USDA Natural Resources Conservation Service

Ecological site F048AY924CO
Douglas Fir/Gambel Oak

Last updated: 3/05/2024
Accessed: 05/17/2024

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.

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.

Classification relationships

NRCS:
Major Land Resource Area 48A, Southern Rocky Mountains (United States Department of Agriculture, Natural Resources Conservation Service, 2006).

USFS:
M331F- Southern Parks and Rocky Mountain Range Section Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow

M331G – South Central Highlands Section Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow

M331H – North Central Highlands and Rocky Mountains Section Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow

M331I – North Parks and Ranges Section Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow

M341B – Tavaputs Plateau Section M341 Nevada-Utah Mountains Semi-Desert - Coniferous Forest - Alpine Meadow (Cleland, et al., 2007).

EPA:
21a – Alpine Zone, 21b – Crystalline Subalpine Forests, 21c – Crystalline Mid-Elevations Forests, 21d -Foothill Shrublands, 21e – Sedimentary Subalpine Forests, 21f – Sedimentary Mid-Elevation Forests, 21g – Volcanic Subalpine Forests, and 21h – Volcanic Mid-Elevation Forests < 21 Southern Rockies < 6.2 Western Cordillera < 6 Northwestern Forested Mountains North American Deserts (Griffith, 2006).

20c – Semiarid Benchlands and Canyonlands and 20e - Escarpements < 20 Colorado Plateau < 10.1 Cold Deserts < 10 North American Deserts (Griffith, 2006).

USGS:
Southern Rocky Mountain Province and the southern part of Unita Basin Section Colorado Plateaus Province

Ecological site concept

This site is found mostly commonly on mountain slopes, hillslopes, scarp slopes on cuestas, and mesas. Soils are moderately deep to very deep (20 to 60+ inches). Soil surface texture is loam, very stony loam, clay loam, stony sandy clay loam or very stony sandy loam. Subsurface textures can be loamy-skeletal or fine-loamy. It is usually ustic udic or typic ustic and frigid. It is a Douglas Fir – Gambel’s Oak – Arizona Fescue plant community. The

effective precipitation ranges from 20 to 25 inches.

Associated sites

F048AY918CO	**Spruce-Fir Woodland** This site is found mostly commonly on mountain slopes, complex landslides, and mesas. Soils are moderately deep to very deep (20 to 60+ inches). Soil surface textures are loam, cobbly loam, gravelly loam, very cobbly sandy loam, very gravelly sandy loam, very stony sandy loam, very cobbly fine sandy loam, or stony fine sandy loam. Subsurface textures can be loamy-skeletal, or clayey-skeletal. It is usually ustic udic or typic udic and cryic. It is a Engelmann Spruce – Subalpine Fir – Elk Sedge – Slender Wheatgrass plant community. The effective precipitation ranges from 20 to 40 inches.
F048AY925CO	**Ponderosa Pine Forest** Ponderosa Pine Forest occurs on hillsides, mountain-slopes, mesas, structural benches and cuestas. Slopes are 3 to 30%. Soils are moderately deep to very deep (20 to 60+ inches). Soils are derived from slope alluvium from sandstone and/or shale, colluvium from sandstone and/or shale, or residuum from sandstone and shale. Soil surface texture is a loam, clay loam, sandy loam, fine sandy loam, very stony loam, cobbly sandy loam, or very boulder sandy loam with fine textured subsurface. It is a Ponderosa Pine - Muttongrass – squirreltail community. It has a typic ustic moisture regime. The effective precipitation ranges from 16 to 20 inches.
R048AY250CO	**Subalpine Loam** This site occurs on hills, mountain-slopes, and mountains. Slopes is between 1 to 30%. Soils are deep to very deep (20 to 60+ inches). Soils are derived from colluvium and alluvium from volcanic rock; complex landslide deposits from igneous, metamorphic, and sedimentary rock; and slope alluvium, colluvium, residuum, alluvium or complex landslide deposits from sandstone and shale or shale. Soil surface texture is loam with loamy textured subsurface. It is a mountain big sagebrush – Thurber's Fescue community. It has an ustic udic/typic udic moisture regime and cryic temperature regime. The effective precipitation ranges from 20 to 30 inches.
F048AY449CO	**Aspen Woodland** Aspen Woodland is a permanent type aspen stand in Western Colorado. This site is found mostly commonly on mountain slopes, hills, and complex landslides. Soils are moderately deep to very deep (20 to 60+ inches), dark and high in organic matter. Soil surface textures are loam, stony loam, very stony loam, cobbly loam, gravelly loam or very cobbly loam. Subsurface textures can be fine-loamy, loamy-skeletal, clayey-skeletal or fine. It is usually ustic udic and can be frigid or cryic. It is a Aspen – Wood's Rose – Slender Wheatgrass community. It Precipitation ranges from 20 to 30 inches, but on favorable north and east aspect it can be found as low as 18
R048AY238CO	**Brushy Loam** This site occurs on hills, mountains, complex landslides, and benches. Slopes is between 3 to 35%. Soils are moderately deep to deep (20 to 60+ inches), soils derived from colluvium, residuum, slope alluvium and alluvium from sandstone and shale. Soil surface texture is loam or clay loam with fine-textured subsurface. It is a Gambel's oak – slender wheatgrass community. It has a typic ustic moisture regime. The effective precipitation ranges from 16 to 20 inches.

Similar sites

F048AY475UT	**Mountain Very Steep Stony Loam (Douglas Fir)** The soils of this site formed mostly in colluvium over residuum from sandstone and shale. Surface soils are extremely bouldery fine sandy loam, extremely stony loam to very channery loam in texture. Rock fragments may be present on the soil surface and throughout the profile, but make up more than 35 percent of the soil volume. These soils are shallow to deep, well-drained, and have moderately slow to moderate permeability. pH is slightly to moderately alkaline. Available water-holding capacity ranges from 2 to 5 inches of water in the upper 60 inches of soil. The soil moisture regime is mostly ustic and the soil temperature regime is frigid. Precipitation ranges from 16-22 inches annually.
F048AY509UT	**High Mountain Loam (Douglas-Fir)** The soils of this site formed mostly in colluvium and/or slope alluvium derived from sedimentary rock over residuum weathered from sedimentary rock. Surface soils are 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 moderately deep, well-drained, and have moderately slow permeability. pH is neutral to slightly alkaline. Available water-holding capacity ranges from 4 to 6 inches of water in the upper 40 inches of soil. The soil moisture regime is mostly udic and the soil temperature regime is cryic. Precipitation ranges from 20-25 inches annually.

F048AY523UT	**High Mountain Stony Loam (Douglas Fir)** The soils of this site formed mostly in colluvium derived from sandstone and shale. Surface soils are clay loam to flaggy clay loam texture. Rock fragments may be present on the soil surface and throughout the profile, and make up more than 50 percent of the soil volume. These soils are moderately deep to deep, well-drained, and have moderately slow permeability. pH is neutral 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 20-30 inches annually.
F048AY530UT	**High Mountain Very Steep Loam (Douglas Fir)** The soils of this site formed mostly in colluvium derived from sedimentary rock and/or shale. Surface soils are very stony fine sandy loam, extremely bouldery loam to loam in texture. Rock fragments may be present on the soil surface and throughout the profile, but generally make up less than 35 percent of the soil volume. These soils are shallow to deep, well-drained, and have moderately slow to moderate permeability. pH is neutral to slightly alkaline. Available water-holding capacity ranges from 2 to 8 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 20-30 inches annually.
F048AY452UT	**Mountain Stony Loam (Douglas Fir)** The soils of this site formed mostly in slope alluvium, colluvium and residuum from sedimentary rock. Surface soils are channery to very channery loam in texture. Rock fragments may be present on the soil surface and throughout the profile, and generally makes up more than 35 percent of the soil volume. These soils are shallow to moderately deep, well-drained, and have moderatel permeability. pH is slightly to moderately alkaline. Available water-holding capacity ranges from 1 to 5 inches of water in the upper 50 inches of soil. The soil moisture regime is mostly ustic and the soil temperature regime is frigid. Precipitation ranges from 16-22 inches annually.

Table 1. Dominant plant species

Tree	(1) *Pseudotsuga menziesii* (2) *Pinus ponderosa*
Shrub	(1) *Quercus gambelii* (2) *Amelanchier alnifolia*
Herbaceous	(1) *Festuca arizonica* (2) *Muhlenbergia montana*

Physiographic features

All forests from 6,950 to 8,200 feet with two phases, the Arizona fescue and Gambel oak.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope (2) Hillslope (3) Scarp slope (4) Mesa
Runoff class	Medium to high
Flooding frequency	None
Ponding frequency	None
Elevation	2,118–2,499 m
Slope	1–60%

Climatic features

Average annual precipitation is about 20 to 25 inches. Of this, approximately 65-75% falls as snow, and 25-35% falls as rain between middle of June to and the middle of September 1. Summer moisture is mostly from thundershowers in July, August and September. May to June is the driest period of the year with the driest month being June. December thru March is the wettest period and the wettest month is usually January. The average annual total snowfall is 198.5 inches. The snow depth usually ranges from 4 to 35 inches during November thru April. The highest winter snowfall record in this area is 354.5 inches which occurred in 1964-1965. The lowest

snowfall record is 68.5 inches during the 1914-1915 winter. The frost-free period typically ranges from 25 to 90 days. The last spring frost is typically the end of June to the middle of July. The first fall frost is the first week of August to the first week of September. Mean daily annual air temperature is about 17.9ºF to 51.5ºF, averaging about 13.6ºF for the winter and 54.9ºF in the summer. Summer high temperatures of 70ºF to mid-70ºF are not unusual. The coldest winter temperature recorded was -47ºF on February 6, 1982 and the warmest winter temperature recorded was 13.6ºF on December 18, 1917. The coldest summer temperature recorded was 15ºF on June 20, 1920 and the warmest was 95 ºF on July 17, 1949. Wide yearly and seasonal fluctuations are common for this climatic zone. Data taken from Western Regional Climate Center (2018) for Crested Butte, Colorado Climate Station.

This zone in MLRA 48 will need to be broken up into at least 7 land resources zones in future projects based on current knowledge of precipitation and temperature patterns.

West Central Zone Stations: use in write up above. Driest month is June and wettest months are December thru March.

Northwest Zone Climate Stations: Marvine Ranch, Pyramid, Vail and Winter Park. Driest month is June and the wettest period is October thru April.

Southwest Zone Climate Stations (Precambrian sedimentary and igneous): Cascade, Electra Lake, Rico, Silverton, Telluride 4 WNW and Trout Lake. This area has driest month as June and the wettest months are July and August.

Southwest Volcanics: Platoro and Rio Grande Reservoir. The driest month is June and the Wettest are August and March.

Northeast (Front Range Igneous and Metamorphic): Allen’s Park 2 NNW, Allen’s Park NNW, Breckenridge, Climax, Jones Pass 2E, and Squaw Mountain. April, May, July and August are the wettest months. February, December, November and October are the driest.

Southeast (Sangre de Cristo Mtns): North Lake – This is the only climate station in this zone. It driest months are December and January with July being the wettest. So, this area receives more summer precipitation than other zones in this climate zone.

Frigid high elevation valleys: Aspen 1 SW, Ouray, Tacoma, Gross Reservoir, Coal Creek Canyon, Steamboat Springs, Marvine, and Buckskin Mtn 1 E. These areas have longer growing seasons by 20 to 40 days over the cryic stations.

Table 3. Representative climatic features

Frost-free period (characteristic range)	5-36 days
Freeze-free period (characteristic range)	40-76 days
Precipitation total (characteristic range)	508-635 mm
Frost-free period (actual range)	3-46 days
Freeze-free period (actual range)	32-88 days
Precipitation total (actual range)	508-635 mm
Frost-free period (average)	19 days
Freeze-free period (average)	56 days
Precipitation total (average)	584 mm

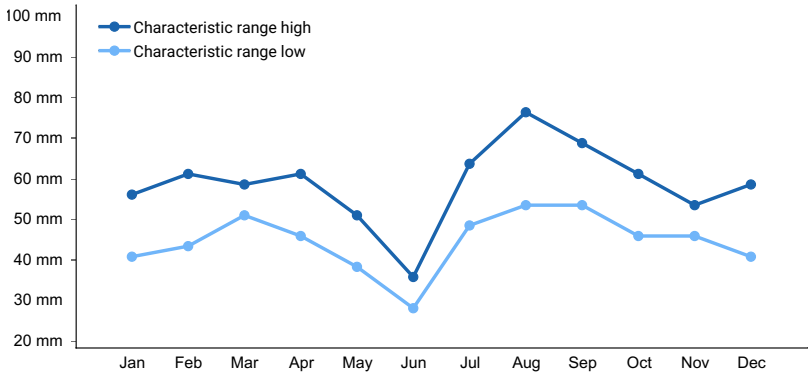


Figure 1. Monthly precipitation range

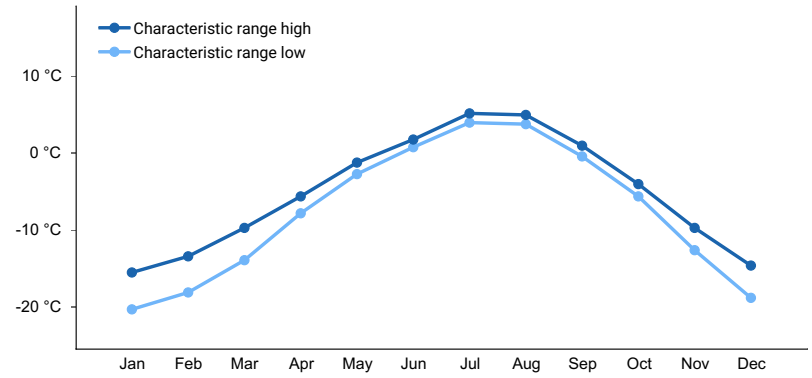


Figure 2. Monthly minimum temperature range

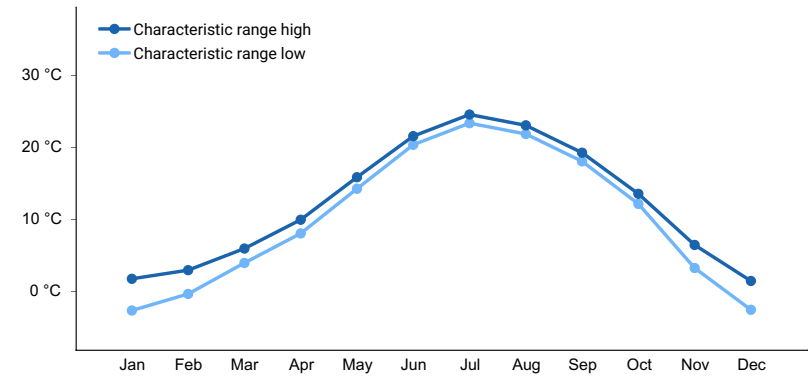


Figure 3. Monthly maximum temperature range

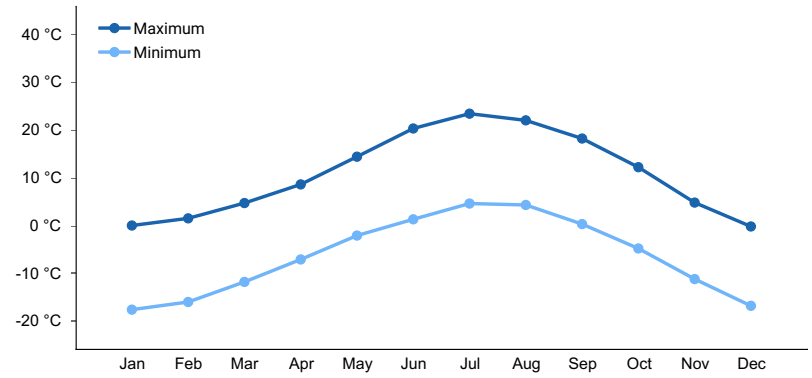


Figure 4. Monthly average minimum and maximum temperature

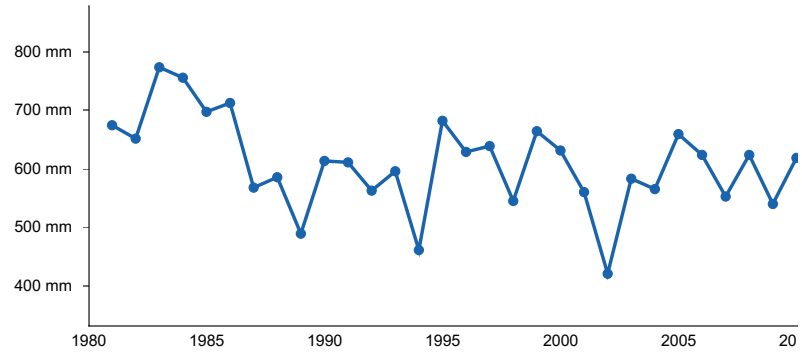


Figure 5. Annual precipitation pattern

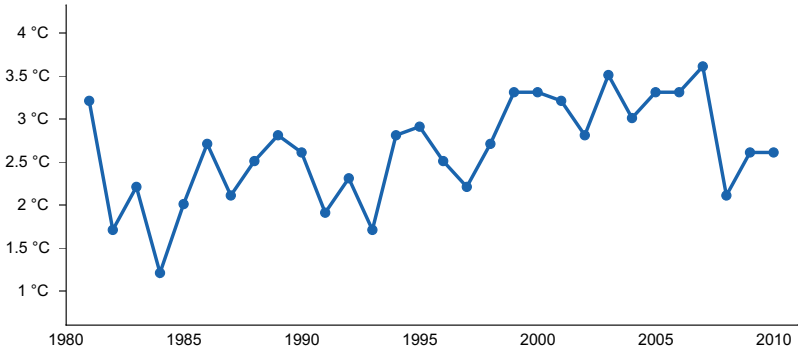


Figure 6. Annual average temperature pattern

Climate stations used

- (1) CLIMAX [USC00051660], Leadville, CO
- (2) CRESTED BUTTE [USC00051959], Crested Butte, CO
- (3) MARVINE RCH [USC00055414], Meeker, CO
- (4) RICO [USC00057017], Cahone, CO
- (5) RIO GRANDE RSVR [USC00057050], Lake City, CO
- (6) SILVERTON [USC00057656], Silverton, CO
- (7) TELLURIDE 4WNW [USC00058204], Telluride, CO
- (8) VAIL [USC00058575], Vail, CO

Influencing water features

None

Soil features

The moisture regime is Typic Ustic and the temperature regime is frigid.

Table 4. Representative soil features

Parent material	(1) Colluvium–sandstone and shale (2) Colluvium–andesite (3) Alluvium–andesite (4) Residuum–andesite (5) Debris spread deposits–sedimentary rock
Surface texture	(1) Very stony loam (2) Loam (3) Clay loam (4) Stony sandy clay loam (5) Very stony sandy loam

Family particle size	(1) Loamy-skeletal (2) Fine-loamy
Drainage class	Well drained
Permeability class	Moderately slow to moderate
Soil depth	51–203 cm
Surface fragment cover <=3"	0–10%
Surface fragment cover >3"	0–10%
Available water capacity (Depth not specified)	6.35–12.7 cm
Calcium carbonate equivalent (Depth not specified)	0–2%
Electrical conductivity (Depth not specified)	0–1 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	6.1–7.3
Subsurface fragment volume <=3" (Depth not specified)	0–10%
Subsurface fragment volume >3" (Depth not specified)	10–45%

Ecological dynamics

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, and kinds and times of timber harvest, 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 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. At the time of European colonization, what would have been observed on these sites depended primarily on the time since the last wildfire occurred. If the site had not experienced fire for about 100 years, Douglas-fir (*Pseudotsuga menziesii*) would have been the dominant species occupying the site with a sparse understory (1.1) due to tree competition, overstory shading, and duff accumulation. Douglas-fir replaces itself without wildfire and would have been the climax dominant. Wildfire (1.1a) would have replaced these stands with a rich herb-dominated vegetation (1.2). In the absence of any major disturbance (1.2a, 1.3a, 1.4a, 1.5a), the re-sprouting vegetation including Gambel oak

(*Quercus gambelii*) and/or quaking aspen (*Populus tremuloides*), would have reclaimed the site (1.3), followed by the increasing presence of aspen (*Populus tremuloides*), first as saplings (1.4), and later as mature aspen with Douglas-fir seedlings (1.5), ultimately to where aspen would have been outcompeted by Douglas-fir returning to the climax vegetation (1.1). Wildfire (1.1a, 1.5b) would have been the primary disturbance factor prior to colonization.

Community Phase 1.1: densely canopied Douglas-fir/ sparse understory
This plant community (1.1) would have been characterized by a stand of mature Douglas-fir with a sparse understory of Mountain Muhly (*Muhlenbergia montana*), Gambel Oak (*Quercus gambelii*), Fendler's meadow-rue (*Thalictrum fendleri*), and creeping barberry (*Mahonia repens*).

Community Pathway 1.1a:
Wildfire would have removed the trees, allowing shade-intolerant herbs to flourish briefly.

Community Phase 1.2: herb-dominated
This plant community would have developed within the first 5 years since the last fire, with Mountain Muhly, Arizona Fescue (*Festuca arizonica*), are the dominant understory species.

Community Pathway 1.2a:
After about 5 years, shrubs would begin to establish in the site.

Community Phase 1.3: re-sprouting aspen, maple, oak/ herbaceous understory
For a period of about 5 to 60 years post fire, a mixture of re-sprouting shrubs would have been dominant on the site, including, quaking aspen, and Gambel oak. Other prominent shrubs would have been mountain snowberry (*Symphoricarpos oreophilus*), chokecherry (*Prunus virginiana*), Saskatoon serviceberry (*Amelanchier alnifolia*), and Oregon boxleaf (*Paxistima myrsinites*), among others. The herbaceous understory would also have been fairly intact.

Community Pathway 1.3a:
About 60 years after fire, aspen would become established in the site.

Community Phase 1.4: immature aspen
This plant community would have been dominated by a stand of immature aspen, which is a seral species while Douglas-fir begins to establish itself under other nurse species. A stand of immature aspen would have existed approximately 60 to 80 years since last fire.

Community Pathway 1.4a:
Aspen would have continued to mature while Douglas-fir would have become well established in the understory.

Community Phase 1.5: mature aspen/ Douglas-fir
A stand of mature aspen intermixed with Douglas-fir saplings would have been encountered approximately 80 to 100 years post fire.

Community Pathway 1.5a:
After about 100 years following the last fire, Douglas-fir would become mature, shading out aspen and the shade-intolerant shrub and herb species in the understory.

Community Pathway 1.5b:
Wildfire would have removed the trees, allowing shade-intolerant herbs to flourish briefly.

Transition T1a: from State 1 to State 2 (Reference State to Secondary Forest/ Introduced 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. Europeans further altered this vegetation largely through logging, livestock grazing, trapping of fur beaver and changing the fire regime. Continued impacts could prevent the recovery toward potential conifer dominance (State 2, various phases). The reversal of these changes (i.e. a return pathway) back to State 1 is not practical.

State 2 Secondary Forest/ Introduced State
State 2 is similar to State 1 in form and function, with the exception of the presence of non-native plants and

animals, possible extinctions of native species, a different climate, and a secondary stand of trees. State 2 is a description of the ecological site shortly following Euro-American settlement. This state can be regarded as the current potential. With the least amount of disturbance or manipulation of fire regime (Alexander 1985; 1988), a mature stand of Douglas-fir with a sparse understory component is expected at this site (2.1). As with the Reference State, time since last wildfire remains the key factor in determining what vegetation would be encountered here. Wildfire, particularly crown fires, or complete harvesting of the forest (2.1b, 2.5b) will replace these stands with a rich herb-dominated vegetation. (2.2). In the absence of any major disturbance (2.2a, 2.3a, 2.4a, 2.5a), the vegetation will progress into more of a shrub-herb co-dominance (2.3), followed by the increasing presence of aspen first as saplings (2.4), and later as mature aspen with Douglas-fir (2.5), ultimately to where Douglas-fir will outcompete aspen returning to the climax vegetation (2.1). Because soils on this site are rocky they are considered “self-armoring,” thus making the site resistant to the effects of erosion. Heavy livestock grazing and tree harvests will reduce the stability of this site, while a reduction in livestock use and tree harvests will maintain stability.

Community Phase 2.1: densely canopied Douglas-fir/ sparse understory
This plant community (2.1) is characterized by a stand of mature Douglas-fir with a sparse understory of Mountain Muhly (*Muhlenbergia montana*), Gambel Oak (*Quercus gambelii*), Fendler’s meadow-rue (*Thalictrum fendleri*), and creeping barberry (*Mahonia repens*) may be present.

Community Pathway 2.1a:
A stand-replacing wildfire or intensive logging will set the vegetation back to an early seral herb-dominated phase. Logging opens up the forest canopy allowing more understory for 20 to 30 years.

Community Pathway 2.1b:
The removal of only the mature Douglas-fir will allow some aspen to return and the immature Douglas-fir to continue growing.

Community Phase 2.2: herb-dominated
This plant community will develop within the first 5 years since the last fire. Dominant grasses are Mountain Muhly, Arizona Fescue, and Geyer’s sedge with yarrow and strawberries as common forbs. A small component of introduced species may also be present.

Community Pathway 2.2a:
The combination of heavy season long livestock grazing and fire exclusion will accelerate woody plant (shrub) establishment and diminish the herbaceous understory.

Community Phase 2.3: re-sprouting aspen, maple, oak/ herbaceous understory
A plant community co-dominated by shrubs and herbs will develop approximately 5 to 60 years post fire. A small component of introduced species may be present.

Community Pathway 2.3a:
The combination of heavy season long livestock grazing and fire exclusion will accelerate woody plant establishment and diminish the herbaceous understory.

Community Pathway 2.3b:
Heavy browsing will lead to Phase 2.1, a densely canopied Douglas-fir community with a sparse understory.

Community Phase 2.4: immature aspen
Aspen will establish in the site 60 to 80 years after the last fire or complete tree removal.

Community Pathway 2.4a:
The combination of heavy season long livestock grazing and fire exclusion will accelerate woody plant establishment and diminish the understory.

Community Phase 2.5: mature aspen/ Douglas-fir
A stand of mature aspen intermixed with Douglas-fir will develop approximately 80 to 100 years following fire or complete tree removal.

Community Pathway 2.5a:
The combination of heavy season long livestock grazing and fire exclusion will accelerate woody plant establishment and diminish the understory.

Community Pathway 2.5b:
A stand-replacing wildfire or intensive logging will set the vegetation back to an early seral herb-dominated phase. Logging opens up the forest canopy allowing more understory for 20 to 30 years.

Community Pathway 2.5c:
The removal of mature aspen will leave a stand of immature aspen, possibly with a few Douglas-fir in the understory.

Transition T2a: from State 2 to State 3 (Secondary Forest/ Introduced State to Tertiary Forest/ Degraded State)
The Secondary Forest/ Introduced State will transition to the Tertiary Forest/ Degraded State following a second cycle of timber harvest or stand replacing wildfire, and further impacts from heavy continuous season-long grazing. Logging opens the forest canopy allowing shade tolerant understory for 20 to 30 years. Secondary and tertiary disturbances produce an assemblage of vegetation from degraded temporary meadows to further simplified forests. A key indicator of the approach to this transition the presence of dominant trees that have reached the size required for commercial harvest. The trigger is a management decision. The second cycle of cutting typically is a clear-cut, where all stems are downed, slash piled and burned.

State 3 Tertiary Forest/ Degraded State
State 3 is characterized by tertiary forests that are further degraded in both understory and remnant tree layers. Active fire suppression speeds up the recovery of dominance by woody plants. Less predictable changes in the vegetation of State 3 will ensue due to global climate changes.

Community Phase 3.1: densely canopied Douglas-fir/ sparse understory
This plant community (3.1) is characterized by a stand of mature Douglas-fir. A sparse understory of Geyer’s sedge and mountain muhly may be present.

Community Pathway 3.1a:
A stand-replacing wildfire or intensive logging will set the vegetation back to an early seral herb-dominated phase. Logging opens up the forest canopy, allowing shade-intolerant grasses, forbs, and shrubs to flourish for 20 to 30 years.

Community Pathway 3.1b:
The removal of only the mature Douglas-fir will allow aspen to return and the immature Douglas-fir to continue growing.

Community Phase 3.2: herb-dominated
This plant community will develop within the first 5 years since the last fire. Dominant grasses are Geyer’s sedge, Arizona Fescue, mountain muhly. A small component of introduced species may be present.

Community Pathway 3.2a:
After about 5 years, shrubs will begin to establish in the site.

Community Phase 3.3: re-sprouting aspen, maple, oak/ herbaceous understory
A plant community co-dominated by shrubs and herbs will develop approximately 5 to 60 years after fire or complete tree removal. A small component of introduced species may be present.

Community Pathway 3.3a:
Aspen will become established at the site after 60-80 years following the last wildfire or complete tree removal.

Community Phase 3.4: immature aspen
Immature aspen dominate the stand 60 to 80 years following the last fire or complete tree removal.

Community Pathway 3.4a:
Aspen matures and immature Douglas-fir become well established in the understory 80 years after the last fire or

complete tree removal.

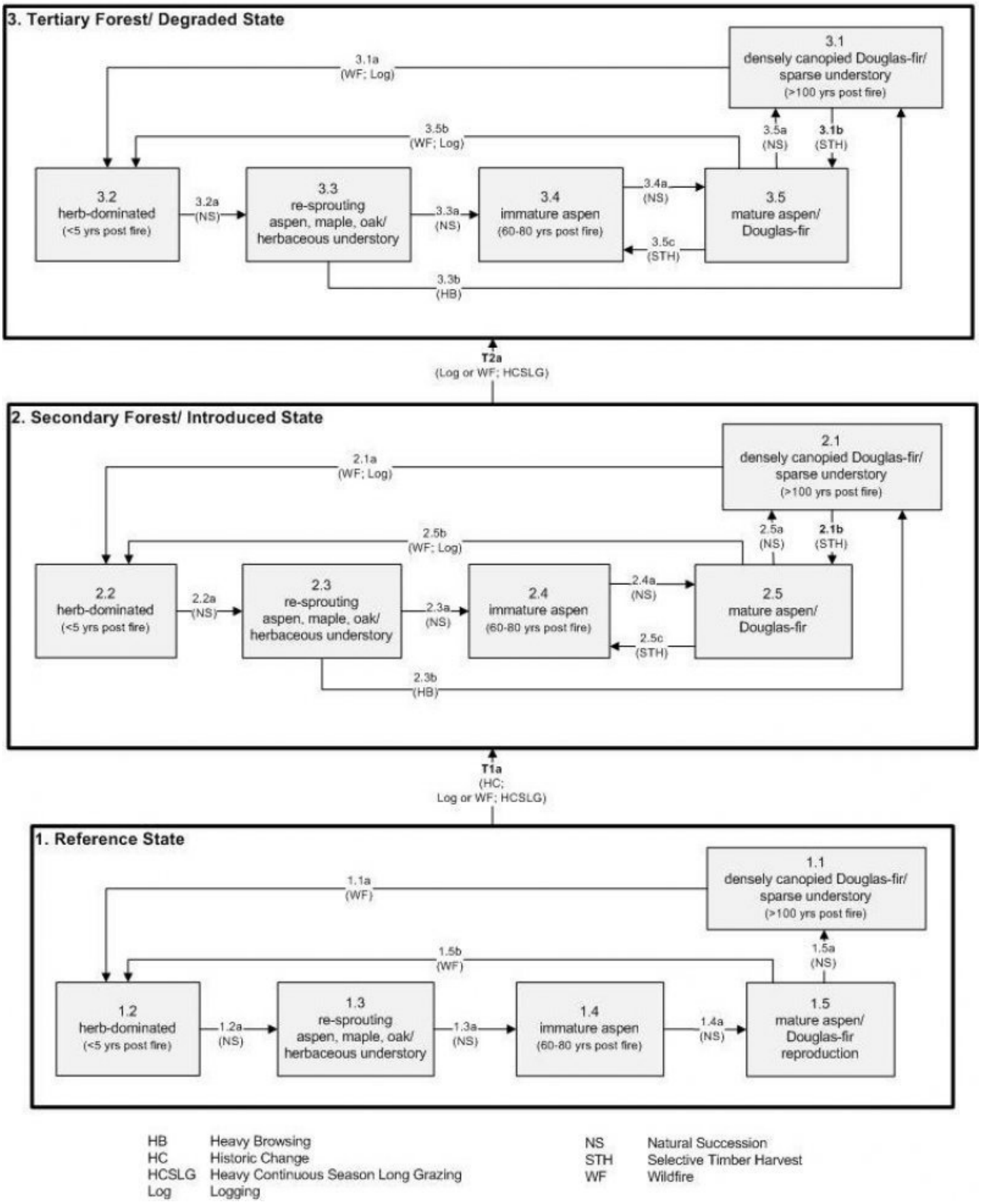
Community Phase 3.5: mature aspen/ Douglas-fir
A stand of mature aspen intermixed with Douglas-fir will develop approximately 80 to 100 years after the last fire or complete tree removal.

Community Pathway 3.5a:
After about 100 years following the last fire, Douglas-fir will become mature, shading out aspen and the shade-intolerant shrub and herb species in the understory.

Community Pathway 3.5b:
A stand-replacing wildfire or intensive logging will set the vegetation back to an early seral herb-dominated phase clear-cut. Logging opens the forest canopy allowing more understory for 20 to 30 years.

Community Pathway 3.5c:
The removal of mature aspen will leave a stand of immature aspen, possibly with a few Douglas-fir in the understory.

State and transition model



State 1
Douglas Fir/Gambel Oak

In addition to Douglas fir, ponderosa pine is often a dominant in the overstory. Undergrowth vary from nongrassy gambel oak dominated to relatively grassy gambel oak-arizona fescue associations. Soils are predominately eutroboralfs, glossoboralfs, and agriborolls. Adjacent sites to the Douglas fir/gambel oak include the white fir/gambel

oak on the upper end and the ponderosa pine/gambel oak on the lower end. As in the other sites where gambel oak is diagnostic, oak is the most conspicuous feature of the vegetation. Grasses are commonly important in the undergrowth, especially in the Arizona fescue phase. This site has broad possibilities for management ranging from forage utilization to timber production, which is low to moderate. Multilayered canopies in the undergrowth in this shrubby site support varied bird species.

Community 1.1
Douglas Fir/Gambel Oak

Total air-dry annual production in an unfavorable year is approximately 800 lbs/acre, average year 900 lbs/acre and in a favorable year is 1000 lbs/acre.

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grasses**			–	
	mountain brome	BRMA4	*Bromus marginatus*	–	–
	Geyer's sedge	CAGE2	*Carex geyeri*	–	–
	Ross' sedge	CARO5	*Carex rossii*	–	–
	squirreltail	ELEL5	*Elymus elymoides*	–	–
	Arizona fescue	FEAR2	*Festuca arizonica*	–	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	–	–
	mountain muhly	MUMO	*Muhlenbergia montana*	–	–
	muttongrass	POFE	*Poa fendleriana*	–	–
Forb					
2	**Forbs**			–	
	common yarrow	ACMI2	*Achillea millefolium*	–	–
	trailing fleabane	ERFL	*Erigeron flagellaris*	–	–
	woodland strawberry	FRVEB2	*Fragaria vesca ssp. bracteata*	–	–
	Virginia strawberry	FRVI	*Fragaria virginiana*	–	–
	northern bedstraw	GABO2	*Galium boreale*	–	–
	creeping barberry	MARE11	*Mahonia repens*	–	–
	Fendler's meadow-rue	THFE	*Thalictrum fendleri*	–	–
	American vetch	VIAM	*Vicia americana*	–	–
	violet	VIOLA	*Viola*	–	–
Shrub/Vine					
3	**Shrubs**			–	
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	–	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	–	–
	leather flower	CLEMA	*Clematis*	–	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	–	–
	chokecherry	PRVI	*Prunus virginiana*	–	–
	Gambel oak	QUGA	*Quercus gambelii*	–	–
	whitestem gooseberry	RIIN2	*Ribes inerme*	–	–
	Woods' rose	ROWO	*Rosa woodsii*	–	–
	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	–	–
Tree					
4	**Trees**			–	
	ponderosa pine	PIPO	*Pinus ponderosa*	–	–
	quaking aspen	POTR5	*Populus tremuloides*	–	–
	Douglas-fir	PSME	*Pseudotsuga menziesii*	–	–

Other references

Chapman, S.S., G.E. Griffith, J.M. Omernik, A.B. Price, J. Freeouf, and D.L. Schrupp. 2006. Ecoregions of Colorado. (2-sided color poster with map, descriptive text, summary tables, and photographs). U.S. Geological

Survey, Reston, VA. Scale 1:1,200,000.

Cleland, D.T.; Freeouf, J.A.; Keys, J.E.; Nowacki, G.J.; Carpenter, C.A.; and McNab, W.H. 2007. Ecological Subregions: Sections and Subsections for the conterminous United States. Gen. Tech. Report WO-76D [Map on CD-ROM] (A.M. Sloan, cartographer). Washington, DC: U.S. Department of Agriculture, Forest Service, presentation scale 1:3,500,000; colored.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Western Regional Climate Center. Retrieved from http://www.wrcc.dri.edu/summary/Climsmco.html on December 10, 2018

Contributors

Scott Woodall
Suzanne Mayne-Kinney

Approval

Kirt Walstad, 3/05/2024

Acknowledgments

Project Staff:
Suzanne Mayne-Kinney, Ecological Site Specialist, NRCS MLRA, Grand Junction SSO
Chuck Peacock, MLRA Soil Survey Leader, NRCS MLRA Grand Junction SSO

Program Support:
Rachel Murph, NRCS CO State Rangeland Management Specialist, Denver
Scott Woodhall, NRCS MLRA Ecological Site Specialist-QA Phoenix, AZ
Eva Muller, Regional Director, Rocky Mountain Regional Soil Survey Office, Bozeman, MT
B.J. Shoup, CO State Soil Scientist, Denver
Eugene Backhaus, CO State Resource Conservationist, Denver

Those involved in developing earlier versions of this site description include: Bob Rayer, retired NRCS Soil Scientist; Herman Garcia, retired CO State RMS and NRCS MLRA Ecological Site Specialist-QA Phoenix, AZ.

--Site Development and Testing Plan--:

Future work to validate and further refine the information in this Provisional Ecological Site Description is necessary. This will include field activities to collect low-, medium-, and high-intensity sampling, soil correlations, and analysis of that data.

Additional information and data is required to refine the Plant Production and Annual Production tables for this ecological site. The extent of MLRA 48A must be further investigated.

Field testing of the information contained in this Provisional ESD is required. As this ESD is moved to the Approved ESD level, reviews from the technical team, quality control, quality assurance, and peers will be conducted.

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	05/17/2024
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:**