Map Unit Properties Table: Hopewell Furnace National Historic Site

Colored rows indicate geologic units mapped within Hopewell Furnace NHS.

Age	Map Unit (Symbol)	Unit Description	Erosion Resistance	Suitability for Infrastructure	Hazards	Paleontological Resources	Cultural Resources	Karst Issues	Mineral Resources	Habitat	Recreation	Geologic Significance
QUATERNARY	Trenton Gravel (**Qt**)	Unit includes some alluvium and swamp deposits, contains gray or reddish-brown gravelly sand interbedded with sand, clay, and silt beds. Crossbeds present locally.	Very low	Avoid stream edge/riparian and wetland areas for heavy development, especially for wastewater treatment facilities due to proximity to water and high permeability.	Unit is associated with stream banks and riparian zone areas, and may be unstable if exposed on a slope or water saturated.	May contain ice age and modern remains.	May contain remains from historic events and settlements.	None.	Sand, clay, silt, gravel.	Unit supports riparian habitats, and marshlands.	Unit is suitable for light recreation unless at a stream edge or wetland.	Unit records modern geomorphological changes in the park area landscape.
TERTIARY	Pensauken and Bridgeton Formations, undifferentiated (**Tpb**) Bryn Mawr Formation (**Tbm**)	**Tpb** contains dark reddish-brown feldspathic quartz sand beds with interlayered fine gravel and some clay and silt. **Tbm** consists of gravelly sand and silt in reddish-brown high-level terrace deposits.	Very low	Avoid most terrace deposits for heavy development due to instability of slopes and high permeability.	Unconsolidated nature of the units render them susceptible to mass wasting on steep to moderate slopes.	May contain plant fragments.	Terrace areas may contain traces of Native American campsites.	None.	Sand, clay, silt, gravel.	Unit supports riparian habitats and well-drained soils.	Suitable for most recreation unless high slopes are present.	Units record history of erosion and deposition throughout the Tertiary.
CRETACEOUS	Patapsco(?) Formation (**Kp**)	Unit is intensely colored, variegated, iron-rich clay with some isolated interbedded sand.	Low	Variations in bedding, sediment, and degree of cementation may render unit unstable on slopes; generally suitable for most development.	Clay-rich massive bedded layers may spall in large blocks when unit is exposed on slope; susceptible to slumps and slides.	May contain Cretaceous age fossils.	None documented.	None.	Sand, clay.	Supports eastern hardwood forests regionally.	Suitable for most recreation unless exposed on slopes.	Widespread unit records Cretaceous depositional environment.
JURASSIC	Sedimentary strata at Jacksonwald and Aspers (**Js**) Diabase (**Jd**)	**Js** is arkosic sandstone with some gray to black shale and limestone interbeds, ripple-cross-laminated siltstone, and boulder conglomerate. **Jd** consists of medium- to coarse-grained tholeiite in dikes, sheets, and scant flows. Individual bodies vary in titanium content and presence of plagioclase phenocrysts.	Moderate to high	Variations in rock type and degree of cementation may render unit unstable on slopes.	**Jd** may form resistant ridges that are prone to rockfall when undercut and/or weathered.	**Js** is fossiliferous.	Diabase was popular building stone. Iron ore for Hopewell Furnace.	Limestone units are prone to dissolution.	Iron Ore. Labradorite, pyroxene, plagioclase phenocrysts (cm-size), diabase.	**Jd** weathers to support iron-, and magnesium-rich substrates.	Suitable for most recreation unless heavily altered or fractured.	Iron ore utilized at Hopewell Furnace associated with Morgantown pluton and intrusion of **Jd. Jd** includes the dark gray York Haven Diabase and the younger Rossville Diabase.
TRIASSIC	Brunswick Formation (**TRb**) Limestone fanglomerate (**TRfl**) Quartz fanglomerate (**TRfq**)	**TRb** is primarily reddish-brown mudstone, siltstone, and shale with some green and brown interbedded shale. Some red and dark gray argillite interlayers near the base. **TRfl** is yellowish-gray to medium gray quartz matrix with limestone and dolomite pebbles, cobbles, and fragments. Some shale-clast beds are locally interlayered. **TRfq** contains a reddish-brown sandy matrix with well-rounded quartzite pebbles, cobbles, and rare boulders.	Moderate	Heterogeneous nature of units may render them unstable on slopes.	Unit is prone to rockfall where weathered shale lies beneath resistant sandstone ledges or where limestone has dissolved beneath overlying rock layers.	May contain Triassic age fossils.	None documented.	Limestone cobbles in **TRfl** may dissolve away creating voids and compromise unit integrity.	None documented.	Units weather to create myriad substrates.	Suitable for most recreation unless heavily weathered and friable.	**TRb** spans the Jurassic-Triassic boundary.

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TRIASSIC	Hammer Creek Formation (**TRh**) Lockatong Formation (**TRl**) Hammer Creek conglomerate (**TRhc**)	**TRh** contains quartzose sandstone, siltstone, and mudstone that appear gray and pale red in outcrop with fine- to coarse-grained textures. **TRl** is dark gray to black, thickly bedded argillite. Lenses and layers of thin-bedded black shale, impure limestone, and calcareous shale present locally. **TRhc** is composed of interbedded cobble and pebble quartz conglomerate with red sandstone.	Moderate	Suitable for most development unless highly fractured, weathered, or undercut on a slope.	Weathered mudstone or dissolved limestone underlying more resistant sandstone or argillite can create rockfall hazards.	May contain Triassic age fossils.	None documented.	Impure limestone layers are susceptible to dissolution and may compromise integrity of units.	Sandstone.	None documented.	Unit is fine for most recreation unless heavily weathered on slopes.	Units record deposition within a Triassic rift basin of varying depth.
TRIASSIC	Stockton Formation (**TRs**) Stockton conglomerate (**TRsc**)	**TRs** contains light gray to buff, coarse-textured arkosic sandstone, with some reddish-brown to purple sandstone, siltstone, and mudstone interbeds. **TRsc** contains cobbles of quartz in a sandy, poorly sorted matrix with some conglomeratic sandstone present locally.	Moderate	Heterogeneous nature of units may render them unstable on slopes.	Units form alternating ridges that may be prone to rockfall and landslides, especially where resistant sandstone layers are underlain by weathered red shales.	May contain Triassic age fossils.	None documented.	None documented.	Sandstone.	None documented.	Conglomeratic outcrops may attract climbers.	Units record deposition and reworking within a Triassic rift basin.
ORDOVICIAN	Martinsburg Formation (**Om**) Hamburg sequence rocks (**Oh**) Shale and Graywacke of Hamburg sequence (**Ohsg**) Limestone of Hamburg sequence (**Ohl**)	**Om** contains dark gray to gray shale and slightly metamorphosed slate. **Oh** includes greenish-gray, purple, and maroon shale, siltstone, and graywacke with some flysch beds containing some of unit **Om**. **Ohsg** consists of shale with conspicuous zones of graywacke. **Ohl** is thick-bedded limestone of the Hamburg sequence.	Moderate	Avoid dissolved units for development of wastewater treatment facilities; weathered units may fail on slopes.	Unit is prone to rockfall where weathered shale is beneath resistant sandstone ledges or where limestone has dissolved beneath overlying rock layers.	May contain Ordovician age fossils.	Slate may have been locally quarried.	Unit **Ohl** is susceptible to dissolution and may undermine stability of overlying units.	Slate.	Cave habitat.	Dissolved caves and cavities may attract attention.	Units record deep water marine depositional environment.
ORDOVICIAN	Cocalico Formation (**Oco**) Jacksonburg Formation (**Ojk**) Annville Formation (**Oan**)	**Oco** includes gray phyllitic shale, maroon shale, and siltstone with silty siliceous interbeds. Some argillaceous and quartzose sandstones present locally. **Ojk** contains dark gray, shaly limestone with slaty cleavage. Some medium- to thick-bedded limestone is present in basal sections. **Oan** consists of light gray, massive-bedded, limestone. Unit is calcium rich and mottled in the basal layers.	Moderate	Avoid heavily dissolved units for development due to weakness of friable textures.	Limestone cements are prone to dissolution and may compromise outcrops of **Ojk**.	May contain Ordovician age fossils.	None documented.	Limestone layers and units are susceptible to dissolution, forming caves, sinkholes, and cavities.	Sandstone, slate.	**Oan** weathers to produce Ca-rich substrates.	Cave-bearing units may attract attention.	**Oco** has allochthonous and autochthonous elements.

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ORDOVICIAN	Beekmantown Group (**Ob**) Ontelaunee Formation (**Oo**) Epler Formation (**Oe**) Rickenbach Formation (**Ori**) Stonehenge Formation (**Os**)	**Ob** includes **Oo**, **Oe**, **Ori**, and **Os**. **Oo** is light to dark gray dolomite with very fine to medium crystalline textures; interlayered light gray limestone; and interbedded nodular, dark gray chert beds at the base. **Oe** includes light gray limestone with fine-grained textures interlayered with gray dolomite. Some coarsely crystalline lenses are present locally. **Ori** contains medium to dark gray coarsely crystalline dolomite in the basal beds topped by medium to light gray fine crystalline dolomite. Chert lenses, interbeds, and nodules are present locally. **Os** includes medium light gray to medium gray, fine crystalline, massive limestone with some dark, siliceous layers and conglomeratic beds.	Moderate	Avoid heavily dissolved units for heavy development due to weakness of friable textures; dissolved units are inherently porous, and thus do not act as effective filters for wastewater.	Resistant chert nodules and beds pose rockfall hazard when surrounding limestone and dolomite dissolve preferentially.	**Os** has fossil fragments in discrete lenses.	Chert nodules may have provided tool material to Native Americans.	Interlayered limestone and dolomite are susceptible to dissolution.	Limestone, dolomite.	Unit may dissolve to form cave habitats and produce Ca- and Mg-rich substrates.	Dissolved caves and cavities may attract attention.	Widespread thick unit that shows facies changes geographically, recording shifting depositional environments.
ORDOVICIAN AND CAMBRIAN	Conestoga Formation (**OCc**)	**OCc** contains light gray, thinly bedded contorted impure limestone with shaly partings. Conglomeratic layers present at base of unit. Locally metamorphosed to phyllite.	Moderate	Unit weathers easily to sand, which may render it too permeable for septic systems or too unstable for heavy development.	Unit is associated with rockfalls and slumps when exposed on slopes; alternating resistant and weaker layers are prone to fail if undercut. Black shale units may contain arsenic that could be released to groundwater and soils.	May contain Cambrian-Ordovician age fossils.	Scant chert nodules may have provided tool material for Native Americans.	Impure limestone layers may partially dissolve and compromise integrity of unit.	Pink marble locally.	Unit underlies deep sandy, well-drained soils.	Unit is friable and may be unstable base for trails on slopes.	Unit spans Cambrian to Ordovician boundary.
CAMBRIAN	Richland Formation (**Cr**) Allentown Formation (**Cal**) Millbach Formation (**Cm**) Elbrook Formation (**Ce**)	**Cr** contains gray dolomite with some oolitic beds and medium gray limestone and dark gray oolitic chert present locally. **Cal** is medium to medium dark gray, thick-bedded interlayered dolomite and impure limestone. Some chert stringers and nodules present locally with oolitic and stromatolitic calcareous siltstones at the base that weather to orange-brown. **Cm** includes pink to white and gray limestone and finely laminated crystalline dolomite. **Ce** is microcrystalline limestone with dolomite and metamorphosed layers of phyllite and marble.	Moderate to moderately high for metamorphic layers	Units are suitable for most development unless highly dissolved and/or fractured.	Units may be associated with karst hazards if dissolution is prevalent. When undercut, units pose rockfall hazards.	Stromatolites in **Cal** and **Cm**.	Chert nodules may have provided tool material for Native Americans.	Interlayered limestone and dolomite are susceptible to dissolution.	Marble, limestone.	None documented.	Units may attract caver attention and provide cave habitats.	Units contain evidence of life along a Cambrian-aged sea.
CAMBRIAN	Leithsville Formation (**Clv**) Buffalo Springs Formation (**Cbs**) Lower (Middle?) Cambrian rocks, undivided (**Cul**) Zooks Corner Formation (**Czc**)	**Clv** contains medium to dark gray crystalline dolomite that weathers to light yellowish-brown and gray. Unit is massive with some oolitic, pink to gray, mottled chert, thin shale and dolomitic shale interbeds with scattered sand grains. **Cbs** contains light pinkish-gray limestone and dolomite with fine to coarse crystalline textures. Numerous siliceous and clay-rich laminae are present. **Cul** includes tectonic slices of **Czc**, **Cl**, **Ck**, **Cv**, **Ca**, **Cah**, and **Ch**. **Czc** includes medium gray dolomite with fine crystalline textures and interlayered siliceous to argillaceous stingers.	Moderate	Heterogeneous nature of units may render them unstable on slopes, but suitable for most light development.	Limestone units may be associated with karst dissolution and processes, creating voids that may cause failure.	Stromatolites in **Cbs** near the top of the unit.	Chert nodules may have provided tool material for Native Americans.	Interlayered limestone and dolomite are susceptible to dissolution, forming caves, sinkholes, and smaller cavities.	Dolomite, limestone.	Units weather to form myriad substrates that support many types of forests.	Units are suitable for most recreation unless heavily dissolved or fractured; caves provide habitats for bats and other fauna.	**Cul** is arranged in tectonic slices, recording the depositional environments and tectonic history of the area. Units contain evidence of life along a Cambrian-aged sea.

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CAMBRIAN	Ledger Formation (**Cl**) Kinzers Formation (**Ck**) Vintage Formation (**Cv**)	**Cl** contains massive pure dolomite with some siliceous grading near the center of the beds. Unit appears light gray and mottled in outcrop. **Ck** consists of dark brown shale, gray to white spotted limestone, and marble in the lower beds, and sandy friable limestone in the upper beds. **Cv** is dark gray argillaceous dolomite with knotty textures and light gray marble in the basal layers locally.	Moderate	Units are suitable for most development unless highly dissolved and/or fractured.	Units weather to form friable, porous rocks that are unstable and may fail easily.	May contain Cambrian age fossils.	None documented.	Limestone and (to a lesser extent) dolomite are susceptible to dissolution.	Marble.	Units weather to well-drained sandy soils with abundant clay clasts.	Units are suitable for most recreation unless steep slopes are present; caves may attract attention.	Units record oscillating Cambrian marine and nearshore depositional environments.
CAMBRIAN	Antietam and Harpers Formations, undivided (**Cah**) Antietam Formation (**Ca**) Hardyston Formation (**Cha**) Harpers Formation (**Ch**) Chickies Formation (**Cch**)	**Cah** includes **Ca** and **Ch**. **Ca** consists of gray quartzite that appears buff in weathered outcrops. **Cha** includes light gray, fine- to medium-grained quartzite and feldspathic sandstone in massive beds. Some quartz pebble conglomerate in basal beds. **Ch** contains dark greenish-gray phyllite and schist with thin quartzite interbeds. **Cch** consists of light gray massive quartzite and quartz schist, with some thin interlayered slate in the upper beds and conglomeratic beds at base.	Moderate to very high for quartzite	Quartzite units cap ridges, and are suitable for most development unless highly fractured and/or exposed on steep slopes.	Units are associated with steep slopes and rockfall.	*Skolithos* in **Cha** and **Cch**.	Quartzite provided building material regionally.	None documented.	Quartzite.	Units underlie ridgetop, a well-drained habitat.	Resistant quartzite layers may attract rock climbers.	Units contain evidence of life along a Cambrian-aged sea.
PROBABLY LOWER PALEOZOIC	Pegmatite (**Xpg**) Granitic gneiss and granite (**Xgr**) Mafic gneiss (**Xmgh**) Ultramafic gneiss (**Xu** Octoraro Formation (**Xo**) "Glenarm Wissahickon" formation (**Xgw**) Wissahickon Formation (**Xw**)	**Xpg** contains coarse- to medium-grained textures and granitic compositions. **Xgr** is metamorphosed granodiorite. **Xmgh** is dark, medium-grained gneiss of metamorphosed sedimentary rocks. **Xu** includes serpentinite, steatite, and other altered peridotites and pyroxenites. **Xo** consists of albite-chlorite schist, phyllite, and hornblende gneiss. Granitized members are present locally. **Xgw** contains oligoclase-mica schist and lenticular amphibolite bodies of ocean floor basalt origin. **Xw** consists of oligoclase-mica schist, hornblende gneiss, augen gneiss, and some granitized quartz and feldspar rich members locally.	Moderately high to high	Avoid areas of intense preferential compositional weathering (along foliation and between heterogeneous lenses). Suitable for most development unless highly weathered and/or fractured.	Rockfall hazard when unit is exposed on slope, especially if slope and dominant foliation planes are parallel.	None.	**Xpg** crystals may have provided trade material.	None.	Pegmatite, augen gneiss.	None documented.	Units are suitable for most recreation unless highly altered, cleaved, and/or fractured.	Units record early metamorphic history and depositional environments.

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PRECAMBRIAN	Metadiabase (**md**) Anorthosite (**a**) Graphitic felsic gneiss (**gqm**) Felsic and intermediate gneiss (**ggd**) Banded mafic gneiss (**gga**) Graphitic felsic gneiss (**gg**) Franklin Marble (**fm**)	Unit **md** is dark gray (greenish), fine-grained altered diabase intrusions. Unit **a** contains medium- to coarse-grained, bluish-gray plagioclase-rich rock with alteration minerals present locally. Unit **gqm** is medium-grained, dark gray, gneissic feldspar and quartz with some altered areas. Unit **ggd** contains medium-grained, pink to greenish-gray gneiss of quartz, feldspar, and mica. Unit **gga** interfingers with **ggd** and contains dark, fine- to medium-grained banded gneiss of sedimentary origin. Unit **gg** contains medium-grained gray gneiss and marble with quartz, feldspar, graphite, and metamorphic minerals. Unit **fm** is coarse-grained, white, crystalline marble with disseminated graphite flakes.	High	Units are fine for most development unless heavily altered and/or fractured.	Rockfall hazard when units are exposed on slope, especially if slope and dominant cleavage direction are parallel.	None.	Marble may have provided quarry material.	Some dissolution of marble beds possible.	Gneiss, marble, graphite.	None documented.	Units are suitable for most recreation unless highly altered, cleaved, and/or fractured.	Units record accretion of distinct crustal blocks onto the North American continent. At approximately 1 billion years old, these are some of the oldest rocks in Pennsylvania
PRECAMBRIAN	Felsic and intermediate gneiss (**fgh**) Felsic gneiss (**fgp**) Hornblende gneiss (**hg**) Mafic gneiss (**mgh**) Mafic gneiss (**mgp**); Felsic to mafic gneiss (**gn**)	Unit **fgh** contains light-appearing gneiss with medium-grained textures likely of sedimentary origin. Unit **fgp** consists of light, medium-grained silicic gneissic rocks. Unit **hg** is dark, medium-grained gneiss likely of sedimentary origin. Units **mgh** and **mgp** are similar, consisting of dark, medium-grained gneiss likely of sedimentary origin. Unit **gn** is quartz and light feldspar-bearing gneiss of medium-grained texture and likely igneous origin.	High unless highly weathered	Avoid areas of intense preferential compositional weathering (along foliation and between heterogeneous lenses). Suitable for most development unless highly weathered and/or fractured.	Units may pose rockfall hazard if undercut or exposed on a slope.	None.	None documented.	None.	Gneiss.	Mafic gneiss develops into Fe-, Mg-, and Ca-rich substrates that support myriad forest types.	Units are suitable for most recreation unless highly altered, cleaved, and/or fractured.	Metamorphosed rocks retain features and compositions characteristic of sedimentary and/or igneous origin. At approximately 1 billion years old, these are some of the oldest rocks in Pennsylvania