USDA Natural Resources Conservation Service

Ecological site F062XB058SD
Highland Hills Pine Forest (15-60% Slope)

Last updated: 2/06/2025
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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): 062X–Black Hills

The Black Hills (MLRA 62) is a unique, low lying mountain range situated in the midst of a mixed short and mid-grass prairie. It is a true Island in the Plains, as it has geophysical and biological attributes that are unlike the surrounding area. The Black Hills have strong floristic ties to four of the North American biomes: Cordilleran (Rocky Mountain) Forest, Northern Coniferous Forest, Eastern Deciduous Forest, and Grasslands.

MLRA 62 is approximately 3,040 square miles in size; 74 percent is located in South Dakota, and 26 percent is in Wyoming. The towns of Lead, Deadwood, Hill City, and Custer, South Dakota, are in this area. U.S. Highways 16 and 385 cross the MLRA. The Black Hills National Forest, Custer State Park, Mt. Rushmore National Monument, Jewel Cave National Monument, and Wind Cave National Park are located in this MLRA.

This area forms the core of the Black Hills and the Bear Lodge Mountains where the elevation ranges between 3,600 to 6,565 feet, however, Black Elk Peak (Harney Peak) rises to 7,242 feet. Slopes range from moderately sloping on some of the high plateaus to very steeply sloping along drainageways and on peaks and ridges. Narrow valleys generally are gently sloping to strongly sloping.

The Black Hills uplift is the product of the Laramide mountain-building episodes that produced most of the ranges in the Rocky Mountains. Uplift began near the end of the Cretaceous period, 65 million years ago and ended by 35 million years ago (Froiland 1999). The core of the Black Hills is a plutonic mass of granite with steeply dipping metamorphic rocks, primarily slate and schist, which directly surrounds the granite core. A plateau of Mississippian limestone surrounds the igneous and metamorphic rock core. The Madison limestone is broken around the outer edges of the uplifted area. The Permian Minnekahta limestone forms the outermost boundary of the area. Many other tilted sandstone, shale, and limestone units are exposed like a bathtub ring inside the steeply dipping Madison limestone.

The dominant soil orders in this MLRA are Alfisols (forest soils) and Mollisols (grassland soils). The soils in the area have a frigid or cryic soil temperature regime, a udic or ustic soil moisture regime, and mixed, micaceous, or smectitic mineralogy. They are shallow to very deep, generally well drained, and loamy in texture.

The Black Hills MLRA supports open to dense forest vegetation. Ponderosa pine is the dominant species across the Black Hills. White spruce grows at the higher elevations and along the major drainageways. Bur oak is found intermixed with pine in the northern and eastern fringes of the Black Hills, and Rocky Mountain Juniper is most common in the southern portion of the Black Hills. Aspen is of minor extent throughout the Black Hills area. Roughleaf ricegrass, slender wheatgrass, bearded wheatgrass, poverty oatgrass, Richardson’s needlegrass, and mountain ricegrass are the most common native grasses under open forest stands. The most common native shrubs are common snowberry, bearberry, common juniper, Oregon grape, and Saskatoon serviceberry.

MLRA 62 land ownership is approximately 47 percent private and 53 percent federal. Rangeland and forestland are split almost equally between private and federal ownership (47 percent each). Minor areas of land are privately

owned cropland and urban development. The forestland in this area is used mainly for timber production, recreation, and grazing.

The major resource concerns are soil erosion and surface compaction caused by logging, mining, wildfires, grazing, and urban expansion. The quality of ground and surface water is another concern, especially in the northern part of the Black Hills. The primary cause is contamination from mine waste and septic systems in areas of rural development and urban expansion (USDA-NRCS, 2006: Ag Handbook 296).

LRU notes

For development of ecological sites, MLRA 62 is divided into three Land Resource Units (LRU's) or physiographic zones (A, B, C, and Y). Each LRU has a set of ecological sites that represents these zones.

The LRU is identified in the Ecological Site ID: R062XY000SD; "062X" identifies the MLRA, the next letter "Y" identifies the LRU. Note: The organization of Ecological Site ID's will likely change in the future.

LRU-A includes the northern Black Hills and Bear Lodge Mountains (22-30" PZ); LRU-B includes the high elevation central core of the Black Hills (25-35" PZ); and LRU-C includes the southern portion of the Black Hills (17-21" PZ).

The Forest ecological sites are representative of sites in the Black Hills, Bear Lodge Mountains (MLRA-62), and the surrounding Dakota Hogback (MLRA-61). These sites are separated by elevation, soil temperature regimes, and slope.

The Low Mountain area includes all of the Black Hills, Bear Lodge Mountains, and Dakota Hogback below 6,200 feet in elevation (LRU's A and C). The soils in this area have a frigid soil temperature regime.

The High Mountain area includes all of the Black Hills above 6,200 feet elevation (LRU-B). The soils in this area have a cryic soil temperature regime.

Classification relationships

USDA Land Resource Region G—Western Great Plains Range and Irrigated Region:
Major Land Resource Area (MLRA) 61—Black Hills Foot Slopes
Major Land Resource Area (MLRA) 62—Black Hills

US Environmental Protection Agency (EPA) Level IV Ecoregions of the Conterminous United States:
Black Hills Foothills—17a
Black Hills Plateau—17b
Black Hills Core Highlands—17c

USDA Forest Service Ecological Subregions: Sections and Subsections of the Conterminous United States:
Black Hills Coniferous Forest Province—M334:
Black Hills Section—334A
Black Hills Foothills Subsection—M334Aa
Black Hills Limestone Plateau-Core Highlands Subsection—M334Ab

Ecological site concept

Occurring throughout the Black Hills, ponderosa pine is the dominant species for most of the area occurring across a variety of landforms and soils. The central concept of this ecological site focuses on dividing the region into three LRU's, and then again by slope class. This ecological site encompasses the higher elevation of the MLRA, LRU B, reaching from 6200-7200 feet on what is considered the Limestone Plateau with slope classes ranging from 15-60%. In the higher elevations, there exists cooler and moister conditions than in most of the surrounding hills. Often this site is dominated by an understory of shrubs, along with forbs and cool season bunchgrasses- with less frequent fires compared to the dryer and warmer lower elevations.

Associated sites

F062XB056SD	**Highland Cool Valley Slopes and Depressions** This ecological site occurs in the same region as the Highland Hills ecological site, often on cool steep slopes or areas of increased moisture.
F062XY057SD	**Cool Fringe Mixed Hardwood Forest** This ecological site often occurs adjacent to or intermixed with the Highland Hills ecological site in areas of increased moisture.

Similar sites

F062XC053SD	**Low Elevation Dry Southern Hills Pine Forest** This site occurs in the southern range of the Black Hills, and is dryer and warmer.
F062XA051SD	**Low Elevation Northern Hills Pine Forest(0-15% Slope)** This site occurs in the northern range of the Black Hills and is warmer.

Table 1. Dominant plant species

Tree	(1) *Pinus ponderosa* (2) *Populus tremuloides*
Shrub	(1) *Juniperus communis* (2) *Arctostaphylos uva-ursi*
Herbaceous	(1) *Nassella* (2) *Danthonia*

Physiographic features

The Highland Hills ecological site occupies elevation ranging from 6200-7200 feet across a wide variety of landforms, ranging from 15-60% slope and encompassing the central region of the Black Hills known as LRU B and the high limestone plateau.

Table 2. Representative physiographic features

Landforms	(1) Hills > Hillslope (2) Ridge (3) Hill
Runoff class	Medium to very high
Flooding frequency	None
Ponding frequency	None
Elevation	1,890–2,195 m
Slope	15–60%
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 62 is in a microclimate caused by the influence of increased elevation which leads to increased precipitation, moderate air temperature, and lower wind velocities compared to the surrounding Great Plains. In general, the Black Hills climate is a continental type, cold in the winter and hot in the summer.

Growth of cool-season plants begins in April, slowing or ceasing growth by mid-August. Warm-season plants begin growth in May and continue to mid-September. Regrowth of cool-season plants may occur in September and October, depending upon soil moisture availability

Table 3. Representative climatic features

Frost-free period (characteristic range)	17 days
Freeze-free period (characteristic range)	54 days
Precipitation total (characteristic range)	533 mm
Frost-free period (actual range)	17 days
Freeze-free period (actual range)	54 days
Precipitation total (actual range)	533 mm
Frost-free period (average)	17 days
Freeze-free period (average)	54 days
Precipitation total (average)	533 mm

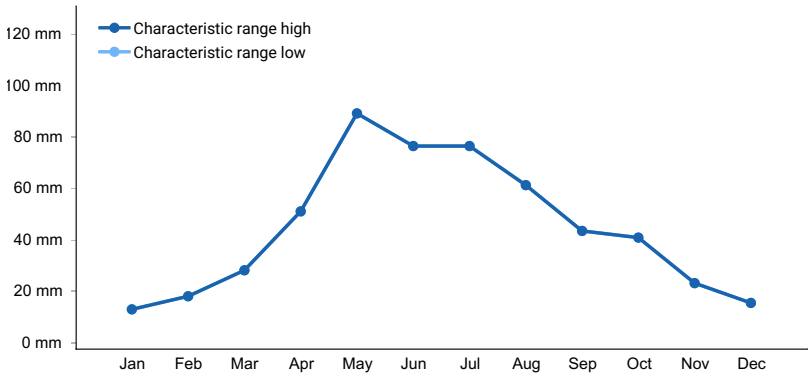


Figure 1. Monthly precipitation range

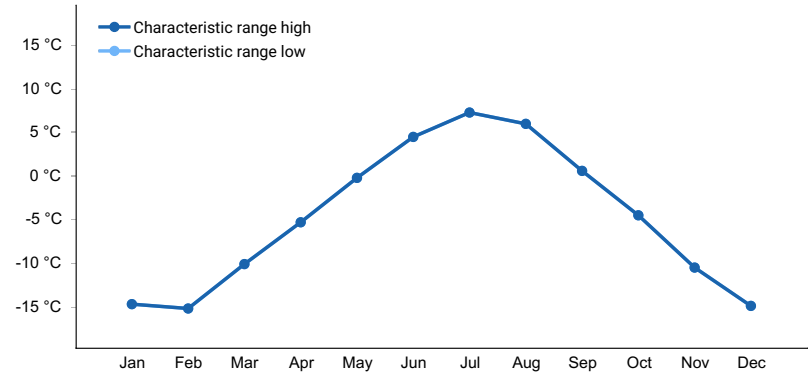


Figure 2. Monthly minimum temperature range

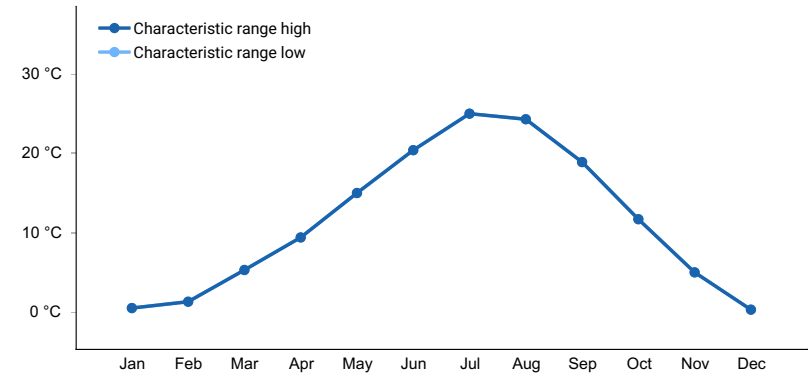


Figure 3. Monthly maximum temperature range

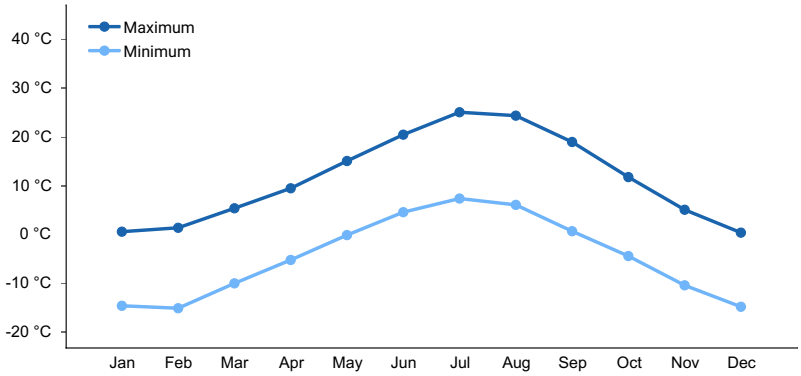


Figure 4. Monthly average minimum and maximum temperature

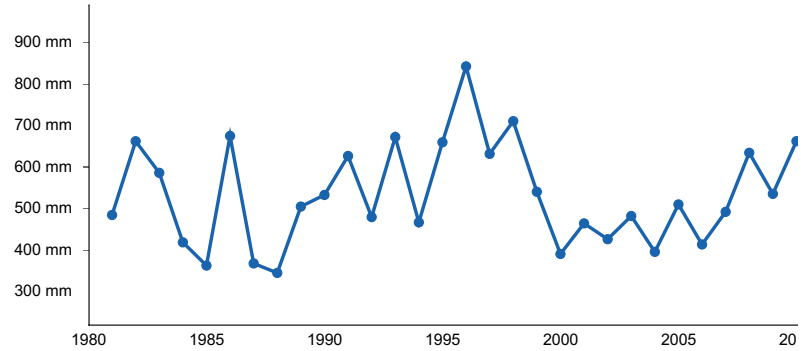


Figure 5. Annual precipitation pattern

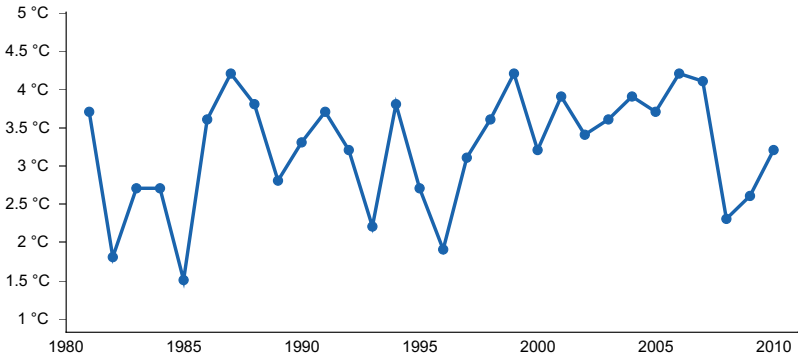


Figure 6. Annual average temperature pattern

Climate stations used

- (1) DEERFIELD 3 SE [USC00392231], Hill City, SD

Influencing water features

There are no water features associated with this site.

Wetland description

Not applicable.

Soil features

This site is represented by the Riflepit and Stovho Soils with 15-60% slopes. Soils in this region that were historically forest often show evidence of an “E” eluviated horizon from decades of eluviation of acidic materials from needle and leaf litter. Acidity at the surface is often in the range of 5.0-6.5 pH while the range from 0-40 inches is in the 5.1 to 8.4 pH range. A thin organic horizon is commonly present at the surface.

More information regarding the soil is available in soil survey reports. Contact the local USDA Service Center for details specific to your area of interest, or go online to access USDA's Web Soil Survey.

Table 4. Representative soil features

Parent material	(1) Residuum–limestone and sandstone (2) Colluvium–schist (3) Alluvium–rhyolite
Surface texture	(1) Loam (2) Channery silt loam (3) Very gravelly sandy loam (4) Clay
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Very slow to rapid
Depth to restrictive layer	51–203 cm
Soil depth	51–203 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–5%
Available water capacity (0-101.6cm)	2.54–21.59 cm
Calcium carbonate equivalent (0-101.6cm)	0–40%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–2
Soil reaction (1:1 water) (0-101.6cm)	5.1–8.4
Subsurface fragment volume <=3" (0-101.6cm)	0–65%
Subsurface fragment volume >3" (0-101.6cm)	0–65%

Ecological dynamics

Dominated by ponderosa pine, the Highland Hills (15-60% Slope) ecological site occupies much of the area of LRU B. There exists a historic reference state, and a managed/invaded state. Given the history of intensive use of the Black Hills and its forestry resources, much of the area today would be found in a managed /invaded state with few areas remaining in the reference state.

This LRU is defined by the cooler temperatures, increased moisture, and a long stretching portion of limestone as the base parent material over much of the area. Natural disturbances such as fire, wind, ice storms, and pests determined the structure and appearance of this ecological site. Fires in this region occurred less often than the surrounding areas due to the increased moisture and cooler temperatures.

This ecological site is characterized by a highly variable uneven age structure of ponderosa pine. Due to an increase in elevation and moisture this ecological site will maintain a hardwood component such as quaking aspen or paper birch and will have a component of white spruce in some communities. The shrub layer is the most important undergrowth lifeform in this habitat type (Hoffman and Alexander 1987), with a variety of shrubs and subshrubs including common juniper, bearberry (kinnikinnick), and Oregon grape.. Often found on this site are native cool season bunchgrasses such as needlesgrasses, oatgrasses, along with rough-leaved ricegrass. Common forbs may include different species of vetches (Astragalus spp), goldenrods (Solidago spp), fleabanes,

asters including arrowleaf balsamroot, and others.

Ponderosa pine is the dominant tree species in the Black Hills and tends to have dark colored bark (blackjacks) until it reaches 75 to 100 years of age, after which the bark progressively changes to a buff or orange color. Morphologically older trees are marked by the presence of thinning foliar and flat-topped crowns. Additional morphology includes larger lower branching with higher crown- based heights and furrowed or very smooth bark.

Historically the Black Hills consisted of a diverse landscape mosaic that varied from grasslands, open stands of ponderosa pine forest with small numbers of large trees, and dense stands of ponderosa pine, with many similar-sized and -aged trees. Spatial heterogeneity was present not only across the Black Hills but also within the smaller dense pine patches (Brown, 2006).This variation of structure consisted of a diverse landscape mosaic that varied from grasslands and stands of ponderosa pine forest with variation in forest structure due to topographically driven soils and microclimates. Resulting in variation of total tree density, tree group size, proportion of trees in groups versus single random trees, and openness.

Fires in this region occurred less often than the surrounding areas due to the increased moisture and cooler temperatures, often with an interval ranging from 30-33 years (Hunter et al. 2007). Prior to Euro-American settlement, the Black Hills fire regime was mixed-severity, with both surface and crown fires being components of the ecosystem (Hunter et al. 2007). "Long fire-free periods were historically common in the Black Hills (Brown and Sieg 1996), which may have led to fuel build-up and high tree density - conditions conducive to crown fire spread (Hunter et al. 2007)". "The occurrence of surface fires and stand-replacing fires, coupled with other disturbance agents, led to a complex mosaic of forest structure composed of dense forests, moderately stocked forests, and treeless openings (Hunter et al. 2007)".

In addition to variable fire, pests, disease, and other natural disturbances played a role in the overall maintenance of diversity, structure, and density the Black Hills. The mountain pine beetle (Dendroctonus ponderosae) is an important driver of forest structure. The mountain pine beetle was first described in the Black Hills in 1901 by Andrew D. Hopkins and the first documented epidemic of bark beetles in the Black Hills occurred in 1895 (Graham et al. 2016). These beetles are native in the Black Hills and have cyclical life cycle and emergence, with a continuous endemic and less frequent epidemics in the Black Hills over the last 129 years (Graham et al. 2016). "Mountain pine beetle outbreaks in the Black Hills from 1894 through 2014 had a mean return interval of 20 years and a mean duration of 13 years" (Graham et al. 2016).

At a variable and localized scale additional disturbances include pine engraver beetles and armillaria root rot(Armillaria ostoyae). Pine engraver beetles are a non-aggressive and breed in windthrown ponderosa pine trees, trees damaged by wind, ice storms, or other non-standing trees. Armillaria has been noted across soil types and locations within the Black Hills (Boldt and Van Deusen 1974; Holah1993; Lundquist 1991; Shepperd, Wayne D.; Battaglia, Michael A. 2002).

Studies have shown the current forest contains about the same basal area (ft2/ac) on average as the historic forest. The difference, however, is that the historic forest was dominated by fewer, but much larger trees, than those present today. This suggests that there has been a simplification in structure at stand to landscape scales, with increased tree density leading to fewer gaps and more even spacing and size distributions within groups (Brown, 2008).

Relative increases in tree density and simplification of structure have contributed to greater vertical and horizontal fuel continuity, and thus increased likelihood for incidence and extent of crown fires. More pole-sized trees (5-to-9-inch DBH) within stands also increases the likelihood of mountain pine beetle outbreaks. This is a concern in the Black Hills where pine beetle outbreaks have been a major disturbance agent during the 20th and early 21st centuries.

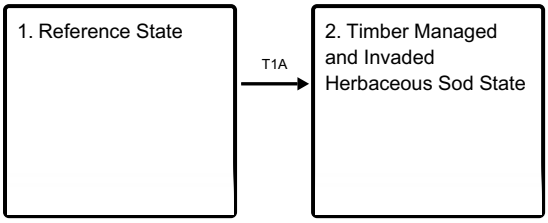
It is also important to note the change in composition in recent decades of ponderosa pine stands, whereby mainly through the mechanism of fire suppression, the dominance of white spruce has grown by an estimated 5% or more from the original 1.5% composition covered historically (Tatina R.E., Hanberry B.B., 2022).

Due to the spread and establishment of non-native cool-season grasses and other anthropogenic disturbances in MLRA 62, the Reference Plant Community (1.1) will only be a close analogy of the pre-settlement plant community.

The following state-and-transition diagram illustrates the common plant communities on the site and the transition pathways between communities. The ecological processes are discussed in more detail in the plant community descriptions following the diagram.

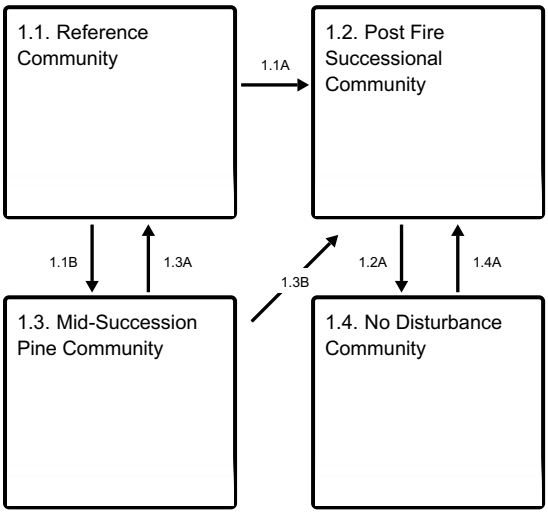
State and transition model

Ecosystem states



T1A - timber harvest designed to achieve forest management objectives.

State 1 submodel, plant communities



1.1A - Infrequent large patch disturbance.

1.1B - 60+ years no disturbance.

1.2A - 30+ years no disturbance.

1.3A - Mixed severity small patch disturbance.

1.3B - Infrequent large patch disturbance.

1.4A - Infrequent large patch disturbance.

State 2 submodel, plant communities

2.1A - Logging, invasion or seeding of invasive sod forming grasses

2.2A - Early season grazing in combination with tree planting, seeding, or prescribed fire

State 1
Reference State

The Reference State represents what is believed to show the natural range of variability that dominated the dynamics of the high elevation Black Hills forested ecosystem. The Reference State (1.0) is dominated by a

ponderosa pine overstory with possible quaking aspen, paper birch and white spruce. The hardwood and white spruce components will be present in younger stands and eventually be out competed by the pine and become less prevalent as the stand ages. The understory consists of shrubs, forbs, and cool-season bunchgrasses and sedges. Predominant shrubs will include common juniper, bearberry (kinnikinnick), Oregon grape. Forbs are common and diverse. Dominant cool-season bunchgrasses will include rough-leaved ricegrass, needlegrasses, and oatgrasses. Sedges will include Hood's sedge, dryspike sedge, and Richardson's sedge. On this site, productivity ranges due to slope percentage, where lower slopes are higher producing than higher slopes. Sedges will increase in productivity as slopes increase. Structural variation within this reference state is driven by available moisture and the length of time since disturbance. On the warmer sites pine will assume dominance over the spruce, but these processes will take longer on northern and western slopes and draw bottoms which hold moisture longer. When there is a longer time between disturbances more trees are able to grow, reducing the number of single trees and increasing the size of tree groups. Heterogeneity at the landscape level (100-1000 acres) is largely dictated by a combination of precipitation from snowfall, spring and fall rains, and climatic variation including multiple wet years to drought years. This effects the resulting disturbance regimes namely mixed severity disturbances with either small or large patches over time that yield variation in tree densities. When there are multiple wet years there are fewer disturbances increasing tree densities. When the wet periods are prolonged and followed by a drought period, the disturbances have a greater likelihood of resulting in large patch disturbances. Primary disturbance mechanisms for this site are relatively moderate frequency (30-to-33-year interval) mixed severity small patch (0-20 acre) disturbances, and rare (>100-year interval) mixed severity large patch (20-200 acre) disturbances. Variation of type, size, and frequency of disturbances contribute to dynamic stand maintenance or transitions. The small and large patchy nature of disturbances and longer intervals between disturbances dictate the dynamics that can occur within the natural range of variability of this site including variation in diameters at breast height (DBH) and amounts of trees per acre (TPA). The main disturbances that drive forest structure are wildfire and mountain pine beetle infestations, both endemic and epidemic populations. Severe weather events in the Black Hills are also a significant disturbance that can result in overstory damage and treefall such as hailstorms, heavy snow fall, tornados, and microbursts. Due to the pervasiveness of non-native cool-season grasses, timber management, and long-term fire suppression in the region, the true Reference State (1.0) is nearly non-existent.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- quaking aspen (*Populus tremuloides*), tree
- paper birch (*Betula papyrifera*), tree
- white spruce (*Picea glauca*), tree
- common juniper (*Juniperus communis*), shrub
- Saskatoon serviceberry (*Amelanchier alnifolia*), shrub
- creeping barberry (*Mahonia repens*), shrub
- sedge (*Carex*), grass
- oatgrass (*Danthonia*), grass

Community 1.1
Reference Community

The reference community for this ecological site would be considered a highly variable uneven-aged structure ponderosa pine forest. Common understory species include shrubs, forbs, grasses, and sedges. Grasses include needlegrasses, roughleaf ricegrass, oatgrass, and upland sedges. This is also considered to be Reference Plant Community (1.1). This community evolved with periodic severe drought, mixed severity small patch (0-20 acres) disturbances with a return interval of 30 to 33 years, rare mixed severity high patch (20-200 acres) disturbances that occurred on a greater than 100-year interval, disturbances include fire, insect and disease outbreaks, severe weather events that include hailstorms, heavy snow fall, tornados, and microbursts. Light to moderate levels of wildlife browsing and grazing also occurred on this site prior to European-American Settlement. The expected forest canopy cover ranges from 30-60% with approximately 84 TPA around 13 inches DBH. The spatial arrangement of ponderosa pine consists of 36% groupings, 8% individual trees, and 58% openings. The tree overstory will have a canopy cover ranging between 30 and 60 percent. Shrubs and subshrubs dominate the understory which would include common juniper, bearberry (kinnikinnick), and Oregon grape. Forbs are scattered, but diverse. The dominant grasses and grass-like species include sedges (Carex spp), oatgrass (Danthonia), and fescues. As the canopy cover and slope increases the herbaceous understory will decrease in production. Shrubs may tend to increase initially then decrease as the canopy closes (South Dakota Guide for Grazable Woodlands,1993). The

dominant tree species on this site is ponderosa pine with a diameter at breast height (DBH) ranging from 9 to 15 inches. Quaking aspen, Paper birch, and White spruce can be scattered throughout the site. This plant community is diverse, stable, productive, and is well adapted to the high elevation Black Hills. Community dynamics, nutrient cycle, water cycle, and energy flow are functioning properly. Plant litter is properly distributed with very little movement offsite, and natural plant mortality is very low. This is a sustainable plant community in terms of soil stability, watershed function, and biologic integrity. This community self sustains itself with moderate frequency mixed severity small patch disturbance or moderate frequency low severity disturbance.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- common juniper (*Juniperus communis*), shrub
- kinnikinnick (*Arctostaphylos uva-ursi*), shrub
- sedge (*Carex*), grass
- oatgrass (*Danthonia*), grass

Community 1.2
Post Fire Successional Community

This plant community is a successional phase of a post-fire ponderosa pine forest. It evolved with natural disturbances including episodic insect and disease outbreaks in ponderosa pine, mixed severity large patch (20-200 acre) fires, or severe weather events. This plant community is usually of small extent. This is a young stand that is over 85% quaking aspen or paper birch and the ponderosa pine and white spruce component often less than 15% of the forest community. This community having a higher number of deciduous trees makes it more open and cooler, contains higher amounts of cool season bunchgrasses, sedges, pioneer forbs, and shrubs.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- paper birch (*Betula papyrifera*), tree
- Saskatoon serviceberry (*Amelanchier alnifolia*), shrub
- sedge (*Carex*), grass

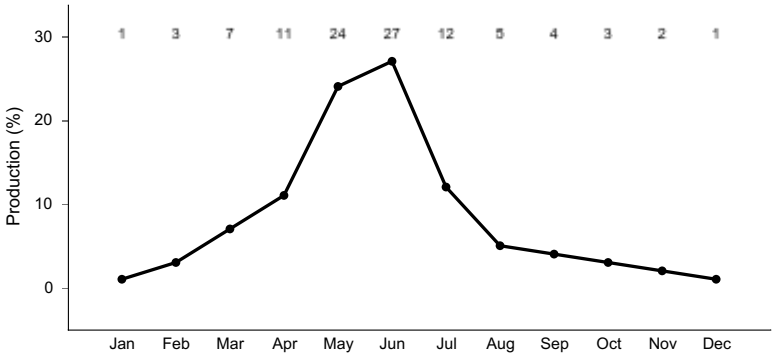


Figure 7. Plant community growth curve (percent production by month). SD6211, Black Hills, heavy conifer canopy. Mature ponderosa pine overstory.

Community 1.3
Mid-Succession Pine Community

This community is succession from a younger aged stand. It has a fairly uniform even aged immature conifer forest dominated by pines with a strong hardwood component. Canopy cover greater than 50% with pole sized (5-9 inches in diameter at breast height) trees approximately 40+% ponderosa pine, <40% white spruce, and less than 30% quaking aspen and/or paper birch. Due to the success of the conifer species, the hardwood species have declined as they are less shade tolerant. The herbaceous understory is much less productive than other communities due to shade. The understory consists bearberry (kinnikinnick), sedges, and scattered forbs.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- white spruce (*Picea glauca*), tree
- kinnikinnick (*Arctostaphylos uva-ursi*), shrub
- sedge (*Carex*), grass

Community 1.4
No Disturbance Community

This community evolved with a prolonged absence of insect and disease outbreaks, fire and severe weather events that include hailstorms, heavy snow fall, tornados, and microbursts. Light to moderate levels of wildlife browsing and grazing also occurred on this site prior to European-American settlement. The expected forest canopy cover is greater than 60% with approximately 114 TPA around 12 inches DBH. The spatial arrangement of ponderosa pine consists of 60% groupings, 2% individual trees, and 38% openings. The tree overstory will have a canopy cover greater than 60 percent. Ground cover is primarily pine litter, with scattered herbaceous plants. The dominant herbaceous species include grasses, grass-likes, forbs, and shrubs. Grasses and grass-like species include upland sedges (Carex spp.), rough-leaved ricegrass (*Oryzopsis asperifolia*), oatgrass (Danthonia). The dominant shrubs include bearberry (kinnikinnick) and Oregon grape. Forbs are scattered, but diverse. Due to the increased canopy cover the herbaceous understory will decrease significantly in production and species diversity. The dominant tree species on this site is ponderosa pine with a diameter at breast height (DBH) ranging from 9 to 14 inches. quaking aspen, paper birch and white spruce will be less frequent but still scattered throughout the site. This is due to the higher pine density shading out the hardwoods and the white spruce being less adapted to the dryer soils and dying out. This state can be self-sustained though frequent low severity surface fire. .

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- kinnikinnick (*Arctostaphylos uva-ursi*), shrub
- creeping barberry (*Mahonia repens*), shrub
- sedge (*Carex*), grass

Pathway 1.1A
Community 1.1 to 1.2

This transition between communities is a result of infrequent (>100 years) mixed severity large patch (20-200 acres) disturbance. This disturbance is often in the form of mixed severity fire with acres group torching or epidemic Mountain Pine Beetle outbreaks. Severe weather events hailstorms, heavy snow fall, ice storms, tornados, and microbursts can also cause large scale tree mortality leading to this transition.

Conservation practices

Prescribed Burning
Forest Stand Improvement

Pathway 1.1B
Community 1.1 to 1.3

This transition between communities is a result of the passing of time (60+ years) with no disturbance allowing for tree growth and density to increase.

Pathway 1.2A
Community 1.2 to 1.4

This transition between communities is a result of the passing of time (30-60 years) with no disturbance allowing for tree growth and density to increase.

Pathway 1.3A
Community 1.3 to 1.1

This transition between communities is a result of) mixed severity small patch (1-20 acres) disturbance. This disturbance is often in the form of mixed severity fire with acres group torching or epidemic Mountain Pine Beetle outbreaks. Severe weather events hailstorms, heavy snow fall, ice storms, tornados, and microbursts can also cause large scale tree mortality leading to this transition.

Pathway 1.3B
Community 1.3 to 1.2

This transition between communities is a result of infrequent (>100 years) mixed severity large patch (20-200 acres) disturbance. This disturbance is often in the form of mixed severity fire with acres group torching or epidemic Mountain Pine Beetle outbreaks. Severe weather events hailstorms, heavy snow fall, ice storms, tornados, and microbursts can also cause large scale tree mortality leading to this transition.

Pathway 1.4A
Community 1.4 to 1.2

This transition between communities is a result of infrequent (>100 years) mixed severity large patch (20-200 acres) disturbance. This disturbance is often in the form of mixed severity fire with acres group torching or epidemic Mountain Pine Beetle outbreaks. Severe weather events hailstorms, heavy snow fall, ice storms, tornados, and microbursts can also cause large scale tree mortality leading to this transition.

State 2
Timber Managed and Invaded Herbaceous Sod State

The Timber managed and Invaded Herbaceous Sod State is largely the result of historic early European-American settlement of the Black Hills region. Large tracts which were logged free of regulatory restraints-prior to establishment of the Forest Reserve in 1897- were commercially clearcut and practically stripped of all trees large enough to yield a mine timber a railroad tie. (Boldt and Van Deusen 1974). Between the mid-1870s to 1890s, the Homestake Mining Company (and their half dozen subsidiary companies) alone cut something upwards of 6 million board feet of timber in the Black Hills. In some areas, this ecological site, was clear-cut for timber, then converted for use as ranch and farmsteads. In other cases, the pine overstory was lost to high- intensity fire events followed by settlement. The cleared areas were often heavily grazed to supply beef and mutton for mining and logging communities. In later years these sites were often seeded to introduced grasses and clover to increase forage quality or farmed for grain crop production. In many cases the shift in land use from forest to livestock, forage, and crop production remains. Those areas that are not under intensive management resist transitioning back to a forest plant community, even though the soils still exhibit forest attributes. The dominant plants associated with this state are introduced sod-forming grasses, introduced legumes, and weedy forbs. This state is very resistant to change through management alone.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- redtop (*Agrostis gigantea*), grass
- oxeye daisy (*Leucanthemum vulgare*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- cinquefoil (*Potentilla*), other herbaceous
- Canada thistle (*Cirsium arvense*), other herbaceous

Community 2.1
Managed Forest

This plant community is a result of forest activities focused on timber management. Virtually all of the Black Hills unreserved and operable forest acres have been cut over at least once; many acres have received multiple partial cuts. (Boldt and Van Deusen 1974). Current structure is based on the management or silvicultural system that was implemented by forestry professionals. There are a variety of forest harvest systems that have been utilized. These dictate the resulting and future forests structure of the site. One of the primary forest structures resulting from forest

management is a single story of evenly spaced trees. The resulting tree size might very from saplings to larger diameter trees. Although the spacing within the site will be fairly uniform different sites will have different spacings ranging from 10ft to 150ft between trees. Generally, the larger the tree the greater the spacing will be between trees. Another common resulting structure of forest management is a site with two separate canopy layers of trees. One layer is commonly made up of lager diameter trees that have a spacing often wider then 30ft. The other layer is seedling and sapling sized trees, these trees may be at an even spacing between 10 and 16 feet apart or they may not be evenly spaced. There are other management objectives and silvicultural systems that result in different forest structures other than then ones previously listed. These structures usually include leaving trees of all sizes from seedling to large dimeter trees in varying amounts. The resulting spatial distribution is generally also uneven with areas of different forest densities. Natural regeneration is the most common following timber management changing the forest structure and need for future management throughout time. Planting of trees maybe done in large fire burn areas,

Community 2.2
Non-Native Cool-Season Grasses/Red Clover-Ox-eye Daisy-Thistle

This plant community is a result of the loss of the overstory ponderosa pine, either from high-intensity fire or timber harvest, followed by heavy continuous grazing, invasion of non-native cool- season grasses, and in some cases seeding to forage or crop species. It is characterized by a dominance of non-native cool- season grasses including timothy, smooth brome, Kentucky bluegrass, and redtop. Forbs will include red and white clover, ox- eye daisy, western yarrow, cinquefoil, and Canada thistle. Native plants, including ponderosa pine, have great difficulty becoming established in this plant community. This site can be renovated through tillage and seeding of introduced forage species. The renovated plant community can remain productive through prescribed grazing with proper stocking rates, change in season of use, and adequate time for plant recovery following grazing event.

Pathway 2.1A
Community 2.1 to 2.2

The Invaded Herbaceous Sod State is largely the result of historic early European-American settlement of the Black Hills region. Large tracts which were logged free of regulatory restraints-prior to establishment of the Forest Reserve in 1897- were commercially clearcut and practically stripped of all trees large enough to yield a mine timber a railroad tie. (Boldt and Van Deusen 1974). Between the mid-1870s to 1890s, the Homestake Mining Company (and their half dozen subsidiary companies) alone cut something upwards of 6 million board feet of timber in the Black Hills. In some areas, this ecological site, was clear-cut for timber, then converted for use as ranch and farmsteads. In other cases, the pine overstory was lost to high- intensity fire events followed by settlement. The cleared areas were often heavily grazed to supply beef and mutton for mining and logging communities. In later years these sites were often seeded to introduced grasses and clover to increase forage quality or farmed for grain crop production. In many cases the shift in land use from forest to livestock, forage, and crop production remains. Those areas that are not under intensive management resist transitioning back to a forest plant community, even though the soils still exhibit forest attributes. The dominant plants associated with this state are introduced sod-forming grasses, introduced legumes, and weedy forbs. This state is very resistant to change through management alone.

Pathway 2.2A
Community 2.2 to 2.1

Early season grazing in combination with tree planting, seeding, or prescribed fire may revert this community back to a timber managed forest once canopy cover exceeds 60%.

Transition T1A
State 1 to 2

The transition to this community from the reference community is a result of timber harvest designed to achieve forest management objectives. These treatments will follow one of the silvicultural treatments below. Which will dictate the resulting structure and composition of the site. • Thinning: a treatment made to reduce stand density of trees primarily to improve growth, enhance forest health. o Thinning from above: removal of trees from dominant or codominant crown classes or canopy layers in order to favor those in lower crown classes or layers. o Thinning

from below: removal of trees from lower crown classes or canopy layers in order to favor those in upper crown classes or layers. o Thin throughout the dimeters: the removal of trees to control stand spacing and favor desired trees, using a combination of thinning criteria without regard to crown position. o Variable density: the removal of trees that deliberately creates non-uniform conditions through a stand. • Even Age: regenerate and maintain a stand with a single age class. o Overstory Removal: The cutting of trees comprising an upper canopy layer in order to release advance regeneration in an understory. o Patch Cutting: removing all of the live trees from areas that are 2 acres in size or smaller. o Seed Tree: cutting of all trees except for a small number of widely dispersed trees retained for seed production and to produce a new age class. o Shelterwood: The cutting of most trees, leaving those needed to produce sufficient shade to establish a new age class. • Uneven Age: methods regenerate and maintain a multiage structure by removing some trees in all size classes either singly, or in small groups. o Group Selection: a group of trees are removed, and new age classes are established in openings created. o Single Tree Selection: Individual trees of all size classes are removed more or less uniformly throughout the stand, to promote growth of remaining trees and to provide space for regeneration

Additional community tables

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range-trained personnel were also used. Those involved in developing this site include: Stan Boltz, range management specialist (RMS), NRCS; Dan Brady, soil scientist (SS), NRCS; Mitch Faulkner, RMS, NRCS; Rick Peterson, (RMS), NRCS, Ezra Hoffman(Ecological Site Specialist)NRCS. All inventory information and data records are compiled within the Rapid City, SD USDA-NRCS Shared “S” network drive.

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Approval

Suzanne Mayne-Kinney, 2/06/2025

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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	05/12/2025
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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2. **Presence of water flow patterns:**

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3. **Number and height of erosional pedestals or terracettes:**

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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:**

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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):**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

---

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

---

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

---

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

---

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

---

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

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17. **Perennial plant reproductive capability:**
