USDA Natural Resources
Conservation Service

Ecological site R047XA440UT
Mountain Shallow Loam (curl-leaf mountain mahogany)

Last updated: 2/05/2025
Accessed: 05/11/2025

General information

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

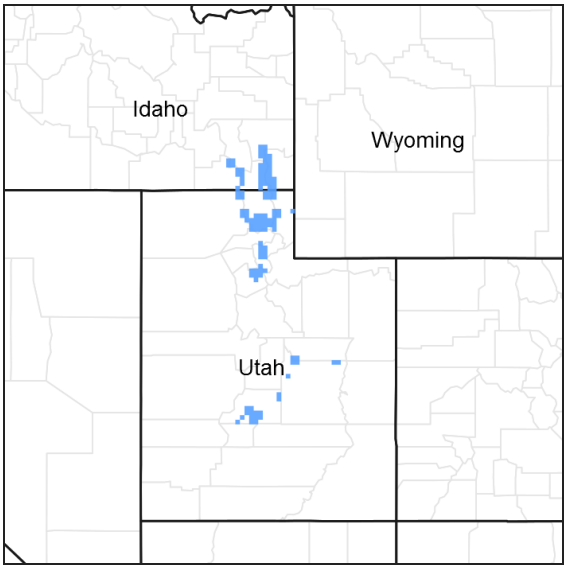


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 047X–Wasatch and Uinta Mountains

MLRA 47 occurs in Utah (86 percent), Wyoming (8 percent), Colorado (4 percent), and Idaho (2 percent). It encompasses approximately 23,825 square miles (61,740 square kilometers). The northern half of this area is in the Middle Rocky Mountains Province of the Rocky Mountain System. The southern half is in the High Plateaus of the Utah Section of the Colorado Plateaus Province of the Intermontane Plateaus. Parts of the western edge of this MLRA are in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. The MLRA includes the Wasatch Mountains, which trend north and south, and the Uinta Mountains, which trend east and west. The steeply sloping, precipitous Wasatch Mountains have narrow crests and deep valleys. Active faulting and erosion are a dominant force in controlling the geomorphology of the area. The Uinta Mountains have a broad, gently arching, elongated shape. Structurally, they consist of a broadly folded anticline that has an erosion-resistant quartzite core. The Wasatch and Uinta Mountains have an elevation of 4,900 to about 13,500 feet (1,495 to 4,115 meters).

The mountains in this area are primarily fault blocks that have been tilted up. Alluvial fans at the base of the mountains are recharge zones for the basin fill aquifers. An ancient shoreline of historic Bonneville Lake is evident on the footslopes along the western edge of the area. Rocks exposed in the mountains are mostly Mesozoic and Paleozoic sediments, but Precambrian rocks are exposed in the Uinta Mountains. The Uinta Mountains are one of the few ranges in the United States that are oriented west to east. The southern Wasatch Mountains consist of

Tertiary volcanic rocks occurring as extrusive lava and intrusive crystalline rocks.

The average precipitation is from 8 to 16 inches (203 to 406 mm) in the valleys and can range up to 73 inches (1854 mm) in the mountains. In the northern and western portions of the MLRA, peak precipitation occurs in the winter months. The southern and eastern portions have a greater incidence of high-intensity summer thunderstorms; hence, a significant amount of precipitation occurs during the summer months. The average annual temperature is 30 to 50 degrees Fahrenheit (-1 to 15 C). The freeze-free period averages 140 days and ranges from 60 to 220 days, generally decreasing in length with elevation.

The dominant soil orders in this MLRA are Aridisols, Entisols, Inceptisols, and Mollisols. The lower elevations are dominated by a frigid temperature regime, while the higher elevations experience cryic temperature regimes. Mesic temperature regimes come in on the lower elevations and south facing slopes in the southern portion of this MLRA. The soil moisture regime is typically xeric in the northern part of the MLRA, but grades to ustic in the extreme eastern and southern parts. The mineralogy is generally mixed and the soils are very shallow to very deep, generally well drained, and loamy or loamy-skeletal.

LRU notes

Major Land Resource Unit 47A is located in the northern half of the Middle Rocky Mountains Province of the Rocky Mountain System. This MLRA includes the Wasatch Mountains which tend to run north and south. These steeply sloping, precipitous mountains have narrow crests and deep valleys. They are primarily fault blocks that have been tilted up. The alluvial fans located at the base of these mountains are important recharge zones for valley aquifers.

Classification relationships

Modal Soil: Agassiz GR-L, 40-70% — loamy-skeletal, mixed, frigid Lithic Haploxerolls

Ecological site concept

The soils of this site are shallow with many large and small rock fragments throughout the profile. These soils were derived primarily from limestone parent materials and formed in either residuum or colluvium over residuum. They have greater than 35 percent rock fragments by volume, and the fine earth fraction is loam or silt loam in texture. Large stones and cobbles are usually visible on the soil surface. Permeability is moderately slow to moderate and drainage class is well to somewhat excessively well drained. Available water holding capacity ranges from 1.4 to 2.2 inches depending on soil depth and percent rock fragments. The soil temperature regime is frigid and the soil moisture regime is xeric.

Associated sites

R047XA406UT	**Mountain Gravelly Loam (mountain big sagebrush)**
R047XA448UT	**Mountain Shallow Loam (oak)**
R047XA461UT	**Mountain Stony Loam (mountain big sagebrush)**

Similar sites

R047XA438UT	**Mountain Shallow Loam (black sagebrush)**
R047XA442UT	**Mountain Shallow Loam (low sagebrush)**

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Cercocarpus ledifolius*
Herbaceous	(1) *Pseudoroegneria spicata*

Physiographic features

This site occurs on Mountain slopes and ridges at elevations between 5,200 and 8,500 feet. It is most commonly found on steep to very steep south and west facing slopes, but may occur on other aspects. Flooding and ponding do not occur on this site and runoff is medium.

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Mountain slope (3) Mountain
Flooding frequency	None
Ponding frequency	None
Elevation	5,200–8,500 ft
Slope	30–70%
Aspect	S, SW, W

Climatic features

The climate of this site is characterized by cold snowy winters and cool dry summers. The average annual precipitation varies between 19 to 27 inches. Distribution of precipitation is 55 to 60 percent during the plant dormant period (October to March). This is the most dependable supply of moisture for plant growth. Lower precipitation and high evapotranspiration rates during July, August, and September reduce growth rates for all plant species and cause dormancy in many herbaceous species.

Table 3. Representative climatic features

Frost-free period (average)	169 days
Freeze-free period (average)	207 days
Precipitation total (average)	27 in

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 shallow with many large and small rock fragments throughout the profile. These soils were derived primarily from limestone parent materials and formed in either residuum or colluvium over residuum. They have greater than 35 percent rock fragments by volume, and the fine earth fraction is loam or silt loam in texture. Large stones and cobbles are usually visible on the soil surface. Permeability is moderately slow to moderate and drainage class is well to somewhat excessively well drained. Available water holding capacity ranges from 1.4 to 2.2 inches depending on soil depth and percent rock fragments. The soil temperature regime is frigid and the soil moisture regime is xeric.

Table 4. Representative soil features

Parent material	(1) Residuum–limestone (2) Colluvium–limestone

Surface texture	(1) Very cobbly silt loam (2) Very cobbly loam (3) Stony loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately slow to moderate
Soil depth	10–20 in
Surface fragment cover <=3"	13–21%
Surface fragment cover >3"	19–30%
Available water capacity (0-40in)	1.4–2.2 in
Calcium carbonate equivalent (0-40in)	0–5%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	20–28%
Subsurface fragment volume >3" (Depth not specified)	18–24%

Ecological dynamics

It is impossible to determine in any quantitative detail the Historic Climax Plant Community (HCPC) 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 that illustrates 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.

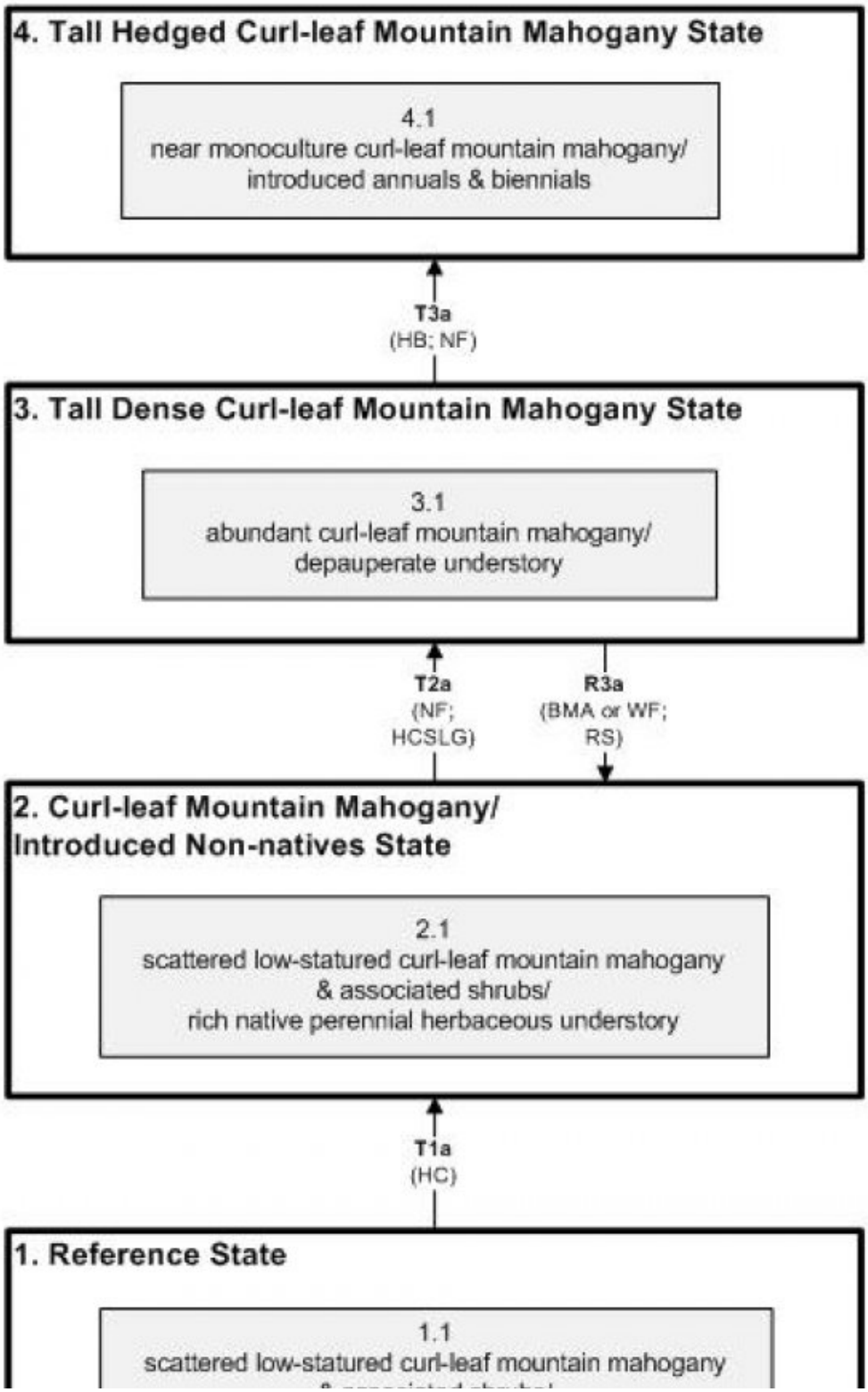
When available, monitoring data (of various types) were employed to validate more subjective inferences made in this diagram. See the complete files in the office of the State Range Conservationist for more details.

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, 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 and 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

R047AY440UT: Mountain Shallow Loam (Curl-leaf Mountain Mahogany)



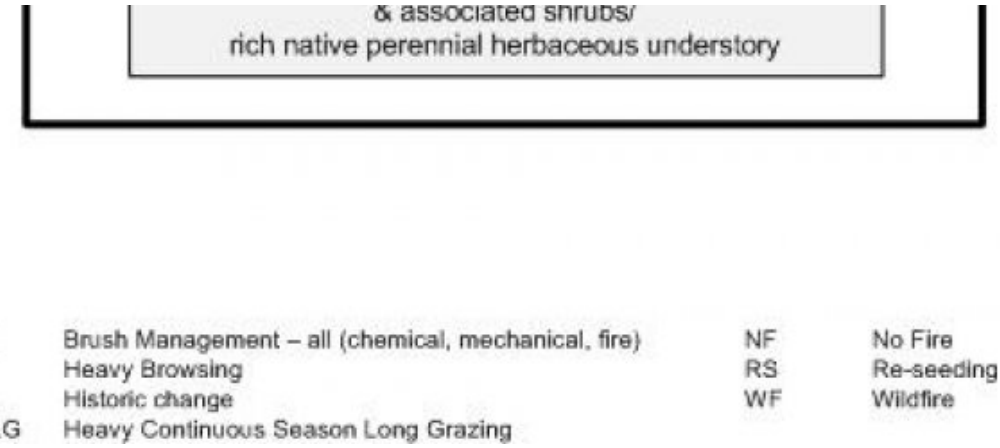


Figure 4. State and Transition Model

State 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.

Community 1.1
scattered low-statured curl-leaf mountain mahogany & associated shrubs/ rich native perennial herbaceous understory

This plant community would have been characterized by a scattering of low-statured curl-leaf mountain mahogany. Antelope bitterbrush and mountain big sagebrush would have also been present with an understory composed of a variety of forbs (spiny phlox, arrowleaf balsamroot, etc.) and grasses (bluebunch wheatgrass, needle and thread, etc.).

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	750	1050	1470
Grass/Grasslike	438	613	858
Forb	63	88	123
Total	**1251**	**1751**	**2451**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	39-41%
Grass/grasslike foliar cover	19-21%
Forb foliar cover	4-6%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 7. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	–	–
>0.5 <= 1	–	–	–	4-6%
>1 <= 2	–	–	19-21%	–
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	39-41%	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

State 2
Curl-leaf Mountain Mahogany/ Introduced Non-natives State

State 2 is a description of the ecological site just following Euro-American settlement, which has been influenced by the introduction of several non-native plants and animals, possible extinctions of native species, and a different climate. The plant community will be very similar to State 1 with the exception that some introduced species are likely to be present. This plant community is considered the current potential, and is dominated by curl-leaf mountain mahogany with a scattering of antelope bitterbrush and mountain big sagebrush. The native perennial herbaceous understory is still intact, but a small component of non-native species will also be present. The resiliency of this state is maintained by the root-sprouting nature of the dominant shrubs. Reductions in livestock use during the growth season will maintain the stability of the state. Alternatively, continued season-long heavy livestock grazing will reduced the stability of this state.

Community 2.1
scattered low-statured curl-leaf mountain mahogany and associated shrubs/ rich native perennial herbaceous understory

This plant community is characterized by a scattering of low-statured curl-leaf mountain mahogany, antelope bitterbrush, and mountain big sagebrush. The native perennial understory is composed of a variety of forbs (spiny phlox, western mountain aster, arrowleaf balsamroot, etc.) and grasses (bluebunch wheatgrass, spike fescue, needle and thread, etc.).

State 3
Tall Dense Curl-leaf Mountain Mahogany State

In the absence of fire, and continued heavy impacts from livestock, deer, and elk grazing, the native grasses will markedly decrease while the shrubs, mainly curl-leaf mountain mahogany, will grow taller and more dense as reproduction becomes rarer. The resiliency of this state is maintained root-sprouting nature of the dominant shrubs. Reductions in livestock use during the growing season will maintain the stability of the state. Alternatively, continued season-long use by both domestic and wild ungulates will reduce the stability of this state.

Community 3.1
abundant curl-leaf mountain mahogany/ depauperate understory

This plant community is characterized by a dramatic increase in curl-leaf mountain mahogany and substantial reduction in the perennial herbaceous component.

State 4
Tall Hedged Curl-leaf Mountain Mahogany State

Following a period of intense deer browsing, curl-leaf mountain mahogany will appear hedged. Without fire, mountain mahogany will grow taller and begin to form a monoculture. Introduced annuals and biennials are also quite common in the understory. In this state, the rockiness of the soil makes it self-armoring, thus reducing the effects of erosion. The steep, rocky locations of this site limit proactive management options.

Community 4.1
near monoculture curl-leaf mountain mahogany/ introduced annuals and biennials

This plant community is super-dominated by curl-leaf mountain mahogany with an understory composed mainly of introduced annuals and biennials. The site will remain in this state until wildfire occurs.

Transition T1A
State 1 to 2

The simultaneous introduction of exotic species, both plants and animals, possible extinctions of native flora and fauna, and 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.

Transition T2A
State 2 to 3

Heavy continuous livestock grazing took place on these sites between the 1850s and 1950s. The effects of this heavy livestock grazing were further worsened with fire exclusion policies. A rapid increase of deer numbers in the 1950s and 1960s caused high-lining of the trees. Curl-leaf mountain mahogany began to grow taller and larger in dbh (diameter at breast height), while the herbaceous understory species were reduced greatly. Key indicators of the approach to this transition are a loss of perennial grass understory, an increase in the shrub component relative to grasses, and an increase in height and dbh of mahogany, as well as high-lining and hedging of trees. This transition is triggered by sustained heavy grazing (over time), first by livestock, and later by excessive numbers of deer.

Restoration pathway R3A
State 3 to 2

Brush management using prescribed fire, mechanical, or herbicidal (i.e. 2, 4-DTM) treatments, or wildfire, in combination with re-seeding efforts should be considered only on gentle to level slopes (these locations however are unusual). Curl-leaf mountain mahogany will not consistently re-sprout after these treatments, and invasive annuals and biennials are very prominent after disturbances. Re-seeding after wildfire must be done promptly or annuals and bi-annuals will takeover.

Transition T3A
State 3 to 4

The region saw a marked increase in mule deer numbers during the 1940s to 1960s. As a preferred forage species for deer, curl-leaf mountain mahogany experienced heavy browsing pressure during that time. Heavy browsing combined with continued lack of fire caused these sites to transition into a near monoculture of curl-leaf mountain mahogany. A key indicator of the approach to this transition is a loss of young, short mountain mahogany, and an increase in tall, large mountain mahogany trees. Excessive ungulate use will trigger this transition. A restoration pathway can be established by restoring fire to the ecosystem and reducing animal use on these sites.

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**			702–990	
	curl-leaf mountain	CELE3	*Cercocarpus ledifolius*	630–810	–

	mahogany				
	antelope bitterbrush	PUTR2	*Purshia tridentata*	54–90	–
	little sagebrush	ARAR8	*Artemisia arbuscula*	18–90	–
3	**Sub-Dominant Shrubs**			252–504	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	90–180	–
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	18–36	–
	black sagebrush	ARNO4	*Artemisia nova*	18–36	–
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	18–36	–
	snowbrush ceanothus	CEVE	*Ceanothus velutinus*	18–36	–
	yellow rabbitbrush	CHVIV4	*Chrysothamnus viscidiflorus ssp. viscidiflorus var. viscidiflorus*	18–36	–
	Watson's goldenbush	ERWA8	*Ericameria watsonii*	18–36	–
	creeping barberry	MARE11	*Mahonia repens*	18–36	–
	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	18–36	–
Grass/Grasslike					
0	**Dominant Grasses**			414–630	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	360–540	–
	muttongrass	POFE	*Poa fendleriana*	54–90	–
1	**Sub-Dominant Grasses**			342–846	
	Grass, annual	2GA	*Grass, annual*	90–180	–
	Grass, perennial	2GP	*Grass, perennial*	90–180	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	18–54	–
	Geyer's sedge	CAGE2	*Carex geyeri*	18–54	–
	squirreltail	ELEL5	*Elymus elymoides*	18–54	–
	sheep fescue	FEOV	*Festuca ovina*	18–54	–
	needle and thread	HECO26	*Hesperostipa comata*	18–54	–
	basin wildrye	LECI4	*Leymus cinereus*	18–54	–
	spike fescue	LEKI2	*Leucopoa kingii*	18–54	–
	western wheatgrass	PASM	*Pascopyrum smithii*	18–54	–
Forb					
2	**Sub-Dominant Forbs**			342–684	
	Forb, annual	2FA	*Forb, annual*	90–180	–
	Forb, perennial	2FP	*Forb, perennial*	90–180	–
	common yarrow	ACMI2	*Achillea millefolium*	18–36	–
	littleleaf pussytoes	ANMI3	*Antennaria microphylla*	18–36	–
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	18–36	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	18–36	–
	Eaton's fleabane	EREA	*Erigeron eatonii*	18–36	–
	low beardtongue	PEHU	*Penstemon humilis*	18–36	–
	spiny phlox	PHHO	*Phlox hoodii*	18–36	–
	stemless mock goldenweed	STAC	*Stenotus acaulis*	18–36	–

Animal community

This site supports plant species that provide nutritious forage for sheep, cattle and horses during the spring, summer and fall.

This site is very valuable for deer and elk winter range. A few species of small mammals and songbirds are found part of the season on this site.

Hydrological functions

Recreational uses

This site is valued for open space and aesthetics. It is not considered good for big game hunting due to the dense areas of Curl-leaf mountain mahogany that provide cover for deer and elk. The soils are usually rocky which may affect the quality of hiking or horseback riding. It is not typically a preferred site for camping or picnicking.

Wood products

Curl-leaf mountain mahogany can furnish some fence posts and stays. Firewood may be harvested for fireplaces and campfires, but is difficult to cut with an axe after it is dry. Novelty items such as lamp stands, rustic furniture, and knick-knacks are sometimes made from Curl-leaf mountain mahogany wood.

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range trained personnel were also used.

Other references

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Contributors

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Approval

Kendra Moseley, 2/05/2025

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.

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Date	11/16/2012
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rare to Slight. Slight rill development may occur in exposed areas, on steeper slopes (> 20%) and/or on areas located below exposed bedrock or other water shedding areas where increased runoff may occur. Where rills are present, they should be fairly short (4-8 feet), < 1 inch deep and somewhat widely spaced (5-10 feet). Minor rill development may be observed on all slopes following major thunderstorm or spring runoff events but should heal during the next growing season.

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2. **Presence of water flow patterns:** Slight. Some minor evidence of water flow patterns may be found winding around perennial plant bases. They show little evidence of current erosion. They are expected to be short (3-6 feet), stable, sinuous and normally not connected. There may be very minor evidence of deposition. Evidence of water flow may increase somewhat on slopes > 20%.

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3. **Number and height of erosional pedestals or terracettes:** Perennial vegetation shows little evidence of erosional pedestalling (1 to 2% of individual plants). Plant roots are covered and most 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):** Bare ground ranges from 25% - 30%. Soil surface may be covered by 20 to >60% coarse fragments. Bare ground openings should not be greater than 1 to 2 feet in diameter and should normally not be connected.

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5. **Number of gullies and erosion associated with gullies:** None to Rare at site level. Scattered landscape level gully channels, however, are a normal component of basin/range environments. Where landscape gullies are present, they should be stable, partially vegetated on their sides and bottoms, with no evidence of head-cutting. Some slight increase in disturbance may be evident following significant weather events or when gullies convey considerable runoff from higher elevation rocky or naturally eroding areas.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None. No evidence of wind generated soil movement is present. Wind caused blowouts and deposition are not present.

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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 >20% 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 5 or 6 under the plant canopies, and a rating of 4 to 5 in the interspaces. The average rating should be a 5. Soil surface textures are typically loams, very fine sandy loams and silt loams.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** (Agassiz) Soil surface 0-7 inches. Texture is a very cobbly silt loam; color is brown (7.5YR 5/3); and structure is moderate medium granular. Mollic epipedon ranges from 7 to 19 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:** Perennial vegetation produces sufficient cover and spatial arrangement to intercept most raindrops and reduce raindrop splash erosion. Litter on soil surface and cryptogamic crusting, where present, also protect the soil surface from splash erosion and encourage higher infiltration. Bare spaces are expected to be small and irregular in shape and usually not connected. Vegetative structure and distribution are 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 such as long-term drought, insect damage, etc., runoff is likely to increase and infiltration be 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. Fractured bedrock occurs at about 19 inches. Some soils may have natural textural variability within their profiles, including changes in clay content, these should not be mistaken for a compaction pan.

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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 (curlleaf mountain mahogany, bitterbrush) > Non-sprouting shrub (mountain big sagebrush) = > Perennial bunchgrasses (bluebunch wheatgrass, muttongrass)

    Sub-dominant: Rhizomatous Grasses (western wheatgrass)> Perennial forbs (arrowleaf balsamroot).

    Other: A wide variety of other perennial grasses and both perennial and annual forbs can be expected to occur in the

plant community.

Additional: Natural disturbance regimes include fire, drought, and insects. Assumed fire cycle of 100+ years. Functional/structural groups may appropriately contain non-native species if their ecological function is the same as the native species in the reference. 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 different functional community phases 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 to 2 inches 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 1700 - 1800 #/acre on an average year but could range from 1200 - 2500 #/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, alyssum, mustard species, Canada thistle, black medic, Utah juniper, Gamble oak.

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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 expected to be present during average and above average growing years.
