Map Unit Properties Table

Colored rows indicate units mapped within Kings Mountain National Military Park.

Age	Unit Name (Symbol)	Features and Description	Erosion Resistance	Suitability for Development	Hazards	Cultural Resources	Mineral Occurrence	Habitat	Recreation	Geologic Significance
QUATERNARY	Dam Material (Qme) Artificial Fill (Qaf) Mine Dump (Qd)	***Qme*** includes concrete and steel material used to construct Ninety-nine Islands Dam. ***Qaf*** contains unconsolidated gravel, sand, fill, and debris used in constructing roads, dams, and building foundations. ***Qd*** contains waste tailings and mine-related debris.	High, low for unconsolidated deposits	Units are associated with modern development.	Mine-related debris may contain heavy minerals and dangerous substances.	Units associated with human development in Kings Mountain area.	None	***Qme*** creates reservoir shoreline habitat.	Mine debris and dam fill should be avoided for recreation.	Units record history of urbanization of the Kings Mountain area
QUATERNARY	Alluvium (Qal) Colluvium (Qc)	***Qal*** consists of mixed deposits of gravel, sand, silt, and clay that is mainly poorly sorted and that is fine to very coarse in grain size. Unit may be present in wide banks as much as 7 m (23 ft) thick. ***Qc*** contains mixed blocks of quartzite, boulders, and coarse cobbles associated with frost-wedging and slope processes.	Low	Unconsolidated nature of units renders them unsuitable for waste-water facility development or heavy development.	***Qc*** is associated with mass-wasting processes and is prone to slumping and sliding when water-saturated and present on a slope.	May contain battlefield relicts or American Indian artifacts	None documented	Modern riparian habitat along waterways	***Qal*** is associated with waterways and is suitable for light recreation. ***Qc*** should be avoided due to association with mass wasting.	Surficial units may have been present at time of battle and record waterway and slope development throughout the area
JURASSIC	Olivine Diabase Dike (Jd)	Unit is dark gray, fine-grained to very fine grained, crystalline mafic igneous intrusions present in north- to northwest-trending parallel dikes as much as 5 m (16 ft) thick.	High	None documented	Unit may be associated with frost-wedging and slope processes when present as boulders; unit may pose rockfall hazard when exposed on a slope.	Unit may have provided trade material.	Labradorite laths, accessory minerals such as augite, olivine, magnetite	Unit may weather to iron- and magnesium-rich soils.	None documented	Units are part of the Central Atlantic Magmatic Province—the most extensive igneous province on the Earth. Unit marks rifting of Pangaea and opening of proto-Atlantic basin.
PENNSYLVANIAN	Cherryville Granite: High Schoals Granite (PNhs) York Pluton: York Pluton (PNy) Fine Grained Leucocratic Facies (PNyf)	***PNhs*** contains very light gray, coarse-grained, porphyritic, gneissic biotite granite and augen gneiss. Phenocrysts are subparallel to biotite-defined foliation. Lenticular inclusions of country rock occur locally. ***PNy*** contains unmetamorphosed, coarse-grained, porphyritic, light-gray adamellite in two separate plutonic bodies. ***PNyf*** is a finer grained and more leucocratic (light-colored) facies of ***PNy*** that is present locally.	High	Some radioactive minerals may exist within these units and should be avoided for basements and water treatment facilities.	Residual boulders (3–9 m [10–30 ft] in diameter) may pose rockfall hazards. ***PNy*** exposed as pedestals may be prone to blockfall. Weathered units may emit radon gas.	Granite unit may have been quarried for monument stones.	Accessory minerals include myrmektite, pyrite, sphene, epidote, allanite, apatite, zircon; abundant feldspar for abrasives.	Weathers to a porous, well-drained sandy soil that supports pastures and orchards.	Pedestals and balds associated with ***PNy*** attract recreation seekers.	Units are among the oldest Alleghanian plutons; unmetamorphosed nature of units renders them good for age-dating (***PNy*** = 321±2 million years old)
MISSISSIPPIAN	Cherryville Granite: Coarse Grained Granite and Pegmatite (Mcp) Muscovite-Biotite Granite (Mc) Granite Pegmatite (Mp) Spodumene Pegmatite (Ms)	***Mcp*** contains weakly foliated, very light gray, coarse-grained biotite-muscovite granite that grades into pegmatite and is also cut by later pegmatite. ***Mc*** includes light-gray, weakly foliated muscovite-biotite granite that has medium- to coarse-grained textures. Unit is largely concordant but locally discordant to country rock foliation. ***Mp*** contains very coarse grained, white pegmatite showing little deformational textures. ***Ms*** includes unzoned, white, medium- to coarse-grained pegmatite containing abundant spodumene and albite-quartz fillings of vugs and cracks. Textures range from unfoliated to strongly foliated, blastomylonitic to augen gneissic in dikes and sills.	High	Some radioactive minerals may exist within these units and should be avoided for basements and water treatment facilities.	Deformed areas within these units may be prone to intense weathering and therefore be zones of weakness within intact rock bodies. Weathered units may emit radon gas.	Granite unit may have been quarried for monument stones.	Microcline, oligoclase, quartz, muscovite, biotite, graphic granite; some magnetite-ilmenite, apatite, zircon, chlorite, epidote, beryl (rare); pegmatite minerals: euhedral garnet (1 cm [0.4 in]), undeformed micas, spodumene (2 cm [0.8 in]), manganapatite, ferrocolumbite, cassiterite, vivianite, fluorapatite, siderite, attractive mineral groupings.	None documented	None documented	Units record complex intrusion and deformation of the Kings Mountain area. Rb-Sr (whole rock) age of 351±20 million years old for ***Mc***; ***Mp*** has Rb-Sr age of 341±40 million years old.
ORDOVICIAN	Cherryville Granite: Toluca Granite (Otg)	Unit is biotite granite and subordinate granodiorite having medium- to coarse-grained and strongly foliated textures. Unit appears very light gray in irregular bodies conformable to the regional country rock	High	Some radioactive minerals may exist within this unit and should be avoided for basements.	Feldspar may weather preferentially to clay, causing zones of weakness throughout otherwise intact rock; these weak zones may develop slip surfaces	None documented.	Oligoclase, microcline, quartz, biotite, muscovite, garnet, monazite, ilmenite, rutile, sillimanite, apatite, zircon.	None documented	Unit is suitable for most recreation unless highly altered in settings prone to mass wasting.	U-Pb dates for this unit suggest Ordovician age; unit records regional deformation.

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CAMBRIAN OR NEOPROTEROZOIC	Inner Piedmont Layered Metamorphic Rocks: Amphibolite (CZa) Muscovite-Biotite Gneiss (CZbg) Muscovite Schist (CZs)	***CZa*** contains layered plagioclase and hornblende-rich bands of amphibolite. Textures are fine grained and equigranular, and unit appears dark gray and banded in outcrop. ***CZbg*** is light-gray to dark-gray gneiss having fine- to medium-grained textures in inequigranular, foliated, layered, and locally sheared bodies. ***CZs*** includes rather coarse grained, well-foliated, yellowish-gray muscovite schist with abundant metamorphic textures and minerals.	Moderately high.	Heterogeneous and locally schistose nature of these units may render them unsuitable for development on slopes due to inherent planes of weakness.	Units may weather preferentially in deformed bands and pose rockfall hazards on slopes; mica-rich units tend to preferentially weather to grayish pink to pale red clay and may form zones of weakness in otherwise intact rock.	Minerals may have provided trade material.	Diopside, calcite, epidote, quartz, hornblende, plagioclase, biotite, garnet, sphene, apatite, pyrrhotite, chlorite, magnetite, sillimanite, garnet, oligoclase, muscovite (2 mm [0.08 in]), staurolite, kyanite, chlorite (secondary), radial clusters of tourmaline in schist	Micaceous units weather to contribute to grayish-pink to pale-red, clayey soils.	None documented	Units record regional metamorphism and ductile deformation at great crustal depths.
PALEOZOIC? OR NEOPROTEROZOIC	Inner Piedmont Layered Metamorphic Rocks: Metadiorite and Metagabbro (PZZgd)	Unit weathers to a mottled dark gray and has medium- to coarse-grained textures and compositions ranging from hornblende-quartz gabbro to hornblende-quartz diorite. Small outcrops appear strongly foliated, massive or gneissic. Some metadiorite appears speckled.	Moderate	Weathered nature of this unit may render it unstable for heavy development.	Deep-weathering nature of these units may render them slippery on slopes and prone to act as failure surfaces due to higher clay concentrations.	None documented.	Labradorite, andesine, green hornblende, quartz, epidote, biotite, magnetite, relict pyroxene	Weathering contributes to distinctive greenish-brown, clayey soil.	Unit tends to weather deeply and also produce large, rounded boulders in streams that may attract recreation seekers to waterways.	Unit postdates regional metatonalite and may be relict oceanic crust subjected to metamorphism and deformation.
NEOPROTEROZOIC	Charlotte Belt Units: Amphibolite and Biotite Gneiss (Zambgn) Mica Schist (Zms) Metatonalite (Zmto) Quartzite (Zq)	***Zambgn*** contains thinly layered, fine-grained amphibolite interlayered with medium-grained biotite gneiss. Layering is locally contorted and disrupted. ***Zms*** contains silica-rich sericite phyllite that appears purple and brown in outcrop. ***Zmto*** includes distinct belts of coarse-grained metatonalite that weather to sharp, blocky exposures. Local mafic lenses are present. ***Zq*** includes brown- and purple-stained quartzose rock in fine-grained, weakly foliated lenses and small bodies.	Moderate to high for quartzite.	Layered and weathered nature of these units may render them unsuitable for heavy development.	Layered units may contain weathered planes of weakness that render them unstable on slopes and prone to blockfall and other forms of mass wasting.	None documented.	Large oligoclase crystals (2–3 cm [0.8–1.2 in]), gray to blue quartz, biotite, muscovite, hornblende, quartzite	***Zmto*** weathers to produce orange, sandy soils containing remnant quartz and oligoclase grains. ***Zq*** contains pits and voids from weathered pyrite that may provide specialized habitat.	Weathered outcrops may be blocky and too sharp for trail development locally.	Amphibolite predates regional belts of metatonalite and places constraints on the timing of metamorphism and deformation.
NEOPROTEROZOIC	Charlotte Belt Units: Metatonalite (Zto) Metatonalite with Mafic Layers (Ztom) Interlayered Mafic and Felsic Gneiss—South (Metatrondhjemite) (Ztrs) Metatrondhjemite and Amphibole Gneiss (Ztr) Silicified Metatrondhjemite (Zts)	*Zto* contains light- to medium-gray metatonalite that is weakly foliated to schistose and has medium- to coarse-grained textures. Some mafic inclusions are locally present. ***Ztom*** is metatonalite containing a high mafic component and is present as mappable layers and inclusions of hornblende gneiss and epidosite. ***Ztrs*** contains interlayered mafic and felsic gneiss (metatrondhjemite), the felsic layers consisting of white to light-gray, medium to finely crystalline, seriate textured rocks and mafic layers containing greenish-gray to black, medium- to coarse-grained hornblende gneiss that is strongly lineated. ***Ztr*** is mixed metatrondhjemite and amphibole gneiss in mostly concordant layers. Metatrondhjemite is very light gray to yellowish-gray, fine- to medium-grained rock that is weakly foliated to schistose to gneissic in texture. Amphibole gneiss is dark greenish gray, medium grained. ***Zts*** contains whitish-tan to pale-green metatrondhjemite having massive textures that is significantly cut by quartz veins.	Moderate to high for unweathered units.	Heterogeneous nature of units as well as heavily altered areas may render the units unsuitable for heavy development projects. Avoid highly fractured areas.	Units may be susceptible to slope processes, including blockfall, landslides, slumping, and slope creep for altered, deformed, and fine-grained areas.	Units may have been associated with gold mining in the area and attracted surveyors.	Oligoclase, quartz, albite, biotite, muscovite, hornblende needles (4 mm [0.16 in] long), epidote, sphene, chlorite, magnetite, pyrite, zircon, apatite, some angular mafic xenoliths, white mica, chlorite, epidosite, actinolite, vein quartz, gold-bearing mineralized zones in *Zts*, pyrite	Units may weather to produce clayey soils.	None documented	Units ***Ztr***, ***Ztrs***, and ***Ztrn*** (not identified on digital geologic map) correlate over a broad geographic area and form part of the core of the South Creek antiform. ***Zts*** was interpreted as shallow depth intrusions.
NEOPROTEROZOIC	Blacksburg Formation: Hornblende Gneiss and Amphibolite (Zbla) Gaffney Marble Member (Zblg) Marble Member of Dixon Branch (Zblm)	***Zbla*** is dark gray and has fine- to coarse-grained, equigranular textures in lenticular sheets parallel to foliation. ***Zblg*** is very light gray to blue-gray calcite and dolomitic marble having fine- to coarse-grained textures and localized banding and schistosity. ***Zblm*** is similar to ***Zblg*** but has more strongly defined banding consisting of layers of calc-silicate rock interbedded with marble. Maximum thickness of ***Zblm*** is 200 m (660 ft).	Moderate	Dissolved carbonate areas should be avoided for waste-water treatment facilities.	Calcitic and dolomitic marble units may be prone to dissolution and karst processes. This may cause instability in overlying or adjacent units.	Marble units were quarried in open-pit operations.	Hornblende, plagioclase, quartz, epidote, augite, calcite, dolomite, marble, phlogopite, tremolite, graphite, epidote, pyrite, white mica, chlorite	Units may weather to produce high-calcium soils.	Friable areas of units may be unsafe for trail base.	Marble units may record carbonate platform present prior to accretion to the North American continent.

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NEOPROTEROZOIC	Blacksburg Formation: Laminated Micaceous Quartzite (Zblq) Phyllitic Metasiltstone (Zbls) Chlorite Phyllonite (Zblc)	***Zblq*** is white to yellowish-gray, equigranular, laminated micaceous quartzite containing phyllite layers. Layers are generally less than 1 m thick, and textures are fine to medium grained. Unit is present as discontinuous beds no thicker than 140 m (460 ft). ***Zbls*** contains well-foliated to blocky, quartz-rich metasiltstone that appears light to dark gray, fine grained, and phyllitic in outcrop. ***Zblc*** contains light-greenish-gray, chlorite-rich phyllonite that includes lenses of bluish-gray dolomitic marble locally.	Moderate for weathered units to moderately high.	Heterogeneous nature of units may prove unstable for heavy foundations and development; strong foliation and cleavage may also weaken the units.	Landslide hazard may exist where unit is exposed on slope, especially if slope and predominant cleavage direction are parallel.	Unit is present within the Kings Mountain gold mine.	Attractive banded quartzite, white mica, biotite, magnetite, garnet, chloritoid, chlorite, calcite, graphite, mica fish (scales) phyllite, epidote, hornblende, plagioclase (4 mm [0.16 in] in diameter)	None documented	Unit is suitable for most recreation unless highly altered, cleaved, and/or fractured.	***Zblc*** has a mineral assemblage suggestive of retrogressively altered hornblende gneiss.
NEOPROTEROZOIC	Battleground Formation: Metadacite and Metatrondhjemite (Zbdt) Quartz-Sericite Phyllite and Schist (Zbs) Draytonville Metaconglomerate Member (Zbd) Jumping Branch Manganiferous Member (Zbj)	***Zbdt*** contains very light gray to yellowish-gray, felsic muscovite-biotite-quartz-plagioclase gneiss having locally mylonitic, fine- to medium-grained textures. ***Zbs*** is mixed and layered phyllite and schist. Unit appears very light to bluish gray and has very fine grained to medium-grained textures. ***Zbd*** is 10–34 m (33–112 ft) thick and contains matrix-supported, coarse-grained metaconglomerate and metasandstone. Primary grains are quartz. Unit appears light to medium gray in outcrop. Quartz pebbles are flattened at an angle to bedding to define a slight foliation. ***Zbj*** is an equigranular garnet-quartz rock interlayered with quartz-sericite schist. Units appear light gray to brown, having fine-grained textures and strong foliation.	Moderate for weathered units to high.	Avoid heavily altered and/or fractured areas of these units for heavy development.	Intact massive and resistant units may be underlain by heavily weathered and/or fractured layers, creating a setting prone to blockfall if exposed on a slope.	Part of Kings Mountain gold mine area; a shaft within the park mined manganese ore from ***Zbj***.	Plagioclase, blue quartz, biotite, sericitic white mica, chlorite, paragonite, muscovite, garnet, chloritoid porphyroblasts (<10 mm [0.4 in]), staurolite, kyanite, andalusite, graphite, tourmaline, zircon, pyrite, hematite, metaconglomerate, hornblende, spessartine-almandine garnets (0.1 mm [0.004 in])	***Zbj*** weathers to produce saprolite and dusky-brown oxides, such as pyrolusite and psilomelane in local soils.	None documented	***Zbdt*** has sheared, but unconformable, contacts with the Blacksburg Formation. ***Zbs*** contains record of high-grade regional metamorphism. Battleground Formation named for exposures on historic Kings Mountain battleground.
NEOPROTEROZOIC	Battleground Formation: Aluminous Quartzite (Zbaq) Kyanite Quartzite (Zkq) Dixon Gap Metaconglomerate Member (Zbc)	***Zbaq*** is high-grade metamorphosed quartzite that appears light to medium gray and contains aggregates of kyanite in a finer grained, quartz-rich matrix having strong foliation. ***Zkq*** crops out as steeply dipping lenticular beds of foliated, kyanite-rich quartzite. Unit appears medium gray with brown to purple stains in coarse-grained exposures. ***Zbc*** contains coarse-grained, very light gray to medium-light-gray quartz-pebble metaconglomerate in which quartz pebbles average 1 cm (0.4 in) in diameter in a finer grained, poorly sorted quartzose matrix. Unit is 10–40 m (33–130 ft) thick.	High for quartzite to moderately high.	Units that are highly weathered may be unstable foundation bases.	Clay-rich horizons may create slip surfaces, rendering units prone to mass wasting.	Minerals may have provided trade material.	Kyanite (1 cm [0.4 in]), sillimanite (<4 mm [0.16 in]), andalusite, biotite, white mica, magnetite, pyrite, quartz (1 cm [0.4 in]), magnetite-ilmenite quartzite, hornblende gneiss, phyllite, chloritoid.	Units may weather to clay-rich soils.	None documented	***Zbaq*** records high-grade metamorphism, aluminosilicate minerals detailing metamorphic evolution of the unit. ***Zkq*** is associated with the hydrothermal alteration zone southwest of Henry Knob. ***Zbc*** records regional deformation with quartz grains flattened at a length-width ratio of 1 to 5 at an angle to regional bedding. Battleground Formation named for exposures on historic Kings Mountain battleground.
NEOPROTEROZOIC	Battleground Formation: Mottled Phyllitic Metatuff (Zbmp) Plagioclase-Crystal Metatuff (Zbct) Greenstone (Zbgs)	***Zbmp*** contains mottled sericite schist and phyllite that is metamorphosed pyroclastic rock (lapilli metatuff). Mottled appearance is from iron-titanium oxides in a lighter colored matrix. Some well-sorted and graded beds are remnants of original textures. Unit appears light bluish gray to medium dark gray in well-foliated outcrops. ***Zbct*** resembles ***Zbmp*** in that it is medium to dark gray and has massive to schistose textures. ***Zbgs*** contains pale-green, fine-grained schist that is rounded and knobby in outcrop.	Moderate	Heterogeneous and schistose nature of units may prove unstable for heavy foundations and development.	Landslide hazard may exist where unit is exposed on slope, especially if (in schistose units) slope and predominant cleavage direction are parallel; shrink-and-swell clays may develop from weathered greenstone units.	Minerals may have provided trade material.	Quartz, plagioclase (<6 mm [0.24 in]), sericitic white mica, iron-titanium oxides, chloritoid (2–4 mm [0.08–0.16 in]), chlorite, epidote, paragonite, muscovite, margarite, kyanite, magnetite (1 mm [0.04 in]), tourmaline, calcite, green amphibole, zircon, apatite, biotite, pyrite.	None documented	Suitable for most recreation unless schistose units are exposed on a steep slope.	***Zbmp*** records early volcanism followed by metamorphism and deformation. ***Zbct*** records andesitic to dacitic volcanism. ***Zbgs*** may be remnant of deep-seated oceanic crust and is the only occurrence of greenstone in the area. Battleground Formation named for exposures on historic Kings Mountain battleground.
NEOPROTEROZOIC	Battleground Formation: Felsic Schist and Gneiss (Metafelsite) (Zbfs) Metavolcanic Hornblende Gneiss (Zbht) Crowders Creek Metaconglomerate Member (Zbmc) Siliceous Metatuff (Zbmps).	***Zbfs*** contains white to light-gray feldspathic biotite schist and gneiss having fine- to medium-grained textures in lenticular bodies. Foliation development varies. ***Zbht*** is metavolcanic gneiss that appears medium to dark gray to greenish gray in outcrop and has a well-developed foliation. ***Zbmc*** contains quartz-pebble metaconglomerate having schistose textures that is light to yellowish gray in outcrop. Pebbles of quartz are subrounded, well sorted, and flattened in the plane of schistosity in a finer grained matrix. Maximum thickness of unit is 15 m (50 ft). ***Zbmps*** is quartzose-mottled phyllitic metatuff that is light to medium gray and fine grained in exposures.	Moderate	Heterogeneous nature of units may render them unsuitable for heavy development if exposed on a slope and highly weathered and/or fractured.	Landslide hazard may exist where units are exposed on slope, especially if slope and predominant cleavage direction are parallel.	***Zbmps*** is a resistant unit that underlies linear ridges from the battlefield of 1780.	Calcic oligoclase (<2 mm [<0.08 in]; 5 mm [0.2 in] in ***Zbht***), albite, quartz, biotite, white mica, microcline, orthoclase, sillimanite, garnet, staurolite, hornblende (<3 mm [0.12 in]), epidote, sphene, pyrite	Units may weather to produce calcium- and potassium-rich soils.	Avoid heavily weathered, foliated, and/or fractured areas exposed on slopes for recreation purposes.	***Zbfs*** contains metamorphosed dacitic tuff and mudstone. Metaconglomerate records high-energy deposition in volcanic, deeper water environment. ***Zbmps*** contains disseminated pyrite, which suggests volcanogenic hydrothermal silicification and epiclastic mixing with quartz-rich sediment. Battleground Formation named for exposures on historic Kings Mountain battleground.

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NEOPROTEROZOIC	Battleground Formation: Micaceous Quartzite (Zbmq) Biotite-Muscovite Schist (Zbms) Volcanic Metaconglomerate (Zbvc)	***Zbmq*** includes micaceous quartzite and phyllite or schistose layering. Unit appears white to yellowish gray in outcrop and has fine- to medium-grained, equigranular textures. Schistose layers are locally a few meters thick, individual quartzite beds being as thick as 50 m (160 ft). ***Zbms*** contains very light gray to bluish-brownish-yellowish-gray, fine- to medium-grained schist and phyllite grading and interfingering with neighboring units. ***Zbvc*** is metamorphosed volcanic conglomerate that is yellowish to medium gray in outcrop. At least five different pebble types are common locally: (1) gray, ferruginous quartz rock containing iron-titanium oxides; (2) white polycrystalline quartz; (3) biotite-muscovite schist (***Zbms***); (4) mottled schistose pyroclastic rock (***Zbmp***); and (5) massive metatuff (***Zbct***). Some crude relict depositional features are present, including bedding, flow layering, and some clast rounding.	Moderate to moderately high for quartzite.	Units with high degree of heterogeneity, alteration, and deformation may be unstable foundation bases.	Resistant quartzite may be prone to blockfall if underlain by weathered schistose units. Strong foliation in schist and phyllite may prove unstable on slopes and prone to mass wasting.	Minerals may have provided trade material.	Quartzite, biotite, magnetite, quartz, sericitic white mica, oligoclase, albite, garnet, chloritoid, staurolite, kyanite, sillimanite, andalusite, chlorite, tourmaline, pyrite, hematite.	None documented	Avoid heavily weathered, foliated, and/or fractured areas exposed on slopes for recreation purposes.	***Zbmq*** correlates on a regional scale with other units in the local stratigraphic column (***Zbj***, ***Zbmc***), which aids in determining the regional geologic history. ***Zbms*** contains record of metamorphic-grade evolution.