Map Unit Properties Table: Valley Forge National Historical Park

Colored rows indicate geologic units mapped within Valley Forge National Historical Park

Age	Map Unit (Symbol)	Features and Detailed Geologic 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 landscape.
TERTIARY	Pennsauken 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 units renders them susceptible to mass wasting on steep to moderate slopes.	May contain plant fragments	Terrace areas may contain traces of American Indian campsites	None	Sand, clay, silt, gravel	Units support riparian habitats and well-drained soils.	Units are 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	Unit supports eastern hardwood forests regionally.	Unit is 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 historically popular building stone	Limestone units are prone to dissolution.	Labradorite, pyroxene, plagioclase phenocrysts (cm-size), diabase	**Jd** weathers to support iron- and magnesium-rich substrates.	Units are suitable for most recreation, unless heavily altered or fractured.	**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.	Units are prone to rockfall where weathered shale underlies 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 completely, creating voids and compromis-ing unit integrity.	None documented	Units weather to create myriad substrates.	Units are 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 comprised of interbedded cobble and pebble quartz conglomerate with red sandstone.	Moderate	Units are 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	Units are suitable 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 arkosic sandstone, with some reddish-brown to purple sandstone, siltstone, and mudstone interbeds. **TRsc** contains quartz cobbles 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.	Variety of body and trace fossils documented outside of park. Fossils not yet documented from TRs within the park.	None documented	None documented	Sandstone	None documented	Conglomeratic outcrops may attract climbers.	Units record deposition and reworking within a Triassic rift basin. Upper unit of Cambrian-Triassic unconformity documented within park.
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.	Units are prone to rockfall where weathered shale underlies resistant sandstone ledges or where limestone has dissolved beneath overlying rock layers.	May contain Ordovician-age fossils	Slate may have been locally quarried historically.	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 calcium-rich substrates.	Cave-bearing units may attract attention.	**Oco** has allochthonous and autochthonous elements.
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 fine-grained limestone 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 finely crystalline dolomite. Chert lenses, interbeds, and nodules are present locally. **Os** includes medium-light-gray to medium-gray, finely crystalline massive limestone with dark siliceous layers and conglomerate beds.	Moderate	Avoid heavily dissolved units for heavy development due to weakness of friable textures; dissolved units are inherently porous and do not act as good 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 American Indians.	Interlayered limestone and dolomite are susceptible to dissolution.	Limestone, dolomite	Units may dissolve to form cave habitats and produce calcium- and magnesium-rich substrates.	Dissolved caves and cavities may attract attention.	Widespread, thick units that show geographic facies changes and record shifting depositional environments.

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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 readily 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- to Ordovician-age fossils	Scant chert nodules may have provided tool material to American Indians.	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 form an unstable base for trails on slopes.	Unit spans Cambrian to Ordovician boundary.
CAMBRIAN	Richland Formation (Cr); Allentown Formation (Cal);[1] Millbach Formation (Cm);[1] 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.** Rare trilobite fossils in **Ce**, not yet documented in the park or surrounding area.	Chert nodules may have provided tool material to American Indians.	Interlayered limestone and dolomite are susceptible to dissolution.	Marble, limestone	None documented	Cave-bearing units may attract attention.	Units record marine depositional environments.
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 coarsely 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 finely crystalline dolomite with 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 to American Indians.	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 forest types.	Units are suitable for most recreation, unless heavily dissolved or fractured; cave habitats for bats and other fauna.	**Cul** is arranged in tectonic slices, recording the depositional environments and tectonic history of the area.
CAMBRIAN	Ledger Formation (Cl); Kinzers Formation (Ck); Vintage Formation (Cv)	**Cl** contains massive pure dolomite with some siliceous grading near the bed centers. 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.	Stromatolites are preserved within **Cl** exposures in the park.	None documented	Limestone, and to a lesser extent, dolomite are susceptible to dissolution. **Cl** hosts karst features within the park.	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. Bone Cave developed in **Cl**. **Cl** is lower unit of Cambrian-Triassic unconformity documented within park.

[1] Unit is of correct stratigraphic age and may be correlative, but not relevant to the Valley Forge area (William Kochanov, Pennsylvania Bureau of Topographic and Geologic Survey, Senior Geologic Scientist, written communication 2010).

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CAMBRIAN	Antietam and Harpers formations, undivided (Cah); Antietam Formation (Ca);[2] Hardyston Formation (Cha); Harpers Formation (Ch); Chickies Formation (Cch)	**Cah** includes **Ca** and **Ch**. **Ca** consists of gray quartzite that appears buff-colored 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.** *Skolithos* fossils within park exposures of **Cch.**	Quartzite historically provided building material regionally, including the restroom facilities near the visitor center and other structures within the park.	None documented	Quartzite	Units underlie ridgetop and well-drained habitat.	Resistant quartzite layers may attract rock climbers.	Erosion resistant units underlie topographic highs of Mount Joy and Mount Misery.
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-colored, 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 where slope and dominant foliation planes are parallel.	None	**Xpg** crystals may have provided prehistoric 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.
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, fine-grained greenish 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 suitable for most development unless heavily altered and/or fractured.	Rockfall hazard when unit is exposed on slope, especially where slope and dominant cleavage direction are parallel.	None	Marble may have provided quarry material historically.	Some dissolution of marble beds is 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.

[2] Although the Antietam Formation is shown to occur on some geologic maps, field evidence suggests that it may be the Chickies and/or Harpers formations (William Kochanov, Pennsylvania Bureau of Topographic and Geologic Survey, Senior Geologic Scientist, written communication 2010).

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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-colored, medium-grained gneiss of probable sedimentary origin. Unit **fgp** consists of light-colored, medium-grained silicic gneissic rocks. Unit **hg** is dark-colored, medium-grained gneiss of probable sedimentary origin. Units **mgh** and **mgp** are similar, consisting of dark, medium-grained gneiss of probable sedimentary origin. Unit **gn** is quartz- and feldspar-bearing gneiss with light color and medium-grained texture of probable 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.	Unit may pose rockfall hazard if undercut or exposed on a slope.	None	None documented	None	Gneiss	Mafic gneiss develops into iron-, magnesium-, and calcium-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.