USDA Natural Resources Conservation Service

Ecological site F044AH003MT
Montane Moderately Warm Dry Coniferous Seeley, Swan, Flathead and Tobacco Valleys

Last updated: 9/08/2023
Accessed: 04/25/2024

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 to 1835 m. 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.

Classification relationships

This ecological site relates to the USFS Habitat Type PSME/SYAL. This site relates to the USFS Habitat Type Group 2 and Fire Group 6. Both of these classification guides are specifically for the western Montana and northern Idaho region. It also relates to the NatureServe classification Pseudotsuga Menziesii /*Symphoricarpos albus* Forest CEGL000459.

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).

Ecological site concept

Ecological Site Concept
• Site is found in well drained mountain slopes and valleys that span the lower elevations, and at higher elevations on southern and western aspects
• Site occurs primarily on drumlins, ground moraines, and mountain slope landforms, on backslope, footslope and summit positions (on drumlins), on moderate to steep slopes ranging 10-30%, at elevations ranging 800 to 1,300 meters
• Vegetation is an overstory of Douglas fir and an understory of patchy common snowberry, serviceberry and white spirea, and a ground hugging layer of creeping barberry and kinnickinnik with abundant rhizomatous grass species of pinegrass and some perennial bunchgrasses blue wildrye, rough and Idaho fescues
• Site does not receive any additional water
• Soils are:
o moderately deep, deep or very deep
o surface with less than 15% stone and boulder cover
o well drained; derived from glacial till
o loamy textured; can have subsurface skeletal material typically gravels and/or cobbles
o not strongly or violently effervescent within surface mineral 4”
o not saline or sodic
o not coarse-granular clay

Associated sites

R044AH036MT	**Droughty Seeley, Swan, Flathead and Tobacco Valleys** This associated site is found lower in elevation in warmer and drier locations.
R044AH032MT	**Loamy Seeley, Swan, Flathead and Tobacco Valleys** This associated site is found lower in elevation in warmer, moister sites with loamy soils.

Similar sites

F044AP902MT	**Shallow Warm Woodland Group** This similar ecological site resides in drier site condition with an overstory dominated by Douglas fir but is wider in scope.

Table 1. Dominant plant species

Tree	(1) *Pseudotsuga menziesii var. glauca* (2) *Pinus ponderosa*
Shrub	(1) *Symphoricarpos albus* (2) *Arctostaphylos uva-ursi*
Herbaceous	(1) *Mahonia repens* (2) *Calamagrostis rubescens*

Physiographic features

This site is found in well drained mountain slopes and valleys that span the lower elevations, and at higher elevations on southern and western aspects. At lower elevations it is bordered by ponderosa pine sites or grasslands, and at higher elevations by subalpine fir sites. It occurs primarily on drumlins, ground moraines, and mountain slope landforms, on backslope, footslope and summit positions, on moderate to steep slopes ranging 10

to 30 percent and elevations ranging 2624 to 4265 feet.

Figure 1. The moderately warm dry coniferous ecological site with higher cover of common snowberry that classifies in the USFS Habitat Type as Douglas fir/common snowberry-pinegrass.

Figure 2. A forest stand of this ecological site that has been mechanically thinned and sustained prescribed fire to recreate historic stand structure.

Table 2. Representative physiographic features

Landforms	(1) Valley > Drumlin (2) Valley > Ground moraine (3) Valley > Mountain slope
Elevation	2,624–4,265 ft
Slope	10–30%
Water table depth	60 in
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, many native bunchgrasses

and forbs are dormant in summer but photosynthetically active from autumn through spring. For example, throughout all the valleys of western Montana, the months with higher precipitation average were November to January and May to June.

Mean Average Precipitation Range 14-19 inches
Mean Average Annual Temperature Range 33-58 degrees
Frost free days Range: 60-110

Table 3. Representative climatic features

Frost-free period (characteristic range)	61-90 days
Freeze-free period (characteristic range)	111-132 days
Precipitation total (characteristic range)	16-21 in
Frost-free period (actual range)	23-94 days
Freeze-free period (actual range)	93-133 days
Precipitation total (actual range)	15-22 in
Frost-free period (average)	71 days
Freeze-free period (average)	119 days
Precipitation total (average)	18 in

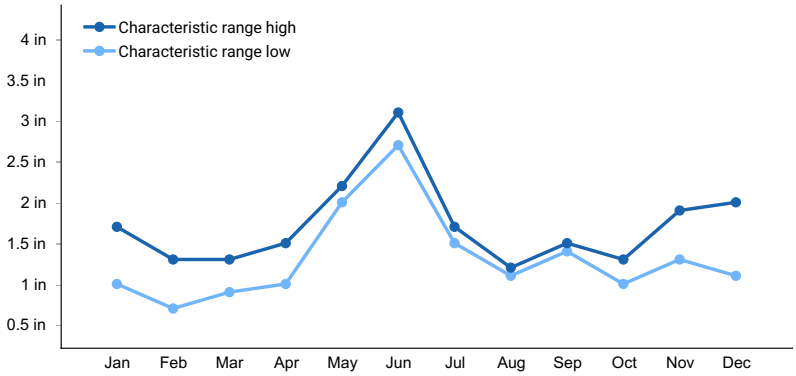


Figure 3. Monthly precipitation range

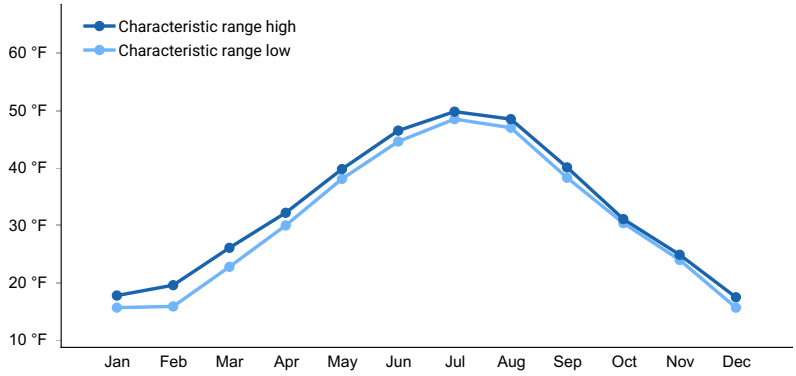


Figure 4. Monthly minimum temperature range

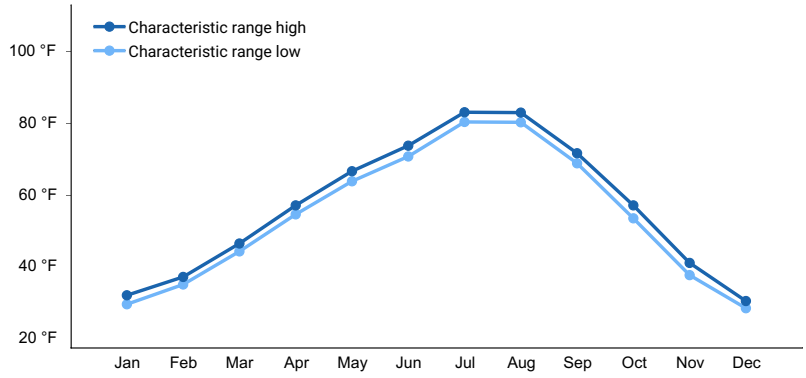


Figure 5. Monthly maximum temperature range

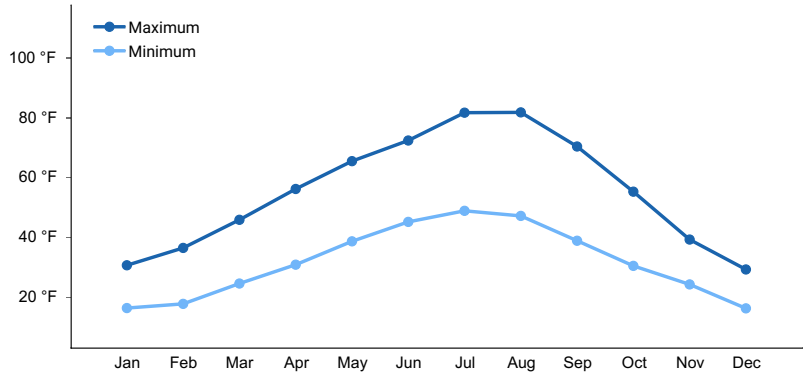


Figure 6. Monthly average minimum and maximum temperature

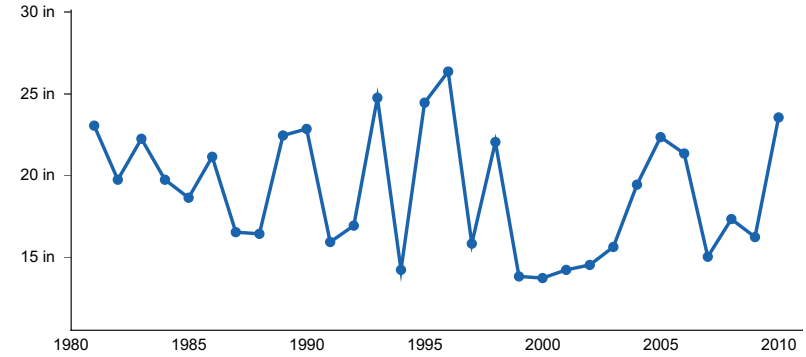


Figure 7. Annual precipitation pattern

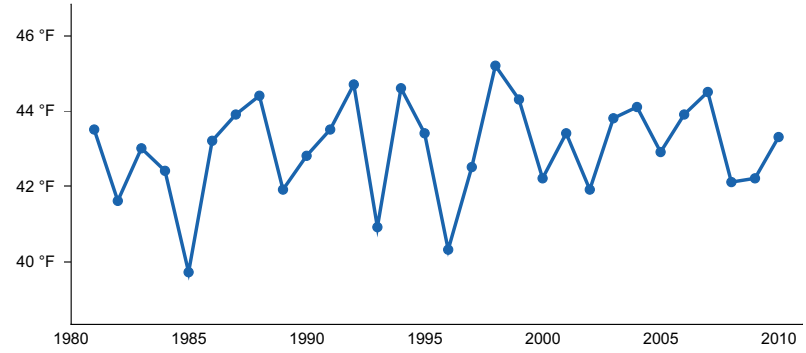


Figure 8. Annual average temperature pattern

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 group is not influenced by wetland or riparian water features.

Soil features

Soils associated with this ecological site are typically deep or very deep, well drained and derived from glacial till. Soil textures are loamy, but commonly contain some amount of rock fragments and can have skeletal subsurface horizons that have a high amount of rock fragments (greater than 35 percent by volume) and relatively lower water-holding capacity. They are typically classified in Alfisols soil order. The deep and very deep depth class means that there is no bedrock encountered within 100 cm. As is common with forested soils, there is often a thin surface layer of slightly decomposed organic material that is less than 5 cm thick. Diagnostic features for diagnostic features for Alfisols may include a zone of albic materials (a zone of leaching), and an argillic diagnostic horizon (a zone of clay accumulation) in the subsoil (Soil Survey Staff, 2015). Some pedons may contain a zone of accumulated calcium carbonates below the argillic horizon. 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

Figure 9. Typical soils associated with the moderately warm dry coniferous ecological site.

Table 4. Representative soil features

Parent material	(1) Till–metasedimentary rock
Surface texture	(1) Loam (2) Gravelly loam
Family particle size	(1) Loamy-skeletal (2) Fine-loamy (3) Fine-silty
Drainage class	Well drained
Permeability class	Moderate to moderately slow
Soil depth	20–60 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (2-6.6in)	Not specified
Soil reaction (1:1 water) (4.5-7.2in)	Not specified

Ecological dynamics

This ecological site relates to the USFS Habitat Type Douglas fir/common snowberry (Pfister, 1977), which is in Fire Group 6 and in the updated USFS Region 1 Montana Potential Vegetation Type Group PSME2 (2 moderately warm and dry) and in the old Habitat Type Group 2. In McDonald's grouping, it was in Douglas fir-Dry Shrub without historic western white pine and low potential for root rot. It was in the Vegetation Response Unit 2.

The 44A Montane Warm Dry Coniferous ecological site is found in open growing stands of Douglas-fir (*Pseudotsuga menziesii*) at lower elevations, but also is found at higher elevations on southerly and westerly aspects. The overstory is dominated by Douglas-fir, with minor amounts of western larch (*Larix occidentalis*), or at lower elevations, it is of ponderosa pine (*Pinus ponderosa*). Douglas-fir and ponderosa pine are well adapted to fire, having thick bark at maturity which protects the cambium layer from overheating. The understory has patchy white spirea, serviceberry, and common snowberry with abundant rhizomatous grass species of pinegrass and lower cover of perennial native bunchgrasses such as rough fescue, Idaho fescue and blue wildrye. The overstory can be multi-storied Douglas-fir or an open, park-like single story. Douglas-fir is moderately shade-tolerant compared to associates ponderosa pine, western larch, and lodgepole pine (*Pinus contorta*), which are all intolerant of shade. Frequent, non-lethal wildfires had historically maintained open, park-like stands. All four species are adapted to the historic fire regime as they regenerate well following disturbance, especially when mineral soils were exposed, which is a key factor in regeneration of ponderosa pine and western larch (and, to a lesser degree, lodgepole pine). Ponderosa pine and western larch are long-living (300 to 400 years), while lodgepole pine survives only 150 to 200 years (Fischer, 1987). In the absence of naturally occurring wildfire, Douglas-fir is the only species that continues to regenerate in any abundance and thus gradually becomes dominant in those undisturbed stands. In this ecological site, Douglas-fir is present in all seral stages with lodgepole pine and western larch, and ponderosa pine is present in the lower-elevation sites. The understory has an abundance of rhizomatous grasses, pinegrass and the medium-sized shrubs common snowberry (*Symphoricarpos albus*), Saskatoon serviceberry (*Amelanchier alnifolia*), creeping barberry (*Mahonia repens*), white spirea (*Spiraea betulifolia*), kinnikinnick (*Arctostaphylos uva-ursi*) and infrequently thinleafed huckleberry (*Vaccinium membranaceum*). Other grass species having lower cover include rough fescue, Idaho fescue, mountain brome and Geyer's sedge. There are diverse forbs present at the site including common yarrow, American vetch, white hawkweed, northern bedstraw, sweetcicely, and heartleaf arnica and onion species. These shrubs are adapted to this fire regime of a frequent, low-severity type by having the ability to resprout from root crowns or rhizomes after the low-intensity fire removes the aboveground portion of the plants. Specifically, Saskatoon serviceberry resprouts from root crowns. Common snowberry, white spirea, and thinleaf huckleberry (*Vaccinium membranaceum*) sprout from rhizomes. McLean (1970) describes the response to fire for common snowberry, white spirea, as "resistant," with taproots or a fibrous root system with rhizomes 5 to13 cm deep. Pinegrass (*Calamagrostis rubescens*), creeping barberry, and heartleaf arnica (*Arnica cordifolia*) are considered "intermediate," with shallower rhizomes. The "susceptible" category included the western rattlesnake plantain (*Goodyera oblongifolia*) and the Pyrola species, although these species are rarely found at this site. Twinflower (Linnea borealis) found rarely in trace cover has rhizomes in duff, kinnikinnick has fibrous roots and stolons, and white hawkweed (*Hieracium albiflorum*) resprout with fibrous roots only. Snowbush ceanothus germinates from fire-stimulated seed, and fireweed produces many windborne seeds that will recolonize sites from unburned areas. If present at this site, these two species can dominate the re-initiation phase. Specifically, at the reference phase the understory has an abundance of rhizomatous grasses, pinegrass and some Geyer's sedge and the medium sized shrub, common snowberry. This ecological site corresponds to the USFS Habitat Types of Douglas Fir/common snowberry phase common snowberry and phase pinegrass. The difference between the habitat types is primarily the proportional amounts of common snowberry and pinegrass. These have management implications in that common snowberry resprouts after disturbance and can dominate the understory for a period of time. The pinegrass phase has less common snowberry and post disturbance management would not have to include shrub removal. The common snowberry phase has an understory that has at least 5 percent canopy cover of common snowberry, regardless of grass or forb abundance. There is a sub-phase of pinegrass in which pinegrass cover is at least 5 percent. The pinegrass phase has an understory of less than 5 percent common snowberry and at least 5 percent cover of pinegrass. These two phases can be very similar and are managed similarly, unless common snowberry has very high cover which would increase post-disturbance. Therefore, at a very shrub dominated understory forest, post-disturbance restoration would need to include shrub management.

Fire Regime Description

This ecological site occurs on moderately warm and dry sites. The open, park-like stands of this ecological site were historically maintained by fires of low to moderate severity that had a return interval of approximately 36 (28 to 52)

years and stand replacing fire frequency of 141 years (Barrett, 1991). This relates to Fire Group Six: moist Douglas fir habitat types with mean fire intervals of 16 to 42 years (Fischer, 1987). Douglas fir habitat type forests on the Bitterroot, Lolo and Flathead National Forests had historic mean fire intervals ranging 25 to 49 years (USFS, FEIS, PSEMENG page). This fire regime has been coined mixed severity, ranging from low to moderate severity surface fires at relatively frequent intervals (7 to 20 years) to severe crown fires at long intervals (50 to 400 years). Frequent fires of moderate intensity favor lodgepole pine and western larch survival and regeneration over Douglas-fir. In the absence of short-interval understory burns, severe stand-replacement fires can occur on this ecological site if a closed canopy configuration develops along with the development of dense understories, resulting in a build-up of hazardous fuels at all levels, especially in periods of severe drought. Stand-replacement fires can favor lodgepole pine, especially if there is a serotinous cone seedbank. The average fuel loading is 12 tons per acre, but can be much heavier. Fire as an agent for seedbed preparation is less important for this ecological site, since Douglas-fir can grow in multiple types of seedbeds.

Forest succession after disturbance follows the stand initiation phase of herbs, shrubs, and seedlings to the competitive exclusion phase of dense pole-sized seral tree species, to the maturing forest stage, and with no further disturbance, the Reference phase (Fischer, 1987). Douglas-fir can be present in all seral stages along with lodgepole pine, western larch, and ponderosa pine, especially at lower elevations. Quaking aspen (*Populus tremuloides*) also has been found in seral succession on certain sites. After a stand-replacement fire, grass, forb, and shrub species dominate the site with seedlings of tree species, usually Douglas-fir, western larch, and lodgepole pine depending upon patch size and adjacent and soil-banked conifer seed sources. If another fire occurs, then this phase would be maintained for longer. Without disturbance, the seedlings grow into saplings. Fire in the sapling stage would thin stands if ponderosa pine or western larch are dominant or eliminate Douglas-fir and lodgepole pine where these are dominant. Pole-sized Douglas-fir, western larch, and ponderosa pine would survive low to moderate fires, whereas severe fires would kill all trees and return the site to the stand initiation phase (Fischer, 1987). In the mature phase, low to moderate severity fires would thin the overstory and understory, while severe fire would return the site to the stand initiation phase. The Reference phase is rare, because of the presence of seral species whose longevity is greater than the usual fire return interval, except where Douglas-fir is also the dominant seral species. Frequent low to moderate severity fires create the open, park-like stands of the reference phase, but severe fire would return the site to the stand initiation phase(Fischer, 1987).

Pest/Disease Description
Douglas-fir is subjected to a variety of diseases and insect pests including Armillaria and Annosus root diseases, Schweinitzii root and butt rot, laminated root rot, pouch and red belt fungus, pini rot, metallic wood borers, roundheaded borers, Douglas-fir beetle, blue-stain of sapwood, spruce canker, fir canker, Douglas-fir dwarf mistletoe, western spruce budworm, Douglas-fir needle midge, and Swiss and Rhabdocline needlecast (Hagle, 2003). Ponderosa pine is a seral species of this ecological site. Ponderosa pine is highly susceptible to western pine beetle and pine engraver beetles and mountain pine beetle (during extreme epidemic conditions or in conjunction with drought) (Hagle, 2003). Lodgepole pine is also a seral tree species found in this ecological site and is a primary host for bark beetles. In seral stands with high composition of ponderosa pine and/or western larch, dwarf mistletoe, western gall rust and atropellis canker can occur (Hagle, 2003).

Aerial photography is a good tool to use to discern the levels of insect and disease, the damage patterns, and whether these are at endemic or epidemic levels. These maps capture only moments in time, and infestations grow and move from location to location following their preferred habitat, so repeated photography can be necessary. For the northern region, the major impact is from defoliation by western spruce budworm, occurs mostly on subalpine fir-Engelmann spruce forests, and to a lesser degree on Douglas-fir-dominated stands. As the name implies, the Douglas-fir beetle attacks Douglas-fir, with the greatest mortality occurring in stressed stands or on stressed individuals. Larch casebearer, a defoliator of western larch, and generalized needlecast of western larch was also found to a much lesser degree. Scattered smaller polygons were also found throughout the region, including mortality from mountain pine beetle on lodgepole pine.

ARMILLARIA ROOT ROT
Another disease affecting this ecological site is root rot. Armillaria root disease is the most common root disease fungus in this region, and especially prevalent west of the Continental Divide. Douglas fir is a primary host for Armillaria root rot disease. 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 (Hagle, 2010). 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 PSME/SYAL (Pfister, 1977). The USFS Habitat Type guide states that the basal area on the WEST side of the Continental Divide for is 172+/-23 ft2 per acre and site index at 50 years for Ponderosa pine=54, Douglas fir=52. The basal area taken at eight sites in the Tobacco Valley averaged 140 square feet per acre of basal area (range of 100 to 186). All of the sites had been somewhat recently thinned. Of note, the USFS Habitat Type guide states that the basal area on the east side of the Continental Divide is 196+/-26 ft2 per acre, and the site index is at 50 years for PIPO=43, PSME=41 (Pfister, 1977).

Timber production ranges from low to high and site preparation must take into account the abundance of rhizomatous grasses and management of common snowberry and other resprouting shrubs post-disturbance (Pfister, 1977).

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).

In Personal communication with silvicultural forester on the Flathead N.F.:
PSME/SYAL HABITAT TYPE
This habitat type is a minority type on the Flathead N.F. and is found mainly in the WUI zone (wildland urban interface). It is managed so that disturbance such as fire do not cross ownership boundaries and impact private lands nearby. In order to achieve this, it is managed for open forest structure and to promote ponderosa pine (*Pinus ponderosa*) when possible. Fire suppression will increase Douglas fir density on this habitat type and Douglas fir is particularly prone to root disease. Root disease is very prevalent on the Flathead N.F. with pockets of effected stands throughout the area. This is a forest health issue. As well, lower density of Douglas fir allows for a fire regime conducive to maintaining ponderosa pine (frequent and lower intensity). If there were a severe stand replacement fire in this habitat type that destroyed mature ponderosa pine, it would be difficult to recover ponderosa pine since its seed dispersal radius is small due to heavy seed. In stands with good ponderosa pine presence, forest health concerns may require thinning of Douglas fir to reduce ladder fuels and increase resiliency of ponderosa pine, use

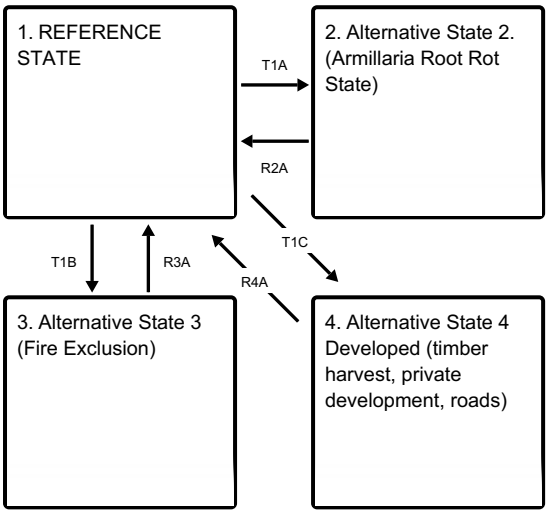
of shelter wood harvests for seedling establishment and no uneven age management strategies (due to the shade tolerant nature of Douglas fir). Prescribed burning is also important to create and maintain resilient mature ponderosa pine (*Pinus ponderosa*) stands, but could be issue with WUI zone. Western larch is managed for the mesic phases of this habitat type. The forest does treat in old growth stands on this habitat type to maintain single story stand conditions that were traditionally maintained by frequent low intensity fire.

Associated Sites
43A Droughty
43A Loamy

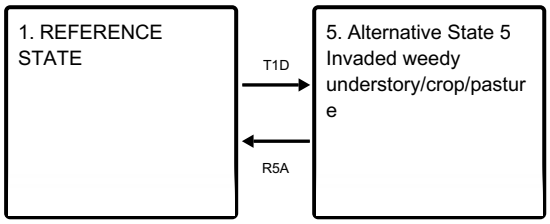
The 44A Droughty has a reference community of cool season perennial bunchgrass species, primarily bluebunch wheatgrass with minor components of perennial forbs and low-growing shrubs.
The 44A Loamy has a reference vegetation community of dominated by rough fescue (*Festuca campestris*), and Richardson's needlegrass (*Achnatherum richardsonii*), Idaho fescue (*Festuca idahoensis*), old man's whiskers (*Geum triflorum*) and sticky purple geranium (*Geranium viscosissimum*).

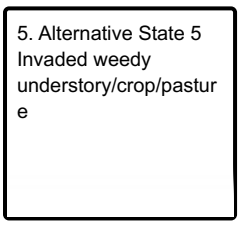
State and transition model

Ecosystem states



States 1 and 5 (additional transitions)





T1A - Armillaria Root Rot State in which the forest has been converted to a shrubland

T1B - Fire exclusion over long periods allowing stands to grow into homogenous, dense, multi-storied stands.

T1C - Housing and road development within Douglas fir forest that reduces forest patch size, increases edge and decreases interior acreage of intact forest and ecological services

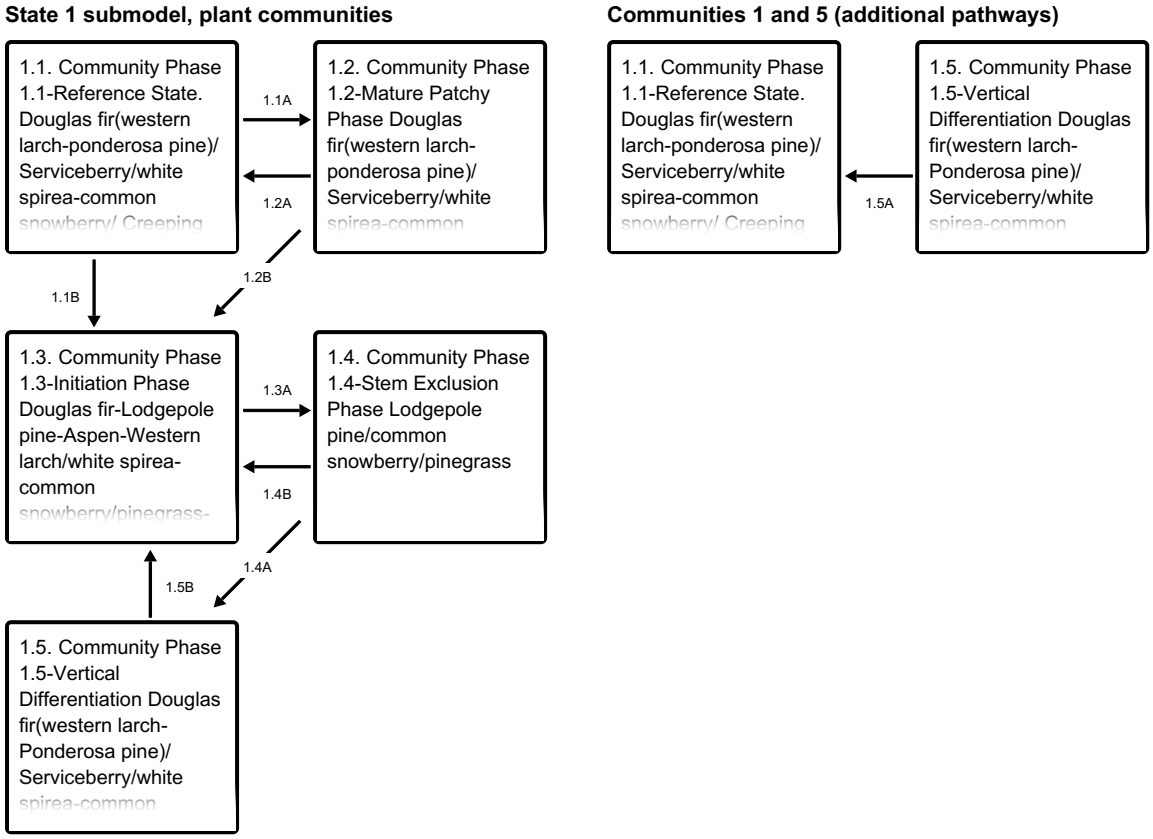
T1D - Forest stand with understory dominated by weedy invasive species or forest converted to cropland or pastureland. Introduced grasses and/or weedy species dominate the understory with overstory of Douglas fir or site is a cropland or pasture.

R2A - Forest management practices to convert shrubland back to forest including tree planting of less Armillaria Root Rot sensitive tree species

R3A - Forest stand structure, composition and historical fire regime restored by overstory thinning, ground and ladder fuels reduction, and prescribed fire.

R4A - Potentially not feasible; removal of housing and road development and restoration for Douglas fir overstory and perennial native bunchgrass understory.

R5A - Range management practices to convert introduced grass and/or weedy species dominated understory to native understory vegetation.



1.1A - Moderate sized patches of tree mortality due to fire, insect, disease, windthrow.

1.1B - Stand replacement disturbance. Severe Fire or insect mortality killing large pine/fir.

1.2A - Time and infilling of moderate sized patches with trees to a reference stand of multistory stand.

1.3A - Time with fire return interval extended to allow natural tree regeneration to grow into dense pole stands

1.4B - Stand replacing severe fire that returns the stem exclusion phase forest to the initiation phase

1.4A - Time without fire to allow vertical differentiation of stand through small gaps from death due to disease, insects, small fires, windthrow.

1.5A - Time with no major disturbance to transition to the reference phase community

1.5B - This is a severe stand replacing fire event that returns the community to the initiation phase

State 1
REFERENCE STATE

Community 1.1
Community Phase 1.1-Reference State. Douglas fir(western larch-ponderosa pine)/ Serviceberry/white spirea-common snowberry/ Creeping barberry-kinnickinik/pinegrass

Community Phase 1.1-Reference State. Douglas fir(western larch-ponderosa pine)/ Serviceberry/white spirea-common snowberry/ Creeping barberry-kinnickinik/pinegrass Structure: Multistory with small gap dynamics or open park-like single story, patchy shrubs, high grass/forb cover. Natural fire regime: Low (15-45 FRI) & Mixed (50-400 FRI). Tree Age: 150 years + Species Scientific Common Foliar Cover % Basal Cover % CARU *Calamagrostis rubescens* Buckley pinegrass 41.9 0.0 MARE11 *Mahonia repens* (Lindl.) G. Don creeping barberry 15.1 0.0 SYAL *Symphoricarpos albus* (L.) S.F. Blake common snowberry 12.0 0.0 ARUV *Arctostaphylos uva-ursi* (L.) Spreng. kinnikinnick 6.2 0.0 SPBE2 *Spiraea betulifolia* Pall. white spirea 3.9 0.0 FECA4 *Festuca campestris* Rydb. rough fescue 2.2 0.1 VIAM *Vicia americana* Muhl. ex Willd. American vetch 2.1 0.0 CACO11 *Carex concinnoides* Mack. northwestern sedge 2.0 0.0 ELGL *Elymus glaucus* Buckley blue wildrye 1.8 0.0 BRMA4 *Bromus marginatus* Nees ex Steud. mountain brome 1.6 0.0 CHUM *Chimaphila umbellata* (L.) W.P.C. Barton pipsissewa 1.6 0.0 JUCO6 *Juniperus communis* L. common juniper 1.0 0.0 SHCA *Shepherdia canadensis* (L.) Nutt. russet buffaloberry 1.0 0.0 NAVI4 *Nassella viridula* (Trin.) Barkworth green needlegrass 0.6 0.0 AMAL2 *Amelanchier alnifolia* (Nutt.) Nutt. ex M. Roem. Saskatoon serviceberry 0.4 0.0 SOSC2 *Sorbus scopulina* Greene Greene's mountain ash 0.4 0.0 HIAL2 *Hieracium albiflorum* Hook. white hawkweed 0.3 0.0 LUAR3 *Lupinus argenteus* Pursh silvery lupine 0.3 0.0 VIOR *Viola orbiculata* Geyer ex Holz. darkwoods violet 0.3 0.0 ANRA *Antennaria racemosa* Hook. raceme pussytoes 0.2 0.0 ARCO9 *Arnica cordifolia* Hook. heartleaf arnica 0.2 0.0 PSME *Pseudotsuga menziesii* (Mirb.) Franco Douglas-fir

0.2 0.0 ROAC *Rosa acicularis* Lindl. prickly rose 0.2 0.0 ROWO *Rosa woodsii* Lindl. Woods' rose 0.2 0.0 SAMA2 *Sanicula marilandica* L. Maryland sanicle 0.2 0.0 ACMI2 *Achillea millefolium* L. common yarrow 0.1 0.0 ACRI8 *Achnatherum richardsonii* (Link) Barkworth Richardson's needlegrass 0.1 0.0 ALLIU Allium L. onion 0.1 0.0 APAN2 *Apocynum androsaemifolium* L. spreading dogbane 0.1 0.0 ARNU *Arabis nuttallii* B.L. Rob. Nuttall's rockcress 0.1 0.0 CAGE2 *Carex geyeri* Boott Geyer's sedge 0.1 0.0 CIVU *Cirsium vulgare* (Savi) Ten. bull thistle 0.1 0.0 EUCO36 *Eurybia conspicua* (Lindl.) G.L. Nesom western showy aster 0.1 0.0 FRVI *Fragaria virginiana* Duchesne Virginia strawberry 0.1 0.0 GABO2 *Galium boreale* L. northern bedstraw 0.1 0.0 GATR3 *Galium triflorum* Michx. fragrant bedstraw 0.1 0.0 LIBO3 *Linnaea borealis* L. twinflower 0.1 0.0 LIRU4 *Lithospermum ruderale* Douglas ex Lehm. western stoneseed 0.1 0.0 OSBE *Osmorhiza berteroi* DC. sweetcicely 0.1 0.0 PERA *Pedicularis racemosa* Douglas ex Benth. sickletop lousewort 0.1 0.0 POPR *Poa pratensis* L. Kentucky bluegrass 0.1 0.0 STATE 1 - REFERENCE STATE Structure: Multistory with small gap dynamics COMMUNITY PHASE 1.1 - Douglas fir (western larch-ponderosa pine)/common snowberry- (white spirea)/creeping barberry-kinnikinick/pinegrass *Pseudotsuga menziesii*(*Larix occidentalis-Pinus ponderosa*)/*Symphoricarpos albus*-(Spirea betulafolia)/*Mahonia repens-Arctostaphylos uva-ursi*/*Calamagrostis rubescens* Structure: Multistory with small gap dynamics in forest of moderate to high canopy cover (average 35 percent (15 to 57 percent) canopy cover), taller, larger (average DBH 15 to 20 inches) trees dominated by Douglas fir. The following description is data supported from fieldwork during a soil survey update project in the Tobacco Valley Montana. These sites are inferred to be in the reference phase due to the dominance of Douglas fir and less cover of seral tree species. The bulk of the dataset is from ocular macroplots. The overstory is dominated by Douglas fir with other seral tree species with small gap dynamics in which small numbers of trees are dead and regeneration is infilling. Overstory absolute canopy cover averages 35 percent and can range from 15 to 57 percent. The average canopy cover of the most frequently occurring tree species present are Douglas fir (35 percent) and western larch (6 percent). The understory has the most frequently occurring species including common snowberry, creeping barberry, pinegrass, white spirea, yarrow, northern bedstraw, kinnickinick and white hawksbeard. Species with moderate to high canopy cover include common snowberry, creeping barberry, pinegrass. Mountain brome occurs in moderate frequency and high canopy cover when it occurs. Foliar cover dataset of four sites indicates that the understory foliar cover is high (75 percent), ground cover is predominantly duff (83 percent), and moss (16 percent) and very little bare soil (1 percent). Species with the highest foliar cover include pinegrass (42 percent), creeping barberry (15 percent) and common snowberry (12 percent). The vegetation structure is that of tall trees with average height of 66 to 100 feet (Western larch, Ponderosa pine and Douglas fir) and a multistoried understory. The top layer is 20 to 40 inches tall and includes common snowberry, serviceberry and blue wildrye. There are two lower layers that include diverse shrubs, forb and grass species. One layer is at an average height of 10 to 16 inches tall and can include white spirea (Spirea betulafolia), sweetcicely and white hawkweed and the lower layer up to 8 inches tall that can include pinegrass, common yarrow, American vetch, northern bedstraw and onion species. The lowest layer, at the ground surface, includes creeping barberry and kinnickinnik. This corresponds to the similar habitat type Douglas fir/common snowberry (Pfister, 1977) in which the following plants were dominant on a sample set of relatively mature stands (approximately 70 years old) with constancy and average canopy cover shown including Douglas fir (constancy 10, canopy cover 50 percent), ponderosa pine (constancy 6, canopy cover 27 percent), lodgepole pine (constancy 2, canopy cover 13 percent), white spirea (constancy 8, canopy cover 11 percent), common snowberry (constancy 10, canopy cover 34 percent) and pinegrass (constancy 10, canopy cover 26 percent), carex geyeri (constancy 8, canopy cover 12 percent), arnica cordifolia (constancy 7, canopy cover 8 percent) and thalictrum occidentalis (constancy 5, canopy cover 7 percent). Constancy values divided into classes including 1=5-15%, 2=15-25%, 3=25-35%, 4=35-45%, 5=45-55%, 6=55-65%, 7=65-75%, 8=75-85%, 9=85-95%, 10=95-100%. The presence of root rot pockets can shift the composition of this community away from its primary host species, Douglas fir, and create open patches of dying and dead trees (Hagle, 2003). Armillaria root rot is a native pathogen and if open patches are small and not coalescing, then forest stand structure is generally maintained. The understory of this community is low storied with the medium shrub white spirea and common snowberry in clumps and the herbaceous layer varied but low growing with pinegrass that can have high cover. This community is prone to Armillaria root rot and defoliation by Western Spruce budworm on fir.

Dominant plant species

- Rocky Mountain Douglas-fir (*Pseudotsuga menziesii var. glauca*), tree
- western larch (*Larix occidentalis*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- common snowberry (*Symphoricarpos albus*), shrub
- Saskatoon serviceberry (*Amelanchier alnifolia*), shrub
- white spirea (*Spiraea betulifolia*), shrub

- pinegrass (*Calamagrostis rubescens*), grass
- creeping barberry (*Mahonia repens*), other herbaceous
- kinnikinnick (*Arctostaphylos uva-ursi*), other herbaceous

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	330	472	660
Shrub/Vine	165	236	330
Forb	55	79	110
Total	**550**	**787**	**1100**

Table 6. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	16%
Biological crusts	0%
Litter	83%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	1%

Community 1.2
Community Phase 1.2-Mature Patchy Phase Douglas fir(western larch-ponderosa pine)/ Serviceberry/white spirea-common snowberry/ Creeping barberry-kinickinik/pinegrass

Community Phase 1.2-Mature Patchy Phase Douglas fir(western larch-ponderosa pine)/ Serviceberry/white spirea-common snowberry/ Creeping barberry-kinickinik/pinegrass Sturcture: Mature stand with moderate patches from disease, insects, competition. Tree Age: 0 to 25 and 150+ years COMMUNITY PHASE 1.2 Douglas fir (western larch-ponderosa pine)/Serviceberry/white spirea-common snowberry/Creeping barberry/pinegrass Structure: Mosaic of mature overstory and regenerating openings Community Phase 1.2 retains areas that resemble Community Phase 1.1, but also contains moderate sized (2 to 5 acres) openings. The openings would be from large and small disturbances such as fire, windthrow and insect and disease damage. Therefore, the openings would be like community phase 1.3 with tree regeneration, resprouting shrubs, grasses and pioneer herbaceous species depending on the type and severity of the disturbance. In the undisturbed, mature forest, overstory canopy cover can range 30 to 50 percent. The overstory is a mixture of Douglas fir, western larch and ponderosa pine at low elevation sites. The understory can have clumps of the tall shrub Saskatoon serviceberry, the medium statured shrubs white spirea and common snowberry, with a carpet of diverse herbaceous layer sometimes dominated by the rhizomatous grass pinegrass (*Calamagrostis rubescens*) and or Geyer’s sedge (*Carex geyeri*). Douglas fir is susceptible to mortality from the Douglas fir beetle and is a host to organisms causing root rot and heart rot and with windthrow can cause large pockets of overstory mortality. These areas may take decades to become reforested, resulting in either patches of shrubs or seral species (western larch, lodgepole pine). As the organisms slowly die off due to a lack of host trees, Douglas fir will re-colonize these areas. This community is prone to Armillaria root rot and defoliation by Western Spruce budworm on fir.

Community 1.3

Community Phase 1.3-Initiation Phase Douglas fir-Lodgepole pine-Aspen-Western larch/white spirea-common snowberry/pinegrass-geyer's sedge-resprouting patches.

Community Phase 1.3-Initiation Phase Douglas fir-Lodgepole pine-Aspen-Western larch/white spirea-common snowberry/pinegrass-geyer's sedge-resprouting patches. Structure: patchy clumps, single story regeneration. Tree Age: 0 to 25 years COMMUNITY PHASE 1.3 (Douglas fir-Lodgepole pine-Ponderosa pine-Western larch)/white spirea-common snowberry/geyer's sedge Structure: Thick carpet of regeneration, single story canopy. Community Phase 1.3 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 as a mixture of conifers including Douglas fir, lodgepole pine, western larch, ponderosa pine and moister areas 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: fireweed, common snowberry, pinegrass, and Geyer's sedge. Pinegrass and Geyer's sedge can have very high canopy cover. After severe fire and with an adequate presence of shrubs or seedbank, snowbrush ceanothus (*Ceanothus velutinus*) can dominate.

Community 1.4
Community Phase 1.4-Stem Exclusion Phase Lodgepole pine/common snowberry/pinegrass

Community Phase 1.4-Stem Exclusion Phase Lodgepole pine/common snowberry/pinegrass Structure: dense single story with diminished understory. Tree Age: 25 to 75 years COMMUNITY PHASE 1.4: PIPO-PSME(LAOC-JUCO6)/SYAL(AMAL2)/ARUV-MARE11 Structure: Dense, single story canopy of trees 50 to 80 years old, 50 to 90 feet tall with DBHs 10 to 15 inches. Community Phase 1.4 is a forest in the competitive exclusion phase, possibly with scattered remnant mature trees; there is increasing competition among individual trees for the available water and nutrients. The canopy cover can range from 60 to 100 percent. The overstory is a mixture of Douglas fir, ponderosa pine, western larch and common juniper; and the understory has clumps of common snowberry, Saskatoon serviceberry, kinnickinick, creeping barberry and pinegrass. Canopy closure is high to very high within the areas successfully reforested, leading eventually to a diminished graminoid community but also providing protection for those species which do well in the shade. The majority of Douglas-fir and ponderosa pine that reach this stage have increased resistance to fire kill with their thickening bark. This community is tolerant of Armillaria root rot due to the forest stand composition. Understory at the three sites in which canopy cover data was collected had high cover. The most frequently occurring species were serviceberry, heartleaf arnica, pinegrass, strawberry species, white spirea and common snowberry. Only common snowberry and pinegrass had moderate to high canopy cover. Data collected on 17 sample sites of the community phase 1.4 of pole sized, middle aged (45 to 85 years old generally), dense, single story canopy condition from 1970 to 1985 on Wood 5 forms for Missoula, Lewis and Clark, Powell and Lake counties that reside in LRU 430H. These sites have been determined to belong to the Douglas fir Habitat Type (associated with this ecological site) defined as having Douglas fir regeneration present and the indicated climax species. These forests are dense with absolute canopy cover averaging 60 percent and total basal area of 147. These forests have Douglas fir that is 50 to 85 years old, 50 to 90 feet tall, pole sized (DBH 10 to 15 inches) and occur in dominant, co-dominant and subdominant configurations relative to seral tree species. There are also pure seral stands with only Douglas fir regeneration present. All these different types of forest stand configurations still fall within this community of 50 to 80 years old trees with high total canopy cover that define the stem exclusion phase. The differences in proportion of Douglas fir to seral species composition depends on the post disturbance seed source availability at each site. Following are the groupings used to describe this community: Douglas fir with 50 to 100 percent relative canopy cover, Douglas fir with 15 to 30 percent cover, Douglas fir with 5 to 10 percent cover and Douglas fir with 0 to 1 percent cover. PSME 50 to 100 percent, 50 to 70 years old, 50 to 80 feet tall (7 sites): These forests are dominated by Douglas fir, though ponderosa pine and western larch are present and can have low to moderate canopy cover. The total canopy cover ranges 45 to 80 percent. Douglas fir are pole sized with DBHs ranging 9 to 17 inches. Site index for Douglas fir range 46 to 64 and total basal area for the stand ranges 100 to 160. PSME 15 to 30 percent, 50 to 85 years old, 55 to 75 feet tall (4 sites): These forests have a mixed composition of Douglas fir with 15 to 30 percent relative canopy cover, ponderosa pine with 0 to 85 percent cover, lodgepole pine with 0 to 30 percent cover, western larch with 0 to 40 percent cover. Total absolute canopy cover ranges 60 to 70 percent and total basal area 152 to 197 (two sites only). Douglas fir is pole sized with DBHs ranging 8 to 16 inches. PSME 5 to 10 percent, 50 to 85 years old, 65 to 75 feet tall (3 sites): These forests are dominated by ponderosa pine having 90 to 95 percent relative canopy cover and Douglas fir 5 to 10 percent and Douglas fir regeneration. The ponderosa pine average age ranges 66 to 90 years with average height ranging 65 to 77 feet tall, pole sized and with site index of 70 to 85. Douglas fir has ages ranging 78 to 85 years old, heights ranging 50 to 80 feet tall and pole sized trees with site index range 38 to 49. Total absolute canopy cover ranges 56 to 64 percent for the stand and basal area ranges 112 to 210. PSME 0 to 1 percent, seral stands 57 to 83 years old,

70 to 90 feet tall (3 sites): These stands are 95 to 100 percent comprised of ponderosa pine or lodgepole pine. There is Douglas fir regeneration at the site. Ponderosa pine average age is 83 to 92 years with a height of 80 to 90 feet tall and 15 to 20 inches DBH and site index of 91 to 96. Lodgepole pine is 57 years old, has an average height of 69 feet, DBH of 7 to 9 inches and site index of 97. Total absolute canopy cover for these stands ranges 50 to 60 percent and total basal area is 157 to 202. Forest understory data collected on 10 PSME/SYAL sites 1.4 dense, single story canopy community phase condition from 1970 to 1985 on Wood 5 forms for Missoula, Lewis and Clark, Powell and Lake counties that reside in LRU 430H. The most frequently occurring species are common snowberry, creeping barberry and pinegrass. Species with the highest average cover are common snowberry and creeping barberry.

Community 1.5
Community Phase 1.5-Vertical Differentiation Douglas fir(western larch-Ponderosa pine)/ Serviceberry/white spirea-common snowberry/ creeping barberry/pinegrass

Community Phase 1.5-Vertical Differentiation Douglas fir(western larch-Ponderosa pine)/ Serviceberry/white spirea-common snowberry/ creeping barberry/pinegrass Structure: some vertical differentiation in stand from insects, disease, root rot, tree competition.Tree Age: 75+ years COMMUNITY PHASE 1.5: PSME/SYAL/CARU-CAGE2 Structure: Single story canopy with few small openings. Community Phase 1.5 is a maturing forest which is starting to differentiate vertically. Nine sample sites of Wood 5 data located in Missoula, Lewis and Clark, Powell and Lake counties that reside in LRU 430H, were used to describe the overstory of this community phase. Three of the nine sample sites had understory data. These forests are dominated by Douglas fir, which has 50 to 97 percent canopy cover relative to other species present, are older than the stem exclusion phase and are 80 to 90 years old, large (DBH range 10 to 19 inches) and 60 to 85 feet tall. Other tree species present are predominantly ponderosa pine and minimal western larch. Ponderosa pine relative canopy cover ranges 10 to 50 percent and western larch 1 to 5 percent. Absolute canopy cover of the stand ranges from 50 to 75 percent. These are productive sites with total basal areas ranging 117 to 198 and site index for Douglas fir ranges 48 to 90 and for ponderosa pine site index ranges 65 to 90. The understory has high canopy cover with common snowberry, pinegrass and geyer’s sedge the most frequent species with high cover. 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. This community is prone to Armillaria root rot and defoliation by Western Spruce budworm on fir.

Pathway 1.1A
Community 1.1 to 1.2

Community Phase Pathway 1.1A This pathway represents a larger disturbance, such as an insect infestation, wind storm, or rot pocket to create this forest structure. Areas of regeneration range from approximately 2 to 5 acres.

Pathway 1.1B
Community 1.1 to 1.3

Community Phase Pathway 1.1B This pathway represents a major stand-replacement fire disturbance such as a high-intensity fire, large-scale wind event, or major insect infestation.

Pathway 1.2A
Community 1.2 to 1.1

Community Phase Pathway 1.2A This pathway represents growth over time with no further significant disturbance. The areas of regeneration pass through the typical stand phases—competitive exclusion, maturation, understory reinitiation—until they resemble the old-growth structure of the Reference Community.

Pathway 1.2B
Community 1.2 to 1.3

Community Phase Pathway 1.2B This pathway represents a major stand-replacement fire disturbance, such as a major insect outbreak or major fire event, which leads to the stand initiation phase of forest development.

Pathway 1.3A
Community 1.3 to 1.4

1.3A – Time with fire return interval extended to allow natural tree regeneration to grow into dense pole stands

Pathway 1.4B
Community 1.4 to 1.3

Community Phase Pathway 1.4b This pathway represents a major stand-replacement fire disturbance, such as a major insect outbreak, or major fire event which leads to the stand initiation phase of forest development.

Pathway 1.4A
Community 1.4 to 1.5

1.4A – Time without fire to allow vertical differentiation of stand through small gaps from death due to disease, insects, small fires, windthrow.

Pathway 1.5A
Community 1.5 to 1.1

Community Phase Pathway 1.5A This pathway represents no further major disturbance. Continued growth over time, as well as ongoing mortality, leads to continued vertical diversification. The community begins to resemble the structure of the Reference Community, with small pockets of regeneration and a more diversified understory.

Pathway 1.5B
Community 1.5 to 1.3

Community Phase Pathway 1.5B This pathway represents a major stand-replacement fire disturbance leading to the stand initiation phase of forest development.

State 2
Alternative State 2. (Armillaria Root Rot State)

Alternative State 2. (Armillaria Root Rot State) 2.1 Community Shrubland. Metasedimentary Parent Material Time=50yrs 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.

State 3
Alternative State 3 (Fire Exclusion)

Alternative State 3 (Fire Exclusion) 3.1 Community Multi-storied stands of Douglas fir/Ponderosa pine with dense understory of shrubs and/or young trees This State has been shaped by fire exclusion in which the forest structure, species composition, patch patterns and fuel loading has been dramatically increased due to a dramatic reduction or elimination of fire from the ecological site. Tree density and fuel loading have reached a point in which fire if it did occur would be of very high severity. Dense multi-layered forests of Douglas-fir and ponderosa pine now exist and is homogenous on the landscape. Intensive forest management practices can reduce the risk of severe fire. There has been a dramatic increase in the area of “Dry PVG” (Douglas fir dominated forests) that used to burn with low severity fires that now has a mixed severity of lethal stand replacing fire regime (Gautreaux, Russ. 1999). Forest stand composition changes with fire suppression as well. Douglas fir does not require a post-fire mineral bed for seedling development like ponderosa pine and will outcompete it when fire does not occur. There is also usually an increase in shrubs that become decadent with the lack of fire. Plant Community 3.1 Multi-level canopy of mature Douglas-fir and ponderosa pine over sapling/pole/seedling stands of Douglas-fir and ponderosa pine. Eventually,

Douglas fir outcompetes ponderosa pine completely with long-term fire suppression. These dense multi-storied Douglas fir forest can be more prone to and capable of supporting populations of western spruce budworm which results in severe defoliation and mortality (Gautreaux, Russ. 1999). As well, more continuous cover of Douglas fir can increase the area of Armillaria root disease of which Douglas fir is a primary host. Large areas of lodgepole pine can have high levels of bark beetle caused mortality. These increases in mortality change forest structure and allow for higher fuel build up and potential for severe stand replacing fire. In areas without tree regeneration dense stands of shrubs will occur, mainly serviceberry, white spirea or snowberry. Forest management practices which include selective overstory removal along with understory fuel load management, including prescribed fire, can transition the forest into a more drought, insect and fire resilient condition.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- Saskatoon serviceberry (*Amelanchier alnifolia*), shrub
- common snowberry (*Symphoricarpos albus*), shrub
- Woods' rose (*Rosa woodsii*), shrub

State 4
Alternative State 4 Developed (timber harvest, private development, roads)

Alternative State 4 Developed (timber harvest, private development, roads) 4.1 Community Development uses alter forest structure, patch size, dynamics, species composition significantly STATE 4 – Developed State A portion of this ecological site has been developed for human uses including timber harvest, private development of houses or roads. This has occurred on the lower slope foothills and valleys. Additionally, other factors have changed forest structure including years of hygrading (harvesting largest best trees on site), prevalence of many roads which create fire breaks, and tree plantations. There are generally more early seral stands now due to the frequency and scale of timber harvest in recent decades on the Kootenai N.F. (Gautreaux, Russ. 1999). Timber harvesting and road development lead to changes in forest patch size.

State 5
Alternative State 5 Invaded weedy understory/crop/pasture

Alternative State 5 Invaded weedy understory/crop/pasture 5.1 Community Understory dominated by weedy invasive species or forest converted to crop or pasture, tame grasses dominate. STATE 5 – Invaded weed understory forest or Forest converted to crop or Pastureland A portion of this ecological site has either been significantly altered by weedy species invasion or the forest has been converted to annual cropland or pasture. This has occurred on the lower slope foothills and valleys. Weedy or increaser species that may be a problem including: slender crupina, rush skeletonweed, musk thistle, leafy spurge, knapweed species, tansy ragwort, dalmatian and yellow toadflaxes, common St. John’s wort and sulphur cinquefoil (Gautreaux, Russ. 1999).

Transition T1A
State 1 to 2

T1A – Armillaria Root Rot State in which the forest has been converted to a shrubland

Transition T1B
State 1 to 3

T1B - Fire exclusion over long periods allowing stands to grow into homogenous, dense, multi-storied stands. This dense forest structure can increase fuel loads of ladder fuels in live trees, standing dead trees and woody and herbaceous litter on the ground. This increase in fuel loading and forest structure can change fire severity once fire occurs.

Transition T1C
State 1 to 4

T1C – Housing and road development within Douglas fir forest that reduces forest patch size, increases edge and decreases interior acreage of intact forest and ecological services

Transition T1D
State 1 to 5

T1D – Forest stand with understory dominated by weedy invasive species or forest converted to cropland or pastureland. Introduced grasses and/or weedy species dominate the understory with overstory of Douglas fir or site is a cropland or pasture. This occurs with the introduction of these introduced/weedy species (through human or livestock use, proximity to development or other means), establishment and dominance of the native understory vegetation community; or active management to convert forest to cropland/pasture by cutting trees, removing stumps and planting introduced crop and/or pasture grasses.

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.

Restoration pathway R3A
State 3 to 1

R3A – Forest stand structure, composition and historical fire regime restored by overstory thinning, ground and ladder fuels reduction, and prescribed fire. This may be economically infeasible, is completely dependent on site conditions and will require numerous entries into a forest stand. R3A – Forest stands restored by overstory thinning, ground and ladder fuels reduction, prescribed fire and seeding of native grasses and forbs. VRU Recommendations for silvicultural practices (Gautreaux, Russ. 1999): • Desired forest structures would reflect the product of frequent low to moderate severity ground fires, and occasional stand replacement events • Largely multi-storied and two-aged conditions would be sustained through prescribed fire and timber harvest at frequencies consistent with natural fire return interval (15 to 45 years). A variety of successional stages represented. • Create small openings (2 to 5 acres) within an irregularly shaped, large treatment area (20-200 acres). • Individual or small group selection on a 20 to 25 year re-entry schedule • Shelterwood preparatory cuts and shelterwood seed cuts • Intermediate harvest methods (improvements cuttings and thinning from below (where stand regeneration is not the intent and root disease is not a concern) • Prescribed fire as a tool for periodic reduction in fuels, restoring and maintaining vegetative composition and structure • Reforestation and species management

Restoration pathway R4A
State 4 to 1

R4A – Potentially not feasible; removal of housing and road development and restoration for Douglas fir overstory and perennial native bunchgrass understory. This is probably the least feasible restoration pathway for this ecological site due to lack of public support to curb private home building and desire to restore developed areas back to forest. The feasibility of restoration depends on size of development i.e. if there is one house on 10 acres with only one dirt road, this may be restored with removal of structures, forestry management practices for the overstory and range management practices for the understory whereas more developed areas will not be feasible to restore.

Restoration pathway R5A
State 5 to 1

R5A – Range management practices to convert introduced grass and/or weedy species dominated understory to native understory vegetation. This may not be feasible if the native plant composition is less than 10 percent and

may be economically infeasible. As well, feasibility is dependent on the type of weed species and amount i.e. extreme cheatgrass or smooth brome coverage may be impossible to restore; soil condition and ability to restore. Overstory restoration through forestry management practices of afforestation through planting of native trees and range management practices of seeding of native grasses, forbs, and shrubs and treatment of invasive plants and Time. This restoration may not be feasible and is dependent on: soil condition and feasibility of restoration with amendments and other practices, amount and type of introduced grasses and weed species on site and feasibility of restoration, and economic feasibility.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**cool rhizomatous grass**			300–600	
	pinegrass	CARU	*Calamagrostis rubescens*	300–600	–
1	**cool season bunchgrass**			15–50	
	rough fescue	FECA4	*Festuca campestris*	15–50	–
Forb					
2	**forbs**			100–270	
	common yarrow	ACMI2	*Achillea millefolium*	45–90	–
	pussytoes	ANTEN	*Antennaria*	45–90	–
	heartleaf arnica	ARCO9	*Arnica cordifolia*	45–90	–
	aster	ASTER	*Aster*	45–90	–
	bluebell bellflower	CARO2	*Campanula rotundifolia*	45–90	–
	fleabane	ERIGE2	*Erigeron*	45–90	–
	blanketflower	GAAR	*Gaillardia aristata*	45–90	–
	northern bedstraw	GABO2	*Galium boreale*	45–90	–
	white hawkweed	HIAL2	*Hieracium albiflorum*	45–90	–
	western stoneseed	LIRU4	*Lithospermum ruderale*	45–90	–
	silky lupine	LUSE4	*Lupinus sericeus*	45–90	–
	sweetcicely	OSBE	*Osmorhiza berteroi*	45–90	–
	American vetch	VIAM	*Vicia americana*	45–90	–
Shrub/Vine					
3	**shrubs**			50–135	
	common snowberry	SYAL	*Symphoricarpos albus*	23–45	–
	white spirea	SPBE2	*Spiraea betulifolia*	23–45	–
	creeping barberry	MARE11	*Mahonia repens*	23–45	–
	spreading dogbane	APAN2	*Apocynum androsaemifolium*	23–45	–

Table 8. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
Rocky Mountain Douglas-fir	PSMEG	*Pseudotsuga menziesii var. glauca*	–	–	15–57	–	–
western larch	LAOC	*Larix occidentalis*	–	–	0–15	–	–
lodgepole pine	PICO	*Pinus contorta*	–	–	0–15	–	–
Engelmann spruce	PIEN	*Picea engelmannii*	–	–	0–10	–	–
common juniper	JUCO6	*Juniperus communis*	–	–	1–5	–	–
ponderosa pine	PIPO	*Pinus ponderosa*	–	–	0–3	–	–
quaking aspen	POTR5	*Populus tremuloides*	–	–	0–1	–	–

Table 9. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
pinegrass	CARU	*Calamagrostis rubescens*	–	–	5–45
mountain brome	BRMA4	*Bromus marginatus*	–	–	0–37
bearded wheatgrass	ELCA11	*Elymus caninus*	–	–	15
green needlegrass	NAVI4	*Nassella viridula*	–	–	0–15
Kentucky bluegrass	POPR	*Poa pratensis*	–	–	0–15
blue wildrye	ELGL	*Elymus glaucus*	–	–	0–7
rough fescue	FECA4	*Festuca campestris*	–	–	2–5
northwestern sedge	CACO11	*Carex concinnoides*	–	–	0–5
cheatgrass	BRTE	*Bromus tectorum*	–	–	2
orchardgrass	DAGL	*Dactylis glomerata*	–	–	2
Columbia needlegrass	ACNEN2	*Achnatherum nelsonii ssp. nelsonii*	–	–	0–1
Richardson's needlegrass	ACRI8	*Achnatherum richardsonii*	–	–	0–1
Idaho fescue	FEID	*Festuca idahoensis*	–	–	0–1
tiny trumpet	COLI2	*Collomia linearis*	–	–	–
Geyer's sedge	CAGE2	*Carex geyeri*	–	–	–
Forb/Herb					
heartleaf arnica	ARCO9	*Arnica cordifolia*	–	–	0–15
raceme pussytoes	ANRA	*Antennaria racemosa*	–	–	0–3
common yarrow	ACMI2	*Achillea millefolium*	–	–	0–2
western pearly everlasting	ANMA	*Anaphalis margaritacea*	–	–	2
Canada thistle	CIAR4	*Cirsium arvense*	–	–	0–2
silky lupine	LUSE4	*Lupinus sericeus*	–	–	0–2
sweetcicely	OSBE	*Osmorhiza berteroi*	–	–	0–2
common mullein	VETH	*Verbascum thapsus*	–	–	0–2
feathery false lily of the valley	MARA7	*Maianthemum racemosum*	–	–	1
western stoneseed	LIRU4	*Lithospermum ruderale*	–	–	0–1
northern bedstraw	GABO2	*Galium boreale*	–	–	0–1
western showy aster	EUCO36	*Eurybia conspicua*	–	–	0–1
bull thistle	CIVU	*Cirsium vulgare*	–	–	1
bluebell bellflower	CARO2	*Campanula rotundifolia*	–	–	0–1

bluebell bellflower	CARO2	*Campanula rotundifolia*	–	–	0–1
onion	ALLIU	*Allium*	–	–	0–1
pointedtip mariposa lily	CAAP	*Calochortus apiculatus*	–	–	–
aster	ASTER	*Aster*	–	–	–
Nuttall's rockcress	ARNU	*Arabis nuttallii*	–	–	–
spotted knapweed	CEST8	*Centaurea stoebe*	–	–	–
fireweed	CHAN9	*Chamerion angustifolium*	–	–	–
field chickweed	CEAR4	*Cerastium arvense*	–	–	–
Virginia strawberry	FRVI	*Fragaria virginiana*	–	–	–
threepetal bedstraw	GATR2	*Galium trifidum*	–	–	–
western rattlesnake plantain	GOOB2	*Goodyera oblongifolia*	–	–	–
twinflower	LIBO3	*Linnaea borealis*	–	–	–
sweetclover	MEOF	*Melilotus officinalis*	–	–	–
timothy	PHPR3	*Phleum pratense*	–	–	–
common selfheal	PRVU	*Prunella vulgaris*	–	–	–
Shrub/Subshrub					
creeping barberry	MARE11	*Mahonia repens*	–	–	2–40
kinnikinnick	ARUV	*Arctostaphylos uva-ursi*	–	–	0–15
Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	–	–	0–2
black hawthorn	CRDO2	*Crataegus douglasii*	–	–	2
chokecherry	PRVI	*Prunus virginiana*	–	–	2
spreading dogbane	APAN2	*Apocynum androsaemifolium*	–	–	–
Sitka alder	ALVIS	*Alnus viridis ssp. sinuata*	–	–	–

Table 10. Community 1.4 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
western larch	LAOC	*Larix occidentalis*	–	–	0–37	–	–
common juniper	JUCO6	*Juniperus communis*	–	–	2–20	–	–
Rocky Mountain Douglas-fir	PSMEG	*Pseudotsuga menziesii var. glauca*	–	–	5–20	–	–
quaking aspen	POTR5	*Populus tremuloides*	–	–	0–5	–	–

Table 11. Community 1.4 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
pinegrass	CARU	*Calamagrostis rubescens*	–	–	20
rough fescue	FECA4	*Festuca campestris*	–	–	3–10
bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	–	–	2
Columbia needlegrass	ACNEN2	*Achnatherum nelsonii ssp. nelsonii*	–	–	1
intermediate wheatgrass	THIN6	*Thinopyrum intermedium*	–	–	1
Forb/Herb					
spotted knapweed	CEST8	*Centaurea stoebe*	–	–	4
common yarrow	ACMI2	*Achillea millefolium*	–	–	1
spiny phlox	PHHO	*Phlox hoodii*	–	–	1
blanketflower	GAAR	*Gaillardia aristata*	–	–	1
white hawkweed	HIAL2	*Hieracium albiflorum*	–	–	0–1
western stoneseed	LIRU4	*Lithospermum ruderale*	–	–	1
northern bedstraw	GABO2	*Galium boreale*	–	–	–
yellow salsify	TRDU	*Tragopogon dubius*	–	–	–
American vetch	VIAM	*Vicia americana*	–	–	–
Shrub/Subshrub					
creeping barberry	MARE11	*Mahonia repens*	–	–	6–15
common snowberry	SYAL	*Symphoricarpos albus*	–	–	5–15
kinnikinnick	ARUV	*Arctostaphylos uva-ursi*	–	–	0–10
Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	–	–	0–7
rosy pussytoes	ANRO2	*Antennaria rosea*	–	–	1–6
antelope bitterbrush	PUTR2	*Purshia tridentata*	–	–	0–5
Woods' rose	ROWO	*Rosa woodsii*	–	–	1

Inventory data references

HISTORIC WOOD 5 DATASET

Data collected on 3 PSME/SYAL sites in late to reference community phase condition from 1970 to 1985 on Wood 5 forms for Missoula, Lewis and Clark, Powell and Lake counties that reside in LRU 430H. These sites have Douglas fir that are over one hundred years old, have forty to eighty percent canopy cover of Douglas fir relative to other species present, are large (DBH range generally 15 to 21 inches) and are 70 to 85 feet tall. Total site indexes for Douglas fir in these forests are 48, 55 and 59 and the total basal area ranges 150 to 156. These are similar values found by Pfister (1977) for the habitat type PSME/SYAL with basal area 172+/-23 and site index for PSME of 52 +/-4. These forests have high absolute canopy cover ranging from 55 to 60 percent. The understory has very high canopy cover including the moderate statured shrubs common snowberry and white spirea, the low shrub kinnickinick and pinegrass. Other species with moderate cover include wood’s rose, creeping barberry, geyers sedge and wood strawberry.

2018 NRCS DATASET
FOREST OVERSTORY
Forest absolute canopy averages 35 percent (15 to 57 percent) and is dominated by Douglas-fir with western larch and ponderosa pine in minor amounts. Data taken on MT634 update soil survey project in Tobacco Valley area, 23 sites.

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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	04/25/2024
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):**

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

---

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

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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:**
