USDA Natural Resources Conservation Service

Ecological site R051XY286CO
Rocky Foothills

Last updated: 12/11/2024
Accessed: 02/07/2025

General information

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

MLRA notes

Major Land Resource Area (MLRA): 051X–High Intermountain Valleys

This MLRA encompasses the San Luis Valley in south central Colorado and the Taos Plateau and Taos alluvial fans of north central New Mexico. As part of the northern portion of the Rio Grande Rift, the MLRA consists of large, alluvium filled basins washed down from adjacent mountain ranges. The Rio Grande River flows through this MLRA, continuing its long function of carrying mountain sediment down to the basin. Cenozoic volcanism is an extensive characteristic of the MLRA where large basalt flows with volcanic hills and domes are abundant.Ancient Lake Alamosa is a large feature within the MLRA.

Classification relationships

NRCS:
Major Land Resource Area 51, High Intermountain Valleys (United States Department of Agriculture, Natural Resources Conservation Service, 2006).

USFS:
331J – Northern Rio Grande Basin M331Ic > 331Ja - San Luis Valley, 331Jb - San Luis Hills and 331C - Mogotes

EPA:
22 - Arizona/New Mexico Plateau > 22a - San Luis Shrublands and Hills ; 22b -San Luis Alluvial Flats and Wetlands ; 22c - Salt Flats; 22e - Sand Dunes and Sand Sheets and 22f -Taos Plateau (Griffith, 2006).

USGS:
Southern Rocky Mountain Province

Ecological site concept

Parent materials are mostly residuum with some colluvium and alluvium, derived from andesite and rhyolite. Soils are shallow. Areas of rock outcrop are scattered throughout. Elevation ranges from 8000 to 9500 feet. Slope position is variable from summit positions to back slopes. The soils are loamy-skeletal with the presence of rocks, cobbles, and stones throughout.

Associated sites

R051XY277CO	**Basalt Hill 7-12 PZ** The Basalt Hills site is associated with basalt flows. Rocky Foothills is associated with andesite and rhyolite volcanic landforms.

R051XY276CO	**Limy Bench** The Rocky Foothills exists on a volcanic formation while Limy Bench is on the surrounding alluvial fan alluvium.
R051XY281CO	**Mountain Outwash** The Mountain Outwash site is made up of deep alluvium on the slope. The Rocky Foothills is very shallow to moderately deep over a lithic contact.
R051XY279CO	**Foothill Sand 9-12 PZ** The Foothill Sand site occurs alluvial fans at the upper portion of slope, connected to the Sangre de Cristo Mountains. The source of parent material is a mixing of both alluvial material from the mountains and eolian material blown in from the San Luis Valley's sand sheet and active dune field. Surface textures range from very cobbly sandy loam to loamy sand. Taxonomic particle size class ranges from loamy-skeletal to sandy. Soils are deep and slope commonly ranges from 4 to 15 percent. There are stringers of pinyon and juniper extending down from tmountain-base and some scattered P-J throughout the site.

Similar sites

R051XY281CO	**Mountain Outwash** The Mountain Outwash site is made up of deep alluvium on the slope. The Rocky Foothills is very shallow to moderately deep over a lithic contact.

Table 1. Dominant plant species

Tree	(1) *Pinus edulis* (2) *Juniperus osteosperma*
Shrub	(1) *Ribes cereum* (2) *Cercocarpus montanus*
Herbaceous	(1) *Pascopyrum smithii* (2) *Hesperostipa comata*

Physiographic features

This site may occur on gentle slopes but is most common on steep, broken land, especially the lower slopes of steep mountain ranges. This site occurs on bedrock controlled slope positions such as the summit, shoulder, and backslope of mountains and mountain slopes.
It is usually dissected by arroyos and small canyons. Slopes range from 2 to 65% and are quite variable. In the driest areas the site may be confined to long northerly-facing slopes. In other places this site is on dry southerly exposures, the opposite slope having a woodland site on them. Elevation is 8,000 to 9,500 feet.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Shoulder (3) Backslope
Landforms	(1) Mountain (2) Mountain slope
Runoff class	Medium to high
Flooding frequency	None
Ponding frequency	None
Elevation	8,000–9,500 ft
Slope	2–65%
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

The climate that typifies the High Intermountain Valley, ranges from arid to semi-arid, and is characterized by cold

winters, moderate summers, and much sunshine. Average annual precipitation ranges from 7 to 10 inches along the valley floor and throughout most of the resource area. Upper elevations and southern reaches range from 9 to 12 inches. This ecological site occurs in the 12 to 16 inch precipitation zone. Precipitation extremes vary from 3 to 20 inches per year depending on location. The San Juan mountain range to the west and the Sangre de Cristo Mountains to the east intercept much of the precipitation causing a two-way rain shadow effect. Approximately 60 to 65 percent of the annual precipitation falls between May 1 and October 1, mostly from short duration high intensity thundershowers in July and August. Snowfall averages 34 inches annually; snow cover is light or patchy throughout much of the winter. Wind speeds average 7 miles per hour annually. High wind velocities are common in the spring.

Cold air from the encompassing mountain ranges drain into the valley and settle. This phenomena results in long cold winters and moderate summer temperatures. July is the hottest month and January is the coldest. Summer temperatures range from highs in the upper 70's and low 80's and occasionally reach to the mid 90o F. Summer nights are cool, with lows averaging in the mid 40's. Temperatures of -20oF to -40oF can be expected each year and are common during some winters. Higher elevations can receive a dusting of snow as early as September 1. There is a 50% probability that the first frost in the fall will occur near September 16, and the last frost in the spring on about June 9. The average length of the growing season is 119 days and varies from 94 to 143 days. Summer humidity is low. Evaporation rates average lower than those of dry regions because of the cool climate.

Most major plant species initiate growth between mid May and late July, but growth may extend into September. Some cool season plants begin growth earlier and complete growth by mid June.

Note: Great Sand Dunes National Monument (CO) and Cerro (NM) are on the edge of the Valley and only cover the lower range (12-14 inches) of precipitation that this site occurs in. There are no climate stations in that are located in the valley in the upper precipitation range of this ecological site.

Table 3. Representative climatic features

Frost-free period (characteristic range)	90-91 days
Freeze-free period (characteristic range)	104-120 days
Precipitation total (characteristic range)	12-16 in
Frost-free period (actual range)	89-92 days
Freeze-free period (actual range)	100-124 days
Precipitation total (actual range)	12-16 in
Frost-free period (average)	91 days
Freeze-free period (average)	112 days
Precipitation total (average)	14 in

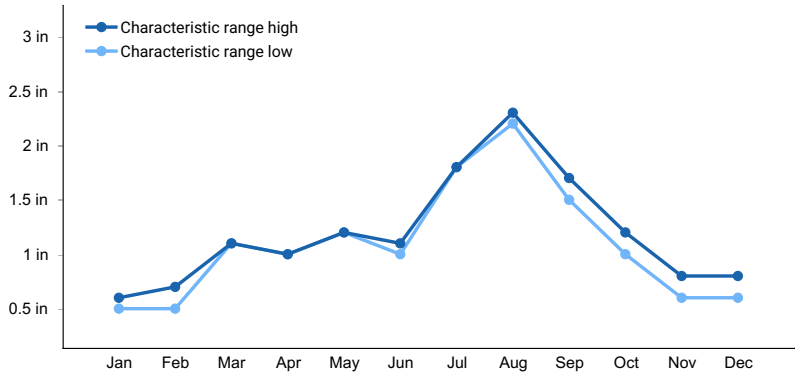


Figure 1. Monthly precipitation range

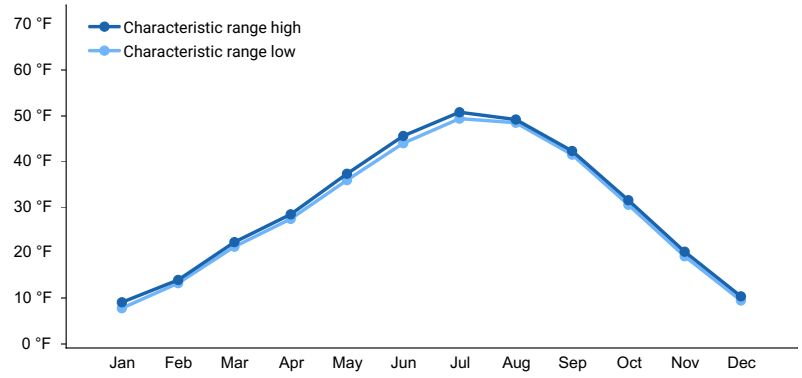


Figure 2. Monthly minimum temperature range

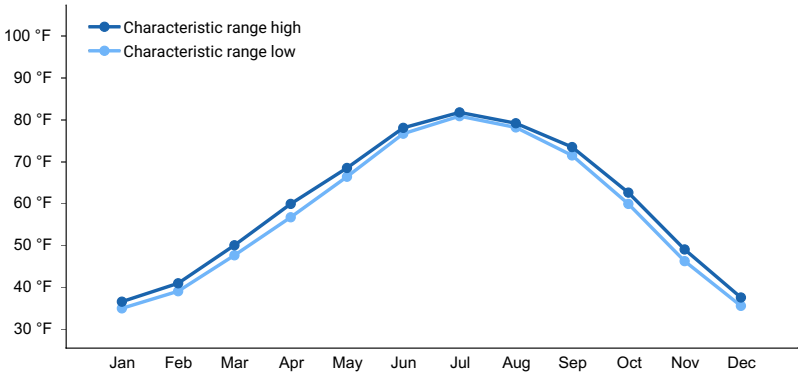


Figure 3. Monthly maximum temperature range

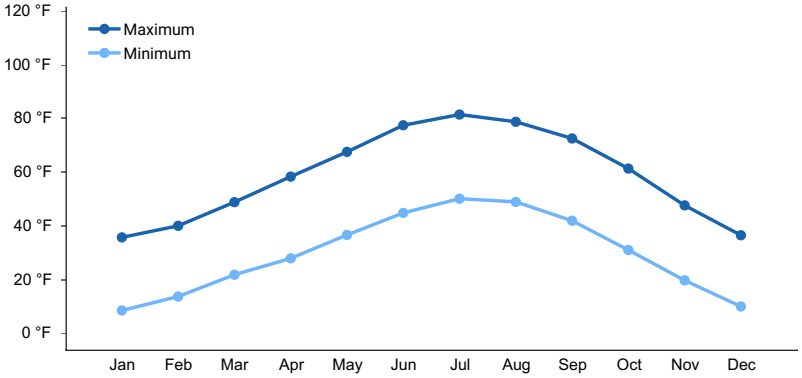


Figure 4. Monthly average minimum and maximum temperature

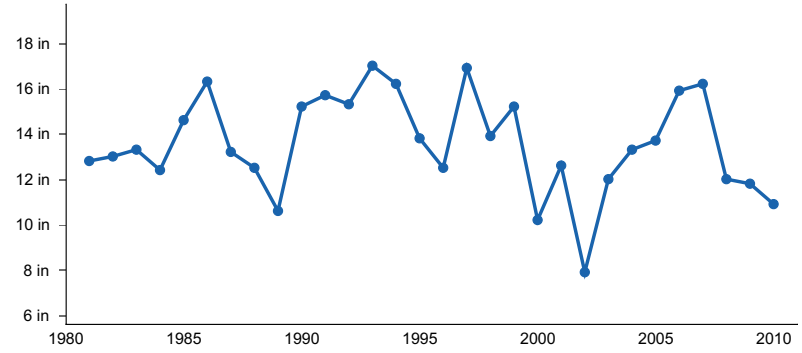


Figure 5. Annual precipitation pattern

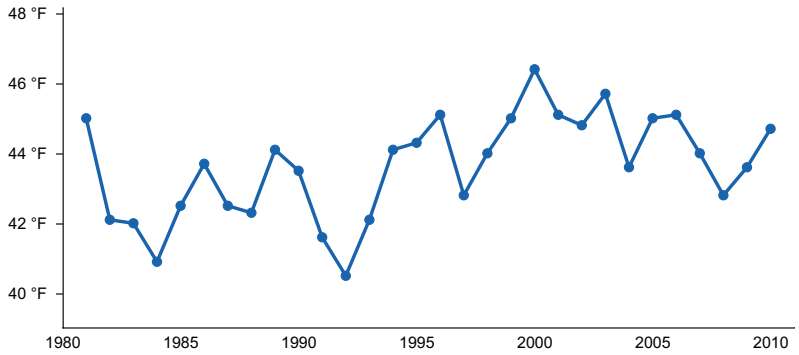


Figure 6. Annual average temperature pattern

Climate stations used

- (1) CERRO [USC00291630], Questa, NM
- (2) GREAT SAND DUNES NM [USC00053541], Mosca, CO

Influencing water features

This site does not have a water table.

Soil features

Soils are skeletal with depth and shallow over lithic contact. Occasionally. this site has been correlated to soils that are 20-30 inches in depth. Typically they contain a great deal of smaller rock fragments as well as stones, and occur in a complex pattern with nearly bare rock outcrops and pockets of deeper soils. Deep rooted plants make use of the deeper soil pockets which collect moisture from surrounding rock outcrops, and in cracks in underlying rock. But water storage is limited by rockiness and general lack of depth.

Table 4. Representative soil features

Parent material	(1) Residuum–andesite (2) Residuum–volcanic rock (3) Colluvium–tuff (4) Colluvium–andesite
Surface texture	(1) Very stony, extremely stony, very cobbly loam (2) Gravelly clay loam (3) Very gravelly coarse sandy loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Depth to restrictive layer	10–20 in
Soil depth	10–20 in
Surface fragment cover <=3"	5–20%
Surface fragment cover >3"	5–60%
Available water capacity (Depth not specified)	0.5–2 in
Calcium carbonate equivalent (Depth not specified)	0%
Electrical conductivity (Depth not specified)	0 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0

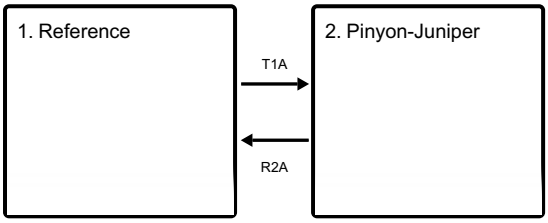
Soil reaction (1:1 water) (Depth not specified)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	10–45%
Subsurface fragment volume >3" (Depth not specified)	10–60%

Ecological dynamics

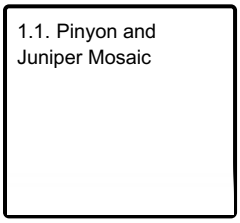
A rather open or patchy growth of pinon pine and juniper (mostly pinon_ mixed with a patchy stand of grasses and shrubs characterizes this site. Deep rooted plants make use of moisture collecting around boulders, in pockets of deeper soil, and in cracks and fissures in the bedrock. Water storage is limited by the skeletal soils and lack of depth. Tree species are twoneedle pinyon, Utah juniper and in some places Rocky Mountain juniper. Species most likely to increase are snakeweed, rubber rabbitbrush, ring muhly and Colorado rubberweed. As the ecological condition deteriorates the above plants often become prominent, along with hairy goldenaster and large amounts of prickly pear. Grasses may decline to an extremely patchy growth of blue grama. Pinon and juniper may increase substantially.

State and transition model

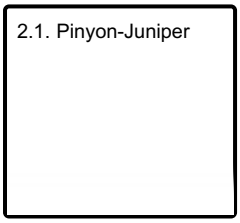
Ecosystem states



State 1 submodel, plant communities



State 2 submodel, plant communities



State 1
Reference

Figure 7. A diversity of grasses, forbs, and shrubs

The reference state has the greatest diversity and production of plants coupled with the least amount of bare ground. This state shows a mosaic of trees, shrubs, grasses, and forbs. Small clusters of pinyon and juniper are scattered throughout where deep and lateral root systems have found areas where moisture collects. Grasses with fibrous root systems such as western wheatgrass, needle and thread, Indian ricegrass, and blue grama take advantage of spring and summer rain to occupy areas where soil has collected between rocks. A diversity of forbs and shrubs use tap root systems to utilize moisture throughout the profile and into the crevices of the bedrock.

Resilience management. The reference state has the greatest resilience to disturbance. The diversity of species and root systems help maintain healthy ecosystem processes.

Community 1.1
Pinyon and Juniper Mosaic

Figure 8. A diverse group of plants

Figure 9. Grasses taking advantage of small cracks and pockets of soil along with a patch of shrubs.

Pinyon and juniper are growing in clusters where roots take advantage of water and nutrients in and around the bedrock. Major grasses include western wheatgrass, needle and thread, Indian ricegrass, and blue grama. Also common are muttongrass, prairie Junegrass, squirreltail, littleseed ricegrass, and (in favored locations) mountain muhly and small amounts of Arizona fescue. Forbs make up a small part of the yield, but some are conspicuous when in bloom. They include buckwheat, paintbrush, penstemon, hairy goldaster, Colorado rubberweed, lupine, and scarlet gilia. Important shrubs are alderleaf mountain mahogany, wax currant, and gooseberry. Serviceberry, skunkbush sumac, snowberry, prairie sagewort, fourwing saltbush, winterfat, prickly pear, and yucca are commonly present, and there may be some rock spirea.

Resilience management. The reference community is the most resilient to disturbance. A diversity of plant species keep the ecological health functional and able to resist colonization by trees.

Dominant plant species

- twoneedle pinyon (*Pinus edulis*), tree
- Utah juniper (*Juniperus osteosperma*), tree
- alderleaf mountain mahogany (*Cercocarpus montanus*), shrub
- whitestem gooseberry (*Ribes inerme var. inerme*), shrub
- western wheatgrass (*Pascopyrum smithii*), grass
- needle and thread (*Hesperostipa comata*), grass

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	220	385	495
Shrub/Vine	100	175	225
Tree	40	70	90
Forb	40	70	90
Total	**400**	**700**	**900**

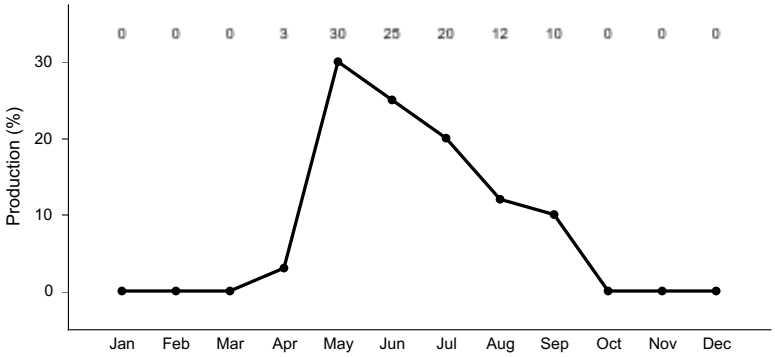


Figure 11. Plant community growth curve (percent production by month). CO5108, Cool-season Dominant Warm-season Subdominant, MLRA 51 Alluvial Fans & fan Remnants. Reference Plant Community for Chico Fan located in LRU 51-5 on fans and fan remnants above valley floor, predominantly in areas surrounding Villa Grove and Saguache, Saguache County..

State 2
Pinyon-Juniper

Community 2.1
Pinyon-Juniper

This state has a dominance of pinyon and juniper with some warm season grasses such as blue grama, threeawn and ring muhly. Forbs and shrubs such as snakeweed, rubber rabbitbrush, and Colorado rubberweed may be present as well. Reference species will still be present in protected areas between rocks or within shrubs.

Resilience management. The site has lost valuable ecosystem services such as wildlife habitat and livestock production. Resilience to disturbance is less as species diversity has decreased.

Transition T1A
State 1 to 2

As herbaceous diversity and cover have decreased due to grazing without adequate recovery periods along with over-utilization of preferred species, bare ground becomes available for expansion and germination of pinon and juniper seedlings. As trees slowly expand, deep and lateral root systems dominate available, seasonal moisture intake. The dropping of needle cast also discourages growth by herbaceous plants.

Restoration pathway R2A
State 2 to 1

A set back to the pinyon and juniper mostly by drought, beetle kill, and fire. This disturbance coupled by management that allows for reference species to recover and colonize will allow for long-term restoration of the site.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1				275–450	
	western wheatgrass	PASM	*Pascopyrum smithii*	80–180	–
	needle and thread	HECO26	*Hesperostipa comata*	50–135	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	50–135	–
	blue grama	BOGR2	*Bouteloua gracilis*	30–90	–
	muttongrass	POFE	*Poa fendleriana*	15–45	–

	squirreltail	ELEL5	*Elymus elymoides*	15–45	–
	littleseed ricegrass	PIMI	*Piptatheropsis micrantha*	15–45	–
	mountain muhly	MUMO	*Muhlenbergia montana*	0–45	–
	Arizona fescue	FEAR2	*Festuca arizonica*	0–45	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	15–45	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–20	–
	mountain brome	BRMA4	*Bromus marginatus*	0–15	–
	roughleaf ricegrass	ORAS	*Oryzopsis asperifolia*	0–15	–
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	5–15	–
	pine dropseed	BLTR	*Blepharoneuron tricholepis*	0–10	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–10	–
	ring muhly	MUTO2	*Muhlenbergia torreyi*	0–5	–
Forb					
2				40–90	
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–10	–
	false boneset	BREU	*Brickellia eupatorioides*	0–10	–
	Wyoming Indian paintbrush	CALI4	*Castilleja linariifolia*	0–10	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–10	–
	bluebells	MERTE	*Mertensia*	0–10	–
	Colorado four o'clock	MIMU	*Mirabilis multiflora*	0–10	–
	sidebells penstemon	PESE11	*Penstemon secundiflorus*	0–10	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–10	–
	hairy clematis	CLHI	*Clematis hirsutissima*	0–10	–
	James' buckwheat	ERJA	*Eriogonum jamesii*	0–10	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–10	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–10	–
	fineleaf hymenopappus	HYFI	*Hymenopappus filifolius*	0–10	–
	pingue rubberweed	HYRI	*Hymenoxys richardsonii*	0–10	–
	scarlet gilia	IPAG	*Ipomopsis aggregata*	0–10	–
	narrowleaf stoneseed	LIIN2	*Lithospermum incisum*	0–10	–
	hoary tansyaster	MACA2	*Machaeranthera canescens*	0–10	–
	broom-like ragwort	SESP3	*Senecio spartioides*	0–10	–
Shrub/Vine					
3				125–225	
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	60–135	–
	wax currant	RICE	*Ribes cereum*	40–90	–
	whitestem gooseberry	RIINI	*Ribes inerme var. inerme*	20–45	–
	skunkbush sumac	RHTR	*Rhus trilobata*	10–20	–
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	0–20	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–20	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–20	–
	rockspirea	HODU	*Holodiscus dumosus*	0–20	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–20	–
	chokecherry	PRVI	*Prunus virginiana*	0–20	–

	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	0–20	–
	spineless horsebrush	TECA2	*Tetradymia canescens*	0–20	–
	soapweed yucca	YUGL	*Yucca glauca*	0–10	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–10	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–10	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–10	–
Tree					
4				40–90	
	Utah juniper	JUOS	*Juniperus osteosperma*	20–65	–
	twoneedle pinyon	PIED	*Pinus edulis*	20–65	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–20	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–10	–
	Douglas-fir	PSME	*Pseudotsuga menziesii*	0–5	–

Inventory data references

Location of Typical Example of the Site:
Rocky, north-facing slope along Rock Creek about 11 miles southwest of Monte Vista, Rio Grand County.

Field Offices in Colorado where the site occurs:
Alamosa, Center, and San Luis

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 posterwith 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 andSubsections 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.

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Contributors

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Approval

Kirt Walstad, 12/11/2024

Acknowledgments

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--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 are required to refine the Plant Production and Annual Production tables for this ecological site. The extent of MLRA 51 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)	C. Villa, S. Woodall, H. Garcia
Contact for lead author	
Date	02/06/2005
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None

2. **Presence of water flow patterns:** Flow paths are short and disconnected. Broken by surface rock and basal cover.

3. **Number and height of erosional pedestals or terracettes:** Pedestals are minimal and associated with flow paths. Debris dams are obvious following rainfall event. Roots not exposed.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Expect 5% or less bare ground. Surface and sub-surface rock are inherent to this site.

5. **Number of gullies and erosion associated with gullies:** None

6. **Extent of wind scoured, blowouts and/or depositional areas:** None

7. **Amount of litter movement (describe size and distance expected to travel):** Some movement is expected due to steepness of slope. Distance varies from 1-3 feet following intense rainfall events.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class rating anticipated to be 3-4 in the interspaces at soil surface.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** SOM ranges from 0.5-3%. Soils are shallow, surface texts are very stony, extremely stony, very cobbly loam. gravelly clay loam or very gravelly coarse sandy loam, and are well drained. The A-horizon ranges from 3-14 inches in depth and color ranges from grayish brown to dark grayish brown. Surface structure is weak fine granular, moderate very fine granular structure, or moderate medium granular structure.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The distribution of diverse grass, shrub, tree/forb canopy and root structure reduces raindrop impact and slows overland flow providing increased time for infiltration to occur. Also, the abundance of rock on the surface, slows velocity of runoff and acts to increase infiltration.

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

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: cool season bunchgrass >

    Sub-dominant: shrubs > cool season rhizomatous grass > trees > warm season bunchgrass >

    Other: forbs

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Perennial vegetation should show minimal mortality/decadence except during extreme drought when some decadence or mortality is expected.

14. **Average percent litter cover (%) and depth (in):** 10-15% litter cover at 0.25 inch depth or less. Extended drought can reduce litter to 5-10%.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 500 lbs./ac. low precip years; 800 lbs./ac. average precip years; 1000 lbs./ac. above average precip years. After extended drought or the first growing season following wildfire, production may be significantly reduced by 100 – 200 lbs./ac. or more.

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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:** None

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17. **Perennial plant reproductive capability:** The only limitations are weather-related, wildfire, natural disease, inter-species competition, wildlife, and insects that may temporarily reduce reproductive capability.
