

H-5: LANDFIRE Vegetation Communities

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APPENDIX H

Landfire Vegetation Class Descriptions from LANDFIRE/GAP Land Cover Map Unit Descriptions (USGS 2016).

Artemisia tridentata ssp. vaseyana Shrubland Alliance

This alliance is widespread in mountainous areas across the western U.S. The vegetation included in this alliance is characterized by an open to dense (10-70% cover) shrub layer in which *Artemisia tridentata* ssp. *vaseyana* is codominant, usually with 40-60% relative cover with non-sagebrush shrub species such as *Amelanchier utahensis*, *Holodiscus dumosus*, *Purshia tridentata*, or *Symphoricarpos oreophilus*. Perennial graminoids typically dominate the open to moderately dense herbaceous layer. The most widespread species are *Pseudoroegneria spicata* and *Festuca idahoensis*, which occur from the Columbia Basin to the northern Rockies, although they may not be the most abundant species in individual stands. Other locally important species may include *Achnatherum occidentale* (= *Stipa occidentalis*), *Bouteloua gracilis*, *Bromus carinatus*, *Elymus trachycaulus*, *Festuca thurberi*, *Festuca viridula*, *Koeleria macrantha*, *Leucopoa kingii* (= *Festuca kingii*), *Leymus cinereus*, *Pascopyrum smithii*, *Poa fendleriana*, and *Poa secunda*. The forb layer is variable and can be very diverse. Species of *Castilleja*, *Potentilla*, *Erigeron*, *Phlox*, *Astragalus*, *Geum*, *Lupinus*, and *Eriogonum* are characteristic. The alliance forms large, continuous stands on mid-elevation mountain slopes and foothills, and can extend above the lower treeline as patches within montane or subalpine coniferous forests. Sites are variable and range from flats to steep slopes to ridgetops with deep to shallow rocky soil.

Barren

Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.

Columbia Plateau Low Sagebrush Steppe

This matrix ecological system is composed of sagebrush dwarf-shrub-steppe that occurs in a variety of shallow-soil habitats throughout eastern Oregon, northern Nevada and southern Idaho. *Artemisia arbuscula* ssp. *arbuscula* and close relatives (*Artemisia arbuscula* ssp. *longiloba* and occasionally *Artemisia nova*) form stands that typically occur on mountain ridges and flanks and broad terraces, ranging from 1000 to 3000 m in elevation. Substrates are shallow, fine-textured soils, poorly drained clays, shallow-soiled areas, almost always very stony, characterized by recent rhyolite or basalt. Other shrubs and dwarf-shrubs present may include *Purshia tridentata*, *Eriogonum* spp., and other species of *Artemisia*. Common graminoids include *Festuca idahoensis*, *Koeleria macrantha*, *Pseudoroegneria spicata*, and *Poa secunda*. Many forbs also occur and may dominate the herbaceous vegetation, especially at the

higher elevations. Isolated individuals of *Juniperus occidentalis* (western juniper) and *Cercocarpus ledifolius* (mountain-mahogany) can often be found in this system.

Dry-mesic Montane Douglas-fir Forest

This alliance is a member of the CES306.959 Middle Rocky Mountain Montane Douglas-fir Forest and Woodland Ecological System. Stands of this alliance are *Pseudotsuga menziesii*-dominated forests and woodlands occasionally with *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus flexilis* (on calcareous substrates), *Populus tremuloides* (on disturbed sites), and *Pinus contorta* (at higher elevations). True firs, such as *Abies concolor*, *Abies grandis*, and *Abies lasiocarpa*, are absent, but occasional *Picea engelmannii* can occur in some stands. *Pinus ponderosa* is also not common in this group. Understory components include shrubs such as *Cercocarpus ledifolius*, *Juniperus communis*, *Mahonia repens*, *Purshia tridentata*, *Spiraea betulifolia*, *Symphoricarpos albus*, and *Symphoricarpos oreophilus*. Common graminoids include *Calamagrostis rubescens*, *Carex rossii*, *Leucopoa kingii*, and *Pseudoroegneria spicata*. Forbs are variable, but typical taxa include *Arnica cordifolia*, *Thalictrum occidentale*, *Viola adunca*, and species of many other genera, including *Antennaria*, *Arenaria*, *Erigeron*, *Eriogonum*, *Lathyrus*, *Lupinus*, *Penstemon*, and *Vicia*. This alliance occurs on relatively dry to mesic sites throughout the middle Rocky Mountains of central and southern Idaho, the Greater Yellowstone region, and the Wind River, Gros Ventre and Bighorn ranges of Wyoming. It extends north into Montana on the east side of the Continental Divide, to the McDonald Pass area, and also into the Rocky Mountain Front region and central "sky island" ranges of Montana. This alliance often occurs at the lower treeline immediately above valley grasslands, or sagebrush steppe and shrublands. Stands are found on all aspects in the Central Rockies where the southern monsoon influence is less and maritime climate regime is not important. Climate is drier and more continental than at higher elevations or in the Pacific Northwest. Annual precipitation ranges from 50-100 cm with moderate snowfall and a greater proportion falling during the growing season. Monsoonal summer rains can contribute a significant proportion of the annual precipitation in the southern portion of the range. Elevations range from less than 1000 m in the central Rocky Mountains to over 2400 m in the Wyoming Rockies. Lower elevation stands typically occupy cooler, less xeric northern exposures often on steep slopes. At higher elevations, these forests occur primarily on southerly aspects or ridgetops and plateaus. Soils are highly variable and derived from diverse parent materials, including extrusive volcanics in the Yellowstone region, and sedimentary rocks elsewhere in the Rockies. The soils are typically well-drained and well-aerated. They can be derived from moderately deep colluvium or shallow-jointed bedrock, and are usually gravelly or rocky.

Inter-Mountain Basins Big Sagebrush Shrubland

This ecological system occurs throughout much of the western U.S., typically in broad basins between mountain ranges, plains and foothills between 1500 and 2300 m elevation. Soils are typically deep, well-drained and non-saline. These shrublands are dominated by *Artemisia tridentata* ssp. *tridentata* (not as common in Wyoming or Montana but possibly on stabilized part of Killpecker Dunes in Wyoming) and/or *Artemisia tridentata* ssp. *wyomingensis* (predominant in Wyoming and Montana). Scattered *Juniperus* spp., *Sarcobatus vermiculatus*, and *Atriplex* spp.

may be present in some stands. *Ericameria nauseosa*, *Chrysothamnus viscidiflorus*, *Purshia tridentata* (not commonly in Montana or Wyoming), or *Symphoricarpos oreophilus* may codominate disturbed stands (e.g., in burned stands, these may become more predominant). Perennial herbaceous components typically contribute less than 25% vegetative cover. Common graminoid species can include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus lanceolatus*, *Festuca idahoensis* (not in Montana or Wyoming), *Hesperostipa comata*, *Leymus cinereus*, *Pleuraphis jamesii* (not present in northeastern portions of the range), *Pascopyrum smithii*, *Poa secunda*, or *Pseudoroegneria spicata* (not in Wyoming). Some semi-natural communities are included that often originate on abandoned agricultural land or on other disturbed sites. In these locations, *Bromus tectorum* or other annual bromes and invasive weeds can be abundant. Most *Artemisia tridentata* ssp. *wyomingensis* communities in Wyoming are placed in ~Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)\$\$; the shrubland system is more restricted in environmental setting than the steppe. Dunes in the Red Desert have areas of large basin big sage with very dense canopies. In Wyoming, this system is likely to only contain *Artemisia tridentata* ssp. *tridentata*.

Inter-Mountain Basins Big Sagebrush Steppe

This widespread matrix-forming ecological system occurs throughout much of the Columbia Plateau and northern Great Basin, east into the Wyoming Basins, central Montana, and north and east onto the western fringe of the Great Plains in Montana and South Dakota. It is found at slightly higher elevations farther south. In central Montana, this system differs slightly, with more summer rain than winter precipitation, more precipitation annually, and it occurs on glaciated landscapes. Soils are typically deep and non-saline, often with a microphytic crust. This shrub-steppe is dominated by perennial grasses and forbs (>25% cover) with *Artemisia tridentata* ssp. *tridentata* (this is not at all important in Wyoming occurrences), *Artemisia tridentata* ssp. *xericensis*, *Artemisia tridentata* ssp. *wyomingensis*, *Artemisia tripartita* ssp. *tripartita* (Snake River valley in Wyoming), *Artemisia cana* ssp. *cana*, and/or *Purshia tridentata* dominating or codominating the open to moderately dense (10-40% cover) shrub layer. *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Sarcobatus vermiculatus*, *Tetradymia* spp., or *Artemisia frigida* may be common especially in disturbed stands. In Montana and Wyoming, stands are more mesic, with more biomass of grass, have less shrub diversity than stands farther west, and 50 to 90% of the occurrences are dominated by *Artemisia tridentata* ssp. *wyomingensis* with *Pascopyrum smithii*. In addition, *Bromus japonicus* and *Bromus tectorum* are indicators of disturbance, and *Bromus tectorum* is typically not as abundant as in the Intermountain West, possibly due to a colder climate. Associated graminoids can include *Achnatherum hymenoides*, *Calamagrostis montanensis*, *Elymus lanceolatus* ssp. *lanceolatus*, *Koeleria macrantha*, *Poa secunda*, *Pascopyrum smithii*, *Hesperostipa comata*, *Nassella viridula*, *Bouteloua gracilis*, and *Pseudoroegneria spicata*. Important rhizomatous species include *Carex filifolia* and *Carex duriuscula*, which are very common and important in the eastern distribution of this system in both Wyoming and Montana. *Festuca idahoensis* is uncommon in this system, although it does occur in areas of higher elevations/precipitation; *Festuca campestris* is also uncommon. In Wyoming, both *Nassella viridula* and *Pseudoroegneria spicata* rarely occur, with the latter typically found in eastern Wyoming on ridgetops and rocky slopes outside of this system. In Montana, there is an absence of *Festuca* spp., except *Vulpia octoflora*. Common

forbs are *Phlox hoodii*, *Arenaria* spp., *Opuntia* spp., *Sphaeralcea coccinea*, *Dalea purpurea*, *Liatris punctata*, and *Astragalus* spp. Areas with deeper soils more commonly support *Artemisia tridentata* ssp. *tridentata* but have largely been converted for other land uses. The natural fire regime of this ecological system likely maintains a patchy distribution of shrubs, so the general aspect of the vegetation is a grassland. Shrubs may increase following heavy grazing and/or with fire suppression, particularly in moist portions of the northern Columbia Plateau where it forms a landscape mosaic pattern with shallow-soil scabland shrublands. Where fire frequency has allowed for shifts to a native grassland condition, maintained without significant shrub invasion over a 50-to 70-year interval, the area would be considered ~Columbia Basin Foothill and Canyon Dry Grassland (CES304.993).

Inter-Mountain Basins Montane Sagebrush Steppe

This ecological system includes sagebrush communities occurring at foothills (in Wyoming) to montane and subalpine elevations across the western U.S. from 1000 m in eastern Oregon and Washington to over 3000 m in the southern Rockies. In Montana, it occurs on mountain "islands" in the north-central portion of the state and possibly along the Boulder River south of Absarokee and at higher elevations. In British Columbia, it occurs between 450 and 1650 m in the southern Fraser Plateau and the Thompson and Okanagan basins. Climate is cool, semi-arid to subhumid. This system primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. In general, this system shows an affinity for mild topography, fine soils, some source of subsurface moisture or more mesic sites, zones of higher precipitation and areas of snow accumulation. Across its range of distribution, this is a compositionally diverse system. It is composed primarily of *Artemisia tridentata* ssp. *vaseyana*, *Artemisia cana* ssp. *viscidula*, and related taxa such as *Artemisia tridentata* ssp. *spiciformis* (= *Artemisia spiciformis*). *Purshia tridentata* may codominate or even dominate some stands. *Artemisia arbuscula* ssp. *arbusculadominated* shrublands commonly occur within this system on rocky or windblown sites. Other common shrubs include *Symphoricarpos* spp., *Amelanchier* spp., *Ericameria nauseosa*, *Peraphyllum ramosissimum*, *Ribes cereum*, and *Chrysothamnus viscidiflorus*. *Artemisia tridentata* ssp. *wyomingensis* may be present to codominant if the stand is clearly montane as indicated by montane indicator species such as *Festuca idahoensis*, *Leucopoa kingii*, or *Danthonia intermedia*. Most stands have an abundant perennial herbaceous layer (over 25% cover, in many cases over 50% cover), but this system also includes *Artemisia tridentata* ssp. *vaseyana* shrublands. Common graminoids include *Danthonia intermedia*, *Festuca arizonica*, *Festuca idahoensis*, *Hesperostipa comata*, *Poa fendleriana*, *Elymus trachycaulus*, *Bromus carinatus*, *Poa secunda*, *Leucopoa kingii*, *Deschampsia caespitosa*, *Calamagrostis rubescens*, and *Pseudoroegneria spicata*. Species of *Achnatherum* are common, including *Achnatherum nelsonii* ssp. *dorei*, *Achnatherum nelsonii* ssp. *nelsonii*, *Achnatherum hymenoides*, and others. In many areas, wildfires can maintain an open herbaceous-rich steppe condition, although at most sites, shrub cover can be unusually high for a steppe system (>40%), with the moisture providing equally high grass and forb cover.

Inter-Mountain Basins Sparsely Vegetated Systems

This sparsely vegetated system group ranges from the Colorado Plateau north to the Columbia Plateau and from Wyoming basins west to the Great Basin and North Pacific Maritime region. It is comprised of cliff faces, narrow canyons, open tablelands, saline playas, eroded badlands, and volcanic areas of cinder fields and cones, lava flows, and active inland dunes that occur near the terminus of glaciers, on the edge of outwash plains, near playas or other sand deposits. Various sparsely vegetated substrates define these systems, including massive layers of sedimentary rock with sandstones interbedded with shale; rounded badland hills and plains of marine shales; volcanic cinder, ash and tuff deposits; basalt flows, dykes, and cliffs; extensive sand deposits; smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types; unstable scree and talus slopes; intermittently flooded playas areas on impermeable soil subhorizons; and dunes and sandsheets. Vegetation on these harsh sites is characterized by sparse cover of trees, shrubs, dwarf-shrubs, forbs or grasses of various mixtures. Species are variable and may include trees such as *Abies concolor*, *Juniperus* spp., *Pinus edulis*, *Pinus flexilis*, *Pinus monophylla*, *Pinus ponderosa*, and shrubs or dwarf-shrubs such as *Allenrolfea occidentalis*, *Alnus* spp., *Artemisia filifolia*, *Artemisia tridentata*, *Atriplex canescens*, *Atriplex confertifolia*, *Atriplex corrugata*, *Atriplex gardneri*, *Artemisia pedatifida*, *Betula papyrifera*, *Eriogonum corymbosum*, *Eriogonum ovalifolium*, *Cercocarpus intricatus*, *Cercocarpus ledifolius*, *Fallugia paradoxa*, *Coleogyne ramosissima*, *Ephedra* spp., *Ericameria nauseosa*, *Grayia spinosa*, *Holodiscus discolor*, *Prunus virginiana*, *Psoralidium lanceolatum*, *Purshia tridentata*, *Salvia dorrii*, *Sarcobatus vermiculatus*, *Tetradymia tetrameres*, and *Tiquilia* spp. Characteristic herbaceous species may include *Achnatherum hymenoides*, *Andropogon hallii*, *Distichlis spicata*, *Eriogonum* sp., *Leymus arenarius*, *Leymus cinereus*, *Leymus flavescens*, *Puccinellia lemmonii*, *Sporobolus airoides*, and species of *Mentzelia*, *Camissonia*, *Mimulus*, or *Cleome*.

Introduced Upland Vegetation-Perennial Grassland and Forbland

Areas that are dominated by introduced perennial forb or grassland species such as: *Cirsium arvense*, *C. vulgare*, *Centaurea* spp., *Euphorbia esula*, *Isatis tinctora*, *Lepidium* sp., *Melilotus albus*, *M. officinalis*, *Onopordum acanthium*, *Agropyron cristatum*, *Bromus inermis*, *Eragrostis lehmannianna*, *Pennisetum* spp., *Poa bulbosa*, *P. pratensis*, *Thinopyrum intermedium*.

Mesic Montane Douglas-fir Forest

Stands are *Pseudotsuga menziesii*-dominated forests and woodlands; occasionally *Populus tremuloides* may codominate on disturbed sites, and *Pinus contorta* may be present at higher elevations. True firs, such as *Abies concolor*, *Abies grandis*, and *Abies lasiocarpa*, are absent, but occasional *Picea engelmannii* can occur in some stands. *Pinus ponderosa* is also not common in this group. Understory components include relatively mesic species such as the shrubs *Acer glabrum*, *Amelanchier alnifolia*, *Linnaea borealis*, and *Physocarpus malvaceus*, and herbs and grasses such as *Achillea millefolium*, *Bromus carinatus*, *Eucephalus engelmannii* (= *Aster engelmannii*), *Fragaria vesca*, *Geranium viscosissimum*, *Lathyrus* spp., *Osmorhiza berteroi*, and *Piptatherum micranthum*. This alliance is restricted to mesic to wet sites in the

middle Rocky Mountains of central and southern Idaho, the Greater Yellowstone region, and the Wind River, Gros Ventre and Bighorn ranges of Wyoming. It extends north into Montana on the east side of the Continental Divide, to the McDonald Pass area, and also into the Rocky Mountain Front region and central "sky island" ranges of Montana. This alliance occurs in the Central Rockies where the southern monsoon influence is less and maritime climate regime is not important. Climate is drier and more continental than at higher elevations or in the Pacific Northwest. Annual precipitation ranges from 50-100 cm with moderate snowfall and a greater proportion falling during the growing season. Monsoonal summer rains can contribute a significant proportion of the annual precipitation in the southern portion of the range. Elevations range from less than 1000 m in the central Rocky Mountains to over 2400 m in the Wyoming Rockies. Stands typically occupy cooler northern exposures in relatively moist sites such as lower slopes, benches and valley bottoms. Lower elevation stands occupy mesic ravines and canyons on northerly aspects. Soils are highly variable and derived from diverse parent materials, including extrusive volcanics in the Yellowstone region, and sedimentary rocks elsewhere in the Rockies. The soils can be derived from moderately deep colluvium or shallow-jointed bedrock, and are usually gravelly or rocky.

Middle Rocky Mountain Montane Douglas-fir Forest and Woodland

This ecological system occurs throughout the middle Rocky Mountains of central and southern Idaho (Lemhi, Beaverhead and Lost River ranges), south and east into the greater Yellowstone region, and south and east into the Wind River, Gros Ventre and Bighorn ranges of Wyoming. It extends north into Montana on the east side of the Continental Divide, north to about the McDonald Pass area, and also into the Rocky Mountain Front region of Montana. This is a *Pseudotsuga menziesii*-dominated system without the maritime floristic composition; these are forests and woodlands occurring in the central Rockies where the southern monsoon influence is less and maritime climate regime is not important. This system includes extensive *Pseudotsuga menziesii* forests, occasionally with *Pinus flexilis* on calcareous substrates, and *Pinus contorta* at higher elevations. True firs, such as *Abies concolor*, *Abies grandis*, and *Abies lasiocarpa*, are absent in these occurrences, but *Picea engelmannii* can occur in some stands. Understory components include shrubs such as *Physocarpus malvaceus*, *Juniperus communis*, *Symphoricarpos oreophilus*, and *Mahonia repens*, and graminoids such as *Calamagrostis rubescens*, *Carex rossii*, and *Leucopoa kingii*. The fire regime is of mixed severity with moderate frequency. This system often occurs at the lower treeline immediately above valley grasslands, or sagebrush steppe and shrublands. Sometimes there may be a "bath-tub ring" of *Pinus ponderosa* at lower elevations or *Pinus flexilis* between the valley non-forested and the solid *Pseudotsuga menziesii* forest. In the Wyoming Basins, this system occurs as isolated stands of *Pseudotsuga menziesii*, with *Artemisia tridentata*, *Pseudoroegneria spicata*, *Leucopoa kingii*, and *Carex rossii*.

Northern Rocky Mountain Conifer Swamp

This ecological system occurs in the northern Rocky Mountains from northwestern Wyoming north into the Canadian Rockies and west into eastern Oregon and Washington. It is dominated

by conifers on poorly drained soils that are saturated year-round or may have seasonal flooding in the spring. These are primarily on flat to gently sloping lowlands, but also occur up to near the lower limits of continuous forest (below the subalpine parkland). It can occur on steeper slopes where soils are shallow over unfractured bedrock. This system is indicative of poorly drained, mucky areas, and areas are often a mosaic of moving water and stagnant water. Soils can be woody peat, muck or mineral but tend toward mineral. Stands generally occupy sites on benches, toeslopes or valley bottoms along mountain streams. Associations present include wetland phases of *Thuja plicata*, *Tsuga heterophylla*, and *Picea engelmannii* forests. The wetland types are generally distinguishable from other upland forests and woodlands by shallow water tables and mesic or hydric undergrowth vegetation; some of the most typical species include *Athyrium filix-femina*, *Dryopteris* spp., *Lysichiton americanus*, *Equisetum arvense*, *Senecio triangularis*, *Mitella breweri*, *Mitella pentandra*, *Streptopus amplexifolius*, *Calamagrostis canadensis*, or *Carex disperma*.

Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest

This ecological system is composed of highly variable montane coniferous forests found in the interior Pacific Northwest, from southernmost interior British Columbia, eastern Washington, eastern Oregon, northern Idaho, western and north-central Montana, and south along the east slope of the Cascades in Washington and Oregon. In central Montana it occurs on mountain islands (the Snowy Mountains). This system is associated with a submesic climate regime with annual precipitation ranging from 50 to 100 cm, with a maximum in winter or late spring. Winter snowpacks typically melt off in early spring at lower elevations. Elevations range from 460 to 1920

m. Most occurrences of this system are dominated by a mix of *Pseudotsuga menziesii* and *Pinus ponderosa* (but there can be one without the other) and other typically seral species, including *Pinus contorta*, *Pinus monticola* (not in central Montana), and *Larix occidentalis* (not in central Montana). *Picea engelmannii* (or *Picea glauca* or their hybrid) becomes increasingly common towards the eastern edge of the range. The nature of this forest system is a matrix of large patches dominated or codominated by one or combinations of the above species; *Abies grandis* (a fire-sensitive, shade-tolerant species not occurring in central Montana) has increased on many sites once dominated by *Pseudotsuga menziesii* and *Pinus ponderosa*, which were formerly maintained by low-severity wildfire. Presettlement fire regimes may have been characterized by frequent, low-intensity ground fires that maintained relatively open stands of a mix of fire-resistant species. Under present conditions the fire regime is mixed severity and more variable, with stand-replacing fires more common, and the forests are more homogeneous. With vigorous fire suppression, longer fire-return intervals are now the rule, and multi-layered stands of *Pseudotsuga menziesii*, *Pinus ponderosa*, and/or *Abies grandis* provide fuel "ladders," making these forests more susceptible to high-intensity, stand-replacing fires. They are very productive forests which have been priorities for timber production. They rarely form either upper or lower timberline forests. Understories are dominated by graminoids, such as *Pseudoroegneria spicata*, *Calamagrostis rubescens*, *Carex geyeri*, and *Carex rossii*, that may

be associated with a variety of shrubs, such as *Acer glabrum*, *Juniperus communis*, *Physocarpus malvaceus*, *Symphoricarpos albus*, *Spiraea betulifolia*, or *Vaccinium membranaceum* on mesic sites. *Abies concolor* and *Abies grandis* X *concolor* hybrids in central Idaho (the Salmon Mountains) are included here but have very restricted range in this area. *Abies concolor* and *Abies grandis* in the Blue Mountains of Oregon are probably hybrids of the two and mostly *Abies grandis*.

Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland

This ecological system of the northern Rocky Mountains is found at lower montane to foothill elevations in the mountains and large valleys of northeastern Wyoming and western Montana, west through Idaho into the Blue Mountains of Oregon, and north into the Okanagan and Fraser plateaus of British Columbia and the Canadian Rockies. They also occur to the east in the central Montana mountain "islands," foothills, as well as the Rocky Mountain Front and Big and Little Belt ranges. These grasslands are floristically similar to ~Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)\$\$, ~Columbia Basin Foothill and Canyon Dry Grassland (CES304.993)\$\$, and ~Columbia Basin Palouse Prairie (CES304.792)\$\$, but are defined by shorter summers, colder winters, and young soils derived from recent glacial and alluvial material. These northern lower montane and valley grasslands represent a shift in the precipitation regime from summer monsoons and cold snowy winters found in the southern Rockies to predominantly dry summers and winter precipitation. In the eastern portion of its range in Montana, winter precipitation is replaced by a huge spring peak in precipitation. They are found at elevations from 300 to 1650 m, ranging from small meadows to large open parks surrounded by conifers in the lower montane, to extensive foothill and valley grasslands below the lower treeline. Many of these valleys may have been primarily sage-steppe with patches of grassland in the past, but because of land-use history post-settlement (herbicide, grazing, fire suppression, pasturing, etc.), they have been converted to grassland-dominated areas. Soils are relatively deep, fine-textured, often with coarse fragments, and non-saline, often with a microphytic crust. The most important species are cool-season perennial bunch grasses and forbs (>25% cover), sometimes with a sparse (<10% cover) shrub layer. >*Pseudoroegneria spicata*, *Festuca campestris*, *Festuca idahoensis*, or *Hesperostipa comata* commonly dominate sites on all aspects of level to moderate slopes and on certain steep slopes with a variety of other grasses, such as *Achnatherum hymenoides*, *Achnatherum richardsonii*, *Hesperostipa curtisetata*, *Koeleria macrantha*, *Leymus cinereus*, *Elymus trachycaulus*, *Bromus inermis* ssp. *pumpellianus* (= *Bromus pumpellianus*), *Achnatherum occidentale* (= *Stipa occidentalis*), *Pascopyrum smithii*, and other graminoids such as *Carex filifolia* and *Danthonia intermedia*. Other grassland species include *Opuntia fragilis*, *Artemisia frigida*, *Carex petasata*, *Antennaria* spp., and *Selaginella densa*. Important exotic grasses include *Phleum pratense*, *Bromus inermis*, and *Poa pratensis*. Shrub species may be scattered, including *Amelanchier alnifolia*, *Rosa* spp., *Symphoricarpos* spp., *Juniperus communis*, *Artemisia tridentata*, and in Wyoming *Artemisia tripartita* ssp. *rupicola*. Common associated forbs include *Geum triflorum*, *Galium boreale*, *Campanula rotundifolia*, *Antennaria microphylla*, *Geranium viscosissimum*, and *Potentilla gracilis*. A soil crust of lichen covers almost all open soil between clumps of grasses;

Cladonia and *Peltigera* are the most common lichens. Unvegetated mineral soil is commonly found between clumps of grass and the lichen cover. The fire regime of this ecological system maintains a grassland due to rapid fire return that retards shrub invasion or landscape isolation and fragmentation that limits seed dispersal of native shrub species. Fire frequency is presumed to be less than 20 years. These are extensive grasslands, not grass-dominated patches within the sagebrush shrub steppe ecological system. *Festuca campestris* is easily eliminated by grazing and does not occur in all areas of this system.

Northern Rocky Mountain Mesic Montane Mixed Conifer Forest

This ecological system occurs in the northern Rockies of western Montana west into northeastern Washington and southern British Columbia. These are vegetation types dominated by *Tsuga heterophylla* and *Thuja plicata* in most cases, found in areas influenced by incursions of mild, wet, Pacific maritime air masses. Much of the annual precipitation occurs as rain, but where snow does occur, it can generally be melted by rain during warm winter storms. Occurrences generally are found on all slopes and aspects but grow best on sites with high soil moisture, such as toeslopes and bottomlands. At the periphery of its distribution, this system is confined to moist canyons and cooler, moister aspects. Generally these are moist, non-flooded or upland sites that are not saturated yearlong. Along with *Tsuga heterophylla* and *Thuja plicata*, *Pseudotsuga menziesii* commonly shares the canopy, and *Pinus monticola*, *Pinus contorta*, *Abies grandis*, *Taxus brevifolia*, and *Larix occidentalis* are major associates. Mesic *Abies grandis* associations are included in this system, and *Abies grandis* is often the dominant in these situations; *Tsuga heterophylla* and *Thuja plicata* can both be absent. *Cornus nuttallii* may be present in some situations. *Picea engelmannii*, *Abies lasiocarpa*, and *Pinus ponderosa* may be present but only on the coldest or warmest and driest sites. *Linnaea borealis*, *Paxistima myrsinites*, *Alnus incana*, *Acer glabrum*, *Spiraea betulifolia*, *Symphoricarpos hesperius* (= *Symphoricarpos mollis* ssp. *hesperius*), *Cornus canadensis*, *Rubus parviflorus*, *Menziesia ferruginea*, and *Vaccinium membranaceum* are common shrub species. The composition of the herbaceous layer reflects local climate and degree of canopy closure; it is typically highly diverse in all but closed-canopy conditions. Important forbs and ferns include *Actaea rubra*, *Anemone piperi*, *Aralia nudicaulis*, *Asarum caudatum*, *Clintonia uniflora*, *Coptis occidentalis*, *Thalictrum occidentale*, *Tiarella trifoliata*, *Trientalis borealis*, *Trillium ovatum*, *Viola glabella*, *Gymnocarpium dryopteris*, *Polystichum munitum*, and *Adiantum pedatum*. Typically, stand-replacement, fire-return intervals are 150-500 years, with moderate-severity fire intervals of 50-100 years.

Northern Rocky Mountain Montane-Foothill Deciduous Shrubland

This shrubland ecological system is found in the lower montane and foothill regions around the Columbia Basin, and north and east into the northern Rockies. These shrublands typically occur below treeline, within the matrix of surrounding low-elevation grasslands and sagebrush shrublands. They also occur in the ponderosa pine and Douglas-fir zones, but rarely up into the subalpine zone (on dry sites). The shrublands are usually found on steep slopes of canyons and in areas with some soil development, either loess deposits or volcanic clays; they occur on all aspects. Fire, flooding and erosion all impact these shrublands, but they typically will persist on

sites for long periods. These communities develop near talus slopes as garlands, at the heads of dry drainages, and toeslopes in the moist shrub-steppe and steppe zones. *Physocarpus malvaceus*, *Prunus emarginata*, *Prunus virginiana*, *Rosa* spp., *Rhus glabra*, *Acer glabrum*, *Amelanchier alnifolia*, *Symphoricarpos albus*, *Symphoricarpos oreophilus*, and *Holodiscus discolor* are the most common dominant shrubs, occurring alone or any combination. *Rubus parviflorus* and *Ceanothus velutinus* are other important shrubs in this system, being more common in montane occurrences than in subalpine situations. Occurrences in central and eastern Wyoming can include *Artemisia tridentata* ssp. *vaseyana* and *Cercocarpus montanus*, but neither of these are dominant, and where they occur, the stands are truly mixes of shrubs, often with *Amelanchier alnifolia*, *Prunus virginiana*, and others being the predominant taxa. In moist areas, *Crataegus douglasii* can be common. *Shepherdia canadensis* and *Spiraea betulifolia* can be abundant in some cases but also occur in ~Northern Rocky Mountain Subalpine Deciduous Shrubland (CES306.961)\$. *Festuca idahoensis*, *Festuca campestris*, *Calamagrostis rubescens*, *Carex geyeri*, *Koeleria macrantha*, *Pseudoroegneria spicata*, and *Poa secunda* are the most important grasses. *Achnatherum thurberianum* and *Leymus cinereus* can be locally important. *Poa pratensis* and *Phleum pratense* are common introduced grasses. *Geum triflorum*, *Potentilla gracilis*, *Lomatium triternatum*, *Balsamorhiza sagittata*, and species of *Eriogonum*, *Phlox*, and *Erigeron* are important forbs.

Northern Rocky Mountain Ponderosa Pine Woodland and Savanna

This inland Pacific Northwest ecological system occurs in the foothills of the northern Rocky Mountains in the Columbia Plateau region and west along the foothills of the Modoc Plateau and eastern Cascades into southern interior British Columbia. These woodlands and savannas occur at the lower treeline/ecotone between grasslands or shrublands and more mesic coniferous forests typically in warm, dry, exposed sites. Elevations range from less than 500 m in British Columbia to 1600 m in the central Idaho mountains. Occurrences are found on all slopes and aspects; however, moderately steep to very steep slopes or ridgetops are most common. This ecological system generally occurs on glacial till, glacio-fluvial sand and gravel, dune, basaltic rubble, colluvium, to deep loess or volcanic ash-derived soils, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acidic pH, an abundance of mineral material, rockiness, and periods of drought during the growing season. In the Oregon "pumice zone" this system occurs as matrix-forming, extensive woodlands on rolling pumice plateaus and other volcanic deposits. These woodlands in the eastern Cascades, Okanagan and northern Rockies regions receive winter and spring rains, and thus have a greater spring "green-up" than the drier woodlands in the central Rockies. *Pinus ponderosa* (primarily var. *ponderosa*) is the predominant conifer; *Pseudotsuga menziesii* may be present in the tree canopy but is usually absent. In southern interior British Columbia, *Pseudotsuga menziesii* or *Pinus flexilis* may form woodlands or fire-maintained savannas with and without *Pinus ponderosa* var. *ponderosa* at the lower treeline transition into grassland or shrub-steppe. The understory can be shrubby, with *Artemisia tridentata*, *Arctostaphylos patula*, *Arctostaphylos uva-ursi*, *Cercocarpus ledifolius*, *Physocarpus malvaceus*, *Purshia tridentata*, *Symphoricarpos oreophilus* or *Symphoricarpos albus*, *Prunus virginiana*, *Amelanchier alnifolia*, and *Rosa* spp.

common species. Understory vegetation in the true savanna occurrences is predominantly fire-resistant grasses and forbs that resprout following surface fires; shrubs, understory trees and downed logs are uncommon. These more open stands support grasses such as *Pseudoroegneria spicata*, *Hesperostipa* spp., *Achnatherum* spp., dry *Carex* species (*Carex inops*), *Festuca idahoensis*, or *Festuca campestris*. The more mesic portions of this system may include *Calamagrostis rubescens* or *Carex geyeri*, species more typical of ~Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805)\$. Mixed fire regimes and ground fires of variable return intervals maintain these woodlands typically with a shrub-dominated or patchy shrub layer, depending on climate, degree of soil development, and understory density. This includes the northern race of Interior Ponderosa Pine old-growth (USFS Region 6, USFS Region 1). Historically, many of these woodlands and savannas lacked the shrub component as a result of 3-to 7-year fire-return intervals.

Northern Rocky Mountain Subalpine Deciduous Shrubland

This shrubland ecological system is found within the zone of continuous forest in the upper montane and lower subalpine zones of the northern Rocky Mountains. Soils tend to be moist to wet. Stands are typically initiated by fires and will persist on sites for long periods because of repeated burns and changes in the presence of volatile oils in the soil which impedes tree regeneration. *Menziesia ferruginea*, *Rhamnus alnifolia*, *Ribes lacustre*, *Rubus parviflorus*, *Alnus viridis*, *Rhododendron albiflorum*, *Sorbus scopulina*, *Sorbus sitchensis*, *Vaccinium myrtillus*, *Vaccinium scoparium*, and *Vaccinium membranaceum* are the most common dominant shrubs, occurring alone or in any combination. Other shrubs can include *Shepherdia canadensis* and *Ceanothus velutinus*, but these also commonly occur in ~Northern Rocky Mountain Montane-Foothill Deciduous Shrubland (CES306.994)\$. *Rubus parviflorus* and *Ceanothus velutinus* are occasionally present, being more common in montane shrublands than in this subalpine system. Important forbs include *Xerophyllum tenax*, *Chamerion angustifolium*, and *Pteridium aquilinum*, reflecting the mesic nature of many of these shrublands.

Northern Rocky Mountain Subalpine Woodland and Parkland

This system of the northern Rockies, Cascade Mountains, and northeastern Olympic Mountains is typically a high-elevation mosaic of stunted tree clumps, open woodlands, and herb-or dwarf-shrub-dominated openings, occurring above closed forest ecosystems and below alpine communities. It includes open areas with clumps of *Pinus albicaulis*, as well as woodlands dominated by *Pinus albicaulis* or *Larix lyallii*. In the Cascade Mountains and northeastern Olympic Mountains, the tree clump pattern is one manifestation, but these are also woodlands with an open canopy, without a tree clump/opening patchiness to them; in fact, that is quite common with *Pinus albicaulis*. The climate is typically very cold in winter and dry in summer. In the Cascades and Olympic Mountains, the climate is more maritime in nature and wind is not as extreme. The upper and lower elevational limits, due to climatic variability and differing topography, vary considerably; in interior British Columbia, this system occurs between 1000 and 2100 m elevation, and in northwestern Montana it occurs up to 2380 m. Landforms include ridgetops, mountain slopes, glacial trough walls and moraines, talus slopes, landslides and rockslides, and cirque headwalls and basins. Some sites have little snow accumulation because

of high winds and sublimation. *Larix lyallii* stands generally occur at or near upper treeline on north-facing cirques or slopes where snowfields persist until June or July. In this harsh, often wind-swept environment, trees are often stunted and flagged from damage associated with wind and blowing snow and ice crystals, especially at the upper elevations of the type. The stands or patches often originate when *Picea engelmannii*, *Larix lyallii*, or *Pinus albicaulis* colonize a sheltered site such as the lee side of a rock. *Abies lasiocarpa* can then colonize in the shelter of the *Picea engelmannii* and may form a dense canopy by branch layering. Major disturbances are windthrow and snow avalanches. Fire is known to occur infrequently in this system, at least where woodlands are present; lightning damage to individual trees is common, but sparse canopies and rocky terrain limit the spread of fire. These high-elevation coniferous woodlands are dominated by *Pinus albicaulis*, *Abies lasiocarpa*, and/or *Larix lyallii*, with occasional *Picea engelmannii*. In the Cascades and Olympics, *Abies lasiocarpa* sometimes dominates the tree layer without *Pinus albicaulis*, though in this dry parkland *Tsuga mertensiana* and *Abies amabilis* are largely absent. The undergrowth is usually somewhat depauperate, but some stands support a near sward of heath plants, such as *Phyllodoce glanduliflora*, *Phyllodoce empetriflora*, *Empetrum nigrum*, *Cassiope mertensiana*, and *Kalmia polifolia*, and can include a slightly taller layer of *Ribes montigenum*, *Salix brachycarpa*, *Salix glauca*, *Salix planifolia*, *Vaccinium membranaceum*, *Vaccinium myrtillus*, or *Vaccinium scoparium* that may be present to codominant. The herbaceous layer is sparse under dense shrub canopies or may be dense where the shrub canopy is open or absent. *Vahlodea atropurpurea* (= *Deschampsia atropurpurea*), *Luzula glabrata* var. *hitchcockii*, and *Juncus parryi* are the most commonly associated graminoids.

Northern Rocky Mountain Subalpine-Upper Montane Grassland

This is an upper montane to subalpine, high-elevation, lush grassland system dominated by perennial grasses and forbs on dry sites, particularly south-facing slopes. It is most extensive in the Canadian Rockies portion of the Rocky Mountain cordillera, extending south into western Montana, eastern Oregon, eastern Washington and Idaho. Subalpine dry grasslands are small meadows to large open parks surrounded by conifer trees but lack tree cover within them. In general, soil textures are much finer, and soils are often deeper under grasslands than in the neighboring forests. Grasslands, although composed primarily of tussock-forming species, do exhibit a dense sod that makes root penetration difficult for tree species. Disturbance such as fire also plays a role in maintaining these open grassy areas. Typical dominant species include *Leymus innovatus* (= *Elymus innovatus*), *Koeleria macrantha*, *Festuca campestris*, *Festuca idahoensis*, *Festuca viridula*, *Achnatherum occidentale* (= *Stipa occidentalis*), *Achnatherum richardsonii* (= *Stipa richardsonii*), *Bromus inermis* ssp. *pumpellianus* (= *Bromus pumpellianus*), *Elymus trachycaulus*, *Phleum alpinum*, *Trisetum spicatum*, and a variety of Carices, such as *Carex hoodii*, *Carex obtusata*, and *Carex scirpoidea*. Important forbs include *Lupinus argenteus* var. *laxiflorus*, *Potentilla diversifolia*, *Potentilla flabellifolia*, *Fragaria virginiana*, and *Chamerion angustifolium* (= *Epilobium angustifolium*). This system is similar to Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040) but is found at higher elevations and is more often composed of species of *Festuca*, *Achnatherum*, and/or *Hesperostipa* with additional floristic components of more subalpine taxa. Occurrences of this

system are often more forb-rich than ~Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)\$.

Rocky Mountain Alpine/Montane Sparsely Vegetated Systems

This ecological system group is found from foothill to alpine elevations within the Rocky Mountain Cordillera and Cascade Range. It also occurs in several scattered locations on the tallest mountains in the Great Basin and Colorado Plateau. It is composed of scree slopes, steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock type. Exposure to desiccating winds, rocky and sometimes unstable substrates, and a short growing season limit plant growth. Substrates are rocky and soil development is limited. There may be small patches of dense vegetation, but it typically includes scattered trees and/or shrubs or sparse herbaceous vegetation. Nonvascular cover may be sparse to moderately dense. Characteristic trees include *Abies concolor*, *Abies lasiocarpa*, *Pinus flexilis*, *Pinus ponderosa*, *Populus tremuloides*, *Pseudotsuga menziesii*, or *Pinus edulis* and *Juniperus* spp. at lower elevations. There may be scattered shrubs present, such as *Amelanchier alnifolia*, *Jamesia americana*, *Mahonia repens*, *Rhus trilobata*, species of *Holodiscus*, *Juniperus*, *Physocarpus*, *Ribes*, and *Rosa*. Herbaceous cover is sparse and restricted to crevices and soil pockets.

Rocky Mountain Aspen Forest and Woodland

This widespread ecological system is more common in the southern and central Rocky Mountains but occurs in the montane and subalpine zones throughout much of the western U.S. and north into Canada. An eastern extension occurs along the Rocky Mountains foothill front and in mountain "islands" in Montana (Big Snowy and Highwood mountains), and the Black Hills of South Dakota. In California, this system is only found on the east side of the Sierra Nevada adjacent to the Great Basin. Large stands are found in the Inyo and White mountains, while small stands occur on the Modoc Plateau. Elevations generally range from 1525 to 3050 m (5000-10,000 feet), but occurrences can be found at lower elevations in some regions. Distribution of this ecological system is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand. Secondly, it is limited by the length of the growing season or low temperatures. These are upland forests and woodlands dominated by *Populus tremuloides* without a significant conifer component (<25% relative tree cover). The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs. In California, *Symphotrichum spathulatum* (= *Aster occidentalis*) is a common forb. Associated shrub species include *Symphoricarpos* spp., *Rubus parviflorus*, *Amelanchier alnifolia*, and *Arctostaphylos uva-ursi*. Occurrences of this system originate and are maintained by stand-replacing disturbances such as avalanches, crown fire, insect outbreak, disease and windthrow, or clearcutting by man or beaver, within the matrix of conifer forests. It differs from ~Northwestern Great Plains Aspen Forest and Parkland (CES303.681)\$\$, which is limited to plains environments.

Rocky Mountain Lodgepole Pine Forest

This ecological system is widespread in upper montane to subalpine elevations of the Rocky Mountains, Intermountain West region, north into the Canadian Rockies and east into mountain "islands" of north-central Montana. These are subalpine forests where the dominance of *Pinus contorta* is related to fire history and topo-edaphic conditions. Following stand-replacing fires, *Pinus contorta* will rapidly colonize and develop into dense, even-aged stands. Most forests in this ecological system occur as early-to mid-successional forests which developed following fires. This system includes *Pinus contorta*-dominated stands that, while typically persistent for >100-year time frames, may succeed to spruce-fir; in the southern and central Rocky Mountains it is seral to ~Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (CES306.828)\$. More northern occurrences are seral to ~Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830)\$. Soils supporting these forests are typically well-drained, gravelly, coarse-textured, acidic, and rarely formed from calcareous parent materials. These forests are dominated by *Pinus contorta* with shrub, grass, or barren understories. Sometimes there are intermingled mixed conifer/*Populus tremuloides* stands, with the latter occurring with inclusions of deeper, typically fine-textured soils. The shrub stratum may be conspicuous to absent; common species include *Arctostaphylos uva-ursi*, *Ceanothus velutinus*, *Linnaea borealis*, *Mahonia repens*, *Purshia tridentata*, *Spiraea betulifolia*, *Spiraea douglasii*, *Shepherdia canadensis*, *Vaccinium caespitosum*, *Vaccinium scoparium*, *Vaccinium membranaceum*, *Symphoricarpos albus*, and *Ribes* spp. In southern interior British Columbia, this system is usually an open lodgepole pine forest found extensively between 500 and 1600 m elevation in the Columbia Range. In the Interior Cedar Hemlock and Interior Douglas-fir zones, *Tsuga heterophylla* or *Pseudotsuga menziesii* may present.

Rocky Mountain Montane Riparian Forest and Woodland

This lower montane riparian systems group is found throughout the Rocky Mountains and Colorado Plateau regions within a broad elevational range from approximately 900 to 2800 m. These systems often occur as mosaics of multiple communities that are tree-dominated with a diverse shrub component. Occurrences are found within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks. They can form large, wide occurrences on mid-channel islands in larger rivers or narrow bands on small, rocky canyon tributaries and well-drained benches. Stands are also found in backwater channels and other perennially wet but less scoured sites, such as floodplains swales and irrigation ditches. Dominant trees may include *Acer negundo*, *Populus angustifolia*, *Populus balsamifera*, *Populus deltoides*, *Populus fremontii*, *Pseudotsuga menziesii*, *Picea pungens*, *Populus tremuloides*, *Salix amygdaloides*, *Juniperus scopulorum*, *Picea mariana*, and *Picea glauca*. Dominant shrubs include *Acer glabrum*, *Alnus incana*, *Betula occidentalis*, *Betula papyrifera*, *Cornus sericea*, *Crataegus rivularis*, *Forestiera pubescens*, *Prunus virginiana*, *Rhus trilobata*, *Salix monticola*, *Salix drummondiana*, *Salix exigua*, *Salix irrorata*, *Salix lucida*, *Shepherdia argentea*, or *Symphoricarpos* spp. Exotic trees *Elaeagnus angustifolia* and *Tamarix* spp. are common in some stands.

Rocky Mountain Poor-Site Lodgepole Pine Forest

This ecological system is widespread but patchy in distribution in upper montane to subalpine elevations of the Rocky Mountains and Intermountain region. These are subalpine forests, occasionally found in the montane zone, where the dominance of *Pinus contorta* is related to topo-edaphic conditions and nutrient-poor soils. These include excessively well-drained pumice deposits, glacial till and alluvium on valley floors where there is cold-air accumulation, warm and droughty shallow soils over fractured quartzite bedrock, and shallow moisture-deficient soils with a significant component of volcanic ash. Pumice soils at lower elevations of the pumice zone of Oregon support this system. Soils on these sites are typically well-drained, gravelly, coarse-textured, acidic, and rarely formed from calcareous parent materials. Following stand-replacing fires, *Pinus contorta* will rapidly colonize and develop into dense, even-aged stands and then persist on these sites that are too extreme for other conifers to establish. In some cases, stands are open to dense and may be multi-aged, not just even-aged. These forests are dominated by *Pinus contorta* with shrub, grass, or barren understories. Sometimes there are intermingled mixed conifer/*Populus tremuloides* stands, with the latter occurring with inclusions of deeper, typically fine-textured soils. In central Oregon, *Pseudotsuga menziesii*, *Pinus ponderosa*, and *Abies concolor* may be present, and *Populus tremuloides* may be present as small patches. The shrub stratum may be conspicuous to absent; common species include *Arctostaphylos uva-ursi*, *Artemisia tridentata*, *Juniperus communis*, *Ceanothus velutinus*, *Linnaea borealis*, *Mahonia repens*, *Purshia tridentata*, *Spiraea betulifolia*, *Shepherdia canadensis*, *Vaccinium scoparium*, *Symphoricarpos albus*, and *Ribes* spp. Some open stands with very sparse understories can experience a form of mixed-severity burning via cigarette burning along downed logs (insufficient fuels between logs to carry fire). Depending on the arrangement and loading of logs to living trees, either mortality or fire-scarring may occur.

Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland

Engelmann spruce and subalpine fir forests comprise a substantial part of the subalpine forests of the Cascades and Rocky Mountains from southern British Columbia east into Alberta, and south into New Mexico and the Intermountain region. They also occur on mountain "islands" of north-central Montana. They are the matrix forests of the subalpine zone, with elevations ranging from 1275 m in its northern distribution to 3355 m in the south (4100-11,000 feet). They often represent the highest elevation forests in an area. Sites within this system are cold year-round, and precipitation is predominantly in the form of snow, which may persist until late summer. Snowpacks are deep and late-lying, and summers are cool. Frost is possible almost all summer and may be common in restricted topographic basins and benches. Despite their wide distribution, the tree canopy characteristics are remarkably similar, with *Picea engelmannii* and *Abies lasiocarpa* dominating either mixed or alone. *Pseudotsuga menziesii* may persist in occurrences of this system for long periods without regeneration. *Pinus contorta* is common in many occurrences, and patches of pure *Pinus contorta* are not uncommon, as well as mixed conifer/*Populus tremuloides* stands. In some areas, such as Wyoming, *Picea engelmannii*-dominated forests are on limestone or dolomite, while nearby codominated spruce-fir forests are

on granitic or volcanic rocks. Upper elevation examples may have more woodland physiognomy, and *Pinus albicaulis* can be a seral component. What have been called "ribbon forests" or "tree islands" by some authors are included here; they can be found at upper treeline in many areas of the Rockies, including the central and northern ranges in Colorado and the Medicine Bow and Bighorn ranges of Wyoming. These are more typically islands or ribbons of trees, sometimes with a krummholz form, with open-meadow areas in a mosaic. These patterns are controlled by snow deposition and wind-blown ice. Xeric species may include *Juniperus communis*, *Linnaea borealis*, *Mahonia repens*, or *Vaccinium scoparium*. In the Bighorn Mountains, *Artemisia tridentata* is a common shrub. More northern occurrences often have taller, more mesic shrub and herbaceous species, such as *Empetrum nigrum*, *Rhododendron albiflorum*, and *Vaccinium membranaceum*. Disturbance includes occasional blowdown, insect outbreaks and stand-replacing fire. Mean return interval for stand-replacing fire is 222 years as estimated in southeastern British Columbia.

Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland

This is a high-elevation system of the Rocky Mountains, dry eastern Cascades and eastern Olympic Mountains dominated by *Picea engelmannii* and *Abies lasiocarpa*. It extends westward into the northeastern Olympic Mountains and the northeastern side of Mount Rainier in Washington, and as far east as mountain "islands" of north-central Montana. *Picea engelmannii* is generally more important in southern forests than those in the Pacific Northwest. Occurrences are typically found in locations with cold-air drainage or ponding, or where snowpacks linger late into the summer, such as north-facing slopes and high-elevation ravines. They can extend down in elevation below the subalpine zone in places where cold-air ponding occurs; northerly and easterly aspects predominate. These forests are found on gentle to very steep mountain slopes, high-elevation ridgetops and upper slopes, plateau-like surfaces, basins, alluvial terraces, well-drained benches, and inactive stream terraces. In the northern Rocky Mountains of northern Idaho and Montana, *Tsuga mertensiana* occurs as small to large patches within the matrix of this mesic spruce-fir system and only in the most maritime of environments (the coldest and wettest of the more Continental subalpine fir forests). In the Olympics and northern Cascades, the climate is more maritime than typical for this system, but due to the lower snowfall in these rainshadow areas, summer drought may be more significant than snowpack in limiting tree regeneration in burned areas. *Picea engelmannii* is rare in these areas. Mesic understory shrubs include *Menziesia ferruginea*, *Vaccinium membranaceum*, *Rhododendron albiflorum*, *Amelanchier alnifolia*, *Rubus parviflorus*, *Ledum glandulosum*, *Phyllodoce empetrifomis*, and *Salix* spp. Herbaceous species include *Actaea rubra*, *Maianthemum stellatum*, *Cornus canadensis*, *Erigeron eximius*, *Gymnocarpium dryopteris*, *Rubus pedatus*, *Saxifraga bronchialis*, *Tiarella* spp., *Lupinus arcticus* ssp. *subalpinus*, *Valeriana sitchensis*, and graminoids *Luzula glabrata* var. *hitchcockii* or *Calamagrostis canadensis*. Disturbances include occasional blowdown, insect outbreaks (30-50 years), mixed-severity fire, and stand-replacing fire (every 150-500 years). The more summer-dry climatic areas also have occasional high-severity fires.

Rocky Mountain Subalpine/Upper Montane Riparian Forest and Woodland

This riparian system group is composed of seasonally flooded forests, woodlands and shrublands found at montane to subalpine elevations of the Rocky Mountain cordillera, from southern New Mexico north into Montana, and west into the Intermountain region and the Colorado Plateau. Elevations range between 1500 and 3300 m; farther north elevation ranges between 900 and 2000 m. Stands are variable, occurring as narrow bands of trees and/or shrubs lining streambanks and alluvial terraces in narrow to wide, low-gradient valley bottoms and floodplains with sinuous stream channels to larger floodplains or terraces of rivers and streams, in V-shaped, narrow valleys and canyons (where there is cold-air drainage). Less frequently, occurrences are found in moderately wide valley bottoms on large floodplains along broad, meandering rivers, and on pond or lake margins. Stands can also be found around seeps, fens, and isolated springs on hillslopes away from valley bottoms. Dominant tree species vary across the latitudinal range, although it usually includes *Abies lasiocarpa* and/or *Picea engelmannii*; other important species include *Pseudotsuga menziesii*, *Picea pungens*, *Picea engelmannii* X *glauca*, *Populus tremuloides*, and *Juniperus scopulorum*. Other trees possibly present but not usually dominant include *Abies concolor*, *Abies grandis*, *Pinus contorta*, *Populus angustifolia*, *Populus balsamifera* ssp. *trichocarpa*, and *Juniperus osteosperma*. The dominant shrubs reflect the large elevational gradient and include *Alnus incana*, *Betula glandulosa*, *Betula occidentalis*, *Cornus sericea*, *Salix bebbiana*, *Salix boothii*, *Salix brachycarpa*, *Salix drummondiana*, *Salix eriocephala*, *Salix geyeriana*, *Salix monticola*, *Salix planifolia*, and *Salix wolfii*.

Rocky Mountain Subalpine-Montane Mesic Meadow

This Rocky Mountain ecological system is restricted to sites from lower montane to subalpine where finely textured soils, snow deposition, or windswept dry conditions limit tree establishment. Many occurrences are small patch in spatial character, and are often found in mosaics with woodlands, more dense shrublands, or just below alpine communities. It is typically found above 2000 m in elevation in the southern part of its range and above 600 m in the northern part. These upland communities occur on gentle to moderate-gradient slopes and relatively moist habitats. The soils are typically seasonally moist to saturated in the spring, but if so will dry out later in the growing season. These sites are not as wet as those found in ~Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)\$. Vegetation is typically forb-rich, with forbs often contributing more to overall herbaceous cover than graminoids. Some stands are comprised of dense grasslands, these often being taxa with relatively broad and soft blades, but where the moist habitat promotes a rich forb component. Important taxa include *Erigeron* spp., *Asteraceae* spp., *Mertensia* spp., *Penstemon* spp., *Campanula* spp., *Lupinus* spp., *Solidago* spp., *Ligusticum* spp., *Thalictrum occidentale*, *Valeriana sitchensis*, *Rudbeckia occidentalis*, *Balsamorhiza sagittata*, and *Wyethia* spp. Important grasses include *Deschampsia caespitosa*, *Koeleria macrantha*, perennial *Bromus* spp., and a number of *Carex* species. *Dasiphora fruticosa* ssp. *floribunda* and *Symphoricarpos* spp. are occasional but not abundant. Burrowing mammals can increase the forb diversity.

Rocky Mountain Wetland-Herbaceous

These are high-elevation communities found throughout the Rocky Mountains and Intermountain regions, dominated by herbaceous species found on wetter sites with very low-velocity surface and subsurface flows. They range in elevation from montane to alpine (1000-3600 m). These types occur as large meadows in montane or subalpine valleys, as narrow strips bordering ponds, lakes, and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on sub-irrigated sites with slopes up to 10%. In alpine regions, sites typically are small depressions located below late-melting snow patches or on snowbeds. Soils of this system may be mineral or organic. In either case, soils show typical hydric soil characteristics, including high organic content and/or low chroma and redoximorphic features. This system often occurs as a mosaic of several plant associations, often dominated by graminoids, including *Calamagrostis stricta*, *Caltha leptosepala*, *Cardamine cordifolia*, *Carex illota*, *Carex microptera*, *Carex nigricans*, *Carex scopulorum*, *Carex utriculata*, *Carex vernacula*, *Deschampsia caespitosa*, *Eleocharis quinqueflora*, *Juncus drummondii*, *Phippsia algida*, *Rorippa alpina*, *Senecio triangularis*, *Trifolium parryi*, and *Trollius laxus*. Often alpine dwarf-shrublands, especially those dominated by *Salix*, are immediately adjacent to the wet meadows. Wet meadows are tightly associated with snowmelt and typically not subjected to high disturbance events such as flooding.

Subalpine Douglas-fir Forest

This forest and woodland alliance is dominated by *Pseudotsuga menziesii* and occurs on relatively dry to mesic sites throughout the middle Rocky Mountains of central and southern Idaho, the Greater Yellowstone region, and the Wind River, Gros Ventre and Bighorn ranges of Wyoming and in Montana on the east side of the Continental Divide. Stands of this alliance are *Pseudotsuga menziesii*-dominated forests and woodlands occasionally with *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus flexilis* (on calcareous substrates), *Populus tremuloides* (on disturbed sites), and *Pinus contorta* (at higher elevations). True firs, such as *Abies concolor*, *Abies grandis*, and *Abies lasiocarpa*, are absent, but occasional *Picea engelmannii* can occur in some stands. *Pinus ponderosa* is also not common in this group. Understory components include shrubs such as *Cercocarpus ledifolius*, *Juniperus communis*, *Mahonia repens*, *Purshia tridentata*, *Spiraea betulifolia*, *Symphoricarpos albus*, and *Symphoricarpos oreophilus*. Common graminoids include *Calamagrostis rubescens*, *Carex rossii*, *Leucopoa kingii*, and *Pseudoroegneria spicata*. Forbs are variable, but typical taxa include *Arnica cordifolia*, *Thalictrum occidentale*, *Viola adunca*, and species of many other genera, including *Antennaria*, *Arenaria*, *Erigeron*, *Eriogonum*, *Lathyrus*, *Lupinus*, *Penstemon*, and *Vicia*. This alliance occurs on relatively dry to mesic sites throughout the middle Rocky Mountains of central and southern Idaho, the Greater Yellowstone region, and the Wind River, Gros Ventre and Bighorn ranges of Wyoming. It extends north into Montana on the east side of the Continental Divide, to the McDonald Pass area, and also into the Rocky Mountain Front region and central "sky island" ranges of Montana. This alliance often occurs at the lower treeline immediately above valley grasslands, or sagebrush steppe and shrublands. Stands are found on all aspects in the Central Rockies where the southern monsoon influence is less and maritime climate regime is not important. Climate is drier and more continental than at higher

elevations or in the Pacific Northwest. Annual precipitation ranges from 50-100 cm with moderate snowfall and a greater proportion falling during the growing season. Monsoonal summer rains can contribute a significant proportion of the annual precipitation in the southern portion of the range. Elevations range from less than 1000 m in the central Rocky Mountains to over 2400 m in the Wyoming Rockies. Lower elevation stands typically occupy cooler, less xeric northern exposures often on steep slopes. At higher elevations, these forests occur primarily on southerly aspects or ridgetops and plateaus. Soils are highly variable and derived from diverse parent materials, including extrusive volcanics in the Yellowstone region, and sedimentary rocks elsewhere in the Rockies. The soils are typically well-drained and well-aerated. They can be derived from moderately deep colluvium or shallow-jointed bedrock, and are usually gravelly or rocky.

Xeric Montane Douglas-fir Forest

This forest and woodland alliance is dominated by *Pseudotsuga menziesii* and occurs on relatively dry to mesic sites throughout the middle Rocky Mountains of central and southern Idaho, the Greater Yellowstone region, and the Wind River, Gros Ventre and Bighorn ranges of Wyoming and in Montana on the east side of the Continental Divide. Stands of this alliance are *Pseudotsuga menziesii*-dominated forests and woodlands occasionally with *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus flexilis* (on calcareous substrates), *Populus tremuloides* (on disturbed sites), and *Pinus contorta* (at higher elevations). True firs, such as *Abies concolor*, *Abies grandis*, and *Abies lasiocarpa*, are absent, but occasional *Picea engelmannii* can occur in some stands. *Pinus ponderosa* is also not common in this group. Understory components include shrubs such as *Cercocarpus ledifolius*, *Juniperus communis*, *Mahonia repens*, *Purshia tridentata*, *Spiraea betulifolia*, *Symphoricarpos albus*, and *Symphoricarpos oreophilus*. Common graminoids include *Calamagrostis rubescens*, *Carex rossii*, *Leucopoa kingii*, and *Pseudoroegneria spicata*. Forbs are variable, but typical taxa include *Arnica cordifolia*, *Thalictrum occidentale*, *Viola adunca*, and species of many other genera, including *Antennaria*, *Arenaria*, *Erigeron*, *Eriogonum*, *Lathyrus*, *Lupinus*, *Penstemon*, and *Vicia*. This alliance occurs on relatively dry to mesic sites throughout the middle Rocky Mountains of central and southern Idaho, the Greater Yellowstone region, and the Wind River, Gros Ventre and Bighorn ranges of Wyoming. It extends north into Montana on the east side of the Continental Divide, to the McDonald Pass area, and also into the Rocky Mountain Front region and central "sky island" ranges of Montana. This alliance often occurs at the lower treeline immediately above valley grasslands, or sagebrush steppe and shrublands. Stands are found on all aspects in the Central Rockies where the southern monsoon influence is less and maritime climate regime is not important. Climate is drier and more continental than at higher elevations or in the Pacific Northwest. Annual precipitation ranges from 50-100 cm with moderate snowfall and a greater proportion falling during the growing season. Monsoonal summer rains can contribute a significant proportion of the annual precipitation in the southern portion of the range. Elevations range from less than 1000 m in the central Rocky Mountains to over 2400 m in the Wyoming Rockies. Lower elevation stands typically occupy cooler, less xeric northern exposures often on steep slopes. At higher elevations, these forests occur primarily on southerly aspects or ridgetops and plateaus. Soils are highly variable and derived from diverse parent materials, including extrusive volcanics in the Yellowstone region, and sedimentary rocks

elsewhere in the Rockies. The soils are typically well-drained and well-aerated. They can be derived from moderately deep colluvium or shallow-jointed bedrock, and are usually gravelly or rocky.

Western Riparian Woodland and Shrubland

No description in LANDFIRE/GAP Land Cover Map Unit Descriptions.

H-6: Whitebark Pine Impacts

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Table H-6-1 Whitebark Pine Impacts under Alternative 1

Occupied Habitat Polygon Number	Total Acres in Polygon within Analysis Area	Total Acres Directly Impacted	Approximate Live Trees in Polygon	Midpoint	Estimated Number of Live Trees Removed	Percent Producing Female Cones	Midpoint	Estimated Number of Trees Producing Female Cones Removed	Direct Impact Project Components
1	56.8	8.0	100 to 150	125	17.5	6 to 10%	8%	1.4	Utilities and Tall Tree Clearing
2	29.1	3.6	11 to 25	18	2.2	1 to 5%	3%	0.1	Utilities and Tall Tree Clearing
3	7.2	0.7	6 to 10	8	0.8	1 to 5%	3%	0.01	Utilities and Tall Tree Clearing
4	33.2	6.7	100 to 150	125	25.4	6 to 10%	8%	2.0	Access Roads, Utilities, and Tall Tree Clearing
10	29.9	4.5	11 to 25	18	2.7	-	-	-	Utilities and Tall Tree Clearing
11	56.2	7.3	26 to 50	38	4.9	1 to 5%	3%	0.1	Utilities and Tall Tree Clearing
14	31.3	2.4	51 to 75	63	4.9	1 to 5%	3%	0.1	Utilities
15	135.8	18.7	150 to 500	125	17.2	-	-	-	Utilities and Tall Tree Clearing
16	33.0	6.1	51 to 75	63	11.6	1 to 5%	3%	0.3	Utilities and Tall Tree Clearing
18	28.2	3.4	100 to 150	125	15.1	1 to 5%	3%	0.5	Utilities and Tall Tree Clearing
22	0.5	0.2	1 to 5	3	1.3	-	-	-	Utilities and Tall Tree Clearing
37	19.4	1.9	1 to 5	3	0.3	-	-	-	Access Roads
40	4.3	0.4	1 to 5	3	0.3	-	-	-	Access Roads
41	0.2	0.03	1 to 5	3	0.4	-	-	-	Access Roads
42	0.6	0.01	1 to 5	3	0.1	-	-	-	Access Roads
43	32.3	2.6	100 to 150	125	10.1	-	-	-	Access Roads
45	52	3.6	100 to 150	125	8.8	-	-	-	Access Roads
46	37.8	4.7	26 to 50	38	4.8	-	-	-	Access Roads
47	61.1	6.3	11 to 25	18	1.9	-	-	-	Access Roads
48	58	7.8	11 to 25	18	2.4	-	-	-	Access Roads
49	3	0.5	6 to 10	8	1.3	-	-	-	Access Roads
50	1.7	0.3	1 to 5	3	0.5	-	-	-	Access Roads
51	0.8	0.002	6 to 10	8	0.0	-	-	-	Access Roads
52	0.6	0.2	1 to 5	3	1.0	-	-	-	Access Roads
54	50	4.6	100 to 150	125	11.5	-	-	-	Access Roads
55	5.2	0.5	1 to 5	3	0.3	-	-	-	Access Roads
58	1.7	0.05	6 to 10	8	0.2	-	-	-	Access Roads
60	12.6	1.2	6 to 10	8	0.8	-	-	-	Access Roads
61	20.9	1.8	1 to 5	3	0.3	-	-	-	Access Roads
62	18.8	5.9	11 to 25	18	5.7	-	-	-	Access Roads
63	9.2	1.1	11 to 25	18	2.1	-	-	-	Access Roads
64	0.02	0.02	1 to 5	3	2.4	-	-	-	Mine Site
68	0.4	0.3	1 to 5	3	2.3	-	-	-	Access Roads
70	4.9	1.2	11 to 25	18	4.4	-	-	-	Mine Site

APPENDIX H-6 – WHITEBARK PINE IMPACTS

Occupied Habitat Polygon Number	Total Acres in Polygon within Analysis Area	Total Acres Directly Impacted	Approximate Live Trees in Polygon	Midpoint	Estimated Number of Live Trees Removed	Percent Producing Female Cones	Midpoint	Estimated Number of Trees Producing Female Cones Removed	Direct Impact Project Components
71	852.3	10.9	150 to 500	325	4.1	-	-	-	Access Roads
72	16.3	1.9	26 to 50	38	4.3	-	-	-	Access Roads
73	12.2	1.1	6 to 10	8	0.7	-	-	-	Access Roads
74	4.6	0.5	6 to 10	8	0.9	-	-	-	Access Roads
75	2.0	0.3	6 to 10	8	1.4	-	-	-	Access Roads
76	3.9	0.3	51 to 75	63	4.5	-	-	-	Access Roads
78	5.0	0.7	11 to 25	18	2.5	-	-	-	Access Roads
79	5.5	0.5	26 to 50	38	3.4	-	-	-	Access Roads
80	4.5	0.8	11 to 25	18	3.0	-	-	-	Access Roads
81	1.7	0.02	26 to 50	38	0.4	-	-	-	Access Roads
83	0.1	0.001	1 to 5	3	0.0	-	-	-	Access Roads
84	61.2	0.1	150 to 500	325	0.8	-	-	-	Access Roads
86	133.8	23.6	500 to 1,000	750	132.6	-	-	-	Access Roads
87	69.1	0.3	150 to 500	325	1.6	-	-	-	Access Roads
88	0.1	0.1	1 to 5	3	2.7	-	-	-	Access Roads
89	2.2	0.1	6 to 10	8	0.3	-	-	-	Utilities
90	8	0.2	26 to 50	38	0.7	-	-	-	Access Roads
91	32.1	22.6	76 to 100	88	62.1	-	-	-	Mine Site
92	3.8	0.9	6 to 10	8	1.9	-	-	-	Utilities and Tall Tree Clearing
93	10.9	0.1	76 to 100	88	0.8	-	-	-	Utilities
94	10.8	0.8	51 to 75	63	4.6	-	-	-	Utilities
95	35.3	1.4	150 to 500	325	13.0	1 to 5%	3%	0.4	Utilities
96	54.1	2.0	500 to 1,000	750	27.8	1 to 5%	3%	0.8	Utilities
97	44.2	3.7	1,000+	1000	83.1	-	-	-	Access Roads
98	45.4	17.0	76 to 100	88	33.0	-	-	-	Access Roads
99	26.5	14.3	11 to 25	18	9.7	-	-	-	Access Roads
100	47.6	6.4	76 to 100	88	11.8	-	-	-	Access Roads
101	0.4	0.1	11 to 25	18	4.2	-	-	-	Access Roads
102	7.2	1.8	1 to 5	3	0.8	-	-	-	Access Roads
103	0.9	0.2	11 to 25	18	4.3	-	-	-	Access Roads
105	4.9	2.0	500 to 1,000	750	305.5	1 to 5%	3%	9.2	Mine Site
108	6.2	0.7	100 to 150	125	14.9	1 to 5%	3%	0.4	Mine Site
111	4.2	4.2	11 to 25	18	18.0	-	-	-	Mine Site
112	34.4	24.8	100 to 150	125	90.0	26 to 50%	38%	34.2	Mine Site
115	3.9	3.7	6 to 10	8	7.5	-	-	-	Mine Site

APPENDIX H-6 – WHITEBARK PINE IMPACTS

Occupied Habitat Polygon Number	Total Acres in Polygon within Analysis Area	Total Acres Directly Impacted	Approximate Live Trees in Polygon	Midpoint	Estimated Number of Live Trees Removed	Percent Producing Female Cones	Midpoint	Estimated Number of Trees Producing Female Cones Removed	Direct Impact Project Components
116	0.9	0.9	1 to 5	3	3.0	-	-	-	Mine Site
117	3.7	0.8	1 to 5	3	0.7	-	-	-	Mine Site
118	12.2	1.4	6 to 10	8	0.9	-	-	-	Access Roads
119	0.7	0.0	1 to 5	3	0.1	-	-	-	Access Roads
TOTAL	2,409.5	257.8	-	-	1,027	-	-	50	-

Table H-6-2 Whitebark Pine Impacts under Alternative 2

Occupied Habitat Polygon Number	Total Acres in Polygon within Analysis Area	Total Acres Directly Impacted	Approximate Live Trees in Polygon	Midpoint	Estimated Number of Live Trees Removed	Percent Producing Female Cones	Midpoint	Estimated Number of Trees Producing Female Cones Removed	Direct Impact Project Components
1	56.8	8.0	100 to 150	125	17.5	6 to 10%	8%	1.4	Utilities and Tall Tree Clearing
2	29.1	3.6	11 to 25	18	2.2	1 to 5%	3%	0.1	Utilities and Tall Tree Clearing
3	7.2	0.7	6 to 10	8	0.8	1 to 5%	3%	0.0	Utilities and Tall Tree Clearing
4	33.2	6.7	100 to 150	125	25.4	6 to 10%	8%	2.0	Access Roads, Utilities, and Tall Tree Clearing
10	29.9	4.5	11 to 25	18	2.7	-	-	-	Utilities and Tall Tree Clearing
11	56.2	7.3	26 to 50	38	4.9	1 to 5%	3%	0.1	Utilities and Tall Tree Clearing
14	31.3	2.4	51 to 75	63	4.9	1 to 5%	3%	0.1	Utilities
15	135.8	18.7	150 to 500	125	17.2	-	-	-	Utilities and Tall Tree Clearing
16	33.0	6.1	51 to 75	63	11.6	1 to 5%	3%	0.3	Utilities and Tall Tree Clearing
18	28.2	3.4	100 to 150	125	15.1	1 to 5%	3%	0.5	Utilities and Tall Tree Clearing
22	0.5	0.2	1 to 5	3	1.3	-	-	-	Utilities and Tall Tree Clearing
37	19.4	1.9	1 to 5	3	0.3	-	-	-	Access Roads
40	4.3	0.4	1 to 5	3	0.3	-	-	-	Access Roads
41	0.2	0.03	1 to 5	3	0.4	-	-	-	Access Roads
42	0.6	0.01	1 to 5	3	0.1	-	-	-	Access Roads
43	32.3	2.6	100 to 150	125	10.1	-	-	-	Access Roads
45	52	3.6	100 to 150	125	8.8	-	-	-	Access Roads
46	37.8	4.7	26 to 50	38	4.8	-	-	-	Access Roads
47	61.1	6.3	11 to 25	18	1.9	-	-	-	Access Roads
48	58	7.8	11 to 25	18	2.4	-	-	-	Access Roads
49	3	0.5	6 to 10	8	1.3	-	-	-	Access Roads
50	1.7	0.3	1 to 5	3	0.5	-	-	-	Access Roads
51	0.8	0.002	6 to 10	8	0.02	-	-	-	Access Roads
52	0.6	0.2	1 to 5	3	1.0	-	-	-	Access Roads
53	0.2	0.0002	1 to 5	3	0.002	-	-	-	Access Roads
54	50	4.6	100 to 150	125	11.5	-	-	-	Access Roads
55	5.2	0.5	1 to 5	3	0.3	-	-	-	Access Roads
58	1.7	0.05	6 to 10	8	0.2	-	-	-	Access Roads
60	12.6	1.2	6 to 10	8	0.8	-	-	-	Access Roads
61	20.9	1.8	1 to 5	3	0.3	-	-	-	Access Roads
62	18.8	5.9	11 to 25	18	5.7	-	-	-	Access Roads and Offsite Facilities
63	9.2	1.1	11 to 25	18	2.1	-	-	-	Access Roads
64	0.02	0.02	1 to 5	3	2.4	-	-	-	Mine Site
68	0.4	0.3	1 to 5	3	2.3	-	-	-	Access Roads

APPENDIX H-6 – WHITEBARK PINE IMPACTS

Occupied Habitat Polygon Number	Total Acres in Polygon within Analysis Area	Total Acres Directly Impacted	Approximate Live Trees in Polygon	Midpoint	Estimated Number of Live Trees Removed	Percent Producing Female Cones	Midpoint	Estimated Number of Trees Producing Female Cones Removed	Direct Impact Project Components
70	4.9	1.2	11 to 25	18	4.4	-	-	-	Mine Site
71	852.3	11.2	150 to 500	325	4.3	-	-	-	Access Roads and Utilities
84	61.2	6.1	150 to 500	325	32.5	-	-	-	Access Roads
85	58.8	6.9	150 to 500	325	38.0	-	-	-	Access Roads
86	133.8	31.4	500 to 1,000	750	176.0	-	-	-	Access Roads
87	69.1	0.3	150 to 500	325	1.6	-	-	-	Access Roads and Utilities
88	0.1	0.1	1 to 5	3	2.7	-	-	-	Access Roads
89	2.2	0.1	6 to 10	8	0.3	-	-	-	Utilities
90	8	0.4	26 to 50	38	1.8	-	-	-	Access Roads
91	32.1	22.6	76 to 100	88	62.1	-	-	-	Mine Site
92	3.8	0.9	6 to 10	8	1.9	-	-	-	Utilities
93	10.9	0.1	76 to 100	88	0.8	-	-	-	Utilities
94	10.8	0.8	51 to 75	63	4.6	-	-	-	Utilities
95	35.3	1.4	150 to 500	325	13.0	1 to 5%	3%	0.4	Utilities
96	54.1	2.0	500 to 1,000	750	27.8	1 to 5%	3%	0.8	Utilities
97	44.2	3.7	1,000+	1000	83.1	-	-	-	Access Roads and Utilities
98	45.4	17.0	76 to 100	88	33.0	-	-	-	Access Roads
99	26.5	14.3	11 to 25	18	9.7	-	-	-	Access Roads
100	47.6	6.4	76 to 100	88	11.8	-	-	-	Access Roads
101	0.4	0.1	11 to 25	18	4.2	-	-	-	Access Roads
102	7.2	1.8	1 to 5	3	0.8	-	-	-	Access Roads
103	0.9	0.2	11 to 25	18	4.3	-	-	-	Access Roads
105	4.9	2.0	500 to 1,000	750	305.5	1 to 5%	3%	9.2	Mine Site
112	34.4	0.1	100 to 150	125	0.2	26 to 50%	38%	0.1	Mine Site
115	3.9	3.7	6 to 10	8	7.5	-	-	-	Mine Site
116	0.9	0.9	1 to 5	3	3.0	-	-	-	Mine Site
117	3.7	0.8	1 to 5	3	0.7	-	-	-	Mine Site
118	12.2	1.4	6 to 10	8	0.9	-	-	-	Access Roads
119	0.7	0.02	1 to 5	3	0.1	-	-	-	Access Roads
TOTAL	2,402.3	243.2	-	-	997	-	-	15	-

Table H-6-3 Whitebark Pine Impacts under Alternative 3

Occupied Habitat Polygon Number	Total Acres in Polygon within Analysis Area	Total Acres Directly Impacted	Approximate Live Trees in Polygon	Midpoint	Estimated Number of Live Trees Removed	Percent Producing Female Cones	Midpoint	Estimated Number of Trees Producing Female Cones Removed	Direct Impact Project Components
1	56.8	5.6	100 to 150	125	12.4	6 to 10%	8%	1.0	Utilities and Tall Tree Clearing
2	29.1	3.0	11 to 25	18	1.9	1 to 5%	3%	0.1	Utilities and Tall Tree Clearing
3	7.2	0.6	6 to 10	8	0.7	1 to 5%	3%	0.0	Utilities and Tall Tree Clearing
4	33.2	4.1	100 to 150	125	15.6	6 to 10%	8%	1.2	Utilities and Tall Tree Clearing
10	29.9	1.6	11 to 25	18	1.0	-	-	-	Tall Tree Clearing
11	56.2	5.8	26 to 50	38	4.0	1 to 5%	3%	0.1	Utilities and Tall Tree Clearing
14	31.3	8.1	51 to 75	63	16.4	1 to 5%	3%	0.5	Utilities
15	135.8	8.9	150 to 500	125	8.2	-	-	-	Utilities and Tall Tree Clearing
16	33.0	2.4	51 to 75	63	4.5	1 to 5%	3%	0.1	Tall Tree Clearing
18	28.2	1.0	100 to 150	125	4.5	1 to 5%	3%	0.1	Tall Tree Clearing
22	0.5	0.1	1 to 5	3	0.5	-	-	-	Utilities and Tall Tree Clearing
37	19.4	1.9	1 to 5	3	0.3	-	-	-	Access Roads
40	4.3	0.4	1 to 5	3	0.3	-	-	-	Access Roads
41	0.2	0.03	1 to 5	3	0.4	-	-	-	Access Roads
42	0.6	0.01	1 to 5	3	0.1	-	-	-	Access Roads
43	32.3	2.6	100 to 150	125	10.1	-	-	-	Access Roads
45	52	3.6	100 to 150	125	8.8	-	-	-	Access Roads
46	37.8	4.7	26 to 50	38	4.8	-	-	-	Access Roads
47	61.1	6.3	11 to 25	18	1.9	-	-	-	Access Roads
48	58	7.8	11 to 25	18	2.4	-	-	-	Access Roads
49	3	0.5	6 to 10	8	1.3	-	-	-	Access Roads
50	1.7	0.3	1 to 5	3	0.5	-	-	-	Access Roads
51	0.8	0.002	6 to 10	8	0.02	-	-	-	Access Roads
52	0.6	0.2	1 to 5	3	1.0	-	-	-	Access Roads
53	0.2	0.0002	1 to 5	3	0.002	-	-	-	Access Roads
54	50	4.6	100 to 150	125	11.5	-	-	-	Access Roads
55	5.2	0.5	1 to 5	3	0.3	-	-	-	Access Roads
58	1.7	0.05	6 to 10	8	0.2	-	-	-	Access Roads
60	12.6	1.2	6 to 10	8	0.8	-	-	-	Access Roads
61	20.9	1.8	1 to 5	3	0.3	-	-	-	Access Roads
62	18.8	5.9	11 to 25	18	5.7	-	-	-	Access Roads
63	9.2	1.1	11 to 25	18	2.1	-	-	-	Access Roads
68	0.4	0.3	1 to 5	3	2.3	-	-	-	Access Roads
71	852.3	46.6	150 to 500	325	17.8	-	-	-	Access Roads and Utilities

APPENDIX H-6 – WHITEBARK PINE IMPACTS

Occupied Habitat Polygon Number	Total Acres in Polygon within Analysis Area	Total Acres Directly Impacted	Approximate Live Trees in Polygon	Midpoint	Estimated Number of Live Trees Removed	Percent Producing Female Cones	Midpoint	Estimated Number of Trees Producing Female Cones Removed	Direct Impact Project Components
72	16.3	1.9	26 to 50	38	4.3	-	-	-	Access Roads
73	12.2	1.1	6 to 10	8	0.7	-	-	-	Access Roads
74	4.6	0.5	6 to 10	8	0.9	-	-	-	Access Roads
75	2.0	0.3	6 to 10	8	1.4	-	-	-	Access Roads
76	3.9	0.3	51 to 75	63	4.5	-	-	-	Access Roads
78	5.0	0.7	11 to 25	18	2.5	-	-	-	Access Roads
79	5.5	0.5	26 to 50	38	3.4	-	-	-	Access Roads
80	4.5	0.8	11 to 25	18	3.0	-	-	-	Access Roads
81	1.7	0.02	26 to 50	38	0.4	-	-	-	Access Roads
83	0.1	0.001	1 to 5	3	0.0	-	-	-	Access Roads
84	61.2	0.1	150 to 500	325	0.8	-	-	-	Access Roads
86	133.8	23.6	500 to 1,000	750	132.6	-	-	-	Access Roads
87	69.1	0.01	150 to 500	325	0.0	-	-	-	Utilities
88	0.1	0.1	1 to 5	3	2.7	-	-	-	Access Roads
90	8	0.2	26 to 50	38	0.7	-	-	-	Access Roads
91	32.1	22.6	76 to 100	88	62.1	-	-	-	Mine Site
92	3.8	0.3	6 to 10	8	0.7	-	-	-	Tall Tree Clearing
93	10.9	0.1	76 to 100	88	0.8	-	-	-	Utilities
94	10.8	0.8	51 to 75	63	4.6	-	-	-	Utilities
95	35.3	1.4	150 to 500	325	13.0	1 to 5%	3%	0.4	Utilities
96	54.1	2.0	500 to 1,000	750	27.8	1 to 5%	3%	0.8	Utilities
97	44.2	0.6	1,000+	1000	13.6	-	-	-	Access Roads
100	47.6	3.7	76 to 100	88	6.9	-	-	-	Mine Site
101	0.4	0.4	11 to 25	18	17.6	-	-	-	Mine Site
102	7.2	5.7	1 to 5	3	2.4	-	-	-	Mine Site
105	4.9	2.0	500 to 1,000	750	305.5	1 to 5%	3%	9.2	Mine Site
108	6.2	0.7	100 to 150	125	14.9	1 to 5%	3%	0.4	Mine Site
111	4.2	4.2	11 to 25	18	18.0	-	-	-	Mine Site
112	34.4	24.8	100 to 150	125	90.0	26 to 50%	38%	34.2	Mine Site
115	3.9	3.7	6 to 10	8	7.5	-	-	-	Mine Site
116	0.9	0.9	1 to 5	3	3.0	-	-	-	Mine Site
117	3.7	0.8	1 to 5	3	0.7	-	-	-	Mine Site
119	0.7	0.7	1 to 5	3	2.8	-	-	-	Mine Site
TOTAL	2,317.6	237.2	-	-	892	-	-	48	-

Table H-6-4 Whitebark Pine Impacts under Alternative 4

Occupied Habitat Polygon Number	Total Acres in Polygon within Analysis Area	Total Acres Directly Impacted	Approximate Live Trees in Polygon	Midpoint	Estimated Number of Live Trees Removed	Percent Producing Female Cones	Midpoint	Estimated Number of Trees Producing Female Cones Removed	Direct Impact Project Components
1	56.8	8.0	100 to 150	125	17.5	6 to 10%	8%	1.4	Utilities and Tall Tree Clearing
2	29.1	3.6	11 to 25	18	2.2	1 to 5%	3%	0.1	Utilities and Tall Tree Clearing
3	7.2	0.7	6 to 10	8	0.8	1 to 5%	3%	0.0	Utilities and Tall Tree Clearing
4	33.2	6.1	100 to 150	125	23.1	6 to 10%	8%	1.8	Access Roads, Utilities, and Tall Tree Clearing
10	29.9	4.5	11 to 25	18	2.7	-	-	-	Utilities and Tall Tree Clearing
11	56.2	7.3	26 to 50	38	4.9	1 to 5%	3%	0.1	Utilities and Tall Tree Clearing
14	31.3	2.4	51 to 75	63	4.9	1 to 5%	3%	0.1	Utilities
15	135.8	18.7	150 to 500	125	17.2	-	-	-	Utilities and Tall Tree Clearing
16	33.0	6.1	51 to 75	63	11.6	1 to 5%	3%	0.3	Utilities and Tall Tree Clearing
18	28.2	3.4	100 to 150	125	15.1	1 to 5%	3%	0.5	Utilities and Tall Tree Clearing
22	0.5	0.2	1 to 5	3	1.3	-	-	-	Utilities and Tall Tree Clearing
41	0.2	0.03	1 to 5	3	0.5	-	-	-	Access Roads
42	0.6	0.01	1 to 5	3	0.1	-	-	-	Access Roads
55	5.2	0.5	1 to 5	3	0.3	-	-	-	Access Roads
58	1.7	0.1	6 to 10	8	0.5	-	-	-	Access Roads
64	0.02	0.02	1 to 5	3	2.4	-	-	-	Mine Site
70	4.9	1.2	11 to 25	18	4.4	-	-	-	Mine Site
87	69.1	0.01	150 to 500	325	0.0	-	-	-	Utilities
89	2.2	0.1	6 to 10	8	0.3	-	-	-	Utilities
91	32.1	22.6	76 to 100	88	62.1	-	-	-	Mine Site
92	3.8	0.9	6 to 10	8	1.9	-	-	-	Utilities and Tall Tree Clearing
96	54.1	0.01	500 to 1,000	750	0.1	1 to 5%	0.03	0.0	Utilities
105	4.9	2.0	500 to 1,000	750	305.5	1 to 5%	0.03	9.2	Mine Site
108	6.2	0.7	100 to 150	125	14.9	1 to 5%	0.03	0.4	Mine Site
111	4.2	4.2	11 to 25	18	18.0	-	-	-	Mine Site
112	34.4	24.8	100 to 150	125	90.0	26 to 50%	0.38	34.2	Mine Site
115	3.9	3.7	6 to 10	8	7.5	-	-	-	Mine Site
116	0.9	0.9	1 to 5	3	3.0	-	-	-	Mine Site
117	3.7	0.8	1 to 5	3	0.7	-	-	-	Mine Site
TOTAL	673.3	123.6	-	-	613	-	-	48	-