USDA Natural Resources Conservation Service

Ecological site F026XY066NV
Cool Concave Mountain Slope 16+ P.Z.

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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): 026X–Carson Basin and Mountains

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MLRA 26 is in western Nevada and eastern California; approximately 69 percent is in Nevada, and 31 percent in California. The area is predominantly in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. Isolated north- south trending mountain ranges are separated by aggraded desert plains. The mountains are uplifted fault-blocks with steep side slopes. The valleys are drained by three major rivers flowing east across MLRA 26; the Truckee, Carson and Walker rivers. A narrow strip along the western border of MLRA 26 is in the Sierra Nevada Section of the Cascade-Sierra Mountains Province of the Pacific Mountain System. The Sierra Nevada Mountains are primarily a large fault-block that has been uplifted with a dominant tilt to the west. The structure creates an impressive wall of mountains directly west of the area creating a rain shadow affect to MLRA 26. Parts of the eastern face; the foothills, mark the western boundary of the area. Elevations range from near 3,806 feet (1,160 meters) on the west shore of Pyramid Lake to 11,653 feet (3,552 meters) on the summit of Mount Patterson in the Sweetwater Mountains.

In MLRA 26, the valleys are composed dominantly of Quaternary alluvial deposits. Quaternary playa or alluvial flat deposits typically occupy the lowest valley bottoms in the internally drained valleys. Tertiary andesitic flows, breccias, ash flow tuffs, rhyolite tuffs or granodioritic rocks dominate the hills and mountains. Quaternary basalt flows are present in lesser amounts. Jurassic and Triassic limestone and shale, and Precambrian limestone and dolomite are also present in very limited amounts. Glacial till deposits, of limited extent are along the east flank of the Sierra Nevada Mountains; the result of alpine glaciation.

The average annual precipitation in MLRA 26 is 5 to 36 inches (125 to 915 millimeters), increasing with elevation. Most of the rainfall occurs as high-intensity, convective storms in spring and autumn. Precipitation is mostly snow in winter. Summers are dry. The average annual temperature is 37 to 54 degrees F (3 to 12 degrees C). The freeze-free period averages 115 days and ranges from 40 to 195 days, decreasing in length with elevation.

The dominant soil orders in MLRA 26 are Aridisols and Mollisols. The soils in the area typically have a mesic soil temperature regime, an aridic or xeric soil moisture regime, and mixed or smectitic mineralogy. The soils are generally well drained, clayey or loamy and are commonly skeletal. The soils depths are typically very shallow to moderately deep.

This area supports shrub-grass vegetation characterized by big sagebrush. Low sagebrush and Lahontan sagebrush are on some soils. Antelope bitterbrush, squirreltail, desert needlegrass, Thurber needlegrass, and Indian ricegrass are important associated plants. Green ephedra, Sandberg bluegrass, desert peach, and several forb species are also common. Juniper-pinyon woodland is typical on mountain slopes. Jeffrey pine, lodgepole pine, white fir, and manzanita grow on the highest mountain slopes. Shadscale is the typical plant in the drier parts of the area. Sedges, rushes, and moisture-loving grasses grow on the wettest parts of the wet flood plains and terraces. Basin wildrye, alkali sacaton, saltgrass, buffaloberry, black greasewood, and rubber rabbitbrush grow on the drier

sites that have a high concentration of salts.

Wildlife species in the area are mule deer, coyote, beaver, muskrat, jackrabbit, cottontail, raptors, pheasant, chukar, blue grouse, mountain quail, and mourning dove, amongst other species. The species of fish in the area include trout and catfish. The Lahontan cutthroat trout in the Truckee River is a threatened and endangered species.

LRU notes

The Sierra Influenced Ranges LRU is characterized by wooded great basin mountains and climatic and biotic affinities to the Sierra Nevada Mountain range. The Sierra Influenced Ranges LRU receives greater precipitation than the mountain ranges of central Nevada.

Amount of precipitation varies in relation to the local strength of the Sierra Nevada rain shadow, characterized by pinyon and juniper trees. The White, Sweetwater, Pine Nut, Wassuk, and Virginia ranges of Nevada support varying amounts of Sierra Nevada flora, like ponderosa pine. Elevations range from 1610 to 2420 meters and slopes range from 5 to 49 percent, with a median value of 22 percent.

Frost free days (FFD) ranges from 92 to 163.

Classification relationships

POTR5 WSG:1R1707

Ecological site concept

The Cool Concave Mountain Slope 16+ P.Z. site is on cool, moist, smooth to concave, mountain side slopes of mostly northern aspects. Slopes range from 4 to 30 percent. Elevations are 7550 to over 9160 feet (2301 to 2792 meters). The soils associated with this site are generally deep to very deep and well drained. The surface soil texture is gravelly ashy sandy loam. The dominant plants are aspen (Populus tremuloides), mountain snowberry (Symphoricarpos oreophilus), mountain brome (Bromus marginatus), and slender wheatgrass (Elymus trachycaulus ssp trachycaulus).

Table 1. Dominant plant species

Tree	(1) *Populus tremuloides*
Shrub	(1) *Symphoricarpos oreophilus*
Herbaceous	(1) *Bromus marginatus* (2) *Elymus trachycaulus ssp. trachycaulus*

Physiographic features

The Cool Concave Mountain Slope 16+ P.Z. site is on cool, moist, smooth to concave, mountain side slopes of mostly northern aspects. Slopes range from 4 to 30 percent. Elevations are 7550 to over 9100 feet (2301 to 2792 meters).

Table 2. Representative physiographic features

Landforms	(1) Mountain
Elevation	7,550–9,100 ft
Slope	4–30%
Aspect	NW, N, NE

Climatic features

The climate associated with this site is subhumid with cool, dry summers and cold, wet winters. Average annual precipitation is 16 to over 20 inches (41 to 51 cms). Mean annual air temperature is 40 to 43 degrees F. The

average growing season is 50 to 70 days. No climate stations are available for this site.

Nevada's climate is predominantly arid, with large daily ranges of temperature, infrequent severe storms, heavy snowfall in the higher mountains, and great location variations with elevation. Three basic geographical factors largely influence Nevada's climate: continentality, latitude, and elevation. Continentality is the most important factor. The strong continental effect is expressed in the form of both dryness and large temperature variations. Nevada lies on the eastern, lee side of the Sierra Nevada Range, a massive mountain barrier that markedly influences the climate of the State. The prevailing winds are from the west, and as the warm moist air from the Pacific Ocean ascend the western slopes of the Sierra Range, the air cools, condensation occurs and most of the moisture falls as precipitation. As the air descends the eastern slope, it is warmed by compression, and very little precipitation occurs. The effects of this mountain barrier are felt not only in the West but throughout the state, with the result that the lowlands of Nevada are largely desert or steppes. The temperature regime is also affected by the blocking of the inland-moving maritime air. Nevada sheltered from maritime winds, has a continental climate with well-developed seasons and the terrain responds quickly to changes in solar heating.

Nevada lies within the mid-latitude belt of prevailing westerly winds which occur most of the year. These winds bring frequent changes in weather during the late fall, winter and spring months, when most of the precipitation occurs. To the south of the mid-latitude westerlies, lies a zone of high pressure in subtropical latitudes, with a center over the Pacific Ocean. In the summer, this high-pressure belt shifts northward over the latitudes of Nevada, blocking storms from the ocean. The resulting weather is mostly clear and dry during the summer and early fall, with scattered thundershowers. The eastern portion of the state receives significant summer thunderstorms generated from monsoonal moisture pushed up from the Gulf of California, known as the North American monsoon. The monsoon system peaks in August and by October the monsoon high over the Western U.S. begins to weaken and the precipitation retreats southward towards the tropics (NOAA 2004).

Table 3. Representative climatic features

Frost-free period (average)	60 days
Freeze-free period (average)	
Precipitation total (average)	18 in

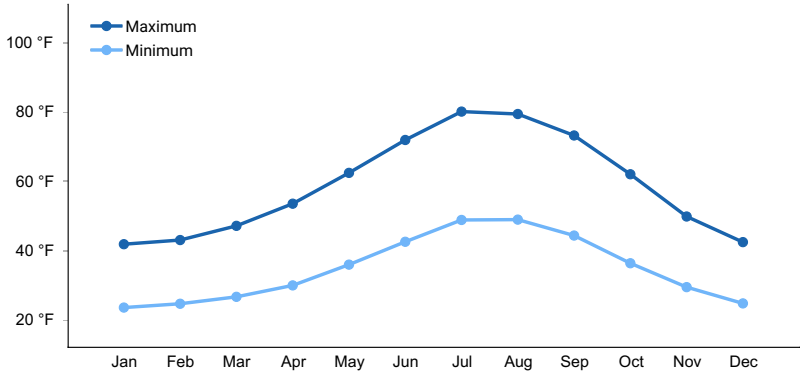


Figure 1. Monthly average minimum and maximum temperature

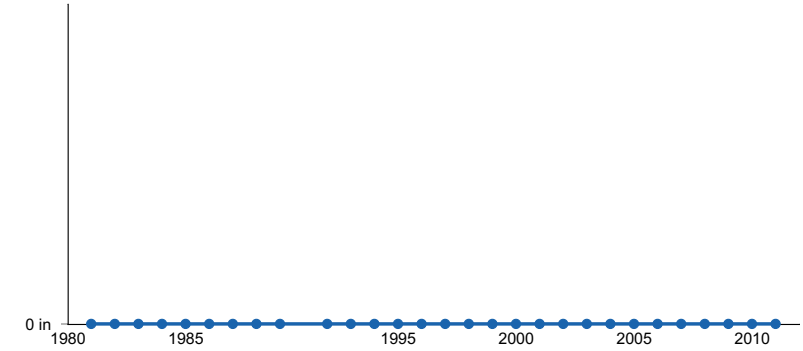


Figure 2. Annual precipitation pattern

Influencing water features

No influencing water features are associated with this site.

Soil features

The soils associated with this site are generally deep to very deep and well drained. These soils have a mollic or umbric epipedon. Surface soils are thick, dark colored, and medium textured. Subsoils are medium to moderately fine textured. These soils are neutral to slightly acid. Available water capacity is high. The soil profile is often modified with a high volume of rock fragments.

Table 4. Representative soil features

Parent material	(1) Colluvium–volcanic rock (2) Residuum–volcanic rock
Surface texture	(1) Gravelly, ashy sandy loam
Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Depth to restrictive layer	39–60 in
Soil depth	39–60 in
Surface fragment cover <=3"	23%
Surface fragment cover >3"	3%
Available water capacity (Depth not specified)	3.7–5.2 in
Calcium carbonate equivalent (Depth not specified)	0%
Electrical conductivity (Depth not specified)	0 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	6.3–7.3
Subsurface fragment volume <=3" (Depth not specified)	21%
Subsurface fragment volume >3" (Depth not specified)	16%

Ecological dynamics

Major Successional Stages of Forestland Development:

HERBACEOUS: Vegetation is dominated by grasses and forbs under full sunlight. This stage is experienced after a major disturbance such as fire, root-rot, insect damage, or tree harvest. Following a major disturbance, the root system gives rise to many root suckers, assuming the root system is intact and healthy. Residual trees left following harvest have little or no affect on the composition and production of the herbaceous vegetation.

SHRUB-HERBACEOUS: Herbaceous vegetation dominates the site. Quaking aspen suckers are evident. If the aspen stand is healthy, these first two stages will only last from one to two years. However, if competing brush and herbaceous plants grow for a full season before aspen suckers emerge, a reduction in growth and survival of aspen suckers may occur.

SAPLING: Early growth of quaking aspen suckers ranges from less than 1 foot to more than 3 feet (91 cm) per year for shoots having good competitive position. In the absence of disturbance, suckers develop into saplings (to 4.5

feet in height (137 cm)) with a range in canopy cover of about 5 to 15 percent. Vegetation consists of grasses, forbs and a few shrubs in association with tree saplings.

POLE STAGE: This stage is characterized by rapid growth of the aspen trees, both in height and canopy cover. Aspen stands are self- thinning, especially at young ages. After the canopy closes, trees stratify into crown classes quickly, despite genetic uniformity within clones. The visual aspect and vegetal structure are dominated by aspen ranging from about 10 to 20 feet in height (3 to 6 meters), and having a diameter at breast height of about 2 to 4 inches (5 to 10 cms). Understory vegetation is moderately influenced by a tree overstory canopy of about 40 to over 60 percent.

IMMATURE FOREST: Growth of the aspen slows during this stage and there is a continual adjustment of trees to growing space. As competition becomes intense enough to affect the diameter growth of dominants, mortality quickly reduces the number of trees in the lower crown classes. Periodic surges in mortality happen, with a large number of trees dying within a short time. The visual aspect and vegetal structure are dominated by aspen mostly greater than 25 feet in height (8 meters). Understory vegetation is moderately influenced by a tree overstory canopy of about 25 to 40 percent.

MATURE FOREST: Diameter growth of aspen shows strong recovery with reduced competition during this stage. The visual aspect and vegetal structure are dominated by single-storied aspen that have reached or are near maximal heights for the site. Tree heights range from 60 to 80 feet (24 meters), depending upon site. Tree canopy cover ranges from 25 to about 35 percent. Despite considerable understory production, the overstory trees do compete with the undergrowth plants for moisture, light, nutrients, and space. Vegetative shoots,saplings of aspen or both are in the understory, but they are inconspicuous and have a high mortality rate.

OVER-MATURE FOREST: In the absence of wildfire or other naturally occurring disturbances, the tree canopy on this site can become very dense. This stage is normally dominated by aspen that have reached maximal heights for the site. Aspen trees have straight, clear stems with short, high-rounded crowns. Uneven-aged stands form under stable conditions where the overstory gradually disintegrates with disease or age, and is replaced by aspen suckers. In the absence of disturbance, over-mature, even-aged aspen stands slowly die. The aspen canopy opens up, and otherwise inconspicuous aspen suckers survive and grow in the openings not shaded by the remaining conifers. These suckers typically arise over a period of several years; the resulting stand is broadly even-aged. If broadly even-aged stands reach old age without disturbance, their deterioration is likely to extend over a longer period than before because of the range of tree ages. That, in turn, will result in a longer regeneration period and a new stand with an even greater range of ages. If this continues over several generations, all-aged stands will result. Tree canopy cover is commonly more than 50 percent. Understory production is strongly influenced by the overstory, as is species composition. Shade tolerant forbs and a few grasses will dominate the understory.

This site is composed of one to several quaking aspen clones, each with a common genetic makeup and individual phenological and physiological characteristics. Wildfire is recognized as a natural disturbance that strongly influenced the structure of the historic climax vegetation of this site. Periodic wildfires prevent over-mature aspen stands and maintain a naturally stratified mosaic of even-aged aspen communities in various stages of successional development.

Fire Ecology:
The most important agent of disturbance in aspen forests before 1900 was fire, although other natural disturbances were locally important including windthrow, snow damage, hail, lightning, fungal diseases and insect damage. Most aspen forests in the West are seral and have been dependent upon fire for their perpetuation. If fire occurs at infrequent intervals (e.g. 50-150 years) and is intense enough to kill most of the aspen and competing conifers, the most aspen sites in the West will retain viable stands of aspen. Periodic wildfires prevent over-mature aspen stands and maintain a naturally stratified mosaic of even-aged aspen communities in various stages of successional development.

Uneven-aged stands form under stable conditions where the overstory gradually disintegrates with disease or age, and is replaced by aspen suckers. Although aspen forests do not burn readily, aspen trees are extremely sensitive to fire. A severe fire will top-kill the aspen overstory and will stimulate abundant suckering. A severe fire also removes the duff and may kill roots. Repeated fires have a detrimental effect on site quality and can eliminate aspen from a site.

Aspen is highly competitive on burned sites and has several adaptations to fire including the following: a) the thin bark has little heat resistance, and aspen is easily top-killed by fire, b) root systems of top-killed stems send up a profusion of sprouts for several years after fire, c)sprouts grow rapidly by extracting water, nutrients, and photosynthate from an extant root system, and may outcompete other woody vegetation, d)following fire, a new, even-aged quaking aspen stand can develop within a decade, and e) aspen is self-thinning and a mature forest of healthy trees can develop from dense sprouts.

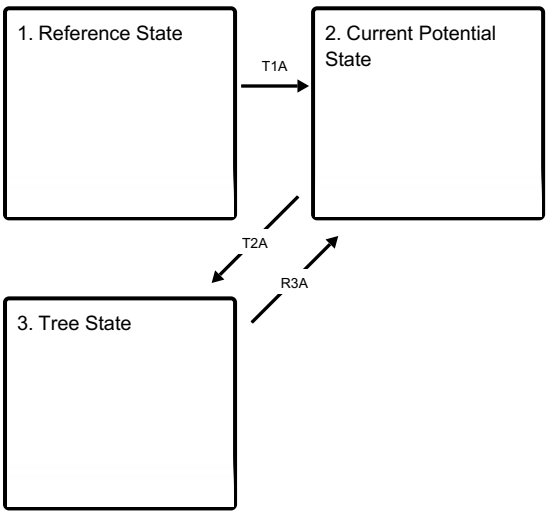
Fires top-kill mountain snowberry. Although plant survival may be variable, mountain snowberry root crowns usually survive even severe fires. Mountain snowberry sprouts from basal buds at the root crown following fire.

Mountain brome is likely to be top-killed by fire, although the coarse stems and broad leaves may be more fire-resistant than fine-leaved bunchgrasses. Creeping barberry is moderately tolerant of fire. It is a vigorous sprouter following fire and may be favored by intense fire. Fires top-kill mountain snowberry. Although plant survival may be variable, mountain snowberry root crowns usually survive even severe fires.

Mountain snowberry sprouts from basal buds at the root crown following fire. Mountain brome is most susceptible to fire damage when it is actively growing in spring and early summer. The effects of fire on slender wheatgrass are dependent on its growth form. Tall, decadent plants with many leaves sustain the most fire damage, while those with short, sparse growth form, is the least likely to sustain damage to the root system during a fire. Bluegrass is generally unharmed by fire. It produces little litter, and its small bunch size and sparse litter reduces the amount of heat transferred to perennating buds in the soil. Its rapid maturation in the spring also reduces fire damage, since it is dormant when most fires occur.

State and transition model

Ecosystem states

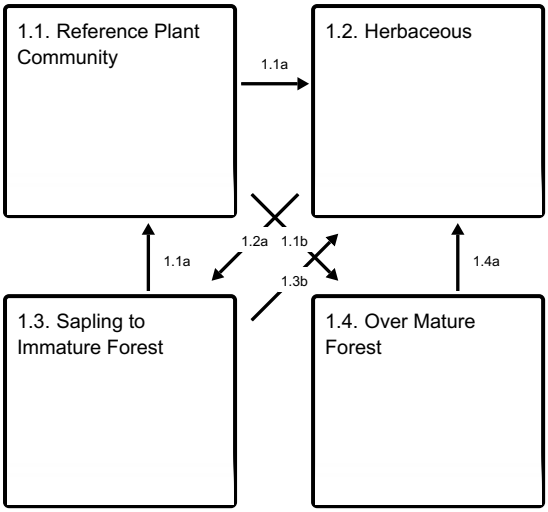


T1A - Trigger: This transition is caused by the introduction of non-native annual plants, such as Kentucky bluegrass, thistles and common dandelion. Slow variables: Over time the annual non-native species will increase within the community. Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

T2A - Trigger: Time and a lack of disturbance allow conifer trees to establish, grow and mature grown in understory. Slow variables: Over time the abundance and size of trees will increase. Threshold: Conifer canopy cover is greater than 60 percent of the stand and conifer height exceeds aspen height. Aspen are decadent and dying with little to no regeneration. Little understory vegetation remains due to competition with trees for site resources.

R3A - This restoration pathway is a result of prescribed fire or mechanical removal of trees, potentially coupled with root ripping to stimulate suckering.

State 1 submodel, plant communities



1.1a - This pathway is when fire reduces the mature aspen and allows for the suckers, saplings and the herbaceous understory to increase.

1.1b - This pathway is a result of time and lack of disturbance which will allow for the conifer trees in the understory to mature and dominate the site.

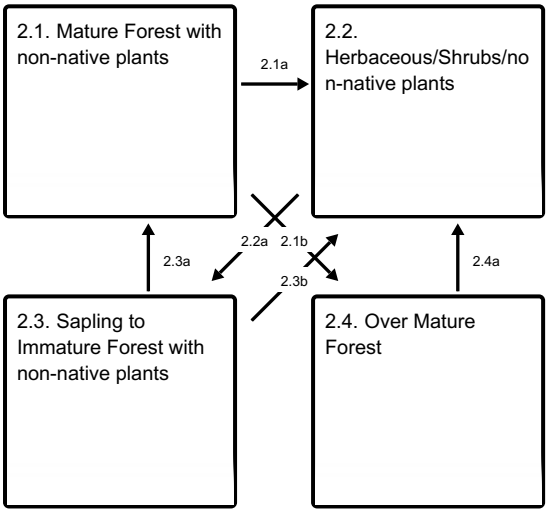
1.2a - This pathway is a result of time and lack of disturbance which will allow for the aspen suckers to mature.

1.1a - This pathway is a result of time and lack of disturbance which will allow for the aspen trees to mature.

1.3b - This pathway is a result of fire, insects, disease or wind damage that can reduce the aspen canopy and the subsequent competition with the understory allowing the understory herbaceous community to increase. Excessive herbivory while trees are still within reach to browse may also reduce aspen growth.

1.4a - This pathway is a result of fire where a decrease in the conifer canopy allows for the aspen suckers to increase.

State 2 submodel, plant communities



2.1a - This pathway is when a fire reduces the mature aspen and allows for the suckers, saplings and the herbaceous understory cover to increase. Annual non-natives are likely to increase in cover after fire.

2.1b - This pathway is a result of time and lack of disturbance which will allow for the conifers in the understory to mature and dominate the site.

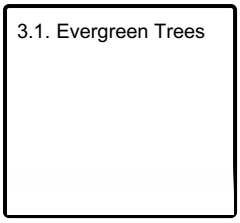
2.2a - This pathway is a result of: (1) time and lack of disturbance, (2) changing of grazing season or grazing reduction or exclusion which will allow for the aspen suckers to mature.

2.3a - This pathway is a result of time and lack of disturbance, a release from browsing or both which will allow for the aspen trees to mature.

2.3b - This pathway is a result of fire, insects, disease or wind damage which can reduce the aspen canopy and the subsequent competition with the understory where the understory herbaceous community cover increases. Inappropriate grazing by sheep especially, or herbivory by large ungulates or both, while trees are within reach to browse may reduce aspen growth.

2.4a - This pathway is a result of fire, or equivalent clearcutting or harvesting of the conifers which allows for the aspen suckers to increase and the understory plant community cover of shrubs and grasses to increase.

State 3 submodel, plant communities



State 1
Reference State

The Reference State 1.0 is a representative of the natural range of variability under pristine conditions. This site has four general community phases; a mature woodland phase, a sucker/sapling phase, an immature woodland phase and an over mature woodland/conifer phase. State dynamics are maintained by interactions between climatic patterns and disturbance regimes. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups, fuel loads, and retention of organic matter and nutrients. Plant community phase changes are primarily driven by fire, periodic drought, insect or disease attack.

Community 1.1
Reference Plant Community

The reference plant community is dominated by quaking aspen and overstory tree canopy composition is typically 100 percent quaking aspen. A total overstory canopy cover of about 30 percent is assumed to be representative of tree dominance on this site in the pristine environment. Mountain brome, slender wheatgrass, Idaho fescue, and Ross' sedge are common understory grasses and grass-like plants. Mountain snowberry, Utah serviceberry, and creeping barberry are the principal understory shrubs. Aspen woodlands are multi-layered as sufficient light is able to penetrate the tree canopy to support abundant undergrowth. Young trees, medium height shrubs, and tall forbs and grasses form an open, often intermittent, layer beneath the tree canopy. MATURE FOREST: Diameter growth of aspen shows strong recovery with reduced competition during this stage. The visual aspect and vegetal structure are dominated by single-storied aspen that have reached or are near maximal heights for the site. Tree heights range from 60 to 80 feet (24 meters), depending upon site. Tree canopy cover ranges from 25 to about 35 percent. Despite considerable understory production, the overstory trees do compete with the undergrowth plants for moisture, light, nutrients, and space. Vegetative shoots,saplings of aspen or both are in the understory, but they are inconspicuous and have a high mortality rate.

Forest overstory. MATURE FORESTLAND: Diameter growth of aspen shows strong recovery with reduced competition during this stage. The visual aspect and vegetal structure are dominated by single-storied aspen that have reached or are near maximal heights for the site. Tree heights range from 60 to 80 feet, depending upon site. Tree canopy cover ranges from 25 to about 35 percent. Despite considerable understory production, the overstory trees do compete with the undergrowth plants for moisture, light, nutrients, and space. Vegetative shoots and/or saplings of aspen occur in the understory, but they are inconspicuous and have a high mortality rate.

Forest understory. Understory vegetative composition is about 40 percent grasses, 20 percent forbs and 40 percent shrubs and young trees when the average overstory canopy is medium (25 to 35 percent). Average understory production ranges from 600 to 1200 pounds per acre with a medium canopy cover. Understory production includes the total annual production of all species within 4½ feet of the ground surface.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	240	360	480
Shrub/Vine	198	297	396
Forb	120	180	240
Tree	42	63	84
Total	**600**	**900**	**1200**

Community 1.2
Herbaceous

HERBACEOUS: Vegetation is dominated by grasses and forbs under full sunlight. This stage is experienced after a major disturbance such as fire, root-rot, insect damage, or tree harvest. Following a major disturbance, the root system gives rise to many root suckers, assuming the root system is intact and healthy. Residual trees left following harvest have little or no affect on the composition and production of the herbaceous vegetation. SHRUB-HERBACEOUS: Herbaceous vegetation dominates the site. Quaking aspen suckers are evident. If the aspen stand is healthy, these first two stages will only last from one to two years. However, if competing brush and herbaceous plants grow for a full season before aspen suckers emerge, a reduction in growth and survival of aspen suckers may occur.

Community 1.3
Sapling to Immature Forest

SAPLING: Early growth of quaking aspen suckers ranges from less than 1 foot to more than 3 feet (91 cms) per year for shoots having good competitive position. In the absence of disturbance, suckers develop into saplings (to 4.5 feet in height (137 cms)) with a range in canopy cover of about 5 to 15 percent. Vegetation consists of grasses, forbs and a few shrubs in association with tree saplings. POLE STAGE: This stage is characterized by rapid growth of the aspen trees, both in height and canopy cover. Aspen stands are self- thinning, especially at young ages. After the canopy closes, trees stratify into crown classes quickly, despite genetic uniformity within clones. The visual aspect and vegetal structure are dominated by aspen ranging from about 10 to 20 feet in height (3 to 6 meters), and having a diameter at breast height of about 2 to 4 inches (5 to 10 cms). Understory vegetation is moderately influenced by a tree overstory canopy of about 40 to over 60 percent. IMMATURE FOREST: Growth of the aspen slows during this stage and there is a continual adjustment of trees to growing space. As competition becomes intense enough to affect the diameter growth of dominants, mortality quickly reduces the number of trees in the lower crown classes. Periodic surges in mortality happen, with many trees dying within a short time. The visual aspect and vegetal structure are dominated by aspen mostly greater than 25 feet in height (7.6 meters). Understory vegetation is moderately influenced by a tree overstory canopy of about 25 to 40 percent.

Community 1.4
Over Mature Forest

OVER-MATURE FOREST: In the absence of wildfire or other naturally occurring disturbances, the tree canopy on this site can become very dense. This stage is normally dominated by aspen that have reached maximal heights for the site. Aspen trees have straight, clear stems with short, high-rounded crowns. Uneven-aged stands form under stable conditions where the overstory gradually disintegrates with disease or age, and is replaced by aspen suckers. In the absence of disturbance, over-mature, even-aged aspen stands slowly die. The aspen canopy opens up, and otherwise inconspicuous aspen suckers survive and grow in the openings not shaded by the remaining conifers. These suckers typically arise over a period of several years; the resulting stand is broadly even-aged. If broadly even-aged stands reach old age without disturbance, their deterioration is likely to extend over a longer period than before because of the range of tree ages. That, in turn, will result in a longer regeneration period and a new stand with an even greater range of ages. If this continues over several generations, all-aged stands will result. Tree canopy cover is commonly more than 50 percent. Understory production is strongly influenced by the overstory, as is species composition. Shade tolerant forbs and a few grasses will dominate the understory.

Pathway 1.1a
Community 1.1 to 1.2

This pathway is when fire reduces the mature aspen and allows for the suckers, saplings and the herbaceous understory to increase.

Pathway 1.1b
Community 1.1 to 1.4

This pathway is a result of time and lack of disturbance which will allow for the conifer trees in the understory to

mature and dominate the site.

Pathway 1.2a
Community 1.2 to 1.3

This pathway is a result of time and lack of disturbance which will allow for the aspen suckers to mature.

Pathway 1.1a
Community 1.3 to 1.1

This pathway is a result of time and lack of disturbance which will allow for the aspen trees to mature.

Pathway 1.3b
Community 1.3 to 1.2

This pathway is a result of fire, insects, disease or wind damage that can reduce the aspen canopy and the subsequent competition with the understory allowing the understory herbaceous community to increase. Excessive herbivory while trees are still within reach to browse may also reduce aspen growth.

Pathway 1.4a
Community 1.4 to 1.2

This pathway is a result of fire where a decrease in the conifer canopy allows for the aspen suckers to increase.

State 2
Current Potential State

This state is similar to the Reference State 1.0 with four similar community phases. Ecological function has not changed; however the resiliency of the state has been reduced by the presence of invasive weeds. Non-natives may increase in abundance but will not become dominant within this State. These non-natives can be highly flammable and can promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These feedbacks include the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. These include the non-natives' high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate, and adaptations for seed dispersal.

Community 2.1
Mature Forest with non-native plants

MATURE FOREST: Diameter growth of aspen shows strong recovery with reduced competition during this stage. The visual aspect and vegetal structure are dominated by single-storied aspen that have reached or are near maximal heights for the site. Tree heights range from 60 to 80 feet (18 to 24 meters), depending upon site. Tree canopy cover ranges from 25 to about 35 percent. Despite considerable understory production, the overstory trees do compete with the undergrowth plants for moisture, light, nutrients, and space. Vegetative shoots, saplings of aspen or both are in the understory, but they are inconspicuous and have a high mortality rate.

Community 2.2
Herbaceous/Shrubs/non-native plants

HERBACEOUS: Vegetation is dominated by grasses and forbs under full sunlight. This stage is experienced after a major disturbance such as fire, root-rot, insect damage, or tree harvest. Following a major disturbance, the root system gives rise to many root suckers, assuming the root system is intact and healthy. Residual trees left following harvest have little or no affect on the composition and production of the herbaceous vegetation. SHRUB-HERBACEOUS: Herbaceous vegetation dominates the site. Quaking aspen suckers are evident. If the aspen stand is healthy, these first two stages will only last from one to two years. However, if competing brush and herbaceous plants grow for a full season before aspen suckers emerge, a reduction in growth and survival of aspen suckers may occur.

Community 2.3
Sapling to Immature Forest with non-native plants

SAPLING: Early growth of quaking aspen suckers ranges from less than 1 foot to more than 3 feet (91 cms) per year for shoots having good competitive position. In the absence of disturbance, suckers develop into saplings (to 4.5 feet in height (137 cms)) with a range in canopy cover of about 5 to 15 percent. Vegetation consists of grasses, forbs and a few shrubs in association with tree saplings. POLE STAGE: This stage is characterized by rapid growth of the aspen trees, both in height and canopy cover. Aspen stands are self- thinning, especially at young ages. After the canopy closes, trees stratify into crown classes quickly, despite genetic uniformity within clones. The visual aspect and vegetal structure are dominated by aspen ranging from about 10 to 20 feet in height (3 to 6 meters), and having a diameter at breast height of about 2 to 4 inches (5 to 10 cms). Understory vegetation is moderately influenced by a tree overstory canopy of about 40 to over 60 percent. IMMATURE FOREST: Growth of the aspen slows during this stage and there is a fairly continual adjustment of trees to growing space. As competition becomes intense enough to affect the diameter growth of dominants, mortality quickly reduces the number of trees in the lower crown classes. Periodic surges in mortality happen, with a large number of trees dying within a short time. The visual aspect and vegetal structure are dominated by aspen mostly greater than 25 feet (7.6 meters) in height. Understory vegetation is moderately influenced by a tree overstory canopy of about 25 to 40 percent.

Community 2.4
Over Mature Forest

OVER-MATURE FOREST: In the absence of wildfire or other naturally occurring disturbances, the tree canopy on this site can become very dense. This stage is normally dominated by aspen that have reached maximal heights for the site. Aspen trees have straight, clear stems with short, high-rounded crowns. Uneven-aged stands form under stable conditions where the overstory gradually disintegrates with disease or age, and is replaced by aspen suckers. In the absence of disturbance, over-mature, even-aged aspen stands slowly die. The aspen canopy opens up, and otherwise inconspicuous aspen suckers survive and grow in the openings not shaded by the remaining conifers. These suckers typically arise over a period of several years; the resulting stand is broadly even-aged. If broadly even-aged stands reach old age without disturbance, their deterioration is likely to extend over a longer period than before because of the range of tree ages. That, in turn, will result in a longer regeneration period and a new stand with an even greater range of ages. If this continues over several generations, all-aged stands will result. Tree canopy cover is commonly more than 50 percent. Understory production is strongly influenced by the overstory, as is species composition. Shade tolerant forbs and a few grasses will dominate the understory.

Pathway 2.1a
Community 2.1 to 2.2

This pathway is when a fire reduces the mature aspen and allows for the suckers, saplings and the herbaceous understory cover to increase. Annual non-natives are likely to increase in cover after fire.

Pathway 2.1b
Community 2.1 to 2.4

This pathway is a result of time and lack of disturbance which will allow for the conifers in the understory to mature and dominate the site.

Pathway 2.2a
Community 2.2 to 2.3

This pathway is a result of: (1) time and lack of disturbance, (2) changing of grazing season or grazing reduction or exclusion which will allow for the aspen suckers to mature.

Pathway 2.3a
Community 2.3 to 2.1

This pathway is a result of time and lack of disturbance, a release from browsing or both which will allow for the aspen trees to mature.

Pathway 2.3b
Community 2.3 to 2.2

This pathway is a result of fire, insects, disease or wind damage which can reduce the aspen canopy and the subsequent competition with the understory where the understory herbaceous community cover increases. Inappropriate grazing by sheep especially, or herbivory by large ungulates or both, while trees are within reach to browse may reduce aspen growth.

Pathway 2.4a
Community 2.4 to 2.2

This pathway is a result of fire, or equivalent clearcutting or harvesting of the conifers which allows for the aspen suckers to increase and the understory plant community cover of shrubs and grasses to increase.

State 3
Tree State

This state is characterized by one community phase dominated by Rocky Mountain fir and Engelmann's spruce. Aspen may be present in trace amounts however trees are decadent and little to no regeneration is present. Understory vegetation is sparse. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These feedbacks include the dense canopy cover of conifer creating a shade rich environment that facilitates the germination and establishment of conifers and retards the growth and suckering of aspen. Positive feedbacks decrease ecosystem resilience and stability of the state. These include high fuel loads from canopy closure and dead and down wood leading to the potential for stand replacing fire.

Community 3.1
Evergreen Trees

This community phase is dominated by Rocky Mountain fir and Engelmann's spruce. Aspen trees may be present but show decadence and are significantly reduced. Understory vegetation is reduced due to competition of the overstory canopy. Annual non-native species may be present.

Transition T1A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual plants, such as Kentucky bluegrass, thistles and common dandelion. Slow variables: Over time the annual non-native species will increase within the community. Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

Transition T2A
State 2 to 3

Trigger: Time and a lack of disturbance allow conifer trees to establish, grow and mature grown in understory. Slow variables: Over time the abundance and size of trees will increase. Threshold: Conifer canopy cover is greater than 60 percent of the stand and conifer height exceeds aspen height. Aspen are decadent and dying with little to no regeneration. Little understory vegetation remains due to competition with trees for site resources.

Restoration pathway R3A
State 3 to 2

This restoration pathway is a result of prescribed fire or mechanical removal of trees, potentially coupled with root ripping to stimulate suckering.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			180–378	
	mountain brome	BRMA4	*Bromus marginatus*	90–216	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	45–81	–
	bluegrass	POA	*Poa*	45–81	–
2	**Secondary Perennial Grasses**			27–135	
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	9–45	–
	western needlegrass	ACOCO	*Achnatherum occidentale ssp. occidentale*	9–45	–
	sedge	CAREX	*Carex*	9–45	–
Forb					
3	**Perennial Forbs**			135–243	
	ragwort	SENEC	*Senecio*	45–81	–
	Fendler's meadow-rue	THFE	*Thalictrum fendleri*	45–81	–
	clover	TRIFO	*Trifolium*	45–81	–
Shrub/Vine					
4	**Primary Shrubs**			180–378	
	Utah serviceberry	AMUT	*Amelanchier utahensis*	90–216	–
	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	45–81	–
5	**Secondary Shrubs**			18–90	
	currant	RIBES	*Ribes*	9–45	–
	willow	SALIX	*Salix*	9–45	–
Tree					
6	**Trees**			45–81	
	quaking aspen	POTR5	*Populus tremuloides*	45–81	–

Table 7. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
quaking aspen	POTR5	*Populus tremuloides*	Native	–	100	–	–

Animal community

Livestock Interpretations:
This site is suited to cattle and sheep grazing during the summer and early fall. Livestock use aspen types for forage and shade. Cattle select for mountain brome, slender wheatgrass, and other forage grasses while sheep select for bluegrasses, meadowrue, and forbs. Browsing has a direct impact on aspen. Through the early sapling stage, browsing reduces aspen growth, vigor and numbers. Heavy browsing by sheep or deer can eliminate aspen sucker regeneration. Suckers can be drastically reduced or eliminated by big game browsing on winter ranges. Sheep browse the aspen with increasing pressure through late summer and early fall. Browsing is incidental to grazing by cattle. If grazing is light to moderate, the effect on aspen will be also. This, however, is less true for sheep and wild ungulates.

Grazing management should allow aspen saplings to attain a minimum height of 55 to 60 inches (140 to 152 cms) before use to prevent destructive browsing by livestock.

Harvesting trees under a sound management program can open up the tree canopy to allow increased production of understory species desirable for grazing and browsing.

Stocking rates vary with such factors as kind and class of grazing animal, season of use and fluctuations in climate. Actual use records for individual sites, a determination of the degree to which the sites have been grazed, and an evaluation of trend in site condition offer the most reliable basis for developing initial stocking rates.

The forage value rating is not an ecological evaluation of the understory as is the range condition rating for rangeland. The forage value rating is a utilitarian rating of the existing understory plants for use by specific kinds of grazing animals.

The amount and nature of the understory vegetation in a forestland is highly responsive to the amount and duration of shade provided by the overstory canopy. Significant changes in kinds and abundance of plants occur as the canopy changes, often regardless of grazing use. Some changes occur slowly and gradually as a result of normal changes in tree size and spacing. Other changes occur dramatically and quickly, following intensive woodland harvest, thinning, or fire.

Wildlife Interpretations:
Quaking aspen communities provide important habitat for many species of birds and mammals. This is especially true where these woodlands are the only upland hardwood tree species. Mule deer and elk use aspen woodlands for forage, thermal cover, and escape cover during severe weather and times of harassment. Commonly associated birds using aspen during breeding season include the Western tanager, common nighthawk, mourning dove, Swainson's hawk and various species of bluebird, thrush and flycatcher. Those using aspen during the wintering season include the Ruby-crowned kinglet, Townsend's solitaire, rough-legged hawk, Cooper's hawk, sharp-shinned hawk and various species of finch and waxwing. Those using aspen yearlong or as migrants include the American robin, American kestrel, mountain chickadee, scrub jay, yellow-bellied sapsucker, long-eared owl, screech owl, great-horned owl, California quail, red-tailed hawk, golden eagle, and various species of sparrow, nuthatch and woodpecker. Commonly associated mammals using the aspen community type include various species of shrew, myotis, bat, mouse and vole. Some very common species include deer mouse, Nuttall's cottontail, least chipmunk, Western gray squirrel, bushy-tailed woodrat, raccoon, long-tailed weasel and the North American porcupine. The mountain lion and bobcat use edges and sometimes the interior of the aspen community for hunting.

The bald eagle is listed as an endangered species in Nevada. The bald eagle occasionally winters in northeast Nevada, between the months of October and March, and probably perches in aspen trees where they occur near bodies of water.

Hydrological functions

A well-stocked aspen stand provides excellent watershed protection. The tree overstory, with an understory of woody and herbaceous species and litter, can potentially furnish total soil cover. A mixture of herbaceous and woody root systems penetrate and anchor the soil. Erosion producing overland flow is rare. The hydrologic cover condition of this site is fair in a representative stand. The average runoff curve is about 55 for group B soils.

Recreational uses

The site offers rewarding opportunities to photographers and for nature study. It has high value for hunting, camping, picnicking, cross country skiing and family wood gathering.

Wood products

Historically, quaking aspen has been used for mine props, posts, bridge planking, flooring, furniture and fuelwood. This tree has a considerable potential for increased utilization. It makes excellent pulp, excelsior, door corestock, paper, particleboard, matchsticks, structural flakeboard, lumber products and boxwood.

Aspen propagates almost entirely by vegetative means throughout the Great Basin. Regeneration by seed is very rare, although aspen in this area produce large quantities of viable seed. Aspen seeds require a continually moist seedbed and the dry spring and summers of the Great Basin are not conducive to seedling survival.

PRODUCTIVE CAPACITY

This site is of low site quality for tree production. Site indexes for quaking aspen range from 30 to about 45 (Baker, 1925).

Productivity class:
CMAI*: 16 to 20 ft3/ac/yr
1.1 to 1.4 m3/ha/yr
*CMAI: is the culmination of mean annual increment or highest average growth rate of the stand in the units specified. Basal Area: About 95 square feet (29 square meters) per acre for stands averaging 50 feet (15 meters) in height at 100 years of age (Table 17, Baker, 1925).
Fuelwood Production: About 10 cords per acre for stands averaging 7 inches (18 cm) in diameter at breast height (Table 17, Baker, 1925). About 203,000 gross British Thermal Units (BTUs) heat content exist per cubic foot of quaking aspen wood. Firewood is commonly measured by the cord, or a stacked unit equivalent to 128 cubic feet (39 cubic meters). Solid wood volume in a cord varies, but assuming an average of 75 cubic feet (23 cubic meters) of solid wood per cord, there are about 15 million BTUs of heat value in a cord of quaking aspen.

Tree Volume per Acre: About 1500 cubic foot (457 cubic meters) per acre for stands averaging 50 feet (15 meters) in height and 7 inches (18 cm) diameter at breast height (Table 17, Baker, 1925).

MANAGEMENT GUIDES AND INTERPRETATIONS

1. LIMITATIONS AND CONSIDERATIONS
a. Potential for sheet and rill erosion is moderate to severe depending on slope.
b. Severe equipment limitations on slopes over 30 percent.
b. Proper spacing is the key to a well managed, multiple use and multi-product aspen forestland.
c. To begin short-rotation management, older stands with larger trees will have to be utilized.
d. Cut residual, unmerchantable, trees to stimulate maximum sucker regeneration and rapid development of a replacement stand – thin resulting sucker stands.

2. ESSENTIAL REQUIREMENTS
a. Adequately protect from high intensity wildfire.
b. Protect soils from accelerated erosion.
c. Apply proper grazing management.

3. SILVICULTURAL PRACTICES
a. Harvest Cutting: Selectively harvest surplus trees to achieve desired spacing. Harvest stands in small blocks of 1/5 to 1/2 acre with slash left in place to shelter emerging aspen suckers from browsing.
(1) Clear-Cutting - Clear-cutting is appropriate when the primary management objective is sustained production of forest products, either saw timber or fiber. Cutting sub-merchantable stems along with the merchantable ones will maximize sucker production, minimize the presence of diseased or defective growing stock in the new stand, and avoid suppression of the new crop by residual overstory stems.
(2) Partial Cutting - Partial cutting may be feasible in some uneven-aged stands where management objectives require vertical canopy diversity or retention of some overstory; partial cutting may result in enough sprouting to adequately regenerate stands. Individual tree or group selection cutting methods can be applied. Extreme care is necessary to avoid injury to residual stems during logging. Partial cutting is not worthwhile in deteriorated aspen clones where root system die back has reduced suckering.
(3) Selective Tree Removal - Remove selected trees on suitable sites to enhance forage production and manage site reproduction.
(a) Thinning - Ordinarily, only stands on saw timber sites should be thinned. Pre-commercial thinning may be uneconomical as the low productivity of this site would not justify thinning costs.
(b) Protection from Disease - No proven forest stand treatments successfully prevent or control disease in aspen. Maintenance of well-stocked stands, minimizing wounding of stems and control of damaging agents, and harvesting at the proper rotation age are the best management recommendations that can be made today.

(c) Protection from Insects - Direct control of insects in aspen forests has not been practical. The environmental side-effects from chemical pesticide spraying usually has not been acceptable in the aspen ecosystem. Maintenance of a well-stocked stand and protection from wounding is the most practical method of coping with insects in the aspen forest.
(d) Protection from Mammals - Domestic livestock, wild ungulates, porcupines, rodents and hares utilize aspen as food and can have measurable impacts on some stands. Most animal damage can be prevented by careful husbandry of domestic livestock and by population control of wild game. Because most aspen stands are grazed by cattle, sheep or both and have a significant population of wild ungulates, grazing management and game management are important to aspen communities.
(e) Fire Management - Fire is a natural feature of the aspen ecosystem. Fire is considered responsible for the abundance of aspen in the west as well as the even-aged structure of many stands. Without human intervention, fire appears to be necessary for the continued well-being of aspen on sites where natural degeneration of the clone occurs, or where insects or pests are especially harmful to the stand.

Fires in aspen generally are infrequent, spread slowly, are of low intensity, and are easy to control. Although aspen forests do not burn readily, aspen trees are extremely sensitive to fire. Even very light fires will kill aspen because the bark is thin and green, and lacks protective corky layers.

Other products

Utah serviceberry fruits are used by Native Americans and have been used by early European explorers in North America for food and medicine.

Other information

Quaking aspens are used to stabilize soil and watersheds. The trees produce abundant litter that contains more nitrogen, phosphorus, potash and calcium than leaf litter of most other hardwoods. The litter decays rapidly, forming nutrient-rich humus that may amount to 25 tons per acre (oven-dry basis). The humus reduces runoff and aids in percolation and recharge of ground water. Utah serviceberry has been used to revegetate big game winter range and for surface stabilization. It grows slowly from seed and therefore transplanting may be more successful than seeding for revegetation projects. Mountain snowberry is useful for establishing cover on bare sites and has done well when planted onto roadbanks. Mountain brome is an excellent native bunchgrass for seeding alone or in mixtures in disturbed areas, including depleted rangelands, burned areas, roadways, mined lands, and degraded riparian zones. Slender wheatgrass is widely used for revegetating disturbed lands. Slender wheatgrass is a short-lived perennial with good seedling vigor. It germinates and establishes quickly when seeded making it a good choice for quick cover on disturbed sites. It persists long enough for other, slower developing species to establish. It is especially valuable for use in saline soils. It has been used for rehabilitating mine spoils, livestock ranges, and wildlife habitat and watershed areas.

Table 8. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
quaking aspen	*POTR5*	30	45	16	20	100	–	–	
quaking aspen	*POTR5*	30	45	16	20	–	–	–	

Inventory data references

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Approval

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Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	05/05/2024
Approved by	Kendra Moseley
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:**