USDA Natural Resources
Conservation Service

Ecological site R234XY701AK
Boreal tussock frozen hummocks

Last updated: 6/09/2025
Accessed: 12/05/2025

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): 234X–Interior Brooks Range Mountains

Geography
The Interior Brooks Range mountains area consists of predominantly steep, jagged mountains and narrow valleys that drain the southern side of the Brooks Range. This area is bordered by the Northern Brooks Range Mountains (Major Land Resource Area (MLRA) 244) to the north, the Western Brooks Range Mountains Foothills and Valleys (MLRA 243) to the west, and the Upper Kobuk and Koyukuk Hills and Valleys (MLRA 233) and the Interior Alaska Highlands (MLRA 231) to the south. The Brooks Range represents a drainage divide that is also the dividing line between MLRA 234 and MLRA 244. Rivers draining to the north wind their way along the North Slope until they reach the Arctic Ocean, while rivers that drain to the south reach the northern Pacific Ocean via the Bering Sea. MLRA 234 covers an area of 22,479 miles and is sparsely populated (USDA, 2022).

Geology
The Brooks Range is the northernmost extension of the Rocky Mountains and the highest range within the Arctic Circle, with high peaks in the eastern part of the range reaching elevations of nearly 9,000 feet. This area falls within the zone of discontinuous permafrost, with the continuous permafrost zone primarily occurring north of the Brooks Range. Wide, U-shaped valleys are evidence of extensive glaciation in the Early and Mid-Pleistocene, with most glaciers retreating to their current, high-elevation positions by the Late Pleistocene. The characteristically sharp upper peaks give way to lower mountain slopes comprised of alluvial and colluvial fans before reaching the gently sloping flood plains and terraces of the valley bottoms. While Paleozoic and Jurassic igneous and volcanic rocks can be found in the eastern part of the range, most of the lower slopes of this area are comprised of modified glacial material, alluvial, and colluvial deposits. Many rivers and

streams, such as the Koyukuk, have their headwaters in the Brooks Range and drain to the Bering Sea and North Pacific Ocean via the Yukon River.

Soils
The dominant soils orders in this MLRA are Gelisols, Entisols, and Inceptisols. Soils in the area have a gelic (subgelic) or cryic temperature regime, a udic or aquic moisture regime, and mixed minerology. Gelisols are common on soils that are shallow or moderately deep to permafrost and are somewhat poorly to very poorly drained. Gelisols are more common on cold slopes and stream terraces. In some cases, higher-intensity wildfires lead to loss of insulation when the surface organic layer is burned. This can lead to permafrost loss or active layer expansion and ultimately alter hydrology and taxonomic classification. Entisols and Inceptisols lacking in permafrost range from excessively-well to poorly drained. Entisols and Inceptisols are more common on rocky terrain, warm boreal slopes, and flood plains. Miscellaneous areas such as glaciers, riverwash, rock outcrop, and rubble land make up 63 percent of the MLRA.

Vegetation
The continental subarctic climate of the Brooks Range in conjunction with shallow, rocky soils leads to a sparsely forested landscape in this MLRA. Spruce-hardwood forests and woodlands tend to be relegated to lower elevations where deeper soils form on foot slopes and terraces. This is contrasted by the ericaceous dwarf shrub communities that are abundant on shallow, rocky slopes and ridges. Exposed sites are predominantly covered in lichen and sporadic forbs. Black spruce (*Picea mariana*) woodlands and tussock-forming sedge communities are on high stream terraces and foot slopes where permafrost occurs, as are wet sedge meadows. Floodplains tend to be dominated by low to tall willow scrub communities.

Land use
Except for areas along the Dalton Highway, access to most of this MLRA is extremely limited, lending itself to intact natural vegetation communities. For this reason, land use primarily takes the form of subsistence hunting, gathering, and fishing by local communities. In additions to subsistence activity, the Brooks Range is also a popular recreation destination, with many users utilizing air taxi and guiding services to access remote parts of the area. As is the case with much of interior Alaska, major resource concerns involve the persistence of permafrost, the degradation of which can lead to various changes in hydrology and nutrient cycling.

LRU notes

This area supports three life zones defined by the physiological limits of plant communities along an elevational gradient: boreal, subalpine, and alpine. The boreal life zone is the elevational band where forest communities dominate. Not all areas in the boreal life zone are forest communities, however, particularly in places where soil is too wet or dry to support tree growth (e.g., bogs or river bluffs). Above the boreal band of elevation, subalpine and alpine vegetation dominate. The subalpine zone is typically a narrow

transitional band between the boreal and the alpine life zones, and is characterized by sparse, stunted trees. In the subalpine, certain types of birch and willow shrub species grow at taller than one meter in height (commonly resin birch (Betula glandulosa) and tealeaf willow (Salix pulchra)). In the alpine, trees no longer occur, and all shrubs are dwarf or lay prostrate on the ground. In this area, the boreal life zone occurs below 2,500 feet elevation on average. The transition between boreal and alpine vegetation can occur within a range of elevations, and is highly dependent on slope, aspect, and shading from adjacent mountains.

Within each life zone, there are plant assemblages that are typically associated with cold slopes and warms slopes. Cold slopes and warm slopes are created by the combination of the steepness of the slope, the aspect, and shading from surrounding ridges and mountains. Warm slope positions typically occur on southeast to west facing slopes that are moderate to very steep (greater than ten percent slope) and are not shaded by the surrounding landscape. Cold slopes typically occur on northwest to east facing slopes, occur in shaded slope positions, or occur in low-lying areas that are cold air sinks. Examples of shaded positions include head slopes, low relief backslopes of hills, and the base of hills and mountains shaded by adjacent mountain peaks. Warm boreal slope soils have a cryic soil temperature regime and lack permafrost. In this area, white spruce (*Picea glauca*) forests are an indicator of warm boreal slopes. Cold boreal slope soils typically have a gelic soil temperature regime and commonly have permafrost. In this area, black spruce forests and woodlands are an indicator of cold boreal slopes. The boreal life zone can occur at higher elevations on warm slopes, and lower elevations on cold slopes.

Classification relationships

Alaska Vegetation Classification
Low open mixed scrub-sedge bog (II.c.2.b. – level IV)
(Viereck et al. 1992)

LANDFIRE Biophysical Settings
7416280 – Western North American Boreal Low Shrub-Tussock Tundra
(LANDFIRE biophysical settings, 2009)

Ecological site concept

Key soil and site characteristics
• Occurs in the boreal life zone
• Cold slopes (northwest to east facing)
• Loamy-skeletal, very poorly drained permafrost soils
• Shallow seasonal water table
• Ponding frequent for long duration
• Gentle slopes (2 to 16 percent)

Associated sites

F234XY713AK	**Boreal forest loamy frozen slopes** Occurs on the same boreal hill and mountain slopes but on steeper footslopes and toeslopes that support stands of black spruce (Picea mariana).

Similar sites

F234XY713AK	**Boreal forest loamy frozen slopes** Both ecological sites occur on toeslopes in the boreal life zone. Ecological site F234XY713AK supports stunted black spruce woodlands and ecological site F234XY701AK supports sedge communities.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Eriophorum vaginatum* (2) *Sphagnum*

Physiographic features

This ecological site occurs on turf hummocks on gently sloping, cold mountain slopes, hills, and plains in the boreal life zone. Slopes generally range from 2 to 16 percent with no known flooding and frequent ponding for long duration. A shallow seasonal water table persists near the soil surface for much of the growing season.

Table 2. Representative physiographic features

Geomorphic position, mountains	(1) Lower third of mountainflank
Landforms	(1) Mountains > Mountain slope > Hummock (2) Mountains > Hillslope > Hummock (3) Plains > Plain > Hummock
Runoff class	Very low to low
Flooding frequency	None
Ponding duration	Long (7 to 30 days)
Ponding frequency	Frequent
Elevation	271–704 m
Slope	2–16%
Water table depth	0 cm
Aspect	NW, N, NE, E

Climatic features

Characterized by a continental subarctic climate, cool, short summers interspace long, cool winters in this Major Land Resource Area (MLRA). Average annual temperatures range from 8 to 16 degrees, with freezing temperatures possible throughout the year. Precipitation ranges from 10 inches at low elevations up to 30 inches in the high elevations, with average snowfall ranging from 60 to 100 inches, annually. On average, there are only four frost free days per year at lower elevations, with frost possible throughout the year at higher elevations. The average high temperature in July (the warmest month, on average) is 65 degrees F, while the average high temperature in January is -1 degrees F. Extreme lows are common throughout interior Alaska. The lowest temperature recorded in Bettles Field, the location of one of the weather stations below, reached -69 degrees F.

Table 3. Representative climatic features

Frost-free period (characteristic range)	3-4 days
Freeze-free period (characteristic range)	48-59 days
Precipitation total (characteristic range)	254-356 mm
Frost-free period (actual range)	3-4 days
Freeze-free period (actual range)	46-61 days
Precipitation total (actual range)	229-356 mm
Frost-free period (average)	4 days
Freeze-free period (average)	54 days
Precipitation total (average)	305 mm

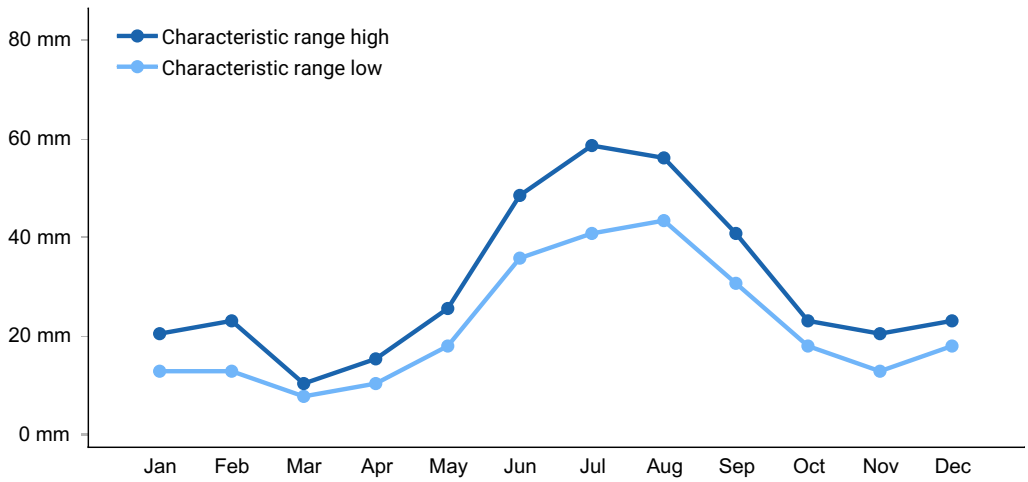


Figure 1. Monthly precipitation range

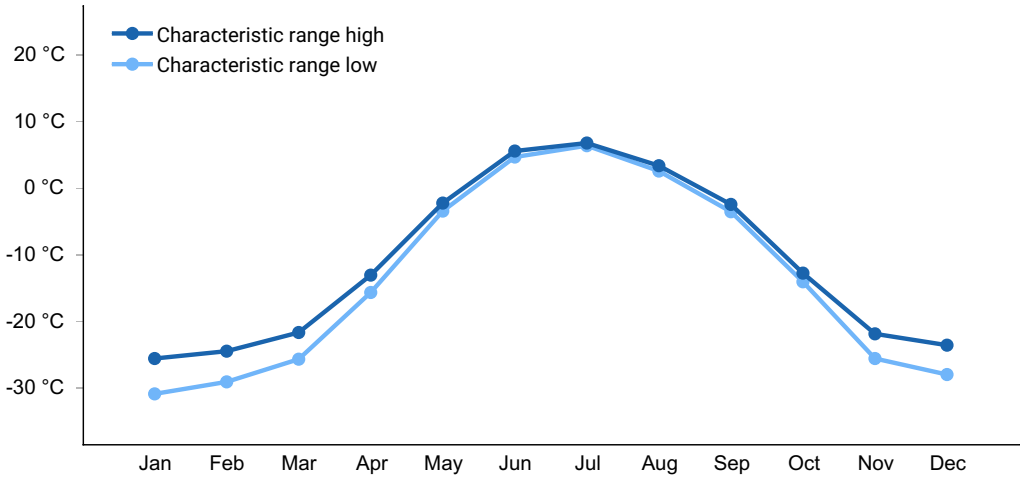


Figure 2. Monthly minimum temperature range

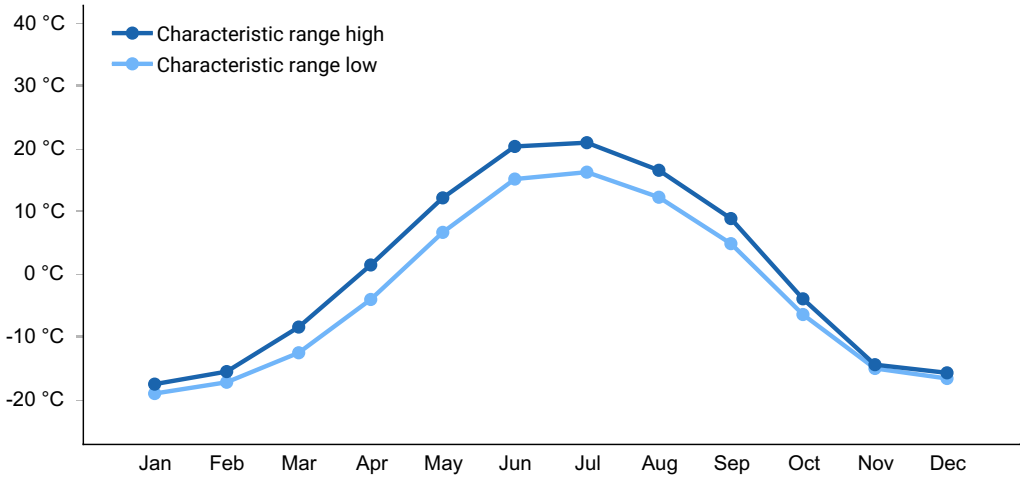


Figure 3. Monthly maximum temperature range

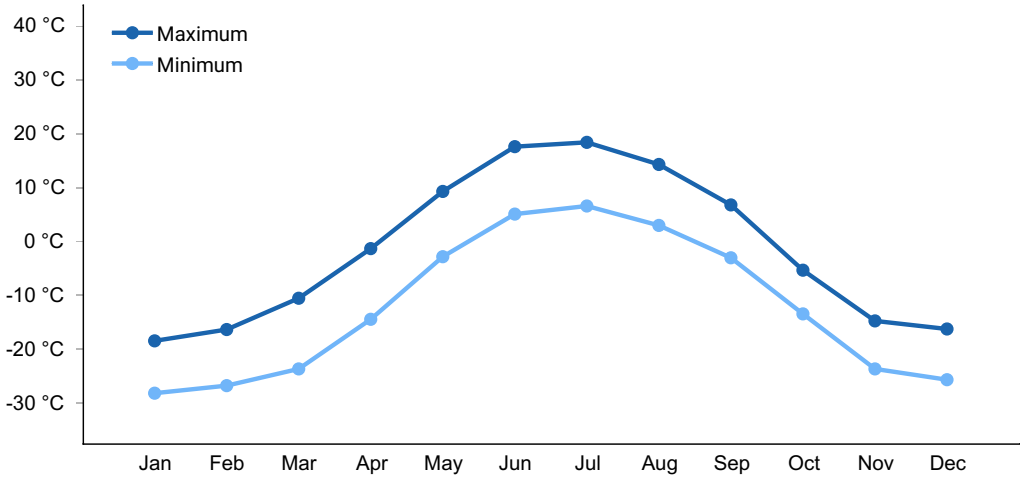


Figure 4. Monthly average minimum and maximum temperature

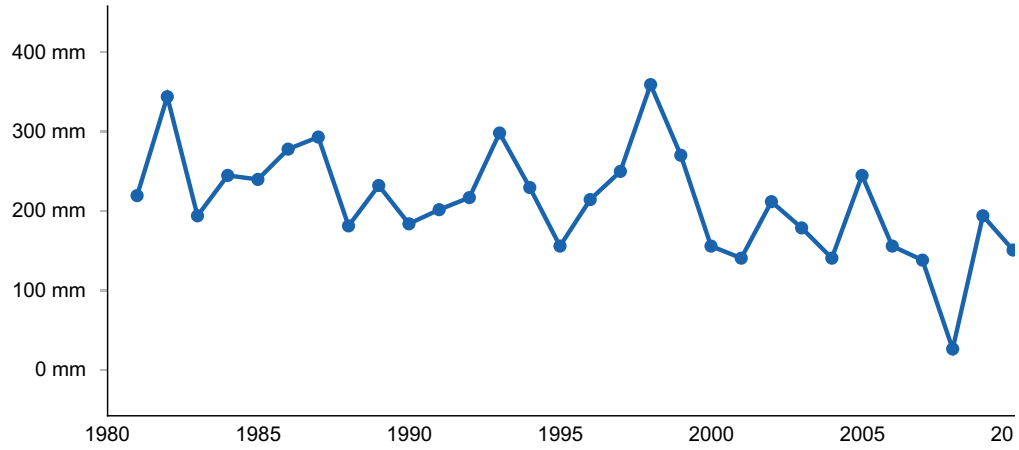


Figure 5. Annual precipitation pattern

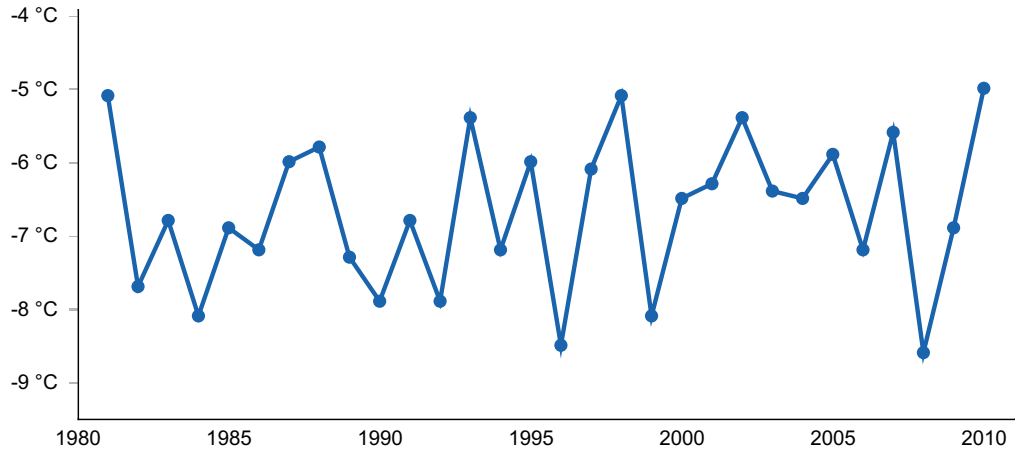


Figure 6. Annual average temperature pattern

Climate stations used

- (1) WISEMAN [USC00509869], Bettles Field, AK
- (2) CHANDALAR SHELF DOT [USC00501497], Southerly North Slope Bo, AK
- (3) CHANDALAR LAKE [USC00501492], Yukon Flats Nat Wildlife, AK

Influencing water features

This ecological site is associated with a shallow water table near the soil surface that persists throughout the growing season. Ponding frequently occurs for long durations.

Soil features

The soils of this ecological site formed in windblow silts and gravelly glacial till and have permafrost. Rock fragments do not occur on the soil surface and mineral soil is capped with 11 inches of saturated organic material. The mineral soil below the organic material is loamy-skeletal derived from windblows silts and glacial till and has moderate rock fragments. Soils are considered very deep, but a restrictive layer occurs within 13 to 18 inches of the soil surface in the form of strongly contrasting textural stratification. Soil pH

range from very strongly acidic to neutral and are very poorly drained with a shallow water table persisting throughout the growing season.

Table 4. Representative soil features

Parent material	(1) Organic material (2) Loess (3) Till
Surface texture	(1) Peat
Family particle size	(1) Loamy-skeletal
Drainage class	Very poorly drained
Permeability class	Moderately rapid
Depth to restrictive layer	33–46 cm
Soil depth	152 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	11.68–22.35 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (25.4-101.6cm)	4.5–6.8
Subsurface fragment volume <=3" (0-152.4cm)	17–28%
Subsurface fragment volume >3" (0-152.4cm)	8–12%

Table 5. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	Not specified
Soil depth	Not specified
Surface fragment cover <=3"	Not specified

Surface fragment cover >3"	Not specified
Available water capacity (0-101.6cm)	8.64–22.35 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified
Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	Not specified
Soil reaction (1:1 water) (25.4-101.6cm)	Not specified
Subsurface fragment volume <=3" (0-152.4cm)	Not specified
Subsurface fragment volume >3" (0-152.4cm)	Not specified

Ecological dynamics

In interior Alaska, fire is a common and natural event that has a significant control on the vegetation dynamics across the landscape. A typical fire event in the lands associated with this ecological site will reset plant succession and alter dynamic soil properties (e.g., depth of permafrost or thickness of organic matter). For this ecological site to progress from the earliest stages of post-fire succession to the oldest stages of succession, data suggest that 20 years or more must elapse without another fire event (Johnstone et al. 2010a).

Within this area, fire is considered a natural and common event that typically is unmanaged. Fire suppression is limited and generally occurs adjacent to various villages spread throughout the area or on allotments with known structures, all of which have a relatively limited acre footprint. Most fires are caused by lightning strikes. Fire-related disturbances are highly patchy and can leave undisturbed areas within the burn perimeter.

The fire regime within interior Alaska follows two general scenarios—low-severity burns, and high-severity burns. It should be noted, however, that the fire regime in interior Alaska is generally thought to be much more complex (Johnstone et al. 2008). Burn severity refers to the proportion of the vegetative canopy and organic material consumed in a fire event (Chapin et al. 2006). Fires in cool and moist habitats tend to result in low-severity burns, while fires in warm and dry habitat tend to result in high-severity burns. Because the soils have a thick organic cap and are poorly to very poorly drained, the typical fire scenario for this ecological site is considered to result in a low severity burn.

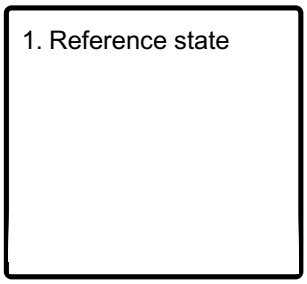
While low-severity fires have a range of impacts to vegetation and soils for this ecological site, permafrost generally remains in the soil profile. While a low-severity fire can consume

the bulk of above ground vegetation, minimal proportions of the organic mat are removed. Organic matter continues to insulate these cold soils. If permafrost remains at similar depths after a fire event, then soil drainage is unlikely to improve post-fire.

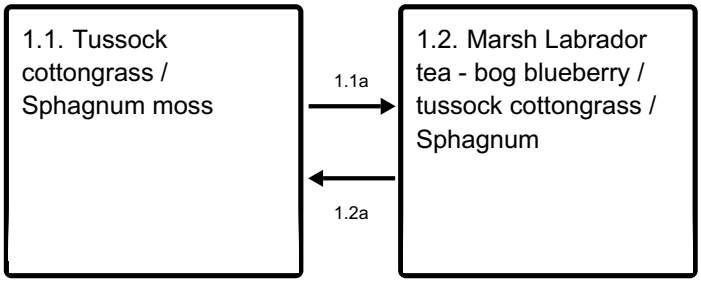
When minimal proportions of the organic mat are consumed, many species regenerate asexually from belowground root systems or rhizomes. Species known to regenerate after low-severity fire events include various graminoids (e.g. sedges (Carex spp.) and cottongrass (Eriophorum spp.)), forbs (e.g. horsetail (Equisetum sp.)), and shrubs (e.g. labrador tea (*Ledum groenlandicum*), bog blueberry (*Vaccinium uliginosum*), willow (Salix spp.)) (Johnstone et al. 2010; Bernhardt et al. 2011). Because the dominant vegetation (sedges, ericaceous shrubs, and shrub birch) grows quickly and commonly regenerate after a fire event, minimal time is needed for postfire recovery back to the reference plant community (as compared to adjacent forested ecological sites). Based on the dominant vegetation associated with this site, full recovery of vegetation is thought to take between 20 to 40 years. In comparison, it typically takes 100 to 150 years for a white spruce (*Picea glauca*) stand in Interior Alaska to mature (Chapin et al. 2006).

State and transition model

Ecosystem states



State 1 submodel, plant communities



1.1a - Fire

1.2a - Time without fire

State 1
Reference state

The reference plant community is open low mixed shrub-sedge tussock bog (Viereck et al. 1992) with the dominant plant being tussock cottongrass (*Eriophorum vaginatum*). There are two plant communities within the reference state related to fire.

Dominant plant species

- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- cloudberry (*Rubus chamaemorus*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- dwarf birch (*Betula nana*), shrub
- tussock cottongrass (*Eriophorum vaginatum*), grass
- sphagnum (*Sphagnum*), other herbaceous

Community 1.1
Tussock cottongrass / Sphagnum moss

The reference plant community is characterized as open low mixed shrub-sedge tussock bog (Viereck et al. 1992) with the dominant plant being tussock cottongrass (*Eriophorum vaginatum*). Seedlings of black spruce (*Picea mariana*) occasionally occur but have limited cover. Common species include marsh Labrador tea (*Ledum palustre* ssp. decumbens), bog blueberry (*Vaccinium uliginosum*), dwarf birch (*Betula nana*), lingonberry (*Vaccinium vitis-idaea*), Bigelow's sedge (*Carex bigelowii*), cloudberry (*Rubus chamaemorus*), various Sphagnum mosses (Sphagnum spp.), curled snow lichen (*Flavocetraria cucullata*), and various reindeer lichen (Cladina spp.). The strata that characterize this community are low shrubs (between 8 and 36 inches), medium graminoids (between 4 and 24 inches), and mosses.

Dominant plant species

- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- dwarf birch (*Betula nana*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- cloudberry (*Rubus chamaemorus*), shrub
- tussock cottongrass (*Eriophorum vaginatum*), grass
- Bigelow's sedge (*Carex bigelowii*), grass
- sphagnum (*Sphagnum*), other herbaceous
- (*Flavocetraria cucullata*), other herbaceous
- reindeer lichen (*Cladina*), other herbaceous

Community 1.2
Marsh Labrador tea - bog blueberry / tussock cottongrass / Sphagnum

Community 1.2 is in the early stage of fire-induced secondary succession for this ecological site. This community is characterized as open low mixed shrub-sedge tussock bog (Viereck et al. 1992). Seedlings of black spruce (*Picea mariana*) occasionally occur but have limited cover. Common species include marsh Labrador tea (*Ledum palustre* ssp. decumbens), lingonberry (*Vaccinium vitis-idaea*), dwarf birch (*Betula nana*), bog blueberry (*Vaccinium uliginosum*), tussock cottongrass (*Eriophorum vaginatum*), Bigelow's

sedge (*Carex bigelowii*), cloudberry (*Rubus chamaemorus*), various Sphagnum mosses (Sphagnum spp.), and juniper polytrichum moss (Polytrichum juniperium). The strata that characterize this community are low shrubs (between 8 and 36 inches), dwarf shrubs (less than 8 inches), medium graminoids (between 4 and 24 inches), and mosses.

Dominant plant species

- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- tussock cottongrass (*Eriophorum vaginatum*), grass
- sphagnum (*Sphagnum*), other herbaceous
- juniper polytrichum moss (*Polytrichum juniperinum*), other herbaceous

Pathway 1.1a
Community 1.1 to 1.2

A fire sweeps through and incinerates much of the above ground vegetation. Because of the associated cold and wet soils, this ecological site commonly experiences low-severity fires. Minimal proportions of the organic mat are typically removed. The pre-fire vegetation generally reestablishes quickly from below ground root systems and rhizomes.

Pathway 1.2a
Community 1.2 to 1.1

Time without fire. Tussock cottongrass (*Eriophorum vaginatum*) cover increases and shrub cover decreases.

Additional community tables

Inventory data references

The vegetation modeled for this ecological site has limited data and is considered provisional. The associated model was largely developed from NRCS (Natural Resources Conservation Service) staff with working knowledge of the area and literature review.

Plant community composition is largely based on ecological sites from Major Land Resource Area (MLRA) 231X: Interior Alaska Highlands.

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Contributors

Tyler Annetts
Phil Barber

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	12/05/2025
Approved by	Blaine Spellman
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):**

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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:

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

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

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

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

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17. **Perennial plant reproductive capability:**
