USDA Natural Resources
Conservation Service

Ecological site R034AA223UT
Semi-desert Silt Loam (Wyoming big sagebrush/ Bluebunch wheatgrass)

Last updated: 2/21/2025
Accessed: 05/10/2025

General information

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

MLRA notes

Major Land Resource Area (MLRA): 034A–Cool Central Desertic Basins and Plateaus

Major Land Resource Area (MLRA) 34A, Cool Central Desertic Basins and Plateaus, consists of approximately 21 million acres in Wyoming, Colorado and Utah, it consists of 11 Land Resource Units (LRU). These units are divisions of the MLRA based on geology, landscape, common soils, water resources and plant community potentials. The elevation spans from approximately 5600 feet (1700 m) along the Green River in UT and CO to approximately 9500 feet (2900 m) near Jeffrey City, WY. Annual precipitation ranges from 7 to 16 inches (177 to 406 mm), with the driest areas in the Green River and Great Divide Basins and the wettest areas in northern Carbon County, Southeast Fremont County and Albany County. There is a seasonal weather pattern that trends west to east, with more winter precipitation in the west and more spring/summer in the east, illustrated by diminishing amounts of Big Sagebrush in the eastern part of the MLRA.

LRU notes

The Bear River Valley LRU is located on the far western side of MLRA 34A between the Bear River Divide and the Monte Cristo Range, from Woodruff, Utah at the southern end to Cokeville, Wyoming at the northern end. The total area of the LRU is approximately 340,000 acres. It shares a boundary with MLRA 47, 43B and 46 (proposed).
This LRU differs from the others in its geology, which is comprised mostly of alluvium and colluvium from the Stump Formation. Its weather patterns are such that the soil moisture is xeric, there is a slight peak in winter precipitation in this LRU, with typical yearly precipitation between 9 to 15 inches (230 to 380 mm). The soil temperature regime of this LRU is frigid with mean annual soil temperatures ranging from 44 to 48 degrees Fahrenheit (6.7 to 8.8 C). The elevation range is from 5700 to 7000 feet (1730 to 2130 m). The soils in the Bear River Valley are dominated by young aged very deep soils developed from sandstone and shale parent material re-worked with recent alluvium. Soils are dominated by Alfisols with young argillic horizons and by Fluvents in more recent alluvium.
The Bear River runs through this LRU, allowing for ample amounts of irrigation water used in the lowland areas to produce hay. Smaller tributaries originating from the neighboring mountains.

Ecological site concept

• This site does not receive any additional water.
• These soils:
o are not saline or saline-sodic
o are moderately deep to deep
o are not skeletal within 20” of the soil surface; and have less than 35 percent rock fragments in the soil subsurface
o are not strongly or violently effervescent in the surface mineral layer (within top 10”)
o have surface textures that usually range from silt loam to silty clay loam in surface mineral layer (4”)
• have slopes less than 30 percent
• clay content is not greater than 35% in mineral soil surface layer (1-2”)

Associated sites

R034AA239UT	**Semi-desert Silt (Basin big sagebrush/ Bluebunch wheatgrass)**

Similar sites

R034AY122WY	**Loamy Green River and Great Divide Basins (Ly)**

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata var. wyomingensis*
Herbaceous	(1) *Pseudoroegneria spicata*

Physiographic features

This site occurs on hills and gentle slopes at elevations between 5,700 and 7,000 feet. Runoff is medium and flooding and ponding do not occur on this site.

Table 2. Representative physiographic features

Landforms	(1) Hill
Flooding frequency	None
Ponding frequency	None
Elevation	5,700–7,000 ft
Slope	3–30%
Aspect	Aspect is not a significant factor

Climatic features

The climate is characterized by warm, dry summers and cold, snowy winters. This climate is modified by local topographic conditions. The mountains appreciably modify both the precipitation and temperature patterns. April, May, September and October are the wettest months; December, January, February and July are the driest.

Table 3. Representative climatic features

Frost-free period (average)	79 days
Freeze-free period (average)	112 days
Precipitation total (average)	13 in

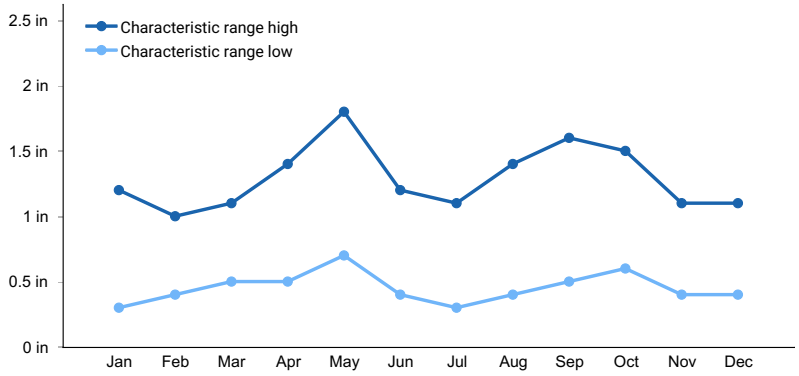

Figure 1. Monthly precipitation range

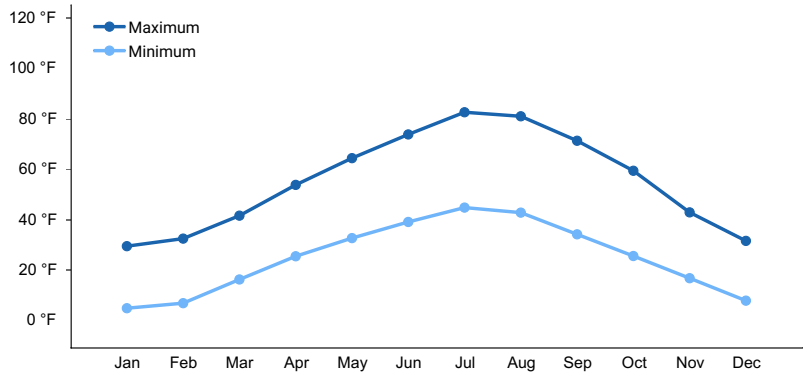

Figure 2. Monthly average minimum and maximum temperature

Influencing water features

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

Wetland description

N/A

Soil features

The soils of this site are moderately deep to deep. They formed in alluvium and colluvium derived from sandstone, quartzite, siltstone, or limestone. Surface and subsurface textures are silt loams and silty clay loams and may be gravelly or cobbly. Rock fragments may be found on the soil surface and throughout the profile. These soils are well-drained and moderately permeable. The soil moisture regime is xeric and the soil temperature regime is frigid.

Table 4. Representative soil features

Parent material	(1) Alluvium–metamorphic and sedimentary rock (2) Colluvium–metamorphic and sedimentary rock
Surface texture	(1) Silt loam (2) Silty clay loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate
Soil depth	20 in
Surface fragment cover <=3"	0–35%
Surface fragment cover >3"	0–35%
Soil reaction (1:1 water) (0-40in)	7.9–9
Subsurface fragment volume <=3" (Depth not specified)	0–35%
Subsurface fragment volume >3" (Depth not specified)	0–35%

Ecological dynamics

It is impossible to determine in any quantitative detail the Reference Plant Community 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

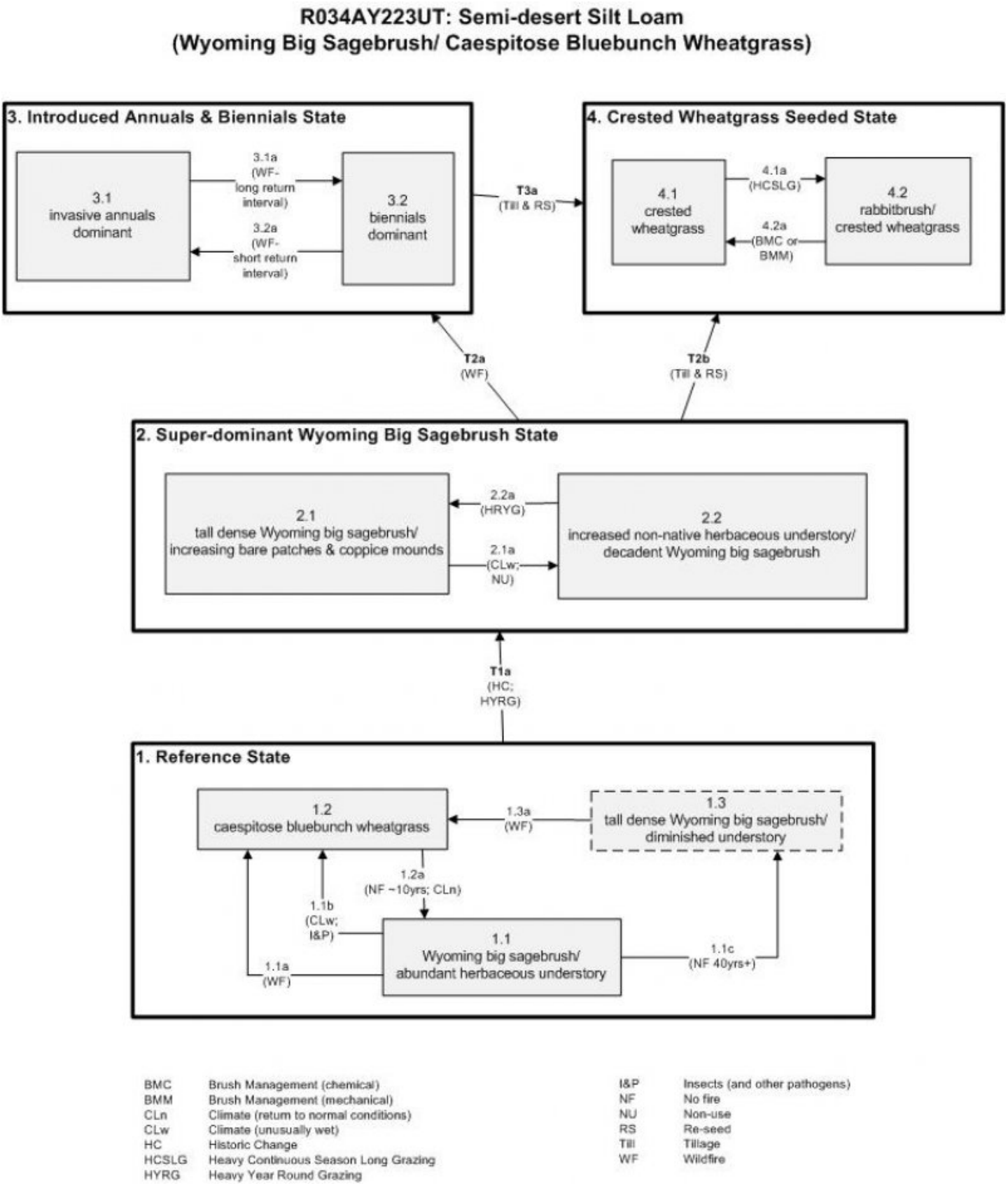

Figure 3. State and Transition Model

State 1
Reference

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 major influences on vegetation in the Reference State would have been time since the last fire and where extra wet periods were followed by Aroga moth or snowmold outbreaks. Thus the three phases within State 1 reflect these combined

influences on re-setting plant succession. Phase 1.1 is a plant community with mature Wyoming big sagebrush (Artemisia tridentate ssp. wyomingensis) which dominates both cover and production but has many perennial grass and forb companions. Wildfire (1.1a, 1.3a) or an unusually wet period followed by either Aroga moth or snowmold outbreak (1.1b) would have created a grass-dominated phase (1.2) prevailing for approximately one decade. Wyoming big sagebrush would have re-established approximately 10 years from the last fire event and a return to normal climate conditions. As the fire interval and/or periods without Aroga moth or snowmold outbreaks increased (i.e. 40 plus years) (1.1c), the sagebrush would have eventually become over-mature and super-dominant with a diminished understory (1.3). The most abundant grass would have been the caespitose form of bluebunch wheatgrass (*Pseudoroegneria spicata*). Needle-and-thread (*Hesperostipa comata*), bottlebrush squirreltail (*Elymus elymoides*), Indian ricegrass (*Achnatherum hymenoides*), and small caespitose bluegrasses (Poa spp.) would have also co-occurred. Dominant forbs would have included buckwheat (Eriogonum spp.), biscuitroot (Lomatium spp.), fleabane (Erigeron spp.), milkvetch (Astragalus spp.), and beardtongue (Penstemon spp.), particularly in the mid-seral condition. The patchiness of these natural disturbances would have produced a mosaic of all three phases across the landscape where this ESD occurs. 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 1.1
Wyoming big sagebrush/ abundant herbaceous understory

Community Phase 1.1: Wyoming big sagebrush/ abundant herbaceous understory This community was characterized by the co-dominance of shrubs, primarily Wyoming big sagebrush, and native perennial herbs. Productivity would have been dependent upon the moisture availability in the vadose (above the water table) zone.

Community 1.2
Caespitose bluebunch wheatgrass

Community Phase 1.2: caespitose bluebunch wheatgrass This was a temporary grassland variant of this plant community, dominated by the caespitose form of bluebunch wheatgrass. This community would have occurred shortly following wildfire or a sagebrush-killing pathogen outbreak, and would exist for approximately a decade.

Community 1.3
Tall dense Wyoming big sagebrush/ diminished understory

Community Phase 1.3: tall dense Wyoming big sagebrush/ diminished understory This community would have been characterized by a dense, tall stand of Wyoming big sagebrush with a diminished understory component.

Pathway 1.1A
Community 1.1 to 1.2

Community Pathway 1.1a Wildfire would have temporarily created a grassland variant of the plant community.

Pathway 1.1B
Community 1.1 to 1.3

Community Pathway 1.1b An unusually wet period (i.e. El Nino Southern Oscillation), followed by an outbreak of Aroga moth or snow mold would have temporarily created a grassland variant of this plant community.

Pathway 1.2A
Community 1.2 to 1.3

Community Pathway 1.2a Sagebrush would have begun to re-establish after a period of approximately 10 years after a return to a normal climate (temperatures and precipitation) and without wildfire.

Pathway 1.3A
Community 1.3 to 1.2

Community Pathway 1.3a As time progressed since the last sagebrush-killing event, Wyoming big sagebrush would become progressively denser and taller at the expense of (suppressing) the understory species.

State 2
Super-dominant Wyoming Big Sagebrush

State 2 is similar to Phase 1.3 of State 1 except that some exotic plants, cheatgrass (*Bromus tectorum*), and mustards (Brassica spp.) and animals (i.e. livestock) are now present. Additionally, some previously influential forces have now since been removed, namely Native American horses and Native American burning practices. The climate has become warmer and the atmosphere holds more carbon dioxide, nitrogen, and sulphur. State 2 is thus a description of the vegetation on this site shortly following Euro-American settlement. Reduction of the native graminaceous understory on these fine-textured soils created a positive feedback including the baring of the soil surface between the shrubs, allowing the wind to move the silt into mounds (coppice dunes) around the larger shrubs (2.1) (West, 1983). Soil organic matter and nutrient reserves concentrated in these coppice dunes, which further contributed to the patchiness of the vegetation. Decades of pronounced removal of the herbaceous component also resulted in a lengthening of the fire-free interval, allowing the height and density of the less palatable sagebrush to increase over that of State 1. Later, both voluntary and mandatory (after 1934 on BLM lands) reductions in numbers of livestock and duration of their grazing (2.1a), brought light recovery of the understory because of the super-dominance of sagebrush and its longevity. In fact, rest from livestock grazing allows the buildup of fire continuous fuels (2.2), especially following wet winters and springs (2.1a). The vegetation is characterized by Wyoming big sagebrush dominance and a caespitose form of bluebunch wheatgrass in the understory.

Community 2.1
Tall dense Wyoming big sagebrush/ increasing bare patches & coppice mounds

Community Phase 2.1: Tall dense Wyoming big sagebrush/ increasing bare patches & coppice mounds This phase is characterized by having tall, dense Wyoming big sagebrush, the presence of minor amounts of exotic annuals and biennials, and mounded micro-relief.

Community 2.2
Increased non-native herbaceous understory/Decadent Wyoming big sagebrush

Community Phase 2.2: Increased non-native herbaceous understory/ Decadent Wyoming big sagebrush This phase is characterized by an increase in the non-native herbaceous understory species and an increase in the height and age of Wyoming big sagebrush.

Pathway 2.1A
Community 2.1 to 2.2

Community Pathway 2.1a Sustained non-use by livestock in combination with an unusually wet winter and/or spring will cause the non-native herbaceous understory component to increase and the sagebrush component to increase in height and age (i.e. to become decadent).

Pathway 2.2A
Community 2.2 to 2.1

Community Pathway 2.2a Heavy year-round livestock grazing will remove more of the herbaceous understory component resulting in an opportunity for more sagebrush to establish and leaving more bare soil patches.

State 3
Introduced Annuals & Biennials

State 3 is characterized by the dominance of several introduced fire-prone species. When fire return intervals are frequent (3.2a) annual species such as cheatgrass and Russian thistle (Salsola spp.) will predominate (3.1). Longer intervals between fire events (3.1a) will result in a plant community dominated by biennial forbs such as knapweeds (Centaurea spp.) and tumble mustard (*Sisymbrium altissimum*) (3.2). There is little evidence for the return of the

native grasses or forbs in State 3, even if all livestock grazing is removed for decades.

Community 3.1
Invasive annuals dominant

Community Phase 3.1: Invasive annuals dominant This plant community will develop where fire return intervals are frequent and annual species such as cheatgrass and Russian thistle predominate.

Community 3.2
Biennials dominant

Community Phase 3.2: Biennials dominant This plant community will develop when intervals between fires are longer, allowing biennial species such as knapweeds, and tumble mustard to become established.

Pathway 3.1A
Community 3.1 to 3.2

Community Pathway 3.1a When intervals between fire events are prolonged, biennial forbs will dominate the plant community.

Pathway 3.2A
Community 3.2 to 3.1

Community Pathway 3.2a When fire return intervals are frequent, annual forbs and grasses will dominate the plant community.

State 4
Crested Wheatgrass

When livestock grazing is heavy, particularly during the growing season of grasses (4.1a), State 4 will eventually be re-invaded by woody species, first by rabbitbrush (Chrysothamnus spp.) and later followed by which ever sagebrush species has the highest seed rain. Thus, if the maintenance of grass production is desired in State 4, it will require re-treatment of the brush either mechanically, chemically, or with fire (4.2a). There is little evidence for the unassisted return of native grasses or forbs in State 4, even if all livestock grazing is removed for decades. Diversification of the plant mix in State 4 will probably require scalping of some of the crested wheatgrass and inter-seeding.

Community 4.1
Crested wheatgrass

Community Phase 4.1: Crested wheatgrass This plant community was artificially created by tilling and seeding of crested wheatgrass to increase forage for livestock.

Community 4.2
Woody encroachment/ Crested wheatgrass

Community Phase 4.2: Woody encroachment/ Crested wheatgrass Crested wheatgrass production is greatly reduced while the site’s woody predecessors, including rabbitbrush and sagebrush, regain dominance.

Pathway 4.1A
Community 4.1 to 4.2

Community Pathway 4.1a Unrestricted heavy use by livestock during the growing season will eventually limit production by crested wheatgrass and allow the encroachment of woody species.

Pathway 4.2A

Community 4.2 to 4.1

Community Pathway 4.2a Maintenance of this state requires retreatment of the brush using chemicals or tilling to maintain grass dominance and remove re-invaded shrubs.

Transition T1A
State 1 to 2

Transition T1a: from State 1 to State 2 (Reference State to Super-dominant Wyoming Big Sagebrush 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. The unrestricted year around grazing on these sites, first by cattle and later by sheep (Parson 1996), was the major cause of the changes between State 1 and State 2. Reversal of such historic changes (i.e. a return pathway) back to State 1 is not practical.

Transition T2A
State 2 to 3

Transition T2a: from State 2 to State 3 (Super-dominant Wyoming Big Sagebrush State to Introduced Annuals & Biennials State) A hotter, larger fire usually follows a build up of fine fuels in the understory in State 2 leading to a transition from State 2 to State 3. Rest from livestock use may facilitate this fuel loading by allowing for the accumulation of more continuous fine fuels, especially following wet winters and springs. Reductions in the intensity of livestock grazing or changes in seasons of use have had little effect changing the proportions of shrubs and herbs in these communities due to the super-dominance of sagebrush.

Transition T2B
State 2 to 4

Transition T2b: from State 2 to State 4 (Super-dominant Wyoming Big Sagebrush State to Crested Wheatgrass State) Because of national demands for red meat production following World War II, many of the areas in State 2 were tilled and seeded to crested wheatgrass to increase forage for livestock.

Transition T3A
State 3 to 4

Transition T3a: from State 3 to State 4 (Introduced Annuals & Biennials State to Crested Wheatgrass State) Similarly to the impoverished sites in State 2, because of national demands for red meat production following World War II, many of the areas in State 3 were also tilled and seeded to crested wheatgrass (T3a) to increase forage for livestock, especially in areas which re-burned frequently.

Additional community tables

Animal community

The suitability for livestock grazing is fair to good. This site provides grazing for cattle and sheep year-round, however prolonged heavy spring grazing will result in loss of perennial grasses, and an increase in unpalatable shrubs and exotics.

Recreational uses

Recreation activities include hunting, horseback riding, ATV riding, birdwatching, etc.

Inventory data references

Data gathered by qualified range professionals within NRCS and cooperating partners.

Other references

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American West. Great Basin Naturalist: 50(2): 181-191. Keywords: [Western U.S., conservation, history, human impact]

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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]

West, N. E. 1983. Overview of North American temperate Deserts and semi-deserts. pp. 321-330 in N.E. West (ed.) Temperate Deserts and Semi-deserts. Vol. 5, Ecosystems of the World, Elsevier, Amsterdam.

Contributors

USU

Approval

Kirt Walstad, 2/21/2025

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)	
Contact for lead author	
Date	02/21/2025
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

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6. **Extent of wind scoured, blowouts and/or depositional areas:**

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7. **Amount of litter movement (describe size and distance expected to travel):**

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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):**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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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):**

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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:

    Sub-dominant:

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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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:

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17. **Perennial plant reproductive capability:**
