USDA Natural Resources
Conservation Service

Ecological site DX032X01B141
Saline Upland Loamy (SUL) Big Horn Basin Rim

Last updated: 2/22/2019
Accessed: 05/19/2024

General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

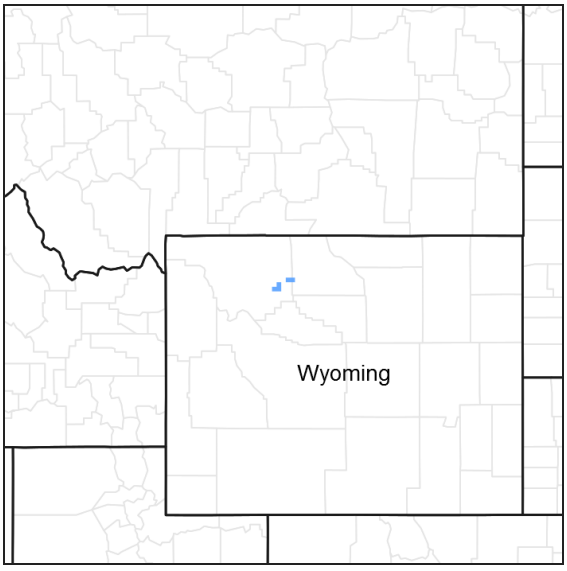


Figure 1. Mapped extent

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): 032X–Northern Intermountain Desertic Basins

032 – Northern Intermountain Desertic Basins – This MLRA is comprised of two major Basins, the Big Horn and Wind River. These two basins are distinctly different and are split by LRU's to allow individual ESD descriptions. These warm basins are surrounded by uplifts and rimmed by mountains, creating a unique set of plant responses and communities. Unique characteristics of the geology and geomorphology single these two basins out.

Further information regarding MLRAs, refer to: United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.
Available electronically at: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053624#handbook.

LRU notes

Land Resource Unit (LRU):

32X02B (WY): This LRU is the Big Horn Basin within MLRA 32. This LRU is lower in elevation, slightly warmer and

receives slightly less overall precipitation than the Wind River Basin (LRU 02). This LRU was originally divided into two LRU's - LRU A which was the core and LRU B which was the rim. With the most current standards, this LRU is divided into two Subsets. This subset is Subset B, referred to as the Rim, is a transitional band between the basin floor and the lower foothills. The subset encircles Subset A which was originally LRU A. As the LRU shifts towards the south and tracks east, changes in geology and relation to the mountain position, creates a minor shift in soil chemistry influencing the variety of ecological sites and plant interactions. The extent of soils currently correlated to this ecological site does not fit within the digitized boundary. Many of the noted soils are provisional and will be reviewed and corrected in mapping update projects. Other map units are correlated as small inclusions within other MLRA's/LRU's based on elevation, landform, and biological references.

Moisture Regime: Ustic Aridic – Prior to 2012, many of the soils within this group were correlated as Frigid Ustic Aridic or as Mesic Typic Aridic, with few mapped within this cross over zone. As progressive soil survey mapping continues, these "crossover" or transitional areas are being identified and corrected.

Temperature Regime: Mesic
Dominant Cover: Rangeland, with Saltbush flats the dominant vegetative cover for this LRU/ESD.
Representative Value (RV) Effective Precipitation: 10-14 inches (254 – 355 mm)
RV Frost-Free Days: 105-125 days

Classification relationships

Relationship to Other Established Classification Systems:

National Vegetation Classification System (NVC):
3 Xeromorphic Woodland, Scrub & Herb Vegetation Class
3.B Cool Semi-Desert Scrub & Grassland Subclass
3.B.1 Cool Semi-Desert Scrub & Grassland formation
3.B.1.NE Western North American Cool Semi-Desert Scrub & Grassland Division
M169 Great Basin Saltbush Scrub Macrogroup
G301 Atriplex corrugate – Artemisia pedatifida – Picrothamnus desertorum Dwarf-Scrub Group
CEGL001439 Atriplex gardneri – Bud Sagebrush Dwarf-shrubland
CEGL001445 Atriplex gardneri / Pascopyrum smithii Dwarf-shrubland

Ecoregions (EPA):

Level I: 10 North American Deserts
Level II: 10.1 Cold Deserts
Level III: 10.1.18 Wyoming Basin
Level IV: 10.1.18.g Big Horn Salt Desert Shrub Basin

Ecological site concept

• Site does not receive any additional water
• Slope is < 30%
• Soils are:
- saline, sodic, or saline-sodic
- Shallow, moderately deep, deep, or very deep
- With < 3% stone and boulder cover and < 20% cobble and gravel cover
- Not skeletal (<35% rock fragments) within 20" (51 cm) of mineral soil surface
- Textures usually range from very fine sandy loam to clay loam
- Clay content is or = 32% in mineral soil surface 4", With an average particle size class > 18% but < 35% clay

Saline Upland, Loamy ecological site exist on well drained soils, derived from alkaline or sodic residuum weathered from a composite of sedimentary sources. Originally, Saline Upland spanned all soil textures (sandy through clayey) grouping them based on the chemical similarities. Comparisons of sites across this spectrum illustrated a marked difference in plant diversity between the sites. Loamy soils held the greatest species richness, and provided the greatest variability between management systems. Moderate textures provide structure with permeability and deep percolation of moisture providing a more hospitable climate than the soil samples high in sands that dry out

quickly and have no structure to support nutrient cycling To address this overlap, the Saline Upland range site will be divided into: Saline Upland, Loamy; Saline Upland, Sandy; and Saline Upland, Clayey. There may also be a need to separate saline/sodic soils that are influenced strongly by gypsum or calcium carbonate accumulations; however, verification with soil laboratory data samples are needed. Division of the 10-14” precipitation band between the Mesic Basin and the frigid foothills was warranted based on the shift in plant populations and production. Cooler temperatures improves the effectiveness of precipitation received, encouraging a quicker recovery from disturbances and encourages a higher plant density, with increased available moisture and improved nutrient cycling. Cooler temperatures and reduced solar reflectivity with decreased bare ground also encourages a longer snow retention that allows for a deeper percolation and deeper soil saturation.

Associated sites

R032XY354WY	**Shale (Sh) 10-14" East Precipitation Zone** Shale sites are a shallow soils created as shale outcrop weathers. As the landform transitions lower on the landscape will see the shale sites weather/ or develop into deeper soils grouped into a Saline Upland site.
DX032X02B122	**Loamy (Ly) Wind River Basin Rim** Loamy sites are found in in intermingled pockets with Saline Upland sites. Interbedded shales and sandstone formations create intermixed pockets of loamy and saline upland sites, with Loamy occurring on concave areas where salts have been flushed lower in the profile, encouraging more desirable species to grow.
R032XY340WY	**Saline Lowland Drained (SLDr) 10-14" East Precipitation Zone** Saline Lowland Drained have lost the recognizable water table and salt indicators in the soils but maintain the salt dominated vegetation, specifically greasewood and possibly remnants of alkali sacaton. They are found on relic stream terraces or along drainages in alluvial fans or slope alluvium derived from shale. As move up the landform, off of old floodplains/stream terraces, the site will transition into Saline Upland.
R032XY344WY	**Saline Upland (SU) 10-14" East Precipitation Zone** The existing Range Description for Saline Upland 10-14" East Foothills and Basins, is being adapted into three distinct sites. As move across the landscape from salt bearing sandstones will see a transition from Saline Upland Sandy (SUS) to Saline Upland Loamy(SUL); or while transitioning away from shale outcrops you will see a shift from Saline Upland Clayey(SUC) to Saline Upland Loamy(SUL).

Similar sites

R032XY244WY	**Saline Upland (SU) 5-9” Wind River Basin Precipitation Zone** This site is a composite of the 5-9" and the lower 10-14" sites that crossed all soil textures within Saline Upland located within the Wind River Basin. This site will be similar to the Big Horn Basin original sites, and will be reviewed to determine if the similar division needs to occur.
R032XY144WY	**Saline Upland (SU) 5-9” Big Horn Basin Precipitation Zone** This site is a composite of the 5-9" and the lower 10-14" sites that crossed all soil textures within Saline Upland. As the Ecological Sites were reviewed, this Site Description was split between LRU A (5-9" Big Horn Basin) and LRU D (10-14" Mesic Big Horn Basin). And then was further divided between saline sites that were loamy, clayey and sandy.
R032XY344WY	**Saline Upland (SU) 10-14" East Precipitation Zone** This site is a composite of the lower 10-14" mesic and the higher 10-14" frigid sites that crossed all soil textures within Saline Upland. As the Ecological Sites were reviewed, this Site Description was split between LRU D (10-14" Mesic Big Horn Basin) and MLRA 46. And then was further divided between saline sites that were loamy, clayey and sandy.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Atriplex gardneri* (2) *Artemisia pedatifida*
Herbaceous	(1) *Achnatherum hymenoides* (2) *Elymus elymoides*

Legacy ID

R032XB141WY

Physiographic features

These sites generally occur on a slope range of nearly level to 30%. Documentation shows a majority of these soils exist on the bottom of drainages in enclosed basins or where marine shales outcrop. They may also occupy residual and fan soils of the foothills and lower mountain ranges with lower precipitation. The inter-bedded and dissected Big Horn Basin has a mixture of these soils creating a wide range of saline-driven communities.

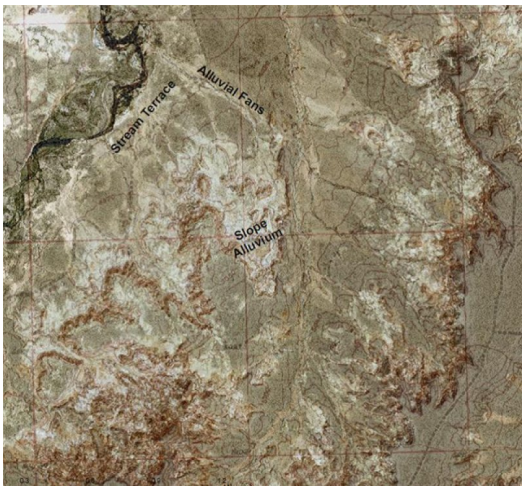


Figure 2. Landscape diagram of Saline Upland Sites

Table 2. Representative physiographic features

Landforms	(1) Alluvial fan (2) Stream terrace (3) Basin-floor remnant
Elevation	1,372–1,701 m
Slope	0–30%
Ponding depth	0 cm
Water table depth	122 cm
Aspect	Aspect is not a significant factor

Climatic features

Annual Precipitation and modeled relative effective annual precipitation ranges from 10 to 14 inches (254 – 355 mm). The normal precipitation pattern shows peaks in May and June and a secondary peak in September. This amounts to about 50% of the mean annual precipitation. Much of the moisture that falls in the latter part of the summer is lost by evaporation and much of the moisture that falls during the winter is lost by sublimation. Average snowfall is about 20 inches annually. Wide fluctuations may occur in yearly precipitation and result in more dry years than those with more than normal precipitation.

Temperatures show a wide range between summer and winter and between daily maximums and minimums, due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in winter and bring rapid rises in temperature. Extreme storms may occur during the winter, but most severely affect ranch operations during late winter and spring. High winds are generally blocked form the basin by high mountains, but can occur in conjunction with an occasional thunderstorm. Growth of native cool-season plants begins about April 1st and continues to about July 1st. Cool weather and moisture in September may produce some green up of cool season plants that will continue to late October.

For detailed information visit the Natural Resources Conservation Service National Water and Climate Center at http://www.wcc.nrcs.usda.gov/. "Clark 3NE", "Cody", "Cody 12SE", "Heart Mtn", and Powelll Fld Stn" are the representative weather stations within LRU D. The following graphs and charts are a collective sample representing the averaged normals and 30 year annual rainfall data for the selected weather stations from 1981 to 2010.

Table 3. Representative climatic features

Frost-free period (average)	109 days
Freeze-free period (average)	131 days
Precipitation total (average)	229 mm

Climate stations used

- (1) CODY [USC00481840], Cody, WY
- (2) POWELL FLD STN [USC00487388], Powell, WY
- (3) CLARK 3NE [USC00481775], Powell, WY
- (4) HEART MTN [USC00484411], Powell, WY
- (5) CODY 12SE [USC00481850], Meeteetse, WY

Influencing water features

None Present. The lack of water table above 48 in (122 cm) during any part of the growing season is a key factor for the Saline Upland sites. As the landscape transitions into the bottomlands (lowlands) or drainages, gaining overland flow and ground water influence changes the site to a saline lowland or saline subirrigated ecological site.

Soil features

The soil characteristics of Saline Upland, Loamy sites are shallow to very deep (greater than 10” (25 cm) to bedrock), well drained with moderate to slow permeability. Soils are moderately to strongly saline and/or sodic. The mineral soil surface will vary from 2 to 6 inches (5-15 cm) in thickness. The most influential soil characteristics on the plant community are the limited available soil moisture and a high quantity of soluble salts. Some soils may contain more soluble salts in the subsurface than in the surface.

Limited moisture is relative to the soil crusting and loss of structure that inhibits the movement of moisture into and through the profile. This wetting at the surface tends to wick salts up from the sodic parent materials increasing the salts within the profile. The interaction of salts with soil particles can create a situation where the soils are hard and compact due to hoof or vehicular action when the soils are wet, and then dry quickly. These disturbances during dry periods can create a loose and “fluffed” surface that is easily blown or washed away during quick precipitation events. This erosive nature, leaves the soil barren of significant cover. When protected from major disturbances, significant bands or patchwork cover of cryptogrammic crusts develop on these soils.

Major soil series correlated to this site include: Muff, Uffens, Kishona, and Leswill-like. Soil series are subject to change upon completion and correlation of the initial soil surveys. It is recognized that some of these series are classified as typic aridic (5-9" precipitation, Mesic); however, map units were mapped across zones that are both typic aridic and ustic aridic (10-14" precipitation, Mesic). As surveys are correlated, this will be corrected.

Typical Pedon – Uffens Soil Series

Taxinomic Classification: Fine-loamy, mixed, superactive, mesic Typic Natrargids; The Uffens series consists of very deep, well drained soils that formed in deltaic and alluvial sediments derived from mixed parent materials. These soils are on terraces and fans and have slopes of 0 to 12 percent. Mean annual temperature is about 52 degrees F., and the average annual precipitation is about 8 inches. Uffens silt loam - rangeland. (Colors are for dry soil unless otherwise noted.)
Geographical Setting: Uffens soils are on nearly level lake plains, terraces, and mesas at elevations of 3,800 to 6,400 feet. Slope ranges from 0 to 12 percent. The soils formed in deltaic sediments and alluvium derived from mixed parent materials. The climate is arid. The average annual precipitation is 6 to 10 inches, the mean annual

temperature is 45 to 56 degrees F., the mean summer temperature is 66 to 73 degrees F., and the frost-free period is 100 to 160 days.
E--0 to 1/2 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine pores; strongly effervescent; strongly alkaline (pH 8.7); clear smooth boundary. (1/2 to 6 inches thick)
Range in Characteristics: The E horizon has dominant hue of 10YR or 2.5Y, but is 7.5YR in some pedons. Value is 5 to 8 dry, 4 to 5 moist, and chroma is 2 to 4. It is moderately to very strongly alkaline and moderately or strongly effervescent.
Btn1--1/2 to 3 inches; light brownish gray (2.5Y 6/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium columnar structure that parts to weak fine blocky; very hard, firm, slightly sticky and plastic; few fine roots; many fine vesicular pores; common thin clay films on faces of peds; strongly effervescent; very strongly alkaline (pH 9.3); clear smooth boundary. (2 to 13 inches thick)
Range in Characteristics: The Btn horizon has hue of 7.5YR through 2.5Y, value of 5 through 7 dry, 4 through 6 moist and chroma of 2 through 6 dry and 2 through 4 moist. It is sandy clay loam or clay loam. The Btn horizon has 15 to 75 percent exchangeable sodium. It is strongly alkaline or very strongly alkaline and moderately or strongly effervescent. This horizon has common to many thin clay films on faces of peds. It ranges from 6 to 23 inches thick.
Btn2--3 to 10 inches; very pale brown (10YR 7/3) sandy clay loam, brown (10YR 5/3) moist; weak medium prismatic structure that parts to weak medium blocky; very hard, firm, sticky and plastic; few fine roots; few fine tubular pores; many thin clay films on faces of peds; strongly effervescent; very strongly alkaline (pH 9.3); clear smooth boundary. (4 to 10 inches thick)
C1--10 to 27 inches; very pale brown (10YR 7/3) sandy clay loam, brown (10YR 5/3) moist; weak coarse blocky structure; very hard, firm, sticky and plastic; common fine roots; many fine tubular pores; strongly effervescent; strongly alkaline (pH 8.9); gradual smooth boundary. (3 to 17 inches thick)
Range in Characteristics: The C horizon has hue of 7.5YR through 2.5Y, value of 5 through 8 dry, 4 through 6 moist and chroma of 2 to 4. It ranges from sand to silty clay loam, but the sand is below a depth of 36 inches. The C horizon is moderately to very strongly alkaline and moderately or strongly effervescent.
C2--27 to 54 inches; light gray (10YR 7/2) sandy clay loam, grayish brown (10YR 5/2) moist; massive; very hard, firm, sticky and plastic; few fine roots; common fine and medium tubular pores; strongly effervescent; strongly alkaline (pH 8.8); clear smooth boundary. (18 to 30 inches)
C3--54 to 57 inches; light gray (2.5YR 7/2) silty clay, grayish brown (2.5YR 5/2) moist; weak medium prismatic structure; extremely hard, firm, sticky and plastic; few fine roots; few fine vesicular pores; moderately effervescent; moderately alkaline (pH 8.4); clear smooth boundary. (3 to 14 inches thick)
2C--57 to 70 inches; light brownish gray (10YR 6/2) sand, light brownish gray (10YR 6/2) moist; single grain; loose; few fine roots; few fine pores; moderately effervescent; strongly alkaline (pH 8.5).
Range in Characteristics:
Mean annual soil temperature is 47 to 57 degrees F
Mean summer soil temperature at depths of 20 inches is 65 to 72 degrees F
Dry in all parts of the moisture control section for 75 to 80 percent of the time the soil temperature is above 41 degrees F.
Combined thickness of the E and Btn horizon ranges from 8 to 29 inches.
Soluble salt content ranges up to about 1.0 percent in some pedons.
Some pedons contain slight or moderate amounts of gypsum in the C horizon.

Type Location: Millard County, Utah; 3 miles south of Deseret and 6 miles west of highway; NE 1/4 of sec. 20, T. 18 S., R. 8 W.

Figure 7. Soil Profile from a pit for Saline Upland Loamy, M

Table 4. Representative soil features

Parent material	(1) Residuum–shale (2) Alluvium–sandstone
Surface texture	(1) Gravelly loam (2) Sandy clay loam (3) Fine sandy loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Slow to moderate
Soil depth	25–152 cm
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	0–5%
Available water capacity (0-101.6cm)	5.84–21.08 cm
Calcium carbonate equivalent (0-101.6cm)	0–14%
Electrical conductivity (0-101.6cm)	4–16 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	3–40
Soil reaction (1:1 water) (0-101.6cm)	7.9–9
Subsurface fragment volume <=3" (Depth not specified)	0–15%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

Salt-tolerant plant species are dominant on this site; specifically, drought-tolerant low woody shrub species and mid-stature cool-season perennial grasses that can persist in the elevated salts, most specifically sodium as well as gypsum. The expected potential composition is 50% grasses, 10% forbs, and 40% shrubs (woody species). The percentage of bare ground is elevated compared to sites without the higher chemistry, due to the soil capping that occurs with the reaction of the salts and soil moisture. The lowered permeability and infiltration rates reduce the ability for plant persistence. The composition and production will vary naturally due to fluctuation in timing and intensity of precipitation. Historic use has shifted the vigor and plant community, removal of sheep and introduction

to cattle has altered the natural selection on this site. Fire frequency is not factor due to the lack of fine fuels necessary to sustain a fire.

As this site deteriorates, the cool season grasses decrease (Indian Ricegrass, Bottlebrush Squirreltail, and rhizomatous wheatgrasses), in both frequency and production and this allows a slight increase in woody species (Gardner's saltbush, Birdfoot sagebrush, and possibly Greasewood). Finally, weedy annuals will begin to invade, including Halogeton and Cheatgrass.

The reference community (description follows the state and transition diagram) has been determined by study of rangeland relic areas, or areas protected from excessive disturbance. Trends in plant communities going from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts have also been used.

The following is a State and Transition Model (STM) diagram for this ecological site. An STM has five fundamental components: states, transitions, restoration pathways, community phases and community pathways. The state, designated by the bold box, is a single community phase or suite of community phases. The reference state is recognized as State 1. It describes the ecological potential and natural range of variability resulting from the natural disturbance regime of the site. The designation of alternative states (State 2, etc) in STMs denotes changes in ecosystem properties that cross a certain threshold.

Transitions are represented by the arrows between states moving from a higher state to a lower state (State 1 -> State 2) and are denoted in the legend as a "T" (T1-2). They describe the variables or events that contribute directly to loss of state resilience and result in shifts between states. Restoration pathways are represented by the arrows between states returning back from a lower state to a higher state (State 2 -> State 1 or better illustrated by State 1<- State 2) and are denoted in the Legend as an "R" (R2-1). They describe the management actions required to recover the state.

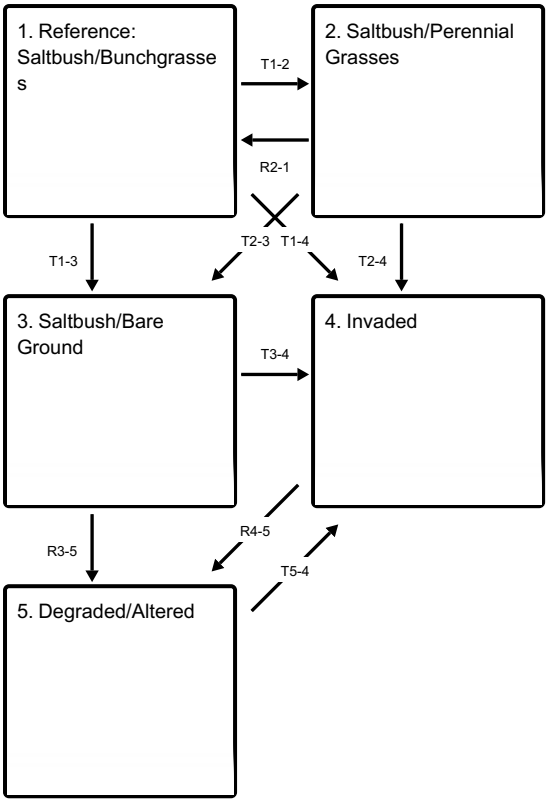
Community phases, small boxes within the bold state boxes, generally have important management or ecological significance. Collectively, the community phases represent the range of variation within a state, including conditions that place the state at risk for transition. Community pathways are represented by the lighter arrows moving between community phases and are labeled with "CP" (CP1.1-1.2). They describe the cause for shifts between community phases. The community phases captured in this STM may not represent every possibility, but are the most prevalent and repeatable plant communities.

The specific ecological processes and community variability will be discussed in more detail in the plant community narratives following the diagram. The plant composition tables, shown within each community phase narrative, have been developed from the best available knowledge at the time of most current revision. As more data is collected, some of these plant communities may be revised or removed, and new ones may be added.

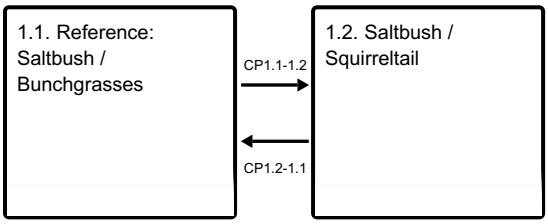
No plant communities should necessarily be thought of as "Desired Plant Communities" (DPC). According to the USDA NRCS National Range and Pasture Handbook, DPC's will be determined by the decision-makers and will meet minimum quality criteria established by the NRCS. The main purpose for including any description of a plant community here is to capture the current knowledge and experience at the time of this revision.

State and transition model

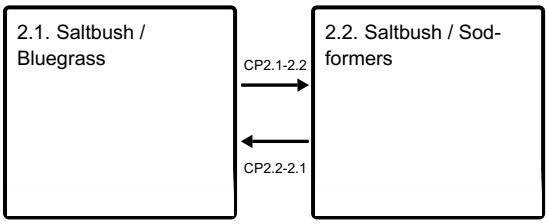
Ecosystem states



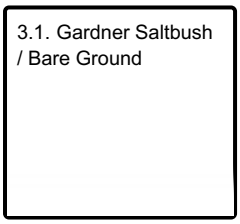
State 1 submodel, plant communities



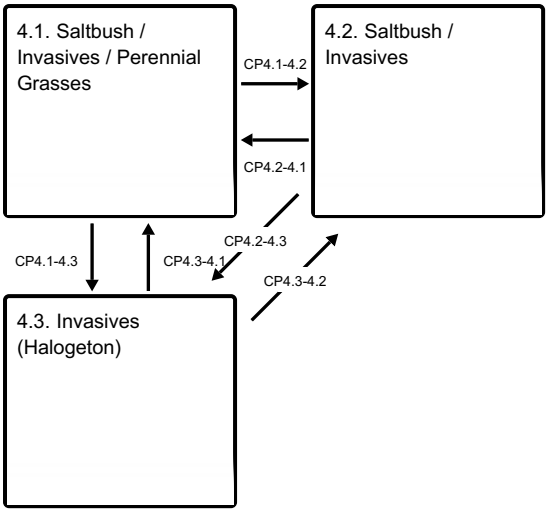
State 2 submodel, plant communities



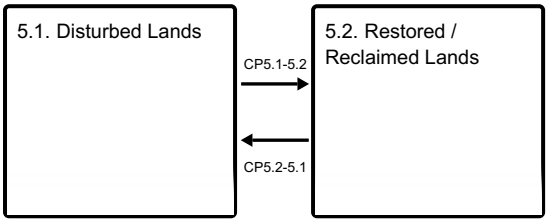
State 3 submodel, plant communities



State 4 submodel, plant communities



State 5 submodel, plant communities



State 1
Reference: Saltbush/Bunchgrasses

Saline/sodic soils within the fine-loamy particle size class, including influences from gypsum and calcium carbonate accumulations, support plant communities that are dominated by Gardner's Saltbush, Birdfoot Sagebrush, and in some locations Greasewood and Winterfat. These dominant low sub-shrubs comprise approximately 40% of the production on the site. The grasses, composing 50% of the plant community, are predominately Bottlebrush Squirreltail and Indian Ricegrass. As the sites transition, Sandberg Bluegrass and Blue Grama will begin to increase. Needleandthread and Western Wheatgrass are minor contributors in this State. The forb component is minor with only 10% of the production comprised by a select few forbs. A variety of biscuitroots/desert parsleys (Lomatiums), wild onion, milkvetches, and asters are found within this State. The general ground cover is open with bare ground consisting of 25 to 40%, but it is stable. The drought tolerance of this state allows for a wide flexibility in production and composition shifts from year to year, but maintains the base diversity for each community phase.

Community 1.1
Reference: Saltbush / Bunchgrasses

Figure 8. Image of a reference site, during a droughty year.

Equal composition of Saltbush and perennial grasses with a minor component of perennial forbs is the signature

characteristic of the reference plant community for the Saline Upland Loamy site. The dominant plant community can be found on areas that are properly managed with prescribed grazing including short periods of rest/deferment. Potential vegetation is about 50% grasses or grass-like plants, 10% forbs, and 40% woody plants. Gardner Saltbush dominates the site with Birdfoot Sagebrush, Winterfat, Indian Ricegrass, Bottlebrush Squirreltail and Sandberg Bluegrass being sub-dominate. Other potential salt tolerant shrubs, namely Greasewood, Rhizomatous wheatgrasses and Needleandthread were stated to be common on these sites in the historic rangeland description. The total annual production (air-dry weight) of this community is about 450 pounds per acre, but it can range from about 230 lbs./acre in unfavorable years to about 700 lbs./acre in above average years. This state is fragile, but well adapted to the Northern Intermountain Desertic Basins climatic conditions. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community but is difficult to re-establish when damaged, in reference to site/soil stability, watershed function, and biologic integrity.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	168	280	476
Grass/Grasslike	84	196	252
Forb	6	28	56
Total	**258**	**504**	**784**

Table 6. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0-2%
Litter	10-25%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	25-40%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	10-20%	–	0-2%
>0.15 <= 0.3	–	–	–	–
>0.3 <= 0.6	–	–	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 10. Plant community growth curve (percent production by month).

WY0701, 10-14E upland sites.

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

Community 1.2
Saltbush / Squirreltail

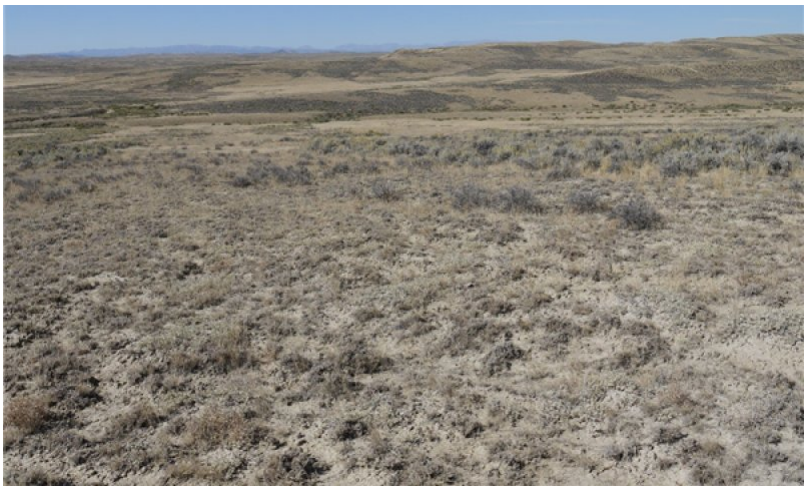


Figure 11. the major grass species being Bottlebrush squirrel

The Saltbush/Squirreltail Community (1.2) is found under moderate season-long grazing by livestock. Prolonged drought can play an important role in the transition to and from this community. Gardner's saltbush, Birdfoot sagebrush, and Bottlebrush squirreltail are the major species components, with other cool-season grasses increasing in the understory. Short warm-season grasses and miscellaneous forbs are found in pockets within the community. Historically, this plant community evolved under grazing by large ungulates, so it is not uncommon to find many of these species rooted within the crown of Saltbush. Dominant grasses include Bottlebrush Squirreltail, Sandberg Bluegrass, and Blue Grama. Forbs commonly found in this plant community include Smooth woodyaster, biscuitroot/desertparsley, and Wild onion. Plains prickly pear and Winterfat may also occur. When compared to the Reference Community (1.1), Birdfoot sagebrush has increased while Indian Ricegrass has decreased and may only exist in trace amounts. In addition, Winterfat may or may not have changed depending on the season of use. The total annual production (air-dry weight) of this state is about 360 pounds per acre but it can range from 155 lbs. /acre in unfavorable years to about 575 lbs/acre in above average years. Rangeland Health Indicators: This plant community is relatively resistant to change. The herbaceous species are well adapted to grazing; however, species composition can be altered through long-term grazing. The herbaceous component is mostly intact and plant vigor and replacement capabilities are sufficient. Water flow patterns and litter movement may occur, but is not extensive. Incidence of pedestalling is minimal. Soils are mostly stable and the surface shows minimal soil loss. The watershed is functioning and the biotic community is intact.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	112	219	364
Grass/Grasslike	56	140	196
Forb	6	45	84
Total	**174**	**404**	**644**

Table 9. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%

Non-vascular plants	0%
Biological crusts	0-2%
Litter	10-20%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	30-50%

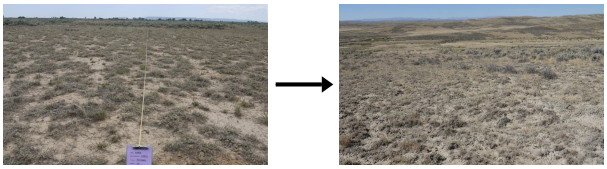
Table 10. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	10-20%	–	1-2%
>0.15 <= 0.3	–	–	–	–
>0.3 <= 0.6	–	–	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 13. Plant community growth curve (percent production by month). WY0701, 10-14E upland sites.

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

Pathway CP1.1-1.2
Community 1.1 to 1.2

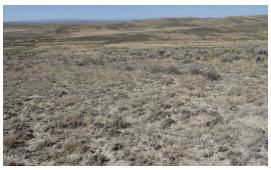


Reference: Saltbush / Bunchgrasses

Saltbush / Squirreltail

Moderate Continuous Season-long Grazing, Drought - Gardner’s Saltbush has shown a tolerance or resilience under slight and moderate grazing pressures over a period of time, however the herbaceous component is susceptible, and is weakened under constant use. Indian Ricegrass is the main species that will decrease initially. As the pressure persists, the vigor and frequency of Indian Ricegrass will begin to decrease while Sandberg Bluegrass will increase, and Bottlebrush Squirreltail will remain fairly stable. Production may not be altered depending on the precipitation for the year, but with continued stress the production will decrease as overall diversity and herbaceous cover is reduced. The transition into community phase 1.2 can be reversed with shifts in management and climatic improvements.

Pathway CP1.2-1.1
Community 1.2 to 1.1



Saltbush / Squirreltail

Reference: Saltbush / Bunchgrasses

Prescribed Grazing or Long-term Prescribed Grazing - Given there is a viable seed source in close proximity, and with the appropriate rest and recovery time between grazing periods, Indian ricegrass can re-establish. The recovery process is slow and low precipitation and poor seedling establishment conditions, it may take several years (10-30 years) for recovery with no outside inputs. At this stage, seeding or other mechanical treatments are not suggested. Ground disturbance provides for a higher risk potential for erosion and invasive species.

Conservation practices

Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Prescribed Grazing
Grazing Management Plan - Applied

State 2
Saltbush/Perennial Grasses

A combination of environmental and utilization disturbances has reduced the flexibility of the plant community leading to the shift to the Saltbush/Perennial Grasses State (State 2). Mid-stature cool season grasses, commonly bluegrasses, and low-stature warm season grasses (Blue grama) have increased in composition, reducing the diversity. Although the state is stable with approximately 30% ground cover by Gardner's Saltbush or salt tolerant shrubs, the production is slightly reduced. The trend noted during sampling was an increase of annual forbs with the decrease of Indian ricegrass and Bottlebrush squirreltail. Current and historic data has documented extreme swings in productivity between years (on an 8-10 year pattern) for Sandberg Bluegrass and Gardner's Saltbush specifically, but also for many of the species present. (Based on a 50 year data set). This swing in production can provide a false sense that a threshold has been crossed, when in actuality, it is a natural response to drought/climatic changes. These changes are what allow the Reference State and this state (State 2) to be sustainable. The trend noted during sampling was an increase of annual forbs with the decrease of Indian ricegrass and Bottlebrush squirreltail. Current and historic data has documented extreme swings in productivity between years (on an 8-10 year pattern) for Sandberg Bluegrass and Gardner's Saltbush specifically, but also for many of the species present. (Based on a 50 year data set). This swing in production can provide a false sense that a threshold has been crossed, when in actuality, it is a natural response to drought/climatic changes. These changes are what allow the Reference State and this state (State 2) to be sustainable.

Community 2.1
Saltbush / Bluegrass

Figure 14. Bluegrass dominant site, on a high productivity ye

Saltbush/Bluegrass plant community is found under moderate, season-long grazing by livestock. Prolonged drought will force a reference community into this state (State2), and together this transition can happen more readily. This community appears to respond with an exaggerated shift in production from wet to dry growing seasons. Typically the fire threat is minimal because of the lack of fine fuels; however, in wet early springs or late fall, bluegrass response may provide the cover and fuels to increase the risk of fire next. This plant community is still dominated by saltbush and cool-season grasses, while short warm-season grasses and miscellaneous forbs account for the balance of the understory. Under continued drought or intense grazing, this community is at-risk of shifting to a sod-forming, warm-season dominated grass community. The dominant plants for this community are Gardner's saltbush and Sandberg bluegrass. Grass species that are incidental on the site include: Prairie junegrass, Blue grama, Bottlebrush squirreltail, and Needleandthread. Forbs commonly found in this plant community include annual mustards, stickseeds, desert parsley/biscuitroot, milk vetches and asters. This plant community maintains diversity, but lacks the structure for cover and wildlife habitat. When compared to the Reference Community, Sandburg bluegrass and Blue grama have increased and Plains prickly pear cactus has invaded. Indian ricegrass and Bottlebrush squirreltail have decreased and may occur in only trace amounts within the patches of Plains prickly pear. Season of use and treatment type may have limited or removed Winterfat from this community. The total annual production (air-dry weight) of this state is about 300 pounds per acre, but it can range from about 100 lbs./acre in unfavorable years to about 750 lbs./acre in above average years. Rangeland Health Implications/Indicators: This plant community is resistant to change, the herbaceous species present are well adapted to grazing. The herbaceous component is mostly intact and plant vigor and replacement capabilities are sufficient. Water flow patterns and litter movement may be occurring but only on steeper slopes. Incidence of pedestalling is minimal. Soils are mostly stable and the surface shows minimum soil loss. The watershed is functioning, and the biotic community is intact.

Table 11. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	84	140	448
Grass/Grasslike	22	168	280
Forb	6	28	112
Total	**112**	**336**	**840**

Table 12. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0-1%
Litter	10-30%
Surface fragments >0.25" and <=3"	0-15%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	25-35%

Table 13. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	10-30%	–	0-2%
>0.15 <= 0.3	–	–	–	–
>0.3 <= 0.6	–	–	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 16. Plant community growth curve (percent production by month). WY0701, 10-14E upland sites.

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

Community 2.2
Saltbush / Sod-formers

Figure 17. site dominated by Blue grama, Gardner's saltbush a

This plant community is the result of frequent and severe year-long grazing, which has adversely affected the mid-stature cool season grasses. Unlike other communities, the shrub component is less affected, but a change in vigor and stature will occur with continued pressure. The droughty nature of the sod is caused by a decrease of infiltration of water in response to the thick shallow mat of roots, channelizing runoff between established clumps or patches of vegetation. The density of the "patches" is smaller than seen in similar Sagebrush communities. This, with the lack of structure to hold moisture, compounded by drought can reduce the stability of the soil, making erosion a more significant problem. When compared to the Reference Plant Community (1.1), Blue grama has increased. Prickly pear cactus has invaded. All cool-season mid-stature grasses, forbs, and most shrubs have been greatly reduced. Production has been significantly decreased. The total annual production (air-dry weight) of this state is about 225 lbs./acre, but it can range from about 125 lbs./acre in unfavorable years to about 450 lbs./acre in above average years. Rangeland Health Implications/Indicators: This community is resistant to change and the removal of grazing does not seem to affect the plant composition or structure. The biotic integrity of this community is not functional and plant diversity is extremely low. The plant vigor is significantly weakened and replacement capabilities are limited due to the reduced number of cool-season grasses. The sod-bound nature of this plant community is resistant to water infiltration, however the open dissected nature of the "patches" of the site only has a minimal impact on infiltration. Sodded areas are protected by root structure, but impacts off-site areas with excessive runoff that can cause rills and gully erosion. Water flow patterns are obvious in areas of bare ground and pedestalling is apparent along the sod edges. Rill channels are noticeable in the interspaces and down slope. The

watershed may or may not be functioning, as runoff may affect adjoining sites.

Table 14. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	73	129	280
Forb	11	39	112
Grass/Grasslike	56	84	112
Total	**140**	**252**	**504**

Table 15. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0%
Litter	10-20%
Surface fragments >0.25" and <=3"	0-15%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	30-45%

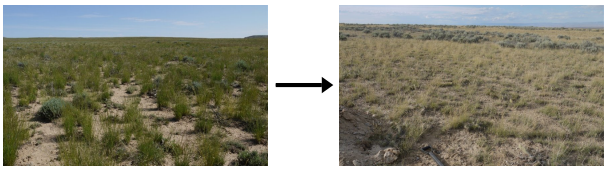
Table 16. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	5-20%	–	2-5%
>0.15 <= 0.3	–	–	–	–
>0.3 <= 0.6	–	–	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 19. Plant community growth curve (percent production by month). WY0504, 5-9 BH Upland Sites Warm Season Dominate. Monthly percentages of total annual growth based on a predominately C4 warm season plant community with shrubs and some C3 plants. Generally sod-forming community..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	15	25	45	10	0	5	0	0	0

Pathway CP2.1-2.2
Community 2.1 to 2.2



Saltbush / Bluegrass | Saltbush / Sod-formers

Frequent and severe grazing of cool season mid-grasses during the growing season, Drought - The low growing warm season grass, Blue grama, is encouraged with the high utilization of the cool season mid-stature grasses. As grazing removes Sandberg bluegrass and opens the canopy, Blue grama, if present in the system, will begin to increase within the interspaces between Gardner's saltbush plants. Drought can also work to open the canopy and to encourage Blue grama to gain dominance in this community.

Pathway CP2.2-2.1
Community 2.2 to 2.1

Saltbush / Sod-formers | Saltbush / Bluegrass

Prescribed Grazing to impact and break the sod - In extended periods of drought or with severe hoof action the sod "patchwork" of Blue grama has been interrupted or opened enough to encourage Sandberg bluegrass and Bottlebrush squirreltail recruitment. Contour furrowing or other mechanical disturbances, as well livestock hoof action (high intensity/low duration), are tools that can be implemented to encourage the mid-stature cool season grasses; however, there is the inherent risk of increased erosion and introduction of invasive species to the system. Unlike the sagebrush counter-part to this community, the Blue grama composition is more broken, and carries less of a restrictive community. Drought, and animal impact are able to open the sod more readily than in non-salt affected soils.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Native Plant Community Restoration and Management
Prescribed Grazing
Grazing Management Plan - Applied

State 3
Saltbush/Bare Ground

The management and climatic interactions that are hypothesized to have led to the Saltbush/Bare ground dominated state may not be clear cut. It is recognized that with continued pressure and drought conditions, the productivity and sustainability of most perennial grasses will decrease leaving a shrub dominated state, and that in the absence of invasive species, this community can persist on the landscape. It was documented with soil/ecological site correlation data, which many of the communities that fit this definition were found to have a heavier textured soil (Clayey or Fine). The slow infiltration and sealing potential of soils of this nature helps to clarify the plant community. There were sites, however, that were classified as fine-loamy that were dominated by this community that were a product of management and drought.

Community 3.1
Gardner Saltbush / Bare Ground

This plant community is found in areas subjected to continuous year-long grazing. Gardner’s Saltbush comprises nearly 100% of the plant community. Most cool season grasses have been eliminated or greatly reduced, and the forb component has transitioned into mostly annual weedy species. The interspaces between plants have expanded significantly leaving the amount of bare ground prevalent and the soil surface exposed to erosive elements. This open and exposed community is highly susceptible to invasion by noxious weeds such as Russian Knapweed and Halogeton. When compared to the reference state (communities 1.1 and 1.2), plant production is diminished due to the excessive amount of bare ground and lack of perennial grasses. The ability for Gardner's saltbush and grasses to respond to precipitation patterns, lead to a highly variable productivity and composition from one year to the next. Gardner's saltbush can produce over 500 pounds one year and less than 50 pounds the next year depending on when moisture is received, making determining average production difficult. Very Long-term Prescribed Grazing, Grazing Land Mechanical Treatment (with seeding possibly) may be practices that can be used to bring this community to near or similar to Reference (Community 1.1 or 1.2). Remnant populations of native perennial grasses will persist in pockets within the Gardner's saltbush, but in some instances, seeding may be required to help bring herbaceous species back to the community. No research has been located for large areas of re-vegetation, but minor success has occurred with seeding trials completed by local bentonite mining reclamation processes within the Big Horn Basin. These seeding trials were very small isolated areas and required extended periods of rest and will require long-term management to bring them back to a state that will resemble Reference. The total annual production (air-dry weight) of this state is about 175 pounds per acre, but it can range from about 60 lbs. /acre in unfavorable years to about 515 lbs./acre in above average years. Rangeland Health Indicators: This plant community is resistant to change as the stand becomes more decadent. These areas are resistant to fire due to the lack of fine fuels and the increase of bare ground between the salt-tolerant shrubs. Continued frequent and severe grazing or the removal of grazing does not seem to affect the plant composition or structure. Plant diversity is extremely low. The plant vigor is diminished and replacement capabilities are severely reduced due to the decrease in the number of cool-season grasses. Plant litter is noticeably less when compared to the reference state. Soil erosion is accelerated because of increased bare ground. Water flow patterns and pedestalling are obvious. Infiltration is reduced and runoff is increased. Rill channels may be noticeable in the interspaces and gullies may be establishing where rills have concentrated down slope.

Table 17. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	56	112	448
Forb	6	56	90
Grass/Grasslike	6	28	39
Total	**68**	**196**	**577**

Table 18. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0%
Litter	10-30%
Surface fragments >0.25" and <=3"	0-7%
Surface fragments >3"	0%
Bedrock	0%
Water	0%

Bare ground	30-50%

Table 19. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	10-20%	–	0-5%
>0.15 <= 0.3	–	–	–	–
>0.3 <= 0.6	–	–	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 21. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			15	50	20	5		10			

State 4
Invaded

The Saline Upland site has proven to be more resistant to invasion by many of the aggressive weedy species threatening the rangelands today. However, there are a few species that still present issues as more land is disturbed by development, continued drought, and shifts in use patterns. Halogeton poses the greatest threat, with Cheatgrass (Downy Brome), whitetop (hoary cress), and a variety of Knapweed and thistles holding their niches on the landscape. The persistence, resistance and resilience of specific communities within this state will be discussed further below.

Community 4.1
Saltbush / Invasives / Perennial Grasses

Figure 22. “patches” of cheatgrass (purple tints) and field p

The Saltbush/Invasives/Perennial Grasses phase has maintained a representative sample of the perennial grasses and forbs that are commonly found in the community within State 1 and State 2, with the accompanying Gardner’s Saltbush composition. The invasive species are present and hold a significant (5% or greater) composition of the landscape, and are prominent in the community (referring to large scale composition, not few isolated patches on

the landscape). Production of desired perennial species are generally reduced but the total production is maintained or elevated due to the production potential of many of the annual or invasive species. Production of this community phase will vary depending on the invasive species. Site-specific investigations will need to be completed to determine productivity and to select the growth curve that is best suited. The curve selected below is for a Cheatgrass influenced community. Rangeland Health Implications/Indicators: Plant diversity is good, but will be reduced with further transition to a more degraded phase. The plant vigor and replacement capabilities are limited but are still sustainable. Plant litter is noticeably more when compared to reference communities due to the potential biomass produced by the invasive species (species dependent). Soil erosion is variable depending on the species of invasion and the associated litter accumulation. This variability also applies to water flow patterns and pedestalling. Infiltration and runoff are unaltered, but will degraded quickly as the community shifts to a more invaded phase.

Figure 23. Plant community growth curve (percent production by month). WY0505, 5-9 BH Upland Sites, Annual Grasses Dominate. Monthly percentages of total annual growth, based on plant communities being affected by annual grasses (cheatgrass) or similar weedy species..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	25	45	5	0	0	10	5	5	0

Community 4.2
Saltbush / Invasives

Figure 24. Image capturing a Gardner Saltbush/Cheatgrass infe

This community phase is the at-risk community. As the native populations of perennial grasses and forbs become weakened, the site becomes invader driven, and is extremely difficult to improve. Gardner’s Saltbush is able to compete and maintain a strong community under a heavy infestation level, but with continued stress will continue to degrade. The system is low in resistance. Rangeland Health Implications/Indicators: This plant community is resistant to change as the stand becomes more decadent. Plant diversity is poor. The plant vigor is diminished and replacement capabilities are limited due to the reduced number of cool-season grasses. Plant litter is noticeably more when compared to reference communities due to the potential biomass produced by the invasive species (species dependent). Soil erosion is variable depending on the species of invasion and the litter accumulation thus associated. The variability of the water flow and pedestalling as well as infiltration and runoff is determined by the invasive species inhabiting the community.

Figure 25. Plant community growth curve (percent production by month). WY0505, 5-9 BH Upland Sites, Annual Grasses Dominate. Monthly percentages of total annual growth, based on plant communities being affected by annual grasses (cheatgrass) or similar weedy species..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	25	45	5	0	0	10	5	5	0

Community 4.3

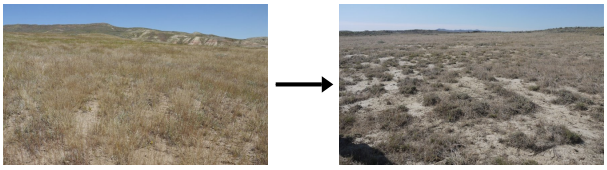
Invasives (Halogeton)

Halogeton is a common annual plant found on a variety of soils and in a wide range of climates. It is aggressive and able to take advantage of disturbed and degraded soils, out-competing other species for limited resources. It is a common species found on the alkaline soils, especially saline or sodic soils. It was thought to fill a niche until perennial natives could establish and begin to out compete for the resource. Studies completed by the University of Wyoming and partnering agencies have found that over time, Halogeton has been able to encroach in and push Gardner's saltbush out of locations. Photo point and transect data has shown that Gardner's Saltbush can fluctuate significantly with precipitation and extended periods of drought, and will recover with the return of adequate moisture events; but given time and continued pressure, the shrub component will eventually be reduced or eliminated. This was seen with grazed as well as ungrazed locations (study completed with an exclosure and photo points over time). Management solutions are still being evaluated, but it appears that grazing is not a factor affecting the movement of this species. As perennial grasses decrease and annual forbs begin to dominate a site, the niche for Halogeton to take over increases. Although chemical control is an option, success and longevity of this type of treatment is still being reviewed in this site specific situation. It is not seen as a stable state that cannot be transitioned out of without significant inputs; however it is a community that is of significant management impacts and is a concern for livestock on the landscape, especially sheep operations. Currently only small isolated areas of this site have been identified on the landscape and no production data has been collected at this time. Halogeton is known to have a wide swing of productivity based on the time and timing of precipitation for the year. Due to the toxic properties of Halogeton, and the uncertainty of production from year to year, site specific evaluation and determination of usability will need to be completed. Rangeland Health Indicators: This plant community is resistant to change. Plant diversity is poor, and vigor is diminished. Replacement capabilities are significantly reduced due to the loss of cool-season grasses. Soil erosion is generally reduced in response to the litter accumulation; however, the annual nature of this plant accentuates the water flow patterns. Infiltration is reduced and runoff is increased with the loss of perennial vegetation and root depth and density.

Figure 26. Plant community growth curve (percent production by month). WY0505, 5-9 BH Upland Sites, Annual Grasses Dominate. Monthly percentages of total annual growth, based on plant communities being affected by annual grasses (cheatgrass) or similar weedy species..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	25	45	5	0	0	10	5	5	0

Pathway CP4.1-4.2
Community 4.1 to 4.2



Saltbush / Invasives / Perennial Grasses

Saltbush / Invasives

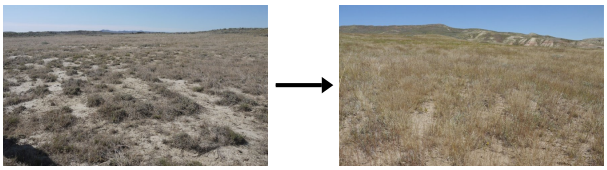
Drought, Non-Use, Disturbance, or Frequent or Severe Grazing – After crossing the threshold into an invaded state, the community will continue to degrade if disturbance or over use continues. Drought and non-use can leave soils dispersed and susceptible to invasion and loss of perennial grasses. Once an invasive species has gained a niche within a community and is able to begin to establish and propagate, the transition from the initial phase in this state to a more degraded phase may happen quickly when multiple factors are influencing the community. However, the transition can be stable and resistant to further degradation in many management situations. Proactive early detection and rapid response can be an effective tool at this stage to prevent this transition.

Pathway CP4.1-4.3
Community 4.1 to 4.3

Frequent or Severe Grazing, Major Ground Disturbance, or Non-Use with Drought – A community that has transitioned into an invaded state is at-risk of deteriorating quickly if the climatic stressor and management situation is not altered. The severity of the disturbance and the state or phase the community was in prior to the introduction of invasive species relate to the rate of degradation. Halogeton has been found to out compete and force Gardner's

saltbush out of a community under certain conditions. Once a community has lost the native herbaceous perennial vegetation, and Halogeton gains a strong foothold in the community, it will slowly move across the landscape. This pattern is seen to occur under no grazing as well as intense grazing situations. Above average or normal precipitation patterns can bring a flush of Gardner's saltbush back into an affected area, but without treatment, Halogeton will continue to become a near monoculture.

Pathway CP4.2-4.1
Community 4.2 to 4.1



Saltbush / Invasives

Saltbush / Invasives / Perennial Grasses

Integrated Pest Management with Prescribed Grazing – The native grasses displaced by the invasive species generally will persist in remnant populations within the crowns of the Saltbush or scattered in small pockets on the landscape. If a site is addressed in the preliminary stages of the transition to this phase, there is a higher likelihood that integrated pest management (weed control) and grazing management will encourage the perennial grasses to increase or persist on the landscape. But as the site continues to degrade or transition to an invasive dominated community, the ability to recover becomes more and more minimal. Halogeton maintains a more desirable community for grasses to persist. Where Cheatgrass and Knapweeds tend to overpower and remove or inhibit the perennial grasses from the system, making recovery more difficult without major inputs.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control
Grazing Management Plan - Applied

Pathway CP4.2-4.3
Community 4.2 to 4.3

Frequent and Severe Grazing, Drought, Disturbance, or Non-Use – Photo points study over a period of years in communities that were a mix of Halogeton and Gardner’s Saltbush have documented the transition to a Halogeton community. Continued season or year-long grazing pressure, severe use by wildlife and livestock, or in areas with extended drought and development disturbance will force the mixed community to a Halogeton dominated community with only a few random annual weedy species in the interspaces. The photo point studies also showed, that within ex-closures, non-use also allowed the transition to continue, and was exacerbated by drought.

Pathway CP4.3-4.1
Community 4.3 to 4.1

Long-term Prescribed Grazing with Integrated Pest Management – Considering the research statements in previous sections, given significant rest, perennial species are expected to return to the community. The time required and the degree of degradation may render this as an infeasible pathway. Ex-closure studies have shown

that a small population of natives will persist and will increase given time. But the success on achieving a significant and sustainable population to support grazing is not known at this time.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Tree/Shrub Establishment
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Livestock Use Area Protection
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control
Grazing Management Plan - Applied

Pathway CP4.3-4.2
Community 4.3 to 4.2

Integrated Pest Management with Prescribed Grazing - Research completed on these communities in Southern Wyoming has shown that when inventories are taken saltbush generally does not register as being present on the site; however, as the Halogeton is suppressed with chemical control, the saltbush will begin to show again on the landscape. It generally is not thought to be possible to completely remove Halogeton, or other invasive species, from an area. But they can be managed at a level to allow saltbush to persist.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Tree/Shrub Establishment
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Livestock Use Area Protection
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control
Grazing Management Plan - Applied

State 5
Degraded/Altered

Energy development/mining, gravel/borrow pits, farming, irrigation canals/drainage laterals, and roads are only a

few of the land uses that have had an impact on these arid, salt-affected landscapes. Much of this site is deemed unfit or non-productive; attempts to reclaim are marginal, and many attempts have failed. Historic attempts to improve productivity has altered the resilience and response pathways, affecting the site potential and stability. Specific reference will be discussed below.

Community 5.1
Disturbed Lands

Degraded or disturbed are used to label lands that have been impacted by human settlement and land use advancement. Many areas within the Big Horn Basin were farmed during settlement periods, but as water and times became difficult many homesteads were abandoned. In currant times, there are many lands that people attempt to expand irrigation out to incorporate sprinkler irrigation or other irrigation techniques but soon realize the difficulties and low productivity of these areas and abandon the project to natural processes or seeded the poorest areas to an inexpensive and readily available seed mix; with minimal or marginal success. Rangeland improvement projects were completed in the late 1950's and early 1960's by the Bureau of Land Management in conjunction with University of Wyoming. Sections of salt-affected barren landscapes were contour furrowed and seeded with predominantly Crested Wheatgrass (Agropyron Cristatum). The furrows were created to increase water holding capacity, which in turn improved vigor and production of Nuttall's or Gardner's saltbush and assisted the establishment of Crested wheatgrass. It was hypothesized that this productivity would last 20 years out from 1972. In 2014 and 2015 a few of these locations were visited across the Big Horn Basin to find only very remnant populations of Crested Wheatgrass existing, however, the furrows were still visible. Productivity variances were found negligible between treated and untreated locations. Mechanical alteration of these areas in conjunction with seeding of an introduced species carried a lasting affect to hydrology; and even though the introduced species did not persist in all locations, these sites are marked as disturbed lands, or altered from the Reference State functionality group. Given more time the furrows may completely disappear from the visual view and thus the benefits of such furrows will be decreased, but the altered hydrology will persist, and the community will not respond the same as an unaltered, natural state. Similarly, with lands that were farmed and/or irrigated, then left to return to a natural state of vegetation, they will not be the same as a reference community in response to management and natural disturbances. The persistence of an introduced, non-native species is a very indicative trait that will assist in identifying this community phase. These non-native species are not invasive, although they may be persistent and aggressive species. Crested wheatgrass, Russian wildrye, and Big bluegrass are a few cultivars that have been planted that have persisted on the landscape, altering the site. The act of seedbed preparation alone, without consideration of the original disturbance can be seen as an alteration to the soil function. The restored/reclaimed lands community phase is very similar to this concept; however, in the term restored/reclaimed the inference is "to a native or natural state pre-disturbance". With the use of introduced or improved cultivars, the site is not similar to pre-disturbance. Productivity of these sites vary greatly depending on the exact disturbance, age and successional stage of recovery from this disturbance, and then if/what species were seeded into the site. Due to the lack of current and comparative production data at this time, no estimate of production is provided. The growth curve will also depend on the species seeded, or the successional community that has established, and so no growth curve will be identified for this phase.

Community 5.2
Restored / Reclaimed Lands

When restoring (returning disturbed lands to a former, original, normal or unimpaired condition) or reclaiming (restoring to a pre-determined level of productivity or usefulness of what was there prior to a disturbance) a site within the Big Horn Basin, climatic limitations are the most limiting factor of success. However, the sodicity/salinity/alkalinity of the Saline Upland sites also causes further complication and limitation of available species. Research has been completed on improving the seedling establishment of Gardner's Saltbush and other herbaceous species in salt-affected soils. Plant Material Centers are developing cultivars of salt adaptive species to tolerate the harsh chemistry of the soils. When reviewing reclamation projects, success is very low or non-existent. Every location that was found had a high rate of annuals and only trace amounts of desired grasses and forbs. Saltbush establishment was found to be very low, but the rate of desired and planted was unknown. Production and the growth curve factors are dependent on the seeding mixtures selected and the level of establishment achieved. As with the disturbed lands, these sites are highly vulnerable to erosion and invasion by annuals or other undesirable species.

Pathway CP5.1-5.2
Community 5.1 to 5.2

Grazing Land Mechanical Treatment and/or Rangeland Seeding with Prescribed Grazing – Degraded sites may be at various levels of succession. To prepare the necessary seedbed, most locations will require soil disturbance (disking, plowing, harrowing, etc.). In some instances, contour furrow plantings similar to those completed in the 1960s by the BLM, may be a preferred practice. Whether a grazing land mechanical treatment or rangeland seeding with natives (or selected seed mix) is completed, once the seed has a chance to establish, prescribed grazing is necessary to maintain the established plant community.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Livestock Use Area Protection
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control
Grazing Management Plan - Applied

Pathway CP5.2-5.1
Community 5.2 to 5.1

No Use, Drought, Disturbances, Severe and Frequent Grazing – After a location has been reclaimed, the establishment/recovery success of the site is drastically affected by use and environmental factors. Further or continued disturbances or use before full establishment will quickly degrade the location. Non-use for extended periods of time after establishment has led to decadence and die-back of species as well. Monitoring and prescribed use is required for success.

Transition T1-2
State 1 to 2

Drought, Frequent or Severe Grazing – Extended periods of drought have the ability to weaken the plant community's resilience, forcing the community over the threshold into the next state. Drought with added stress of frequent or severe grazing can expedite the process, removing the key species leaving the site dominated by the less desirable herbaceous species. Any combination of these factors will reduce or remove the key bunchgrasses, Indian ricegrass and Bottlebrush squirreltail, and leave a Sandberg bluegrass or Blue grama dominated site.

Transition T1-3
State 1 to 3

Frequent and Severe Grazing, Severe Ground Disturbance, Drought - The combination of frequent and severe grazing, especially when drought is a factor, continues the process of decreasing the forbs and grasses within the community. The desirable herbaceous species may become very sparse or are removed leaving a saltbush dominated community. Extended long periods of drought alone, or severe ground disturbance, will remove or inhibit the sustainability of the herbaceous component of this community.

Transition T1-4
State 1 to 4

Frequent and Severe Grazing, Drought, Non-Use, or Ground Disturbance (with Seed Source Present) – Halogeton, Cheatgrass (Downy Brome), and many of the invasive weeds that are present in the Big Horn Basin are drought tolerant and able to establish in poor soils and growing conditions. The barren, open canopy that is typical with Saline Upland landscapes are a prime target for these invaders. Given any level of disturbance, whether it is from heavy and frequent grazing use, drought or other ground disturbances, if there is a seed source present, these invaders will find a niche for establishment. The dispersed nature of salt affected soils, especially in the absence of compaction by hoof action or traffic, allows for any variety of invasive species to quickly transition the reference state into an invaded state.

Restoration pathway R2-1
State 2 to 1

Long-term Prescribed Grazing – Given time and favorable conditions, Indian Ricegrass and Bottlebrush Squirreltail are able to re-establish when seed sources were within the area. With these factors, the ability for the Saltbush/Perennial Grasses state to transition back to the Saltbush/Bunchgrass state (Reference) may take a substantial amount of time, but it is able to recover with only minor inputs. When a sod-type community has established, it may take significant hoof impact or mechanical measures to break the root mats to allow other more desirable natives to establish. This ground disturbance will or can alter the hydrology and structure of the soils, preventing the improved community from responding the same to management and disturbance regimes. Studies completed on BLM lands within the Big Horn Basin in the late 1950's helped to demonstrate this concept, where contour furrows have altered the hydrology of rangelands for over 60 years.

Conservation practices

Integrated Pest Management (IPM)
Prescribed Grazing
Grazing Management Plan - Applied

Transition T2-3
State 2 to 3

Frequent and Severe Grazing, Repeated Ground Disturbance, Drought – Continued stress on the a degraded community of perennial herbaceous species with decreased diversity and resilience to changing conditions opens the transition from the Saltbush/Perennial grasses to a Saltbush/*Bare Ground* dominated community (State 3). Stressors such as over-use, repeated disturbance (recreation, mining) or prolonged drought are key triggers forcing the community over the threshold to the next State.

Transition T2-4
State 2 to 4

Drought, Ground Disturbance, Frequent or Severe Grazing or Non-use with a seed source present – The vulnerability of this state to transition to an invaded state is increased as the canopy is opened with further disturbance, drought or grazing use. No use is also a factor, because of the nature of the soils to become dispersed (loose) and open to seedling establishment. If the seed source is present (in the area), drought or abnormal precipitation patterns as well as non-use provide the opportunity for invasive species to establish. Many of the sources of disturbance (recreational vehicles, animals, and development activities provide a source to bring invasive species into an area.

Transition T3-4
State 3 to 4

Drought, Frequent or Severe Grazing, Non-Use, or Ground Disturbance with a seed source present – Once the community has transitioned into a saltbush dominated state, productivity and functionality are at risk. If further

disturbance occurs (be it from over-use, human impacts, or environmental), saltbush will begin to decrease and invasive species will increase in dominance, forcing this community to transition into an invaded state. The effect of this plant composition shift is a decrease in hydrologic function and increase in the erosional hazard within the community.

Restoration pathway R3-5
State 3 to 5

Grazing Land Mechanical Treatment or Rangeland Seeding with Prescribed Grazing - The large scale success of contour furrowing on the rangelands with a mixture of crested wheatgrass and other introduced/cultivated species has shown that this landscape can be restored to a functional community using improved varieties and selective grazing land mechanical treatments. Once established, management is required to encourage establishment and to sustain the species. Once the soil is disturbed there is a risk of erosion until seedling establishment can occur. Management of undesired species (noxious or invasive weed species) will need to be completed to ensure that the community is restored to an acceptable composition. Seedbed preparation and ground disturbance by any mechanical means will alter the soil structure and hydrology of an area, preventing the location from returning to Reference (Community Phase 1.1 and 1.2). Although, they may appear similar, post disturbance response to management is altered from reference and so is recognized as a reclaimed or restored community (State 5).

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Native Plant Community Restoration and Management
Prescribed Grazing
Grazing Management Plan - Applied

Restoration pathway R4-5
State 4 to 5

Integrated Pest Management, Grazing Land Mechanical Treatment, or Rangeland Seeding with Prescribed Grazing – Once a community has degraded to an invaded state, especially if Cheatgrass or Knapweeds are dominant; eradication is not a feasible option, preventing restoration to a Reference state. An invaded site, however, can be restored to a functional plant community through intensive and integrated pest management and grazing land mechanical treatments. Removal of or reducing existing populations and establishment of forage species that are desirable and able to tolerate/compete with the invasive species helps to improve the function of the landscape. When a community has been significantly invaded, losing all of the key grazing species, re- seeding the site to a competitive species may be the only option. Establishment will be slow and the variety of available seed sources for salt-affected soil conditions is minimal, but small scale projects have been achieved with marginal success.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)

Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Livestock Use Area Protection
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control
Agrichemical Handling Facility
Grazing Management Plan - Applied

Transition T5-4
State 5 to 4

Drought, Severe and Frequent Grazing, Ground Disturbance, or Non-Use with seed source present – Loose soils as a result of no hoof action during non-use or the decrease in key herbaceous species due to severe and frequent grazing, drought or disturbance opens the canopy and provides opportunity for invasive species to establish. With continued stress or addition of undesirable species will weaken this community even further.

Additional community tables

Table 20. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				56–140	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	56–140	10–30
2				28–84	
	squirreltail	ELEL5	*Elymus elymoides*	28–84	5–10
3				0–56	
	western wheatgrass	PASM	*Pascopyrum smithii*	22–56	0–10
	Sandberg bluegrass	POSE	*Poa secunda*	0–28	0–5
	Grass, perennial	2GP	*Grass, perennial*	0–28	0–5
	needle and thread	HECO26	*Hesperostipa comata*	0–28	0–5
Forb					
4				1–56	
	milkvetch	ASTRA	*Astragalus*	0–28	0–5
	desertparsley	LOMAT	*Lomatium*	1–28	0–5
	salsify	TRPO	*Tragopogon porrifolius*	0–28	0–5
	woodyaster	XYLOR	*Xylorhiza*	0–28	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–22	0–5
	textile onion	ALTE	*Allium textile*	0–22	0–5
Shrub/Vine					
5				84–280	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	84–280	10–40
6				0–112	
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–112	0–10
7				0–84	
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–56	0–10
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–56	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–56	0–5

Table 21. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				28–112	
	squirreltail	ELEL5	*Elymus elymoides*	28–112	5–40
2	**Miscellaneous Grasses**			11–84	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–56	0–10
	Sandberg bluegrass	POSE	*Poa secunda*	6–34	2–10
	Grass, perennial	2GP	*Grass, perennial*	0–11	0–5
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	1–11	1–5
	blue grama	BOGR2	*Bouteloua gracilis*	1–11	1–5
	needle and thread	HECO26	*Hesperostipa comata*	0–11	0–5
Forb					
3				6–56	
	textile onion	ALTE	*Allium textile*	0–28	0–5
	plains pricklypear	OPPO	*Opuntia polyacantha*	1–28	1–5
	Forb, perennial	2FP	*Forb, perennial*	0–11	0–5
	aster	ASTER	*Aster*	0–11	0–5
	desertparsley	LOMAT	*Lomatium*	0–11	0–5
	tenpetal blazingstar	MEDE2	*Mentzelia decapetala*	0–11	0–2
	tansyaster	MACHA	*Machaeranthera*	0–6	0–2
4	**Annual Forbs**			0–78	
	flatspine stickseed	LAOC3	*Lappula occidentalis*	1–78	0–5
	threadleaf phacelia	PHLI	*Phacelia linearis*	0–6	0–2
	madwort	ALYSS	*Alyssum*	0–6	0–2
Shrub/Vine					
5				84–224	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	84–224	10–25
6				0–140	
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–168	0–15
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–28	0–5
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–11	0–5
	Shrub, other	2S	*Shrub, other*	0–11	0–5

Table 22. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				0–168	
	Sandberg bluegrass	POSE	*Poa secunda*	0–56	0–30
2				0–22	
	blue grama	BOGR2	*Bouteloua gracilis*	0–22	0–5
3	**Miscellaneous Grasses**			0–28	
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–112	0–2
	mustard	BRASS2	*Brassica*	0–56	0–2
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–11	0–5
	squirreltail	ELEL5	*Elymus elymoides*	0–11	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–11	0–5
	threadleaf phacelia	PHLI	*Phacelia linearis*	0–11	0–2
	woolly plantain	PLPA2	*Plantago patagonica*	0–6	0–2
	western wheatgrass	PASM	*Pascopyrum smithii*	0–6	0–2
	Grass, perennial	2GP	*Grass, perennial*	0–6	0–2
Forb					
3	**Annual Forbs**			0–112	
	plains pricklypear	OPPO	*Opuntia polyacantha*	1–39	0–5
	desertparsley	LOMAT	*Lomatium*	0–22	0–5
	textile onion	ALTE	*Allium textile*	0–6	0–2
4				1–39	
	aster	ASTER	*Aster*	0–6	0–2
	tansyaster	MACHA	*Machaeranthera*	0–6	0–2
	woodyaster	XYLOR	*Xylorhiza*	0–6	0–2
	tenpetal blazingstar	MEDE2	*Mentzelia decapetala*	0–6	0–1
5	**Miscellaneous Forbs**			0–17	
Shrub/Vine					
7				84–392	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	78–392	5–20
8				0–112	
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–168	0–20
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–56	0–5
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–28	0–5
	Shrub, other	2S	*Shrub, other*	0–28	0–5

Table 23. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				34–112	
	blue grama	BOGR2	*Bouteloua gracilis*	34–112	10–40
2				0–22	
	squirreltail	ELEL5	*Elymus elymoides*	0–11	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	0–11	0–5
3	**Miscellaneous Grasses**			0–17	
	needle and thread	HECO26	*Hesperostipa comata*	0–28	0–5
	western wheatgrass	PASM	*Pascopyrum smithii*	0–11	0–5
	Grass, perennial	2GP	*Grass, perennial*	0–6	0–1
Forb					
4				0–56	
	desertparsley	LOMAT	*Lomatium*	0–56	0–5
	tansyaster	MACHA	*Machaeranthera*	0–11	0–5
	textile onion	ALTE	*Allium textile*	0–11	0–5
5	**Miscellaneous Forbs**			0–28	
	Forb, perennial	2FP	*Forb, perennial*	0–28	0–5
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–28	0–5
	woodyaster	XYLOR	*Xylorhiza*	0–28	0–5
6	**Annual Forbs**			0–28	
	Forb, annual	2FA	*Forb, annual*	0–28	0–5
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–28	0–5
	threadleaf phacelia	PHLI	*Phacelia linearis*	0–28	0–5
Shrub/Vine					
7				56–280	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	56–280	5–20
8				0–112	
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–112	0–10
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–28	0–5
	Shrub, other	2S	*Shrub, other*	0–11	0–5

Table 24. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				0–17	
	squirreltail	ELEL5	*Elymus elymoides*	0–11	0–5
	western wheatgrass	PASM	*Pascopyrum smithii*	0–11	0–2
	alkali sacaton	SPAI	*Sporobolus airoides*	0–6	0–1
2	**Miscellaneous Grasses**			0–28	
	Sandberg bluegrass	POSE	*Poa secunda*	0–22	0–5
	needle and thread	HECO26	*Hesperostipa comata*	0–11	0–2
	Grass, perennial	2GP	*Grass, perennial*	0–6	0–2
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–6	0–2
	blue grama	BOGR2	*Bouteloua gracilis*	0–6	0–2
Forb					
3	**Perennial Forbs**			0–56	
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–39	0–3
	Forb, perennial	2FP	*Forb, perennial*	0–11	0–2
	textile onion	ALTE	*Allium textile*	0–6	0–2
	tansyaster	MACHA	*Machaeranthera*	0–6	0–2
	woodyaster	XYLOR	*Xylorhiza*	0–6	0–2
	desertparsley	LOMAT	*Lomatium*	0–6	0–1
	aster	ASTER	*Aster*	0–2	0–1
4	**Annual Forbs**			0–34	
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–112	0–5
	woolly plantain	PLPA2	*Plantago patagonica*	0–11	0–2
	threadleaf phacelia	PHLI	*Phacelia linearis*	0–6	0–2
	Forb, annual	2FA	*Forb, annual*	0–6	0–2
	mustard	BRASS2	*Brassica*	0–6	0–2
Shrub/Vine					
5				84–420	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	84–420	0–20
6				0–84	
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–112	0–10
	Shrub, other	2S	*Shrub, other*	0–11	0–2
	seepweed	SUAED	*Suaeda*	0–2	0–1

Animal community

Animal Community – Wildlife Interpretations

1.1 - Saltbush/Bunchgrasses: The predominance of woody plants in this plant community provides winter grazing for mixed feeders, such as elk, an antelope. Suitable thermal and escape cover for these animals are limited due to the low quantities of tall woody plants. When found adjacent to sagebrush-dominated states, this plant community may provide lek sites for sage grouse. Other birds that would frequent this plant community include western meadowlarks, horned larks, and golden eagles. Some grassland obligate small mammals would occur here.

1.2 - Saltbush/Squirreltail: The combination of shrubs, grasses, and forbs can provide a forage source for large

grazers, such as wild horses, deer and antelope. Suitable thermal and escape cover for these animals is limited due to the low quantities of tall woody plants. When found adjacent to sagebrush dominated states, this plant community may provide lek sites for sage grouse. Other birds that would frequent this plant community include western meadowlarks, horned larks and golden eagles. Some grassland obligate small mammals would occur here.

2.1 - Saltbush/Bluegrass: Decreased diversity and change in phenology of grasses and forbs reduces the value for the large grazers, but still has a forage source for them. Thermal and Escape cover suitable for large animals is still very limited due to the low quantities of tall woody plants. Areas with sagebrush-dominated states adjacent to this plant community may provide lek sites for sage grouse, and in productive years provides better cover for birds and some of the grassland obligate small mammals.

2.2 - Saltbush/Sod-formers: Forage value for large grazers has shifted to provide a late spring early summer source of green forage, although less accessible due to low growth stature. Cover is essentially non-existent, but when adjacent to sagebrush-dominated states, this plant community provides lek sites for sage grouse.

3.1 - Saltbush/*Bare Ground*: This Plant community exhibits a low level of plant species diversity. It may have forage value for antelope and deer, but in most cases is not a desirable plant community due to the lack of cover and selectivity by the wildlife. It is not, for most cases, a desirable plant community to select as a wildlife habitat management objective. Due to the open and exposed nature of this community, it may be a location for sage grouse leks, if there is edge effect provided by a sagebrush site surrounding the saltbush community.

4.1 - Perennial Grasses/Invasives/Saltbush: The unpalatable nature of many of the invasive species would reduce the value of this plant community for large grazers; however, there would still be forage available depending on the forage composition. Suitable thermal and escape cover is very limited and highly variable. Seeds from invasive species would serve as a forage source for sage grouse and other birds as well as small mammals.

4.2 - Invasives/Saltbush: This plant community exhibits a low level of plant species diversity. It is not a desirable plant community to select as a wildlife habitat management objective. However, seeds produced by many of the invasive species serve as a forage source for sage grouse and other birds as well as grassland obligate small mammals. Knapweeds provide good cover for small mammals and birds as well.

4.3 - Halogeton: This plant community exhibits a low level of plant species diversity. It is not a desirable plant community to select as a wildlife habitat management objective. No known benefit to wildlife is known.

5.1 - Disturbed/Restored/Reclaimed: Depending on the stage of succession of these sites or the selected seed mixture planted, locations may vary widely on value for wildlife habitat management.

Animal Community – Grazing Interpretations

The following table lists suggested stocking rates for cattle under continuous season-long grazing with normal growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Often, the current plant composition does not entirely match any particular pant community (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. Under more intensive grazing management, improved harvest efficiencies can result in an increased carrying capacity. If distribution problems occur, stocking rates must be reduced to maintain plant health and vigor.

The Carrying capacity is calculated as the production for a normal year X .25 efficiency factor / 912.5 #/AUM to calculate the AUM's/Acre.

Plant Community Production
Plant Community Description/Title Lbs./Acre AUM/Acre*
Below Ave. Normal Above Ave.
1.1 Reference: Saltbush / Bunchgrasses 230 450 700 0.12
1.2 Saltbush / Squirreltail 155 360 575 0.10
2.1 Saltbush / Bluegrass 100 300 750 0.08
2.2 Saltbush / Blue Grama 125 225 450 0.06

3.1 Saltbush / *Bare Ground* 60 175 515 0.05
4.1 Saltbush / Annuals / Perennial Grasses ** ** ** **
4.2 Saltbush / Annuals ** ** ** **
4.3 Halogeton ** ** ** **
5.1 Disturbed/Degraded ** ** ** **
5.2 Restored/Reclaimed ** ** ** **

* - Continuous, Season-long grazing by cattle under average growing conditions.
** - Production and Carrying Capacity is dependent on the species mixture that is present and the stage of succession that each community is at. Site specific investigation is necessary due to the highly variable composition.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide year-long forage for cattle, sheep, or horses. Supplementation of livestock may be necessary during the dormant season (protein/minerals) if the quality does not meet minimum livestock requirements.

Distance to water, terrain, slope/slope length, access, shrub density, fencing, and management can affect carrying capacity (grazing capacity) within a management unit as well as kind, class, and breeds of livestock. Adjustments should be made for the area that is considered necessary for reduction of animal numbers. For example, 30% of a management unit may have 25% slopes and distances of greater than one mile from water; therefore, the adjustment is only calculated for 30% of the unit (i.e. 50% reduction on 30% of the management unit).

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group B and C, with localized areas in hydrologic group D. Infiltration ranges from moderately slow to moderate. Runoff potential for this site varies from low to moderate depending on soil hydrologic group and ground cover. In many cases, areas with greater than 75% 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% have the greatest potential to have reduced infiltration and higher runoff (refer to Part 630, NRCS National Engineering Handbook for detailed hydrology information).

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 1-2% of the soil surface.

Recreational uses

This site provides marginal hunting opportunities for upland game species. Because of the raw nature of these sites, cultural artifacts can be found or viewed in the area, especially along the drainages that typically dissect these landforms. The extent of this ecological site is found within three different wild horse ranges: Pryor Mountain, McCullough Peaks, and 15 Mile. Wild Horse/Wildlife Excursions are found as recreational venues for BLM lands and State lands within the Big Horn Basin. This ecological site, however, proves to be limited in association with roadways and trails in relation to erosion potential and functionality. The soils will be sticky or slick when wet and

are more erosive than other associated ecological sites. Need to take these soils into consideration when crossing the area with trails or roadways. The site is generally rough and provides no soft cover for camping or resting.

Wood products

No appreciable wood products are present on the site.

Other products

Herbs: There are a select few forb species that are found on this site, that have medicinal characteristics and have ben used by the Native Americans in
this area, and currently are in use by the naturopathic profession.

Ornamentals Species: The flowering forbs of this site have been found useful in landscaping and xeriscaping. The shrub component has cultivated species that have been used in conservation plantings and in more natural landscaping schemes.

Inventory data references

Information presented here has been derived from NRCS inventory data, Field observations from range trained personnel, and the existing range site descriptions. Those involved in developing the Loamy range site include: Chris Krassin, Range Management Specialist, NRCS and Everet Bainter, Range Management Specialist. Those involved in the development of the Saline Upland Loamy Ecological site include: Ray Gullion, Area Range Management
Specialist, NRCS; Jim Wolf, Resource Manager, USDI-BLM; Jack Mononi, Range Management Specialist, USDI-BLM; Daniel Wood, MLRA Soil Survey Leader, NRCS; Jane Karinen, Soil Data Quality Specialist, NRCS; and Marji Patz, Ecological Site Specialist, NRCS.

Data references were taken from the following publication:
H.G. FIsser, D.C. Trueblood, and D.D. Samuelson. 1979. "Soil-Vegetation Relationships on Rangeland Exclosures in the Grass Creek Planning Unit of North Central Wyoming". University of Wyoming Cooperative Research Report to the Bureau of Land Management. 280 pp.

Type locality

Location 1: Park County, WY	
Township/Range/Section	T52N R99W S10
UTM zone	N
UTM northing	4930049.16
UTM easting	679910.268
Latitude	44° 30′ 4″
Longitude	108° 44′ 12″
General legal description	162m W, 55m S of NE corner of Sec. 10. Travel 17 mi E of Cody, WY on Hwy 14 (Greybull Highway). Turn N on BLM Access road, travel 1.9 mi NW. Site is 175m W of access road.

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Approval

Scott Woodall, 2/22/2019

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)	Marji Patz, Ray Gullion, Everet Bainter
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Date	02/23/2015
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rare to non-existent. Where present, short and widely spaced.

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2. **Presence of water flow patterns:** Barely observable.

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3. **Number and height of erosional pedestals or terracettes:** Not evident on slopes less than 9%, but erosional pedestals will be present with terracettes at debris dams on slopes greater than 9%.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground will range from 25 to 45%, occurring as small openings between plants.

5. **Number of gullies and erosion associated with gullies:** Active gullies should not be present, except in concentrated water flow pattern zones on steeper slopes (>9% slope).

6. **Extent of wind scoured, blowouts and/or depositional areas:** Minimal to non-existent.

7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous litter movement expected to move only small amounts (to leeward side of shrubs) due to wind. May see minor litter damming between shrubs on steeper slopes along water flow areas.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability index ratings average at 4.7 in the interspaces, and 5.2 under plant canopy. Average values should be 4.0 or greater.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Typically the surface is comprised of an A-Horizon of 1-6 inches (2-15 cm) wit h medium platy structure parting to granular structure and color hues of 10YR or 5Y, values of 5-7 and chromas of 2-4. In some soils a shallow E-Horizon of 1-3 inches (2-7 cm) with a weak platy structure parting to granular structure that is grayish brown (i.e 2.5Y 5/2) will replace the A-Horizon. Organic matter typically ranges from 0.5-2%.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The evenly distributed, clustered plant community provides 30-60% foliar cover, with minimal basal footprint. The tendency for the surface to seal slows infiltration rates and results in slight to moderate runoff. The lack of basal cover (less than 5%) does little to effect runoff from this site.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer exists, but some soil crusting in dry conditions is typical. The soil structure may appear platy in nature due to the dispersion of particles from salts in the soil. The caps of the natric horizon may be platy parting to granular structure, and could be mistaken as a compaction layer.

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: Low Growing Perennial Shrubs > Mid-stature Grasses

    Sub-dominant: Mid-stature Grasses > Perennial Forbs

    Other: Forbs = Short-stature Grasses

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal or very low incidence of decadence is expected, but minor loss is seen.

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14. **Average percent litter cover (%) and depth (in):** Litter ranges from 5-25% of total canopy cover with the total litter (including beneath the plant canopy) from 15-35%. Herbaceous litter depth is typically shallow ranging from 2-7 mm. Woody litter depth ranges from from .1 to 0.5 of an inch (0.25-1.25 cm).

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** The average total above ground production on a normal year is 475 lbs./acre (532 kg/ha); ranging from 275 to 700 lbs/acre (308-785 kg/ha) in poor to above average years.

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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:** Birdfoot sagebrush, Greasewood, Sandberg bluegrass, Woolly Plantain, native annual mustards and pepperweeds and a variety of other native annual forbs will invade the site as it degrades. Invasive species that are common include but are not limited to: Halogeton, Cheatgrass, Knapweeds (Russian and Spotted have been located) and a variety of thistles. For a current and more complete list consult the County and State Weed and Pest Noxious Weed List.

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17. **Perennial plant reproductive capability:** All species are capable of reproducing, but are limited due to effective soil moisture and seed/soil contact. The lack of perennial canopy with the dispersal tendencies of the soil create a crusting effect from rain drop impact/wetting and drying of the soil. The cracking of these soils as they dry provide small areas for seeds to catch and germinate. Drought inhibits seed viability as well as reduces the root propagation potential.
