

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) <i>Pinus ponderosa</i> (2) <i>Populus tremuloides</i>
Shrub	(1) <i>Juniperus communis</i> (2) <i>Arctostaphylos uva-ursi</i>
Herbaceous	(1) <i>Nassella</i> (2) <i>Danthonia</i>

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 – 2,200 m
Slope	20 – 60 %
Water table depth	200 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)	20 days
Freeze-free period (characteristic range)	50 days
Precipitation total (characteristic range)	530 mm
Frost-free period (actual range)	20 days
Freeze-free period (actual range)	50 days

Precipitation total (actual range)	530 mm
Frost-free period (average)	20 days
Freeze-free period (average)	50 days
Precipitation total (average)	530 mm

- (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	50 – 200 cm
Soil depth	50 – 200 cm
Surface fragment cover <=3"	0 – 10 %
Surface fragment cover >3"	0 – 10 %
Available water capacity (0-101.6cm)	2.54 – 21.59 cm
Calcium carbonate equivalent (0-101.6cm)	0 – 40 %
Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-101.6cm)	5.1 – 8.4
Subsurface fragment volume <=3" (0-101.6cm)	0 – 70 %
Subsurface fragment volume >3" (0-101.6cm)	0 – 70 %

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

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 6. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 7. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 8. Community 1.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 9. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 10. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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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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Contributors

Rick L. Peterson, Rangeland Management Specialist-NRCS(Retired)
Mitch D. Faulkner, Rangeland Management Specialist-NRCS
Stan C. Boltz, Rangeland Management Specialist-NRCS
Ezra Hoffman, Ecological Site Specialist-NRCS
Laura Bosworth, State Forester, NRCS
Nancy Bane, Silviculturist, USFS(Retired)
Kara Dunlap, Timber Program Manager, USFS
David Jalali, MLRA Soil Scientist, NRCS
Dan Brady, Soil Scientist, NRCS

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	08/28/2026
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. Number and extent of rills:

2. Presence of water flow patterns:

3. Number and height of erosional pedestals or terracettes:

4. Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):

5. Number of gullies and erosion associated with gullies:

6. Extent of wind scoured, blowouts and/or depositional areas:

7. Amount of litter movement (describe size and distance expected to travel):

8. Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):

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

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

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

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

Dominant:

Sub-dominant:

Other:

Additional:

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

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

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

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

17. Perennial plant reproductive capability:
