRA	*Astragalus*	0–22	–
	white prairie clover	DACA7	*Dalea candida*	0–22	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–22	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–22	–
	dotted blazing star	LIPU	*Liatris punctata*	0–22	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–22	–
	Indian breadroot	PEDIO2	*Pediomelum*	0–22	–
	beardtongue	PENST	*Penstemon*	0–22	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–22	–

	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–22	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–22	–
	ironweed	VERNO	*Vernonia*	0–22	–
	American vetch	VIAM	*Vicia americana*	0–22	–
13	**15"-17"**			71–211	
	Forb, perennial	2FP	*Forb, perennial*	0–71	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–28	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–28	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–28	–
	milkvetch	ASTRA	*Astragalus*	0–28	–
	white prairie clover	DACA7	*Dalea candida*	0–28	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–28	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–28	–
	dotted blazing star	LIPU	*Liatris punctata*	0–28	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–28	–
	Indian breadroot	PEDIO2	*Pediomelum*	0–28	–
	beardtongue	PENST	*Penstemon*	0–28	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–28	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–28	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–28	–
	ironweed	VERNO	*Vernonia*	0–28	–
	American vetch	VIAM	*Vicia americana*	0–28	–
Shrub/Vine					
7	**12"-14"**			0–112	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–56	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–56	–
	soapweed yucca	YUGL	*Yucca glauca*	0–56	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–22	–
	prairie rose	ROAR3	*Rosa arkansana*	0–22	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–22	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–22	–
14				0–140	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–71	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–71	–
	soapweed yucca	YUGL	*Yucca glauca*	0–71	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–28	–
	prairie rose	ROAR3	*Rosa arkansana*	0–28	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–28	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–28	–

Animal community

Wildlife Interpretations:

Reference Plant Community—Needle and Thread, Blue Grama, Little Bluestem, Sideoats Grama

The predominance of grasses plus high forb diversity in the Reference Plant Community favors large grazers such as pronghorn and elk. Suitable thermal and escape cover for mule deer is limited due to low shrub cover. White and black- tailed jackrabbit, badger, and coyote commonly use this community. This community also provides habitat for a wide array of smaller mammals, so diverse prey populations are available for raptors such as ferruginous and Swainson's hawks. Birds such as western kingbird, western meadowlark, lark bunting, and grasshopper sparrow utilize this community for nesting and foraging.

1.2 Community—Increased Blue Grama and Threadleaf Sedge, with Remnant Midgrasses

The reduction in taller grasses in this community results in decreased use by lark buntings and western meadowlarks. Use by long-billed curlew increases, provided there is standing water within one-quarter mile. Killdeer, horned larks, and McCown's longspurs also make significant use of this community. Pronghorn may forage in this community.

2.1 Community—Blue Grama, Buffalograss, Threadleaf Sedge

This community provides limited foraging for antelope and other grazers. Ground-nesting birds favoring sparse vegetation use this community. Long-billed curlews use this community if standing water is present nearby. Generally, this is not a target vegetative community for wildlife habitat management.

3.1 Community—Annual Grasses and Forbs, Cheatgrass, Invasives, Broom Snakeweed, and *Bare Ground*

Sparse vegetation and greater amounts of bare ground provide suitable habitat for horned larks and McCown's longspurs. However, a lack of complex vegetation structure and residual cover makes this community poor habitat in general for most ground-nesting birds and big game species.

1.3 Community—Low Plant Density, Standing Dead Canopy, Increased Litter, Decadent Plants

This community has low habitat value for most wildlife species. Horned larks may nest in this community.

Grazing Interpretations

The following table is a guide to stocking rates for the plant communities described in the Limy Upland site. These are conservative estimates for initial planning. On-site conditions will vary, and stocking rates should be adjusted based on range inventories, animal kind/class, forage availability (adjusted for slope and distance to water), and the type of grazing system (number of pastures, planned moves, etc.), all of which is determined in the conservation planning process.

The following stocking rates are based on the total annual forage production in a normal year multiplied by 25 percent harvest efficiency of preferred and desirable forage species, divided by 912 pounds of ingested air-dry vegetation for an animal unit per month. An animal unit month (AUM) is defined as the amount of forage required by one 1,000-pound cow, for one month (Natl. Range and Pasture Handbook, 1997).

Plant Community (PC) Production (total lbs. /acre in a normal year) and Stocking Rate (AUMs/acre) are listed below:

Example: Reference PC – (1000) (.27)
Take 1,000 lbs. per acre X 25% Harvest Efficiency = 250 lbs. forage demand for one month. Then, 250 lbs. per acre/912 demand per AUM =.27

Plant Community (PC) Production (lbs.ac), and Stocking Rate (AUM/Acre)

12-14" PZ:

Reference PC - (1000) (0.27)

1.2 PC - (750) (0.21)
2.1 PC - (500) (0.14)

15-17" PZ

Reference PC – (1250) (0.34)
1.2 PC – (950) (0.26)
2.1 PC – (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. During the dormant period, livestock may need supplementation based on reliable forage analysis.

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 groups B and C, with localized areas in hydrologic group D. Infiltration ranges from moderately slow to moderate. The runoff potential for this site varies from low to moderate, depending upon 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 ESD 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 to NRCS Section 4, National Engineering Handbook (NEH-4USDA–NRCS, 1972 –2012) for runoff quantities and hydrologic curves). Rills and gullies should not typically be present. Water flow patterns should be barely distinguishable if at all present. Pedestals are only slightly present in association with bunchgrasses. Litter typically falls in place, and signs of movement are not common.

Chemical and physical crusts are rare to non-existent. Cryptogamic crusts are present, but only cover 1to 2 percent of the soil surface.

Recreational uses

This site provides hunting, hiking, photography, bird watching, and other recreational 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 & 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.

Annual Production Table is from the “Previously Approved” ESD (2008).

The Annual Production Table and Species Composition List will be reviewed 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.
Wildlife Interpretations: Plant community names updated. Narrative is from “Previously Approved” ESD (2008). Wildlife species will need to be updated at the next Approved level.

Livestock Interpretations: Plant community names and stocking rates updated.

Hydrology, Recreational Uses, Wood Products, and Other Products carried over from previously “Approved” ESD (2008).
Plant Preferences tables removed. These will be released as a technical guide notice by NRCS NE and WY state offices in the future.

Existing NRI or 417 Inventory Data References updated.

Reference Sheet:
Rangeland Health Reference Sheet carried over from previously “Approved” ESD (2008).
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)

Inventory data references

Data Source: NRI
Number of Records: 4
Sample Period: 2006-2013
State: NE
Counties: Garden, Morrill

Data Source: 417s
Number of Records: 5
Sample Period: 1969-1983
State: NE
Counties: Morrill, Scotts Bluff, Sioux

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.

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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)	Dave Cook, Kristin Dickinson, George Gamblin, John Hartung, Andy Steinert, Nadine Bishop
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Date	01/01/2005
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None. Rills are not expected on the site.

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2. **Presence of water flow patterns:** Typically, none. Water flow patterns may be present on slopes of 10 percent or greater. Water flow patterns may occur during extreme precipitation events and will be less than 12 inches long, less than 6 inches wide, and discontinuous.

3. **Number and height of erosional pedestals or terracettes:** Essentially non-existent

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is typically less than 5 percent, and patches less than 2 to 3 inches (5.1 to 7.6 cm) in diameter. Multi-year drought can cause bare ground to increase to 10 to 15 percent.

5. **Number of gullies and erosion associated with gullies:** None. Gullies should not be present on this site.

6. **Extent of wind scoured, blowouts and/or depositional areas:** Small scoured sites may be observed

7. **Amount of litter movement (describe size and distance expected to travel):** Litter should fall in place. Slight amount of movement of fine litter from water is possible, but not normal. Litter movement from wind is not expected.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil aggregate stability ratings should typically be 5 to 6, normally 6. Surface organic matter adheres to the soil surface. Soil surface peds will typically retain structure indefinitely when dipped in distilled water.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The surface layer ranges from 3 to 12 inches (7.6 to 30.5 cm) thick. Soil surface structure is fine to medium granular. Soil colors are highly variable and may be gray, grayish brown, very pale brown, brown, or light brownish gray (values of 4 to 7) when dry and very dark grayish brown, dark brown, dark grayish brown, or yellowish brown (values of 3 to 5) when moist.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The functional/structural groups provide a combination of rooting depths and structure which positively influences infiltration. Combination of shallow and deep rooted species (mid & tall rhizomatous and tufted perennial cool season grasses) with fine and coarse roots positively influences infiltration.

    The expected composition of the plant community is 75-90 percent perennial grasses and grass-likes, 5-15 percent forbs, and 0-10 percent shrubs.

    In the 12-14” PZ, the perennial grass and grass-like component is made up of tall and mid, warm-season, grasses (15-35%); cool-season grasses (20-40%); mid, warm season grasses (10-20%), short, warm-season grasses (5-15%); and grass-likes (10-15%).

    In the 15-17” PZ, the perennial grass and grass-like component is made up of cool-season grasses (20-40%); warm-season, mid and tall grasses (15-35%), short, warm-season grasses (20-25%); and grass-likes (10-15%)

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be**

mistaken for compaction on this site): None. A compaction layer is not expected on this site.

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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: 12-14” PZ - Community 1.1:
    1. Native, C3 grasses – 200-400 #/ac (20-40%): 2 species minimum
    2. Native, C4, mid and tall grasses – 150-350 #/ac (15-35%), 2 species minimum

    15-17” PZ - Community 1.1:
    1. C3 grasses – 250-500 #/ac (20-40%): 2 species minimum
    2. Native, C4, mid and tall grasses – 188-438 #/ac (15-35%), 2 species minimum

    Sub-dominant: 12-14” PZ - Community 1.1:
    3. Native, C4, short grasses – 200-250 #/ac (20-25%), 1 species minimum
    4. Grass-likes – 100-150 (10-15%), 1 species minimum
    5. Native, Perennial and Annual Forbs – 50-150 #/ac (5-15%), 5 species minimum

    15-17” PZ - Community 1.1:
    3. Native, C4, short grasses – 250-313 #/ac (20-25%), 1 species minimum
    4. Grass-likes – 125-188 (10-15%), 1 species minimum
    5. Native, Perennial and Annual Forbs – 63-188 #/ac (5-15%), 5 species minimum

    Other: 12-14” PZ - Community 1.1:
    6. Minor:Shrubs, Vines, Cacti – 0-100 #/ac: (0-10%)

    15-17” PZ - Community 1.1:
    6. Shrubs, Vines, Cacti – 0-125 #/ac: (0-10%)

    Additional: 12a. Relative Dominance:
    Community 1.1: Native, C3 grasses = Native, C4, Mid and tall grasses > C4, short grasses > Grass-likes > or = Native, Perennial and Annual Forbs > Shrubs, cacti, vines.
    12b. F/S Groups not expected for the site: Introduced annual grasses, perennial introduced and naturalized grasses, trees.
    12c. Number of F/S Groups: 6
    12d. Species number in Dominant and Sub-dominant F/S Groups: 11

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very little evidence of decadence or mortality. Bunch grasses have strong, healthy centers with less than 3 percent mortality and shrubs have few dead stems. The exception is the potential for increased mortality of mid and short, warm-season bunch grasses during multi-year drought cycles.

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14. **Average percent litter cover (%) and depth (in):** Plant litter cover is evenly distributed throughout the site and is expected to be 35 to 50 percent. Litter depth is expected to be 0.25 to 0.50 inches (0.65-1.30 cm).

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** In the 12-14” precipitation zone, annual production ranges from 600 to 1200 pounds per acres (air dry basis). Average annual production is 1,000 pounds per acre under normal precipitation and weather conditions.

In the15-17” Precipitation Zone, annual production ranges from 750 to 1750 pounds per acre (air dry basis). Average annual production is 1,250 pounds per acre under normal precipitation and weather conditions.

No significant reduction is expected the growing season following wildfire.

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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:** Annual bromes, sixweeks fescue, common mullein, Russian thistle, kochia, pricklypear cacti, fringed sagewort, and others as they become known.

    See:
    Colorado Department of Agriculture Invasive Species Website:
    https://www.colorado.gov/pacific/agconservation/noxious-weed-species
    Wyoming Weed and Pest Council Website: https://wyoweed.org/
    Nebraska Invasive Species website: https://neinvasives.com/plants.

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17. **Perennial plant reproductive capability:** All perennial species exhibit high vigor relative to recent weather conditions. Perennial grasses should have vigorous rhizomes or tillers; vegetative and reproductive structures are not stunted. All perennial species should be capable of reproducing annually.
