Ecological site R007XY930WA
Loamy Bottom

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General information

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

MLRA notes

Major Land Resource Area (MLRA): 007X–Columbia Basin

This MLRA is in the Walla Walla Plateau section of the Columbia Plateaus province of the Intermontane Plateaus. The Columbia River flows through this MLRA, and the Snake and Yakima Rivers join the Columbia River within it. This MLRA is almost entirely underlain by Miocene basalt flows. Columbia River Basalt is covered in most areas with as much as 200 feet of eolian, lacustrine, and alluvial deposits. The dominant soil orders in this MLRA are Aridisols and Entisols. The soils in the area dominantly have a mesic temperature regime, an aridic moisture regime, and mixed mineralogy. They generally are moderately deep to very deep and well drained to excessively drained.

Classification relationships

Major Land Resource Area (MLRA): 007X – Columbia Basin

LRU – Common Resource Areas (CRA):
7.1 – Sandy Missoula Flood Deposits
7.2 – Silty Missoula Flood Deposits
7.3 – Dry Loess Islands
7.4 – Dry Yakima Folds
7.5 – Yakima Valley – Pleistocene Lake Basins

Ecological site concept

In the upland setting ecological sites are often expansive, and thus, can be delineated and separated on aerial photos. But in the landscape position of bottoms, basins and depressions this is rarely the case as small changes in soil chemistry, the water table and elevation or aspect results in significant changes in plant community composition. In short distances there are often big swings of available water holding capacity, and soils can go from hydric to non-hydric, or from saline-sodic to not. So, in bottoms, riparian areas and depressions, ecological sites and community phases occur as small spots, strips and patches, or as narrow rings around vernal ponds. And generally, in a matter of steps one can walk across several ecological sites. On any given site location, two or more of these ecological sites occur as a patchwork – Loamy Bottom, Alkali Terrace, Sodic Flat, Wetland complex and Riparian complex. These ecological sites may need to be mapped as a complex when doing resource inventory.

Diagnostics:
The first thing that strikes you about the Loamy Bottom ecological site is the vegetation is much taller, and vastly more productive than any upland site. The tall, upright bunchgrasses and shrubs can be taller than six feet. Another striking feature of the Loamy Bottom ecological site is that it provides excellent protection from wind for livestock and wildlife, and provides good habitat (hiding cover, nesting cover, standing winter forage).

Loamy Bottom ecological site is part of the lentic (standing water) ecosystem, but this site is not a wetland, nor or the soils hydric. It occurs on moisture receiving sites such as bottoms, draws, basins and depressions. This site also occurs as a narrow zonal ring around ponds, lakes and vernal pools. The Loamy Bottom ecological site is an important “hinge site” as it connects upland sites with riparian areas, wetlands and saline-sodic sites. The Loamy Bottom ecological site in MLRA 007X is more limited in scope than the similar site in MLRA 008X.

Soils are deep and unrestricted for plant growth. The soils are silt loam or sandy loam texture and are not saline or sodic, and not hydric. In addition, the landscape position of this site could be conducive to soils possibly containing andic soil properties, i.e. volcanic ash. These andic soil properties can be important for productivity in that they retain larger amounts of water compared to other parent materials (higher water-holding capacity (AWC)), have high cation exchange capacity (CEC) and high availability of organically bound plant nutrients.

Across most of the sagebrush steppe region, this site is a basin wildrye-basin or Wyoming big sagebrush site. While tall bunchgrasses and tall, fire-sensitive shrubs dominate the Reference State overstory, mid-sized bunchgrasses and forbs fill the interspaces. The overstory layer is head-high or taller basin wildrye with equally tall basin big or Wyoming big sagebrush. The next layer is bluebunch wheatgrass or Nelson’s needlegrass, and a variety of native wildflowers, while Sandberg bluegrass is the shortest layer.

The natural fire regime maintains a patchy distribution of shrubs. Depending on the time interval since the last fire, the shrub canopy can be as little 0 to 3 percent or as much as 40 percent.

Principle Vegetative Drivers:
The vegetative expression of Loamy Bottom ecological site is driven by two situations. First, this site receives both surface runoff and discharging groundwater from adjacent upland ecological sites. Second, the soils are deep and unrestricted. This makes the Loamy Bottom ecological site far more productive and any upland site.

Associated sites

R007XY970WA	**Alkali Terrace**
R007XY978WA	**Sodic Flat**
R007XY988WA	**Wetland Complex**
R007XY720WA	**Riparian Complex**
R007XY130WA	**Loamy**
R007XY120WA	**Stony**

Similar sites

R009XY930WA	**Loamy Bottom**

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata ssp. wyomingensis* (2) *Artemisia tridentata ssp. tridentata*
Herbaceous	(1) *Leymus cinereus* (2) *Pseudoroegneria spicata*

Physiographic features

The landscape is part of the Columbia basalt plateau. Loamy Bottom ecological site occurs on non-wetland bottoms, draws, basins, & depressions. The site also occurs as fringes around ponds and lakes at elevations of 300 to 1,500 feet. In bottoms, riparian areas and depressions, as a complex of ecological sites and often is one of the narrow bands around ponds, lakes, vernal pools, springs and seeps.

Physiographic Division: Intermontane Plateau
Physiographic Province: Columbia Plateau

Physiographic Sections: Walla Walla Plateau Section

Table 2. Representative physiographic features

Landforms	(1) Basin (2) Valley (3) Terrace (4) Flood plain (5) Depression
Flooding frequency	None to occasional
Ponding frequency	None
Elevation	300–1,500 ft
Slope	1–3%
Water table depth	20–60 in
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	250–3,000 ft
Slope	0–5%
Water table depth	Not specified

Climatic features

The climate is characterized by moderately cold, wet winters, and hot, dry summers, with limited precipitation due to the rain shadow effect of the Cascades. The average annual precipitation for the Loamy Bottom ecological site is mostly between 4 and 9 inches. Seventy to seventy-five percent of the precipitation comes late-October through March as a mixture of rain and snow. Precipitation that comes after March is not as effective for plant growth. June through early-October is mostly dry. Freezing temperatures generally occur from late-October through early-April. Temperature extremes are -10 degrees Fahrenheit in winter and 110 degrees Fahrenheit in summer.

Table 4. Representative climatic features

Frost-free period (characteristic range)	150-180 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	102-229 in
Frost-free period (actual range)	140-200 days
Freeze-free period (actual range)	
Precipitation total (actual range)	

Influencing water features

A plant’s ability to grow on a site and overall plant production is determined by soil-water-plant relationships:
1. Whether rain and melting snow run off-site or infiltrate into the soil
2. Whether soil condition remain aerobic or become saturated and anaerobic
3. How quickly the soil reaches the wilting point

Loamy Bottom ecological site receives both surface runoff and discharging groundwater from nearby upland sites. The soils are deep, well drained, and unrestricted, and thus, remain saturated for only a short period in late winter to early spring. With adequate cover of live plants and litter, there are no water infiltrating restrictions on the Loamy

Bottom ecological site.

Soil features

This ecological site soil components are dominantly Typic, Torrifluventic, Fluvaquentic and Aridic taxonomic subgroups of Haploxerolls, Argixerolls, Endoaquolls great groups of the Mollisols taxonomic orders. Soils are dominantly very deep, but strongly contrasting textural stratification can occur up to 20 inches. Average available water capacity of about 6.0 inches (15.3 cm) in the 0 to 40 inches (0-100 cm) depth range.

Soil parent material is dominantly alluvium derived from mixed sources with possibly minor amounts of ash in the upper part of the soil.

The associated soils are Ashue, Esquatzel, Royal, Toppenish, Weirman, Zillah and similar soils.

Table 5. Representative soil features

Parent material	(1) Alluvium
Surface texture	(1) Silt loam (2) Gravelly loam
Family particle size	(1) Fine-silty (2) Coarse-loamy
Drainage class	Somewhat poorly drained to excessively drained
Depth to restrictive layer	60 in
Soil depth	60 in
Surface fragment cover <=3"	3%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	6 in
Calcium carbonate equivalent (Depth not specified)	0–10%
Electrical conductivity (Depth not specified)	0–10 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–10
Soil reaction (1:1 water) (0-10in)	6.1–9.4
Subsurface fragment volume <=3" (Depth not specified)	20%
Subsurface fragment volume >3" (Depth not specified)	10%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Depth to restrictive layer	Not specified
Soil depth	Not specified
Surface fragment cover <=3"	0–10%
Surface fragment cover >3"	0–5%
Available water capacity (0-40in)	1.6–9.1 in

Calcium carbonate equivalent (Depth not specified)	Not specified
Electrical conductivity (Depth not specified)	Not specified
Sodium adsorption ratio (Depth not specified)	Not specified
Soil reaction (1:1 water) (0-10in)	Not specified
Subsurface fragment volume <=3" (Depth not specified)	0–35%
Subsurface fragment volume >3" (Depth not specified)	0–25%

Ecological dynamics

Vegetation Dynamics:
Loamy Bottom ecological site produces about 3000 pounds per acre of biomass annually.

Regarding saline-alkali soils Daubenmire (page 50) wrote, “It seems impossible to find areas where one can be confident that the vegetation has not been somewhat altered by domesticated animals.” The same is also true of loamy bottoms, riparian areas and wetlands. Some areas were also manipulated by tillage or other farming practices.

Basin wildrye, also called Great Basin wildrye, is at the core of the Loamy Bottom ecological site and warrants a degree of understanding. Basin wildrye is a cool season bunchgrass but is considered weakly rhizomatous. It has coarse, robust stems and leaves, grows to 5 to 7 feet tall and sometimes exceeds three feet in diameter, and thus, is one of the highest producing species. Basin wildrye is commonly found on loamy bottoms, mildly to moderately saline-sodic soils and on the tops of loamy mounds. It tolerates alkaline soils and seasonal flooding but not anaerobic conditions. On a good Loamy Bottom ecological site, basin wildrye, given good plant vigor, can take ownership even with invasive species in the community.

Basin big sagebrush and Wyoming big sagebrush overlap in range and elevation. Basin big sagebrush plants are taller (up to 13 feet) and typically have a single main trunk. Wyoming big sagebrush is considerably shorter (3 to 5 feet), and plants have multiple main stems branching from the ground. Big sagebrush in a long-lived, multi-branched, evergreen shrub. Sagebrush has a significant rooting system, composed of a two-part rooting structure with a primary deep taproot, and a shallow extensive network of finer roots that spread laterally. This rooting system allows big sagebrush to survive in the hottest and driest portions of the sagebrush range by tapping into groundwater sources deep into the soil profile itself. This also allows sagebrush to be more competitive with bunchgrasses when the landscape positions and soils are less ideal for grass species to maintain the competitive advantage.

The stability and resiliency of the reference communities on Loamy Bottom ecological sites is directly linked to the health and vigor of basin wildrye. Given the opportunity (good vigor and favorable moisture), basin wildrye can establish ownership and expand across the Loamy Bottom ecological site. Basin wildrye expands via two processes: (1) Tillering from basal buds for new shoots, and (2) new seedlings from germinating seed.

The natural fire regime maintains a patchy distribution of shrubs. Depending on the time interval since the last fire, the shrub canopy can be as little 0 to 3 percent or as much as 40 percent.

The natural disturbance regime for sagebrush-bunchgrass communities is periodic lightning-caused fires. The fire return intervals (FRI) listed in research for sagebrush steppe communities is quite variable. Ponderosa pine communities have the shortest FRI of about 10 to 20 years (Miller). The FRI increases as one moves to wetter forested sites or to drier shrub steppe communities. Given the uncertainties and opinions of reviewers, a mean of 75 years and a range of 50 to 100 was chosen for Wyoming big sagebrush communities (Rapid Assessment Model). The FRI for Loamy Bottom ecological site is the same as upland sites.

Some fires are spotty or do not burn hot enough to fully remove the sagebrush. Fires with light severity will remove less sagebrush and open smaller patches for grass and forb recovery, whereas the more severe fires will remove almost all the sagebrush and leave vast areas open to return to bunchgrass dominance. This is how the patchy distribution occurs. Rabbitbrush is a sprouting shrub and may also increase following fire.

Because basin wildrye produces a large amount of biomass, fire can burn and smolder in the crown of the plant for considerable time. This leaves basin wildrye plants much diminished. It can take a few years for basin wildrye to fully recover from the effects of fire.

Grazing is another common disturbance that occurs to this ecological site. Grazing pressure can be defined as heavy grazing intensity, or frequent grazing during reproductive growth, or season-long grazing. As grazing pressure increases the plant community unravels in stages:
1. More preferred grasses decline first and then basin wildrye plants produce fewer shoots and tillers and crowns become smaller.
2. As some basin wildrye plants die and other plants are weaker yet, native species such as sagebrush expands
3. As the decline continues invasive species such as knapweed, perennial pepperweed and cheatgrass colonize the site
4. With further decline the site can become a sagebrush-invasive weed community

Managing sagebrush steppe to improve the vigor and health of native bunchgrasses begins with an understanding of grass physiology. New growth for existing bunchgrasses begins each year from basal buds. Basin wildrye plants can expand via tillering, or new plants through natural reseeding. Regrowth from spring grazing comes mostly from photosynthesis.

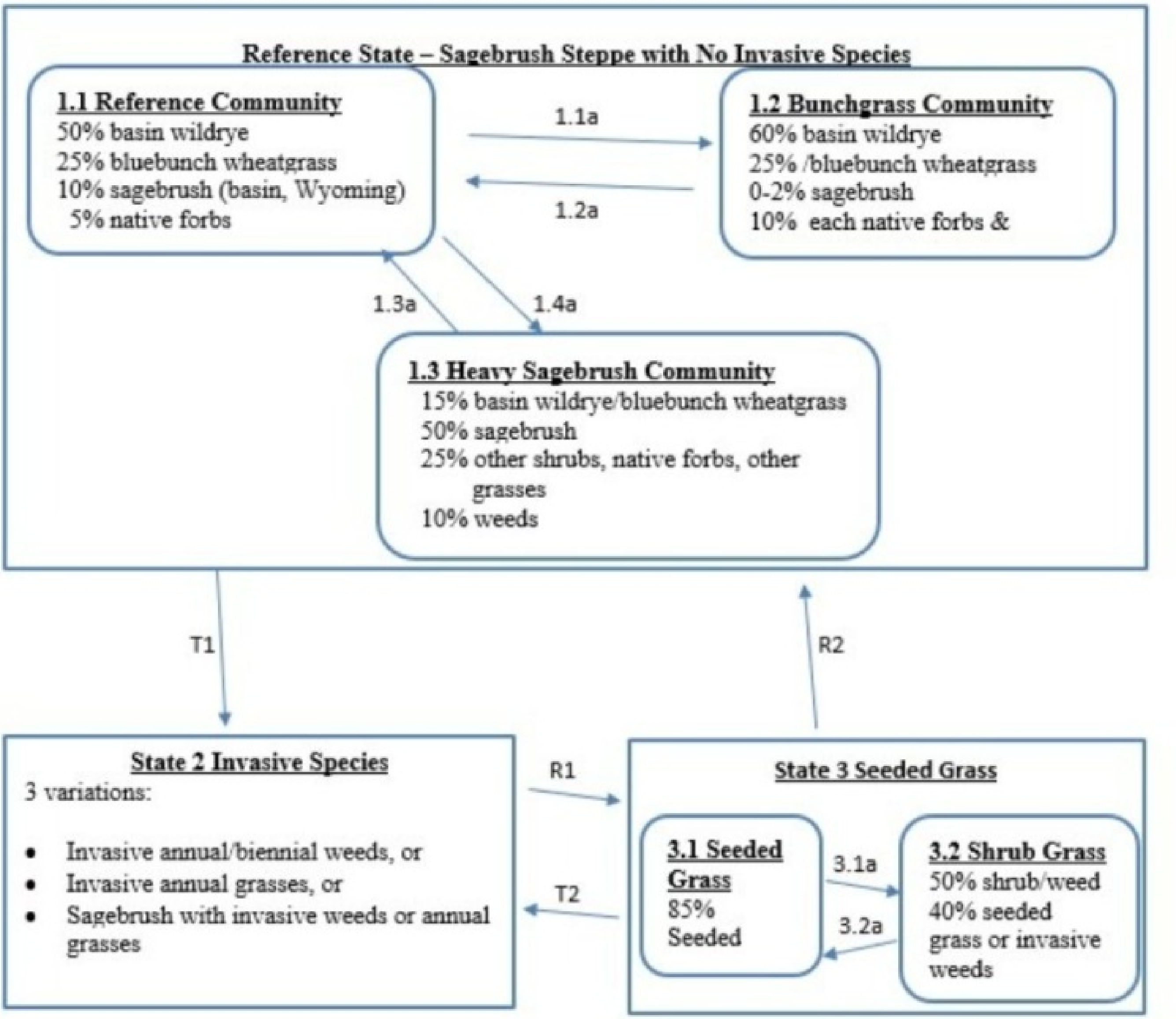
In the spring each year it is important to monitor and maintain an adequate top growth: (1) to optimize regrowth following spring grazing, (2) so plants have enough energy to replace basal buds annually, and (3) to protect the elevated growing points of basin wildrye.

During seed formation, the growing points of basin wildrye become elevated 4 to 6 inches and are vulnerable to damage or removal. Repeated grazing during late spring is especially damaging. Over several years each native bunchgrass pasture should be rested during the critical period two out of every three years (approximately April 15through July 15). And each pasture should be rested the entire growing-season every third year (approximately March 1 through July 15).

Basin wildrye and bluebunch wheatgrass remain competitive if:
(1) Basal buds are replaced annually,
(2) Enough top-growth is maintained for growth and protection of growing points, and
(3) The timing of grazing and non-grazing is managed over a several-year period. Careful management of late spring grazing is especially critical

In Washington, basin wildrye-sagebrush communities provide habitat for a variety of upland wildlife species.

State and transition model



State 1
Reference

State 1 represents sagebrush steppe with none to minor amounts of invasive or exotic weed species. All the functional, structural groups have one or more native species. Reference Community 1.1 is dominated by basin wildrye with some sagebrush. Community 1.2 is even more strongly bunchgrass dominated. Community 1.3 is dominated by sagebrush with basin wildrye as sub-dominate. Native forbs and other shrubs are prevalent and there are minor amounts of weeds (broadleaf or annual grasses). There is enough basin wildrye remaining for Community 1.3 to shift back to the other communities in the reference state as basin wildrye can be aggressive on favorable sites such as Loamy Bottom ecological site. On a good Loamy Bottom ecological site basin wildrye can and will push out other herbaceous species. At-risk Communities: • All communities in the reference state are at risk of invasion by exotic species. Annual or biennial weeds and annual grass seeds blow onto most sites annually • Community Phase 1.3, the heavy sagebrush community, has the highest risk of moving to State 2 which is dominated by invasive weeds or annual grasses • Any Loamy Bottom ecological site plant community with high sagebrush cover and low cover of basin wildrye will also have some invasive weeds • To seed or not to seed is the question after a fire. Community 1.3 should be seeded to basin wildrye to minimize weed infestation. Any site with low cover of basin wildrye and any site with low to moderate cover of weeds should be seeded after a fire. State 2 and Community 3.2 should also be seeded

Community 1.1
Basin Wildrye, Basin Big Sagebrush, and Wyoming Big Sagebrush

50% basin wildrye 25% bluebunch wheatgrass 10% Wyoming big sagebrush and basin big sagebrush 5% native forbs

Community 1.2
Basin wildrye and Bunchgrass

60% basin wildrye 25% bluebunch wheatgrass 5% sagebrush 10% native forbs

Community 1.3
Sagebrush

15% basin wildrye and bluebunch wheatgrass 50% sagebrush 25% other shrubs, native forbs, and other grasses 10% weeds

Pathway 1.1A
Community 1.1 to 1.2

Result: Shift from reference community 1.1 to bunchgrass community 1.2. Sagebrush cover is all but eliminated, while basin wildrye has a moderate increase in cover. Primary Trigger: Moderate-severity fire consumes above-ground plant biomass and kills almost all the sagebrush. With a lot of biomass, the fire burns into the crowns of basin wildrye, but some of the crown remains intact. So, basin wildrye survives and increases its vigor the next few years. For other bunchgrasses and forbs there is no impact to their crowns and these species return post-fire with good vigor. Post-fire the bunchgrasses are now more susceptible to grazing damage. Burned rangeland pastures need two growing seasons rest before grazing resumes or, the pastures can be lightly grazed during the dormant season the first two years post-fire. Beyond two years for the bunchgrasses to expand, moderate grazing intensity, and both critical period and growing season deferments must be implemented on burned pastures. Secondary Trigger: Several years above of average precipitation. High seasonal water table kills most of the sagebrush, allowing basin wildrye to assert almost total cover dominance. This is a rare occurrence, but it did happen in the mid-1980s. Ecological process: Fire kills sagebrush and it does not have any sprouting ability. A few sagebrush plants remain, but only in patches that did not burn. The reduction in sagebrush releases resources and increases light for grasses and forbs. Basin wildrye, bluebunch wheatgrass and other bunchgrasses have good vigor post-fire and expand via tillering and new seedlings.

Pathway 1.1B
Community 1.1 to 1.3

Result: shift from reference community 1.1 to heavy sagebrush community 1.3. Primary Trigger: With excessive grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) and a period of no fire, sagebrush increases its cover while basin wildrye, bluebunch wheatgrass and other bunchgrasses suffer a big decline. Ecological process: with consistent defoliation pressure basin wildrye and other bunchgrass have low vigor, shrinking crowns and some mortality. This gives sagebrush the opportunity to set new seedlings and expand its cover. Increased shade from the new sagebrush plants also plays a role in this process.

Pathway 1.2A
Community 1.2 to 1.1

Result: Shift from bunchgrass community 1.2 to reference community 1.1. Primary Trigger: Soil disturbances coupled with a period of no fire. Secondary Trigger: Several years of average or below normal precipitation leading to a significant drop in the lateral water flow and drying out the soil profile, which leads to fine root die-off of basin wildrye. Slight competitive advantage shifts to sagebrush. Good management is required to keep the basin wildrye loss to a minimum as sagebrush re-enters the community Ecological process: Spots with soil disturbance receive sagebrush seed from remnant plants in unburned patches or from adjacent sites, seed germinates in the spring and a few sagebrush seedlings establish. For most locations it may take up to 10 years for sagebrush to re-enter the community. With a slight increase in shade perennial bunchgrasses experience a slight decline.

Pathway 1.3A
Community 1.3 to 1.1

Result: Significant shift from heavy sagebrush community 1.3 to reference community 1.1. Primary Trigger: Moderate-severity fire consumes above-ground plant biomass and kills almost all the sagebrush. With a lot of biomass, the fire burns into the crowns of basin wildrye, but some of the crown remains intact. So, basin wildrye survives and increases its vigor the next few years. For bunchgrasses and forbs there is no impact to their crowns and these species return post-fire with good vigor. Post-fire the bunchgrasses are now more susceptible to grazing damage. Burned rangeland pastures need two growing seasons rest before grazing resumes or, the pastures can be lightly grazed during the dormant season the first two years post-fire. Beyond two years for the bunchgrasses to expand, moderate grazing intensity, and both critical period & growing season deferments must be implemented on burned pastures. Secondary Trigger: Several years above of average precipitation. High seasonal water table kills most of the sagebrush, allowing basin wildrye to assert almost total cover dominance. This is a rare occurrence, but it did happen in the mid-1980s. Ecological process: Fire kills sagebrush and it does not have any sprouting ability. A few sagebrush plants remain, but only in patches that did not burn. The reduction in sagebrush releases resources and increases light for grasses and forbs. Basin wildrye can aggressively attains the competitive edge and reclaims niches vacated by sagebrush. Bluebunch wheatgrass and other bunchgrasses have good vigor post-fire and expand via tillering and new seedlings.

State 2
Invaded

State 2 represents communities that have crossed a biological threshold. Invasive species dominate the site and virtually all the native functional, structural groups are missing. This state can occur with or without sagebrush. Dominant State 2 Species: Invasive weeds: mustard, prickly lettuce, perennial pepperweed, knapweeds Invasive annual grasses: annual bromes, cheatgrass Sagebrush, rabbitbrush R2 No Recovery within reason. Result: Shift from invasive species in State 2 back to Reference State. This restoration transition does not occur without a significant commitment of time & resource inputs to restore ecological processes, native bunchgrasses, sagebrush and native forb species. TWO OPTIONS: Option#1: Step 1 seed to introduced grasses; Step 2 seed to native species Step 1 shifting from State 2 to State 3: It will take two years or longer to kill annual species and to exhaust the seedbank of invasive weed seed. Site will then need to be seeded to introduced perennial species such as crested wheatgrass to restore soil properties before native species can survive and thrive on site. The seeded species rebuild some of the basic soil properties including increased soil organic matter, improved pore spaces and increased soil moisture within the soil profile. The site would also need several years of no significant fires and proper grazing management as well. See narrative for R1 recovery above. Step 2 shifting from State 3 to State 1: This assumes that the shift from State 2 to State 3 has been successful. Introduced grasses and any remaining weeds must be killed while maintaining soil structure to ensure a proper seedbed (cloddy, a little rough and trashy to provide safe sites for the seed). A pulverized dust mulch must be avoided at all costs. The seeding of native species could occur in two steps: (1) first year, use a grass seed mix to duplicate the Reference Community (mostly basin wildrye with other native bunchgrasses) so that broadleaf weeds may be controlled, and (2) second year re-introduce sagebrush and native forbs. Plugs may be used for sagebrush and native forbs rather than seed. Post-seeding the site would also need several years with no significant fires and proper grazing management as well to ensure plant establishment and vigor. Option #2: seed directly to native species Take two years or more to kill weeds and to exhaust the weed seedbank while maintaining soil structure. As in Option 1 above, the seeding of native species could occur in two steps: (1) first year, use a grass seed mix to duplicate the Reference Community (mostly basin wildrye with other native bunchgrasses) so that broadleaf weeds may be controlled, and (2) second year re-introduce sagebrush and native forbs. Plugs may be used for sagebrush and native forbs rather than seed. Post-seeding the site would also need several years with no significant fires and proper grazing management as well to ensure plant establishment and vigor.

Community 2.1
Invasive Annual and Biennial Weeds and Invasive Annual Grasses

State 3
Seeded

State 3 represents a site that has been seeded to desirable grasses such as basin wildrye or intermediate wheatgrass. Community 3.1 remains stable with 0.8 plant per square foot or greater of mid-sized bunchgrasses or with a full stand of basin wildrye.

Community 3.1
Seeded Grasses

Community 3.2
Shrubs and Seeded Grasses

Pathway 3.1A
Community 3.1 to 3.2

Result: shift from seeded grass community 3.1 to shrub grass community 3.2 with a mixture of seeded grasses and shrubs and invasive weeds Primary Trigger: Grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) to seeded grasses Ecological process: Due to consistent defoliation pressure seeded grass have low vigor, shrinking crowns and some mortality. This gives sagebrush the opportunity to set new seedlings and expand its cover. Increased shade from the new sagebrush plants also plays a role in this process.

Pathway 3.2A
Community 3.2 to 3.1

Result: shift from shrub/weed dominated community 3.2 back to community 3.1 dominated by seeded grasses. Primary Trigger: Human intervention to kill shrubs, reduce invasive weed population and to re-seed or inter-seed desirable grass species. Ecological process: shrub and weed control open the site to allow successful seeding. Herbicide application, tillage and seeding operation must be timely. Seed placement should ensure seed-soil contact at 1/8 to 1/4 inch depth. Post-seeding management should ensure that desirable grass seedlings become established and broadleaf weeds are controlled. After killing shrubs and weeds, and with a good population of remnant desirable grasses, it may be possible that the desirable grasses expand naturally without seeding.

Transition T1A
State 1 to 2

Result: Shift from Reference State (native shrub steppe with no invasive species) to State 2 which is dominated by invasive weeds or annual grasses. The pathway from State 1 to State 2 occurs as Community 1.3 declines until it crosses the biological threshold. This transition occurs once the cover of basin wildrye drops to 5 percent and invasive species cover is at least 40 percent. Primary Trigger: grazing pressure (heavy grazing, season-long grazing, or late spring grazing) to basin wildrye. Secondary Trigger: Frequent fires or one severe fire can have the same effect. Also, several years of drought can put the basin wildrye in decline. Ecological process: with consistent defoliation pressure basin wildrye and other bunchgrass have low vigor, shrinking crowns and mortality. Weed seeds from invasive species blow onto the site or are carried in with runoff water. On most sites weed seeds are waiting for an opportunity to colonize. As basin wildrye cover declines invasive species increase accordingly. Over time the invasive species expand to a position of dominance. Indicators: Decreasing cover of basin wildrye and increasing cover of invasive species. Increasing canopy gaps between native perennial species. Decreasing soil organic matter, soil water retention, limited water infiltration and percolation in the soil profile.

Restoration pathway R2A
State 2 to 3

This restoration transition does not occur without significant time and inputs to control weeds, prepare a seedbed, seed desirable species, and post-seeding weed control and management. This can require a commitment of two years or more for weed control. Care must be taken to maintain soil structure so that the seedbed has many safe-sites for the seed. Seed placement must be managed to achieve seed-soil contact at very shallow depth (about 1/8-1/4 inch is desired). Proper grazing management is essential to maintain the stand post-seeding. Basin wildrye and intermediate wheatgrass are highly adapted to the Loamy Bottom ecological site. The actual transition occurs when the seeded species have successfully established and are outcompeting the annual species for cover and dominance of resources.

Transition T3A
State 3 to 2

Result: Shift from State 3 (seeded grasses) to State 2 which dominated by invasive weeds or annual grasses. Primary Trigger: grazing pressure (heavy grazing, season long grazing, or frequent late spring grazing) to seeded grasses. Secondary Trigger: Frequent fires or a severe fire that burn out plant crowns of native species and give competitive advantage to the invasive species. This transition occurs when chronic heavy grazing has removed too much of the perennial bunchgrass cover allowing invasive annual species to colonize the site. As this continues the competitive advantage goes to the exotic species which are opportunistic and take most of the site's resources. Ecological process: with consistent defoliation pressure seeded grasses have low vigor, shrinking crowns and mortality. Weed seeds from invasive species blow onto the site or are carried in with runoff water. On most sites weed seeds are waiting for an opportunity to colonize. As the cover of seeded grass declines invasive species increase accordingly. Over time the invasive species expand to a position of dominance. Indicators: shrinking crowns and mortality of desirable species, increasing gaps between perennial species, and increasing cover by invasive annual species.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)

Inventory data references

Data to populate Reference Community came from several sources: (1) NRCS ecological sites from 2004, (2) Soil Conservation Service range sites from 1980s and 1990s, (3) Daubenmire's habitat types, and (4) ecological systems from Natural Heritage Program

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Approval

Kirt Walstad, 2/06/2025

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	01/31/2025
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

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

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

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

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

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

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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

17. **Perennial plant reproductive capability:**