USDA Natural Resources
Conservation Service

Ecological site R003XN542WA
Southern Washington Cascades Subalpine Parkland

Last updated: 1/29/2025
Accessed: 05/21/2025

General information

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

MLRA notes

Major Land Resource Area (MLRA): 003X–Olympic and Cascade Mountains

Steep mountains and narrow to broad, gently sloping valleys characterize this region. A triple junction of two oceanic plates and one continental plate is directly offshore from Puget Sound. Subduction of the oceanic plates under the westerly and northwesterly moving continental plate contributes to volcanic activity in the Cascades. Movement between these plates has resulted in major earthquakes in this area in the past and the formation of large stratovolcanoes. The Cascade Mountains consist primarily of volcanic crystalline rocks with some associated metasedimentary rocks. The average annual precipitation ranges from 60 to 100 inches in much of the region and 30 to 60 inches on the east side of the Cascade Mountains.

The dominant soil orders in this MLRA are Andisols, Spodosols, and Inceptisols, with minor amounts of Entisols, and Histosols. The soils in the area dominantly have a frigid or cryic soil temperature regime and an udic soil moisture regime. They generally are shallow to very deep, well drained, ashy to medial, and loamy or sandy and occur on mountain slopes and ridges.

Ecological site concept

This ecological site is found in subalpine parklands at middle and high elevations of the Southern Washington Cascades. The site is predominantly comprised of low growing shrubs, forbs, grass, and grass-like species. This site is located on the north and east slopes of Mount Rainier, but occurs on all aspects within that zone. The primary factors that distinguish this ecological site are landscape position and climate.
This site is found on exposed ridges, glacial valley walls, and cirques and cirque floors that

all experience high winds and reduced precipitation that limits soil moisture during the growing season and affects plant production and composition. Prevailing winds from the south and west result in a rain shadow that heavily influences this ecological site. The reduced summer precipitation and reduced cloud cover resulting from the rain shadow, in conjunction with the coarse soil texture, limit the amount of moisture available to plants during the growing season. Additionally, drying winds on exposed slopes and ridges add to the moisture deficient through increased evapotranspiration. These effects are most pronounced on the exposed south and west slopes and ridgetops. As a result, plants are more sparsely located on the landscape and primarily drought tolerant species.
Seasonal snowpack melts earlier on these sites and the lack of saturation in the soil profile allows soil to warm quickly with rising seasonal air temperature. Soils that support this ecological site occur in the cryic soil temperature regime and the udic soil moisture regime and are generally coarse textured, formed in volcanic ash and colluvium, and high in organic matter.
Common plants in the reference community include fescue (Festuca), mountain hairgrass (*Vahlodea atropurpurea*), smooth woodrush (*Luzula glabrata*), Sitka valerian (*Valeriana sitchensis*), false hellebore (*Veratrum viride*), American bistort (*Polygonum bistortoides*), arctic lupine (*Lupinus arcticus*), high mountain cinquefoil (*Potentilla flabellifolia*), subalpine fleabane (*Erigeron peregrinus*), Cascade desertparsley (*Lomatium martindalei*), spreading phlox (*Phlox diffusa*), and Cascade huckleberry (*Vaccinium deliciosum*).

Associated sites

R003XN541WA	**Southern Washington Cascades Moist Subalpine Parkland** Ecological Site R003XN542WA, Southern Washington Cascades Subalpine Parkland, and Ecological Site R003XN541WA, Southern Washington Cascades Moist Subalpine Parkland are found within the same elevations. Both ecological sites are parkland ecosystems, however moisture availability plays a key role in distinguishing the Ecological Sites. Ecological Site R003XN542WA is more commonly found in rain shadow areas and, as a result, are drier and warmer habitats. Ecological Site R003XN541WA has higher soil moisture and able to support a more diverse vegetative ecosystem with a higher percentage of vegetative cover when compared to site R003XN542WA.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Vaccinium deliciosum* (2) *Phyllodoce empetriformis*
Herbaceous	(1) *Phlox diffusa* (2) *Lupinus arcticus*

Physiographic features

This ecological site occurs across many landscape positions on ridges, swales on ridges,

cirques, cirque floors, glacial-valley walls, and swales of glacial-valley walls in the Cascade Mountains (3,650-7,450 ft) in Mt. Rainier National Park. Although the ecological site may reach 7,450 feet in elevation, the site is most commonly found between 3,650 and 7,000 feet. The site is found on all slopes, however it is most commonly found between 10 to 40 percent slopes.

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Cirque (3) Glacial-valley wall
Flooding frequency	None
Ponding frequency	None
Elevation	1,113–2,271 m
Slope	0–100%
Water table depth	25–0 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

This ecological site receives most of its annual precipitation from October to March. The mean annual precipitation ranges from 59 to 122 inches and the annual temperature ranges from 33 to 42 degrees Fahrenheit. Microclimate may vary depending on soil temperature and site specific features. Generally, this site occupies areas with cool, dry summers and cold, wet winters.

Table 3. Representative climatic features

Frost-free period (characteristic range)	30-60 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	1,499-3,099 mm

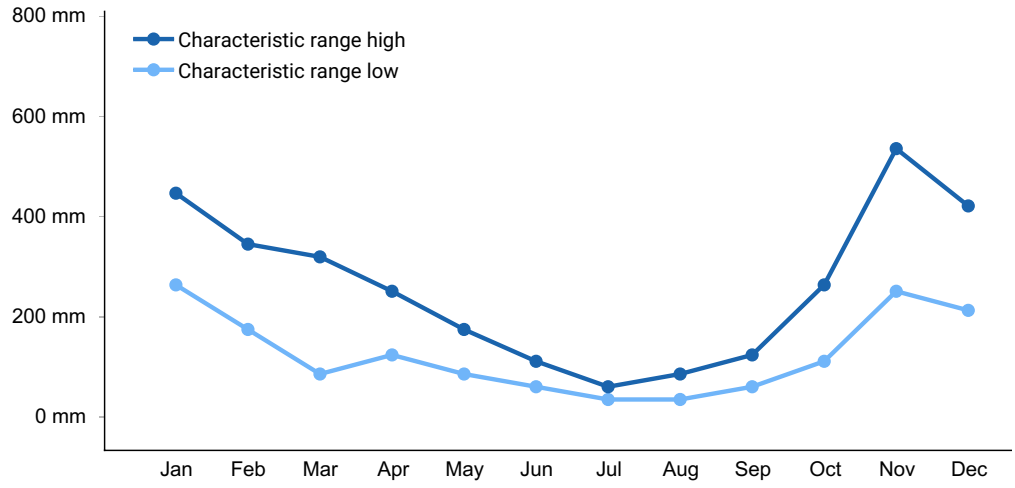


Figure 1. Monthly precipitation range

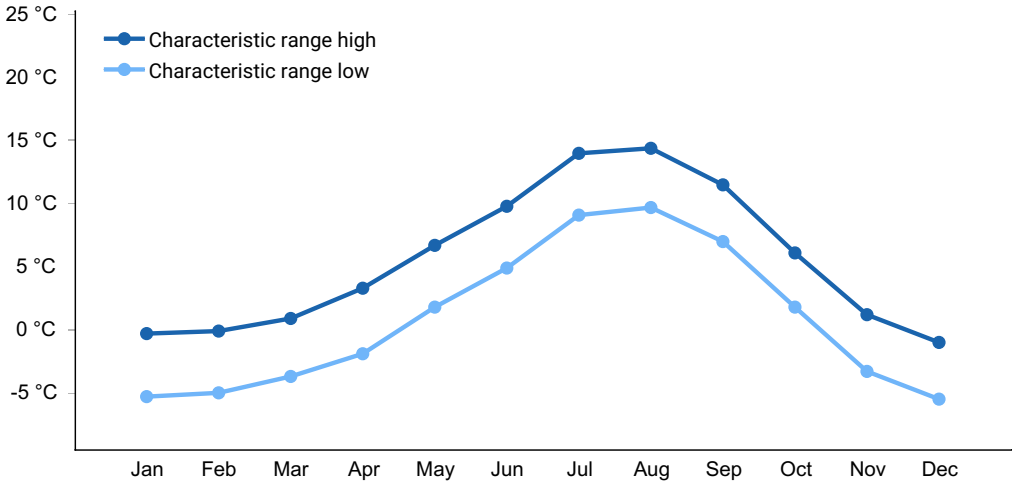


Figure 2. Monthly minimum temperature range

Influencing water features

This site is located in the middle to high elevations on the ridges, swales on ridges, cirques, cirque floors, swales on glacial valley-walls, and glacial-valley walls in Mount Rainier National Park. This site does not experience ponding or flooding. The water table will typically rise during the spring and summer months and recede in the fall.

Soil features

Applicable Soils: Burroughs, Chenuis, Littletahoma, Mountwow, Sarvant, Tatoosh

Applicable Soil Map Units within Mt. Rainier National Park: 8211, 8255, 8256, 8257, 9255, 9256, 9257, 9258, 9259

Soils that support this ecological site occur in the cryic soil temperature regime and the udic soil moisture regime. Soils representative of this ecological site vary in drainage and depth, however the over-riding factor for this ecological site is the position on the landscape and the amount of time and duration of snowpack and precipitation during the

growing season. Burroughs, Chenuis, Littletahoma, Sarvant, and Tatoosh soils are well drained. Mountwow and Wahpenayo soils are somewhat poorly drained. Chenuis, Littletahoma, and Mountwow soils are very deep, Burroughs, Sarvant and Wahpenayo soils are moderately deep, and Tatoosh soils are shallow. These soils are found on ridges, cirques and glacial valley walls and are formed from volcanic ash and andesite colluvium, with or without andesite bedrock. Mountwow and Wahpenayo soils have a seasonally high water table between 10 and 20 inches of the surface at some point during the growing season. None of these soils have flooding or ponding potential. Chenuis and Sarvant soils have greater than 35 percent rock fragments in the control section, while all others do not. Soil textures are coarse, primarily medial sandy loams and medial loamy sands. These soils exhibit andic soil properties in all mineral horizons. Melanization is the dominant pedogenic process and podsolization is not evident in these profiles given the lack of coniferous forest cover. An umbric epipedon and cambic horizons are present in most soils. Thin organic horizons consisting of decomposing litter are present on the soil surface of the Mountwow, Burroughs and Chenuis soils, serving to protect the soil from wind and water erosion.

Table 4. Representative soil features

Parent material	(1) Volcanic ash (2) Colluvium–andesite (3) Residuum–andesite
Surface texture	(1) Sandy loam (2) Loamy sand
Drainage class	Well drained to somewhat poorly drained
Soil depth	46–152 cm
Surface fragment cover <=3"	0–70%
Surface fragment cover >3"	0–40%
Available water capacity (Depth not specified)	6.35–22.86 cm
Soil reaction (1:1 water) (Depth not specified)	4.5–5.5
Subsurface fragment volume <=3" (Depth not specified)	0–70%
Subsurface fragment volume >3" (Depth not specified)	0–50%

Ecological dynamics

This ecological site is found in subalpine parklands at middle and high elevations of the Southern Washington Cascades. It is located on the north and east slopes of Mount Rainier, but occurs on all aspects within that zone. Since this site is influenced by slope

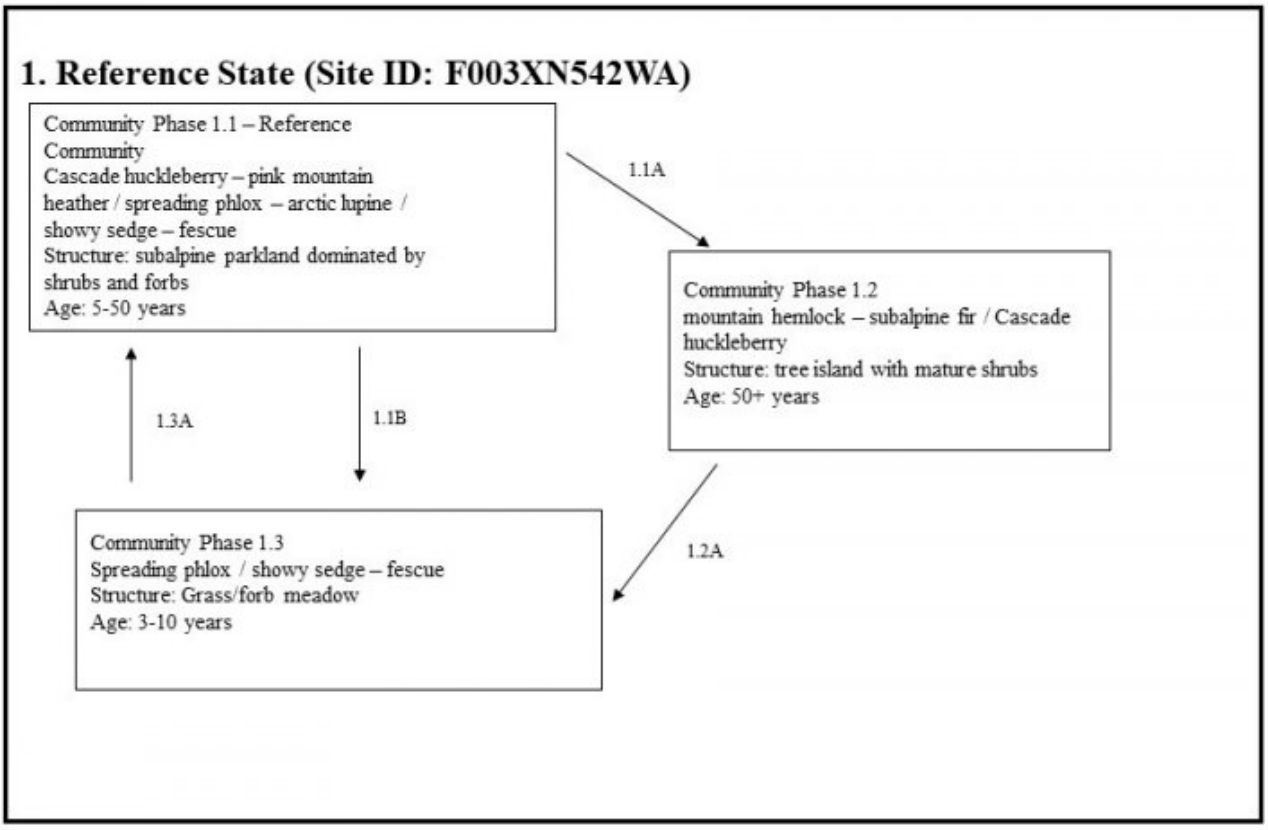
location, it is one of the earliest sites in the subalpine zone to start plant growth in the summer. Seasonal snowpack melts earlier on these sites and the lack of saturation in the soil profile allows soil to warm quickly with rising seasonal air temperature. Plant production is directly correlated to the snow release date which can be highly variable from year to year (Canaday, 1974). Soils that support this ecological site occur in the cryic soil temperature regime and the udic soil moisture regime. Generally, soils are coarse textured, formed in volcanic ash and colluvium, and high in organic matter.

Prevailing winds from the south and west result in a rain shadow that heavily influences this ecological site. The reduced summer precipitation and reduced cloud cover resulting from the rain shadow, in conjunction with the coarse soil texture, limit the amount of moisture available to plants during the growing season. Additionally, drying winds on exposed slopes and ridges add to the moisture deficient through increased evapotranspiration. These effects are most pronounced on the exposed south and west slopes and ridgetops.

The site is less susceptible to frequent natural disturbances, such as avalanches and soil movement. Historically, fire (anthropogenic and natural) was an important disturbance factor, suppressing the growth of encroaching conifers and retaining a forb, grass, and grass-like dominated parkland ecosystem (Hemstrom, 1982). This site is highly sensitive to small disturbances from soil compaction and damage to vegetation which may have significant impacts to the ecological integrity and resilience of the site. If there is a long period without disturbance, the site is subject to conifer encroachment including mountain hemlock (*Tsuga mertensiana*) and subalpine fir (*Abies lasiocarpa*) creating tree islands.

The reference community may be most common, but it is likely that all community phases occur as a matrix across the landscape. Common plants include fescue (Festuca), mountain hairgrass (*Vahlodea atropurpurea*), smooth woodrush (*Luzula glabrata*), Sitka valerian (*Valeriana sitchensis*), false hellebore (*Veratrum viride*), American bistort (*Polygonum bistortoides*), arctic lupine (*Lupinus arcticus*), high mountain cinquefoil (*Potentilla flabellifolia*), subalpine fleabane (*Erigeron peregrinus*), Cascade desertparsley (*Lomatium martindalei*), spreading phlox (*Phlox diffusa*), and Cascade huckleberry (*Vaccinium deliciosum*).

State and transition model



Vaccinium deliciosum – Phyllodoce empetriformis / Phlox diffusa - Lupinus arcticus / Carex Spectabilis – Festuca

Cascade huckleberry – pink mountain heather / spreading phlox - arctic lupine / showy sedge – fescue

Community Phase Pathway 1.X = Community Phase X#Y = Transition Pathway
1.XY = Pathway (ecological response to natural processes)

State 1
Reference

Community 1.1
Cascade Huckleberry, Pink Mountain Heather, Spreading Phlox, Arctic Lupine, Showy Sedge, and Fescue

Structure: subalpine parkland of shrubs, forbs, grass, and grass-like species The reference community is a floristically rich mosaic of shrubs, forbs, and grass species that have been relatively undisturbed by natural and human influences. These subalpine ecosystems are located on aspects where snowmelt occurs in spring and early summer, providing for a longer growing season. Plant percent cover is variable but the reference community plants are common throughout the entire ecological site. Low-growing shrubs such as pink mountain-heather and Cascade huckleberry are most dominant, but white mountain heather and black huckleberry can be common and prolific in areas. Forbs including spreading phlox, American bistort, arctic lupine, and Sitka valerian cover the landscape with showy sedge interspersed. Dwarfed species of mountain hemlock, subalpine fir, and Alaska cedar are scattered throughout the ecosystem, forming tree islands in places. Small natural disturbances such as frost heaving, wind blasting, and variation in snowpack can have small scale, but significant impacts on alpine vegetation. Soil compaction and damage to vegetation may have significant impacts on the ecological site integrity. Herbivores such as marmots, pikas, elk, migratory birds, and mountain goats will forage on the vegetation which may create patches of open ground (Martin, 2001).

Dominant plant species

- mountain hemlock (*Tsuga mertensiana*), tree
- subalpine fir (*Abies lasiocarpa*), tree
- Alaska cedar (*Callitropsis nootkatensis*), tree
- Cascade bilberry (*Vaccinium deliciosum*), shrub
- pink mountainheath (*Phyllodoce empetriformis*), shrub
- thinleaf huckleberry (*Vaccinium membranaceum*), shrub
- western moss heather (*Cassiope mertensiana*), shrub
- showy sedge (*Carex spectabilis*), grass
- arctic lupine (*Lupinus arcticus*), other herbaceous
- Sitka valerian (*Valeriana sitchensis*), other herbaceous
- American bistort (*Polygonum bistortoides*), other herbaceous
- spreading phlox (*Phlox diffusa*), other herbaceous

Community 1.2
Mountain Hemlock, Subalpine Fir, and Cascade Huckleberry

Structure: tree islands Community phase 1.2 represents a community stage of tree islands that are developed over long periods without disturbance. The establishment of conifers such as subalpine fir (*Abies lasiocarpa*) and mountain hemlock (*Tsuga mertensiana*) are successful and have developed pockets of mature trees. Common understory species include pink mountain heather, Sitka valerian, and Cascade huckleberry.

Dominant plant species

- mountain hemlock (*Tsuga mertensiana*), tree
- subalpine fir (*Abies lasiocarpa*), tree
- Alaska cedar (*Callitropsis nootkatensis*), tree
- Cascade bilberry (*Vaccinium deliciosum*), shrub
- pink mountainheath (*Phyllodoce empetriformis*), shrub
- Sitka valerian (*Valeriana sitchensis*), other herbaceous

Community 1.3
Spreading Phlox, Showy Sedge, and Fescue

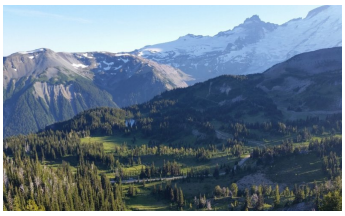
Structure: Grass/Forb Meadow Early seral species of grasses and forbs are established following disturbance. Common plants such as arctic lupine, Sitka valerian, American bistort, Idaho fescue, and black sedge begin to dominate.

Dominant plant species

- showy sedge (*Carex spectabilis*), grass
- fescue (*Festuca*), grass
- Sitka valerian (*Valeriana sitchensis*), other herbaceous
- American bistort (*Polygonum bistortoides*), other herbaceous
- arctic lupine (*Lupinus arcticus*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

Cascade Huckleberry, Pink Mountain Heather, Spreading Phlox, Arctic Lupine, Showy Sedge, and Fescue



Mountain Hemlock, Subalpine Fir, and Cascade Huckleberry

This pathway represents an ongoing lack of disturbance which favors the establishment of pockets of trees.

Pathway 1.1B
Community 1.1 to 1.3

This pathway represents an extreme disturbance. The most typical disturbance is wildfire, however other extreme disturbances may include avalanche, landslide, or slower form of mass movement that removes the majority of the vegetation. Wildfire intensity will be elevation driven, and it is expected that lower elevations will be more devastated by higher intensity wildfires and the recovery time will be longer as a result.

Pathway 1.2A
Community 1.2 to 1.3

This pathway represents an extreme disturbance. The most typical disturbance is wildfire, however other extreme disturbances may include avalanche, landslide, or slower form of mass movement that removes the majority of the vegetation. Wildfire intensity will be

elevation driven, and it is expected that lower elevations will be more devastated by higher intensity wildfires and the recovery time will be longer as a result.

Pathway 1.3A
Community 1.3 to 1.1

This pathway represents no further major disturbance and maturation of present species. Re-establishment of shrubs such as Cascade huckleberry and pink mountain heather occur as well as diversification of forb species.

Additional community tables

Table 5. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
smooth woodrush	LUGL2	*Luzula glabrata*	Native	0.3–3.7	0–50
showy sedge	CASP5	*Carex spectabilis*	Native	0.3–3.7	0–45
fescue	FESTU	*Festuca*	Native	0.3–3.7	0–40
Forb/Herb					
arctic lupine	LUAR2	*Lupinus arcticus*	Native	0.3–3.7	0–50
Sitka valerian	VASI	*Valeriana sitchensis*	Native	0.3–11	0–50
spreading phlox	PHDI3	*Phlox diffusa*	Native	0.3–1.2	0–20
green false hellebore	VEVI	*Veratrum viride*	Native	0.3–14.6	0–15
American bistort	POBI6	*Polygonum bistortoides*	Native	0.3–11	0–10
subalpine fleabane	ERPE3	*Erigeron peregrinus*	Native	0.3–3.7	0–5
Shrub/Subshrub					
pink mountainheath	PHEM	*Phyllodoce empetriformis*	Native	0.3–11	0–50
Cascade bilberry	VADE	*Vaccinium deliciosum*	Native	0.3–4.9	0–40
thinleaf huckleberry	VAME	*Vaccinium membranaceum*	Native	0.3–14.6	0–25

Table 6. 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
subalpine fir	*ABLA*	64	76	55	71	105	–	–	
mountain hemlock	*TSME*	–	43	–	–	–	–	–	

Inventory data references

Relationship to Other Established Classifications

This ecological site falls within the National Vegetation Classification Group- North Pacific Alpine- Subalpine Dwarf-Shrubland and Heath

This ecological site includes the following USDI National Park Service Associations Groups:
CASMER-PHYEMP
VACDEL-FESVIR

Type locality

Location 1: Pierce County, WA	
Township/Range/Section	T17N R09E S16
Latitude	46° 57′ 26″
Longitude	121° 40′ 37″

Other references

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Contributors

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Approval

Kirt Walstad, 1/29/2025

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	05/10/2024
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen,**

moss, plant canopy are not bare ground):

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

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

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

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

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

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

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

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

    Dominant:

    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:**