Geology Report

Geology is the foundation of the Midland Trail. Because of the ancient history en route, coal, oil, gas, salt, limestone, sandstone, shale, water, sand and gravel are present and accessible to maintain life throughout the Trail . They have been instrumental in attracting people and industry to the area and profoundly influencing the culture, history and economy of the heart of the state. The Trail's exquisite scenery also lies on the backbone of its geology. The story of how geology has set the stage for life on the Midland Trail can only add to the travelers' enjoyment of this Scenic Byway.

While our Town Pages Chapter 5 place the Intrinsic qualities in their specific surroundings, we have found geologist Claudette Simard's review of the Midland Trail's geology so helpful that we asked her to update it to include the western extension for this 2005 Revised CMP.

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OVERVIEW OF THE MIDLAND TRAIL'S GEOLOGY Intrinsic Qualities

The Midland Trail is a prime example of the tremendous effect mineral resources and geology have had on West Virginia. The Trail is richly endowed with coal, oil, gas, limestone, sandstone, shale, salt, sand and gravel because of its 380 million year old history. The conditions were perfect for depositing the minerals then later exposing them for easy access. As these minerals were discovered and extracted, they attracted people and industry to this area having a profound impact on the culture and history of the heart of West Virginia - the Midland Trail. An increasingly important aspect of the state, its scenic beauty, is directly related to the underlying rocks and the processes that shaped them over time.

In this report, the Midland Trail has been divided into four parts based on changes in geology expressed in the landscape. Each section includes recommendations for pull off areas and signs to explain the essential role geology plays in the available mineral resources, history, and scenic beauty of the area. Attached is a page describing photos needed for the recommended stops, as Mr. Thibeault suggested.

Section 1 Charleston to Huntington (east to west, new mile 61, Chas. to new mile 0, Kenova)

West of the Capitol, the Midland Trail follows the Kanawha River until it makes a left at Amandaville. At that point, it follows the pleasant valleys created by Tackett and Hurricane Creeks. Hurricane Creek (and the Trail) flow into the Teays Valley which was created and abandoned long ago by the Teays River. More than two million years ago, before the last Ice Age, what is now the Kanawha River did not flow north to Point Pleasant but made a westward bend at Scary and flowed through the Teays Valley to the Ohio River at Huntington. During the last Ice Age, glaciers extending into southern Ohio blocked the flow of the Ohio River thereby creating a dam. As a result, the Ohio River and the rivers flowing into it, including the Teays, were backed up forming a large lake similar to those formed by modern dams. In these quiet lake waters, more than 100 feet of mud and clay settled onto the bottom of the lake (Fridley, 1950). The glacier eventually melted and allowed the Ohio River and its feeding streams to flow once more. The water of the Teays could not break through the thick mud at Scary but found an easier path by joining the Pocatalico River at Poca and flowing north

(Fridley, 1950). I recommend a signs where the Trail enters Hurricane or in Milton to describe this ancient, relatively unknown history of the Teays Valley, see photo 6.

Besides providing a wide valley for building roads and communities, the Ice Age left a valuable legacy of clay behind in the glacial lake. In scattered places throughout the Valley, especially near active building excavations, these clay layers can be seen. The clay has historically been an important resource for the manufacturing of "good quality brick, tile, hollow blocks, pottery and similar products" produced near Huntington, Barboursville, Culloden and other places in the vicinity (Cross and Schemel, 1956).

Brick and tile had also been produced until 1977 from the Pennsylvanian-aged red shales at Barboursville and Huntington. The Barboursville Brick Manufacturing Company, one of the state's leading brick producers from 1902 to 1977, produced 10 million bricks a year, (70,000 bricks a day) during peak production years of the "baby boom" 1950's (Kessler, 1998). West Virginia Brick in Charleston, owned by the same company, also used local shales to produce their brick.

The Teays and Ohio Valleys are home to a thriving hand blown glass industry. Since the early 1900s, glass producers have been drawn to the area, (and the state), by the abundant, cheap natural gas. As late as 1975, West Virginia was one of the leading glass manufacturing states (Eggleston, 1975). Blenko Glass Company and Gibson Glass at Milton, and the smaller independent glass artists like Hammond Glass at Teays all produce glass sought after by tourists and West Virginians alike. Their products, ranging from window glass to fine crystal are sold worldwide. All of these companies give free tours of this fascinating process and have showrooms with items for sale. The small brown glass factory signs on Route 60 do not do justice to these attractions. They need to be enhanced or at least enlarged.

The Teays Valley area has several productive oil and gas fields. The Midland Trail's petroleum resources have been one of the key features attracting industries to the Kanawha and Ohio River Valleys. A depleted gas field in the Hurricane area has been converted to a gas storage field where gas from other areas is stored in the summer when demand is low, and withdrawn in the winter when demand is high.

Last, but by no means least, is the Ohio River Valley at Huntington/Ceredo/Kenova. The Ohio River dominates these areas by its sheer size and influence. Its numerous sand and gravel terraces were deposited by glacial meltwater draining through the river during the last Ice Age. Rounded gravels of granites and other nonnative rock from as far north as Canada are relicts of glaciers that never reached West Virginia. These flat easily excavated deposits provide excellent building sites for homes, industry, roads and railroads as well as the important sand and gravel needed to build them. Throughout time, the river has always been a vital transportation link for its inhabitants and commerce to the rest of West Virginia and states along the Ohio and Mississippi Rivers. Of particular interest is the flood wall that the U.S. Army Corps of Engineers built around the towns after the greatest flood of record in 1937. Pullman Square related development at at the end of 11th Street in Huntington is a great place to tell the story of the Ohio River and its flood wall, see photo 7.

In Kenova the Big Sandy River dumps into the Ohio River at Virginia Point Park, the western most point of West Virginia.

Section 2 Charleston to Gauley Bridge (mile 61 to 99; old mile 0 to 38)

The Kanawha River Valley's ancient history is the foundation for its cultural history. Charleston and the other communities built along the Kanawha owe their existence to the area's 300 million year old history. At that time, known as the Pennsylvanian Geologic Period, North America was near the equator, ferns were as big as trees and dragonflies had three foot wing spans. The sandstones that dominate the Trail's road cuts and cliffs are the remains of sandy streams meandering across a low-lying coastal area next to an inland sea. Plant fossils give proof that these were stream rather than beach sands. In places, the streams were separated by flood plains where mud accumulated and was later compressed into thinly layered shales. In other places, swamps were teaming with luxuriant tropical-like plants that thrived in this hot equatorial climate. The plants died and piled up into layers that formed peat and were eventually compressed over time into coal. Limey mud would settle in large lakes or a shallow arm of the ocean would cover the area and deposit thin layers of what is now limestone. Over time, the inland sea drained and these rock layers were uplifted then worn down to their present heights above the Kanawha River. These rocks are typical of the sedimentary rocks (made of particles or sediments) found in 99 percent of West Virginia.

The sandstones have been quarried over the years for decorative building stone and crushed stone for making roads (Haught, 1968). From the early 1800s to about 1980, some of the shales have been used to produce the tile, building brick and road brick so common in the area (Haught, 1968).

At Malden, the sandstones are a source of oil, gas and brine that have, in places, filled the tiny pore spaces between the sand grains. The brine, or ancient sea water, was instrumental in attracting Indians and later settlers, industry and workers to the area. Over the last 300 million years, the brine has migrated to these sandstones known as the

"Salt Sands" (Ludlum, 1951). The oil and gas, formed from decomposed marine plants and animals mixed in with sea floor sediments, has also slowly migrated to these rocks. At Burning Spring Creek, gas bubbling through the spring was believed to have been recognized by Native Americans and perhaps used for fuel (Eggleston, 1975). Technology developed by the Ruffner brothers to drill brine wells in 1806 was essential equipment for drilling for oil and gas later in that century (Eggleston, 1975). Oil and gas, which were considered a nuisance by the salt well drillers, were wasted to the extent that the Kanawha River was long known as "Old Greasy" by boatmen (Eggleston, 1975). In 1841, the value of gas was first realized commercially when it was used to evaporate brine in the Dickinson area (Ludlum, 1951). Not until 1826 was oil used for lamps in workshops and factories (Eggleston, 1975). The Kelley Creek Oil Field near Chelyan (mile 14) and the Cabin Creek Oil Field near Cedar Grove (mile 18) are important gas producers for the area (Gulley et al, 1937). Today, Kanawha County is one of the state's larger producers of gas and lesser amounts of oil.

Coal, West Virginia's most valuable mineral worth more than $4.5 billion annually, was first used commercially in 1817 when it replaced charcoal as fuel at the Kanawha River salt furnaces (Eggleston, 1975). By 1840, 200,000 of the 300,000 tons of coal produced that year were used at the Kanawha salt furnaces (Eggleston, 1975). In 1997, 13 million tons of coal were produced in Kanawha County, ranking it 5th among 28 coal producing counties, a distinction it has held for at least the past 30 years (Ludlum, 1951; WV Department of Mines, 1997). West Virginia competes with Kentucky every year for the position of second leading coal producing state.

West Virginia's southern coal fields formed under ideal conditions to make them the best low sulfur coals in the world (Workman, 1998). As a result of their high quality, the Kanawha Formation coals have been extensively mined east of Charleston to the Gauley Bridge area. At Shrewsbury, mile 15, these coals are being mined and the tipple is still active. I recommend this site as an ideal pull off area for signs to describe how coal formed and its impact on the economy, see photo 1. The Kanawha Formation also contains some relatively rare cannel coals used for extracting lamp fuel oil. By the mid 1800s, petroleum had replaced them as lamp fuel (Workman, 1998). Today, the majority of these and other West Virginia coals are burned in power plants like the Glasgow Power Plant (mile 20) to supply electricity for homes and industry. West Virginia is the nations leading exporter of electricity.

The Kanawha River's wide flood plains provided some of the rare flat land for building trails, then later roads, communities and industry. The River has always been a vital transportation link to the Ohio River for people and commerce. It has been and still is an important water source for local communities and industry. The Marmet Lock and Dam (mile 8) and the London Lock and Dam Number 3 (mile 24) maintain a constant river level for barge transportation of products such as coal on the Kanawha. Flood control and navigation dams at Bluestone, Summersville and Sutton hold back flooding water that would normally inundate communities on the Kanawha flood plain. I recommend signs at the dams to explain the role the river plays in the lives of its inhabitants, see photo 2.

The Kanawha Falls park is an excellent place to showcase the scenic beauty in view of Kanawha Falls and to describe the vital role geology plays in the development of the Falls, the New River Gorge, and the most valuable coals of the state, the New River coals. I also recommend a geologic/scenic sign for Kanawha Falls park at the Glen Ferris Power Plant, mile 36, see photo 3.

Section 3 Gauley Bridge to Rainelle (mile 99 to 134; old mile 38 to 73)

In this section, the Midland Trail leaves the Kanawha and New River Valleys to traverse the ridge tops. The Trail climbs a large arch in the rock that has lifted the New River Formation's Nutall sandstones from 700 feet under the surface at Dickinson to a 1270 foot elevation at Hawks Nest (Ludlum, 1951). This tough sandstone is the same one that produces gas in this area and brine and gas at Dickinson (Ludlum, 1951). Numerous small cascades grace this section of the Trail as they flow over the edge of the resistant sandstones. The Trail clings precipitously to the New River Gorge's edge as it winds its way to the top of Gauley Mountain. En route, it passes through 30 of the 100 coal zones in the state, 20 of which are worked commercially somewhere in West Virginia (Ludlum, 1951). The New River Formation coals of the area "furnish some of the purest coal and cokes of the state" according to I. C. White (1903). The low sulfur "smokeless" coals were premium steam coals sought after for steam ship and locomotive fuel in the late 1800s and early 1900s (White, 1903).

I recommend a geology/scenic sign at Hawks Nest State Park or one of the scenic pull-offs before the park. From any of them, West Virginia's name, the "Mountain State," will be strikingly obvious from the scenery, rugged topography, and geology typical of the greater part of central West Virginia. The spectacular view of the New River 510 feet below (Ludlum, 1951) will be a perfect backdrop to explain the rock's effect on the river, the history of the river and how Union Carbide harnessed its energy to produce hydroelectric power, see photo 4.

In the past, beehive coke ovens at Ansted, Boomer (Gulley, et al., 1937), and many other parts of the state burned coal to concentrate the fuel. The result is a clean burning fuel used in smelting iron and steel and for domestic heat (Ludlum, 1951). The Sewell seam of the New River Formation coals, which is commercially mined almost exclusively in Fayette County, was mined for coking as well as other uses (Ludlum, 1951). Fayette County produced close to four million tons of coal in 1997, ranking it 15th of 28 coal producing counties (WV Department of Mines, 1997).

Lookout, at mile 58, is at the center of the arch in the rocks that lifted the New River Formation's sandstones and coals to the surface. This uplift and subsequent erosion created the area's spectacular scenery and made the valuable New River Formation coals accessible. The arch was folded when the continents collided about 200 million years ago. During this collision, rocks in eastern West Virginia were folded into northeast-southwest trending ridges. Rock layers closer to the collision point (those in eastern West Virginia) were more severely folded than those farther away (western part of the state). As a result, the Midland Trail will pass through more and more severely folded rock layers as it traverses eastward.

Babcock State Park, about 3 miles from the Midland Trail on Route 41, is another recommended geologic/scenic stop. Glades and Manns Creeks have carved a 1000 foot gorge on their journey to the New River. The gorge slices through the Pennsylvanian-aged New River and Pocahontas Formations to expose the Mississippian-aged rock (approximately 340 million years old) below.

The distinctive rust color of the rock along the Trail from mile 60 to mile 94 is from iron in the rock that rusted when exposed to air. The color occurs in some of the Pennsylvanian rocks but is even more pronounced in the older Mississippian-aged Mauch Chunk Group of rocks from Rainelle to just beyond Clintonville. One of the Mauch Chunk sandstones that is slightly iron stained into a beautiful pink and yellow color is quarried and cut into building stone near Alderson.

Scenic view areas near mile 69 would be ideal places to explain the role the area's ancient history plays in creating the terrain, especially since the highest elevation on the Midland Trail is nearby.

Section 4 Rainelle to White Sulphur Springs (mile 134 to 181 old mile 73 to 120)

At the Fayette/Greenbrier County line, mile 73, the rivers and streams have cut through the younger Pennsylvanian age New River and Pocahontas Formation layers to expose Missippian-aged rocks below. In 1997, 500,000 tons of New River and Pocahontas coals in western Greenbrier County's hills were produced, ranking it 24th out of 28 coal producing counties (WV Department of Mines, 1997). At one time, all of the coal mined in this county passed through Rainelle (Heck, 1939) making it a booming town as shown by the historic King Coal Hotel at mile 75. According to Heck (1939), more than 1.5 million tons of coal traveled through Rainelle annually during the 1930's. This is the last coal seen on the Trial driving east because the rest of the Trail is in older Mississippian-aged rocks which do not have any mineable coal.

The communities from Rainelle to Sam Black Church are on the wide flood plain of the Meadow River and its tributaries. These streams have worn through Mississippian rock that is much easier to erode than the tough New River sandstones downstream. As a result, the streams have used their erosive energy to cut unusually wide valleys through this area. The Meadow River and its tributaries meander lazily across it and pond into numerous wetlands. I recommend a geologic/scenic sign at Rainelle to explain this interesting feature, see photo 5.

The dividing line between the rock layers that are horizontal and the layers that are folded is at Clintonville, mile 91. From Charleston to a few miles west of this point, the rock layers appear to be flat. From this point east, they are inclined or dipping at an angle from the folding that occurred during continental collision about 200 million years ago. The ridges on the rest of the journey, like Brushy Ridge at Alta (mile 95), have a definite northeast-southwest orientation from the folding. The folding has also raised the rock layers higher and cracked them, enabling erosive forces of water and wind to wear the younger Pennsylvanian rock layers away completely. This left the older, once buried, Mississippian layers at the surface for the rest of the route.

At mile 94 is the Boxley Greenbrier Limestone Quarry that produces crushed stone mainly for use in building roads. Boxley quarries the Greenbrier Limestone, the limestone that yields 60% of the state's production. Greenbrier County, West Virginia's leading limestone producing county, quarries almost three million of the state's 15 million ton annual total. West Virginia's limestone is mainly used in the state's roads although some is sold to other states.

The Greenbrier Limestone continues westward to underlie the younger Pennsylvanian rock. Along the Trail, it ranges in thickness from 600 feet in this county to 200 feet at the Ohio River (McCue et al, 1939). The Greenbrier's thickness and marine shell fossils are proof that West Virginia was under the ocean for an extended period of time about 340 million years ago. The Greenbrier

Limestone below the surface has been one of the state's leading gas producers and a less significant oil producer (Avary, 1998).

From Richland, at mile 99, to Lewisburg, the Midland Trail traverses prime examples of land features unique to limestone. Because limestone slowly dissolves from rainwater which is naturally slightly acidic, it often contains caves, sinking creeks, sinkholes (depressions on the land) and springs. Numerous fine examples of these land forms can be seen on either side of the Trail toward Lewisburg. More spectacular examples include the very large sinkhole that Lewisburg is built in and Lost World Caverns, located about three miles north of town. Because limestone is slowly dissolved over time, it forms wide fertile valleys that are prime agricultural land, a bonus for this county. I recommend a scenic/geologic pull off with signs near Richland or Lewisburg to explain these interesting features.

At the eastern edge of Lewisburg, close to mile 167/106, the Midland Trail travels on Greenbrier Mountain formed from the resistant sandstones of the Mississippian Maccrady and Pocono Groups. At mile 108, the Trail crosses the Greenbrier River, which drains the eastern half of the county and flows into the New River at Hinton. From Caldwell to the Greenbrier Resort in White Sulphur Springs, the Trail is built on Howard Creek's flood plain that was carved through the oldest rock en route, the 380 million year old Devonian shales. The world famous White Sulphur Springs emerge from these shales (Ludlum, 1954). The medicinal waters of the springs and the mild summer temperatures have attracted tourists to White Sulphur Springs since the mid 1700s (McColloch, 1985).

In summary, geology is the foundation of the Midland Trail. Because of the ancient history en route, coal, oil, gas, salt, limestone, sandstone, shale, water, sand and gravel are present and accessible to maintain life throughout the Trail and West Virginia. They have been instrumental in attracting people and industry to the area and profoundly influencing the culture, history and economy of the heart of the state. The Trail's exquisite scenery also lies on the backbone of its geology. The story of how geology has set the stage for life on the Midland Trail can only add to the travelers' enjoyment of this Scenic Byway.

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