Ecological site R047XA301UT
Upland Clay Loam (early sagebrush)

Accessed: 04/26/2024

General information

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

Associated sites

R047XA308UT	**Upland Loam (basin big sagebrush)** This site is typically geographically located both upslope and downslope from R047XA301UT.
R047XA320UT	**Upland Shallow Loam (Wyoming big sagebrush)** This site is typically geographically located both upslope and downslope from R047XA301UT.

Similar sites

R047XA316UT	**Upland Shallow Loam (black sagebrush)** This site has a very similar plant community throughout. It is often hard to decipher the difference between early sagebrush and black sagebrush. In addition both communities are positioned on very similar landforms.
R047XA302UT	**Upland Clay (low sagebrush)** This site has a very similar plant community throughout. It is often hard to decipher the difference between early sagebrush and little sagebrush.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia arbuscula ssp. longiloba*
Herbaceous	(1) *Pascopyrum smithii* (2) *Pseudoroegneria spicata*

Physiographic features

This site is found on south, west, and east-facing mountainsides at elevations between 6,000 and 7,200 feet. Slopes range from 4 to 50 percent. Runoff is medium to very high and neither flooding nor ponding occurs on this site.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope (2) Hill
Flooding frequency	None
Ponding frequency	None
Elevation	6,000–7,200 ft
Slope	4–50%
Aspect	E, S, W

Climatic features

The climate of this site is characterized by cold, snowy winters and cool, dry summers. The average annual precipitation ranges from 14 to 17 inches, but in a few instances is as high as 20. June is commonly the driest month in precipitation. Annual distribution varies from 20 to 45% during the plant growth period, May to October. The effective moisture for plant growth is the 55 to 80 percent that falls during the plant dormant period.

Table 3. Representative climatic features

Frost-free period (average)	115 days
Freeze-free period (average)	149 days
Precipitation total (average)	17 in

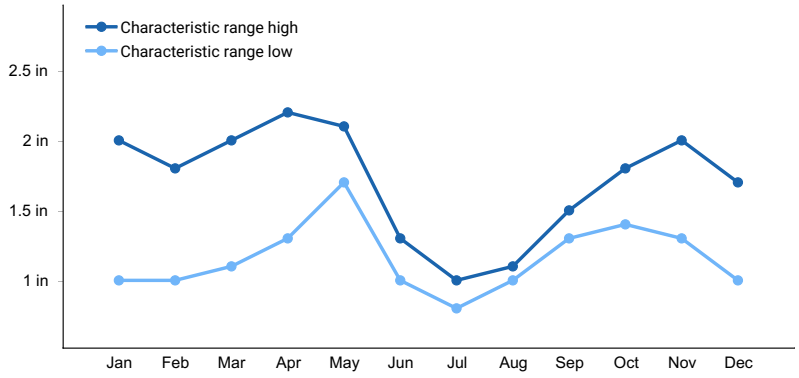

Figure 1. Monthly precipitation range

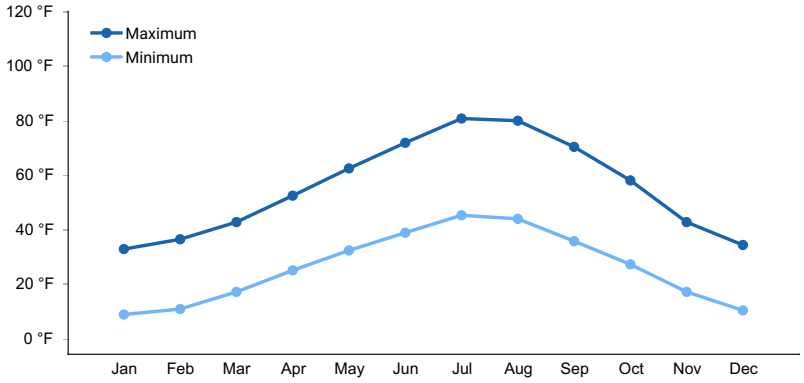

Figure 2. Monthly average minimum and maximum temperature

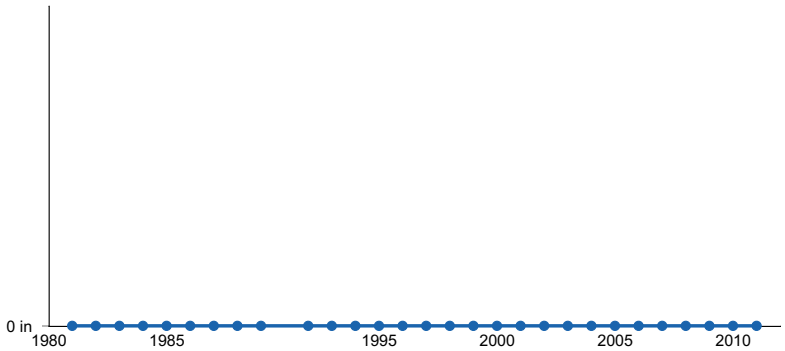

Figure 3. Annual precipitation pattern

Influencing water features

Due to its landscape position, this site is not typically influenced by streams or wetlands.

Soil features

The soil of this site formed in colluvium and alluvium derived from shale and sandstone. They are moderately deep to deep, well-drained and moderately-slowly permeable. The surface layer is a dark reddish-brown loam about 5 inches thick. The subsoil is a reddish-brown clay loam about 36 inches thick, over soft weathered sandstone. The available water-holding capacity ranges from 6.6 to 7.0 inches of water in the upper 40 inches of soil. Rock fragments are not common on the soil surface or throughout the profile. The soil moisture regime is aridic xeric and the soil temperature regime is frigid. This soil has been mapped in the Summit Area soil survey, Econ soil map unit.

Table 4. Representative soil features

Parent material	(1) Alluvium–sandstone and shale
Surface texture	(1) Loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Moderately slow
Soil depth	40–60 in
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	6.6–7 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.6–7.8
Subsurface fragment volume <=3" (Depth not specified)	0–4%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

It is impossible to determine in any quantitative detail the reference state for this ecological site because of the lack of direct historical documentation preceding all human influence. In some areas, the earliest reports of dominant plants include the cadastral survey conducted by the General Land Office, which began in the late 19th century for this area (Galatowitsch 1990). However, up to the 1870s the Shoshone Indians, prevalent in northern Utah and neighboring states, grazed horses and set fires to alter the vegetation for their needs (Parson 1996). In the 1860s, Europeans brought cattle and horses to the area, grazing large numbers of them on unfenced parcels year-long (Parson 1996). Itinerant and local sheep flocks followed, largely replacing cattle as the browse component increased.

Below is a State and Transition Model diagram to illustrate the “phases” (common plant communities), and “states” (aggregations of those plant communities) that can occur on the site. Differences between phases and states depend primarily upon observations of a range of disturbance histories in areas where this ESD is represented. These situations include grazing gradients to water sources, fence-line contrasts, patches with differing dates of fire, herbicide treatment, tillage, etc. Reference State 1 illustrates the common plant communities that probably existed just prior to European settlement.

The major successional pathways within states, (“community pathways”) are indicated by arrows between phases.

“Transitions” are indicated by arrows between states. The drivers of these changes are indicated in codes decipherable by referring to the legend at the bottom of the page and by reading the detailed narratives that follow the diagram. The transition between Reference State 1 and State 2 is considered irreversible because of the naturalization of exotic species of both flora and fauna, possible extinction of native species, and climate change. There may have also been accelerated soil erosion.

When available, monitoring data (of various types) were employed to validate more subjective inferences made in this diagram. See the complete files in the office of the State Range Conservationist for more details.

The plant communities shown in this State and Transition Model may not represent every possibility, but are probably the most prevalent and recurring plant communities. As more monitoring data are collected, some phases or states may be revised, removed, and/or new ones may be added. None of these plant communities should necessarily be thought of as “Desired Plant Communities.” According to the USDA NRCS National Range & Pasture Handbook (USDA-NRCS 2003), Desired Plant Communities (DPC’s) will be determined by the decision-makers and will meet minimum quality criteria established by the NRCS. The main purpose for including descriptions of a plant community is to capture the current knowledge at the time of this revision.

State and transition model

Ecosystem states

1. Reference State

2. Early Sagebrush/ Introduced Herb State

3. Disturbed State

State 1 submodel, plant communities

1.1. Reference State

State 2 submodel, plant communities

2.2. Early Sagebrush/ Introduced Herb State

State 3 submodel, plant communities

3.3. Disturbed State

State 1
Reference State

Community 1.1
Reference State

The Reference State is a description of this ecological site just prior to Euro-American settlement but long after the arrival of Native Americans. The description of the Reference State was determined by NRCS Soil Survey Type Site Location information and familiarity with rangeland relict areas where they exist. The Reference State for this site would have been a shrub steppe characterized by early sagebrush (*Artemisia arbuscula* spp. longiloba) and associated native perennial forbs and grasses. A more complete list of species by lifeform for the Reference State is available in the accompanying tables in the “Plant Community Composition by Weight and Percentage” section of this document. Community Phase 1.1: early sagebrush/ native perennial herbs This plant community would have been a shrub steppe characterized by early sagebrush and associated native perennial herbs. The primary perennial grasses would have included western wheatgrass (*Pascopyrum smithii*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), Indian ricegrass (*Achnatherum hymenoides*), and needle-and-thread (*Hesperostipa comata*). Common forbs would have included shortstem buckwheat (*Eriogonum brevicaule*), Tolmie’s owl’s-clover (*Orthocarpus tolmiei*), Cushion phlox (Phlox spp.), and longleaf phlox (*Phlox longifolia*). T1.1-2.1: Transition from State 1 to State 2 (Reference State to Early Sagebrush/ Introduced Herb State) The simultaneous introduction of exotic species, both plants and animals, and possible extinctions of native flora and fauna, along with climate change, has caused State 1 to transition to State 2. Reversal of such historic changes (i.e. a return pathway) back to State 1 is not practical.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	350	425	550
Shrub/Vine	350	425	500
Forb	45	115	185
Total	**745**	**965**	**1235**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	35-40%
Grass/grasslike foliar cover	18-20%
Forb foliar cover	4-6%
Non-vascular plants	0%
Biological crusts	5-7%
Litter	8-10%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%

Bare ground	8-10%

Table 7. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	–	–
>0.5 <= 1	–	–	–	4-6%
>1 <= 2	–	–	24-26%	–
>2 <= 4.5	–	34-36%	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

State 2
Early Sagebrush/ Introduced Herb State

Community 2.1
Early Sagebrush/ Introduced Herb State

Figure 6. State 2

State 2 is very similar to State 1 in form and function, with the exception of the presence of exotic plants and animals, possible extinctions of native species, and a different climate. State 2 is a description of the ecological site shortly following Euro-American settlement. This state can be regarded as the current potential. State 2 is dominated by early sagebrush and associated native perennial herbs with a small component of introduced species

such as cheatgrass (*Bromus tectorum*) and Russian thistle (Salsola spp). The primary perennial grasses include western wheatgrass (*Pascopyrum smithii*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), Indian ricegrass (*Achnatherum hymenoides*), needle-and-thread (*Hesperostipa comata*), Smooth brome (*Bromus inermis*), and Sandberg's bluegrass (*Poa secunda*). Common forbs include shortstem buckwheat (*Eriogonum brevicaule*), Tolmie's owl's-clover (*Orthocarpus tolmiei*), and longleaf phlox (*Phlox longifolia*). The resiliency of this State is maintained by a healthy, productive, and diverse plant community that can provide native seed sources and promotes soil stability, water infiltration, and soil moisture retention. The resiliency of this state will be negatively impacted by continued heavy growing season livestock grazing. Mechanical or chemical shrub control or prescribed burning is not recommended because high soil erosiveness and poor biological and economic responses, especially on steep slopes. This site should be reseeded with native perennial herbs quickly after fire or mechanical disturbances. Community Phase 2.1: early sagebrush/ bunch and rhizomatous grasses co-dominant This plant community is characterized by early sagebrush and native perennial herbs. Some non-native herbaceous species such as cheatgrass may be present. The phase is fully functioning as it relates to soil & site stability, hydrologic function and biotic integrity. This phase represents a relatively equal abundance of rhizomatous and bunch grasses. Community Pathway 2.1-2.2: This pathway is triggered when the site is exposed to heavy continued season-long grazing by livestock and big game (elk). Community Phase 2.2: Early sagebrush with depleted understory/rhizomatous grasses greater than bunch grasses This plant community is characterized by increasing dominance of larger, older shrubs, and rhizomatous grasses becoming more dominant than the bunch grasses due to the bunch grasses being more susceptible to grazing. Soil erosion is accelerated because of increased bare ground, water flow patterns and pedestals become more abundant. Although the overall functionality of the site is still intact, it is at risk with further degradation. Community Pathway 2.2-2.1: This pathway is triggered when the site is restored due to the implementation of prescribed grazing. Community Pathway 2.1-2.3: This pathway is triggered when the site is protected from grazing and/or fire. Community Phase 2.3: This plant community is characterized by increasing dominance of larger, older shrubs, and bunch grasses becoming more dominant than rhizomatous grasses. With the plant interspaces becoming larger from the reduction of rhizomatous grasses, soil erosion may accelerate because of the increased bare ground. Water flow patterns and pedestals become more abundant. Although the overall functionality of the site is still intact, it is at risk with further degradation. Community Pathway 2.3-2.1: This pathway is triggered when the site is restored due to the implementation of management practices such as prescribed grazing. Community Pathway 2.1-2.4: This pathway is triggered when the site has brush management applied (chemical, mechanical, or fire). Community Phase 2.4: This Phase will have a significantly reduced sagebrush composition that has shifted to a native and/or introduced herbaceous species dominated site. Depending on the health/vigor of the understory herbaceous species, a rangeland seeding may be necessary. Community Pathway 2.4-2.1: This Phase (2.4) will be re-invaded by sagebrush at a rate dependent upon levels of grazing use and climatic conditions. T2-3.1: Transition from State 2 to State 3 (Early Sagebrush/Introduced Herbaceous Species/Disturbed State) This transition occurs when the site experiences a disturbance such as the use of excavation equipment.

State 3
Disturbed State

Community 3.1
Disturbed State

Figure 7. State 3

State 3: Disturbed State Due to extent of the disturbance, this site has become extremely susceptible to accelerated erosion due to the complete loss of the vegetative community. Community Phase 3.1: This Phase is dominated by native and/or introduced grasses and forbs that used in the reclamation process. Community Pathway 3.1-3.2: This Pathway occurs in this State when over time through natural succession along with utilizing prescribed grazing or non-use. Community Phase 3.2: This Phase occurs on sites that overtime have sagebrush moving back into them. The Phase is characterized by still being dominated by perennial herbaceous vegetation with a minor component of early sagebrush recolonizing the site. Community Pathway 3.2-3.1: By implementing brush management or through natural or prescribed fire, this Phase (3.2) will return to Phase 3.1.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Shrub/Vine					
0	**Dominant Shrubs**			300–390	
	little sagebrush	ARARL	*Artemisia arbuscula ssp. longiloba*	300–390	–
3	**Sub-Dominant Shrubs**			60–120	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	20–100	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	10–29	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	10–20	–
	spineless horsebrush	TECA2	*Tetradymia canescens*	10–20	–
	yellow rabbitbrush	CHVIV4	*Chrysothamnus viscidiflorus ssp. viscidiflorus var. viscidiflorus*	10–20	–
Grass/Grasslike					
0	**Dominant Grasses**			245–320	
	western wheatgrass	PASM	*Pascopyrum smithii*	95–175	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	95–130	–
	squirreltail	ELEL5	*Elymus elymoides*	55–75	–
1				140–180	
	Grass, perennial	2GP	*Grass, perennial*	140–180	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	20–40	–
	needle and thread	HECO26	*Hesperostipa comata*	20–40	–
Forb					
2	**Sub-Dominant Forbs**			70–150	
	Forb, annual	2FA	*Forb, annual*	20–50	–
	Forb, perennial	2FP	*Forb, perennial*	20–50	–
	Wyoming Indian paintbrush	CALI4	*Castilleja linariifolia*	5–10	–
	shortstem buckwheat	ERBR5	*Eriogonum brevicaule*	5–10	–
	Tolmie's owl's-clover	ORTO	*Orthocarpus tolmiei*	5–10	–
	low beardtongue	PEHU	*Penstemon humilis*	5–10	–
	longleaf phlox	PHLO2	*Phlox longifolia*	5–10	–

Animal community

This site provides well-balanced nutritious forage for livestock during spring, summer, and fall.
The potential is very poor for openland habitat, fair for woodland habitat, very poor for wetland habitat, and fair for

rangeland habitat.

Hydrological functions

The soils in this site are in b and c hydrologic groups. When the vegetation is in good condition the hydrologic curves are 74 to 61.

Recreational uses

This site has fair values for aesthetics and natural beauty. Hunting is fair for deer, antelope, upland game, and rabbits.

Wood products

None, except for some firewood for campfires.

Other references

Galatowitsch, S.M. 1990. Using the original land survey notes to reconstruct pre-settlement landscapes in the American West. Great Basin Naturalist: 50(2): 181-191. Keywords: [Western U.S., conservation, history, human impact]

Parson, R. E. 1996. A History of Rich County. Utah State Historical Society, County Commission, Rich County, Utah. Keywords: [Rich County, Utah, Historic land use, European settlements]

USDA-NRCS. 2003. National Range and Pasture Handbook. in USDA, editor, USDA-Natural Resources Conservation Service-Grazing Lands Technology Institute. Keywords: [Western US, Federal guidelines, Range pasture management]

Web Soil Survey, Official Soil Series Descriptions. Available at: http://soils.usda.gov/technical/classification/osd/index.html. Accessed 19 June 2009.

Contributors

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Rangeland health reference sheet

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

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Date	10/17/2012
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None to very few. Some very minor rill development may occur on steeper slopes (>15%) or on areas located below exposed bedrock or other water shedding areas where increased runoff may occur. Any rills present should be <1 inch deep, fairly short (<6 feet long) and somewhat widely spaced (8-10 feet). Minor rill development may be observed following major thunderstorm or spring runoff events, but they should heal during the next growing season.

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2. **Presence of water flow patterns:** Slight. Some very minor evidence of water flow patterns may be found around perennial plant bases. They show little evidence of current erosion. They are expected to be somewhat short (3-6 feet), stable, sinuous and not connected. There may also be very minor evidence of deposition. Evidence of water flow may increase somewhat with slope.

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3. **Number and height of erosional pedestals or terracettes:** None to Slight. Perennial vegetation shows little evidence of erosional pedestalling (2 to 3% of individual plants). Plant roots are covered and litter remains in place around plant crowns. Terracettes should be absent or, if present, stable. A slight increase in both pedestal and terracette development may occur with increasing slope.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 10-15% bare ground. Soil surface is typically covered by <5% coarse fragments. Bare ground spaces should not be greater than 2 to 3 feet in diameter and should not be connected.

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5. **Number of gullies and erosion associated with gullies:** None to rare. Rare gullies may be present in landscape settings where they transport runoff from areas of greater water flow such as exposed bedrock. These gullies will be limited to slopes exceeding 20% slope and adjacent to sites where this runoff accumulation occurs. Any gullies present should show little sign of accelerated erosion and should be stabilized with perennial vegetation.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None. No evidence of wind generated soil movement is expected.

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7. **Amount of litter movement (describe size and distance expected to travel):** Most litter resides in place with some redistribution caused by water movement. Minor litter removal may occur in flow channels with deposition occurring within 1 to 2 feet at points of obstruction. The majority of litter accumulates at the base of plants. Some grass leaves and small twigs (grass stems) may accumulate in soil depressions adjacent to plants. Woody stems are not likely to move. However, some litter movement is expected (up to 6 feet) with increases in slopes >10% and/or increased runoff resulting from heavy thunderstorms.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** This site should have a soil stability rating of 4 or 5 under the plant canopies, and a rating of 3 to 4 in the interspaces. The average rating should be a 4. Soil surface texture is typically a loam.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** (Econ) Soil surface 0-2 inches. Texture is a loam; color is dark brown (7.5YR 4/4); structure is moderate fine platy parting to

moderate fine granular. Ochric epipedon ranges to 5 inches. Use the specific information for the soil you are assessing found in the published soil survey to supplement this description.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The heavy loam surface texture and clay within the soil profile provide a runoff surface that will normally reduce infiltration in all but gentle storms and slow snowmelt. Perennial vegetation produces sufficient cover and spatial arrangement to intercept most raindrops and reduce raindrop splash erosion. Litter on soil surface and biological soil crusts, where present, also protects soil from splash erosion and encourages a higher rate of infiltration. Good plant spatial distribution should slow runoff, allowing additional time for infiltration. Bare spaces are expected to be small and irregular in shape and are usually not connected. Vegetative structure is usually adequate to capture snow and ensure that snowmelt occurs in a controlled manner, allowing maximum time for infiltration, and reducing runoff and erosion in all but the most extreme storm events. When perennial grasses and shrubs decrease due to natural events including drought, insect damage, etc., which reduce ground cover and increasing bare ground, runoff is expected to increase and any associated infiltration reduced.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. This site has a well developed argillic horizon beginning at 5 inches that should not be mistaken for a compaction laver.

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Sprouting shrubs (alkali sagebrush, green rabbitbrush), > Rhizomatous grasses (western wheatgrass), Perennial bunchgrasses (bluebunch wheatgrass, bottlebrush squirreltail).

    Sub-dominant: Other perennial bunchgrasses (Indian ricegrass, needle-and-thread >> Shrubs (winterfat) >> Perennial forbs (tolmie owlclover).

    Other: Perennial and annual forbs can be expected to vary widely in their expression in the plant community based upon departures from average growing conditions.

    Additional: Natural disturbance regimes include fire, drought, and insects. Assumed fire cycle of 50 to 60+ years. Functional/structural groups may appropriately contain non-native species if their ecological function is the same as the native species in the reference state. Following a disturbance such as fire, drought, rodents or insects that remove woody vegetation, forbs and perennial grasses (herbaceous species) may dominate the community for a period of time. If a disturbance has not occurred for an extended period of time, woody species may continue to increase. These conditions would reflect a functional community phase within the reference state.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** All age classes of perennial grasses should be present under average to above average growing conditions with age class expression likely subdued during periods of extended drought. Slight decadence in the principle shrubs could occur near the end of the fire cycle or during periods of extended drought, or insect infestations. In general, a mix of age classes should be expected with some dead and decadent plants present.

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14. **Average percent litter cover (%) and depth (in):** Litter cover will be heavier under plants. Most litter will be herbaceous and depths of 1/2 to 3/4 inch would be considered normal. Perennial vegetation should be well distributed

on the site.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Annual production in air-dry herbage should be approximately 850 - 950#/acre on an average year, but could range from 650 to 1200#/acre during periods of prolonged drought or above average precipitation.

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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:** Cheatgrass, halogeton, Russian thistle, Utah juniper, alyssum, & mustard species.

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17. **Perennial plant reproductive capability:** All perennial plants should have the ability to reproduce in all years, except in extreme drought years. Green rabbitbrush sprouts vigorously following fire. There are no restrictions on either seed or vegetative reproduction. Some seedling recruitment of major species is present during average and above average growing years.
