USDA Natural Resources Conservation Service

Ecological site AX003X05X005
Western Cascades Low Cryic Udic Forest Group

Last updated: 2/29/2024
Accessed: 04/27/2024

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

The Cascade and Olympic Mountains (MLRA 3) include the west slope and parts of the east slope of the Cascades Mountains in Washington and Oregon. The Olympic Mountains in Washington State are also included. These mountains are part of a volcanic arc located at a convergent plate boundary. Volcanic rocks predominate but metamorphic and sedimentary rocks occur in the North Cascades and Olympic Mountains. Topography is generally dissected and steep, but some areas consist of constructional volcanic platforms and isolated stratovolcanoes. Elevation is usually 500 to 6000 feet but reaches to 14,410 ft at the summit of Mount Rainier. Many areas hosted alpine glaciers or ice sheets during the Pleistocene, and a few remain today.
Climate becomes cooler and moister with increasing elevation and latitude. Low elevations experience a long growing season and mild temperatures. High elevations can accumulate snowpack lasting into summer and frost may occur in any month. Average annual precipitation ranges from 60 to 180 inches in most areas. Most precipitation falls during the fall, winter, and spring during low-intensity frontal storms. Summers are relatively dry. Average annual temperature is 27 to 50 degrees F. The frost-free period is 10 to 180 days.

LRU notes

The Western Cascades land resource unit (LRU E) is located in western Oregon. It is bounded by the Santiam River on the north, the High Cascade volcanic platform on the east, the Rogue-Umpqua Divide on the south, and the Willamette and Umpqua Valleys on the west. This area is equivalent to the area generally known as the “Old Cascades.”
Bedrock consists of basalt and andesite of the Sardine Formation overlying the Little Butte Volcanic Series which contains soft tuff (Orr, et al. 1992). The Sardine Formation “cap” is absent at many locations. Topography is dissected and steep in most areas. Areas of low relief contain ancient and contemporary landslides. Alpine glaciation occurred in headwater basins during the Pleistocene but subsequent mass movement has partially obscured glacial features (Noller, et al. 2016).
Soil moisture regime is udic or aquic. Soil temperature regime ranges from mesic to cryic. Soils in this LRU generally have higher apparent clay content compared with those to the north and Spodosols do not occur. Most soils contain an appreciable amount of volcanic glass. Inceptisols usually have isotic mineralogy. Andisols are usually amorphic and meet the second criteria for andic soil properties (Soil Survey Staff, 2014). Ultisols can occur at the lowest elevations.
Conifer forest is the dominant vegetation. Natural fire is dominantly moderately frequent, mixed-severity (Spies, et al. 2018). Franklin and Spies (1991) noted an increase in tree bole fire scars south of 44.5 degrees latitude in the Oregon Cascades. This LRU hosts small amounts of fire-tolerant species common in the Siskiyou-Trinity Area (MLRA 5) but absent in areas to the north. These species include Pacific madrone (Arbutus menziesii), incense cedar (Calocedrus decurrens), giant chinkapin (*Chrysolepis chrysophylla*), and sugar pine (Pinus lambertiana).
At low to mid elevations, Douglas-fir (*Pseudotsuga menziesii*) is a long-lived, early-seral tree; western hemlock (*Tsuga heterophylla*) is an associated shade-tolerant tree. Red alder (Alnus rubra) is a short-lived, early-seral tree. It occurs ephemerally on uplands but persists on wet or repeatedly-disturbed sites.
At high elevations, Noble fir (*Abies procera*) is an early-seral tree; Pacific silver fir (Abies amabilis) is an associated

shade-tolerant tree. Sitka alder (Alnus viridis ssp. sinuata) and vine maple (*Acer circinatum*) form persistent shrubfields on sites subject to heavy snowpack or avalanches. Wetlands typically support shrubby or herbaceous vegetation.

Classification relationships

This ecological site group description covers a variety of warm Pacific silver fir plant associations including the following (McCain and Diaz 2002):

• Pacific silver fir / threeleaf foamflower
• Pacific silver fir / Oregon oxalis
• Pacific silver fir / vine maple / threeleaf foamflower
• Pacific silver fir - grand fir / starry false lily of the valley
• Pacific silver fir / Alaska blueberry / bunchberry dogwood
• Pacific silver fir / Pacific rhododendron - Alaska blueberry / bunchberry dogwood
• Pacific silver fir - western hemlock / Pacific rhododendron - salal
• Pacific silver fir / Alaska blueberry - salal
• Pacific silver fir / Pacific rhododendron - Cascade barberry
• Pacific silver fir / Cascade barberry

Ecological site concept

This forested site occurs in the warmer portion of the Pacific silver fir zone characterized by substantial winter snow accumulations and occasional summer frost. Soil temperature regime is cryic, and soil moisture regime is udic. Forest litter turnover and associated nutrient cycling may be rather slow compared with western hemlock sites. Elevation is typically 3500 to 4600 feet.

Associated sites

AX003X05X004	**Western Cascades Frigid Udic Forest Group** Lower elevation, warmer, and drier.

Similar sites

AX003X03X007	**Glaciated Western Cascades Cryic Udic Forest Group** Glaciated landforms and higher elevation community.

Table 1. Dominant plant species

Tree	(1) *Pseudotsuga menziesii* (2) *Abies amabilis*
Shrub	Not specified
Herbaceous	Not specified

Legacy ID

F003XE005OR

Physiographic features

Landform: mountain slopes, landslides
Elevation: 3500 to 4600 feet
Slope: 0 to 90 percent
Aspect: all aspects
Flooding: none
Ponding: none

Table 2. Representative physiographic features

Landforms	(1) Mountain slope (2) Landslide
Flooding frequency	None
Ponding frequency	None
Elevation	3,500–4,600 ft
Slope	0–90%
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

Mean annual air temperature: 39 to 45 degrees F
Mean annual precipitation: 65 to 120 inches
Frost free period: 50 to 110 days

Precipitation occurs mainly during fall, winter, and spring. Summers are dry. Substantial snowpack accumulates during winter, and summer frost occasionally occurs.

Influencing water features

None

Wetland description

None

Soil features

Drainage class: well drained or moderately well drained
Parent material: colluvium, residuum, till; mixed with volcanic ash
Restrictive feature(s): shallow to very deep to bedrock
Soil temperature regime: cryic
Soil moisture regime: udic
Soil reaction: very strongly or strongly acid
Soil mineralogy: amorphic or isotic

Soils are usually very deep and well drained, but those with a brief seasonal water table still capable of supporting Douglas-fir (*Pseudotsuga menziesii*) are included in this concept. The rooting zone is usually moist but may be dry up to 45 consecutive days in late summer. Litter layers under mature forest are rather thick and often exhibit an advanced stage of decomposition. O horizons associated with this site on the Willamette National Forest were usually 4 to 8 cm thick (inner quartiles, n=44). Organic materials at the surface were slightly decomposed, but 59 percent of pedons contained moderately or highly decomposed plant materials above an abrupt boundary with mineral soil (Rand, 2020). Springtails and mites are the primary arthropod shredders (Moldenke, et al. 2000) whose small body size may account for the apparent lack of mixing at the litter-mineral soil interface. Soils usually have umbric epipedons. Andic soil properties derived from the weathering of volcanic ash are usually present throughout the profile. Andisols are the primary soil order, but Inceptisols are also present. Spodosols do not occur. Apparent fine-earth textures are usually loams, silt loams, or sandy loams. Apparent clay content ranges from 10 to 27 percent.

Table 3. Representative soil features

Parent material	(1) Colluvium (2) Residuum (3) Till (4) Volcanic ash
Drainage class	Moderately well drained to well drained

Ecological dynamics

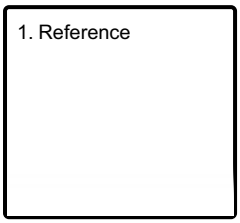
Central Concept:
This forested site occurs in the warmer portion of the Pacific silver fir zone characterized by substantial winter snow accumulations and occasional summer frost. Soil temperature regime is cryic, and soil moisture regime is udic. Forest litter turnover and associated nutrient cycling may be rather slow compared with western hemlock sites. Elevation is typically 3500 to 4600 feet.
In contrast, cooler Pacific silver fir environments beyond the limits of this site occur at higher elevations, have more persistent snowpack, and more frequent summer frost. Mountain hemlock is often present. Stand replacement fires dominate in this environment at frequencies > 200 years. Mixed severity fires may occur very infrequently (Morrison and Swanson 1990, Garza 1995, Agee 1996, Weisberg 1998, Spies et al. 2018).
Range in Variability:
Duration of snowpack and length of seasonal soil dryness linked to local landscape position, aspect, and soil depth may define subtypes with distinctive reference communities. Southern exposures and convex slopes may support drought-tolerant communities. Northern exposures and concave slopes may support moist communities. Soils with a seasonal water table may restrict rooting depth for some species.
Disturbance:
Fire is the dominant natural landscape level driver. Mixed severity fires occur in this vegetation type, with areas of low (< 30%), moderate (30-70%), and high (> 70%) overstory mortality expressed across an area, with proportions varying dependent on site and fire weather characteristics. Fires are less frequent than in the western hemlock zone, with historical fire frequency varying from 100 to 250 years mean fire return intervals (MFRI) (Morrison and Swanson 1990, Garza 1995, Weisberg 1998, Spies et al. 2018). Wind, insects and pathogens, snow and ice, and infrequent landslides may also shape forest composition and pattern at finer scales. Human management is prevalent in this type, with activities such as regeneration harvest and thinning occurring within its range and dominating phase trajectories over fire (Spies et al. 2013).
Vegetation composition:
Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), Pacific silver fir and western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) are common tree associates that span most of these types. Noble fir (*Abies procera* Rehder), an early seral species, is also found throughout, and may become co-dominant in some areas. Other trees, such as western redcedar (*Thuja plicata* Donn ex D. Don), and grand fir (*Abies grandis* (Douglas ex D. Don) Lindl.) are found more commonly in the warmer and sometimes drier portions of this type (McCain and Diaz 2002).
Understory shrub species are varied. Tall shrubs, such as Pacific rhododendron (*Rhododendron macrophyllum* D. Don ex G. Don) and thinleaf huckleberry (*Vaccinium membranaceum* Douglas ex Torr) as well as low shrubs such as Cascade barberry (*Mahonia nervosa* (Pursh) Nutt.) are common dominants and key indicators of this vegetation group. Vine maple (*Acer circinatum* Pursh) and pipsissewa (*Chimaphila umbellata* (L.) W.P.C. Barton) are also frequent. Dwarf rose (*Rosa gymnocarpa* Nutt.), red huckleberry (*Vaccinium parvifolium* Sm.), salal (*Gaultheria shallon* Pursh), and roughfruit berry (*Rubus lasiococcus* A. Gray) occur in warmer areas. On cooler, moister sites Alaska blueberry (*Vaccinium alaskaense* Howell) may cooccur with thinleaf huckleberry (McCain and Diaz 2002).
A diverse array of herbs occupy these sites. Sweet after death (*Achlys triphylla* (Sm.) DC), Columbian windflower (*Anemone deltoidea* Hook.), bunchberry dogwood (*Cornus canadensis* L.), bride's bonnet (*Clintonia uniflora* (Menzies ex Schult. & Schult. f.) Kunth), western rattlesnake plantain (*Goodyera oblongifolia* Raf.), twinflower (*Linnaea borealis* L.), starry false lily of the valley (*Maianthemum stellatum* (L.) Link), sidebells wintergreen (*Orthilia secunda* (L.) House), threeleaf foamflower (*Tiarella trifoliata* L), Pacific trillium (*Trillium ovatum* Pursh), evergreen violet (*Viola sempervirens* Greene) and common beargrass (*Xerophyllum tenax* (Pursh) Nutt.) are common throughout. Oregon oxalis (*Oxalis oregana* Nutt.) is found in moister conditions within this type (McCain and Diaz 2002).
Structural Descriptions:

Phases are described by size class, cover class and layering. Size class description refers to either the average diameter of the dominant and co-dominant trees (quadratic mean diameter or qmd) in the state and transition model or the general sizes by species in the following narrative.

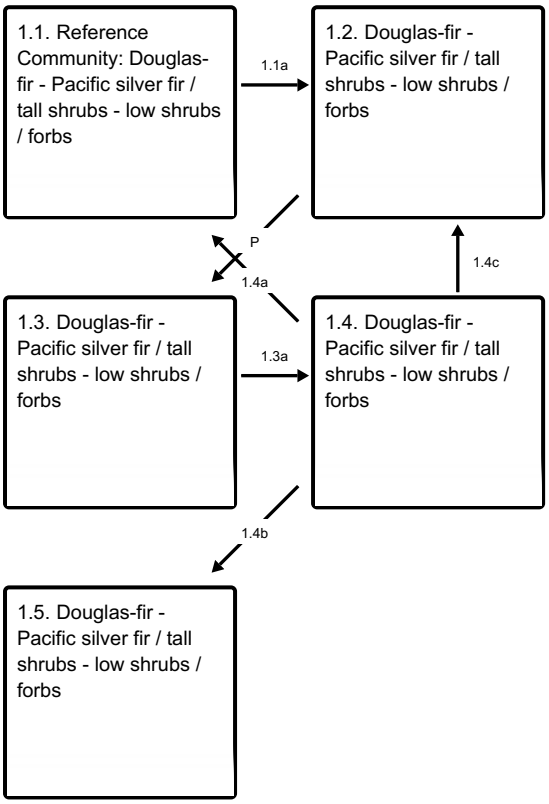
Size Class
Grass Forb/Seedling Sapling Pole Small Medium Large/Giant
DBH (inches) NA 0.1-4.9 5-9.9 10-19.9 20-29.9 =30
Canopy Cover Class
Open Moderate Closed
Canopy cover (%) <10 10-60 >60

State and transition model

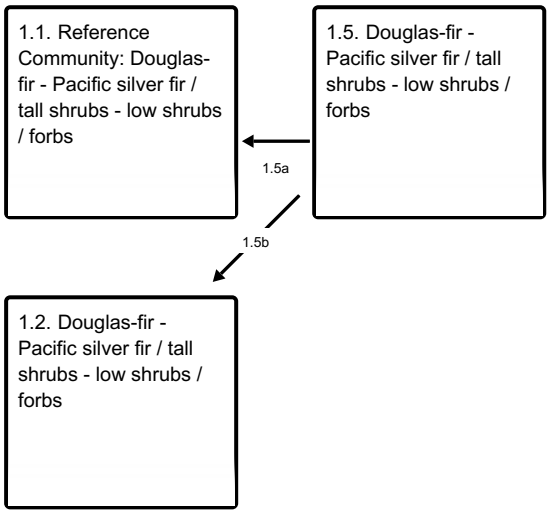
Ecosystem states



State 1 submodel, plant communities



Communities 1, 5 and 2 (additional pathways)



State 1
Reference

Community 1.1
Reference Community: Douglas-fir - Pacific silver fir / tall shrubs - low shrubs / forbs

Growth from community phase 1.4 and 1.5 are the dominant pathways producing this condition. Moderate to low severity fire and background mortality (insects, pathogens, wind, ice/snow damage etc.) processes also serve to maintain a heterogeneous horizontal and vertical range of compositional and live and dead structural conditions, with multi-layered forest intermixed with gaps of various sizes. Small to giant snags are present, as well as down wood (Mellen-McLean et al. 2017). Dominant and co-dominant large and giant Douglas-fir, with large Pacific fir and western hemlock are indicators of reference condition. Large noble fir may also co-occur in some areas as well. Small to large Pacific silver fir and western hemlock and Douglas-fir can be found in the mid canopy, depending on fire history and gap dynamics. On drier sites, other trees such as coniferous small to large western redcedar and grand fir may occur in mid to upper canopies. Shade tolerant Pacific silver fir dominates the understory, with

western hemlock scattered throughout. Shade intolerant Douglas-fir may regenerate after moderate severity fire (Bailey and Dunn 2008). A diverse understory is found in this condition. Evergreen shrubs, such as Cascade barberry, pipsissewa, and roughfruit berry are found in moderate to high cover (averages ranging 20-65%). On the warmest, driest sites, salal may dominate. Vine maple, thinleaf huckleberry, and Pacific rhododendron contribute to the tall shrub cover that averages 10-55%. A diverse mix of herbs with highly variable cover occur. Sweet after death, bunchberry dogwood, western rattlesnake plantain, twinflower, threeleaf foamflower, Pacific trillium, and common beargrass can be found with cover averaging 15-75% (McCain and Diaz 2002). CP1.1 Reference Community. Douglas-fir - Pacific silver fir / tall shrubs - low shrubs / forbs Large/Giant, multi-layered, moderate-closed canopy, scattered diverse sized gaps, regenerating shade tolerant and intolerant tree species Age class: >125 years

Community 1.2
Douglas-fir - Pacific silver fir / tall shrubs - low shrubs / forbs

This community phase is a post-disturbance, early seral condition, resulting from high severity fire or regeneration harvest. Open canopy conditions, with or without legacy structure and tree regeneration characterize this phase. Douglas-fir may exist as scattered live legacy overstory. Post-fire conditions may consist of high densities of small to large/giant snags, resulting in diverse cover of down wood (Mellen-McLean et al. 2017). Seedlings of various coniferous species may be present, with early seral species such as Douglas-fir, western white pine (*Pinus monticola* Douglas ex D. Don), and noble fir establishing along with shade tolerant Pacific silver fir, western hemlock, and western redcedar. Early seral hardwoods such as bitter cherry (*Prunus emarginata* (Douglas ex Hook.) D. Dietr.) may be present (Oakley and Franklin 1998). Shrubs such as vine maple, Cascade barberry, thinleaf huckleberry, and Pacific rhododendron often persist from pre-disturbance conditions. Species such as California blackberry (*Rubus ursinus* Cham. & Schltdl.), Oregon boxleaf (*Paxistima myrsinites* (Pursh) Raf.) and the shrub form of giant chinquapin (*Chrysolepis chrysophylla* (Douglas ex Hook.) Hjelmqvist) may increase in cover from pre-disturbed conditions. Willow species (Salix L.), snowbrush ceanothus (*Ceanothus velutinus* Douglas ex Hook), redstem ceanothus (*Ceanothus sanguineus* Pursh), thimbleberry (*Rubus parviflorus* Nutt.), and several currant species (e.g. *Ribes lacustre* (Pers.) Poir., *Ribes viscosissimum* Pursh) are native early seral shrubs that may be present. Snowbrush ceanothus can dominate on drier sites after burning. Many late seral herb species recover and persist. Early seral native species such as fireweed (*Chamerion angustifolium* (L.) Holub), western pearly everlasting (*Anaphalis margaritacea* (L.) Benth.), and western brackenfern (*Pteridium aquilinum* (L.) Kuhn) may be ephemeral components. Bull thistle (*Cirsium vulgare* (Savi) Ten), common St. Johnswort (*Hypericum perforatum* L), and slender false brome (*Brachypodium sylvaticum* (Huds.) P. Beauv.), non-native herbs, may invade the understory if seed source is present (White et al. 1996, McCain and Diaz 2002, Brown et al. 2013). CP1.2 Douglas-fir - Pacific silver fir / tall shrubs - low shrubs / forbs Grass, forbs, seedlings, single layered, open canopy Age class: 1-25

Community 1.3
Douglas-fir - Pacific silver fir / tall shrubs - low shrubs / forbs

This mid-seral phase is the result of growth from CP 1.2. Large to giant decayed snags from previous disturbances may persist in this phase, although low levels of small snags may be more common. Down wood is variable, with high levels possible in post-fire generated conditions (Mellen-McLean et al. 2017). The live canopy has simple structure, dominated by sapling to pole sized trees, with some stands displaying some large to giant pre-disturbance legacy trees. Douglas-fir may be most common in managed stands, with more of a mix of Douglas-fir, Pacific silver fir, and western hemlock in post-fire stands. Western white pine, western redcedar and noble fir may also be present to varying degrees dependent on site conditions. Canopy cover is moderate to high due to the high tree density, especially in some post-fire conditions. This results in minimal to no tree regeneration and very low to moderate cover of shrub and herbs. On heavily burned sites snowbrush ceanothus may continue to dominate the shrub layer (Brown et al. 2013). Low shrubs, such as Cascade barberry, California blackberry, Oregon boxleaf and tall shrubs (e.g. vine maple, Pacific rhododendron, thinleaf huckleberry) may be found, especially in pockets and gaps in high cover stands. Native willow species and snowbrush ceanothus may be present in variable cover in these stands. Native herbs will persist, and non-native herbs, such as slender false brome may continue to inhabit this phase. CP1.3 Douglas-fir - Pacific silver fir / tall shrubs - low shrubs / forbs Sapling/pole-sized, single layered, moderate-closed canopy Age class:25-65

Community 1.4

Douglas-fir - Pacific silver fir / tall shrubs - low shrubs / forbs

Growth from CP1.3 produces this community phase. Large and giant snags and down wood from previous disturbances are likely present but declining in abundance due to decay and fragmentation. Smaller snags are being created from background mortality due to competition, snow/ice damage, insects, and pathogens (Mellen-McLean et al. 2017). Forest structure is still simple and largely single layered, although some multi-layered development may be beginning to be expressed in scattered openings. Canopy cover is usually moderate to high and dominated by small to medium sized Douglas-fir, Pacific silver fir, and western hemlock. Small to medium western white pine, noble fir, and western redcedar may also be found in varying amounts. Some legacy large and giant trees may be present in some cases. Regeneration of shade tolerant species such as Pacific silver fir and western hemlock may occur. Low shrubs such as California blackberry, Oregon boxleaf, and tall shrubs (e.g. vine maple, Pacific rhododendron, thinleaf huckleberry) may be found, especially in pockets and gaps in high cover stands. Herbs are varied depending on understory light levels. CP1.4 Douglas-fir - Pacific silver fir / tall shrubs - low shrubs / forbs Small/Med, single layered, moderate-closed canopy Age class: 65-125

Community 1.5
Douglas-fir - Pacific silver fir / tall shrubs - low shrubs / forbs

This phase is the result of moderate severity fire or moderate thinning of CP 1.4. Small to medium sized Douglas-fir, Pacific silver fir and western hemlock, as well as varying amounts of western white pine and noble fir comprise the overstory canopy layer. Large and giant snags and down wood from previous disturbances are likely present but declining in abundance due to decay and fragmentation. Small and medium snags in varying densities may result from fire and may lead to later recruitment of down wood (Mellen-McLean et al. 2017). A range of shade tolerant (Pacific silver fir, western hemlock, western redcedar) and shade intolerant trees (Douglas-fir, western white pine, noble fir) may be present, depending on the severity and size of the disturbance (Tepley et al. 2013). Regeneration may also include shade tolerant and intolerant species. Shrub species are varied, with evergreen low shrubs such as Cascade barberry, pipsissewa, and tall shrubs (vine maple, thinleaf huckleberry, Pacific rhododendron) persisting due to sprouting adaptation. Native and non-native herbs are present, depending on seed source and disturbance severity. CP1.5 Douglas-fir - Pacific silver fir / tall shrubs - low shrubs / forbs Small/Med, multi layered, open to closed canopy, diverse sized gaps, regenerating shade tolerant and intolerant Age class: 75-150 years

Pathway 1.1a
Community 1.1 to 1.2

Stand replacing fire is the most common pathway from this condition. Timber management, large scale ice/snow, wind or insects and pathogens may also return this phase to an early seral condition.

Pathway P
Community 1.2 to 1.3

Pathway 1.3a
Community 1.3 to 1.4

Growth is the major process transitioning out of this phase. Pre-commercial thinning may also serve to change phases.

Pathway 1.4a
Community 1.4 to 1.1

Growth will serve to transition this phase into the reference community.

Pathway 1.4c
Community 1.4 to 1.2

Regeneration harvest or stand replacing fire can return this phase to early seral conditions.

Pathway 1.4b

Community 1.4 to 1.5

Management actions such as thinning can trigger a shift in phases. Mixed severity fire can also result in a transition to more diverse stand conditions.

Pathway 1.5a
Community 1.5 to 1.1

Growth will serve to transition this phase into the reference community.

Pathway 1.5b
Community 1.5 to 1.2

Regeneration harvest or stand replacing fire can return this phase to early seral conditions.

Additional community tables

Other references

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Approval

Kirt Walstad, 2/29/2024

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	10/05/2023
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:**