USDA Natural Resources Conservation Service

Ecological site F044AH002MT
Montane Wet Cool Coniferous Seeley, Swan, Flathead and Tobacco Valleys

Last updated: 5/06/2024
Accessed: 05/17/2024

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): 044A–Northern Rocky Mountain Valleys

This ecological site currently resides in the Major Land Resource Area (MLRA) 44A Northern Rocky Mountain Valleys. This MLRA includes the northern portion of the Northern Rocky Mountain Valleys Province of the Rocky Mountain System. The mountain valleys are deeply dissected and are typically bordered by mountains trending north to south. The nearly level broad flood plains are bordered by gently to strongly sloping terraces and alluvial fans. The surrounding mountains and in some areas the valleys experienced glaciation. The average precipitation is 12 to 16 inches generally, though can vary widely. The dominant soil orders are Inceptisols, Mollisols and Andisols. The valleys support coniferous forests, shrublands and grasslands. The area of MLRA 44A is huge and is in the process of being restructured into a new MLRAs further divided into new Land Resource Units (LRU). A detailed description of MLRA 44A can be found at: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053624

LRU notes

This LRU includes the Flathead Valleys, with the predominant landscape as valleys with landforms including floodplains, stream terraces, outwash, lacustrine terraces, foothills, glacial moraines. The estimated acres are 1,412,271 and it is primarily private lands. Land use is development and agriculture. Climatically, this LRU has a cryic/frigid soil temperature regime and a xeric/udic soil moisture regime. It has a mean annual air temperature of 6, mean frost free days of 94 and mean annual precipitation of 590 and REAP of 58. Elevations range 751-1835m. Vegetation is predominantly Douglas Fir-Ponderosa Pine-Lodgepole Pine Forest and Woodland. Minor Engelmann Spruce-Subalpine Fir, open water, developed areas and agriculture. Trace Western Redcedar and Western Hemlock and Grand Fir. The geology is predominantly fluvial and bedform topography related to Cordilleran glaciation. Rock types are dominantly metasedimentary of the Belt Supergroup (Ravalli group) with some Tertiary sediments, eolian deposits, open water, Glacial lake deposits. The soils are dominantly very deep well developed soils formed in alluvium, lacustine deposits, glacial outwash and till from metasedimentary parent materials. These tend to be well drained, neutral to moderately alkaline soils with both skeletal and non-skeletal sandy loam, loam and clay loam textures. Poorly drained soils are present as well but are generally confined to areas along riparian corridors. Volcanic ash influenced soils occur here as well, but tend to be limited to stable footslope positions marginal to the valley floor.
This is related to the EPA land classification framework of: Level 3 the Northern Rockies and includes numerous Level 4 including: Stillwater-Swan Wooded Valley, Tobacco Plains, Flathead Valley, a small part of the Western Canadian Rockies (Level 3 is Canadian Rockies) and a small part of the rattlesnake-Blackfoot-south Swan-Northern Garnet-Sapphire Mountains and the Foothill Potholes (both in the Middle Rockies Level 3 subdivision). This area is related predominantly to the USFS Provinces: Predominantly resides in the northern portion in M333Bc (Flathead River Valley), the middle portion of in M333Cb (Canadian Rockies-Whitefish-Swan Mountains) and the southern portion in M332Bp (Avon-Nevada Valleys).

Classification relationships

This ecological site relates to the USFS Habitat Type Picea Engelmannii/*Clintonia uniflora*. This site relates to the USFS Habitat Type Group 7 and Fire Group 9. Both of these classification guides are specifically for the western Montana and northern Idaho region. It also relates to the NatureServe classification Picea Engelmannii/*Clintonia uniflora* CEGL000360.

Ecological site concept

• Site is found in wide valleys and intermontane basins
• Site occurs primarily on drainageways or in swales
• Vegetation is an overstory of Engelmann spruce and an understory of patchy common snowberry, redosier dogwood, bunchberry dogwood and a ground hugging layer of
twinflower with trailplant, fragrant bedstraw and wild sarspirilla
• Site does receive additional water
• Season high water table is <60 cm (24 inches); none-frequent flooding and/or ponding of long duration
• Soils are:
o very deep
o surface with less than 15% stone and boulder cover
o somewhat poorly to very poorly drained
o not organic

Associated sites

R044AH004MT	**Montane Rich to Intermediate Basin Plate Type Fen Seeley, Swan, Flathead and Tobacco Valleys** This ecological site is mainly found adjacent to riparian areas including the Basin Fen ecological site.
R044AH003MT	**Wet Meadow Seeley, Swan, Flathead and Tobacco Valleys** This ecological site is mainly found adjacent to riparian areas including the Wet Meadow ecological site.

Similar sites

F044AP904MT	**Upland Cool Moist Woodland Group** This similar ecological site has similar moist site conditions to this ecological site.

Table 1. Dominant plant species

Tree	(1) *Picea engelmannii*
Shrub	(1) *Cornus sericea ssp. sericea*
Herbaceous	(1) *Aralia nudicaulis* (2) *Galium triflorum*

Physiographic features

This site is found in wide valleys and intermontane basins, primarily on drainage ways or in swales.

Table 2. Representative physiographic features

Landforms	(1) Valley > Drainageway (2) Valley > Swale
Flooding duration	Long (7 to 30 days)
Flooding frequency	None to frequent
Ponding duration	Long (7 to 30 days)
Ponding frequency	None to frequent
Elevation	750–1,550 m
Slope	0–15%
Water table depth	0–102 cm

Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

The dissected northern Rocky Mountain Valleys are considered to have a maritime climate. Precipitation is fairly evenly distributed throughout the year with less than about 35 percent of the annual precipitation occurring during the growing season in Montana. Rainfall occurs as high-intensity, convective thunderstorms in the spring and fall. Most of the precipitation in the winter is snow or rain on fully or partially frozen ground. Average precipitation is 14 to 19 inches, and the frost-free period averages 60 to 110 days. The soil moisture regime is xeric and the soil temperature regime is frigid. The majority of precipitation comes early in the form of snow and spring rain. Summers are usually dry. The growing season is short and cool; primary growth typically occurs between May and July, and dominant plants are those that have adapted to these conditions. There is abundant moisture available during the cooler months and very little during the period of mid-to late summer drought conditions. For example, throughout all the valleys of western Montana, the months with higher precipitation averages were November to January and May to June. Therefore, many native bunchgrasses and forbs are dormant in summer but photosynthetically active from autumn through spring.

Mean Average Precipitation Range
·14 to 19 inches
Mean Average Annual Temperature Range
·33 to 58°F
Frost free days Range:
·60 to 110 days

Table 3. Representative climatic features

Frost-free period (characteristic range)	36-83 days
Freeze-free period (characteristic range)	99-124 days
Precipitation total (characteristic range)	381-483 mm
Frost-free period (actual range)	17-87 days
Freeze-free period (actual range)	90-127 days
Precipitation total (actual range)	381-533 mm
Frost-free period (average)	58 days
Freeze-free period (average)	111 days
Precipitation total (average)	432 mm

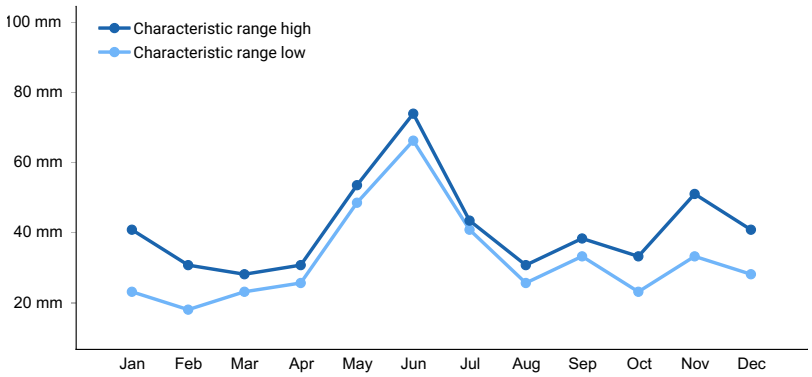


Figure 1. Monthly precipitation range

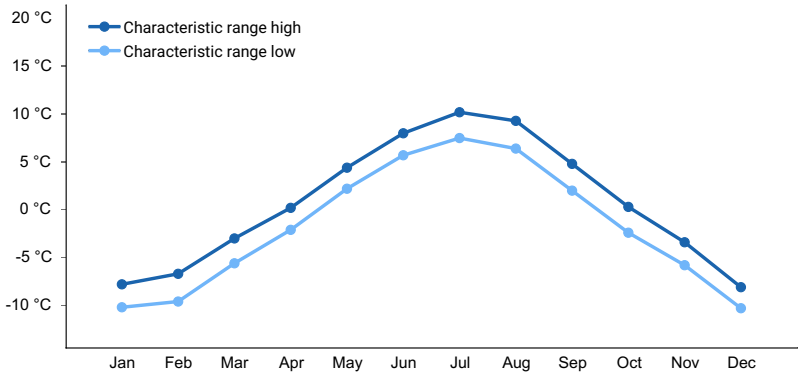


Figure 2. Monthly minimum temperature range

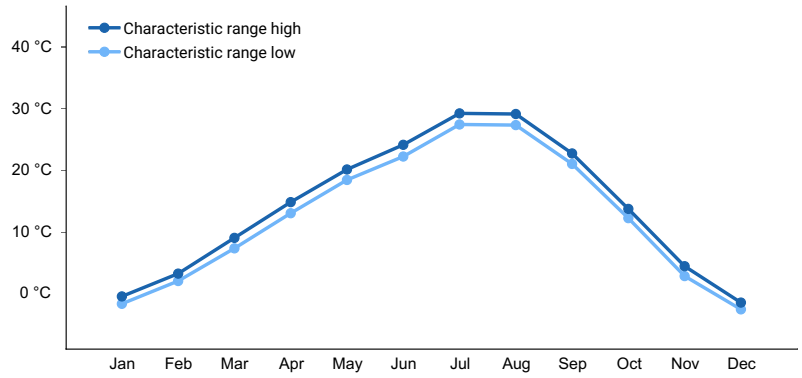


Figure 3. Monthly maximum temperature range

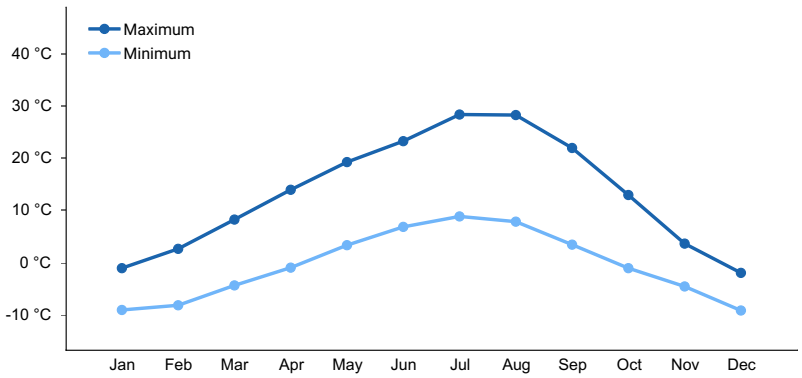


Figure 4. Monthly average minimum and maximum temperature

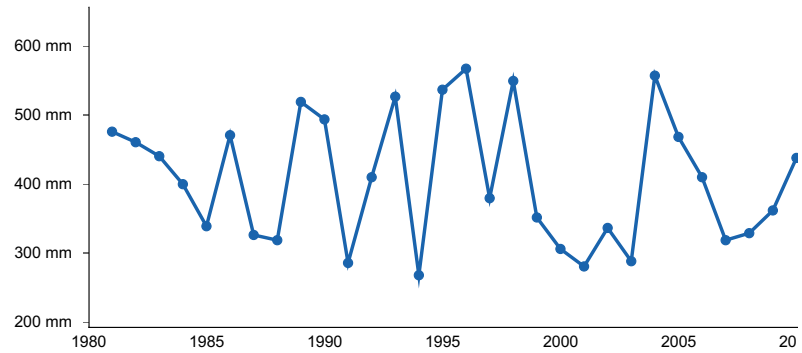


Figure 5. Annual precipitation pattern

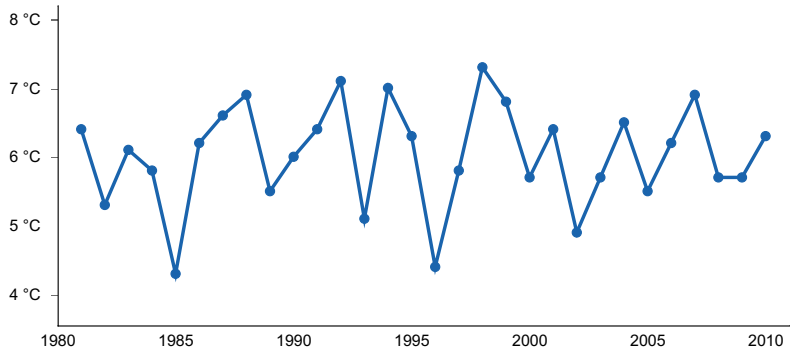


Figure 6. Annual average temperature pattern

Climate stations used

- (1) EUREKA RS [USC00242827], Eureka, MT
- (2) FORTINE 1 N [USC00243139], Eureka, MT
- (3) OLNEY [USC00246218], Whitefish, MT
- (4) WHITEFISH [USC00248902], Whitefish, MT
- (5) KALISPELL 9 NNE [USC00244560], Kalispell, MT
- (6) CRESTON [USC00242104], Kalispell, MT

Influencing water features

This ecological site is influenced by wetland or riparian water features.
USDI FWS Wetland classification: System= palustrine; Class=forested wetland; Subclass=needle-leaved evergreen; Water Regime (nontidal)=temporarily flooded (to saturated for the wettest site conditions) (Hansen, 1995).

Soil features

Soils associated with this ecological site group are very deep, somewhat poorly to very poorly drained, and formed predominantly from lacustrine, outwash, and glacial till parent materials from metasedimentary sources. These soils are typically Alfisols and Inceptisols. Alfisols are well-developed forest soils with a significant clay increase below the surface horizons, while Inceptisols are less developed soils that lack an accumulation of clay in the subsoil. The soil textures are often loamy or silty near the soil surface and may coarsen in the subsurface as the abundance of gravels increases. The surface usually does not have many large rock fragments, but thin organic layers at the surface are common especially in soils with seasonal wetness and water commonly found within 100 cm of the soil surface. Argillic horizons, present in Alfisols, generally have less than 35 percent clay and sometime overlie a calcic horizon. Loam, silty loam and silty clay loam textures typically hold a lot of water and transmit it slowly. Water tables in these soils may have significant season variation, however, these soils are commonly wet to some degree year round (Soil Survey Staff, 2015).

For more information on soil taxonomy, please follow this link:
http://http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/class/?cid=nrcs142p2_053580

Table 4. Representative soil features

Parent material	(1) Lacustrine deposits–metasedimentary rock (2) Outwash–metasedimentary rock (3) Till–metasedimentary rock
Surface texture	(1) Loam (2) Silt loam
Family particle size	(1) Loamy
Drainage class	Somewhat poorly drained to very poorly drained
Permeability class	Moderate to moderately slow

Soil depth	152–254 cm
Surface fragment cover <=3"	0–35%
Surface fragment cover >3"	0–15%

Ecological dynamics

This ecological site group relates to numerous USFS Habitat Types in the Engelmann spruce series (Pfister, 1977), which is in Fire Group 9 and in the updated USFS Region 1 Montana Potential Vegetation Type Group PICEA (9 cool and wet) and in the old Habitat Type Group 8. It was in the Vegetation Response Unit 8.

►OVERVIEW◄
The Montane Wet Cool Coniferous ecological site group spans the zone between the lower, warmer and drier Douglas fir zone and the higher and cooler subalpine fir zone. This ecological site includes a range of wet to moist site conditions and is typified by an overstory of Engelmann spruce with various understories and seral communities. The wet site conditions are less common than the moist site conditions within this LRU. The moist to wet site conditions, location on drainageways or swales, occurrence of mesic plants and dominance by Engelmann spruce in the overstory define the modal concept, though the water table depth and degree of flooding and ponding vary slightly between these site conditions. The wettest sites will have only Engelmann spruce in all seral stages and have an understory dominated by field horsetail in the reference community. The moist site conditions will have Engelmann spruce and seral tree species including Douglas fir, western larch, and lodgepole pine as well as a diverse understory.
The wettest site conditions will be found on flat areas with poor drainage on broad alluvial valley bottoms with soils that are usually wet throughout the year and often have standing water (ponding). This relates to the USFS Habitat Type Engelmann spruce/field horsetail (Pfister, 1977). The water tables are usually less than 50 cm deep. These wettest sites are usually located near drainages, ponds or fens. Engelmann spruce is present in all seral stages and dominates the overstory in the reference stage, though other species, usually subalpine fir, may be present in trace amounts on dry hummock microsites (composed of root crown and windthrow mounds) (Pfister, 1977). The understory is dominated by field horsetail (*Equisetum arvense*) and to a lesser extent mesic species including redosier dogwood (*Cornus sericea*), twinberry honeysuckle (*Lonicera involucrata*), sedges (Carex species), fragrant bedstraw (*Galium triflorum*), arrowleaf ragwort (*Senecio triangularis*), largeleaf avens (*Geum macrophyllum*), claspleaf twistedstalk (*Streptopus amplexifolius*), common ladyfern (*Athyrium filix-femina*), dwarf red blackberry (*Rubus pubescens*), bunchberry dogwood (*Cornus canadensis*), Canadian white violet (*Viola canadensis*), and rarely American skunkcabbage (*Lysichiton americanus*). Post-disturbance community is dominated by Engelmann spruce, water birch (*Betula occidentalis*), thinleaf alder (Alnus incaca ssp. tenuifolia), Bebb willow (*Salix bebbiana*), and field horsetail (*Equisetum arvense*) (Pfister, 1977). This ecological site group has limited use for cattle but moderate use by wildlife (Hansen, 1995). It can be important as shading areas for livestock, but the soils are sensitive to disturbance due to wet conditions, and cattle can easily churn the wet soil and destroy plant cover. Due to high water tables, the trees are extremely susceptible to windthrow and soil loss may follow all forms of timber harvesting- therefore limiting potential use (Hansen, 1995). Deer, elk, moose have moderate use; field horsetail (*Equisetum arvense*) is important food for grizzly bears, black bear use it for wallows, big game for rutting, and small mammals and avian species make high use due to structural diversity (Gautreaux, Russ. 1999).
This ecological site also includes moist site condition areas which have less flooding and ponding and a deeper seasonal water table than the wet sites. It is found on undulating or flat alluvial benches and gentle north slopes (Hansen, 1995). The reference community has an overstory dominated by Engelmann spruce but has a variety of tree species in the seral communities including Douglas fir, western larch and lodgepole pine. The understory is diverse with multi-layered shrubs, forbs and grasses including: bride's bonnet (*Clintonia uniflora*), wild sarsaparilla (*Aralia nudicaulis*), bunchberry dogwood (*Cornus canadensis*), redosier dogwood (*Cornus sericea*), dwarf red blackberry (*Rubus pubescens*), twinflower (*Linnaea borealis*), American trailplant (*Adenocaulon bicolor*), and fragrant bedstraw (*Galium triflorum*). The warmest, driest sites will not have bride's bonnet (*Clintonia uniflora*), but will have bunchberry dogwood (*Cornus canadensis*), fragrant bedstraw (*Galium triflorum*), dwarf bilberry (*Vaccinium cespitosum*). This relates to the USFS Habitat Type Engelmann spruce/bride's bonnet (Pfister, 1977). The drier site conditions, compared to the wet sites, will have more livestock and wildlife use, but this use is still low. Herbage production is low to moderate due to dense overstory and therefore limits use by livestock (Gautreaux, Russ. 1999). Redosier dogwood is very desirable to livestock and wildlife such as deer and elk, and browsing can be very high (Hansen, 1995). Deer and elk use these sites as winter range and moose will use them year-long in flat mountain valleys. Timber production ranges moderate to high but is complicated or restricted by high water tables (Hansen,

1995). Two other habitat types associated with this ecological site are found in moist conditions including Englemann spruce/fragrant bedstraw and Englemann spruce/starry false lily of the valley. The former is found in cool, moist locations usually bordering streams with an understory of various wet site forbs including fragrant bedstraw, red baneberry, claspleaf twistedstalk, thimbleberry, prickly currant and common snowberry (Pfister, 1977). The latter is found on warm, moist benches and lower slopes with an understory of forbs including starry and feathery false lily of the valley, western meadowrue, roughfruit fairybells, Richardson's geranium (Pfister, 1977). The driest site conditions within the spectrum for this ecological site has an overstory dominated by Engelmann spruce in the reference community but has various tree species in seral communities and a diverse understory. Understory species include pinegrass, dwarf bilberry (*Vaccinium cespitosum*), twinflower (*Linnaea borealis*), white spirea (*Spiraea betulifolia*), common snowberry (*Symphoricarpos albus*). The post-disturbance community includes: Saskatoon serviceberry (*Amelanchier alnifolia*), starry false lily of the valley (*Maianthemum stellatum*), Virginia strawberry (*Fragaria virginiana*), sweetcicely (*Osmorhiza berteroi*), western meadow-rue (*Thalictrum occidentale*), Rocky Mountain maple (*Acer glabrum*), creeping barberry (*Mahonia repens*), redosier dogwood, alderleaf buckthorn (*Rhamnus alnifolia*). This relates to the USFS Habitat Type Engelmann spruce/dwarf bilberry (Pfister, 1977). Engelmann spruce reestablishes quickly after disturbance but assumes dominance slowly and shrub cover is moderate (Hansen, 1995). Another habitat type found in drier sites is Englemann spruce/twinflower which resides on cool, well drained benches and gentle northeast slopes with an understory of thinleaf huckleberry, VASC, ALVIS, pinegrass and common snowberry (Pfister, 1977).

►ECOLOGICAL DYNAMICS◄

The primary ecological processes are infrequent events such as severe flooding, windthrow, and wind-driven fire from adjacent drier sites. Specifically, fire is not a significant (in terms of frequency or common severity level) disturbance agent due to moist fuel beds, lush mesic undergrowth, and high humidity (Gautreaux, Russ. 1999). Engelmann spruce is easily killed by fire due to the dead, dry, flammable lower limbs, low growing canopy, thin bark and lichen growth in the branches which contribute to low fire resistance. Additionally, the shallow root system is readily subject to injury from fire burning through the duff (the deep accumulation of resinous needle litter) (Hansen, 1995). Large older trees may survive light severity fires. Redosier dogwood (*Cornus sericea*) and the associated shrub species can survive all but the most severe fires that remove duff and cause extended heating of the upper layer of soil. These resprout from surviving rhizomes or stolons. Seral and climax stages dominated by Engelmann spruce and other seral species occur on hummocks or drier areas within the site on wettest site conditions; while drier conditions have other tree species during seral phases including: Douglas fir, western larch and lodgepole pine. Stands have moderate or high density forest structure and these are periodically reduced by bark beetles, windthrow or fire from surrounding drier areas (Gautreaux, Russ. 1999). Mature stands in highly productive, moist settings are susceptible to high levels of heartrot, root disease, white pine blister rust, dwarf mistletoe (Hagle, 2003). In stands with root disease, fir engraver beetles may occur as well. Blowdown susceptibility is high due to the high water table, shallow-rooted species, and presence of root disease or other decay-causing pathogens. Scouler willow can dominate in sites where a rise in water table height follows a severe fire. Additionally, the effects of extensive tree mortality can increase the level of cold air at a site resulting in frost impacts on conifer regeneration. This delay would allow for shrubs, such as serviceberry, thinleaf alder, redosier dogwood, and Rocky Mountain maple, to dominated (Gautreaux, Russ. 1999).

►FIRE REGIME◄

Due to the moist or wet site conditions, fire is not the dominant disturbance process for this ecological site. Fires can occur on this site, usually as wind driven events from adjacent, drier terrain. The fire regimes of northern Rocky Mountain conifer swamp communities has a modeled fire interval using LAND FIRE that is 400 years and severity is replacement (FEIS, USDA, USFS). The fire regime group was Five, which indicates the frequency is over 200 years and with generally replacement severity fires, but can include fires of any severity (FEIS, USDA, USFS). The fire frequency during average moist and moderate summers is generally low. Burning of the understory by creeping fires is not a major impact because of the high fuel moisture and the long fire return interval typical of this ecological site. Non-uniform lethal fires have a 300 to 400 year fire return interval in spruce bottoms (Gautreaux, Russ. 1999). In the Kootenai National Forest, lethal fires historically occurred every 150 to 400 years in riparian areas with an average 220 year fire return interval (FRI) for VRU 8 (wet cool types)(Gautreaux, Russ. 1999). Wetter sites are a deterrent to ground fires, but fire can scar trees residing on the edges. Stand replacing events occur only during prolonged drought conditions that dry out the high levels of fuels. After severe fire, regeneration is dependent on site conditions. Shade tolerant species are favored in small openings where duff is still intact whereas shade intolerant species and hardwoods dominate early seral stages in large openings by overtopping the tolerant species (Gautreaux, Russ. 1999). Cold temperatures, wet soils, and lush undergrowth favor early dominance by spruce (Hansen, 1999). Fire exclusion has not produced measurable effects because most historic fire return intervals were

longer than the period of effective fire suppression.

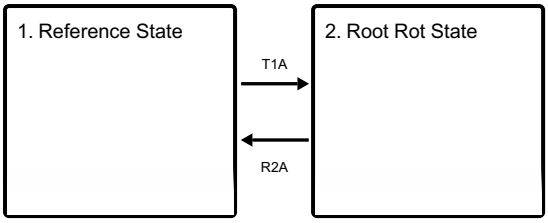
►PEST/DISEASE DESCRIPTIONS◄
Engelmann spruce is susceptible to a variety diseases and insect pest damage to the root, stem, and foliage. Armillaria and Annosus root disease and Schweinitzii root- and butt-rot can be a concern, although the primary hosts for these diseases are Douglas fir and subalpine fir (Hagle, 2003). Stem decays on Engelmann spruce include Red belt fungus and Pini rot. Bark beetles and wood borers that attack include Metallic and roundheaded wood borers and Spruce beetle. Blue stain of sap wood also damages the stem. Spruce broom rust and Spruce cankers harm the branches and terminals of Engelmann spruce, while the foliage is damaged by Brown felt blight.

►ARMILLARIA ROOT ROT◄
Armillaria root disease is the most common root disease fungus in this region, and especially prevalent west of the Continental Divide. It may be difficult to detect until it has killed enough trees to create large root disease pockets or centers, ranging in size from a fraction of an acre to hundreds of acres. The root disease spreads from an affected tree to its surrounding neighbors through root contact. The root disease effects the most susceptible tree species first, leaving less susceptible tree species that mask the presence of disease. When root rot is severe, the pocket has abundant regeneration or dense brush growth in the center. In western Montana and northern Idaho, Armillaria is present in most stands with diffuse mortality and large and small root disease centers. The disease pattern is one of multiple clones merging to form essentially continuous coverage of sites. Grouped as well as dispersed mortality involves entire stands and drainages, and often is severe by age 40. A mosaic of brushy openings, patches of dying trees, and apparently unaffected trees may cover large areas. There can be highly significant losses, usually requiring species conversion in the active management approach. Management tactics include to correctly identify the type of root disease(s) on the management unit, and manage species such as late seral pine and larch. Pre-commercial thinning will improve growth and vigor of the residual stand. Thinning and harvest operations should remove susceptible species (Douglas-fir or true firs) to the degree practical, retaining late seral species such as western larch and pine (Hagle, 2010). Tree planting can be used to facilitate a shift in species composition to those conifers which have greater tolerance to root diseases. There has been a link determined between parent material and susceptibility to root disease. Metasedimentary parent material is thought to increase the risk of root disease. Rock types of the Flathead Valleys area is dominated by metasedimentary parent material of the Belt Supergroup (Ravallii group) with some Tertiary sediments, eolian deposits and glacial lake deposits. Metasedimentary rocks may be more at risk than other areas to root disease (Kimsey et al., 2012). If a stand sustains very high levels of roots disease mortality, then a forest stand could cross a threshold and become a shrubland, once all trees are gone (Kimsey et al., 2012). Persistent shrub fields may take a century or longer for the infected root mass to decline, which will return the root disease potential to background levels, and allow the reintroduction of resistant conifer species.

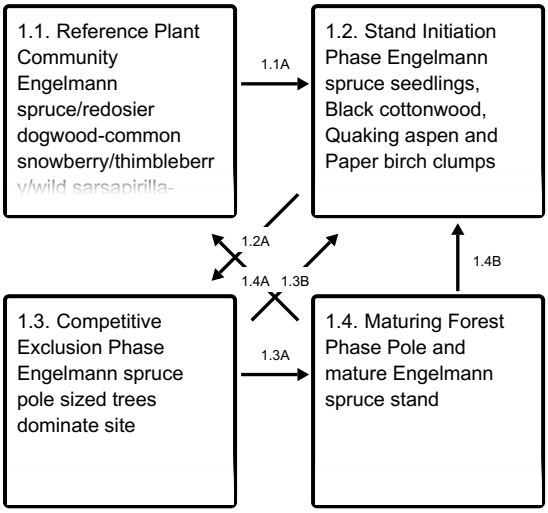
►MANAGEMENT◄
There are various management strategies that can be employed for this ecological site, depending upon the ownership of the particular land and which value is prioritized. The management of the forest determines the composition of the stand and the amount of fuel loading. A stand will be managed differently and look differently if it is managed for timber or ecological services like water quality and quantity, old growth, or endangered species. If a stand is managed for timber, it may be missing certain attributes necessary for lynx habitat. If a stand is managed for lynx habitat, it may have increased fuels and therefore an increased risk of wildfires.
This ecological site relates to the USFS Habitat Type PICEA/CLUN2 (Pfister, 1987). The USFS Habitat Type guide states that the basal area on the WEST side of the Continental Divide is 241+/- 38 ft2 per acre and site index at 50 years for PSME= 60, PICO=60, PICEA=69 (Pfister, 1987). It also relates to the USFS Habitat Type PICEA/VACA which has site index for PICO=65, LAOC=74, PICEA=64 (Pfister, 1987).
Timber production ranges from moderate to high and feasibility must take into account the wet soils and management of redosier dogwood and other resprouting shrubs post-disturbance (Pfister, 1987).
A guiding USFS document is the Green et al. document (2005) which defines “Old Growth” forest for the northern Rocky Mountains. This document provides an ecologically-based classification of old growth based on forest stand attributes including numbers of large trees, snags, downed logs, structural canopy layers, canopy cover, age, and basal area. This document finds that the bulk of the pre-settlement upland old growth in the northern Rockies was in the lower elevation, ground fire-maintained ponderosa pine/western larch/Douglas-fir types (Losensky, 1992).

State and transition model

Ecosystem states



State 1 submodel, plant communities



1.1A - Major disturbance such as a major flooding of the site or a stand replacing fire or a major insect infestation that transitions the reference community (1.1) to the stand initiation community (1.2).

1.2A - Time without disturbance that allows the stand initiation phase to transition to the competitive exclusion community (1.3)

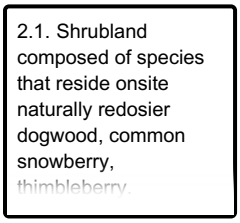
1.3B - Major disturbance such as a major flooding of the site or a stand replacing fire or a major insect infestation that transitions the competitive exclusion community (1.3) to the stand initiation community (1.2).

1.3A - Time without disturbance that allows the competitive exclusion community (1.3) to transition to the maturing forest community (1.4)

1.4A - Time without disturbance that allows the maturing forest community (1.4) to transition to the reference community (1.1)

1.4B - Major disturbance such as a major flooding of the site or a stand replacing fire or a major insect infestation that transitions the reference community (1.4) to the stand initiation community (1.2).

State 2 submodel, plant communities



State 1
Reference State

Very wet sites with water table from 60 to 100 cm found along streams and associated with wetlands. Due to this very wet condition, the fire free interval can be very long. Stand Replacing Fire (SRF) occurs in patches 200 to 2000 hectare patch

Community 1.1
Reference Plant Community Engelmann spruce/redosier dogwood-common snowberry/thimbleberry/wild sarsapirilla-fragrant bedstraw-field horsetail

COMMUNITY PHASE 1.1 Average tree canopy cover 45% Structure: Multistory with Small gap dynamics; underburns rare Prone to Armillaria. Defoliation by W. Spruce Budworm on fir occurs. Structure: Multistory with small gap dynamics FOREST OVERSTORY OF REFERENCE PHASE WOOD5 DATA. PIEN IS CO-DOMINANT WITH SERAL SPECIES Reference Community Phase = 3 SITES Site Index PIEN RANGE=53-71, AVERAGE=64

(3 sites) PIEN AGE=78-147 years, Height=75-120 feet LAOC AGE=137-157 years, Height=119-127 feet, Site Index=60 (1 site) PICO AGE=98-105 years, Height=83-97 feet, Site Index=91 (1 site) Basal Area Average = 149 Average Relative canopy cover (the total canopy cover is 100%): PIEN =45% (40-50%), LAOC=15% (10-35%), PICO=32% (25-40%), Trace of PSME, PIPO, SALIX, POTR5. The understory has a mix of moist and drier species. GLACIER NATIONAL PARK DATASET (REFERENCE PHASE FOR COMPARISON) FOREST OVERSTORY Forest absolute canopy cover ranges from 20 to 70 percent, with a median of 36 percent and is dominated by Engelmann spruce with western larch, lodgepole and Douglas fir in minor amounts. The understory has high cover in the following species: thimbleberry, viola species, American redraspberry, wild sarsapirilla, horsetail species and fragrant bedstraw.

Dominant plant species

- Engelmann spruce (*Picea engelmannii*), tree
- redosier dogwood (*Cornus sericea ssp. sericea*), shrub
- common snowberry (*Symphoricarpos albus*), shrub
- thimbleberry (*Rubus parviflorus*), shrub
- wild sarsaparilla (*Aralia nudicaulis*), other herbaceous
- fragrant bedstraw (*Galium triflorum*), other herbaceous
- field horsetail (*Equisetum arvense*), other herbaceous

Community 1.2
Stand Initiation Phase Engelmann spruce seedlings, Black cottonwood, Quaking aspen and Paper birch clumps

COMMUNITY PHASE 1.2 Herb-Shrub Phase Seedling/Sapling Phase Avg canopy cover <10% Engelmann spruce seedlings/saplings clumps Black Cottonwood, Quaking aspen, Paper birch If serotinous Lodgepole pine then dominant Structure: patchy clumps, single Story. Underburns rare. Structure: Thick carpet of regeneration, single story canopy. This is a reconstructed plant community. The overall community concepts remain the same. Community Phase 1.2 is a forest in the stand initiation phase, possibly with scattered remnant mature trees; the composition of the seedlings depends on the natural seed sources available. Canopy cover is generally less than 10 percent. Seedlings can be entirely Engelmann spruce (wettest site conditions) or as a mixture of conifers (moist site conditions) including Engelmann spruce, Douglas fir, lodgepole pine, western larch, and resprouting aspen. If serotinous lodgepole seedbank is present, then this species will dominate the area. The understory is a mixture of shrubs and herbaceous species including: Black and narrowleaf cottonwood, quaking aspen and paper birch occurred in clumps. The most frequently occurring understory species included: common snowberry, thimbleberry (*Rubus parviflorus*), redosier dogwood, fragrant bedstraw, horsetail species, starry false lily of the valley (Maianthemum stellata), and sweetcicely (*Osmorhiza berteroi*).

Community 1.3
Competitive Exclusion Phase Engelmann spruce pole sized trees dominate site

Competitive Exclusion Phase 1.3 Dense polesized trees. Engelmann spruce pole size trees (Lodgepole pine, western larch, Douglas fir), clumps of Quaking aspen, Paper birch, Black Cottonwood. Structure: dense single story With diminished understory. Tolerant to Armillaria. Defoliation by W. Spruce budworm on fir occurs. Underburns rare. Structure: Dense, single story canopy. Community Phase 1.3 is a forest in the competitive exclusion phase, possibly with scattered fire remnant mature trees; there is increasing competition among individual trees for the available sunlight, water and nutrients. The canopy cover averages 60 percent. The overstory is either dominated by Engelmann spruce or is a mixture with Douglas fir, lodgepole pine and western larch. Canopy closure is very high within the areas successfully reforested, leading eventually to a diminished understory community but also providing protection for those species which do well in the shade. Engelmann spruce is susceptible to fire due to its thin bark, resinous needles and in this stand configuration more prone to severe fire with severe drought conditions. This community is tolerant of Armillaria root rot due to the forest stand composition (McDonald, 2000). The Wood 5 sample sites used to describe this community phase are related to the following USFS Habitat Types: Englemann spruce/brides bonnet (3 sites), Englemann spruce/common horsetail (1 site), Englemann spruce/twinflower (3 sites), Englemann spruce/false Soloman’s seal (3 sites) and Englemann spruce/dwarf bilberry (1 site) and one site is undetermined. SERAL FOREST COMMUNITY PHASE 1.3 = 12 SITES WOOD5 DATA OVERSTORY HAS 0-10% PIEN, DOMINATED BY COMBINATION OF SERAL TREE SPECIES: LAOC, PIPO, PSME, PICO RANGES OF TREE AGE, HEIGHT AND SITE INDEX BY SPECIES: LAOC AGE=55-100 years (141-170 yrs. - 1 site), Height=70-

100 feet, Site Index=38-60 PIPO AGE=75-106 years, Height=84-107 feet, Site Index=94-98(average=96) PSME AGE=44-80 (92-251 yrs. - 1 site), Height=50-80 feet, Site Index=44-56 (average=52) PICO AGE=57-132 years, Height=62-94, Site Index=71-110 Relative canopy cover (equals 100%)= PSME 32% PIPO 31% PICO 38% LAOC 36% PIEN 4% POTR5 TRACE ABLA TRACE Understory common species include: kinnikinick, pinegrass, prince's plume, twinflower, wood's rose and common snowberry.

Community 1.4
Maturing Forest Phase Pole and mature Engelmann spruce stand

MATURING FOREST 1.4 Pole and mature Engelmann spruce stand, lesser: Lodgepole pine, western larch, Douglas fir, Quaking aspen, Black Cottonwood, Paper birch. Understory: redosier dogwood, bunchberry dogwood, twinflower, fragrant bedstraw, common ladyfern, field horsetail, Pacific oakfern Structure: Some vertical Differentiate in stand. Underburns rare. Prone to Armillaria/W. spruce budworm. Structure: Single story canopy with few small openings This is a reconstructed plant community. The overall community concepts remain the same. Community Phase 1.4 is a maturing forest which is starting to differentiate vertically. Canopy cover ranges 30 to 60 percent. Individual trees are dying (whether due to insects, disease, competition or windthrow) allowing some sunlight to reach the forest floor. This allows for an increase in the understory as well as some pockets of overstory tree species regeneration. The understory is a mixture of shrubs, deciduous trees, and herbaceous species including: Black and narrowleaf cottonwood, quaking aspen and paper birch occurred in clumps. The most frequently occurring understory species included: common snowberry, thimbleberry (*Rubus parviflorus*), redosier dogwood, fragrant bedstraw, horsetail species, starry false lily of the valley (Maianthemum stellata), and sweetcicely (*Osmorhiza berteroi*). This community is prone to Armillaria root rot and defoliation by Western Spruce budworm on fir (McDonald, 2000).

Pathway 1.1A
Community 1.1 to 1.2

1.1A – Major disturbance such as a major flooding of the site or a stand replacing fire or a major insect infestation that transitions the reference community (1.1) to the stand initiation community (1.2). The flooding and ponding frequency can be frequent and is of long duration when either occurs. The fire return interval on this site is variable depending on the wetness of the site spanning 100 to 400 years between major fires. Fires occur during dry periods of extended drought.

Pathway 1.2A
Community 1.2 to 1.3

1.2A – Time without disturbance that allows the stand initiation phase to transition to the competitive exclusion community (1.3)

Pathway 1.3B
Community 1.3 to 1.2

1.3B – Major disturbance such as a major flooding of the site or a stand replacing fire or a major insect infestation that transitions the competitive exclusion community (1.3) to the stand initiation community (1.2). The flooding and ponding frequency can be frequent and is of long duration when either occurs. The fire return interval on this site is variable depending on the wetness of the site spanning 100 to 400 years between major fires. Fires occur during dry periods of extended drought.

Pathway 1.3A
Community 1.3 to 1.4

1.3A – Time without disturbance that allows the competitive exclusion community (1.3) to transition to the maturing forest community (1.4)

Pathway 1.4A
Community 1.4 to 1.1

1.4A – Time without disturbance that allows the maturing forest community (1.4) to transition to the reference community (1.1)

Pathway 1.4B
Community 1.4 to 1.2

1.4B – Major disturbance such as a major flooding of the site or a stand replacing fire or a major insect infestation that transitions the reference community (1.4) to the stand initiation community (1.2). The flooding and ponding frequency can be frequent and is of long duration when either occurs. The fire return interval on this site is variable depending on the wetness of the site spanning 100 to 400 years between major fires. Fires occur during dry periods of extended drought.

State 2
Root Rot State

STATE 2 ARMILLARIA ROOT ROT STATE Community 2.1 Shrubland composed of species that reside onsite naturally (Redosier dogwood, common snowberry, thimbleberry).

Dominant plant species

- common snowberry (*Symphoricarpos albus*), shrub
- Saskatoon serviceberry (*Amelanchier alnifolia*), shrub
- redosier dogwood (*Cornus sericea ssp. sericea*), shrub
- thimbleberry (*Rubus parviflorus*), shrub
- snowbrush ceanothus (*Ceanothus velutinus*), shrub
- redstem ceanothus (*Ceanothus sanguineus*), shrub

Community 2.1
Shrubland composed of species that reside onsite naturally redosier dogwood, common snowberry, thimbleberry.

STATE 2 ARMILLARIA ROOT ROT STATE Community 2.1 Shrubland composed of species that reside onsite naturally redosier dogwood, common snowberry, thimbleberry.

Transition T1A
State 1 to 2

T1A – Armillaria Root Rot State in which the forest has been converted to a shrubland. If a stand sustains very high levels of roots disease mortality, then a forest stand could cross a threshold and become a shrubland, once all trees are gone (Kimsey et al., 2012). Persistent shrub fields may take a century or longer for the infected root mass to decline, which will return the root disease potential to background levels, and allow the reintroduction of resistant conifer species. Extensive management is needed to convert the resultant shrubland back to a forest community. The shrubs that would create the converted shrubland are from those already on the ecological site such as common snowberry, serviceberry, and white spirea. A mosaic of brushy openings, patches of dying trees, and apparently unaffected trees may cover large areas.

Restoration pathway R2A
State 2 to 1

R2A – Forest management practices to convert shrubland back to forest including tree planting of less Armillaria Root Rot sensitive tree species There can be highly significant losses, usually requiring species conversion in the active management approach. Management tactics include to correctly identify the type of root disease(s) on the management unit, and manage species such as late seral pine and larch. Pre-commercial thinning will improve growth and vigor of the residual stand. Thinning and harvest operations should remove susceptible species (Douglas-fir or true firs) to the degree practical, retaining late seral species such as western larch and pine (Hagle, 2010). Tree planting can be used to facilitate a shift in species composition to those conifers which have greater tolerance to root diseases. There has been a link determined between parent material and susceptibility to root

disease.

Additional community tables

Inventory data references

►VEGETATION COMMUNITY PHASE AND PATHWAY DESCRIPTIONS◄
The dataset used to describe these communities comes from 15 historic Wood5 dataset sites (of which 3 are in the reference phase and 12 in the seral stage 1.4) in which soils and vegetation, including forestry measurements, were taken throughout 1971-1985 in Missoula, Lewis and Clark and Powell counties. There are also 5 sites in Glacier N.P., which resides in MLRA 43 LRU A, that also include soils and vegetation data which are added here for comparison.

►WOOD 5 DATA DESCRIPTION◄
15 sites total; three sites in reference phase community
In the reference phase, the overstory is a mixture of Engelmann spruce, western larch and lodgepole pine. Engelmann spruce has 40 to 50 percent canopy cover and are over 80 years of age, up to 147 years old and 75 to 120 feet tall with site indexes of 53, 69 and 71. In addition to Engelmann spruce, one site had 35 percent western larch that was 137 to 157 years old, 119 to 127 feet tall with a site index of 60. The other site also had lodgepole pine with 30 percent canopy cover, with ages 98 to 105 years old and 83 to 97 feet tall and a site index of 91. The understory is a mixture of medium to low growing shrubs, forbs and grasses. The dataset is only two sites for the understory, but species occurring in both sites are serviceberry, kinnickinick, pinegrass, fireweed, strawberry, twinflower and snowberry. These sites relate to the USFS Habitat Type designations of Engelmann spruce/ twinflower, Engelmann spruce/starry Soloman's seal, Engelmann spruce/common horsetail, Engelmann spruce/queencup beadlily, and Engelmann spruce/dwarf huckleberry. These sites related to the USFS Habitat Types (Pfister, 1977) of Englemann spruce/ common horsetail, Englemann spruce/ starry Soloman's seal and Englemann spruce/twinflower.

►GNP DATA DESCRIPTION◄
This dataset may give insight into the vegetation community found in this MLRA 44 LRU A, besides the reference citations by Pfister (1977), Fischer (1987), Hansen (1999) and Gautreaux (1999) summarized in the narrative. These sites had a mixed tree species overstory with Engelmann spruce dominant or co-dominate with western larch, Douglas fir and lodgepole pine. Engelmann spruce was always present and usually in the dominant and subdominant tree canopy layers, whereas western larch and Douglas fir occurred on three sites and lodgepole pine on two sites. Black and narrowleaf cottonwood, quaking aspen and paper birch occurred in clumps. The most frequently occurring understory species included: common snowberry, thimbleberry (*Rubus parviflorus*), redosier dogwood, fragrant bedstraw, horsetail species, starry false lily of the valley (Maianthemum stellata), and sweetcicely (*Osmorhiza berteroi*). These site would fall into the moist, not wet, spectrum of this ecological site. These sites relate to the USFS Habitat Type designations of Engelmann spruce/ sweetscented bedstraw, Engelmann spruce/starry Soloman's seal, and Engelmann spruce/common horsetail. The presence of root rot pockets can shift the composition of this community away from its host species, although the threat is moderate not high since Engelmann spruce is not the primary host for this disease. This community is prone to moderate threat of Armillaria root rot (McDonald, 2000) and defoliation by Western Spruce budworm on fir (Hagle, 2003).

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Approval

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Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	10/25/2023

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:

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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:**
