USDA Natural Resources
Conservation Service

Ecological site R035XY238UT
Semidesert Shallow Hardpan (Utah Juniper-Pinyon)

Accessed: 05/11/2025

General information

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

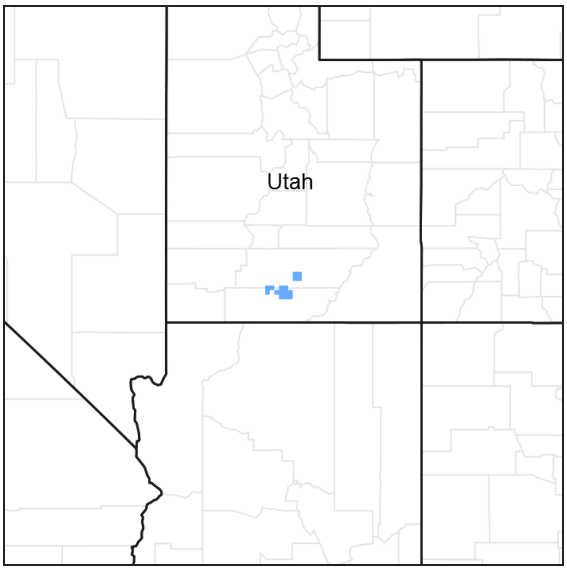

Figure 1. Mapped extent

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

Classification relationships

Colorado Plateau Pinyon-Juniper Woodland (NatureServ 2015).

Pinus edulis - Juniperus spp. / *Artemisia tridentata* (ssp. wyomingensis, ssp. vaseyana) Woodland (NatureServ 2015).

Pinus edulis - (*Juniperus osteosperma*) / *Bouteloua gracilis* Woodland (NatureServ 2015).

Ecological site concept

This site occurs in the semidesert zone of the Colorado and Green River Plateaus Region (MLRA 35) in southeastern Utah. It typically occurs on remnant stream terraces at elevations of 6000 to 7200 feet on slopes ranging from 2 to 15%. Soils are shallow over a cemented petrocalcic horizon, and formed in alluvium derived from sedimentary rocks. Soils are well-drained with moderately rapid permeability, with an aridic ustic soil moisture regime mesic soil temperature regime. The climax plant community is an open canopy of Utah juniper (*Juniperus osteosperma*) - twoneedle pinyon (*Pinus edulis*) over a Wyoming big sagebrush (*Artemisia tridentata* subsp. wyomingensis) shrub layer and productive blue grama (*Bouteloua gracilis*) – James' galleta (*Pleuraphis jamesii*) perennial grass layer. Shrub and grass cover is higher following disturbance that removes forest canopy. Biological soil crust (BSC) cover is characterized as high. The natural disturbance regime includes very infrequent stand-clearing fire, light grazing by native wildlife, and fluctuating climate with significant dry and wet periods.

Associated sites

R035XY209UT	**Semidesert Loam (Wyoming Big Sagebrush)** This site occurs on adjacent moderately to very deep soils. Wyoming big sagebrush is strongly dominant, and Indian ricegrass is a dominant grass. Utah juniper and twoneedle pinyon are minor species if present.
R035XY246UT	**Semidesert Stony Loam (Utah Juniper-Pinyon)** This site occurs on adjacent deep soils with bouldery or cobbly surfaces. Utah juniper and twoneedle pinyon dominate over a diverse shrub and grass understory. Wyoming big sagebrush is a trace species if present.

Similar sites

R035XY316UT	**Upland Shallow Loam (Pinyon-Utah Juniper) AWC >3** This site occurs on soils that are very shallow to shallow to sandstone bedrock. Mean annual precipitation is higher, and supports a more productive woodland. Twoneedle pinyon is dominant, and a diverse mixture of shrubs, forbs and grasses are found in the understory.

Table 1. Dominant plant species

Tree	(1) *Juniperus osteosperma*
Shrub	(1) *Artemisia tridentata subsp. wyomingensis*
Herbaceous	(1) *Bouteloua gracilis* (2) *Pleuraphis jamesii*

Physiographic features

This site occurs on remnant stream terraces at elevations between 6000 to 7200 feet. Slopes range from 2-15%. Runoff class is medium.

Table 2. Representative physiographic features

Landforms	(1) Stream terrace
Flooding frequency	None
Ponding frequency	None
Elevation	6,000–7,200 ft
Slope	2–15%

Climatic features

The climate is characterized by hot summers and cool winters. Large fluctuations in daily temperature are common. Precipitation is bimodal, with summer monsoons from July through October and winter rains from January through March. Precipitation is variable from month to month and from year to year and typically ranges between 8 and 14 inches. Snowpacks are generally light and not persistent.

Table 3. Representative climatic features

Frost-free period (average)	125 days
Freeze-free period (average)	140 days
Precipitation total (average)	11 in

Climate stations used

- (1) ESCALANTE [USC00422592], Escalante, UT
- (2) BOULDER [USC00420849], Boulder, UT

Influencing water features

Soil features

The soils associated with this ecological site are shallow over a cemented petrocalcic horizon, and formed from alluvium derived from sedimentary rock. Soils are well drained with moderate permeability. The soil moisture regime is aridic bordering on ustic and the soil temperature regime is mesic. The surface texture is a fine sandy loam. Surface rock fragments smaller than 3 inches in average 5% and larger rock fragments average 2%. Biological crust cover is characterized as moderate. Subsurface textures are loam, gravelly fine sandy loam, very gravelly fine sandy loam, and extremely gravelly loamy fine sand. Subsurface rock fragments smaller than 3 inches in diameter average 13% by volume, and larger fragments average 2%. The Horsemountain soils (Loamy, mixed, superactive, mesic, shallow Ustalfic Petrocalcids) are correlated to this ecological site.

This ecological site has been correlated to the following mapunits and soil components:

UT686 - Grand Staircase-Escalante National Monument - 5132 - Horsemountain (25%)
UT686 - Grand Staircase-Escalante National Monument - 5021 - Horsemountain (2%)

Typical Soil Profile:
A--0-4 inches; fine sandy loam; noncalcareous; slightly alkaline
Bt--4-7 inches; loam; slightly calcareous with disseminated carbonates; slightly alkaline
Btk--7 to 14 inches; gravelly fine sandy loam; strongly calcareous with carbonates in interior of peds; moderately alkaline
Bkm--14 to 19 inches; indurated petrocalcic layer of strongly effervescent, calcium carbonate cemented, extremely gravelly soil materials with a 0.5 to 1 inch thick laminar cap; moderately alkaline
Bk1--19 to 32 inches; very gravelly fine sandy loam; strongly calcareous with disseminated carbonates and segregated as moderately thick coatings on rock fragments; moderately alkaline
Bk2--32 to 61 inches; extremely gravelly loamy fine sand; strongly calcareous with disseminated carbonates and segregated as moderately thick coatings on rock fragments; moderately alkaline
Bk3--61 to 69 inches; gravelly fine sandy loam; strongly calcareous with carbonates are segregated as 1 mm thick coatings on rock fragments; moderately alkaline

Table 4. Representative soil features

Surface texture	(1) Fine sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate
Soil depth	8–20 in
Surface fragment cover <=3"	5%
Surface fragment cover >3"	2%
Available water capacity (0-40in)	1.4–1.7 in
Calcium carbonate equivalent (0-40in)	1–5%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	7.4–7.9
Subsurface fragment volume <=3" (Depth not specified)	13%

Subsurface fragment volume >3" (Depth not specified)	2%

Ecological dynamics

This site occurs in the semidesert zone of the Colorado and Green River Plateaus Region (MLRA 35) in southeastern Utah. The climax plant community is an open canopy of Utah juniper (*Juniperus osteosperma*) - twoneedle pinyon (*Pinus edulis*) over a Wyoming big sagebrush (*Artemisia tridentata* subsp. wyomingensis) shrub layer and productive blue grama (*Bouteloua gracilis*) – James' galleta (*Pleuraphis jamesii*) perennial grass layer. Shrub and grass cover is higher following disturbance that removes forest canopy. Biological soil crust (BSC) cover is characterized as high. The natural disturbance regime includes very infrequent stand-clearing fire, light grazing by native wildlife, and fluctuating climate with significant dry and wet periods. The current interpretive state is impacted by livestock grazing which has impacted BSC cover, soils and vegetative cover.

Low severity understory fires are generally accepted to have never been a significant process in pinyon-juniper systems on the Colorado Plateau (e.g. Floyd et al. 2004, Romme et al. 2009, Shinneman and Baker 2009). All evidence points to natural regime of very long fire rotations (400-600 years) with high-intensity stand-initiating events. Following fire (or other vegetation clearing disturbance), recovery of the woodland structure is very slow (West 1979, Floyd et al. 2000, Floyd et al. 2004, Floyd et al. 2008, Romme et al. 2009, Shinneman and Baker 2009), with a succession of early dominance by herbaceous species, a long-period of shrub dominance, and tree dominance taking as long as 250 years (West 1979, Floyd et al. 2004, Floyd et al. 2008, Shinneman and Baker 2009). Cheatgrass (*Bromus tectorum*) invasion in pinyon-juniper woodlands may increase fine fuel loads and increase fire frequency, thus significantly changing the natural dynamic (Floyd et al. 2008, Romme et al. 2009). No cheatgrass was observed during data collection for this ecological site, and the shallow soils with low water holding capacity may be relatively unsusceptible to cheatgrass.

The composition and productivity of this site is also significantly influenced by climatic patterns, and interactions of climate with fuel buildup and pathogen outbreaks (e.g. Floyd et al. 2004, Romme et al. 2009). Dramatic climate fluctuations that include periods of catastrophic drought and unusually wet conditions have been the norm for the Colorado Plateau for at least the past several centuries. Decadal scale variation in precipitation due to the Pacific Decadal Oscillation (PDO) has characterized the climate of the Colorado Plateau over the last century, with a wet period from 1905-1941, a dry period between 1942-1977, a wet period from 1978-1998, and a dry period from 1999 to the present, with a particularly catastrophic drought in 2002 (Ehleringer et al. 2000, Hereford et al. 2002, Miller 2004, Schwinning et al. 2008). Twoneedle pinyon is especially susceptible to mortality from both direct effects of drought, and indirect effects such as barkbeetle (Ips) attack (Romme et al. 2009). Severe drought with high temperatures caused widespread twoneedle pinyon mortality throughout the Colorado plateau, with trees of cone bearing age suffering the greatest losses (Romme et al. 2009). Megadrought in the late 1500's is also thought to have caused severe pinyon mortality, and explain the general absence of twoneedle pinyon greater than 400 years old (Romme et al. 2009). Large recruitment pulses typically occured during the first wet period after sustained drought, and caused a surge in twoneedle pinyon recruitment early in the 20th century (Romme et al. 2009, Shinneman and Baker 2009). Utah juniper is much more drought resilient; very old juniper are more prevalent, and Utah juniper recruitment pulses have been more or less continuous over time (Shinneman and Baker 2009). In this ecological site drought impacts severe enough to cause a shift to a new community phase have not been observed; however fluctuations in precipitation are certainly important in the community dynamics of this site. Drought has caused mortality of twoneedle pinyon in the area, and precipitation determines herbaceous fuel loads, recovery trajectories after disturbance, and annual productivity, which interacts with browse and livestock impacts.

Historically the vegetation of the Colorado Plateau experienced only light grazing by native ungulates whose populations were kept in check by native predators such as mountain lions and wolves (Mack and Thompson 1982, Cole et al. 1997, Schwinning et al. 2008). One of the most significant impacts of livestock grazing in this arid region has been damage to biological soil crust (BSC), including reductions in species diversity, cover, and alteration of species composition, with simplified communities of cyanobacteria replacing lichen and moss species that may take decades to recover (e.g Evans and Belnap 1999, Belnap and Eldridge 2003). The loss of BSC reduces soil stability, and soil moisture holding capacity, and consequently increases erosion potential (Evans and Belnap 1999, Belnap and Eldridge 2003, Harris et al. 2003, Neff et al. 2005). The shallow soils of this site are extremely susceptible to erosion with a loss of BSC and vegetative cover. The loss of microsites for plant establishment and survival, and declines in soil moisture availability with the loss of crust have had significant impacts on the vegetation community, with perennial grasses largely disappearing from impacted areas.

Global climate change predictions for the Colorado Plateau include an increase in both average and extreme temperatures, which will increase the impacts of drought even if precipitation patterns remain relatively unchanged (Schwinning et al. 2008). The Colorado Plateau may be particularly sensitive to global climate change due to a transitional climatic position between strong monsoon dominated systems to the south and cool season precipitation dominance to the north (Ehleringer et al. 2000, Miller 2004). Evidence for global climate change so far shows an increase in minimum temperatures since the 1960s, a weak trend towards increasing winter precipitation and no change in the summer monsoon (Spence 2001). Climate change impacts could eventually eliminate twoneedle pinyon from this site.

The following State-and-Transition Model describes the most commonly occurring plant communities found on this ecological site. Separations between states and community phases are based on professional consensus. All tabular data listed for a specific community phase within this ecological site description represent a summary of one or more field data collection plots taken in modal communities within the community phase, except for community phase 1.1, which is inferred from community phase 2.1. Although such data are valuable in understanding the phase (kinds and amounts of ground and surface materials, canopy characteristics, community phase overstory and understory species, production and composition, and growth), they do not represent the absolute range of characteristics or an exhaustive listing of all species that may occur in that phase over the geographic range of the ecological site.

State and transition model

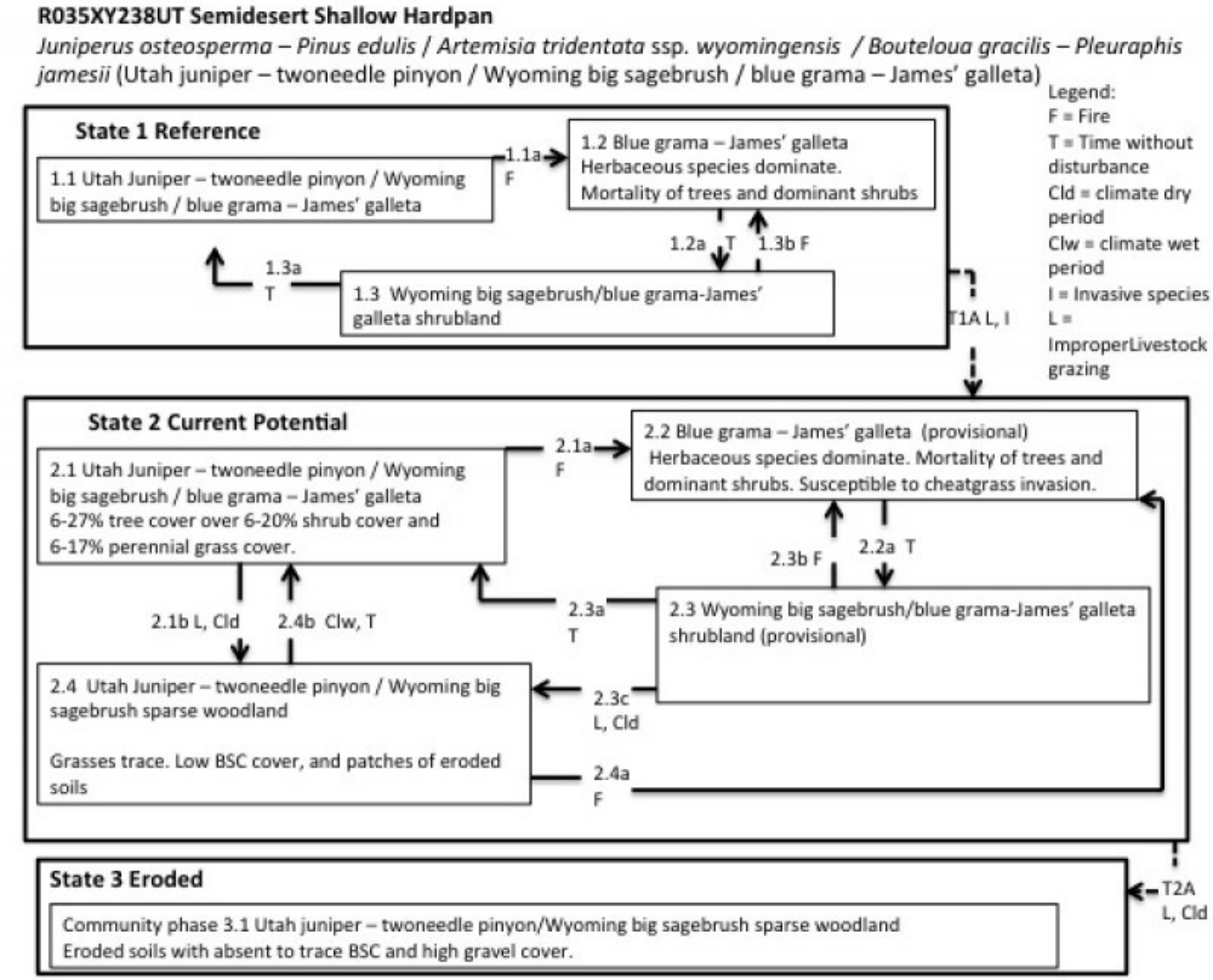

Figure 6. R035XY238UT

State 1
Reference

The reference state was determined by literature review, historical accounts, reports, and observations of trends in plant community dynamics. The reference state represents the plant communities and ecological dynamics of this ecological site under pre-settlement conditions and a natural disturbance regime. The plant communities of the reference state were similar to those of the current potential state (State 2), with a quasi climax community characterized by an open canopy of Utah juniper and twoneedle pinyon, over an open shrub layer dominated by Wyoming big sagebrush and a productive perennial grass component. The grass component could have had different composition in the reference plant community, as both blue grama and James' galleta may increase with grazing pressure, while less tolerant species like Indian ricegrass decline (Schmutz et al. 1967, Kleiner 1983, Tuhey and MacMahon 1988, Cole et al. 1997). Infrequent stand clearing fires would have created stands of shrublands and woodlands in different phases of succession. Non-native species were not present in the reference state. The species composition of the reference state BSC was likely different than in the current grazed state, with a higher proportion of lichens and mosses, and cover of BSC was probably greater. The primary disturbances included infrequent fire, fluctuations in precipitation, and native ungulate browsing. Plant communities will naturally shift among the three phases with very infrequent fire and climatic fluctuations. Reference State: Plant communities influenced by fire, browse, and climate fluctuations between wet and dry periods. Indicators: Dominance by Utah juniper and twoneedle pinyon with Wyoming big sagebrush and a productive perennial grass component, with stands of plant communities representing different phases of succession present over the landscape. Feedbacks: Very infrequent stand-clearing fire and light browse pressure allows for a self-sustaining woodland with herbaceous and shrub successional phases. At-risk Community Phase: All community phases are susceptible to severe impacts to BSC and soils from improper livestock grazing. Community phase 1.2 is particularly susceptible to invasion due to a lack of competition and extensive bare soil; however all phases are susceptible to invasion, especially with heavy grazing, browse or other disturbances that remove vegetative cover and disturb soils. Trigger: Improper livestock grazing, and introduction of invasive species.

Community 1.1
Utah Juniper – twoneedle pinyon / Wyoming big sagebrush / blue grama – James' galleta

Data for this community phase does not exist, but the community composition was likely similar to Community Phase 2.1. Indian ricegrass may have been more important in this phase, and broom snakeweed was likely less abundant (Cole et al. 1997). There was also probably higher overall vegetative cover, and higher BSC cover. Species composition in the below table was inferred from community phase 2.1.

Community 1.2
Blue grama – James' galleta

Data for this community phase does not exist, but the community composition was likely similar to Community Phase 2.2.

Community 1.3
Wyoming big sagebrush/blue grama-James' galleta shrubland

Data for this community phase does not exist, but the community composition was likely similar to Community Phase 2.3, except with possibly higher Indian ricegrass cover, higher overall vegetative cover, and higher BSC cover.

Pathway 1.1a
Community 1.1 to 1.2

This pathway occurs with infrequent, stand-clearing fire.

Pathway 1.2a
Community 1.2 to 1.3

This pathway occurs with time without additional disturbance. It will take a minimum of 11 years, and could take

much longer depending on precipitation amount and timing, and the availability of off-site seed for dispersal.

Pathway 1.3a
Community 1.3 to 1.1

This pathway occurs with time and a lack of additional disturbance.

Pathway 1.3b
Community 1.3 to 1.2

This pathway occurs with fire. Fire rotations in Wyoming big sagebrush are typically long, 35 to 100+ years (Baker 2006).

State 2
Current Potential

This state represents the current potential of this ecological site, and in addition to very infrequent fire and climate fluctuations, the dynamics include disturbance by livestock, which has caused significant erosion. The current potential state will naturally fluctuate between community phases 2.1 and 2.2, and will shift to community phase 2.3 with abusive livestock or recreational use. Continued abusive use, especially if coupled with severe drought, could cause a transition to an eroded state. Current Potential State: Plant communities influenced by very infrequent fire, climate fluctuations between wet and dry periods, and livestock grazing. Indicators: Dominance by Utah juniper and twoneedle pinyon with Wyoming big sagebrush and a productive perennial grass component, with stands of plant communities representing different phases of succession present over the landscape. Blue grama is the dominant grass, and James' galleta is an important species. Broom snakeweed is a significant minor species in all communities. BSC cover is not continuous, and in community phase 1.3 may be absent over large areas. Feedbacks: Very infrequent stand-clearing fire and light browse and grazing pressure allow for a self-sustaining woodland with herbaceous and shrub successional phases. At-risk Community Phase: Community 2.4 is especially at risk of transitioning to an eroded state with continued abusive livestock use, especially if accompanied by severe drought.

Community 2.1
Utah Juniper – twoneedle pinyon / Wyoming big sagebrush / blue grama – James' galleta

Figure 8. Community Phase 2.1

This community phase is characterized by 6 to 27% canopy cover of short-statured Utah juniper and twoneedle pinyon, with Utah juniper dominant, over 6 to 20% shrub canopy, with Wyoming big sagebrush the dominant shrub. Perennial grass cover ranges from 6 to 17% and is dominated by blue grama. Secondary shrubs may include broom snakeweed, Mormon tea (*Ephedra viridis*), banana yucca (*Yucca baccata*), and plains pricklypear (*Opuntia polyacantha*). James' galleta may be an abundant grass, and squirreltail (*Elymus elymoides*) and Indian ricegrass may be minor species. Forbs are a minor component of this community, and species may include Nevada biscuitroot (*Lomatium nevadense*), sego lily (*Calochortus nuttallii*), freckled milkvetch (*Astragalus lentiginosus*), longleaf phlox (*Phlox longifolia*), and pepperweed (Lepidium spp). Recruitment of Utah juniper and twoneedle

pinyon is evident with 2-15% cover of seedling and sapling juniper and 4-16% cover of seedling and sapling pine. Total foliar canopy cover averages 36%. The soil surface is dominated by BSC at 17 to 43% cover, with 0-4% moss, 7-16% litter, 1-6% woody debris, 0-4% gravel, and 0-37% bare ground.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	230	555	1130
Tree	300	375	420
Shrub/Vine	80	108	145
Forb	0	0	5
Total	**610**	**1038**	**1700**

Table 6. Ground cover

Tree foliar cover	6-27%
Shrub/vine/liana foliar cover	6-20%
Grass/grasslike foliar cover	6-17%
Forb foliar cover	0-1%
Non-vascular plants	0%
Biological crusts	17-43%
Litter	8-21%
Surface fragments >0.25" and <=3"	0-4%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0-37%

Table 7. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	0-1%	0-2%	6-9%	0-2%
>0.5 <= 1	0-1%	0-2%	0-17%	0-2%
>1 <= 2	0-1%	4-13%	0-4%	–
>2 <= 4.5	0-1%	2-6%	–	–
>4.5 <= 13	2-7%	–	–	–
>13 <= 40	3-19%	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 2.2
Blue grama – James' galleta (provisional)

Data was not collected for this community phase, and composition is based on literature review. This phase is characterized by herbaceous dominance, and may last for 11 or more years. Crown-sprouting shrubs such as banana yucca and Mormon tea, and grasses such as blue grama, James' galleta, squirreltail and Indian ricegrass will regenerate in the first year after fire. Annual forbs are likely to become abundant soon after fire, and remain

abundant in this phase if adequate precipitation is available. Perennial forbs and grasses gradually become dominant, and Wyoming big sagbrush, Utah juniper and twoneedle pinyon will begin to regenerate from seed.

Community 2.3
Wyoming big sagebrush/blue grama-James' galleta shrubland (provisional)

Data was not collected for this community phase, and composition is based on literature review. This phase is characterized by shrub dominance, with scattered regenerating trees. Wyoming big sagebrush is dominant, and secondary shrubs likely include Mormon tea, broom snakeweed, banana yucca, and plains pricklypear. Herbaceous species remain abundant in this phase, with blue grama and James' galleta dominant.

Community 2.4
Utah Juniper – twoneedle pinyon / Wyoming big sagebrush sparse woodland

Figure 10. Community Phase 2.4

This community phase is characterized by severe declines in the perennial grass component, with grass cover reduced to 2%, declines in BSC, and patches of soil erosion. Tree cover typically remains similar to community phase 2.1, although increases in twoneedle pinyon recruitment may occur with reduced competition from perennial grasses (e.g. Harris et al. 2003, Landis and Bailey 2005, Shinneman and Baker 2009). Shrub cover may be slightly higher in this phase due to reduced competition, and composition remains similar to community phase 2.1. Forb cover often increases in this phase, and the increaser rose heath (*Chaetopappa ericoides*) may be abundant. Biological soil crust cover is 5-9%, litter cover 4-8%, woody debris 1-4%, gravels 20-30% and bare ground 20-36%. This phase represents a significantly degraded ecological community, and is at high risk for transitioning to an eroded state with continued improper livestock use and/or drought.

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Tree	300	375	420
Shrub/Vine	70	105	155
Forb	0	44	65
Grass/Grasslike	9	13	20
Total	**379**	**537**	**660**

Table 9. Ground cover

Tree foliar cover	6-27%
Shrub/vine/liana foliar cover	15-20%
Grass/grasslike foliar cover	0-2%
Forb foliar cover	0-2%

Non-vascular plants	0%
Biological crusts	5-9%
Litter	5-12%
Surface fragments >0.25" and <=3"	20-30%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	20-36%

Table 10. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	0-1%	0-2%	0-1%	0-2%
>0.5 <= 1	0-1%	0-2%	0-2%	–
>1 <= 2	0-3%	3-10%	–	–
>2 <= 4.5	0-3%	8-15%	–	–
>4.5 <= 13	0-3%	–	–	–
>13 <= 40	6-20%	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Pathway 2.1a
Community 2.1 to 2.2

This pathway occurs with infrequent, stand-clearing fire.

Pathway 2.1b
Community 2.1 to 2.4

Utah Juniper – twoneedle pinyon / Wyoming big sagebrush / blue grama – James' galleta

Utah Juniper – twoneedle pinyon / Wyoming big sagebrush sparse woodland

This pathway occurs with improper livestock use that damages BSC and soils, leading to a loss of BSC cover and patches of erosion. Perennial grass cover and production decline. Drought will exacerbate this pathway.

Pathway 2.2a
Community 2.2 to 2.3

This pathway occurs with time without additional disturbance. It will take a minimum of 11 years, and could take much longer depending on precipitation amount and timing, and the availability of off-site seed for dispersal.

Pathway 2.3a
Community 2.3 to 2.1

This pathway occurs with time and a lack of additional disturbance. Forty to 100 years may be required before canopy trees are a dominant aspect of the community (e.g. West 1979, Shinneman and Baker 2009, Romme et al. 2009).

Pathway 2.3b
Community 2.3 to 2.2

This pathway occurs with fire. Fire rotations in Wyoming big sagebrush are typically long, 35 to 100+ years, but may be accelerated with cheatgrass invasion (Baker 2006).

Pathway 2.3c
Community 2.3 to 2.4

This pathway occurs with improper livestock use that damages BSC and soils, leading to a loss of BSC cover and patches of erosion. Perennial grass cover and production decline. Drought will exacerbate this pathway.

Pathway 2.4a
Community 2.4 to 2.2

This pathway occurs with fire. Fire is more unlikely in this phase due to a lack of fine fuels; however fire may occur with extreme fire weather (Romme et al. 2009).

State 3
Eroded

This state is characterized by tree dominance with only trace herbaceous cover, loss of BSC and eroded soils. Interpretive State: Plant communities influenced by soil erosion that inhibits recruitment, very infrequent fire and livestock grazing. Indicators: Dominance by Utah juniper and twoneedle pinyon with decadent Wyoming big sagebrush in the shrub layer and virtually no herbaceous layer. Lack of BSC and high gravel cover. Feedbacks: A soil surface inhospitable to vegetation recruitment and continued livestock grazing prevents a herbaceous component from establishing. Fire may be even more unlikely to occur in this phase due to the lack of fine fuels.

Community 3.1
Utah juniper – twoneedle pinyon/Wyoming big sagebrush sparse woodland

Figure 12. Community Phase 3.1

This community phase is characterized by a lack of herbaceous species. Squirreltail is the only grass present, and is at trace levels. Freckled milkvetch was the only forb recorded. Trees are the dominant component of this community phase. Shrub cover may be similar or reduced relative to the Interpretive state. Cactus cover is higher in this community phase due to the absence of competition and droughty shallow soils without ameliorating crust cover. Bare ground dominates the ground cover at 35-45%, with 20-30% gravels, 0-2% BSC, 5-9% litter, and 4-8% woody debris.

Table 11. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Tree	345	515	770
Shrub/Vine	75	110	165
Forb	0	0	1
Grass/Grasslike	0	0	1
Total	**420**	**625**	**937**

Table 12. Ground cover

Tree foliar cover	10-20%
Shrub/vine/liana foliar cover	10-15%
Grass/grasslike foliar cover	0%
Forb foliar cover	0%
Non-vascular plants	0%
Biological crusts	0%
Litter	9-17%
Surface fragments >0.25" and <=3"	20-30%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	35-45%

Table 13. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	0-1%	0-2%	0-1%	0-1%
>0.5 <= 1	0-1%	0-2%	0-1%	–
>1 <= 2	0-1%	0-2%	–	–
>2 <= 4.5	0-2%	7-15%	–	–
>4.5 <= 13	0-5%	–	–	–
>13 <= 40	10-20%	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Transition T1A
State 1 to 2

Transition from reference state (State 1) to current potential state (State 2). This transition may occur with improper livestock use and introduction of invasive species.

Transition T2A
State 2 to 3

This transition may occur with continued improper livestock grazing that causes further declines in BSC and vegetative cover. It may also occur with drought even if livestock grazing ends if the soil is already too destabilized.

Additional community tables

Table 14. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Shrub/Vine					
1	**Shrubs**			80–145	
	Shrub, other	2S	*Shrub, other*	0–10	0–2
	mormon tea	EPVI	*Ephedra viridis*	0–5	0–1
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–5	0–1
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–2	0–1
	banana yucca	YUBA	*Yucca baccata*	0–2	0–1
Tree					
2	**Trees**			300–420	
	Utah juniper	JUOS	*Juniperus osteosperma*	330–420	3–24
	twoneedle pinyon	PIED	*Pinus edulis*	21–170	2–7
Grass/Grasslike					
3	**Perennial Grasses**			700–1860	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	500–1000	5–10
	blue grama	BOGR2	*Bouteloua gracilis*	200–800	2–5
	James' galleta	PLJA	*Pleuraphis jamesii*	10–100	1–3
	Grass, perennial	2GP	*Grass, perennial*	0–50	0–3
	squirreltail	ELEL5	*Elymus elymoides*	0–10	0–1
Forb					
4	**Forbs**			0–5	
	Forb, annual	2FA	*Forb, annual*	0–5	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–5	0–5
	freckled milkvetch	ASLE8	*Astragalus lentiginosus*	0–1	0–1
	sego lily	CANU3	*Calochortus nuttallii*	0–1	0–1
	pepperweed	LEPID	*Lepidium*	0–1	0–1
	Nevada biscuitroot	LONE	*Lomatium nevadense*	0–1	0–1
	longleaf phlox	PHLO2	*Phlox longifolia*	0–1	0–1

Table 15. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Shrub/Vine					
1	**Shrubs**			80–145	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	5–25	1–4
	Shrub, other	2S	*Shrub, other*	0–10	0–2
	mormon tea	EPVI	*Ephedra viridis*	0–5	0–1
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–2	0–1
	banana yucca	YUBA	*Yucca baccata*	0–2	0–1
Tree					
2	**Trees**			300–420	
	Utah juniper	JUOS	*Juniperus osteosperma*	330–420	3–24
	twoneedle pinyon	PIED	*Pinus edulis*	21–170	2–7
Grass/Grasslike					
3	**Perennial Grasses**			230–1130	
	blue grama	BOGR2	*Bouteloua gracilis*	225–1023	6–12
	James' galleta	PLJA	*Pleuraphis jamesii*	0–90	0–5
	Grass, perennial	2GP	*Grass, perennial*	0–50	0–3
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–10	0–1
	squirreltail	ELEL5	*Elymus elymoides*	0–10	0–1
Forb					
4	**Native Forbs**			0–5	
	Forb, annual	2FA	*Forb, annual*	0–5	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–5	0–5
	freckled milkvetch	ASLE8	*Astragalus lentiginosus*	0–4	0–1
	sego lily	CANU3	*Calochortus nuttallii*	0–1	0–1
	pepperweed	LEPID	*Lepidium*	0–1	0–1
	Nevada biscuitroot	LONE	*Lomatium nevadense*	0–1	0–1
	longleaf phlox	PHLO2	*Phlox longifolia*	0–1	0–1

Table 16. Community 2.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Shrub/Vine					
1	**Shrubs**			70–155	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	9–26	1–2
	mormon tea	EPVI	*Ephedra viridis*	6–18	1–2
	kingcup cactus	ECTR	*Echinocereus triglochidiatus*	0–3	0–1
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–1	0–1
Tree					
2	**Trees**			300–420	
	Utah juniper	JUOS	*Juniperus osteosperma*	330–420	3–24
	twoneedle pinyon	PIED	*Pinus edulis*	21–170	2–7
Grass/Grasslike					
3	**Perennial Grasses**			9–20	
	squirreltail	ELEL5	*Elymus elymoides*	7–20	1–2
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–1	0–1
	blue grama	BOGR2	*Bouteloua gracilis*	0–1	0–1
Forb					
4	**Forbs**			0–65	
	rose heath	CHER2	*Chaetopappa ericoides*	0–65	0–1
	Wright's bird's beak	COWR2	*Cordylanthus wrightii*	0–1	0–1

Table 17. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Shrub/Vine					
1	**Shrubs**			75–165	
	plains pricklypear	OPPO	*Opuntia polyacantha*	15–45	2–10
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	6–18	1–2
	banana yucca	YUBA	*Yucca baccata*	0–5	0–1
	slender buckwheat	ERMI4	*Eriogonum microthecum*	0–5	0–1
Tree					
2	**Trees**			345–770	
	Utah juniper	JUOS	*Juniperus osteosperma*	175–520	2–15
	twoneedle pinyon	PIED	*Pinus edulis*	85–255	1–15
Grass/Grasslike					
3	**Perennial Grasses**			0–1	
	squirreltail	ELEL5	*Elymus elymoides*	0–1	0–1
Forb					
4	**Native Forbs**			0–1	
	freckled milkvetch	ASLE8	*Astragalus lentiginosus*	0–1	0–1

Animal community

--Livestock and Wildlife Grazing--

This site provides good grazing conditions for livestock and wildlife during fall, winter, and spring when in good

ecological condition due to accessibility and available nutritious forage. This site often lacks natural perennial water sources, which can influence the suitability for livestock and wildlife grazing. Care should be taken to maintain the native perennial grasses and shrubs due to the poor suitability for re-seeding or restoring this site. Reseeding and/or restoration are difficult due to the extreme temperatures and variability in time and amount of precipitation. This site may occur in mule deer habitat; however in many places the populations will be small and have little grazing impact on the site.

The plant community is generally equal mixtures of grasses, shrubs, and trees. Grasses include Indian ricegrass, blue grama, galleta, and squirreltail. These grasses provide good grazing conditions for all classes of livestock and wildlife. Palatable shrubs include Wyoming big sagebrush and green mormontea. These shrubs provide good winter browse for cattle, sheep, goats, and mule deer. Utah juniper and pinyon pine provide good cover for livestock and wildlife; mule deer and goats may also graze these trees. Forb composition and annual production depends primarily on precipitation amounts and thus is challenging to use in livestock grazing management decisions. However, forb composition should be monitored for species diversity, as well as poisonous or injurious plant communities which may be detrimental to livestock if grazed. Before making specific grazing management recommendations, an onsite evaluation must be made.

Hydrological functions

The hydrologic group is D.

Recreational uses

Recreational uses of this site are hiking, picnicking, and hunting.

Wood products

Potential wood products are fuel and posts.

Other information

--Poisonous/Toxic Plant Communities--

Toxic plants associated with this site include freckled milkvetch/spotted locoweed and broom snakeweed. Milkvetch/locoweed is toxic to all classes of livestock and wildlife. This plant is palatable and has similar nutrient value to alfalfa, which may cause animals to consume it even when other forage is available. Milkvetch/locoweed contains swainsonine (indolizdine alkaloid) and is poisonous at all stages of growth. Poisoning will become evident after 2-3 weeks of continuous grazing and is associated with 4 major symptoms: 1) neurological damage, 2) emaciation, 3) reproductive failure and abortion, and 4) congestive heart failure linked with “high mountain disease”. Broom snakeweed contains steroids, terpenoids, saponins, and flavones that can cause abortions or reproductive failure in sheep and cattle, however cattle are most susceptible. These toxins are most abundant during active growth and leafing stage. Cattle and sheep will generally only graze broom snakeweed when other forage is unavailable, typically in winter when toxicity levels are at their lowest.

Potentially toxic plants associated with this site include some buckwheat species and Wyoming big sagebrush. Some buckwheat species may accumulate selenium, but only when growing on selenium enriched soils. These plants, when consumed will cause alkali disease or chronic selenosis, which affects all classes of livestock (excluding goats). Typically animals consuming 5-50 ppm selenium will develop chronic selenosis and animals consuming greater than 50 ppm selenium will develop acute selenosis. Clinical signs include lameness, soughing of the hoof, hair loss, blindness, and aimless wondering. Horses tend to develop what is called a “bob” tail or “roached” main due to breakage of the long hairs. Wyoming big sagebrush contains sesquiterpene lactones and monoterpenes which have been suspected of being toxic to sheep. An experimental dosage of ¾ lbs of big sagebrush fed to sheep for three days was found to be lethal.

Inventory data references

High intensity sampling (Caudle et al. 2013) was used to describe this ecological site (Community Phase 2.1). Site characteristics such as aspect, slope, elevation and UTMS were recorded for each plot, along with complete species inventory by ocular percent cover. The line-point intercept method was used to measure foliar cover, groundcover, and vegetation structure. At 100 points along a 200 foot transect, ground cover and intercepted plant species were recorded by height. The first hit method (Herrick et al. 2009) was used to generate the foliar cover values entered in the community phase composition tables. Annual production was estimated using the double-weight sampling method outlined in the National Range and Pasture Handbook and in Sampling Vegetation Attributes (NRCS 2003 and Interagency Technical Reference 1999 pgs. 102 - 115). For herbaceous vegetation, ten 9.6 square foot circular sub-plots were evenly distributed along a 200 foot transect. For woody and larger herbaceous species, production was estimated in four 21x21 foot square plots along the same transect. Weight units were collected for each species encountered in the production plots. The number of weight units for each species is then estimated for all plots.

Type locality

Location 1: Garfield County, UT	
UTM zone	N
UTM northing	4152941
UTM easting	408752
General legal description	The type location is approximately 1/2 mile east of Cottonwood Canyon Road, approximately 3 miles south of the town of Cannonville, and approximately 1/2 mile west of the boundary of Kodachrome Basin State Park.

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Contributors

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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)	Robert Stager (BLM), Dana Truman (NRCS), Paul Curtis (BLM), Shane A. Green (NRCS), Randy Beckstrand (BLM), Alice Miller (Pyramid Botanical Consultants)
Contact for lead author	shane.green@ut.usda.gov
Date	02/22/2016
Approved by	Shane A. Green
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** A. On more gentle slopes (< 10 %): Common and occur throughout site. Rills may be 6 to 10 feet in length. Sides of rills may be up to 3 inches deep. B. On steeper slopes (> 10 %): Common. Occur throughout the site. Rills may extend down entire slope. An increase in rill formation may be seen after disturbance events such as recent fire or thunderstorms in adjacent landscape settings where increased runoff may accumulate (such as areas below exposed bedrock).

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2. **Presence of water flow patterns:** Frequent and occur throughout area, and wind between plant bases. Interspaces between well developed biological soil crusts appear to be water depression storage areas but actually serve as water flow patterns across areas covered with biological soil crust during episodic precipitation events. Evidence of flow will increase with slope.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals may form at the base of plants that occur on the edge of rills. Larger rills and gullies may remove soil from the base of trees exposing roots that resemble pedestals. Interspaces between well developed biological soil crusts resemble pedestals and may be up to 2 inches high. Terracettes are present. Debris dams of small to medium sized litter (up to 2 inches in diameter) may form in water flow patterns, rills, and gullies. These debris dams may accumulate smaller litter (leaves, grass and forb stems).

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 0 to 37 %. Most bare ground is associated with water flow patterns, rills, and gullies. The soil surface is dominated by biological soil crust at 17 to 43 %. Areas with well developed biological soil crusts should not be counted as bare ground. Poorly developed biological soil crusts that are interpreted as functioning as bare ground (therefore they would be susceptible to raindrop splash erosion) should be recorded as bare ground. Ground cover is based on first raindrop impact, and bare ground is the opposite of ground cover. Ground cover + bare ground = 100%.

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5. **Number of gullies and erosion associated with gullies:** Few. On steeper slopes and areas below and adjacent to sites with concentrated water flow (such as exposed bedrock), gullies may increase. Length is short. Gullies are shallow and wide and may be armored with stones and vegetation. Gullies may remove soil from the base of trees exposing roots. Any gullies present should show little sign of accelerated erosion.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Minor evidence of wind generated soil movement.

Wind scoured (blowouts) and depositional areas are rarely present. Trees and shrubs break the wind, and biological soil crust covering the soil reduces the potential for wind erosion.

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7. **Amount of litter movement (describe size and distance expected to travel):** Most litter accumulates at base of plants and exposed rocks. Woody stems from trees not moved unless present in water flow pattern, rill, or gully. On steeper slopes of 15 percent, woody stems may be washed from site. Large rills may remove accumulated litter from under trees.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** This site should have a soil stability rating of 4 or 5 under the plant canopies using the soil stability kit test, and a rating of 3 to 4 in the interspaces. The average should be a 4. Surface texture is fine sandy loam. Biological soil crusts, vegetation cover, and litter reduce erosion.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface horizon is 4 inches deep. Structure is weak fine granular. Color is light brown (7.5YR6/4). Use the specific information for the soil you are assessing found in the published soil survey to supplement this description.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Spatial distribution of well developed biological soil crusts intercept raindrops reduce splash erosion and provide areas of surface detention to store water allowing additional time for infiltration. Crowns of trees and accumulating litter at base of trees appear to create a micro-topography that may enhance development of water flow patterns below the drip line of the canopy. Perennial grasses obstruct water flow patterns creating sinuosity.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. The shallow depth (8 to 20 inches) to an petrocalcic hardpan should not be considered compaction.

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Dominance by average annual production: Perennial grasses > Trees (Juniper > Pinyon) > Non-sprouting shrubs.
    Functional/structural groups may appropriately contain non-native species if their ecological function is the same as the native species in the reference state (e.g. Crested wheatgrass, Intermediate wheatgrass, etc.)

    Sub-dominant: Forbs

    Other: Following a recent disturbance such as fire, drought, or insects that removes the woody vegetation, forbs and perennial grasses (herbaceous species) may dominate the community. If a disturbance has not occurred for an extended period of time, woody species may continue to increase crowding out the perennial herbaceous understory species. In either case, these conditions would reflect a functional community phase within the reference state.

    Additional: Dominants — Utah juniper, Two-needle pinion, Wyoming sagebrush, blue grama, James' galleta. Sub

Dominants — Mormontea, Indian ricegrass, squirreltail and other shrubs and forbs. Perennial and annual forbs can be expected to vary widely in their expression in the plant community based upon departures from average growing conditions.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Several standing dead trees may be present on the site and approximately 20% of the trees and shrubs can show evidence of decadence. In drought tree mortality may increase with the first sign being a yellowish to reddish leaf color.

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14. **Average percent litter cover (%) and depth (in):** Variability may occur due to weather.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 610 to 1700 lbs/ac

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Cheatgrass, rabbitbrush and annual mustards are most likely to invade or increase on this site.

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17. **Perennial plant reproductive capability:** All perennial plants should have the ability to reproduce sexually or asexually in most years, except in drought years.
