USDA Natural Resources Conservation Service

Ecological site F047XB512UT
High Mountain Loam (Douglas-fir)

Last updated: 2/05/2025
Accessed: 02/26/2025

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): 047X–Wasatch and Uinta Mountains

MLRA 47 occurs in Utah (86 percent), Wyoming (8 percent), Colorado (4 percent), and Idaho (2 percent). It encompasses approximately 23,825 square miles (61,740 square kilometers). The southern half is in the High Plateaus of the Utah Section of the Colorado Plateaus Province of the Intermontane Plateaus. Parts of the western edge of this MLRA are in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. The MLRA includes the Wasatch Mountains, which trend north and south. The steeply sloping, precipitous Wasatch Mountains have narrow crests and deep valleys. Active faulting and erosion are a dominant force in controlling the geomorphology of the area.
The mountains in this area are primarily fault blocks that have been tilted up. Alluvial fans at the base of the mountains are recharge zones for the basin fill aquifers. An ancient shoreline of historic Bonneville Lake is evident on the foot slopes along the western edge of the area. Rocks exposed in the mountains are mostly Mesozoic and Paleozoic sediments. The southern Wasatch Mountains consist of Tertiary volcanic rocks occurring as extrusive lava and intrusive crystalline rocks.
The average precipitation is from 8 to 16 inches in the valleys and can range up to 73 inches in the mountains. The southern and eastern portions have a greater incidence of high-intensity summer thunderstorms; hence, a significant amount of precipitation occurs during the summer months. The average annual temperature is 30 to 50 degrees F (-1 to 15 C). The freeze-free period averages 140 days and ranges from 60 to 220 days, generally decreasing in length with elevation.
The dominant soil orders in this MLRA are Aridisols, Entisols, Inceptisols, and Mollisols. The lower elevations are dominated by a frigid temperature regime, while the higher elevations experience cryic temperature regimes. Mesic temperature regimes come in on the lower elevations and south facing slopes in the southern portion of this MLRA. The soil moisture regime is typically ustic and udic in the southern parts. The minerology is generally mixed and the soils are very shallow to very deep, generally well-drained, and loamy or loamy-skeletal.

Ecological site concept

This site occurs on ridges and hillslopes and does not receive additional moisture above normal precipitation or flooding. Precipitation ranges from 18 to 25 inches. Areas occur on east and west oriented ridges at elevations ranging from 8,200 to 10,500 feet. Soils can be shallow however most are deep with a high runoff class, well-drained, moderately slow to moderate permeability rate and are moderately acidic to slightly acidic. Parent material is colluvium derived from intermediate volcanic rock or residuum weathered from intermediate volcanic rock. Soils are mapped having a ustic moisture regime and a cryic to frigid temperature regime.

Associated sites

R047XB508UT	**High Mountain Loam (aspen)** Sites often occur adjacent to each other.

Similar sites

R047XB532UT	**High Mountain Stony Loam (Douglas-fir)** This site has similar floristic characteristics but has more rock fragment in the soil profile.

Table 1. Dominant plant species

Tree	(1) *Pseudotsuga menziesii*
Shrub	(1) *Prunus virginiana* (2) *Mahonia repens*
Herbaceous	(1) *Carex geyeri* (2) *Poa*

Physiographic features

This ecological site typically occurs on ridges and hill slopes. Slopes normally range from 30 to 70 percent but may occasionally be steeper. Slope steepness, aspect and elevation will influence the vegetative floristics of this site. Sites are typically located between 8,200 to 10,500 feet in elevation. Runoff is high to very high.

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Hillslope
Runoff class	Medium to high
Flooding frequency	None
Ponding frequency	None
Elevation	8,200–10,500 ft
Slope	30–70%
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	2–70%

Climatic features

The climate is characterized by cold, snowy winters and cool, moist summers. Approximately 50 percent of the moisture comes during the plant growth period from April 1 through September 30. On the average April, May, and June are the driest months and July, August, and September are the wettest months.

Table 4. Representative climatic features

Frost-free period (characteristic range)	70 days
Freeze-free period (characteristic range)	88 days
Precipitation total (characteristic range)	29 in
Frost-free period (actual range)	70 days
Freeze-free period (actual range)	88 days
Precipitation total (actual range)	29 in

Frost-free period (average)	70 days
Freeze-free period (average)	88 days
Precipitation total (average)	29 in

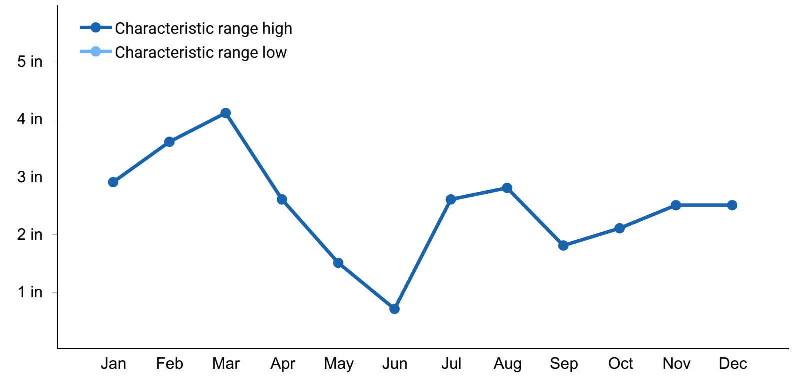


Figure 1. Monthly precipitation range

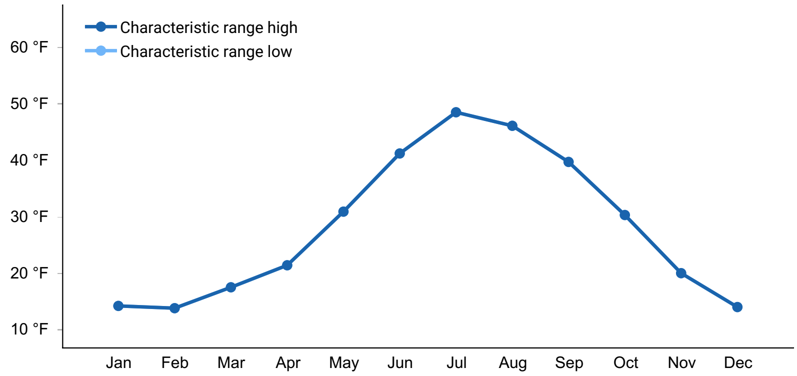


Figure 2. Monthly minimum temperature range

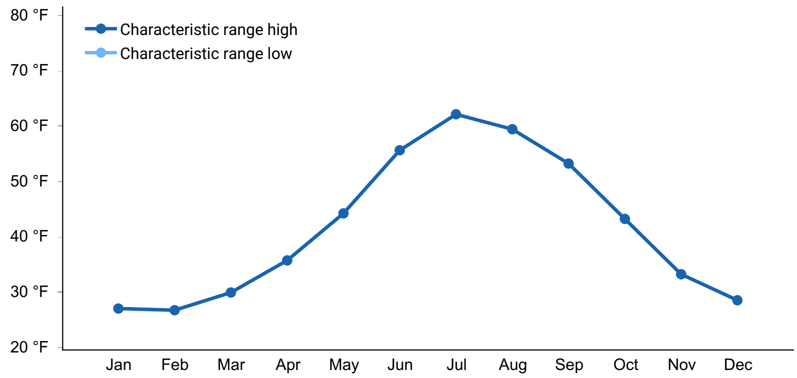


Figure 3. Monthly maximum temperature range

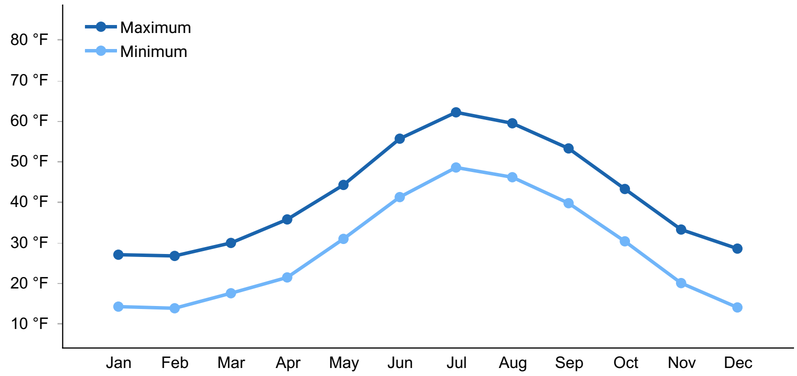


Figure 4. Monthly average minimum and maximum temperature

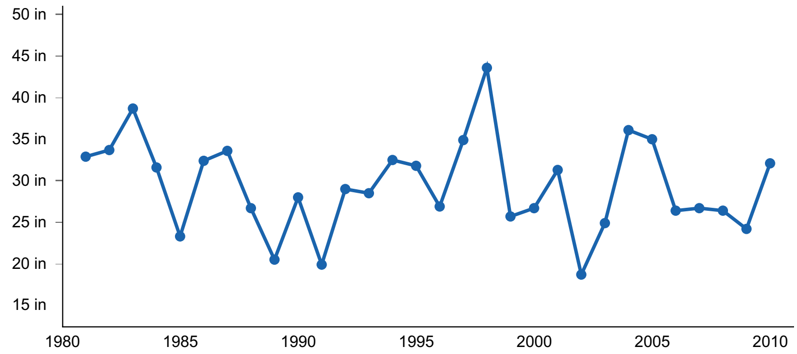


Figure 5. Annual precipitation pattern

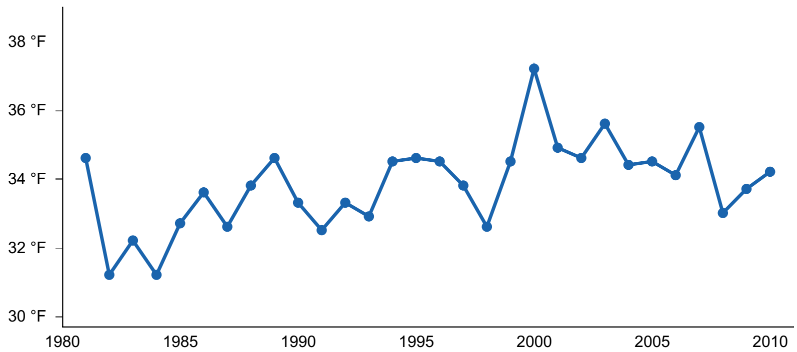


Figure 6. Annual average temperature pattern

Climate stations used

- (1) BLOWHARD MTN RADAR [USC00420757], Brian Head, UT

Influencing water features

Not associated with any water features.

Wetland description

N/A

Soil features

This site occurs on ridges and hillslopes and does not receive additional moisture above normal precipitation or flooding. Precipitation ranges from 18 to 25 inches. Areas occur on east and west oriented ridges at elevations ranging from 8,200 to 10,500 feet. Soils can be shallow however most are deep with a high runoff class, well drained, moderately slow to moderate permeability rate and are moderately acidic to mildly acidic. Available water holding capacity ranges from 4.7 to 5.5 inches. Parent material is colluvium derived from intermediate volcanic rock and/or residuum weathered from intermediate volcanic rock. Soils are mapped having a ustic moisture regime and a cryic or frigid temperature regime.

Table 5. Representative soil features

Parent material	(1) Colluvium–igneous rock (2) Residuum–igneous rock
Surface texture	(1) Loam (2) Very fine sandy loam
Family particle size	(1) Fine
Drainage class	Well drained

Permeability class	Moderately slow to moderate
Depth to restrictive layer	40–60 in
Soil depth	40–60 in
Surface fragment cover <=3"	0–8%
Surface fragment cover >3"	0–5%
Available water capacity (0-40in)	4.7–6 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	5.6–6.5
Subsurface fragment volume <=3" (0-40in)	2–10%
Subsurface fragment volume >3" (0-40in)	0–45%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	Not specified
Soil depth	20–60 in
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	0–36%
Available water capacity (0-40in)	Not specified
Calcium carbonate equivalent (0-40in)	0–10%
Electrical conductivity (0-40in)	Not specified
Sodium adsorption ratio (0-40in)	Not specified
Soil reaction (1:1 water) (0-40in)	5.6–7.8
Subsurface fragment volume <=3" (0-40in)	2–14%
Subsurface fragment volume >3" (0-40in)	Not specified

Ecological dynamics

Ecological Dynamics of the Site
It is impossible to determine in any quantitative detail the Historic Climax Plant Community (HCPC) for this ecological site because of the lack of direct historical documentation preceding all human influence. In the 1860s, Europeans brought cattle and horses to the area, grazing large numbers of them on unfenced parcels year-long. Itinerant and local sheep flocks followed, largely replacing cattle as the browse component increased.

Below is a state-and-transition model diagram that illustrates the “phases” (common plant communities), and “states” (aggregations of those plant communities) that can occur on the site. Differences between phases and states depend primarily upon observations of a range of disturbance histories in areas where this ESD is represented. These situations include grazing gradients to water sources, fence-line contrasts, patches with differing dates of fire, herbicide treatment, tillage, and kinds and times of timber harvest, etc. Reference State 1 illustrates the common plant communities that probably existed just prior to European settlement.

The major successional pathways within states, (“community pathways”) are indicated by arrows between phases. “Transitions” are indicated by arrows between states. The drivers of these changes are indicated in codes decipherable by referring to the legend at the bottom of the page and by reading the detailed narratives that follow the diagram. The transition between Reference State 1 and State 2 is considered irreversible because of the naturalization of exotic species of both flora and fauna, possible extinction of native species, and climate change. There may have also been accelerated soil erosion.

When available, monitoring data (of various types) were employed to validate more subjective inferences made in this diagram. See the complete files in the office of the State Range Conservationist for more details.

The plant communities shown in this state-and-transition model may not represent every possibility, but are probably the most prevalent and recurring plant communities. As more monitoring data are collected, some phases or states may be revised, removed, and new ones may be added. None of these plant communities should necessarily be thought of as “Desired Plant Communities.” According to the USDA NRCS National Range & Pasture Handbook (USDA-NRCS 2003), Desired Plant Communities (DPC’s) will be determined by the decision-makers and will meet minimum quality criteria established by the NRCS. The main purpose for including descriptions of a plant community is to capture the current knowledge at the time of this revision.

Community 1.1
Reference State
The Reference State is a description of this ecological site just prior to Euro-American settlement but long after the arrival of Native Americans. At the time of European colonization, what would have been observed on these sites depended primarily on the time since the last wildfire occurred. If the site had not experienced fire for about 100 years, Douglas-fir (*Pseudotsuga menziesii*) would have been the dominant species occupying the site with a sparse understory (1.1) due to tree competition, overstory shading, and duff accumulation. Douglas-fir replaces itself without wildfire and would have been the climax dominant. Wildfire (1.1a) would have replaced these stands with a rich herb-dominated vegetation (1.2). In the absence of any major disturbance (1.2a, 1.3a, 1.4a, 1.5a), the re-sprouting vegetation including quaking aspen (*Populus tremuloides*), bigtooth maple (*Acer grandidentatum*), and Gambel oak (*Quercus gambelii*) would have reclaimed the site (1.3), followed by the increasing presence of aspen (*Populus tremuloides*), first as saplings (1.4), and later as mature aspen with Douglas-fir seedlings (1.5), ultimately to where aspen would have been outcompeted by Douglas-fir returning to the climax vegetation (1.1). A more complete list of species by lifeform for the Reference State is available in accompanying tables in the “Plant Community Composition by Weight and Percentage” section of this document. Wildfire (1.1a, 1.5b) would have been the primary disturbance factor prior to colonization.

Community Phase 1.1: densely canopied Douglas-fir/sparse understory
This plant community (1.1) would have been characterized by a stand of mature Douglas-fir with a sparse understory of Geyer’s sedge (*Carex geyeri*), bluegrass (Poa spp.), chokecherry (*Prunus virginiana*), Fendler’s meadow-rue (*Thalictrum fendleri*), and creeping barberry (*Mahonia repens*).

Community Pathway 1.1a:
Wildfire would have removed the trees, allowing shade-intolerant herbs to flourish briefly.

Community Phase 1.2: herb-dominated
This plant community would have developed within the first 5 years since the last fire, with Geyer’s sedge, bluegrass, slender wheatgrass (*Elymus trachycaulus*), heartleaf arnica (*Arnica cordifolia*) and feathery false lily of the valley (*Maianthemum racemosum* ssp. racemosum) being the dominant understory species.

Community Pathway 1.2a:
After about 5 years, shrubs begin to establish.

Community Phase 1.3: re-sprouting aspen, maple, oak/herbaceous understory
For a period of about 5 to 60 years post fire, a mixture of re-sprouting shrubs would have been dominant on the site, including, quaking aspen, bigtooth maple, and Gambel oak. Other prominent shrubs would have been mountain snowberry (*Symphoricarpos oreophilus*), chokecherry (*Prunus virginiana*), Saskatoon serviceberry (*Amelanchier alnifolia*), and Oregon boxleaf (*Paxistima myrsinites*), among others. The herbaceous understory would also have been fairly intact.

Community Pathway 1.3a:
About 60 years after fire, aspen would become established in the site.

Community Phase 1.4: immature aspen
This plant community would have been dominated by a stand of immature aspen, which is a seral species while Douglas-fir begins to establish itself under other nurse species. A stand of immature aspen would have existed approximately 60 to 80 years since last fire.

Community Pathway 1.4a:
Aspen would have continued to mature while Douglas-fir would have become well established in the understory.

Community Phase 1.5: mature aspen/ Douglas-fir
A stand of mature aspen intermixed with Douglas-fir saplings would have been encountered approximately 80 to 100 years post fire.

Community Pathway 1.5a:
After about 100 years following the last fire, Douglas-fir would become mature, shading out aspen and the shade-intolerant shrub and herb species in the understory.

Community Pathway 1.5b:
Wildfire would have removed the trees, allowing shade-intolerant herbs to flourish briefly.

Transition T1a: from State 1 to State 2 (Reference State to Secondary Forest/ Introduced State)
The simultaneous introduction of exotic species, both plants and animals, and possible extinctions of native flora and fauna, along with climate change, has caused State 1 to transition to State 2. Europeans further altered this vegetation largely through logging, livestock grazing, trapping of fur beaver and changing the fire regime. Continued impacts could prevent the recovery toward potential conifer dominance (State 2, various phases). The reversal of these changes (i.e. a return pathway) back to State 1 is not practical.

State 2
Secondary Forest/ Introduced State
Community 2.2
Secondary Forest/ Introduced State
State 2 is similar to State 1 in form and function, with the exception of the presence of non-native plants and animals, possible extinctions of native species, a different climate, and a secondary stand of trees. State 2 is a description of the ecological site shortly following Euro-American settlement. This state can be regarded as the current potential. With the least amount of disturbance or manipulation of fire regime (Alexander 1985; 1988), a mature stand of Douglas-fir with a sparse understory component is expected at this site (2.1). As with the Reference State, time since last wildfire remains the key factor in determining what vegetation would be encountered here. Wildfire, particularly crown fires, or complete harvesting of the forest (2.1b, 2.5b) will replace these stands with a rich herb-dominated vegetation. (2.2). In the absence of any major disturbance (2.2a, 2.3a, 2.4a, 2.5a), the vegetation will progress into more of a shrub-herb co-dominance (2.3), followed by the increasing presence of aspen first as saplings (2.4), and later as mature aspen with Douglas-fir (2.5), ultimately to where Douglas-fir will outcompete aspen returning to the climax vegetation (2.1). Because soils on this site are rocky they are considered "self-armoring," thus making the site resistant to the effects of erosion. Heavy livestock grazing and tree harvests will reduce the stability of this site, while a reduction in livestock use and tree harvests will maintain stability.

Community Phase 2.1: densely canopied Douglas-fir/ sparse understory
This plant community (2.1) is characterized by a stand of mature Douglas-fir with a sparse understory of Geyer's

sedge, and bluegrass may be present.

Community Pathway 2.1a:
A stand-replacing wildfire or intensive logging will set the vegetation back to an early seral herb-dominated phase. Logging opens up the forest canopy allowing more understory for 20 to 30 years.

Community Pathway 2.1b:
The removal of only the mature Douglas-fir will allow some aspen to return and the immature Douglas-fir to continue growing.

Community Phase 2.2: herb-dominated
This plant community will develop within the first 5 years since the last fire. Dominant grasses are Geyer's sedge, bluegrass, and slender wheatgrass with heartleaf arnica and feathery false lily of the valley as common forbs. A small component of introduced species may also be present.

Community Pathway 2.2a:
The combination of heavy season long livestock grazing and fire exclusion will accelerate woody plant (shrub) establishment and diminish the herbaceous understory.

Community Phase 2.3: re-sprouting aspen, maple, oak/ herbaceous understory
A plant community co-dominated by shrubs and herbs will develop approximately 5 to 60 years post fire. A small component of introduced species may be present.

Community Pathway 2.3a:
The combination of heavy season long livestock grazing and fire exclusion will accelerate woody plant establishment and diminish the herbaceous understory.

Community Pathway 2.3b:
Heavy browsing will lead to Phase 2.1, a densely canopied Douglas-fir community with a sparse understory.

Community Phase 2.4: immature aspen
Aspen will establish in the site 60 to 80 years after the last fire or complete tree removal.

Community Pathway 2.4a:
The combination of heavy season long livestock grazing and fire exclusion will accelerate woody plant establishment and diminish the understory.

Community Phase 2.5: mature aspen/ Douglas-fir
A stand of mature aspen intermixed with Douglas-fir will develop approximately 80 to 100 years following fire or complete tree removal.

Community Pathway 2.5a:
The combination of heavy season long livestock grazing and fire exclusion will accelerate woody plant establishment and diminish the understory.

Community Pathway 2.5b:
A stand-replacing wildfire or intensive logging will set the vegetation back to an early seral herb-dominated phase. Logging opens up the forest canopy allowing more understory for 20 to 30 years.

Community Pathway 2.5c:
The removal of mature aspen will leave a stand of immature aspen, possibly with a few Douglas-fir in the understory.

Transition T2a: from State 2 to State 3 (Secondary Forest/ Introduced State to Tertiary Forest/ Degraded State)
The Secondary Forest/ Introduced State will transition to the Tertiary Forest/ Degraded State following a second cycle of timber harvest or stand replacing wildfire, and further impacts from heavy continuous season-long grazing. Logging opens up the forest canopy allowing shade tolerant understory for 20 to 30 years. Secondary and tertiary disturbances produce an assemblage of vegetation from degraded temporary meadows to further simplified forests.

A key indicator of the approach to this transition the presence of dominant trees that have reached the size required for commercial harvest. The trigger is a management decision. The second cycle of cutting typically is a clear-cut, where all stems are downed, slash piled and burned.

State 3
Tertiary Forest/ Degraded State
State 3 is characterized by tertiary forests that are further degraded in both understory and remnant tree layers. Active fire suppression speeds up the recovery of dominance by woody plants. Less predictable changes in the vegetation of State 3 will ensue due to global climate changes.

Community Phase 3.1: densely canopied Douglas-fir/ sparse understory
This plant community (3.1) is characterized by a stand of mature Douglas-fir. A sparse understory of Geyer's sedge and bluegrass may be present.

Community Pathway 3.1a:
A stand-replacing wildfire or intensive logging will set the vegetation back to an early seral herb-dominated phase. Logging opens up the forest canopy, allowing shade-intolerant grasses, forbs, and shrubs to flourish for 20 to 30 years.

Community Pathway 3.1b:
The removal of only the mature Douglas-fir will allow aspen to return and the immature Douglas-fir to continue growing.

Community Phase 3.2: herb-dominated
This plant community will develop within the first 5 years since the last fire. Dominant grasses are Geyer's sedge, bluegrass, and slender wheatgrass. A small component of introduced species may be present.

Community Pathway 3.2a:
After about 5 years, shrubs will begin to establish in the site.

Community Phase 3.3: re-sprouting aspen, maple, oak/ herbaceous understory
A plant community co-dominated by shrubs and herbs will develop approximately 5 to 60 years after fire or complete tree removal. A small component of introduced species may be present.

Community Pathway 3.3a:
Aspen will become established at the site after 60-80 years following the last wildfire or complete tree removal.

Community Phase 3.4: immature aspen
Immature aspen dominate the stand 60 to 80 years following the last fire or complete tree removal.

Community Pathway 3.4a:
Aspen matures and immature Douglas-fir become well established in the understory 80 years after the last fire or complete tree removal.

Community Phase 3.5: mature aspen/ Douglas-fir
A stand of mature aspen intermixed with Douglas-fir will develop approximately 80 to 100 years after the last fire or complete tree removal.

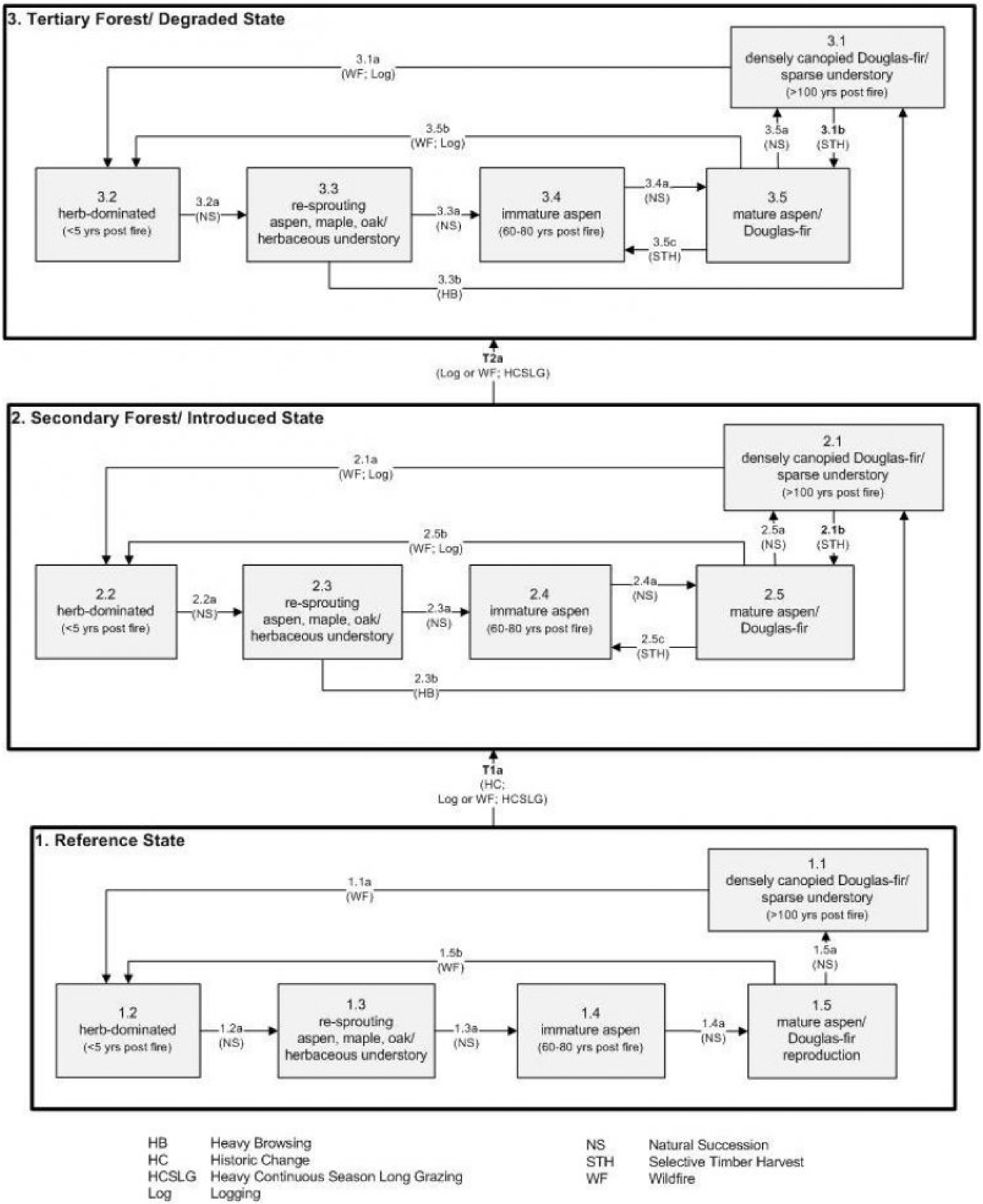
Community Pathway 3.5a:
After about 100 years following the last fire, Douglas-fir will become mature, shading out aspen and the shade-intolerant shrub and herb species in the understory.

Community Pathway 3.5b:
A stand-replacing wildfire or intensive logging will set the vegetation back to an early seral herb-dominated phase clear-cut. Logging opens up the forest canopy allowing more understory for 20 to 30 years.

Community Pathway 3.5c:

The removal of mature aspen will leave a stand of immature aspen, possibly with a few Douglas-fir in the understory.

State and transition model



Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range trained personnel were also used.

Other references

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Contributors

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Approval

Kendra Moseley, 2/05/2025

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	02/26/2025
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:**