

**APPENDIX B**

**Geologic Description**

## **Catskill Formation, Duncannon Member**

The Catskill Formation, Duncannon Member area is located in the northern most part of the Township along the Mahantango Creek and on the lower elevations on the northern edge of Mahantango Mountain.

Description: The formation is interbedded red and gray sandstone, red siltstone, and red mudstone. The sandstone is generally fine and very fine grained, silty, poorly sorted, micaceous, and locally conglomerate. The formation's thickness is from 560 to 3,000 feet.

Bedding: Well bedded; medium to massive; crossbedded; mudstone is thick to massive bed.

Fracturing: Joints are well developed in blocky and tabular pattern; generally closely spaced (2 inches to 2 feet), except wide spaces in mudstone; open, narrow and steeply inclined to bedding.

Weathering: Slightly weathered to a shallow depth; weathered surface is hacky, except on mudstone, where it is smooth; fragments are blocky, 2 inches to 4 feet in diameter. The overlying mantle is moderately thick, often made up of boulder colluvium from the Pottsville Formation above.

Topography: The formation forms hills and ridges of moderate to high relief and lower slopes of mountains capped by the Pocono Formation; moderate to very steep natural slopes on which overlying mantle can be subject to land slides.

Drainage: Good surface drainage.

Porosity and Permeability: The joint and bedding plane openings provide a secondary porosity; low in massive mudstone; moderate permeability except in mudstone, which has low permeability.

Groundwater: Moderate to good aquifer potential; best yields are expected from sandstone; reported yields are 7 to 40 gal/min. In wells averaging 150 feet deep; quality is generally good except for occasional high sulfur content.

Ease of Excavation: Moderately difficult; moderate drilling rate, except in conglomerate zones, which have slower drilling rate.

Cut-Slope Stability: Fair to good; mantle and weathered bedrock are subject to landslides; unweathered rock stands will in near vertical cuts; some rockfall.

Foundation Stability: Excellent after excavation of overlying mantle.

Construction Materials: Good for rock fill and riprap.

## **Spechty Kopf Formation**

This formation is located south of the Catskill Formation and to the north of the Pocono Formation along the ridge of Mahantango Mountain. The formation is relatively thin and forms the top of Mahantango Mountain.

Description: The Spechty Kopf Formation is a light to olive-gray, fine to medium sandstone containing interbeds of olive-gray to dark-gray shale and siltstone; locally has grayish-red shale near top and conglomerate at base and in the middle; contains minor thin coal and coalified plant fragments; the formation has a depth of up to 575 feet thick.

Bedding: Well bedded; planar bedding and some crossbedding; beds are 2 inches to 5 feet thick.

Fracturing: Highly developed joints; irregular spacing, generally 2 inches to 3 feet thick, open 10 to 50 millimeters.

Weathering: The formation is highly resistant to weathering; slightly weathered to a shallow to moderate depth; fragments are blocky to tabular, 1 inch to 10 feet in diameter; overlying mantle is thin to moderately thick in boulder colluvium on some slopes.

Topography: This formation forms mountains of high relief; topographic expression is approximately 800 to 900 feet; natural slopes are moderate to steep and stable.

Drainage: Good surface drainage.

Porosity and Permeability: The formation's joint, fault, and bedding-plane openings provide a moderate to low secondary porosity and moderate permeability.

Groundwater: Generally unproductive on ridge crests but favorable for development below ridge crests; median yield is 25 gal/min. From wells between 40 and 350 feet deep; generally good quality; occasional high iron content; salt water may be found in deeper wells.

Ease of Excavation: Difficult; moderately difficult in shale; drilling rate is slow to moderate.

Cut-Slope Stability: Generally good; poor where cut-slope parallels strike and dip of bedding; rockfall occurs in steep cuts, notably where sandstone overhangs easily eroded shale beds.

Foundation Stability: Excellent after removal of unconsolidated mantle.

Construction Material: Quarried for crushed stone and aggregate for road construction; good source of riprap, rock protection, and rock fill.

### **Pocono Formation**

This formation is located on the southern face of Mahantango Mountain running east and west. The area is adjacent to the Mauch Chunk Formation and the Township's valley region.

Description: This formation is light to olive-gray, fine to medium-grained, crossbedded sandstone, siltstone and conglomerate. The conglomerate at the base is composed of abundant rounded white quartz pebbles as large as 3 inches in diameter; where conglomerate exists in middle of formation, it is used to divide the unit into an upper member (Mount Carbon Member) and a lower member (Beckville Member); maximum thickness is in excess of 1,700 feet.

Bedding: Well developed; thin to thick; crossbedding is common.

Fracturing: Joints are well developed; moderately to highly abundant; regular; moderately to closely spaced; open and mostly steeply dipping to vertical.

Weathering: Highly resistant; breaks into large blocks; overlying mantle is thin.

Topography: Forms high rough ridges, crests of mountains, and hogbacks, natural slopes are steep and stable.

Drainage: Surface drainage is good.

Porosity and Permeability: Interstitial porosity and secondary porosity give the formation a high effective porosity; moderate to low permeability.

Groundwater: Median yield is 40 gal/min.; high iron may be a quality problem; soft water.

Ease of Excavation: Difficult; moderate to slow drilling rate.

Cut-Slope Stability: Good; rockfalls occur where bedding and joint surfaces intersect and rock is steeply dipping toward the cut; condition would be aggravated by a very steep vertical cut.

Foundation Stability: Good.

Construction Materials: Good source of building stone, embankment facing, road material and riprap.

### **Mauch Chunk Formation**

The Mauch Chunk Formation stretches from Frackville, Schuylkill County, to Millersburg and along the Wiconisco Valley around Short Mountain. The area underlies the Township's valley region.

Description: The Mauch Chunk Formation is generally composed of shale, claystone, sandstone and siltstone. The sandstone in this formation is generally fine to medium grained and crossbedded. Shale and claystones are described as red, while sandstones and siltstones are usually gray, green and greenish-gray. The maximum thickness of this formation is approximately 3,000 ft.

Bedding: The Mauch Chunk Formation is characterized as being well bedded. This bedding, or separation within its various rock types, is thin and flaggy. Crossbedding is

common in sandstone and siltstone, while ripple marks and rain marks are common on shale bedding planes.

Fracturing: Fractures are breaks in rocks caused by underlying stresses. Joints in the Mauch Chunk Formation are abundant and moderately well formed. These joints are regularly spaced at close to moderate distances, depending on the rock composition. Fractures that exist are generally open and vertical.

Weathering: The Mauch Chunk Formation is moderately resistant to weathering, in general. Shale and claystone exposures may be severely weathered, whereas sandstone and siltstone beds appear only slightly weathered. The overlying mantle, which is comprised of broken and incoherent rock material and soils, is generally considered thin in most places.

Topography: The general topographic condition of the Mauch Chunk Formation is characterized as rolling valleys of medium relief, with slopes being fairly steep and stable.

Drainage: In general, the Mauch Chunk Formation is characterized as having good surface drainage.

Porosity and Permeability: The total effective porosity of the Mauch Chunk Formation is generally high. Sandstone and siltstone characteristically have low to moderately porosity, while joints provide abundant secondary porosity in shale, sandstone and siltstone. The permeability of this formation is moderate to low.

Groundwater: Median yield is 55 gal/min.; extensively developed for water supply; iron content may be high; generally, water quality is good and water is soft.

Ease of Excavation: The ease of excavating this rock formation is generally characterized as moderately easy to moderately difficult. Variations depend on the particular rock type and the extent of any fracturing.

Cut Slope Stability: This characteristic is rated good in the Mauch Chunk Formation, provided that severe undercutting of resistant beds does not occur.

Foundation Stability: The stability of the Mauch Chunk Formation for building foundations is generally good, provided that foundations are excavated to sound bed rock.

Construction Materials: Good source of road material and fill; shale is good raw material for brick.

### **Pottsville Group**

This formation is located south of the Mauch Chunk area, and along the lower and middle slopes of Bear Mountain.

Description: Light to dark-gray, fine grained to coarsely conglomerate sandstone; subordinate amounts of gray shale, siltstone, limestone, coal and underclay occur;

includes Olean and Sharon conglomerates of northwestern Pennsylvania; locally, minable coals and commercially valuable high alumina clay are present. The Pottsville Group includes those rocks in western Pennsylvania that are correlative with the Pottsville rocks of the Anthracite region of eastern Pennsylvania. The thickness of this group varies from approximately 80 to 270 feet.

Bedding: Generally well developed; sandstone and siltstone are crossbedded in many places; ranges from a fraction of an inch in shale to several feet in sandstone.

Fracturing: Jointing and faulting are important. Joints are moderately well formed; distribution is moderate to high; spacing is wide to moderate in sandstone, close in shale; patterns are mostly regular; open and vertical. Subsidence fractures may be encountered in connection with underground clay and coal mining.

Weathering: Variable, reflecting rock type; sandstone is highly to moderately resistant; overlying mantle is thin; sandstone breaks into medium to large blocks and in places disintegrates to grains.

Topography: Forms crests, flanks ridges, and other breaks in topography, steep natural slopes are stable.

Drainage: Surface drainage is good.

Porosity and Permeability: Variable, depending on lithology; sandstone has high moderate effective porosity; low effective porosity's are common in other rock types; moderate to low permeability.

Groundwater: Median yield is 50 gal/min; sandstone and limestone provide highest yields, which may exceed 300 gal/min; iron content of water may be high; high topographic position is unfavorable; where countered more than 100 feet below major drainage level, may contain salt water.

Ease of Excavation: Excavation of sandstone and conglomerate is difficult; other rock types are moderately easily excavated; moderate drilling rate.

Cut-Slope Stability: Fair; undercutting in shale and underclay under thick sandstone units causes rockfalls and slumping; drainage maintenance may be needed.

Foundation Stability: Good, except on or above underclay, which will deform under load when wet; underground coal and clay mines that have possible roof subsidence will need special study.

Construction Materials: Good source of road material and fill, building stone, riprap, embankment facing and refractory clay.

### **Llewellyn Formation**

This formation is located in the southern portion of the Township on the top of Bear Mountain.

Description: Interbedded sandstone, siltstone, and conglomerate; medium to coarse grained; light gray to brown; contains coal and dark gray to black shales; a maximum thickness of 830 feet has been reported.

Bedding: Moderately well developed; coal and shale are thin; sandstone, siltstone, and conglomerate may be thick to massive.

Fracturing: Joints are moderately developed; moderately abundant; blocky pattern; moderately spaced; regular sequence; open and steeply dipping.

Weathering: Slightly to moderately weathered; shallow to moderate depth; depending on lithology, rubble consists of small to medium, flat, elongate fragments to large blocky fragments; overlying mantle is thin to moderate.

Topography: Low ridges and valleys in rolling terrain; natural slopes are stable at moderate angles.

Drainage: Surface drainage is good.

Porosity and Permeability: Total effective porosity is moderate; moderate to low permeability.

Groundwater: Average yield is 38 gal/min; high iron and acidity are common quality problems.

Ease of Excavation: Difficult; fast to slow drilling rate, depending on lithology.

Cut-Slope Stability: Fair to good; undercutting of shale and siltstone under more resistant sandstone and conglomerate units can be a severe problem; support drainage maintenance may be required to reduce weathering from excessive moisture.

Foundation Stability: Good; should be excavated to sound material; extreme caution should be exercised where coals have been removed underground.

Construction Materials: Good source of road material and fill; conglomerate is suitable for building stone, flagstone, embankment facing and riprap.

Source: The Environmental Geology Report #1, developed by the Pennsylvania Department of Environmental Resources Office of Resource Management, Bureau of Topographic and Geologic Survey.