

Ecological site R035XY308UT Upland Loam (Mountain Big Sagebrush)

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General information

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

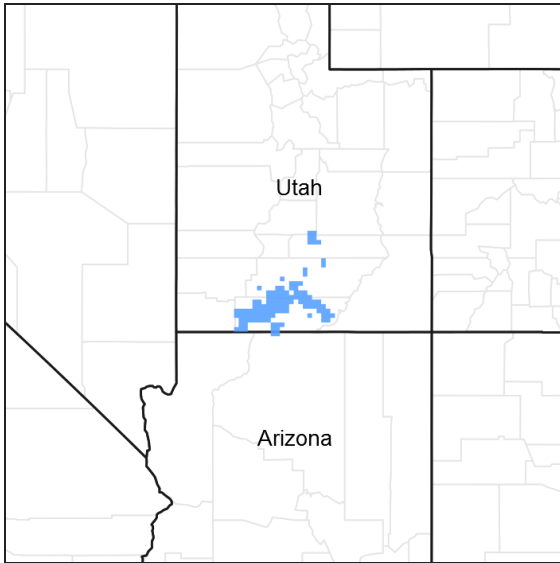


Figure 1. Mapped extent

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.

Ecological site concept

Site concept: This site occurs in the upland climate zone of the Colorado and Green River Plateaus region (MLRA 35), at elevations between 5,500 to 7,200 feet. It is found mostly on gently-sloping alluvial flats, structural benches, and remnant stream terraces. Average annual precipitation ranges from 11 to 16 inches, with about 40% coming as convective thunderstorms from July through October. The soils are deep with very few rock fragments. Surface textures are loamy and range from silt loams to fine sandy loams. The soil moisture regime is aridic ustic and the soil temperature regime is mesic. Mountain big sagebrush, blue grama, and needle-and-thread dominate the plant community. Cheatgrass is the most common non-native species to invade the understory, and two-needle pinyon and Utah juniper are capable of dominating this site when fire is suppressed well beyond the natural fire return interval of 15-40 years.

Similar sites

R035XY306UT	Upland Loam (Basin Big Sagebrush) This site has similar soils and plant community composition, but the dominant shrub is basin big sagebrush instead of mountain big sagebrush.
R035XY307UT	Upland Sand (Mountain Big Sagebrush) This site has very similar plant community composition, but soils are sandy instead of loamy. As a result, this site supports a more diverse shrub community, and pinyon and juniper are less able to invade and dominate.

R035XY011UT	Loamy Bottom (Basin Big Sagebrush) This is a run-in site dominated by basin big sagebrush. Soils are similar, but this site rarely occurs in the upland climate zone.
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Table 1. Dominant plant species

Tree	(1) <i>Pinus edulis</i>
Shrub	(1) <i>Artemisia tridentata</i> var. <i>vaseyana</i>
Herbaceous	(1) <i>Hesperostipa comata</i> (2) <i>Bouteloua gracilis</i>

Physiographic features

This site occurs on structural benches, dip slopes, alluvial flats, and remnant streams. Slopes typically range from 2-15%, and elevations are generally 5500-7200 ft.

Table 2. Representative physiographic features

Landforms	(1) Structural bench (2) Alluvial flat (3) Dip slope
Flooding frequency	None
Ponding frequency	None
Elevation	1,676–2,195 m
Slope	2–15%

Climatic features

The climate is characterized by warm summers and cold winters. Average annual precipitation ranges from 11 to 16 inches. About 40% of the summer precipitation occurs as convection thunderstorms. June is typically the driest month during the growing season, and August is typically the wettest. Large fluctuations in daily temperatures are common, and precipitation varies greatly from month to month and from year to year.

In addition to the Bryce Canyon weather station, this section was developed using modeled climate data (PRISM).

Table 3. Representative climatic features

Frost-free period (average)	82 days
Freeze-free period (average)	102 days
Precipitation total (average)	356 mm

Influencing water features

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

Soil features

The soils of this site are deep and loamy with very few rock fragments on the soil surface or in the profile. They were formed in eolian sands, alluvium, and/or slope alluvium derived mostly from sandstone and shale. Surface textures are typically loamy, but range from silt loams to loamy fine sands. They are well-drained with moderate permeability. The soil moisture regime is aridic ustic and the soil temperature regime is mesic. Available water holding capacity ranges from 3.6 to 7.0 inches of water in the upper 40 inches of soil, with shallower, coarser soils holding less water than deeper, finer soils.

This site has been used in the following soils surveys and has been correlated to the following components:

UT636 – Panguitch Area, Parts of Garfield, Iron, and Kane Counties--Henrieville; Hernandez family; Mikim; Yenlo
 UT685 –Capitol Reef National Park-- Plumasano, Whitesage family;
 UT686 – Escalante Grand Staircase National Monument, Parts of Kane and Garfield Counties--Brumley; Epedro; Evpark; Nomrah; Parkelei; Plumasano; Shalona; Sili

Table 4. Representative soil features

Parent material	(1) Eolian deposits--sandstone and shale
Surface texture	(1) Fine sandy loam (2) Loamy fine sand (3) Loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Soil depth	51 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	9.14–17.78 cm
Calcium carbonate equivalent (0-101.6cm)	0–5%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–10%
Subsurface fragment volume >3" (Depth not specified)	0–1%

Ecological dynamics

This site is influenced by many of the natural disturbances typical of MLRA 35. Fire is among such disturbances and the natural fire return interval is expected to be about 15-40 years (Johnson 2000). Following a burn, perennial grasses generally dominate the community. After a few years of average precipitation, mountain big sagebrush regains dominance of the site. In contrast, lack of fire results in pinyon and juniper encroachment and an increase in large woody material. Due to modern disturbances such as brush treatments, invasive species, and recreation, the resilience of the plant communities may be reduced compared to the reference plant community. Disturbances that reduce the vigor of perennial grasses and shrubs result in an opportunity for pinyon and juniper, or invasive annuals, to enter the system and alter ecological processes. Although an annual invasive state has not been discovered for this site, it is recommended that caution is used to protect this site from the possible threat of dominance by annual invasive species such as cheatgrass.

Continuous season long grazing and or heavy stocking rates may result in a reduction of perennial grass species. This type of grazing may accelerate the transition from the reference plant community. Intense grazing may increase the chance of invasion by pinyon and juniper, snakeweed, cheatgrass, and invasive annual forbs. As ecological condition deteriorates due to overgrazing, needleandthread, muttongrass, Indian ricegrass, squirreltail, and winterfat decrease while mountain big sagebrush, two-needle pinyon, Utah juniper, blue grama, yellow rabbitbrush, broom snakeweed, and pricklypear increase.

When the potential natural plant community is burned, mountain big sagebrush can be temporarily eliminated, while muttongrass, needleandthread, rabbitbrush, snakeweed, pricklypear, James' galleta, and blue grama may increase. In the absence of fire, pinyon and juniper may become dense enough to exclude the understory. When this happens, soil erosion is likely to increase.

As vegetation communities respond to changes in management or natural influences, return to previous states may not be possible without major energy inputs. The amount of energy needed to affect vegetative shifts depends on present biotic and abiotic features and the desired results. The following diagram does not necessarily depict all the transitions and states that are possible, but it does show some of the most commonly occurring plant communities. These plant communities may not represent every possibility, but they are the most prevalent and repeatable. As more data is collected, some of these plant communities may be revised or removed, and new ones may be added. This model was developed using range data collected over the last 30 years in MLRA D35 in southeastern Utah. Both ocular and measured data was collected and utilized.

State and transition model

R035XY308UT Upland Loam (Mountain Big Sagebrush)

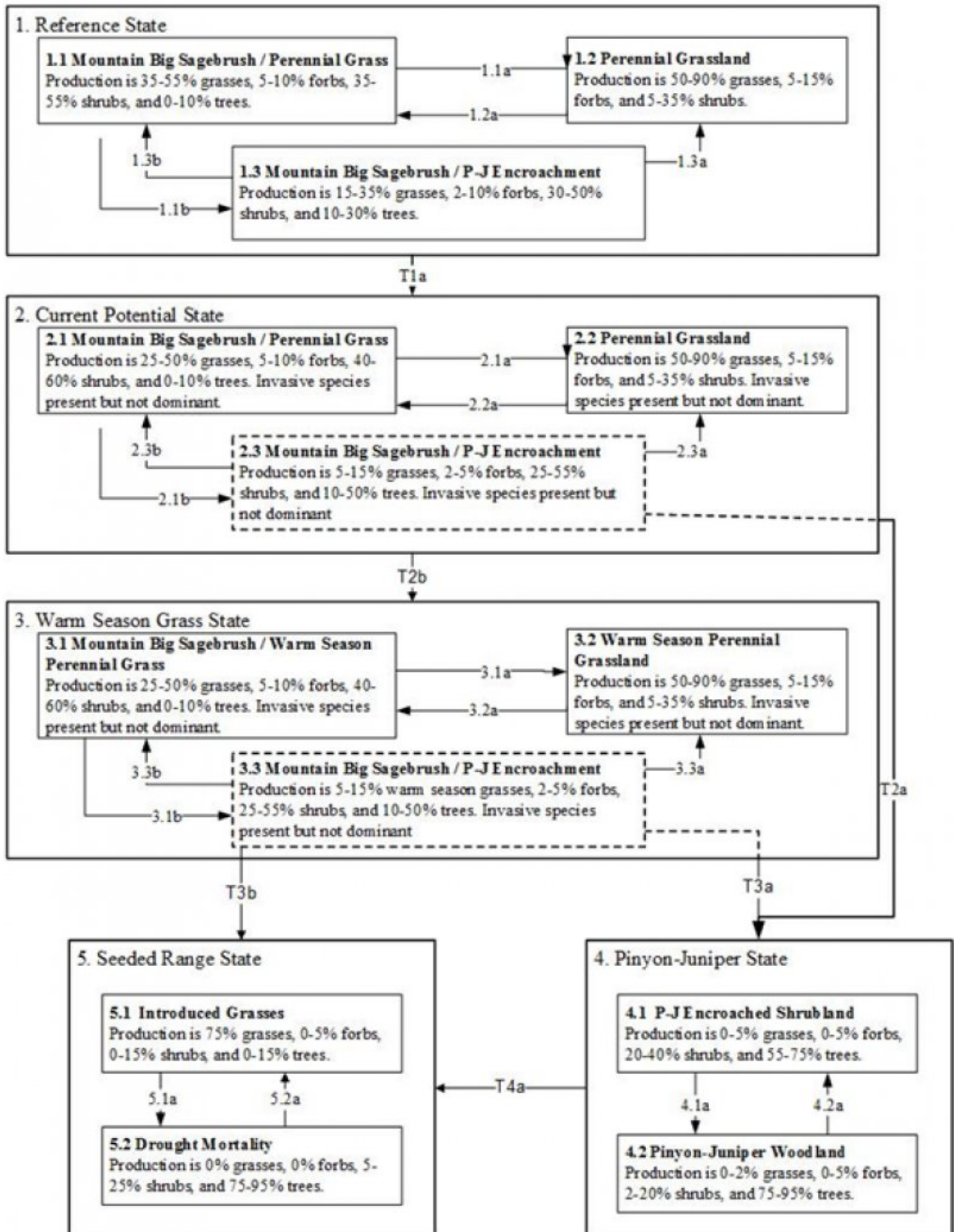


Figure 6. S&TM

State 1
Reference State

The reference state represents the plant communities and ecological dynamics of the upland loam (mountain big sagebrush) site. This state includes the biotic communities that become established on the ecological site if all successional sequences are completed under the natural disturbance regime. The reference state is generally dominated by perennial grasses and mountain and/or Bonneville big sagebrush. The reference state is self sustaining and resistant to change due to high resistance to natural disturbances and high resilience following natural disturbances. When natural disturbances occur, the rate of recovery is variable due to disturbance intensity. Once invasive plants establish, return to the reference state may not be possible.

Community 1.1
Mountain Big Sagebrush / Perennial Grass

Sagebrush and perennial grass communities. Blue grama, yellow rabbitbrush, and prairie junco are also abundant. Capitol Reef Soil Survey, Plumasano soil. NAD 83 Zone 12S E. 0485249 N. 4207917. Photo by Jake Owens, August 17, 2010.



Figure 7. Phase 1.1

This community is dominated by both Mountain big sagebrush and perennial grasses. Needleandthread and blue grama are typically the dominant grass species, but other functionally similar species may also be abundant. Composition by air-dry weight is 35-55% grass, 5-10% forbs, 35-55% shrubs, and 0-10% trees. Two-needle pinyon and Utah juniper may be present in this phase, but are only a minor component of the plant community.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	280	364	448
Grass/Grasslike	196	308	420
Forb	17	45	84
Tree	–	39	84
Total	493	756	1036

Table 6. Ground cover

Tree foliar cover	0-5%
Shrub/vine/liana foliar cover	15-25%
Grass/grasslike foliar cover	20-30%
Forb foliar cover	2-10%
Non-vascular plants	0%
Biological crusts	0-2%
Litter	15-25%
Surface fragments >0.25" and <=3"	0-5%

Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	20-30%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	0-5%	0-5%
>0.15 <= 0.3	–	0-5%	5-15%	0-5%
>0.3 <= 0.6	–	5-15%	5-15%	0-5%
>0.6 <= 1.4	0-5%	5-15%	0-5%	–
>1.4 <= 4	0-5%	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 1.2 Perennial Grassland

This community is dominated by perennial grasses, with possibly some fire-tolerant shrubs and shrub seedlings. Commonly seen grasses include Indian ricegrass and needle and thread, and blue grama. Composition by air-dry weight is 50-90% grasses, 5-15% forbs, and 5-35% shrubs.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	336	448	560
Shrub/Vine	28	140	224
Forb	17	56	95
Total	381	644	879

Table 9. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0-10%
Grass/grasslike foliar cover	30-50%
Forb foliar cover	1-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	15-25%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	25-50%

Table 10. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	2-10%	0-5%
>0.15 <= 0.3	–	0-5%	5-15%	0-5%
>0.3 <= 0.6	–	0-5%	5-15%	0-5%
>0.6 <= 1.4	–	0-2%	2-10%	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 1.3 Mountain Big Sagebrush / P-J Encroachment

Vegetation, mountain big sagebrush and tree grass communities, two needle pinyon and Utah juniper, capture best community. NAD 83 Zone 12S E. 0484724 N. 4212506. Photo by Jake Owens, August 16, 2010.



Figure 10. Phase 1.3

This community is characterized by a mountain big sagebrush shrub canopy with abundant perennial grasses. Two-needle pinyon and Utah juniper are increasing in the community, while perennial grasses are decreasing somewhat. Composition by air-dry weight is 15-35% grasses, 2-10% forbs, 30-50% shrubs, and 10-30% trees.

Table 11. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	224	308	448
Tree	112	224	336
Grass/Grasslike	112	196	280
Forb	17	45	84
Total	465	773	1148

Table 12. Ground cover

Tree foliar cover	5-20%
Shrub/vine/liana foliar cover	10-20%
Grass/grasslike foliar cover	5-15%
Forb foliar cover	1-5%

Non-vascular plants	0%
Biological crusts	0%
Litter	20-30%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	25-40%

Table 13. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	0-5%	0-5%
>0.15 <= 0.3	–	0-5%	2-10%	0-5%
>0.3 <= 0.6	–	5-10%	2-10%	0-5%
>0.6 <= 1.4	0-10%	5-10%	0-2%	–
>1.4 <= 4	2-15%	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Pathway 1.1a Community 1.1 to 1.2

Fire reduces the big sagebrush, resulting in a perennial grassland.

Pathway 1.1b Community 1.1 to 1.3



Mountain Big Sagebrush /
Perennial Grass



Mountain Big Sagebrush / P-J
Encroachment

Time without disturbance results in an increase in woody species, particularly two-needle pinyon, Utah juniper, and sometimes mountain big sagebrush. Perennial grasses are reduced, but still capable of propagating themselves in the event of woody plant reduction by fire or other disturbance.

Pathway 1.2a Community 1.2 to 1.1

Time without disturbance results in a reduction of perennial grasses, and an increase in mountain big sagebrush and other shrubs.

Pathway 1.3a Community 1.3 to 1.2

Fire reduces the big sagebrush dominance of this site and results in a grass dominated community.

Pathway 1.3b Community 1.3 to 1.2

Less severe fire, aroga moth, drought, or heavy wildlife browsing can reduce the dominance of big sagebrush. This transition occurs when big sagebrush cover is reduced, but big sagebrush remains a dominant species.

State 2 Current Potential State

The current potential state is similar to the reference state in community structure and ecological function, however the presence of invasive species reduces the resilience of the site to further degradation. This state is generally dominated by mountain or Bonneville big sagebrush. Primary disturbance mechanisms include climate fluctuations, fire, native herbivore grazing, domestic livestock grazing and surface disturbances such as road and pipeline development and off road vehicle (OHV) use. Timing of these disturbances dictates the ecological dynamics that occur. The current potential state is self sustaining; but is losing resistance to change due to lower resistance to disturbances and lower resilience following disturbances.

Community 2.1 Mountain Big Sagebrush / Perennial Grass

This community is dominated by Mountain big sagebrush and perennial grasses. Needleandthread and blue grama are typically the dominant grass species, but other functionally similar species may also be abundant. Composition by air-dry weight is 25-50% grass, 5-10% forbs, 40-60% shrubs, and 0-10% trees. Two-needle pinyon and Utah juniper may be present in this phase, but are only a minor component of the plant community. Cheatgrass or other non-native species are present but not dominant.

Table 14. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	280	392	504
Grass/Grasslike	168	280	392
Forb	17	45	84
Tree	–	39	84
Total	465	756	1064

Table 15. Ground cover

Tree foliar cover	0-5%
Shrub/vine/liana foliar cover	20-30%
Grass/grasslike foliar cover	15-25%
Forb foliar cover	2-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	15-25%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	20-40%

Table 16. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	0-5%	0-5%
>0.15 <= 0.3	–	0-15%	5-15%	0-5%
>0.3 <= 0.6	–	5-15%	5-15%	0-5%
>0.6 <= 1.4	0-5%	5-15%	0-5%	–
>1.4 <= 4	0-5%	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 2.2 Perennial Grassland

This community is dominated by perennial grasses, with possibly some fire-tolerant shrubs and shrub seedlings. Commonly seen grasses include Indian ricegrass and needle and thread, and blue grama. Composition by air-dry weight is 50-90% grasses, 5-15% forbs, and 5-35% shrubs. Cheatgrass or other non-native species are present but not dominant.

Table 17. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	336	448	560
Shrub/Vine	28	140	224
Forb	17	56	95
Total	381	644	879

Table 18. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0-10%
Grass/grasslike foliar cover	30-50%
Forb foliar cover	1-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	15-25%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	25-50%

Table 19. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	2-10%	0-5%
>0.15 <= 0.3	–	0-5%	5-15%	0-5%
>0.3 <= 0.6	–	0-5%	5-15%	0-5%
>0.6 <= 1.4	–	0-2%	2-10%	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 2.3 Mountain Big Sagebrush / P-J Encroachment

This community is characterized by a mountain big sagebrush shrub canopy with abundant perennial grasses. Two-needle pinyon and Utah juniper are increasing in the community, while perennial grasses are decreasing somewhat. Composition by air-dry weight is 5-15% grasses, 2-5% forbs, 25-55% shrubs, and 10-50% trees. Cheatgrass or other non-native species are present but not dominant.

Table 20. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	280	392	504
Shrub/Vine	224	336	448
Grass/Grasslike	34	73	112
Forb	17	45	84
Total	555	846	1148

Table 21. Ground cover

Tree foliar cover	5-20%
Shrub/vine/liana foliar cover	10-20%
Grass/grasslike foliar cover	3-10%
Forb foliar cover	1-5%
Non-vascular plants	0%
Biological crusts	0%
Litter	15-25%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	30-45%

Table 22. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	0-5%	0-5%
>0.15 <= 0.3	–	0-5%	0-5%	0-5%
>0.3 <= 0.6	–	5-10%	0-5%	0-5%
>0.6 <= 1.4	0-10%	5-15%	0-2%	–
>1.4 <= 4	5-15%	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Pathway 2.1a **Community 2.1 to 2.2**

Fire reduces the big sagebrush, resulting in a perennial grassland.

Pathway 2.1b **Community 2.1 to 2.3**

Time without disturbance results in an increase in woody species, particularly two-needle pinyon, Utah juniper, and sometimes mountain big sagebrush. Perennial grasses are reduced, but still capable of propagating themselves in the event of woody plant reduction by fire or other disturbance.

Pathway 2.2a **Community 2.2 to 2.1**

Time without disturbance results in a reduction of perennial grasses, and an increase in mountain big sagebrush and other shrubs

Pathway 2.3b **Community 2.3 to 2.1**

Less severe fire, aroga moth, drought, or heavy wildlife browsing can reduce the dominance of big sagebrush. This transition occurs when big sagebrush cover is reduced, but big sagebrush remains a dominant species.

Pathway 2.3a **Community 2.3 to 2.2**

Fire reduces the big sagebrush dominance of this site and results in a grass dominated community.

State 3 **Warm Season Grass State**

This state is dominated by two-needle pinyon and Utah juniper. It occurs when perennial grasses, shrubs, and forbs decrease in the community to the point where they are no longer capable of reproduction at a rate necessary to dominate the site in the event of tree removal by fire or other means. This state is the least resistant to soil erosion and may be at significant risk of permanent soil loss. An eroded state has not yet been documented on this site, but phase 3.2 has been characterized as having noticeable soil movement.

Community 3.1 **Mountain Big Sagebrush / Warm Season Perennial Grass**

This community is dominated by Mountain big sagebrush and warm season perennial grasses. Blue grama and galleta are typically the dominant grass species, but other functionally similar species may also be abundant. Composition by air-dry weight is 25-50% grass, 5-10% forbs, 40-60% shrubs, and 0-10% trees. Two-needle pinyon and Utah juniper may be present in this phase, but are only a minor component of the plant community. Cheatgrass or other non-native species are present but not dominant.

Table 23. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	280	392	504
Grass/Grasslike	168	280	392
Forb	17	50	84
Tree	–	39	84
Total	465	761	1064

Table 24. Ground cover

Tree foliar cover	0-5%
Shrub/vine/liana foliar cover	20-30%
Grass/grasslike foliar cover	15-25%
Forb foliar cover	2-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	15-25%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	20-40%

Table 25. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	0-5%	0-5%
>0.15 <= 0.3	–	0-15%	5-15%	0-5%
>0.3 <= 0.6	–	5-15%	5-15%	0-5%
>0.6 <= 1.4	0-5%	5-15%	0-5%	–
>1.4 <= 4	0-5%	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 3.2

Warm Season Perennial Grassland

This community is dominated by warm season perennial grasses, with possibly some fire-tolerant shrubs and shrub seedlings. Commonly seen grasses include Blue grama and galleta. Composition by air-dry weight is 50-90%

grasses, 5-15% forbs, and 5-35% shrubs. Cheatgrass or other non-native species are present but not dominant.

Table 26. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	336	448	560
Shrub/Vine	28	140	224
Forb	17	56	95
Total	381	644	879

Table 27. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0-10%
Grass/grasslike foliar cover	30-50%
Forb foliar cover	1-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	15-25%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	25-50%

Table 28. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/Grasslike	Forb
<0.15	–	0-5%	2-10%	0-5%
>0.15 <= 0.3	–	0-5%	5-15%	0-5%
>0.3 <= 0.6	–	0-5%	5-15%	0-5%
>0.6 <= 1.4	–	0-2%	2-10%	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 3.3 Mountain Big Sagebrush / P-J Encroachment

This community is characterized by a mountain big sagebrush shrub canopy with abundant war season perennial grasses. Two-needle pinyon and Utah juniper are increasing in the community, while perennial grasses are decreasing somewhat. Composition by air-dry weight is 5-15% grasses, 2-5% forbs, 25-55% shrubs, and 10-50% trees. Cheatgrass or other non-native species are present but not dominant.

Table 29. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	280	392	504
Shrub/Vine	224	336	448
Grass/Grasslike	34	73	112
Forb	17	45	84
Total	555	846	1148

Table 30. Ground cover

Tree foliar cover	5-20%
Shrub/vine/liana foliar cover	10-20%
Grass/grasslike foliar cover	3-10%
Forb foliar cover	1-5%
Non-vascular plants	0%
Biological crusts	0%
Litter	15-25%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	30-45%

Table 31. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	0-5%	0-5%
>0.15 <= 0.3	–	0-5%	0-5%	0-5%
>0.3 <= 0.6	–	5-10%	0-5%	0-5%
>0.6 <= 1.4	0-10%	5-15%	0-2%	–
>1.4 <= 4	5-15%	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

State 4

Pinyon-Juniper State

This state is dominated by introduced perennial grasses, typically crested wheatgrass, Siberian wheatgrass, or Siberian wildrye. It can persist for decades with minimal reestablishment of sagebrush, and practically no reestablishment of native forbs or grasses.

Community 4.1

Pinyon-Juniper Encroached Shrubland



Figure 18. Phase 3.1

Two-needle pinyon and Utah juniper dominate. Mountain big sagebrush and other shrubs are still abundant in the understory, but perennial grasses and forbs are greatly reduced. Trees continue to increase in the absence of fire or other tree reducing disturbance.

Table 32. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	448	560	673
Shrub/Vine	56	112	168
Grass/Grasslike	–	22	45
Forb	–	17	34
Total	504	711	920

Table 33. Ground cover

Tree foliar cover	20-30%
Shrub/vine/liana foliar cover	5-15%
Grass/grasslike foliar cover	0-5%
Forb foliar cover	0-5%
Non-vascular plants	0%
Biological crusts	0%
Litter	25-40%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	15-45%

Table 34. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-2%	0-2%	0-2%
>0.15 <= 0.3	–	0-2%	0-5%	0-5%
>0.3 <= 0.6	–	0-5%	0-2%	0-2%
>0.6 <= 1.4	0-10%	5-15%	–	–
>1.4 <= 4	10-20%	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 4.2 Pinyon-Juniper Woodland

4262601. Photo by Jake Owens, October 14, 2010.



Figure 20. Phase 3.2

Two-needle pinyon and Utah juniper dominate. Shrubs, perennial grasses and forbs are very sparse or absent. Trees continue to increase and are resistant to fires. Soil erosion is a hazard of this phase that increases with increased slope and decreased herbaceous cover.

Table 35. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	616	785	953
Shrub/Vine	–	22	56
Forb	–	6	17
Grass/Grasslike	–	6	17
Total	616	819	1043

Table 36. Ground cover

Tree foliar cover	20-35%
Shrub/vine/liana foliar cover	0-5%
Grass/grasslike foliar cover	0-2%
Forb foliar cover	0-2%
Non-vascular plants	0%

Biological crusts	0%
Litter	40-50%
Surface fragments >0.25" and <=3"	0-10%
Surface fragments >3"	0-10%
Bedrock	0%
Water	0%
Bare ground	10-40%

Table 37. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-1%	0-1%	0-1%
>0.15 <= 0.3	–	0-1%	0-1%	0-1%
>0.3 <= 0.6	–	0-2%	0-1%	0-1%
>0.6 <= 1.4	0-5%	0-5%	–	–
>1.4 <= 4	15-25%	–	–	–
>4 <= 12	0-5%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

State 5 Seeded Range State

This state is dominated by introduced perennial grasses. It is resistant to invasive annuals and resilient to grazing pressure. Primary disturbance mechanisms include climate fluctuations, fire, native herbivore grazing, domestic livestock grazing and surface disturbances such as road and pipeline development and off road vehicle (OHV) use. Timing of these disturbances dictates the ecological dynamics that occur.

Community 5.1 Introduced Grasses

This community is dominated by introduced perennial grasses, with possibly some shrubs and tree seedlings. Commonly seen grasses include crested wheatgrass and Russian wildrye.

Community 5.2 Drought Mortality

This community is dominated by sagebrush and juniper trees. Overall production is greatly diminished and the appearance of bare ground is prolific. This ecological site is particularly resistant to annual grass dominance. The circumstances observed in this plant community phase would typically result in weed invasion and dominance, however, the weed free condition of this plant community has been observed to exist for years.

Pathway 5.1a Community 5.1 to 5.2

Severe prolonged drought (7 years or more) can cause mortality of the dominant introduced perennial grasses. Crested wheatgrass is particularly vulnerable, Russian wildrye has been shown to be resistant to droughts on this ecological site and can withstand droughts.

Pathway 5.2a

Community 5.2 to 5.1

This pathway has not been observed, but it is presumed that introduced perennial grasses could be re-established under the right growing conditions.

Transition T1

State 1 to 2

This transition occurs when a seed source and germination sites facilitate the establishment of non-native invasive species, particularly cheatgrass. Modern disturbances such as livestock grazing and recreation may accelerate this transition by providing both seeds and soil surface disturbance, however, cheatgrass and other invasive species are capable of establishing in the absence of major disturbance on this site. Once non-native species are present, the resilience of the site is reduced and it is not practical to return to the reference state.

Transition T2a

State 2 to 3

This transition occurs when two-needle pinyon and Utah juniper dominate. Shrubs may still be abundant, but perennial grasses are unable to propagate themselves in the event of fire or other reduction in woody species. Fire suppression, improper livestock grazing, or other disturbances that reduce the vigor of perennial grasses can accelerate this transition. The threshold is the point where perennial grasses can no longer re-establish themselves following fire, herbicide, or other disturbance that removes woody species. Two-needle pinyon and Utah juniper are increasing in the community and become more dominant than sagebrush.

Transition T2b

State 2 to 3

This transition occurs when improper grazing (continuous season long, stocking rate too high) causes mortality of cool season perennial grasses. Shrubs may still be abundant. The threshold is the point where cool season perennial grasses can no longer survive improper grazing practices. The surviving warm season perennial grasses are more grazing tolerant.

Transition T3a

State 3 to 4

This transition occurs when two-needle pinyon and Utah juniper dominate. Shrubs may still be abundant, but perennial grasses are unable to propagate themselves in the event of fire or other reduction in woody species. Fire suppression, improper livestock grazing, or other disturbances that reduce the vigor of perennial grasses can accelerate this transition. The threshold is the point where perennial grasses can no longer re-establish themselves following fire, herbicide, or other disturbance that removes woody species. Two-needle pinyon and Utah juniper are increasing in the community and become more dominant than sagebrush.

Transition T3b

State 3 to 5

A rangeland seeding, typically preceded by brush management (i.e. chaining) and typically with introduced perennial grasses.

Transition T4a

State 4 to 5

A rangeland seeding, typically preceded by brush management (i.e. chaining) and typically with introduced perennial grasses.

Additional community tables

Table 38. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	Dominant Shrubs			224–336	
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata ssp. vaseyana</i>	224–336	12–18
3	Sub-dominant Shrubs			6–112	
	Gambel oak	QUGA	<i>Quercus gambelii</i>	0–34	0–3
	mormon tea	EPVI	<i>Ephedra viridis</i>	0–34	0–2
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0–34	0–2
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0–34	0–2
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–28	0–2
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0–22	0–2
	mountain snowberry	SYOR2	<i>Symphoricarpos oreophilus</i>	0–22	0–2
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0–17	0–1
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0–17	0–1
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–11	0–1
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	0–11	0–1
	Saskatoon serviceberry	AMAL2	<i>Amelanchier alnifolia</i>	0–11	0–1
	Utah serviceberry	AMUT	<i>Amelanchier utahensis</i>	0–11	0–1
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–6	0–1
Grass/Grasslike					
0	Dominant Grasses			196–420	
	needle and thread	HECOC8	<i>Hesperostipa comata ssp. comata</i>	45–280	3–18
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	56–224	4–15
1	Sub-Dominant Grasses			56–112	
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0–90	0–5
	muttongrass	POFE	<i>Poa fendleriana</i>	0–78	0–5
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0–45	0–3
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0–45	0–3
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0–45	0–2
	Grass, perennial	2GP	<i>Grass, perennial</i>	0–34	0–2
	saline wildrye	LESAS	<i>Leymus salinus ssp. salinus</i>	0–34	0–2
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	0–11	0–1
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0–11	0–1
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0–11	0–1
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0–6	0–1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0–6	0–1
Forb					
2	Forbs			17–84	
	Forb, perennial	2FP	<i>Forb, perennial</i>	0–34	0–2
	Great Basin lupine	LUAL5	<i>Lupinus ×alpestris</i>	0–28	0–2

	Forb, annual	2FA	<i>Forb, annual</i>	0–22	0–2
	Wright's bird's beak	COWR2	<i>Cordylanthus wrightii</i>	0–17	0–1
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0–17	0–1
	cushion buckwheat	EROV	<i>Eriogonum ovalifolium</i>	0–11	0–1
	lobeleaf groundsel	PAMU11	<i>Packera multilobata</i>	0–11	0–1
	beardtongue	PENST	<i>Penstemon</i>	0–9	0–1
	ragwort	SENEC	<i>Senecio</i>	0–6	0–1
	Utah fleabane	ERUT	<i>Erigeron utahensis</i>	0–6	0–1
	cryptantha	CRYPT	<i>Cryptantha</i>	0–6	0–1
	sanddune wallflower	ERCAC	<i>Erysimum capitatum var. capitatum</i>	0–6	0–1
	blue eyed Mary	COLLI	<i>Collinsia</i>	0–6	0–1
	freckled milkvetch	ASLE8	<i>Astragalus lentiginosus</i>	0–6	0–1
	woolly locoweed	ASMO7	<i>Astragalus mollissimus</i>	0–6	0–1
	sego lily	CANU3	<i>Calochortus nuttallii</i>	0–2	0–1
	sulphur-flower buckwheat	ERUM	<i>Eriogonum umbellatum</i>	0–2	0–1
Tree					
4	Trees			0–84	
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	0–84	0–4
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	0–34	0–2

Table 39. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
0	Dominant Grasses			224–448	
	needle and thread	HECOC8	<i>Hesperostipa comata ssp. comata</i>	56–280	3–18
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	56–224	3–15
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata ssp. vaseyana</i>	0–168	0–6
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	11–112	2–10
1	Sub-Dominant Grasses			56–168	
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0–90	0–5
	Grass, perennial	2GP	<i>Grass, perennial</i>	0–78	0–5
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0–50	0–3
	saline wildrye	LESAS	<i>Leymus salinus ssp. salinus</i>	0–45	0–2
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0–45	0–2
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0–28	0–2
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0–28	0–2
	muttongrass	POFE	<i>Poa fendleriana</i>	0–22	0–2
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0–17	0–1
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	0–11	0–1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0–11	0–1
Forb					
2	Forbs			17–95	

	Forb, perennial	2FP	<i>Forb, perennial</i>	0–34	0–2
	Great Basin lupine	LUAL5	<i>Lupinus ×alpestris</i>	0–28	0–2
	Forb, annual	2FA	<i>Forb, annual</i>	0–22	0–2
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0–17	0–1
	lobeleaf groundsel	PAMU11	<i>Packera multilobata</i>	0–11	0–1
	cushion buckwheat	EROV	<i>Eriogonum ovalifolium</i>	0–11	0–1
	beardtongue	PENST	<i>Penstemon</i>	0–9	0–1
	ragwort	SENEC	<i>Senecio</i>	0–6	0–1
	Utah fleabane	ERUT	<i>Erigeron utahensis</i>	0–6	0–1
	blue eyed Mary	COLLI	<i>Collinsia</i>	0–6	0–1
	cryptantha	CRYPT	<i>Cryptantha</i>	0–6	0–1
	sanddune wallflower	ERCAC	<i>Erysimum capitatum var. capitatum</i>	0–6	0–1
	freckled milkvetch	ASLE8	<i>Astragalus lentiginosus</i>	0–6	0–1
	woolly locoweed	ASMO7	<i>Astragalus mollissimus</i>	0–6	0–1
	sego lily	CANU3	<i>Calochortus nuttallii</i>	0–2	0–1
	sulphur-flower buckwheat	ERUM	<i>Eriogonum umbellatum</i>	0–2	0–1
Shrub/Vine					
3	Shrubs			56–224	
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata ssp. vaseyana</i>	0–112	0–8
	Gambel oak	QUGA	<i>Quercus gambelii</i>	0–45	0–3
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0–34	0–2
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0–34	0–2
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–28	0–2
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0–22	0–2
	mormon tea	EPVI	<i>Ephedra viridis</i>	0–22	0–2
	mountain snowberry	SYOR2	<i>Symphoricarpos oreophilus</i>	0–22	0–2
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	0–22	0–2
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0–17	0–2
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0–17	0–1
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–11	0–1
	Saskatoon serviceberry	AMAL2	<i>Amelanchier alnifolia</i>	0–11	0–1
	Utah serviceberry	AMUT	<i>Amelanchier utahensis</i>	0–11	0–1
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–6	0–1

Table 40. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	Dominant Shrubs			168–392	
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata ssp. vaseyana</i>	168–392	8–18

3	Sub-dominant Shrubs			56-168	
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0-45	0-3
	mormon tea	EPVI	<i>Ephedra viridis</i>	0-34	0-3
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0-34	0-2
	Gambel oak	QUGA	<i>Quercus gambelii</i>	0-34	0-2
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0-28	0-2
	mountain snowberry	SYOR2	<i>Symphoricarpos oreophilus</i>	0-22	0-2
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0-22	0-2
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	0-22	0-1
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0-17	0-1
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0-17	0-1
	Saskatoon serviceberry	AMAL2	<i>Amelanchier alnifolia</i>	0-11	0-1
	Utah serviceberry	AMUT	<i>Amelanchier utahensis</i>	0-11	0-1
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0-11	0-1
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0-6	0-1
Grass/Grasslike					
0	Dominant Grasses			90-224	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	45-224	3-15
	needle and thread	HECOC8	<i>Hesperostipa comata ssp. comata</i>	45-224	3-15
1	Sub-Dominant Grasses			0-84	
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0-90	0-5
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0-45	0-3
	muttongrass	POFE	<i>Poa fendleriana</i>	0-45	0-2
	saline wildrye	LESAS	<i>Leymus salinus ssp. salinus</i>	0-34	0-2
	Grass, perennial	2GP	<i>Grass, perennial</i>	0-34	0-2
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0-34	0-2
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0-17	0-1
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	0-11	0-1
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0-11	0-1
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0-11	0-1
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0-6	0-1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0-6	0-1
Forb					
2	Forbs			17-84	
	Forb, perennial	2FP	<i>Forb, perennial</i>	0-34	0-2
	Great Basin lupine	LUAL5	<i>Lupinus ×alpestris</i>	0-28	0-2
	Forb, annual	2FA	<i>Forb, annual</i>	0-22	0-1
	Wright's bird's beak	COWR2	<i>Cordylanthus wrightii</i>	0-17	0-1
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0-17	0-1
	cushion buckwheat	EROV	<i>Eriogonum ovalifolium</i>	0-11	0-1
	lobeleaf groundsel	PAMU11	<i>Packera multilobata</i>	0-11	0-1
	beardtongue	PENST	<i>Penstemon</i>	0-9	0-1

	ragwort	SENEC	<i>Senecio</i>	0–6	0–1
	Utah fleabane	ERUT	<i>Erigeron utahensis</i>	0–6	0–1
	cryptantha	CRYPT	<i>Cryptantha</i>	0–6	0–1
	sanddune wallflower	ERCAC	<i>Erysimum capitatum var. capitatum</i>	0–6	0–1
	blue eyed Mary	COLLI	<i>Collinsia</i>	0–6	0–1
	freckled milkvetch	ASLE8	<i>Astragalus lentiginosus</i>	0–6	0–1
	woolly locoweed	ASMO7	<i>Astragalus mollissimus</i>	0–6	0–1
	sego lily	CANU3	<i>Calochortus nuttallii</i>	0–2	0–1
	sulphur-flower buckwheat	ERUM	<i>Eriogonum umbellatum</i>	0–2	0–1
Tree					
4	Trees			112–336	
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	90–336	5–18
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	22–67	1–4

Table 41. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	Dominant Shrubs			224–392	
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata ssp. vaseyana</i>	224–392	14–20
3	Sub-dominant Shrubs			6–112	
	Gambel oak	QUGA	<i>Quercus gambelii</i>	0–34	0–10
	mormon tea	EPVI	<i>Ephedra viridis</i>	0–34	0–2
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0–34	0–2
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0–34	0–2
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–28	0–2
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0–22	0–2
	mountain snowberry	SYOR2	<i>Symphoricarpos oreophilus</i>	0–22	0–2
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0–17	0–1
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0–17	0–1
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	0–11	0–5
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–11	0–1
	Saskatoon serviceberry	AMAL2	<i>Amelanchier alnifolia</i>	0–11	0–1
	Utah serviceberry	AMUT	<i>Amelanchier utahensis</i>	0–11	0–1
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–6	0–1
Grass/Grasslike					
0	Dominant Grass			168–392	
	needle and thread	HECOC8	<i>Hesperostipa comata ssp. comata</i>	56–280	4–18
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	56–224	4–15
1	Sub-Dominant Grasses			0–112	
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0–90	0–4
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0–45	0–3

	Grass, perennial	2GP	<i>Grass, perennial</i>	0–34	0–2
	saline wildrye	LESAS	<i>Leymus salinus ssp. salinus</i>	0–34	0–2
	cheatgrass	BRTE	<i>Bromus tectorum</i>	2–22	0–2
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0–17	0–2
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	0–11	0–1
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0–11	0–1
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0–11	0–1
	muttongrass	POFE	<i>Poa fendleriana</i>	0–6	0–2
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0–6	0–1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0–6	0–1
Forb					
2	Forbs			17–84	
	Forb, perennial	2FP	<i>Forb, perennial</i>	0–34	0–2
	Great Basin lupine	LUAL5	<i>Lupinus ×alpestris</i>	0–28	0–2
	Forb, annual	2FA	<i>Forb, annual</i>	0–22	0–1
	Wright's bird's beak	COWR2	<i>Cordylanthus wrightii</i>	0–17	0–1
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0–17	0–1
	cushion buckwheat	EROV	<i>Eriogonum ovalifolium</i>	0–11	0–1
	lobeleaf groundsel	PAMU11	<i>Packera multilobata</i>	0–11	0–1
	beardtongue	PENST	<i>Penstemon</i>	0–9	0–1
	ragwort	SENEC	<i>Senecio</i>	0–6	0–1
	Utah fleabane	ERUT	<i>Erigeron utahensis</i>	0–6	0–1
	cryptantha	CRYPT	<i>Cryptantha</i>	0–6	0–1
	sanddune wallflower	ERCAC	<i>Erysimum capitatum var. capitatum</i>	0–6	0–1
	blue eyed Mary	COLLI	<i>Collinsia</i>	0–6	0–1
	freckled milkvetch	ASLE8	<i>Astragalus lentiginosus</i>	0–6	0–1
	woolly locoweed	ASMO7	<i>Astragalus mollissimus</i>	0–6	0–1
	sego lily	CANU3	<i>Calochortus nuttallii</i>	0–2	0–1
	sulphur-flower buckwheat	ERUM	<i>Eriogonum umbellatum</i>	0–2	0–1
Tree					
4	Trees			0–84	
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	0–135	0–6
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	22–67	0–4

Table 42. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
0	Dominant Grasses			224–448	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	6–168	2–8
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata ssp. vaseyana</i>	0–168	0–6
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	11–112	2–10

1	Sub-Dominant Grasses			56-168	
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0-90	0-5
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0-45	0-3
	Grass, perennial	2GP	<i>Grass, perennial</i>	0-34	0-2
	cheatgrass	BRTE	<i>Bromus tectorum</i>	2-34	0-2
	saline wildrye	LESAS	<i>Leymus salinus ssp. salinus</i>	0-34	0-2
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0-17	0-1
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	0-11	0-1
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0-11	0-1
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0-11	0-1
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0-6	0-1
	muttongrass	POFE	<i>Poa fendleriana</i>	0-6	0-1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0-6	0-1
Forb					
2	Forbs			17-95	
	Forb, perennial	2FP	<i>Forb, perennial</i>	0-34	0-2
	Great Basin lupine	LUAL5	<i>Lupinus ×alpestris</i>	0-28	0-2
	Forb, annual	2FA	<i>Forb, annual</i>	0-22	0-1
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0-17	0-1
	lobeleaf groundsel	PAMU11	<i>Packera multilobata</i>	0-11	0-1
	cushion buckwheat	EROV	<i>Eriogonum ovalifolium</i>	0-11	0-1
	beardtongue	PENST	<i>Penstemon</i>	0-9	0-1
	ragwort	SENEC	<i>Senecio</i>	0-6	0-1
	Utah fleabane	ERUT	<i>Erigeron utahensis</i>	0-6	0-1
	blue eyed Mary	COLLI	<i>Collinsia</i>	0-6	0-1
	cryptantha	CRYPT	<i>Cryptantha</i>	0-6	0-1
	sanddune wallflower	ERCAC	<i>Erysimum capitatum var. capitatum</i>	0-6	0-1
	freckled milkvetch	ASLE8	<i>Astragalus lentiginosus</i>	0-6	0-1
	woolly locoweed	ASMO7	<i>Astragalus mollissimus</i>	0-6	0-1
	sego lily	CANU3	<i>Calochortus nuttallii</i>	0-2	0-1
	sulphur-flower buckwheat	ERUM	<i>Eriogonum umbellatum</i>	0-2	0-1
Shrub/Vine					
3	Shrubs			56-224	
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0-34	0-2
	mormon tea	EPVI	<i>Ephedra viridis</i>	0-34	0-2
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0-34	0-2
	Gambel oak	QUGA	<i>Quercus gambelii</i>	0-34	0-2
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0-28	0-2
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0-22	0-2
	mountain snowberry	SYOR2	<i>Symphoricarpos oreophilus</i>	0-22	0-1
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0-17	0-1
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0-17	0-1

	Saskatoon serviceberry	AMAL2	<i>Amelanchier alnifolia</i>	0–11	0–1
	Utah serviceberry	AMUT	<i>Amelanchier utahensis</i>	0–11	0–1
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–11	0–1
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	0–11	0–1
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–6	0–1

Table 43. Community 2.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	Dominant Shrubs			168–392	
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata ssp. vaseyana</i>	168–392	8–15
3	Sub-dominant Shrubs			56–168	
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0–34	0–2
	mormon tea	EPVI	<i>Ephedra viridis</i>	0–34	0–2
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0–34	0–2
	Gambel oak	QUGA	<i>Quercus gambelii</i>	0–34	0–2
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–28	0–2
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0–22	0–2
	mountain snowberry	SYOR2	<i>Symphoricarpos oreophilus</i>	0–22	0–2
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0–17	0–1
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0–17	0–1
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–11	0–1
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	0–11	0–1
	Saskatoon serviceberry	AMAL2	<i>Amelanchier alnifolia</i>	0–11	0–1
	Utah serviceberry	AMUT	<i>Amelanchier utahensis</i>	0–11	0–1
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–6	0–1
Grass/Grasslike					
0	Dominant Grasses			34–112	
	needle and thread	HECOC8	<i>Hesperostipa comata ssp. comata</i>	6–224	2–15
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	6–112	2–8
1	Sub-Dominant Grasses			0–56	
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0–90	0–5
	muttongrass	POFE	<i>Poa fendleriana</i>	0–78	0–5
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0–45	0–3
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0–45	0–2
	Grass, perennial	2GP	<i>Grass, perennial</i>	0–34	0–2
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0–34	0–2
	cheatgrass	BRTE	<i>Bromus tectorum</i>	1–34	0–2
	saline wildrye	LESAS	<i>Leymus salinus ssp. salinus</i>	0–34	0–2
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	0–11	0–1
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0–11	0–1

	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0–11	0–1
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0–6	0–1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0–6	0–1
Forb					
2	Forbs			17–84	
	Forb, perennial	2FP	<i>Forb, perennial</i>	0–34	0–2
	Great Basin lupine	LUAL5	<i>Lupinus ×alpestris</i>	0–28	0–2
	Forb, annual	2FA	<i>Forb, annual</i>	0–22	0–1
	Wright's bird's beak	COWR2	<i>Cordylanthus wrightii</i>	0–17	0–1
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0–17	0–1
	cushion buckwheat	EROV	<i>Eriogonum ovalifolium</i>	0–11	0–1
	lobeleaf groundsel	PAMU11	<i>Packera multilobata</i>	0–11	0–1
	beardtongue	PENST	<i>Penstemon</i>	0–9	0–1
	ragwort	SENEC	<i>Senecio</i>	0–6	0–1
	Utah fleabane	ERUT	<i>Erigeron utahensis</i>	0–6	0–1
	cryptantha	CRYPT	<i>Cryptantha</i>	0–6	0–1
	sanddune wallflower	ERCAC	<i>Erysimum capitatum var. capitatum</i>	0–6	0–1
	blue eyed Mary	COLLI	<i>Collinsia</i>	0–6	0–1
	freckled milkvetch	ASLE8	<i>Astragalus lentiginosus</i>	0–6	0–1
	woolly locoweed	ASMO7	<i>Astragalus mollissimus</i>	0–6	0–1
	sego lily	CANU3	<i>Calochortus nuttallii</i>	0–2	0–1
	sulphur-flower buckwheat	ERUM	<i>Eriogonum umbellatum</i>	0–2	0–1
Tree					
4	Trees			280–504	
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	168–448	10–24
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	168–336	10–20

Table 44. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
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Table 45. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	Trees			448–673	
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	336–560	15–25
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	112–336	8–18
	needle and thread	HECOC8	<i>Hesperostipa comata ssp. comata</i>	6–280	2–15
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	6–168	2–8
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata ssp. vaseyana</i>	0–168	0–6
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	11–112	2–10
	cheatgrass	BRTE	<i>Bromus tectorum</i>	1–11	1–2

Shrub/Misc

Shrub/vine

1	Shrubs			56-168	
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata ssp. vaseyana</i>	56-168	4-10
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0-90	0-10
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0-45	0-8
	saline wildrye	LESAS	<i>Leymus salinus ssp. salinus</i>	0-34	0-5
	Grass, perennial	2GP	<i>Grass, perennial</i>	0-34	-
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0-17	0-5
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	0-11	0-5
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0-11	0-5
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0-11	0-2
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0-11	0-1
	Torrey's jointfir	EPTO	<i>Ephedra torreyana</i>	0-11	0-1
	rubber rabbitbrush	ERNA10	<i>Ericameria nauseosa</i>	0-11	0-1
	Utah serviceberry	AMUT	<i>Amelanchier utahensis</i>	0-11	0-1
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0-6	0-2
	muttongrass	POFE	<i>Poa fendleriana</i>	0-6	0-2
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0-6	0-2
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0-6	0-1
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0-6	0-1
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	0-6	0-1

Forb

2	Forbs			0-34	
	Forb, annual	2FA	<i>Forb, annual</i>	0-11	0-1
	Forb, perennial	2FP	<i>Forb, perennial</i>	0-11	0-1
	snowball sand verbena	ABFR2	<i>Abronia fragrans</i>	0-6	0-1
	freckled milkvetch	ASLE8	<i>Astragalus lentiginosus</i>	0-6	0-1
	woolly locoweed	ASMO7	<i>Astragalus mollissimus</i>	0-6	0-1
	blue eyed Mary	COLLI	<i>Collinsia</i>	0-6	0-1
	Wright's bird's beak	COWR2	<i>Cordylanthus wrightii</i>	0-6	0-1
	cryptantha	CRYPT	<i>Cryptantha</i>	0-6	0-1
	cushion buckwheat	EROV	<i>Eriogonum ovalifolium</i>	0-6	0-1
	Utah fleabane	ERUT	<i>Erigeron utahensis</i>	0-6	0-1
	Great Basin lupine	LUAL5	<i>Lupinus ×alpestris</i>	0-6	0-1
	lobeleaf groundsel	PAMU11	<i>Packera multilobata</i>	0-6	0-1
	beardtongue	PENST	<i>Penstemon</i>	0-6	0-1
	ragwort	SENEC	<i>Senecio</i>	0-6	0-1
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0-6	0-1
	sulphur-flower buckwheat	ERUM	<i>Eriogonum umbellatum</i>	0-2	0-1

Grass/Grasslike

3	Grasses			0-45	
	mormon tea	FPVI	<i>Ephedra viridis</i>	0-56	0-10

Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0–34	0–10
Gambel oak	QUGA	<i>Quercus gambelii</i>	0–34	0–10
mountain snowberry	SYOR2	<i>Symphoricarpos oreophilus</i>	0–22	0–15
fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0–22	0–5
yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0–17	0–5
winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0–17	0–5
antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	0–11	0–5
Saskatoon serviceberry	AMAL2	<i>Amelanchier alnifolia</i>	0–11	0–5
Utah serviceberry	AMUT	<i>Amelanchier utahensis</i>	0–11	0–5
blue grama	BOGR2	<i>Bouteloua gracilis</i>	0–11	0–1
cheatgrass	BRTE	<i>Bromus tectorum</i>	0–11	0–1
needle and thread	HECO26	<i>Hesperostipa comata</i>	0–11	0–1
Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0–11	–
broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–6	0–2
squirreltail	ELEL5	<i>Elymus elymoides</i>	0–6	0–1
muttongrass	POFE	<i>Poa fendleriana</i>	0–6	0–1
spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0–6	0–1
sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0–6	0–1
sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0–6	0–1
Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0–6	0–1
purple threeawn	ARPU9	<i>Aristida purpurea</i>	0–6	0–1
narrowleaf yucca	YUAN2	<i>Yucca angustissima</i>	0–1	0–2
brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–1	0–1
plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–1	0–1

Table 46. Community 4.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	Trees			616–953	
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	448–785	15–25
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	168–448	8–18
	needle and thread	HECOC8	<i>Hesperostipa comata ssp. comata</i>	0–112	0–8
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata ssp. vaseyana</i>	0–90	0–10
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0–56	0–5
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	0–56	0–5
	cheatgrass	BRTE	<i>Bromus tectorum</i>	1–11	1–2
Shrub/Vine					
1	Shrubs			0–56	
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0–17	0–5
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	0–11	0–5
	muttongrass	POFE	<i>Poa fendleriana</i>	0–11	0–2

	saline wildrye	LESAS	<i>Leymus salinus ssp. salinus</i>	0-11	0-2
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0-11	0-2
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0-11	0-2
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0-11	0-1
	Utah serviceberry	AMUT	<i>Amelanchier utahensis</i>	0-11	0-1
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata ssp. vaseyana</i>	0-11	0-1
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0-11	0-1
	mormon tea	EPVI	<i>Ephedra viridis</i>	0-11	0-1
	rubber rabbitbrush	ERNA10	<i>Ericameria nauseosa</i>	0-11	0-1
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	0-11	0-1
	roundleaf buffaloberry	SHRO	<i>Shepherdia rotundifolia</i>	0-11	0-1
	Grass, perennial	2GP	<i>Grass, perennial</i>	0-11	-
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0-6	0-8
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0-6	0-2
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0-6	0-2
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0-6	0-2
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0-6	0-1
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0-6	0-1

Grass/Grasslike

2	Grasses			0-17	
	Great Basin lupine	LUAL5	<i>Lupinus ×alpestris</i>	0-28	0-10
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0-17	0-5
	Wright's bird's beak	COWR2	<i>Cordylanthus wrightii</i>	0-17	0-2
	Forb, perennial	2FP	<i>Forb, perennial</i>	0-17	0-1
	lobeleaf groundsel	PAMU11	<i>Packera multilobata</i>	0-11	0-5
	cushion buckwheat	EROV	<i>Eriogonum ovalifolium</i>	0-11	0-5
	Grass, perennial	2GP	<i>Grass, perennial</i>	0-11	0-1
	Forb, annual	2FA	<i>Forb, annual</i>	0-11	0-1
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	0-11	0-1
	cheatgrass	BRTE	<i>Bromus tectorum</i>	0-11	0-1
	beardtongue	PENST	<i>Penstemon</i>	0-9	0-4
	ragwort	SENEC	<i>Senecio</i>	0-6	0-2
	blue eyed Mary	COLLI	<i>Collinsia</i>	0-6	0-2
	cryptantha	CRYPT	<i>Cryptantha</i>	0-6	0-2
	sanddune wallflower	ERCAC	<i>Erysimum capitatum var. capitatum</i>	0-6	0-2
	freckled milkvetch	ASLE8	<i>Astragalus lentiginosus</i>	0-6	0-2
	woolly locoweed	ASMO7	<i>Astragalus mollissimus</i>	0-6	0-2
	Utah fleabane	ERUT	<i>Erigeron utahensis</i>	0-6	0-2
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0-6	0-1
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0-6	0-1
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0-6	0-1
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0-6	0-1

	muttongrass	POPE	<i>Poa tenaeriana</i>	0-6	0-1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0-2	0-1
	sulphur-flower buckwheat	ERUM	<i>Eriogonum umbellatum</i>	0-2	0-1
	sego lily	CANU3	<i>Calochortus nuttallii</i>	0-1	0-2
Forb					
3	Forbs			0-17	
	mormon tea	EPVI	<i>Ephedra viridis</i>	0-56	0-10
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0-34	0-10
	Gambel oak	QUGA	<i>Quercus gambelii</i>	0-34	0-10
	mountain snowberry	SYOR2	<i>Symphoricarpos oreophilus</i>	0-22	0-15
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0-22	0-5
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0-17	0-5
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0-17	0-5
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	0-11	0-5
	Saskatoon serviceberry	AMAL2	<i>Amelanchier alnifolia</i>	0-11	0-5
	Utah serviceberry	AMUT	<i>Amelanchier utahensis</i>	0-11	0-5
	Forb, annual	2FA	<i>Forb, annual</i>	0-11	0-1
	Forb, perennial	2FP	<i>Forb, perennial</i>	0-11	0-1
	Wright's bird's beak	COWR2	<i>Cordylanthus wrightii</i>	0-11	0-1
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0-11	-
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0-6	0-2
	narrowleaf yucca	YUAN2	<i>Yucca angustissima</i>	0-1	0-2
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0-1	0-1
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0-1	0-1

Animal community

--General wildlife--

This site provides both food and cover for wildlife. There is palatable browse for mule deer and pronghorn, and when present, grasses such as Indian rice grass offer good grazing. When this site occurs near water, the species richness and the abundance of large mammals is increased. Birds, Bats, lizards, snakes and rodents are more common when this site occurs far from water.

--Grazing Interpretations--

This site provides good grazing conditions for livestock and wildlife during spring, summer, and fall when in good ecological condition due to accessibility and nutritious forage. However, 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/restoration is possible, but the major limiting factor is the lack of precipitation at critical times. This site may occur in mule deer and elk habitat; however in many places the populations will be small and have little grazing impact on the site.

The plant community is generally an equal mixture of shrubs and grasses. Shrubs include mountain big sagebrush, antelope bitterbrush, gamble's oak, broom snakeweed, and Utah serviceberry, which provide good browse for cattle, sheep, goats, elk, and mule deer. The dominant shrub, mountain big sagebrush, is more palatable than the other two sub species of big sagebrush (Wyoming and basin) and thus is utilized more readily by livestock and wildlife, especially in the winter. The presence of grasses including blue grama, needleandthread, Indian ricegrass, mutton bluegrass, bottlebrush squirreltail, and western wheatgrass provide desirable grazing conditions for all

classes of livestock and wildlife. 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.

--References--

Relative Forage Preference of Plants for Grazing Use by Season: Plants commonly found in Major Land Resource Area D35 --The Colorado Plateau. 2007

Stubbendieck, J., S. L. Hatch, and C. H. Butterfield. 1997. North American range plants. Lincoln, NE: University of Nebraska Press. 501p.

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Hydrological functions

Runoff and Soil Loss

The following runoff and soil loss data was generated using the Rangeland Hydrology and Erosion Model Web Tool. See reference below.

Hydrology and erosion are approximately the same for both state 1 and state 2 (refer to STM). Soil textures range from sandy loam to loam sand and slope ranges from 2-15 percent on this site. The average soil loss on all slopes and soil textures is about .26 tons/acre/year, but may be as high as .84 tons/acre/year in a single 100-year storm event. The average runoff ranges from 1.14 inches/year (loamy sand soils) to 1.2 inches/year (sandy loam soils), but may be as high as 2.4 inches during a single 100-year storm event. Long-term soil loss is not a concern on this site, but rather the rare storm events (i.e. 25, 50 or 100 year storms) result in significant soil loss that are more likely to impact the soil resource. Average rainfall ranges from 14-20 inches per year, but a single 100-year storm event can generate 3.4 inches of precipitation in a 24-hour period.

Individual sagebrush plants are uniformly distributed, resulting in high tortuosity which slows down overland flow and promotes on-site infiltration. The grasses and forbs in the shrub interspaces when present also increase infiltration. Heavy grazing that reduces the presence of grass in the interspaces may alter the infiltration of this site. Soil physical crusts and weak biological crusts (light cyanobacteria) are the most susceptible to water erosion.

Soil Group Curve Number

The soils associated with this ecological site are generally in hydrologic groups B and C (NRCS National Engineering Handbook). Hydrologic groups are used in equations that estimate runoff from rainfall. These estimates are needed for solving hydrologic problems that arise in planning watershed-protection and flood-prevention projects and for designing structures for the use, control and disposal of water (National Range and Pasture Handbook, 2003)

--References--

National Engineering Handbook. US Department of Agriculture, Natural Resources Conservation Service. Available: <http://www.info.usda.gov/CED/Default.cfm#National%20Engineering%20Handbook>. Accessed February 25, 2008.

NRCS Grazing Lands Technology Institute. 2003. National Range and Pasture Handbook. Fort Worth, TX, USA: US Department of Agriculture, Natural Resources Conservation Service, 190-VI-NRPH.

Southwest Watershed Research Center. 2008. Rangeland Hydrology and Erosion Model Web Tool. Tuscon, Arizona, USA: US Department of Agriculture, Agricultural Research Service. Available at <http://apps.tucson.ars.ag.gov/rhem/>. Accessed on Dec, 2010.

Recreational uses

Recreational values are hiking, hunting, horseback riding, and ATV riding.

Wood products

Juniper posts and firewood can be gathered on locations with juniper encroachment.

Other information

--Poisonous and Toxic Plant Communities-- Toxic plants associated with this site include oak brush, broom snakeweed, and woolly and freckled milkvetch. Oakbrush is thought to contain tannins that can be detrimental to cattle, sheep, and occasionally horses if grazed as more than 50% of the diet. Oak is highly toxic during the budding stage, leafing stage, and when acorns are available. Symptoms include lack of appetite, weakness, excessive thirst, edema, reluctance to follow the herd, and emaciation. 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 generally will only graze broom snakeweed when other forage is unavailable, typically in winter when toxicity levels are at their lowest. Woolly and freckled milkvetch are toxic to all classes of livestock and wildlife. Milkvetch are palatable and has similar nutrient value to alfalfa, which may cause animals to consume it even when other forage is available. These plants contain swainsonine (indolizidine alkaloid) and are 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".

Potentially toxic plants associated with this site include fourwing saltbush, some buckwheat species, and mountain big sagebrush. Fourwing saltbush and 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, souging 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. Mountain big sagebrush contains sesquiterpene lactones and monoterpenes which have been suspected of being toxic to sheep. An experimental dosage of $\frac{3}{4}$ lbs of big sagebrush fed to sheep for three days was found to be lethal.

Russian thistle is an invasive toxic plant, causing nitrate and to a lesser extent oxalate poisoning, which affects all classes of livestock. The buildup of nitrates in these plants is highly dependent upon environmental factors, such as after a rain storm during a drought, cool/cloudy days, and soils high in nitrogen and low in sulfur and phosphorus, all which cause increased nitrate accumulation. Nitrate collects in the stems and can persist throughout the growing season. Clinical signs of nitrate poisoning include drowsiness, weakness, muscular tremors, increased heart and respiratory rates, staggering gait, and death. Conversely, oxalate poisoning causes kidney failure; clinical signs include muscle tremors, tetany, weakness, and depression. Poisoning generally occurs when livestock consume and are not accustomed to grazing oxalate-containing plants. Animals with prior exposure to oxalates have increased numbers of oxalate-degrading rumen microflora and thus are able to degrade the toxin before clinical poisoning can occur.

--Invasive Plant Communities--

Generally as ecological conditions deteriorate and perennial vegetation decreases due to disturbance (fire, over grazing, drought, off road vehicle overuse, erosion, etc.) annual forbs and grasses will invade the site. Of particular concern in semi-arid environments are the non-native annual invaders including cheatgrass, Russian thistle, kochia, halogeton, and annual mustards. The presence of these species will depend on soil properties and moisture availability; however, these invaders are highly adaptive and can flourish in many locations. Once established, complete removal is difficult but suppression may be possible. Pinyon pine and Utah juniper are natural invaders if stands are found adjacent to this site. Trees left uncontrolled can form dense stands and eventually dominate the site.

--References--

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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.

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Date	01/07/2007
Approved by	S. Green
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None to very few. Any rills present should be short in length (less than 6 feet long) and only occur on areas with increased runoff on the lower parts of steeper slopes and areas below exposed bedrock, and be somewhat widely spaced (4-8 feet). An increase in rill formation may be seen after disturbance events such as thunderstorms.

2. **Presence of water flow patterns:** None to few. Flow patterns wind around perennial plant bases and should show little to no evidence of deposition where water accumulates. They are short (less than 8 feet long) and stable, not connected.

3. **Number and height of erosional pedestals or terracettes:** Rare-Plants should show little or no pedestalling. Terracettes should be absent or few, increasing with slope.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 20-30% bare ground. Ground cover is based on the first raindrop impact, and bare ground is the inverse of ground cover. Well developed biological soil crusts should not be recorded 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.

5. **Number of gullies and erosion associated with gullies:** None to few. Few gullies may be present but only in landscape settings where increased runoff may accumulate (such as areas below exposed bedrock). Such gully development is expected to be limited to slopes exceeding 20% and adjacent to sites where runoff accumulation occurs. Any gullies present should show little sign of accelerated erosion and should be stabilized with perennial vegetation.

6. **Extent of wind scoured, blowouts and/or depositional areas:** Very minor evidence of wind generated soil movement slight deposition at the base of shrubs may form very small coppice dunes. Wind caused blowouts are not present.

7. **Amount of litter movement (describe size and distance expected to travel):** Most litter resides in place under plant canopies with some redistribution caused by water movement. Minor litter removal may occur in flow patterns or rills with deposition occurring at points of obstruction. The majority of litter accumulates at the base of plants. Some grass leaves and small twigs (grass stems) may accumulate in soil depressions adjacent to plants. Woody litter is not likely to move.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** 75 to 85% of this site should have an erosion rating of 5 to 6 under plant canopies using the soil stability kit test. 15 to 25% may have a rating of 3 to 5 in the interspaces. The average should be a 5. Vegetation cover, litter, biological soil crusts and surface rock reduce erosion.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface varies from 2 to 3 inches thick. Structure is granular to thin platy. Color is reddish brown to brown. There is little if any difference under canopy or in interspaces and a recognizable A horizon is expected to be present throughout. Use the specific information for the soil you are assessing found in the published soil survey to supplement this description.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plants occur in sufficient cover and spatial arrangement to intercept raindrops and prevent raindrop splash erosion. Litter on soil surface and condition of soil surface also protect soil from splash erosion and encourage a high rate of infiltration. Plant spatial distribution will slow runoff allowing additional time for infiltration. Bare spaces are small and circular in shape and are usually not connected. The vegetative structure is adequate to capture snow and ensure snowmelt occurs in a subdued manner allowing maximum time for infiltration.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. Some soils have increase in clay content at 3 to 9 inches that could be mistaken for a compaction layer. Naturally occurring hard layers (clay, calcic horizon) should not be considered as compaction layers.

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: Blue grama, Needle and thread, Indian ricegrass, Mountain big sagebrush. The perennial grass and non-sprouting shrub functional groups are expected on this site. Perennial and annual forbs can be expected to vary widely in their expression in the plant community based upon departures from average growing conditions.

Sub-dominant:

Other:

Additional: Disturbance regime includes fire, drought, and insects. Assumed fire cycle of 30-60 years.

Dominance is based on average annual production, air dry weight: Non-Sprouting shrubs > perennial grasses > sprouting shrubs > forbs. 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, Smooth brome, Intermediate wheatgrass, small burnet, etc.)

Biological soil crust is variable in its expression where present on this site and is measured as a component of ground cover.

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, Sagebrush, Pinyon and juniper may continue to increase crowding out the perennial herbaceous understory species. In either case, these conditions may reflect a functional community phase within the reference state.

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** All age classes of perennial grasses should be present under average to above average growing conditions with age class expression likely subdued in below average conditions, or on sites with high (usually greater than 65%) similarity index (late seral to historic climax). Slight decadence in the principle shrubs could occur near the end of the fire cycle. In general, a mix of age classes may be expected with some dead and decadent plants present.

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

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 700#/acre on an average year

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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: Broom snakeweed, Utah juniper, Pinion pine, Green rabbitbrush.
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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.
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