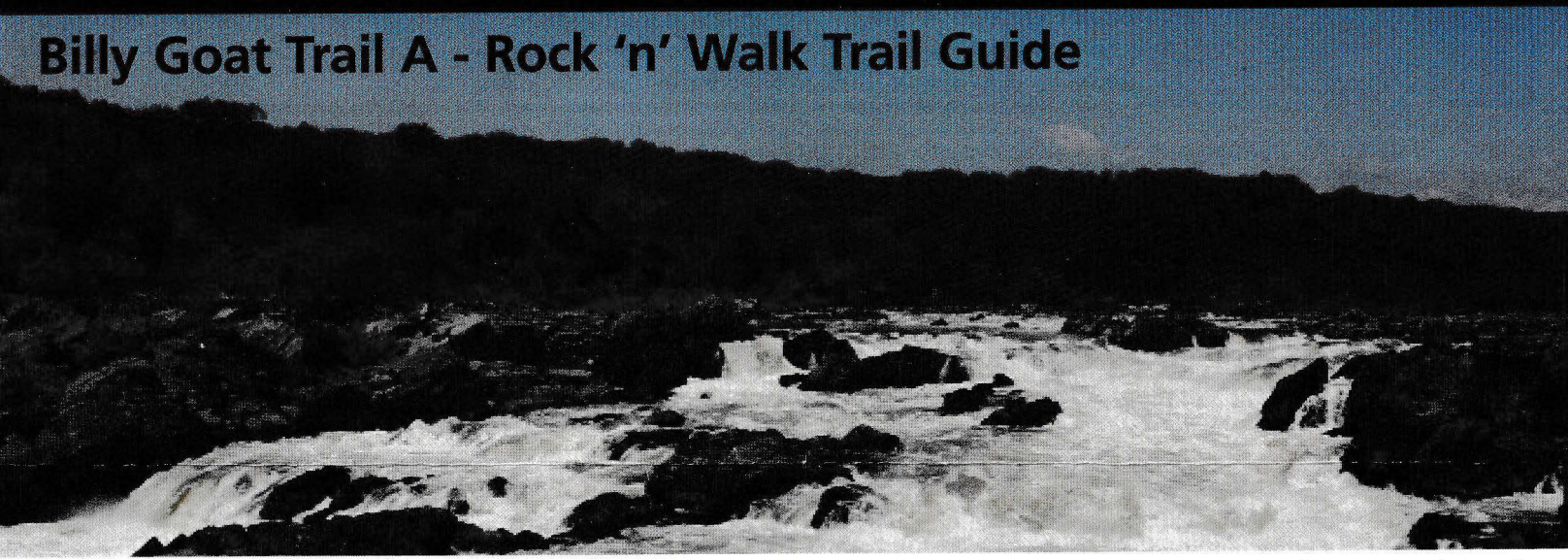
Chesapeake and Ohio Canal

National Park Service
U.S. Department of the Interior

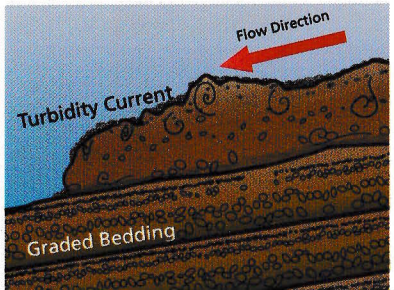
Chesapeake and Ohio Canal
National Historical Park

Billy Goat Trail A - Rock 'n' Walk Trail Guide



Welcome to the Billy Goat Trail! This guide will take you on a geology tour through the Mather Gorge and includes a geologic map you can use to identify all the different rocks along your journey. This trail makes a 3.7 mile loop via the towpath should take about 3-4 hours to complete. **Warning!** The path can be **strenuous** in some areas so please make sure to wear sturdy hiking shoes and to bring plenty of water.

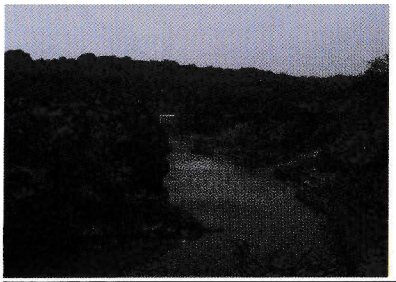
Stop 1 - Great Falls Overlook



Head south from the Visitor Center down the towpath for about 0.25 mi until you reach the Olmsted Island Bridge. Take the bridge to the Great Falls Overlook. The rocks around you were deposited as underwater landslides over 600 million years ago (Mya). As these currents slow down, large grains become too heavy and fall out of flow while smaller particles are deposited afterwards. This creates a "graded bedding" pattern where large grains are on the bottom and smaller grains are on the top. Keep an eye for this pattern when looking at the "dirty sandstone" rock, called metagreywacke (meta-GREY-wak-ee), along the trail (labeled 'Є Zmg' on the map provided).

Return to the towpath and walk down stream to your right for an additional 0.15 mi until you reach a section of the towpath with a wooden guard rail on the right alongside Rocky Island

Stop 2 - Rocky Island Channel



You have just descended about 10 meters (~33 feet) in elevation since leaving the Tavern. Have you also noticed how much higher the towpath is above the Potomac? This height difference gives you an idea on the elevation changes that occur along the Fall Zone. But what is "the Fall Zone?" The Fall Zone is the boundary that separates the hard, crystalline rock of the Piedmont Province in the west from the soft sediment deposits of the Coastal Plain Province to the east. This difference in underlying rock is what causes the varying topography and the resulting waterfalls. The creation of the C&O Canal was to make navigation past the Fall Zone possible.

Continue along the towpath until you reach the Billy Goat A trail head just before the stop gate bridge.

Stop 3 - Lamprophyre Dikes

Walk along the trail for about 0.20 miles until you pass the tip of Rocky Island. Continue to look to the west until you see four black bands on the cliff face across the gorge. The black bands you see are lamprophyre (LAM-pruh-fire) dikes. They are rare igneous rocks that were injected into the surrounding sedimentary layers as hot liquid magma about 360 Mya. The dikes do not follow a straight trend across the river and might have been offset by a fault running through Mather Gorge, but scientists still debate this. A fault could explain why the gorge is so straight by creating a path for the river to cut through.

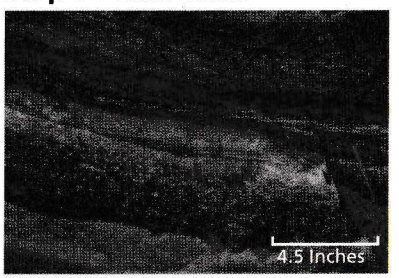
Continue along the trail until you pass the first trail marker labeled TM-1 on the map.

Stop 4 - Pothole Alley

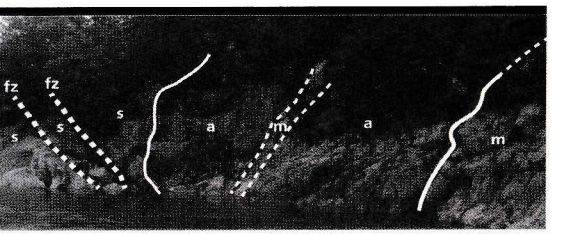
After you pass TM-1, the trail emerges out of the woods and continues along a rocky ridge just on the edge of the gorge. **Be careful around here!** This area is an older bedrock terrace that represents the original river bed before the gorge was cut. Notice the potholes along the trail.
These potholes form when cobbles and pebbles are swirled by the roaring current and grind into depressions in the bedrock while silts and sands polish the rocks smooth. This process is ongoing, with potholes forming underwater right now!

Now, continue along the trail until you reach TM-2.

Stop 5 - Echo Cliffs



After passing TM-2, you will emerge onto a small sandy brush-filled valley with rock outcrops by the river. Continue walking and look across the gorge towards the east to see several large cliff faces. Here, dark colored igneous rocks called amphibolite (am-FIB-uh-lite) sills cut through the surrounding rock about 540 Mya. Observe the cliff in the photo to the right and read the rock descriptions on the legend provided.



fz - fault zone, s - schist (Ꞓzmg), a - amphibolite (Ꞓa), m - metagreywacke (Ꞓzmg)

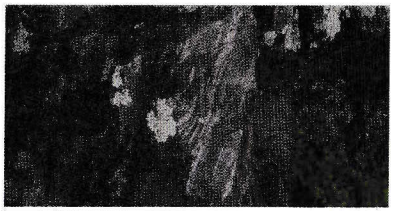
Continue along the trail while keeping an eye out for graded bedding on some of the boulders. You may consider resting at Purplehorse Beach.

Stop 6 - Red Creek

After you pass Purplehorse Beach and finish admiring the surrounding boulders (read their descriptions below), you will climb up a rocky knob. Near the top, the trail will begin to curve around a lagoon but keep an eye out for a deep red creek. The creek gets its red color from iron-oxide, or rust, that is leeched from bodies of iron-rich rocks. Iron is typically found igneous rocks like the amphibolite sill you are currently standing on!

Make your way around the lagoon and continue your hike through the rest of Section A of the Billy Goat Trail.

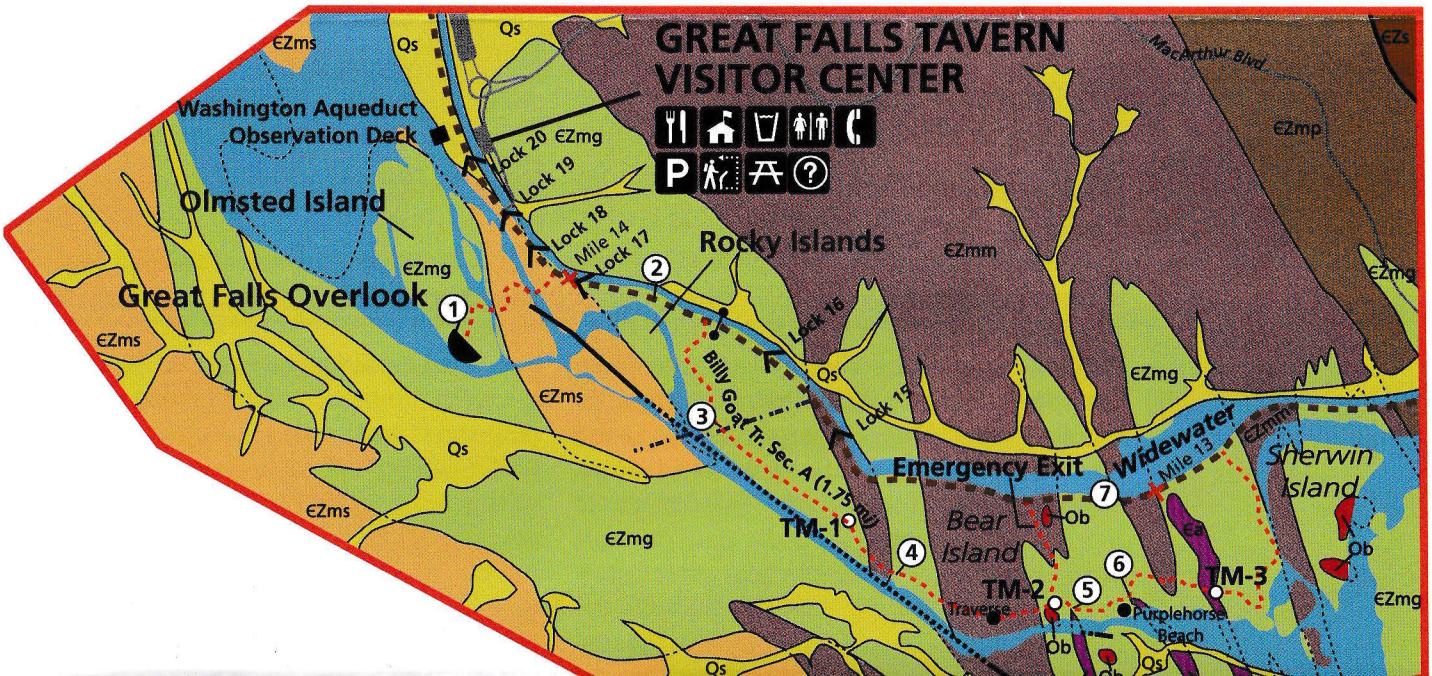
Stop 7 - Migmatite Outcrop



After completing the trail, there is one last stop. Make a left onto the towpath and walk about 0.15 mi until you are about 100 ft from the towpath bridge. On your left should be a small outcrop of migmatite that has alternating black and white bands. Migmatites share both igneous and metamorphic features. As the rock was exposed to high heat and pressure, the lighter-colored minerals partialy melted and recrystallized. To return to the tavern, continue upstream.

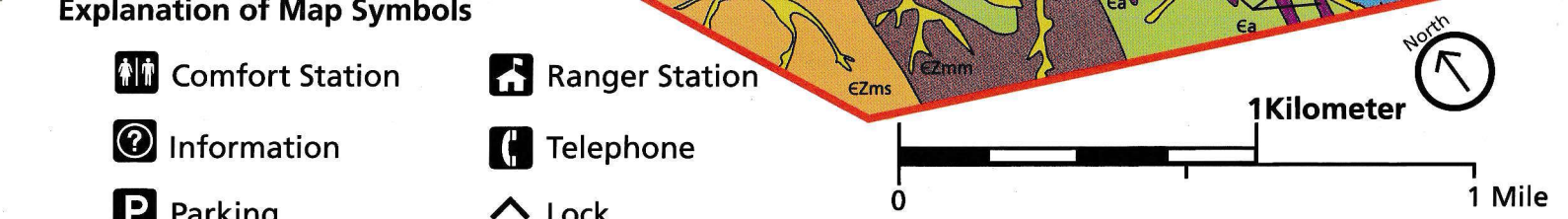
Congratulations on completing Section A of the Billy Goat Trail! There are a lot more places to see along the trail, so remember to explore!

Geological Map of the Billy Goat Trail and Great Falls, MD



Explanation of Map Symbols

- Comfort Station
- Information
- Parking
- Snack Bar
- Water
- Hiking Trail Access
- Picnic Area
- Ranger Station
- Telephone
- Lock
- Overlook
- Trail Marker
- Towpath Milepost
- Stop Gate Bridge
- Towpath
- Trail
- Boundary between rock units - Dashed where concealed by other units or by water.
- Fault - Dashed where concealed by other units or by water.
- Trail Stops
- Paved Road



Description of Map Units

NOTE: Geological maps may be different from any other maps you have seen in the past. Different colors represent different rock units that are unique and identifiable that may be based on their physical properties such as rock type, color, mineral composition, etc.

Surficial Deposits

Qs — **Quaternary sediments** - 10,000 years old to present day sediments that were either deposited naturally from rivers and streams or artificially during towpath and canal construction.

Older Igneous Rocks

Lamprophyre dikes- Rare 360 million year old (Devonian), dark colored intrusive igneous rock that are rich in biotite mica (black-colored mica) and occur as tabular intrusions that cut across the surrounding rock. Biotite grains are larger in the center because intrusive igneous rocks cooled faster on the edges, allowing crystals in the center to grow more.

Ob — **Bear Island Granodiorite & pegmatite** - 470 million year old (Ordovician) intrusive igneous rock that typically form elliptical bodies. Rocks are light in color and rich in white mica. Pegmatite crystals are large (> 2.5 cm) in size. Small blobs of this lightly pinkish rock can be seen in some of the amphibolite at Stop 6.

€a — **Amphibolite sills** - 540 million year old (Cambrian) intrusive igneous rock that is dark in color and rich in the mineral amphibole . These slabs were injected parallel to the bedding of the surrounding rock and were even partially folded. They were originally deposited as molten material similar to basalt, but were metamorphosed into the amphibolite we see today.

Metamorphosed Sedimentary Rocks (Lower Cambrian and (or) Late Proterozoic—about 600 million years old)

Mather Gorge Formation

€Zms — **Quartz-rich schist and mica gneiss** - Greenish-gray rocks with different textures; schist is fine grained and very shiny because of its mica grains while gneiss (pronounced "nice") has straight, alternating bands of light and dark minerals that form under intense heat and pressure.

€Zmg — **Metagraywacke and metasiltstone schist** - Gray and dirty sandstone interbedded with finer grained siltstone; originally deposited in submarine turbidity currents on the ocean floor. The schist is composed of metamorphosed ocean sediments and small mica grains that grew during stages of high heat and pressure. Schist is a mid-grade metamorphic rock.

€Zmm — **Migmatite** - Complex, light- and dark-gray, high-grade metamorphic rock that formed when rocks where pressed and heated so much during metamorphism that they partially melted. Migmatites feature both metamorphic and igneous rock characteristics because the partial melt crystallizes into an igneous rock while the rest remains metamorphic.

€Zmp — **Phyllonite with vein quartz** - Shiny, greenish-gray, fine-grained rock with pods and veins of white quartz. These rocks get a light sheen from the presence of microscopic mica grains that formed during metamorphism, but they are considered as low-grade metamorphic rock.

Map adapted from *Geologic map of the Billy Goat Trail, Great Falls, and surrounding area*
By Scott Southworth, Carrie Fingeret, and Thomas Weik (USGS): Open File Report 00-264
Original Map Available from http://geology.er.usgs.gov/eespteam/Greatfalls/web_site/pdf_files/gf_layout.pdf