

Ecological site R048AY503UT High Mountain Clay

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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): 048A–Southern Rocky Mountains

MLRA 48A makes up about 45,920 square miles (119,000 square kilometers) and is the southern part of the Rocky Mountains. The Southern Rocky Mountains lies east of the Colorado Plateau, south of the Wyoming Basin, west of the Great Plains, and north of the Rio Grande Rift. It is in western and central Colorado, southeastern Wyoming, eastern Utah, and northern New Mexico. The headwaters of major rivers such as the Colorado, Yampa, Arkansas, Rio Grande, North Platte and South Plate rivers are located here. This MLRA has numerous national forests, including the Medicine Bow National Forest in Wyoming; the Routt, Arapaho, Roosevelt, Pike, San Isabel, White River, Gunnison, Grand Mesa, Uncompahgre, Rio Grande, and San Juan National Forests in Colorado; the Carson National Forest and part of the Santa Fe National Forest in New Mexico. Rocky Mountain National Park also is in this MLRA.

MLRA 48A is the southern Rocky Mountains physiographic region. The Southern Rocky Mountains consist primarily of two belts of strongly sloping to precipitous mountain ranges trending north to south. Several basins, or parks, are between the belts. Some high mesas and plateaus are included. It is characterized by mountain ranges that were uplifted during the Laramide Orogeny and then had periods of glaciation. The ranges include the Sangre de Cristo Mountains, the Laramie Mountains, and the Front Range in the east and the San Juan Mountains and the Sawatch and Park Ranges in the west. The ranges are dissected by many narrow stream valleys having steep gradients. In some areas the upper mountain slopes and broad crests are covered by snowfields and glaciers. Elevation typically ranges from 6,500 to 14,400 feet (1,980 to 4,390 meters) in this area. The part of this MLRA in central Colorado includes the highest point in the Rockies, Mount Elbert, which reaches an elevation of 14,433 feet (4,400 meters). More than 50 peaks in the part of the MLRA in Colorado are at an elevation of more than 14,000 feet (4,270 meters). Many small glacial lakes are in the high mountains.

The mountains in this area were formed mainly by crustal uplifts during the late Cretaceous and early Tertiary periods. This large MLRA can be subdivided into at least 4 large general divisions. First is the Rockies on the east side of this area are called the "Front Range," which is a fault block that has been tilted up on edge and uplifted and is largely igneous and metamorphic geology. It was tilted up on the east edge, so there is a steep front on the east and the west side is more gently sloping and in the south east there are rocks exposed in the mountains are mostly Precambrian igneous and metamorphic rocks. Second is the tertiary rocks, primarily basalt and andesitic lava flows, tuffs, breccias, and conglomerates, are throughout this area (San Juan Mountains Area). The third division is Northwest part of the MLRA is dominantly sedimentary rock from the cretaceous/tertiary and Permian/Pennsylvanian periods. The fourth subset is the long and narrow Sangre de Cristos mountains uplifted in the Cenozoic are between the Rio Grande rift and the great plains. Many of the highest mountain ranges were reshaped by glaciation during the Pleistocene. Alluvial fans at the base of the mountains are recharge zones for local basin and valley fill aquifers. They also are important sources of sand and gravel.

The average annual precipitation ranges predominantly from 12 to 63 inches. Summer rainfall commonly occurs as high-intensity, convective thunderstorms. About half of the annual precipitation occurs as snow in winter; this proportion increases with elevation. In the mountains, deep snowpacks accumulate throughout the winter and

generally persist into spring or early summer, depending on elevation. Some permanent snowfields and small glaciers are on the highest mountain peaks. In the valleys at the lower elevations, snowfall is lighter and snowpacks can be intermittent. The average annual temperature is 26 to 54 degrees F (-3 to 12 degrees C). The freeze-free period averages 135 days and ranges from 45 to 230 days, decreasing in length with elevation. The climate of this area is strongly dependent upon elevation; precipitation is greater, and temperatures are cooler at the higher elevations. The plant communities vary with elevation, aspect and change in latitudes due to changing in precipitation kind and timing and temperature.

The dominant soil orders in this MLRA are Mollisols, Alfisols, Inceptisols, and Entisols. The soils in the area dominantly have a frigid or cryic soil temperature regime and an ustic or udic soil moisture regime. Mineralogy is typically mixed, smectitic, or paramicaceous. In areas with granite, gneiss, and schist bedrock, Glossocryalfs (Seitz, Granile, and Leadville series) and Haplocryolls (Rogert series) formed in colluvium on mountain slopes. Dystrocryepts (Leighcan and Mummy series) formed on mountain slopes and summits at the higher elevations. In areas of andesite and rhyolite bedrock, Dystrocryepts (Endlich and Whitecross series) formed in colluvium on mountain slopes. In areas of sedimentary bedrock, Haplustolls (Towave series) formed on mountain slopes at low elevations and with low precipitation. Haplocryolls (Lamphier and Razorba series), Argicryolls (Cochetopa series), and Haplocryalfs (Needleton series) formed in colluvium on mountain slopes at high elevations.

Ecological site concept

The soils of this site formed mostly in alluvium derived from igneous rock and/or till derived from igneous rock. Surface soils are silt loam to loam in texture. Rock fragments may be present on the soil surface and throughout the profile, but make up less than 35 percent of the soil volume. These soils are deep to very deep, well-drained, and have slow to moderate permeability. pH is slightly acidic to slightly alkaline. Available water-holding capacity ranges from 4 to 7 inches of water in the upper 60 inches of soil. The soil moisture regime is mostly udic and the soil temperature regime is cryic. Precipitation ranges from 22 to 35 inches annually.

Associated sites

R048AY516UT	High Mountain Loam (Mountain Big Sagebrush) Often occurs adjacent to this site.
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Similar sites

R048AY515UT	High Mountain Loam (Thurber Fescue) Similar in that it is a high mountain site where the reference community is dominated by grasses and forbs.
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Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) <i>Symphoricarpos oreophilus</i>
Herbaceous	(1) <i>Elymus trachycaulus</i> (2) <i>Wyethia amplexicaulis</i>

Physiographic features

This site occurs at elevations between 8,600 and 10,400 feet. It is found on outwash fans and mountain slopes with slopes ranging from 3 to 25 percent. Flooding and ponding do not occur on this site.

Table 2. Representative physiographic features

Landforms	(1) Outwash fan (2) Mountain slope
Runoff class	Medium
Flooding frequency	None
Ponding frequency	None

Elevation	2,621–3,170 m
Slope	3–25%
Aspect	Aspect is not a significant factor

Climatic features

The climate of this site is dry subhumid and semiarid. It is characterized by cold, snowy winters and warm, dry summers. The average annual precipitation ranges from 22 to 35 inches. July, August, and October are typically the wettest months with June being the driest. The most reliable sources of moisture for plant growth are the snow that accumulates over the winter and spring rains. Summer thunderstorms are intermittent and sporadic in nature, and thus, are not reliable sources of moisture to support vegetative growth on this site. The soil moisture regime is mostly udic and the soil temperature regime is cryic.

Table 3. Representative climatic features

Frost-free period (characteristic range)	40-70 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	559-889 mm

Influencing water features

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

Soil features

The soils of this site formed mostly in alluvium derived from igneous rock and/or till derived from igneous rock. Surface soils are silt loam to loam in texture. Rock fragments may be present on the soil surface and throughout the profile, but make up less than 35 percent of the soil volume. These soils are deep to very deep, well-drained, and have slow to moderate permeability. pH is slightly acidic to slightly alkaline. Available water-holding capacity ranges from 4 to 7 inches of water in the upper 60 inches of soil. The soil moisture regime is mostly udic and the soil temperature regime is cryic. Precipitation ranges from 22-35 inches annually.

Table 4. Representative soil features

Parent material	(1) Alluvium–igneous rock (2) Till–igneous rock
Surface texture	(1) Silt loam (2) Loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate
Depth to restrictive layer	152–254 cm
Soil depth	152–254 cm
Surface fragment cover ≤3"	8–12%
Surface fragment cover >3"	2%
Available water capacity (Depth not specified)	10.16–17.78 cm
Calcium carbonate equivalent (Depth not specified)	0%
Electrical conductivity (Depth not specified)	0 mmhos/cm

Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	5.6–7.3
Subsurface fragment volume ≤3" (Depth not specified)	15–17%
Subsurface fragment volume >3" (Depth not specified)	6–17%

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 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.

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 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 least modified plant community would have been co-dominated by a mixture of grass and forb species (1.1), with slender wheatgrass (*Elymus trachycaulus*) and mule-ears (*Wyethia amplexicaulis*) as the primary species. A more complete list of species by lifeform for the Reference State is available in accompanying tables in the “Plant Community Composition by Weight and Percentage” section of this ESD document.

Community Phase 1.1: co-dominant grass-forb mixture/ scattered snowberry & other low shrubs

This plant community would have been characterized by a co-dominance of grass and forb species. Grasses would have included slender wheatgrass, mountain brome (*Bromus marginatus*), Columbia needlegrass (*Achnatherum nelsonii*), and Letterman’s needlegrass (*Achnatherum lettermanii*). Forb species would have included mule-ears, silvery lupine (*Lupinus argenteus*), showy goldeneye (*Helioeris multiflora*), and western mountain aster (*Symphotrichum spathulatum*) among others. Mountain snowberry (*Symphoricarpos oreophilus*) would also have

been scattered throughout the site.

Transition T1a: (State 1 to State 2)

The simultaneous introduction of exotic species, both plants and animals, possible extinctions of native flora and fauna, climate change, the advent of heavy continuous season long livestock grazing, and fire prevention 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.

State 2 Shrub Steppe State

State 2 is a description of the ecological site shortly 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. Historic heavy continuous season long grazing by livestock and the prevention of wildfire also had a major impact on these sites creating a shrub steppe which should now be considered the present potential. Unpalatable species such as mule-ears and native woody species such as mountain snowberry, and silver sagebrush (*Artemisia cana*) increased while the palatable herbaceous species diminished.

Community Phase 2.1: snowberry & sagebrush increased/ palatable grasses & forbs depleted

This plant community is characterized by a relative increase in native woody species such as snowberry, and silver sagebrush and unpalatable forbs, particularly mule-ears.

Transition T2a: (State 2 to State 3)

Mechanical disturbance of woody species and continued heavy livestock grazing during the growing season of grasses will cause a transition from State 2 to a perennial forb and annual grass-dominated state (State 3). The churning clay soils naturally favor herbs over woody species, thus shrubs are a temporary occupier of such sites. However both the mechanical and herbivory of interzonal grazing can trigger the shrubs which are moderately palatable, especially to sheep. Mule-ears is however, unpalatable to all animals and its massive root structure allows it to prevail under all treatments except deep plowing and/or herbicides. Reducing livestock grazing has little effect on reducing its competitive hold. The only potential restoration pathway requires massive tillage with subsequent herbicide and reseeding efforts to convert these sites to perennial grasslands.

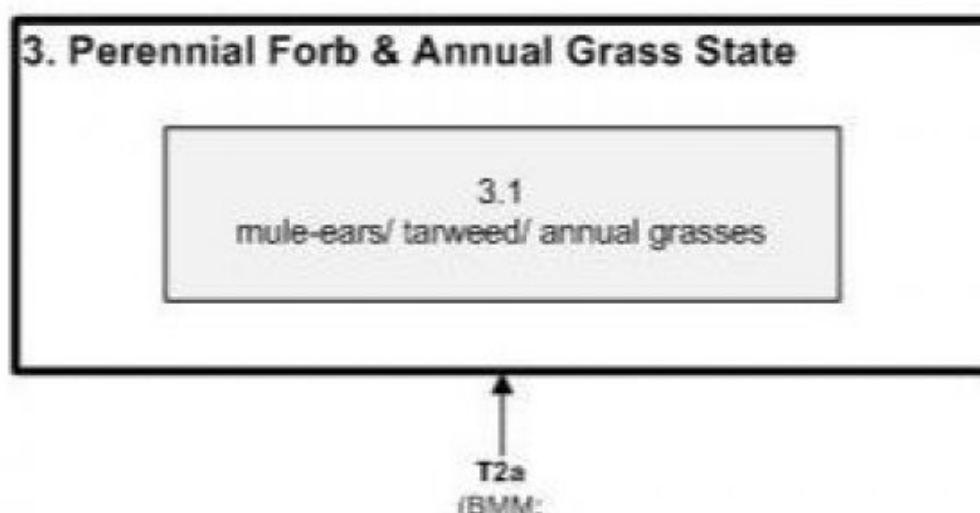
State 3 Perennial Forb & Annual Grass State

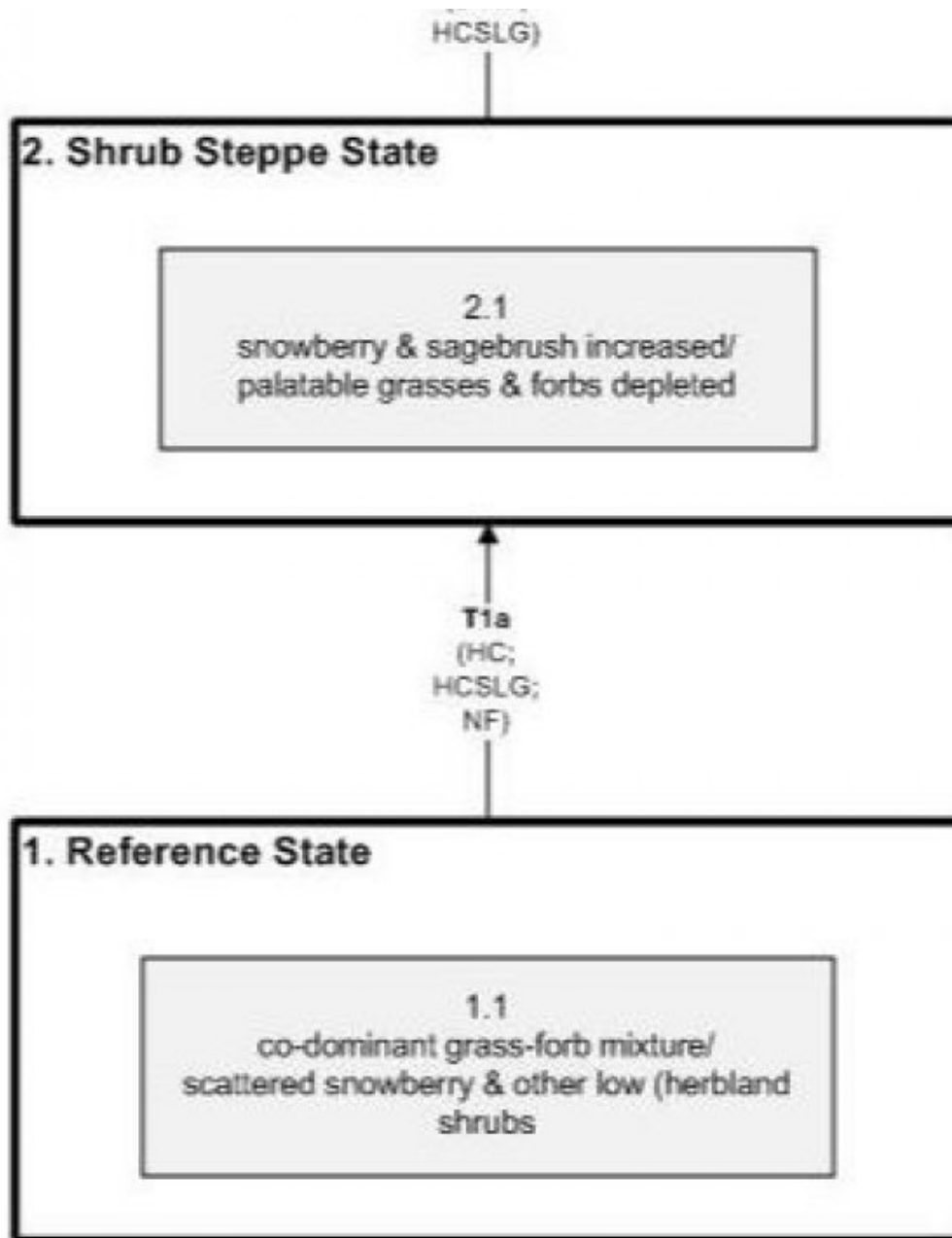
With continued impacts from heavy livestock grazing and mechanical, herbicidal, or fire removal of native shrubs, the native grass component will markedly decrease or be absent, shrubs will also be reduced to absence, but perennial forbs and annual grasses such as mule-ears, tarweed, (*Madia glomerata*) and cheatgrass (*Bromus tectorum*) will increase.

Community Phase 3.1: mule-ears/ tarweed/ annual grasses

This plant community is characterized by a suite of very grazing-tolerant herbaceous species such as mule-ears, tarweed, and cheatgrass.

State and transition model





BMM	Brush Management Mechanical
HC	Historic Change
HCSLG	Heavy Continuous Season Long Grazing
NF	No Fire

Inventory data references

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.

Other references

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Contributors

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Approval

Kirt Walstad, 3/05/2024

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	05/11/2025
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:**

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

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

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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

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

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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:

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

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

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

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:**

17. **Perennial plant reproductive capability:**
