Roadside Geology Along the Alexandria to Ashland Highway—

Kentucky 9, Kentucky 10, and U.S. 23 Between Greenup Locks and Dam and Interstate 64

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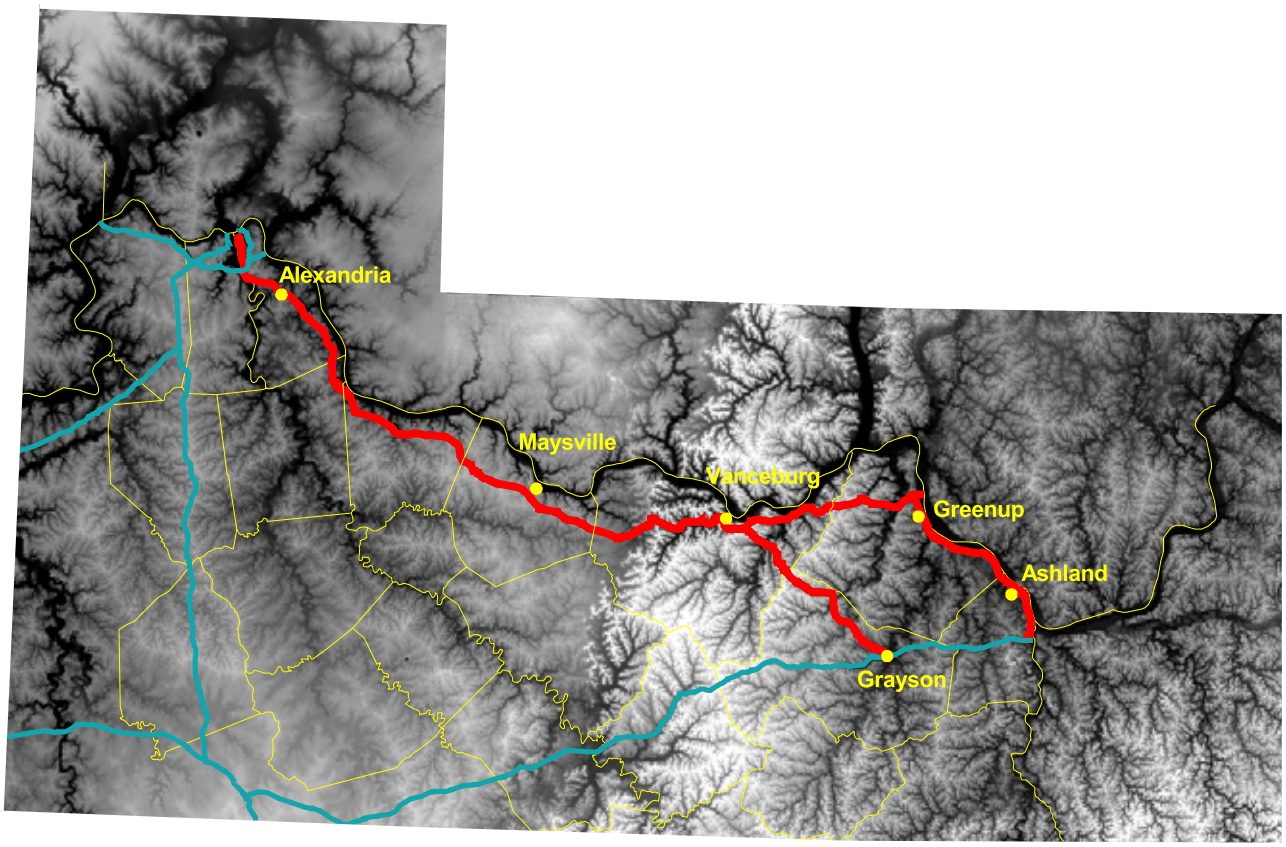

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Kentucky Geological Survey
University of Kentucky, Lexington
James C. Cobb, State Geologist and Director

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Large anticline associated with the Cincinnati Arch between miles 19.2 and 18.8, Bracken County.

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Contents

Figures

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Roadside Geology Along the Alexandria to Ashland Highway— Kentucky 9, Kentucky 10, and U.S. 23 Between Greenup Locks and Dam and Interstate 64

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Introduction

The construction of Kentucky's Interstate highways, state parkways, and state highways has provided travelers with an outdoor classroom in which to study and enjoy the diverse and interesting geology of the Commonwealth. The class curriculum is presented in the rocks and other geologic features exposed in the thousands of roadcuts along the highways. Geologic roadlogs and strip maps published by the Kentucky Geological Survey can help you recognize, appreciate, and better understand some of the world's classic geology. Previously published reports about the geology along Kentucky highways are "Roadside Geology Along Interstate Highway 75 in Kentucky" (Haney and Noger, 1992a) and "Roadside Geology Along Interstate Highways 71 and 65 in Kentucky" (Haney and Noger, 1992b). These roadlogs describe selected rock units and explain the geologic features that can be observed from the roadway, and are referenced to highway mile markers. So, buckle your seatbelts and begin your lesson of Kentucky's geology along one of its most beautiful highways.

This roadlog describes the rock units and other significant features (such as geologic faults, fossil localities, stratigraphic boundaries, and ancient river valleys) exposed along, or adjacent to, the Alexandria to Ashland (AA) Highway and U.S. 23 from Greenup Locks and Dam through Ashland, Ky., to Interstate 64. Also included is the roadlog for the newly constructed bypass around Maysville, Ky., which exposes the longest continuous section of rocks of Late Ordovician age in Kentucky. (The Ordovician Period is a division of geologic time that began 500 million years ago and ended 435 million years ago.)

No formal training in geology is necessary to understand these roadlogs. Major emphasis has been placed on the most prominent and easily recognized features, and we have tried to avoid the use of most technical jargon. In some cases, however, the use of technical terms is unavoidable. A glossary of selected geologic terms is provided to help the user understand unfamiliar words and terms. Also, when possible, we have included illustrations and photographs to help explain the geologic features along the AA Highway/U.S. 23. A list of selected references is provided, for those interested in more detailed information about the geology along and in the vicinity of the AA Highway/U.S. 23.

General Geology

The AA Highway/U.S. 23 follows a generally east–west route of 161 miles, which traverses two of the four major structural provinces in Kentucky: the Cincinnati Arch and the Appalachian Basin (Fig. 1). Throughout geologic time, earth forces caused the rocks of eastern and western Kentucky to depress or sag, forming the Appalachian and Illinois (also called the Eastern Interior) Basins, and later the Mississippian Embayment. Concurrently, the rocks of central Kentucky were gradually uplifted, forming the Cincinnati Arch, a linear north–south-trending geologic feature of broadly arched rocks. The basins filled with thick accumulations of sediments, and the Cincinnati Arch was generally an area subject to erosion or the nondeposition of sediments. Thus, the oldest rocks exposed in Kentucky occur along the Cincinnati Arch, and much younger rocks are exposed in the adjacent basins (Fig. 2).

The progression of rocks exposed along the AA Highway/U.S. 23 is illustrated in Figure 3, a graphic representation of these rock layers. This stratigraphic column is organized with the oldest rocks at the bottom and the youngest rocks at the top. Thus, the older Ordovician rocks exposed in the Cincinnati Arch Province are overlain by the younger rocks of the Appalachian Basin Province. Rock units exposed along the AA Highway/U.S. 23 are classified by geologists as sedimentary rocks because they are formed by the deposition of sediments such as sand, silt, clay, or lime mud. These rock units are formed by accumulation, layer by layer, over very long periods of time, in ancient oceans, river deltas, river systems, or along coastlines.

Geologists subdivide these sedimentary rocks into formations, members, and beds based on the types of rocks they contain. For example, the Bisher Dolomite is composed of dolomite, which is easily distinguished from the shale beds of the Crab Orchard Formation and the carbonaceous shale beds of the Ohio Shale.

The contact between the Bisher Dolomite and the Ohio Shale is also one of the major unconformities present in the rocks exposed along the AA Highway. An unconformity is a break or gap in the geologic record, where a rock unit is overlain by another that is not next in the stratigraphic succession. The gap of missing time at the Bisher Dolomite–Ohio Shale contact is about 30 million years.

Fossils occur in great abundance in the Ordovician rocks exposed along the AA Highway between Alexandria and Maysville. The Ordovician rocks of northern Kentucky, southwestern Ohio, and southeastern Indiana are world famous for the preservation and diversity of fossils. Fossil collecting can be an exciting and rewarding experience, so several fossil-

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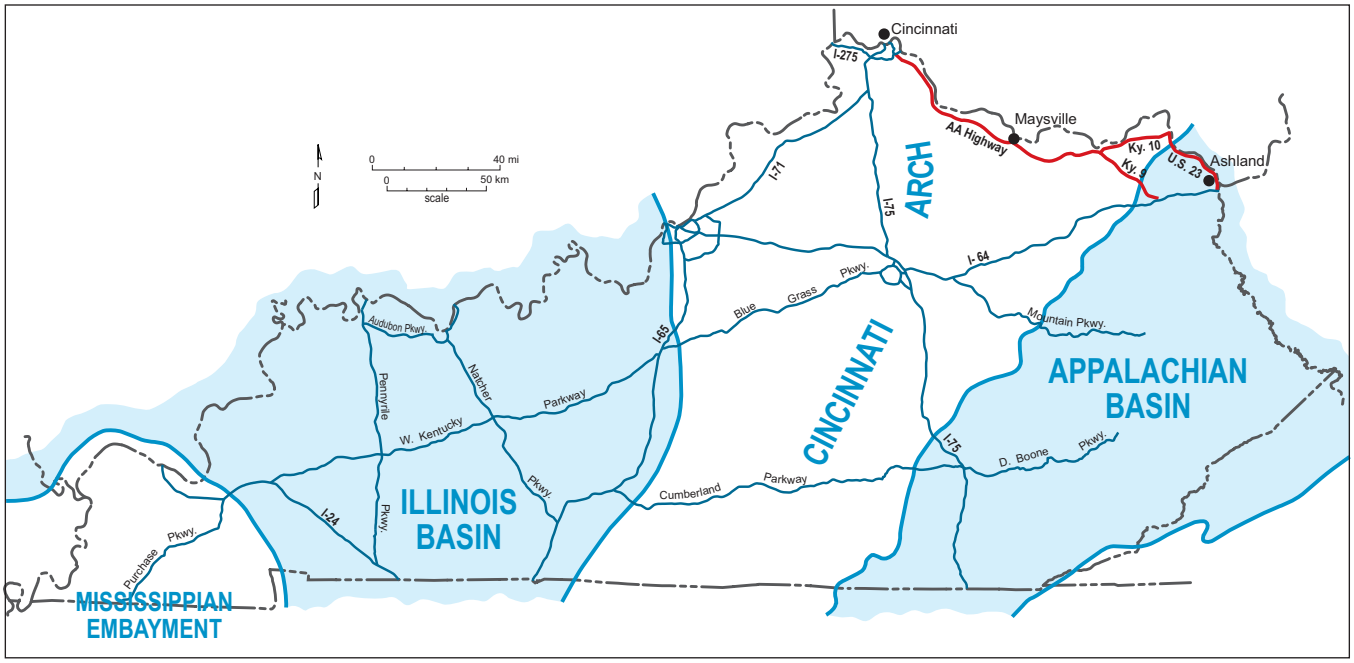

Figure 1. Major geologic provinces and Interstate highways and parkways in Kentucky.

collecting localities along the AA Highway are noted on the roadlog.

Ice Age Drainage Modification

The AA Highway/U.S. 23 parallels the modern Ohio River across northeastern Kentucky. Only a few hundred thousand years ago, however, the Ohio River did not exist. The Teays River was the major river that drained much of Kentucky, West Virginia, Ohio, Indiana, and Illinois (Fig. 4). This river originated in the mountains of western Virginia and North Carolina and flowed northwestward through West Virginia and Ohio. In western Ohio, the Teays River flowed westward through central Indiana before turning to the southwest and joining the ancestral Mississippi River in southern Illinois. The Licking River, Little Sandy River, and Tygarts Creek were major tributaries of the Teays River, and drained much of the area presently traversed by the AA Highway/U.S. 23.

The Teays River and its tributaries cut deep valleys, often hundreds of feet below the surrounding countryside. Today these valleys have disappeared almost without a trace, buried by hundreds of feet of glacial drift (Fig. 4). Geologists know of their existence mainly through the drilling of water and oil and gas wells.

If the glaciers destroyed the Teays River, why did the Ohio River form in its place? The ice age consisted of the advance and retreat of four continental glaciers from Canada into the midwestern United States and back into Canada. Each glacier would advance over sections of the Teays River and its tributaries, blocking the flow of water and forming large lakes. The lakes would continue to fill until they were hundreds of feet deep and extended for hundreds of miles. Over time, the lakes would fill up and flow into an adjacent lake or ice-free drainage system. Much as happens when a dam breaks, the rapid flow of water would erode a deep valley, especially if the glacier was melting. This process produced many new river valleys, which connected former valleys previously separated by high ground.

This was the process responsible for the formation of the modern Ohio River. About 2 million years ago, the first of four great glaciers advanced to a position roughly following the Ohio-Kentucky state line between Cincinnati, Ohio, and Maysville, Ky. Large lakes filled the ancient valleys of the Licking and Little Sandy Rivers and Tygarts Creek and their tributaries. East of Maysville was an area of high ground that separated the Licking River from the Little Sandy River and Tygarts Creek. Apparently, near Cincinnati, the glacier retreated enough to allow water to flow down the Ohio River west of Cincinnati. Meltwater continued to rise in the lakes, filling the Little Sandy River and Tygarts Creek and their tributaries. The high ground east of Maysville was topped by the rising water and cut the modern Ohio River Valley.

As the glacier continued to melt, large quantities of meltwater continued to erode and deepen the Ohio River Valley. The meltwater transported and deposited large amounts of sand and gravel in the valley. Long after the glacier is gone, downcutting of the Ohio River has eroded much of this material, leaving behind sand and gravel terraces that lie up to 100 feet above the modern floodplain of the Ohio River.

Scenic Terrain Along the AA Highway/ U.S. 23

The AA Highway/U.S. 23 crosses a variety of different types of terrain or physiographic regions. Where natural landforms (lay of the land) differ significantly from one another, this generally indicates that each type of terrain is underlain by a different type of rock. The major physiographic regions crossed by the AA Highway/U.S. 23 are shown in Figure 5.

Eden Shale Belt

This region is characterized by hills formed in easily eroded shales; it extends from Alexandria to Mason County.

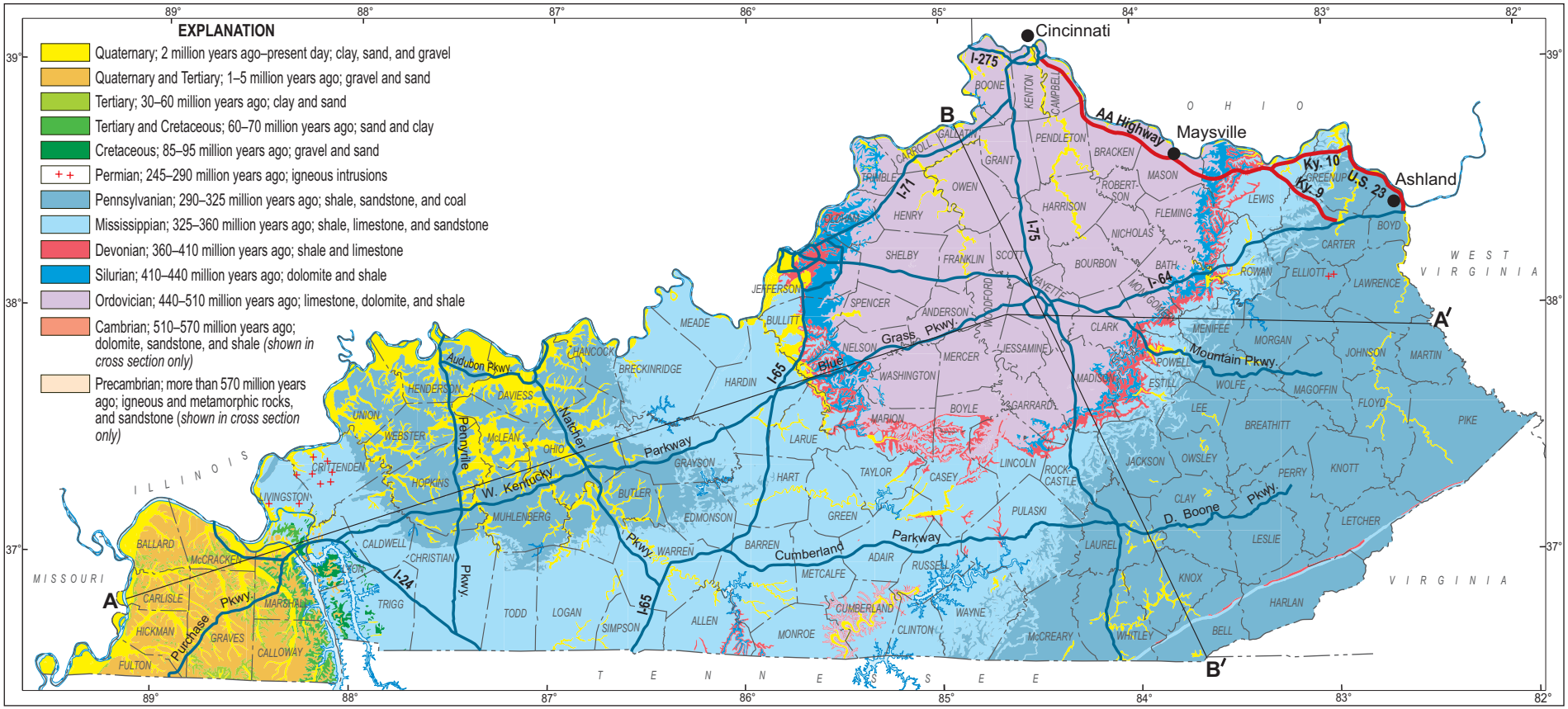

Figure 2. Geology of Kentucky showing selected Interstate highways and parkways.

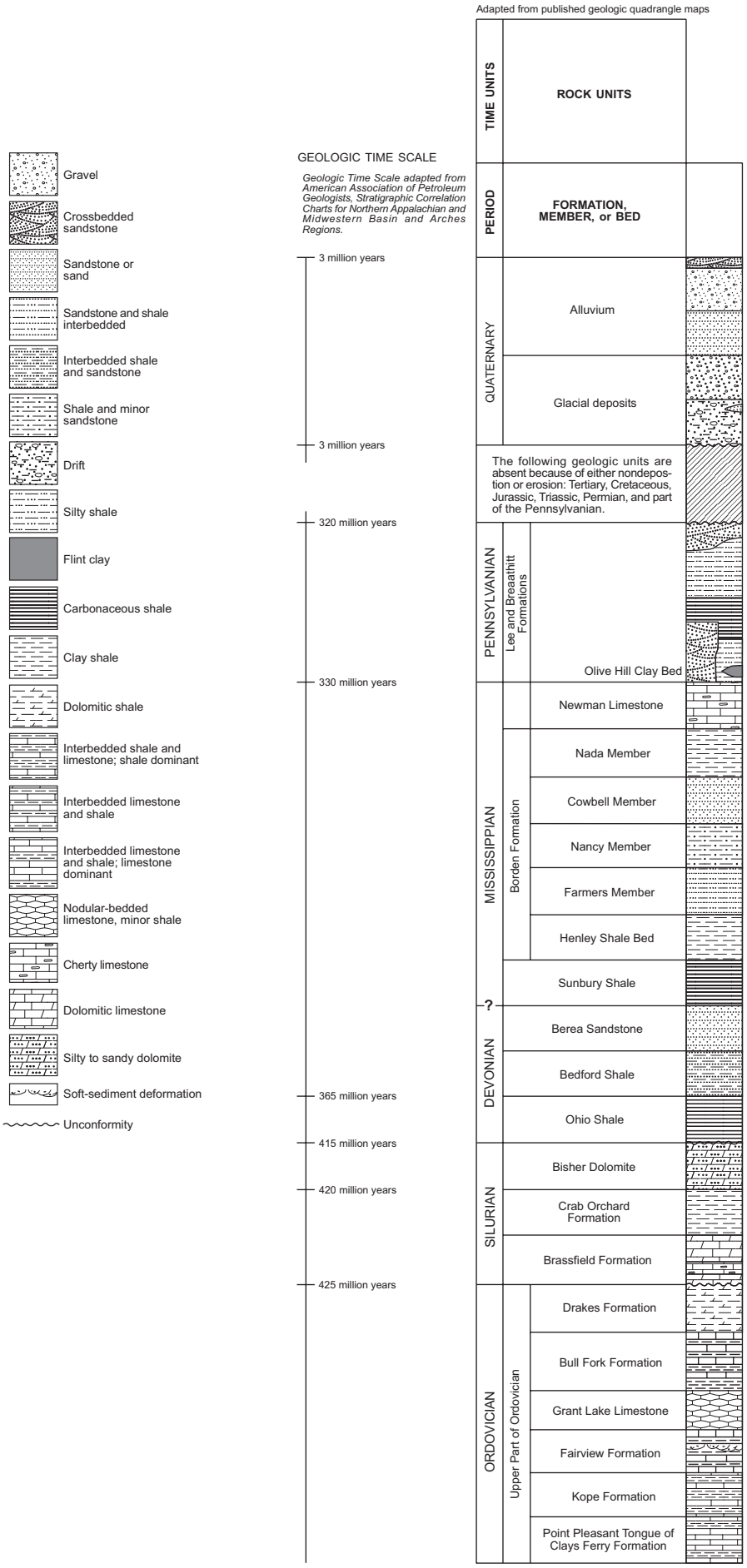

Figure 3. Stratigraphy of rock units along the AA Highway and U.S. 23.

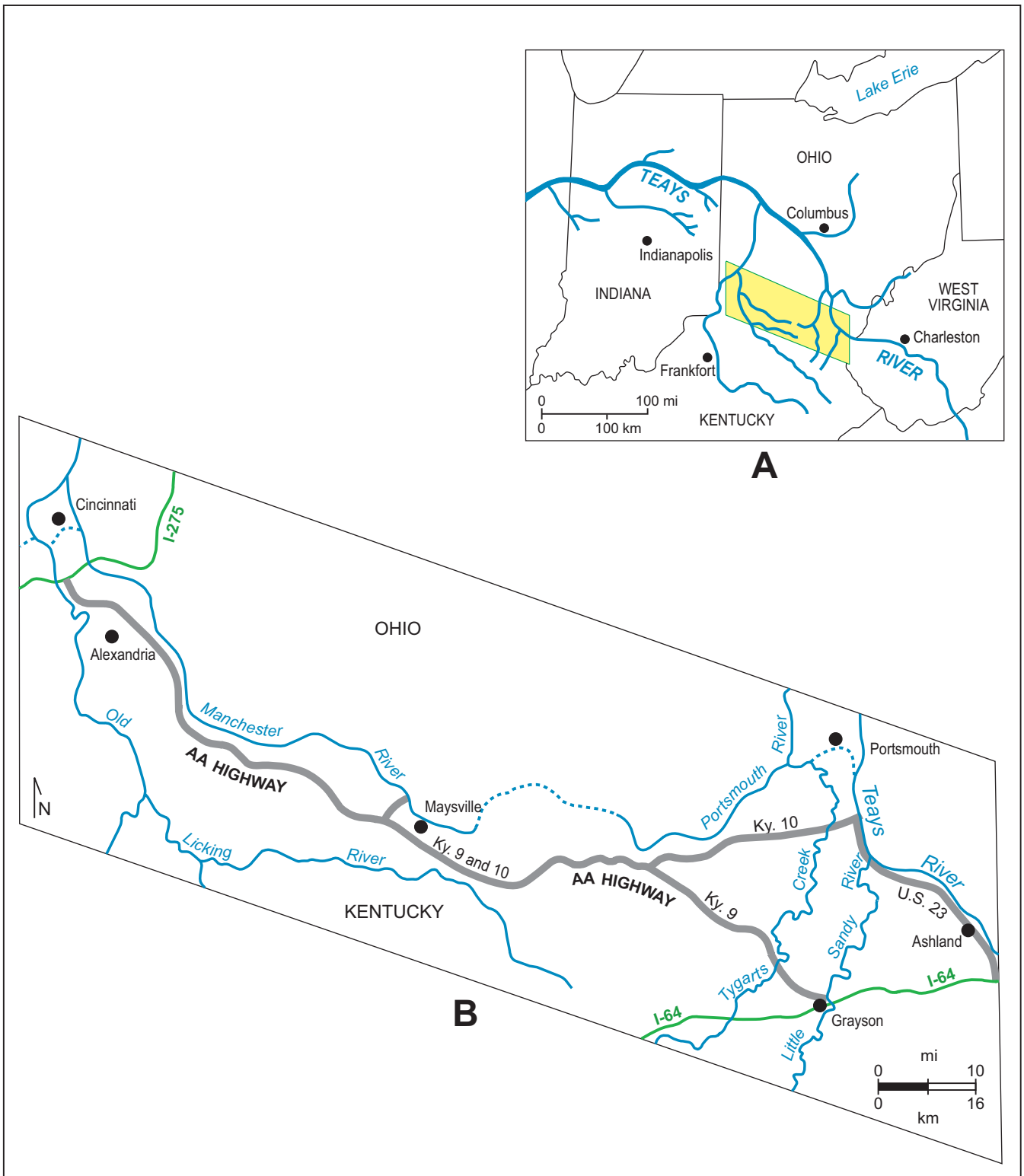

Figure 4. Teays River and related preglacial rivers of the east-central United States (inset A). Inset B illustrates preglacial drainage adjacent to the Alexandria to Ashland Highway and U.S. 23. Solid river segments delineate preglacial tributaries of the Teays River and dashed segments illustrate new channels cut through drainage divides to form the modern Ohio River (modified from Teller and Goldthwait, 1991, Fig. 1).

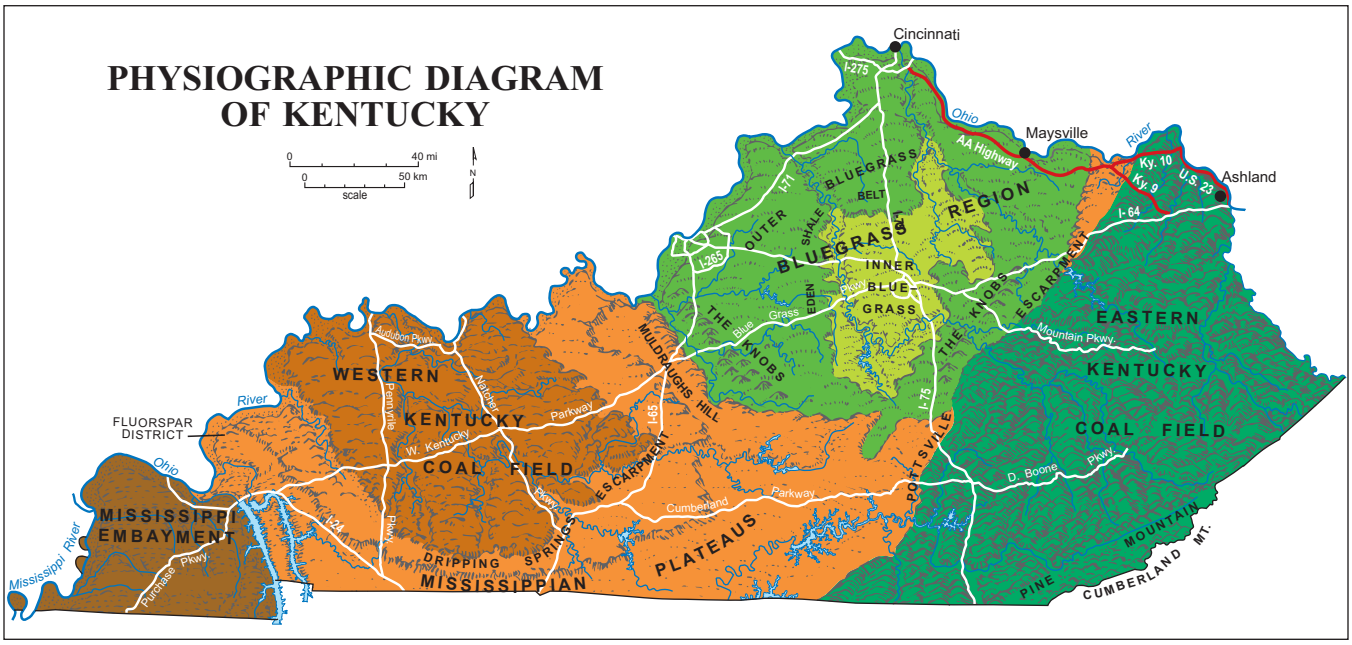

Figure 5. Physiography and Interstate highways and parkways in Kentucky.

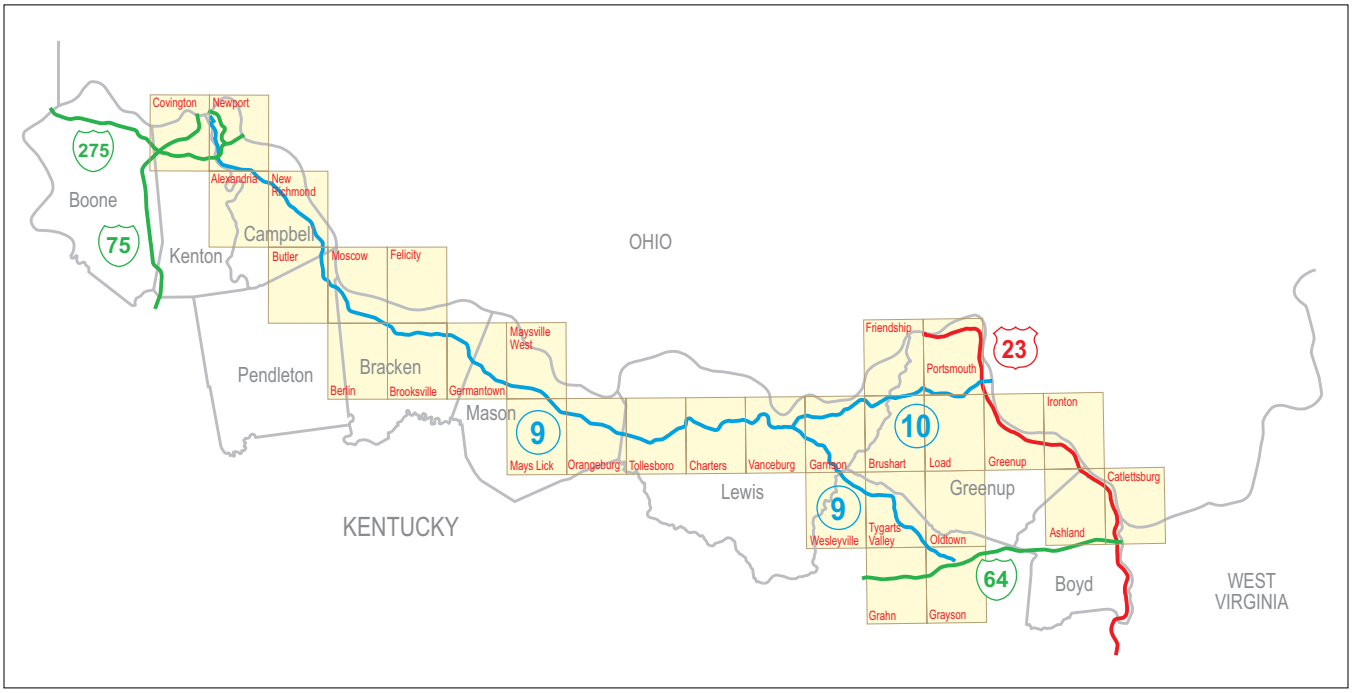

Figure 6. Geologic quadrangle maps covering the path of the AA Highway and U.S. 23. These detailed maps are at a scale of 1:24,000 (1 inch on the map equals 2,000 feet on the ground), and geologic units that are present at the earth's surface are shown in various colors. Copies of these maps may be purchased from the Kentucky Geological Survey at the University of Kentucky in Lexington.

Outer Bluegrass

Characterized by gently rolling uplands underlain by interbedded limestone and shale, this region is well developed in Mason and eastern Lewis Counties. Ky. 9 enters the Outer Bluegrass Region in the vicinity of mile 19.5 in Mason County.

The Knobs

The Knobs is a narrow belt of ridges and conical hills, many of which are capped by resistant siltstone and limestone. The hills are generally separated by shale-floored valleys. Ky. 9 crosses the Knobs in the vicinity of mile 2.1 in Lewis County, and Ky. 10 in the vicinity of mile 7.0 northeast of Vanceburg in Lewis County.

Pottsville Escarpment

The escarpment is a band of sinuous ridges and narrow valleys generally underlain by quartz sandstone. Ky. 9 crosses the Pottsville Escarpment in the vicinity of mile 9.2 in Carter County and Ky. 10 in the vicinity of mile 4.6 in Greenup County.

Eastern Kentucky Coal Field

This region of irregular, narrow-crested ridges and deep valleys underlain by shales, clays, sandstones, and coal is one of the most important coal-producing areas in the world. Ky. 9 enters the Eastern Kentucky Coal Field in the vicinity of mile 9.0 in Carter County, and Ky. 10 in the vicinity of mile 4.8 in Greenup County.

Roadlog

Geologic units are shown on continuous strip maps that extend approximately 0.5 mile on either side of the AA Highway/U.S. 23. The production of these strip maps was possible because of the availability of detailed 1:24,000-scale (1 inch on the map equals 2,000 feet on the ground) geologic maps for the entire state. The AA Highway/U.S. 23 crosses the area covered by 28 geologic quadrangle maps, which are identified in Figure 6 (p. 11).

All descriptions of rock strata, physiographic features, and geologic features are referenced to highway mile markers, which occur at 1-mile intervals along the shoulder of the AA Highway/U.S. 23. Mile markers decrease in value from west to east, and are reset at county boundaries as one travels from Alexandria to Grayson on Ky. 9. For example, at the Campbell-Pendleton County line, mile markers are reset from Campbell County mile 0.0 to Pendleton County mile 4.3. Mile markers increase in value and are reset to 0.0 at county lines as one travels from west to east on Ky. 10 from Vanceburg to U.S. 23 and Greenup Locks and Dam. Mile markers decrease in value and are reset to 0.0 as one travels from north to south on U.S. 23.

The Alexandria-Ashland Highway (Ky. 9 and 10) divides into two branches in the vicinity of Vanceburg. Ashland is reached via Ky. 9, Ky. 1, and I-64; the Ohio River and Portsmouth, Ohio, are reached via Ky. 10 and U.S. 23. The roadlog and strip maps are also divided into two sections: the first begins at the interchange of Ky. 9 and I-275 in northern Kentucky, and continues southeast to join Ky. 1 and I-64 at Grayson. The second section begins at the junction of Ky. 9 and Ky. 10, east of Vanceburg, and continues east on Ky. 10 to U.S. 23, and then south on U.S. 23 through Ashland to I-64. The Maysville Bypass roadlog is inserted in the first section where it joins the AA Highway in Mason County.

Throughout the roadlog, we have included numerous illustrations and photographs to help explain the geologic and historic features along a particular segment of the highway.

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Glossary

Alluvium—Unconsolidated (not cemented or compacted together) deposits of streams that underlie floodplains and terraces, and typically consist of clay, silt, sand, and gravel. These deposits are common adjacent to the many streams crossed by the AA Highway/U.S. 23. Many of the most fertile soils along the highway are developed on alluvium.

Anticline—A geologic structure formed by upward folding of rock layers. An excellent example occurs along the AA Highway in Bracken County, between miles 19.2 and 18.8.

Bed—A distinctly layered unit of rock thicker than 4 inches. Beds are the fundamental unit of geology.

Bedding—The arrangement of rocks in beds or layers of varying thickness and form.

Bedding plane—Top or bottom of a bed. Bedding planes are natural planes of weakness; commonly these surfaces record evidence of animals that burrowed or crawled along the sea bottom (trace fossils).

Bedrock—General term for the first consolidated, hard, coherent material underlying soils, alluvium, and colluvium. Roadcuts along the AA Highway/U.S. 23 expose bedrock that ranges in age from the Ordovician Period to the Pennsylvanian Period (500 million to 290 million years ago).

Carbonaceous—Rock or sediment rich in organic carbon. Examples along the AA Highway/U.S. 23 include the black shales and coals of Devonian and Pennsylvanian age (410 million to 290 million years ago) in many roadcuts in Carter, Lewis, and Greenup Counties.

Chert—Fine-grained, dense, hard rock composed chiefly of silica. It is common in the Brassfield Formation between miles 30.3 and 25.2 in Lewis County, and in the Breathitt Formation between miles 7.6 and 8.0 in Greenup County.

Clay—Fine-grained material that consists chiefly of silicate minerals and fine silt; it becomes plastic when wet. Its lithified equivalent is called shale. Clay is common in many of the roadcuts along the AA Highway/U.S. 23.

Coal—Combustible black rock of concentrated carbonaceous material formed from altered plant remains. It is present along the AA Highway/U.S. 23 in rocks of Pennsylvanian age (290 million to 330 million years old) in Carter and Greenup Counties.

Colluvium—A deposit of weathered bedrock and soil that occurs mostly on slopes. This loose, unsorted, locally derived material moves slowly, but occasionally rapidly, downslope, especially when saturated with water. Weathering of the shale-dominant Kope Formation, Crab Orchard Formation, and Breathitt Formation produces thick deposits of colluvium.

Crossbedding—An arrangement of inclined layering within a bed. Crossbedding is common in the sandstones of the Breathitt Formation exposed by the AA Highway/U.S. 23 in Carter and Greenup Counties.

Cross section—A vertical slice across either the topography or bedrock that shows geologic formations and lateral relationships.

Deformed bedding—The bending or breaking of lithified beds by earth movements. The small fault and associated anticline present at mile 3.9 in Campbell County are excellent examples.

Dip—A line or direction perpendicular to the strike line; the dip angle measures the inclination of a surface or bedding plane. The flanking beds of the anticline exposed between miles 19.2 and 18.8 in Bracken County display northwestern and southeastern dips.

Dolomite—Sedimentary rock composed chiefly of the mineral dolomite (calcium-magnesium carbonate). Good examples are the Brassfield Formation and Bisher Dolomite in Lewis County. Some geologists use the term “dolostone” to refer to the rock, in order to avoid confusion with the mineral dolomite.

Erosion—Natural process that results in the wearing away and removal of materials at the earth’s surface by running water, waves and currents, moving ice, or wind.

Escarpment—A geographic term for a distinctive line of hills that overlooks a lower area; an example is the Pottsville Escarpment in western Lewis County.

Fault—A fracture in the earth’s crust along which rock units on either side have slipped past each other. Along the AA Highway, faults occur in the Kope Formation at Campbell County mile 3.9, in the Crab Orchard Formation at Lewis County mile 18.1, and in the Berea Sandstone at Lewis County mile 12.8 on Ky. 10.

Flint clay—A hard, silicified clay with a conchoidal (glass-like) fracture. An excellent example is the Olive Hill Clay Bed, exposed between Greenup County miles 4.6 and 4.8 on Ky. 10.

Formation—A body of rock characterized by identifiable lithologic features; the basic rock unit used in stratigraphic classification.

Floodplain—An elongate, low area near a stream or river that is intermittently flooded. Common along many of the streams crossed by the AA Highway/U.S. 23.

Fossil—Any part of a plant or animal preserved in rock. Along the AA Highway/U.S. 23, rocks of Late Ordovician age (500 to 435 million years old) contain abundant fossils.

Fracture—A break or opening in a rock along which little or no movement has occurred.

Geologic age—Periods of geologic time during which corresponding rock units were deposited. Along the AA Highway/U.S. 23 are rocks of five periods: Ordovician (500–435 million years old), Silurian (435–410 million years old), Devonian (410–360 million years old), Mississippian (360–330 million years old), and Pennsylvanian (330–290 million years old).

Geologic province—An extensive region characterized by similar rock types, structural features, and geologic history.

Geologic quadrangle map—A map on which the distribution and nature of rock units and the occurrences of geologic features, mineral deposits, and fossil localities are shown.

Glacial drift—General term for material eroded, transported, and deposited by an ice sheet.

Glacial limit—The position of maximum advance by an ice sheet.

Glaciation—The formation, invasion, and retreat of glaciers in an area.

Ice-margin stream—A stream located at the front or side of an ice sheet. An example of a now-abandoned ice-margin stream occurs at Campbell County mile 10.2, where the modern Fourmile Creek flows in a valley cut by the ancient course of the Ohio and Licking Rivers at the limit of the ice advance during the third glacial stage.

Interbedded—One rock type interlayered with another. Along the AA Highway/U.S. 23, an example is the alternation of limestone and shale beds in rocks of Ordovician age (500–435 million years old).

Landslide—A general term for the downhill movement of unconsolidated material such as colluvium, soil, glacial drift, etc. Excellent examples are present on abandoned Ky. 10 at Lewis County mile 22.0.

Limestone—A sedimentary rock composed of the mineral calcite (calcium carbonate).

Lithology—The physical character of a rock, including color, bedding, mineralogic composition, and grain size.

Lithification—The conversion of unconsolidated sediment to hard rock, typically by cementation and compaction.

Meander—A horseshoe-shaped segment of a stream. Salt Lick Creek between Charters (Lewis County mile 18.5) and Vanceburg (Lewis County mile 12.0) displays many meanders.

Meltwater—Water derived from melting ice; an important source of sands and gravels.

Member—Subdivision of a formation, distinguishable from adjacent parts of the formation.

Physiographic region—Area in which the pattern of landforms differs significantly from that in adjacent areas.

Preglacial—Refers to the time before the advent of ice sheets into Kentucky.

Quartz—An important rock-forming mineral composed of silicon and oxygen.

Roadcut—Rock exposure created by highway construction.

Roadlog—A descriptive record of geologic features and their locations along a roadway.

Sandstone—Sedimentary rock generally composed of quartz grains that have been cemented together. It is a common rock type in roadcuts along the AA Highway/U.S. 23 in Lewis, Carter, and Greenup Counties.

Shale—Sedimentary rock generally composed of cemented clay minerals and silt. It is the most common rock type in the roadcuts of the AA Highway/U.S. 23.

Siltstone—Sedimentary rock composed mainly of very small quartz grains. It is a common rock type in the Cowbell Member of the Borden Formation, exposed along the AA Highway/U.S. 23 in Lewis, Carter, and Greenup Counties.

Sinkhole—Circular depression caused by dissolution of limestone or dolomite bedrock. Along the AA Highway/U.S. 23, sinkholes are present in the uplands of Mason County.

Slide or slump—*See* landslide.

Soft-sediment deformation—Flowage and movement of sediments prior to lithification. An excellent example is exposed in a roadcut on Ky. 1159 just north of the AA Highway at mile 10.2 in Bracken County.

Strata—Tabular or sheet-like layers of sedimentary rock.

Stratigraphic column—Diagram that shows in a single column the sequence of rock units and the subdivisions of part or all of geologic time.

Strike—The direction of a horizontal line on a bedding plane or other planar surface—the "level line direction" of strata.

Structural geologic province—A region whose geologic structure differs significantly from that of adjacent regions.

Terrace—A flat, elongate area near and above a stream that was formerly an active floodplain. It is commonly an excellent source of sand and gravel.

Topography—The general configuration of a land surface, including its relief; also the form of natural and man-made features.

Trace fossil—Animal tracks, trails, or burrows preserved in rocks.

Unconformity—A break or gap in the geologic record, where a rock unit is overlain by another that is not next in the stratigraphic succession.

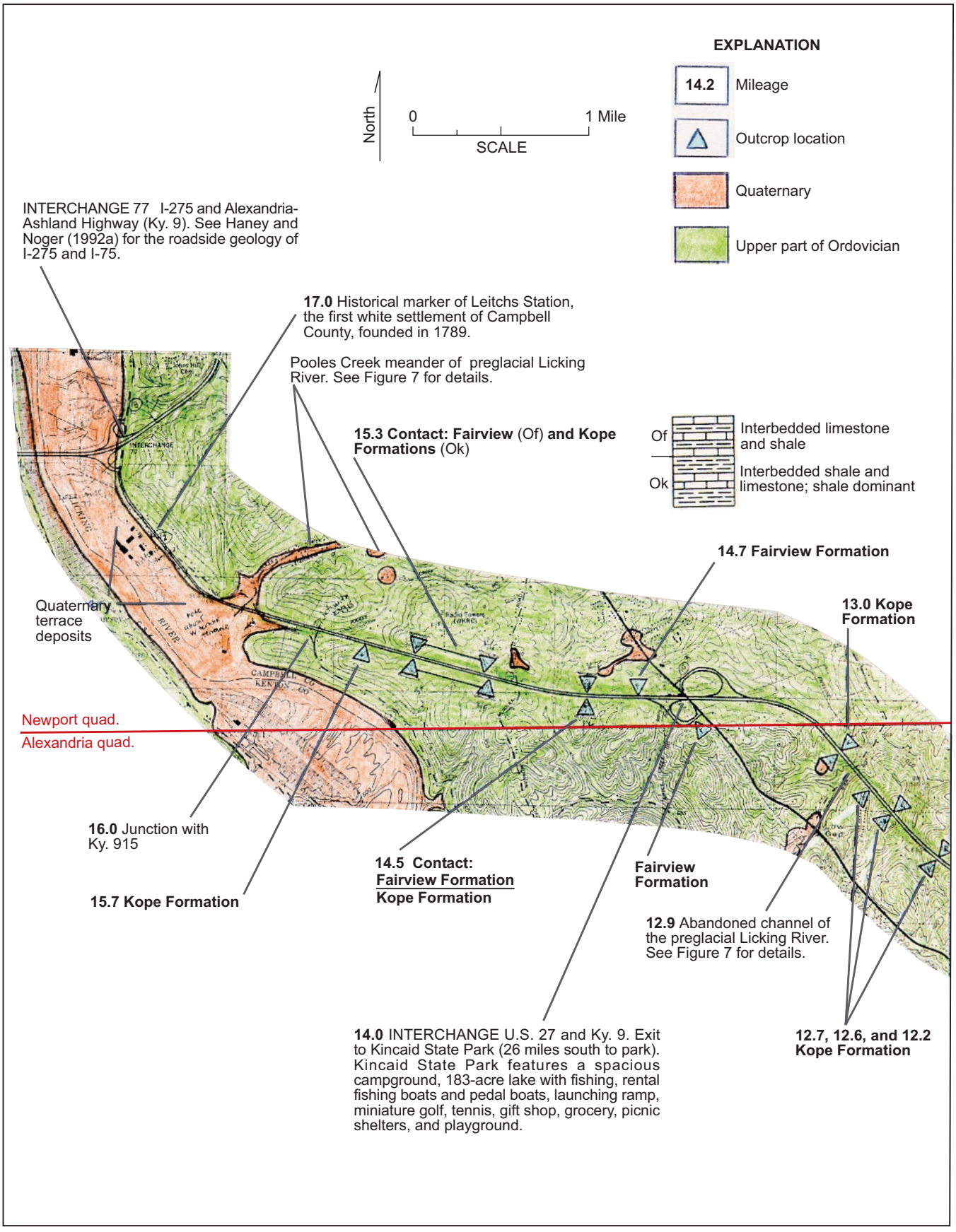
Underclay—A soft, plastic clay, commonly with plant root impressions beneath a coal bed.

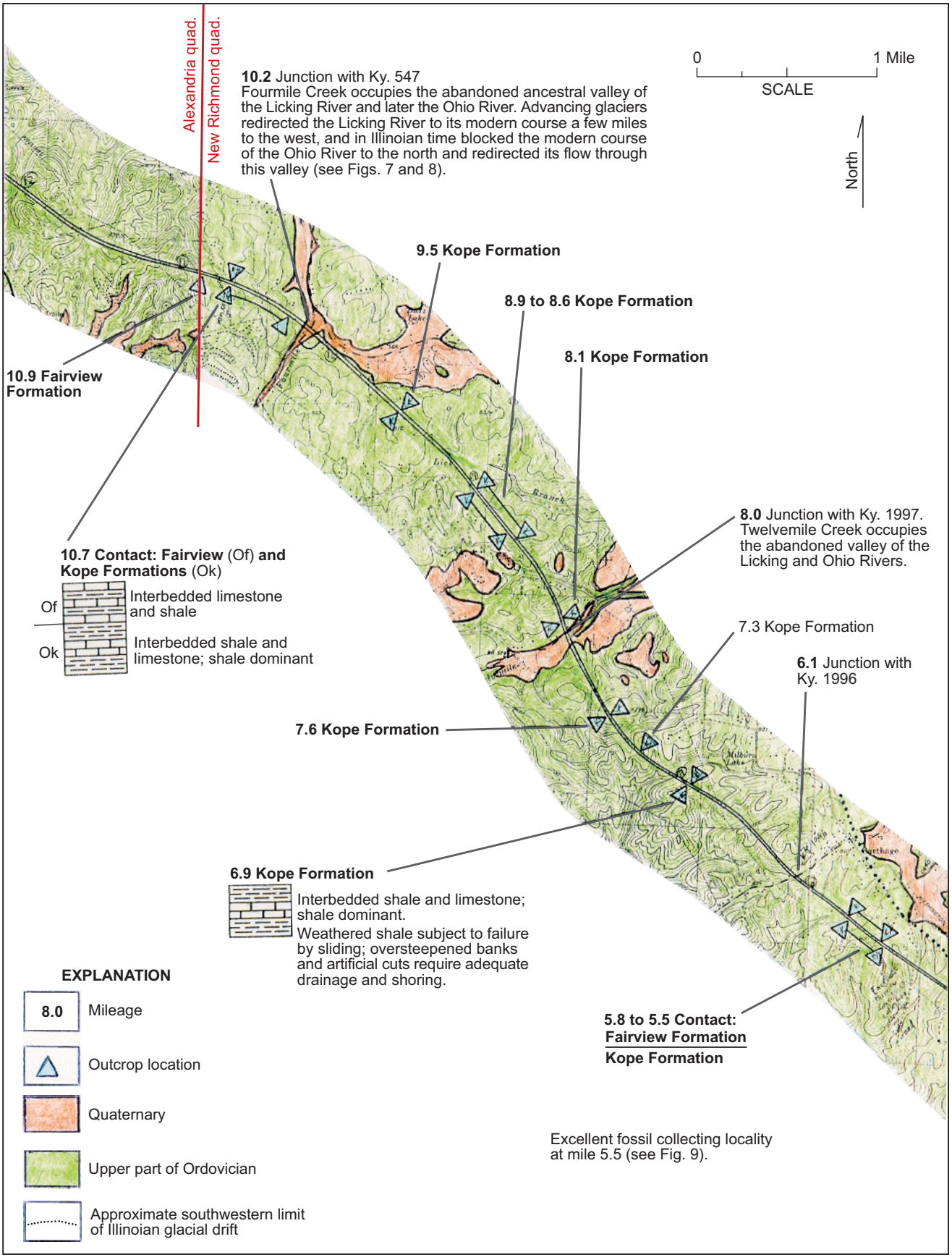
Weathering—The complex processes that combine to decompose solid rock into soil.

ALEXANDRIA TO ASHLAND HIGHWAY:

KENTUCKY 9
From Alexandria, Ky., to Grayson, Ky.

The Borden Formation: Farmers and Nancy Members in a spectacular roadcut between Lewis County miles 9.6 and 9.1, east of Vanceburg, Ky.


EXPLANATION
14.2 Mileage
Outcrop location
Quaternary
Upper part of Ordovician
North
0
1 Mile
SCALE
INTERCHANGE 77 I-275 and Alexandria-Ashland Highway (Ky. 9). See Haney and Noger (1992a) for the roadside geology of I-275 and I-75.
17.0 Historical marker of Leitchs Station, the first white settlement of Campbell County, founded in 1789.
Pooles Creek meander of preglacial Licking River. See Figure 7 for details.
15.3 Contact: Fairview (Of) and Kope Formations (Ok)
Of
Interbedded limestone and shale
Ok
Interbedded shale and limestone; shale dominant
14.7 Fairview Formation
13.0 Kope Formation
Quaternary terrace deposits
Newport quad.
Alexandria quad.
16.0 Junction with Ky. 915
15.7 Kope Formation
14.5 Contact:
Fairview Formation
Kope Formation
Fairview Formation
12.9 Abandoned channel of the preglacial Licking River. See Figure 7 for details.
14.0 INTERCHANGE U.S. 27 and Ky. 9. Exit to Kincaid State Park (26 miles south to park). Kincaid State Park features a spacious campground, 183-acre lake with fishing, rental fishing boats and pedal boats, launching ramp, miniature golf, tennis, gift shop, grocery, picnic shelters, and playground.
12.7, 12.6, and 12.2 Kope Formation


Alexandria quad.
New Richmond quad.
0
1 Mile
SCALE
North
10.2 Junction with Ky. 547
Fourmile Creek occupies the abandoned ancestral valley of the Licking River and later the Ohio River. Advancing glaciers redirected the Licking River to its modern course a few miles to the west, and in Illinoian time blocked the modern course of the Ohio River to the north and redirected its flow through this valley (see Figs. 7 and 8).
9.5 Kope Formation
8.9 to 8.6 Kope Formation
8.1 Kope Formation
10.9 Fairview Formation
8.0 Junction with Ky. 1997. Twelvemile Creek occupies the abandoned valley of the Licking and Ohio Rivers.
10.7 Contact: Fairview (Of) and Kope Formations (Ok)
Of
Interbedded limestone and shale
Ok
Interbedded shale and limestone; shale dominant
7.3 Kope Formation
6.1 Junction with Ky. 1996
7.6 Kope Formation
6.9 Kope Formation
Interbedded shale and limestone; shale dominant.
Weathered shale subject to failure by sliding; oversteepened banks and artificial cuts require adequate drainage and shoring.
EXPLANATION
8.0
Mileage
Outcrop location
Quaternary
Upper part of Ordovician
Approximate southwestern limit of Illinoian glacial drift
5.8 to 5.5 Contact:
Fairview Formation
Kope Formation
Excellent fossil collecting locality at mile 5.5 (see Fig. 9).

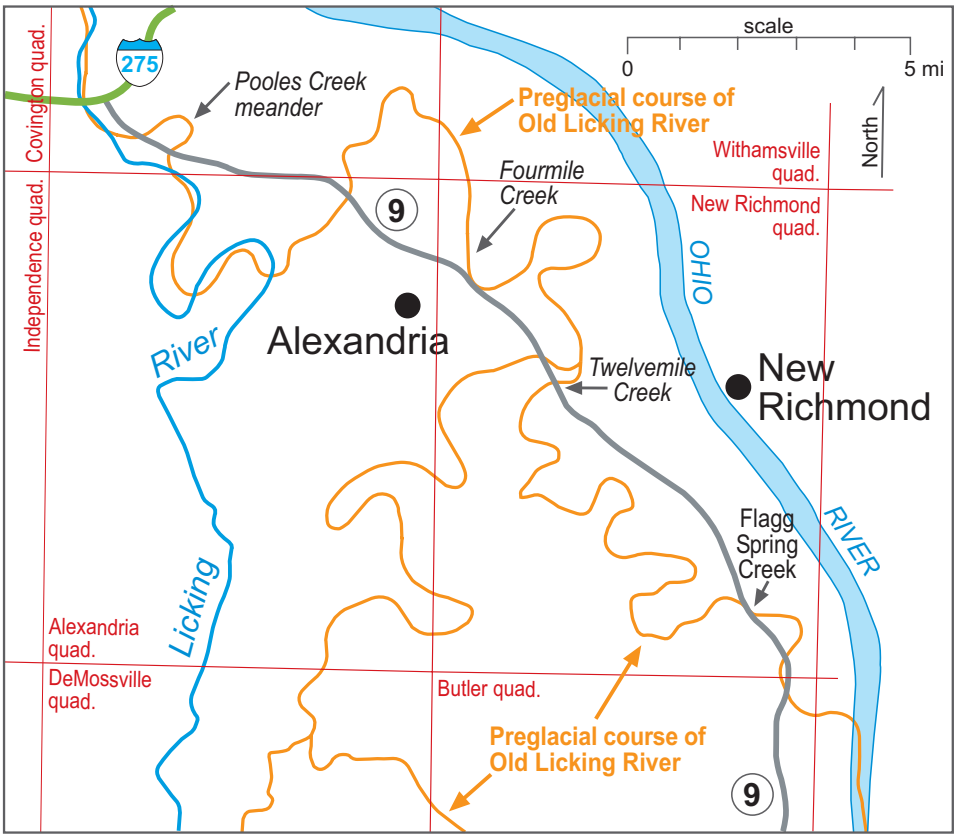
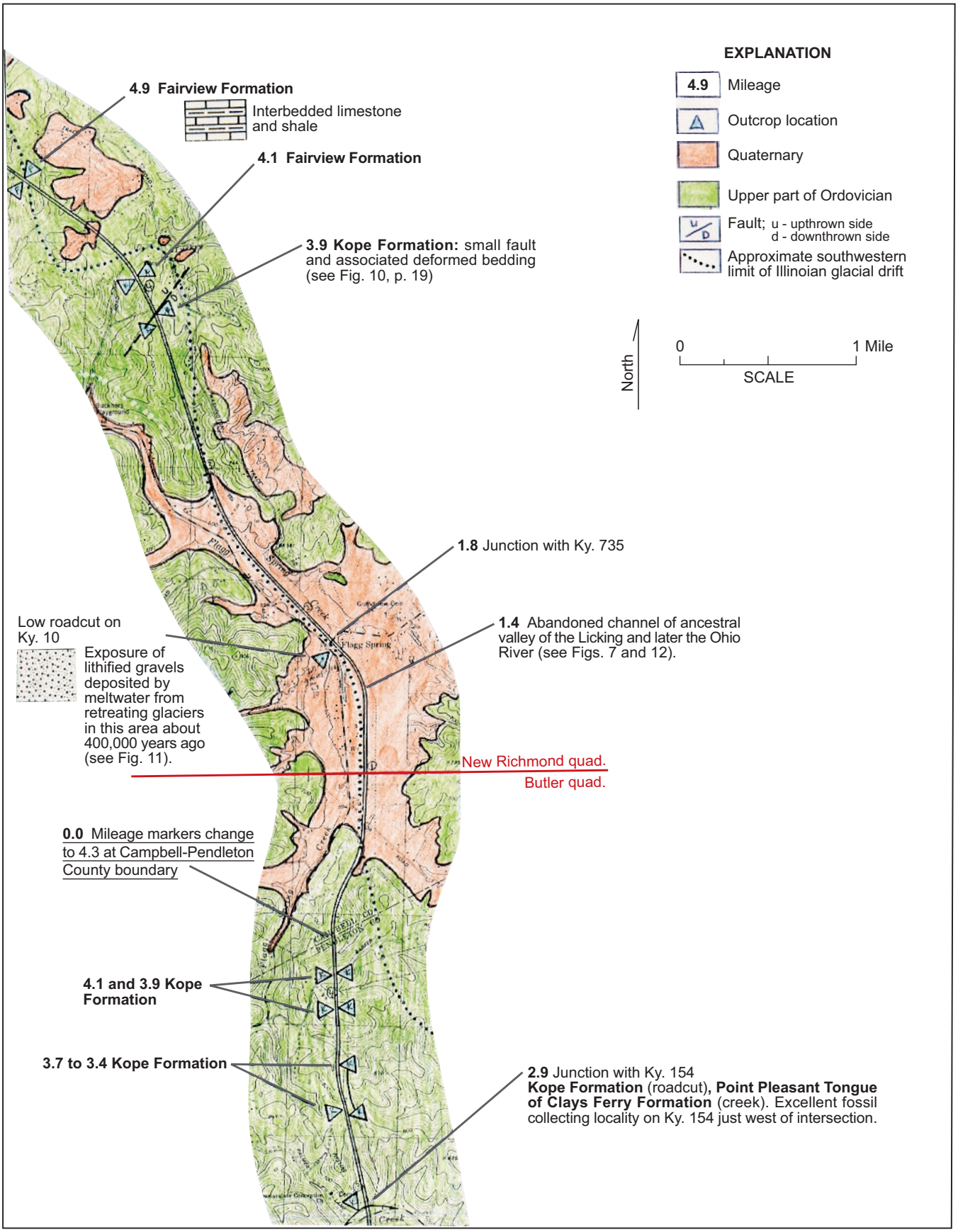


Figure 7. The relationship of the preglacial Licking River and the AA Highway (Ky. 9) (modified from Luft, 1980).

Figure 8. Preglacial, abandoned valley of the Licking River, mile 10.2 of Ky. 9, Campbell County. View is to the north.

Figure 9. Contact of Fairview and Kope Formations on north side of the AA Highway between miles 5.8 and 5.5 of Ky. 9, Campbell County.

Figure 10. Fault and associated deformed bedding in the Kope Formation, mile 3.9 of Ky. 9, Campbell County.


EXPLANATION
4.9 Mileage
Outcrop location
Quaternary
Upper part of Ordovician
Fault; u - upthrown side
d - downthrown side
Approximate southwestern limit of Illinoian glacial drift
North
0
1 Mile
SCALE
4.9 Fairview Formation
Interbedded limestone and shale
4.1 Fairview Formation
3.9 Kope Formation: small fault and associated deformed bedding (see Fig. 10, p. 19)
1.8 Junction with Ky. 735
Low roadcut on Ky. 10
Exposure of lithified gravels deposited by meltwater from retreating glaciers in this area about 400,000 years ago (see Fig. 11).
1.4 Abandoned channel of ancestral valley of the Licking and later the Ohio River (see Figs. 7 and 12).
New Richmond quad.
Butler quad.
0.0 Mileage markers change to 4.3 at Campbell-Pendleton County boundary
4.1 and 3.9 Kope Formation
3.7 to 3.4 Kope Formation
2.9 Junction with Ky. 154
Kope Formation (roadcut), Point Pleasant Tongue of Clays Ferry Formation (creek). Excellent fossil collecting locality on Ky. 154 just west of intersection.

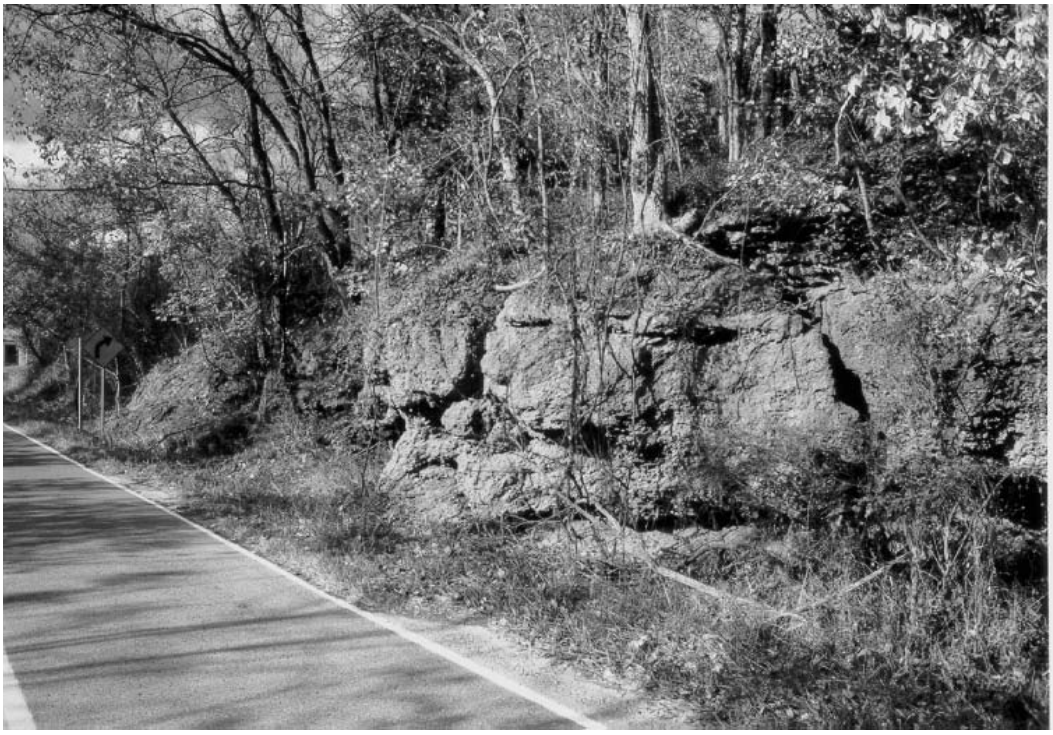
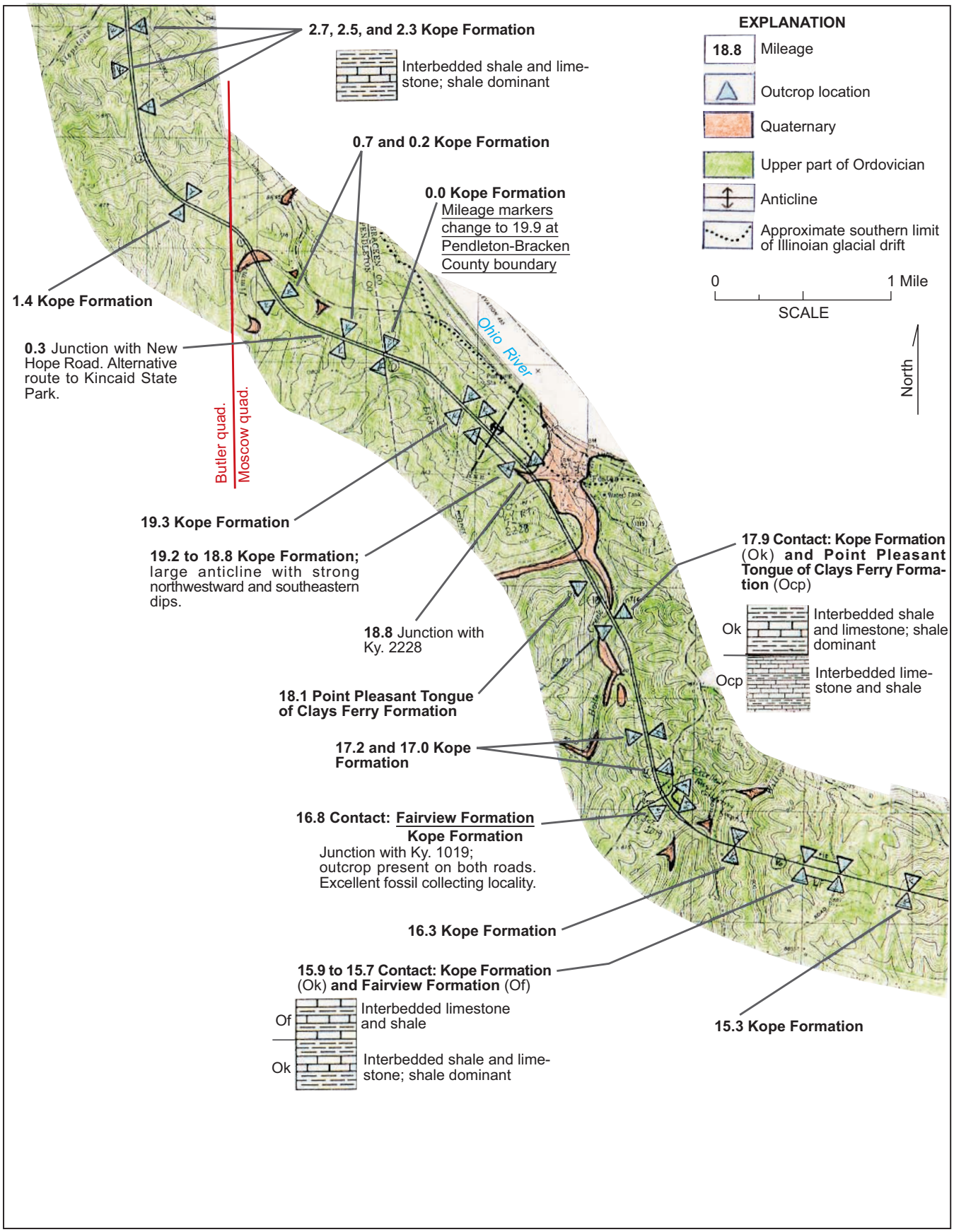


Figure 11. Lithified glacial drift in a roadcut on Ky. 10 adjacent to the AA Highway at mile 1.8, Campbell County.

Figure 12. Abandoned valley of the preglacial Licking River and ice-margin Ohio River. Modern Flagg Spring Creek currently occupies this broad valley at Campbell County mile 1.4.


EXPLANATION
18.8 Mileage
Outcrop location
Quaternary
Upper part of Ordovician
Anticline
Approximate southern limit of Illinoian glacial drift
0
1 Mile
SCALE
North
2.7, 2.5, and 2.3 Kope Formation
Interbedded shale and limestone; shale dominant
0.7 and 0.2 Kope Formation
0.0 Kope Formation
Mileage markers change to 19.9 at Pendleton-Bracken County boundary
1.4 Kope Formation
0.3 Junction with New Hope Road. Alternative route to Kincaid State Park.
Butler quad.
Moscow quad.
Ohio River
19.3 Kope Formation
19.2 to 18.8 Kope Formation; large anticline with strong northwestward and southeastern dips.
18.8 Junction with Ky. 2228
18.1 Point Pleasant Tongue of Clays Ferry Formation
17.9 Contact: Kope Formation (Ok) and Point Pleasant Tongue of Clays Ferry Formation (Ocp)
Ok
Interbedded shale and limestone; shale dominant
Ocp
Interbedded limestone and shale
17.2 and 17.0 Kope Formation
16.8 Contact: Fairview Formation
Kope Formation
Junction with Ky. 1019; outcrop present on both roads. Excellent fossil collecting locality.
16.3 Kope Formation
15.9 to 15.7 Contact: Kope Formation (Ok) and Fairview Formation (Of)
Of
Interbedded limestone and shale
Ok
Interbedded shale and limestone; shale dominant
15.3 Kope Formation

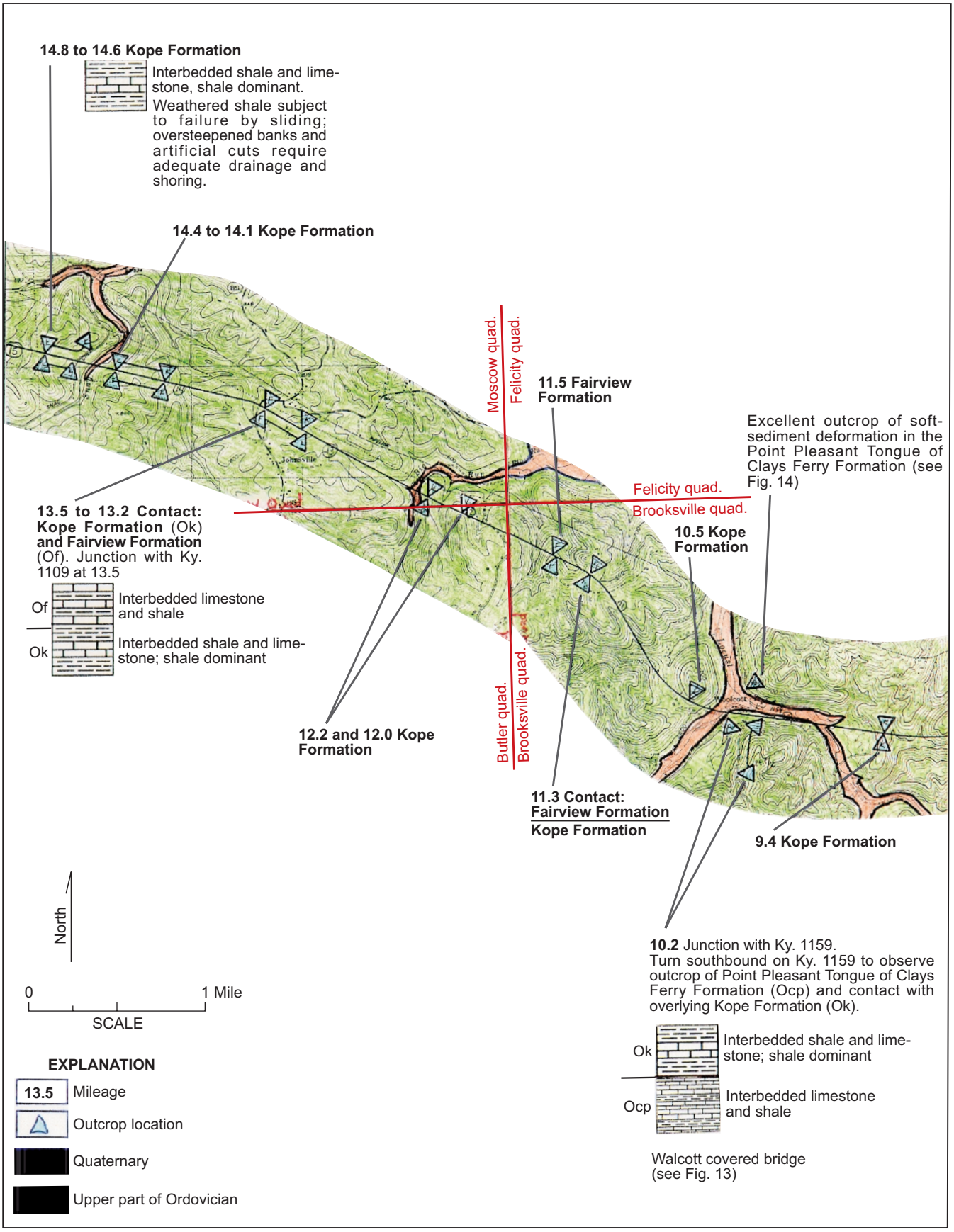
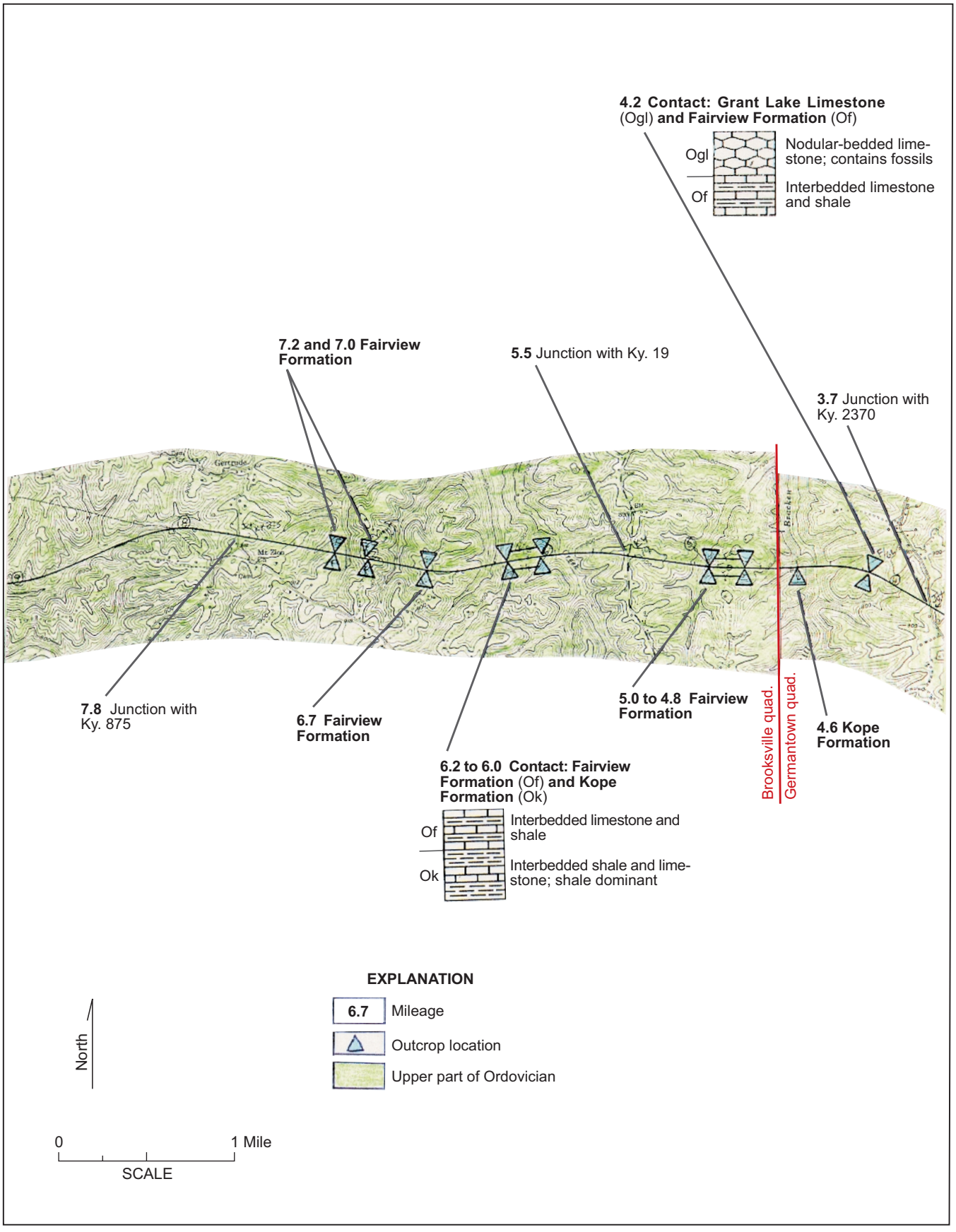
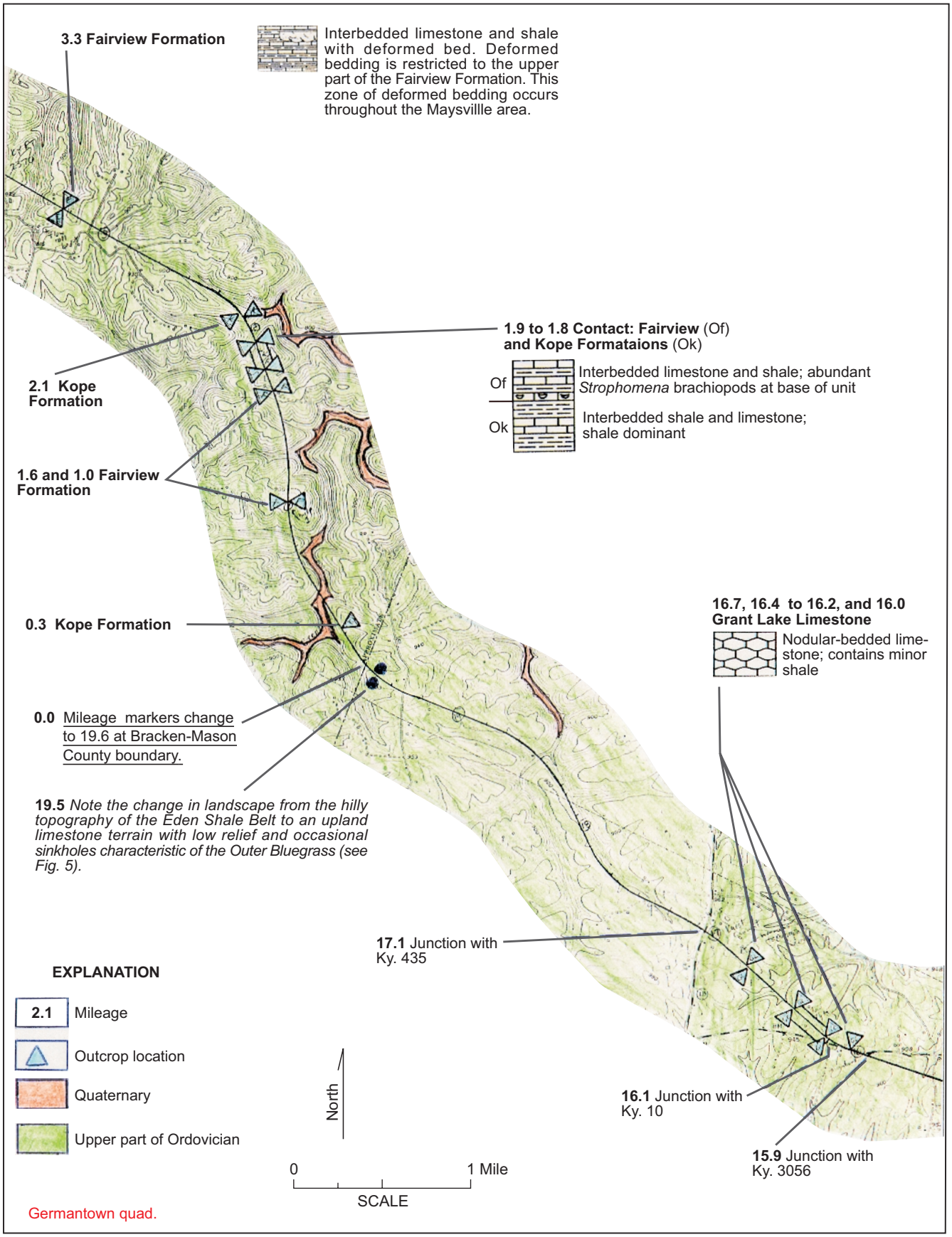
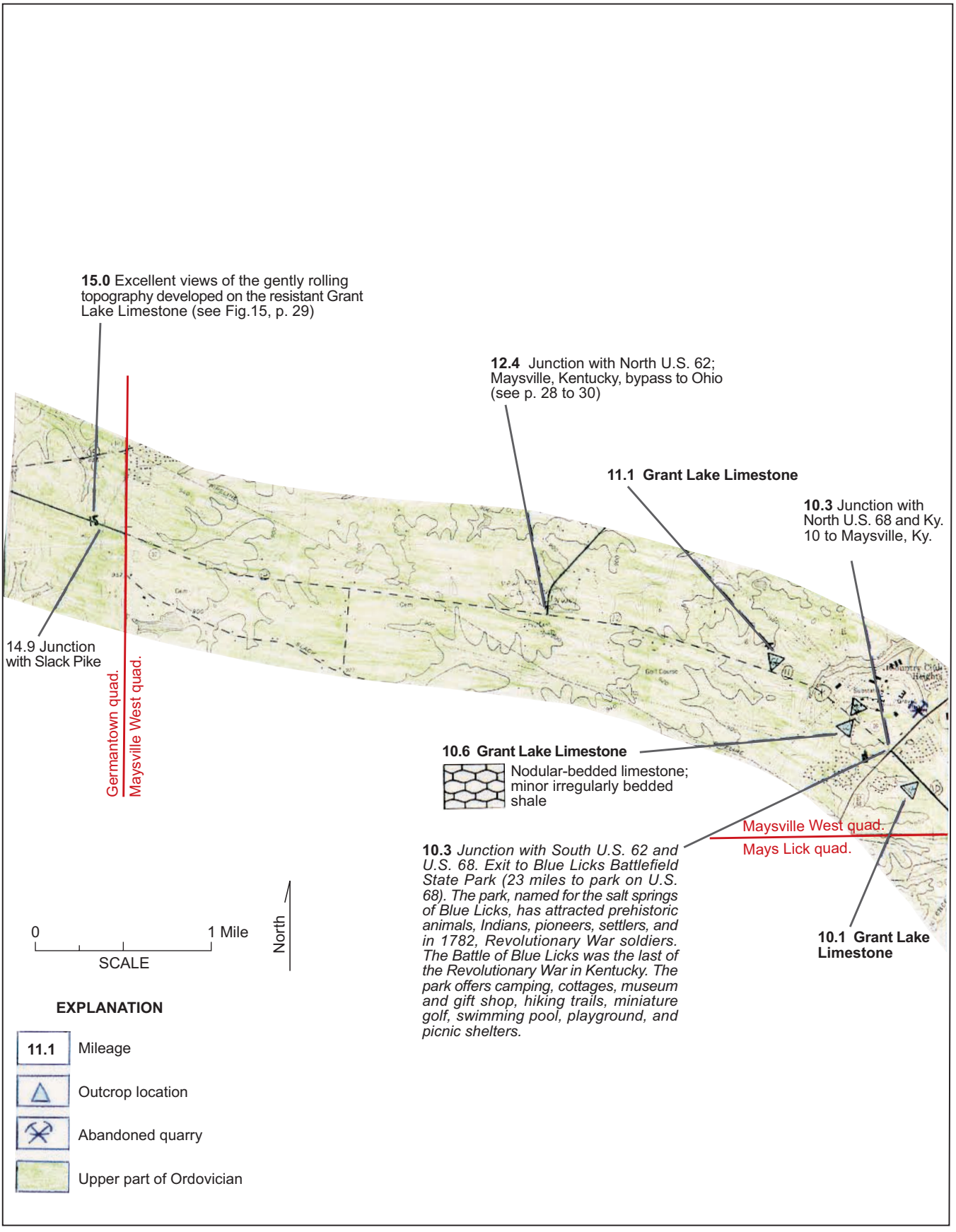

14.8 to 14.6 Kope Formation
Interbedded shale and limestone, shale dominant.
Weathered shale subject to failure by sliding; oversteepened banks and artificial cuts require adequate drainage and shoring.
14.4 to 14.1 Kope Formation
Moscow quad.
Felicity quad.
11.5 Fairview Formation
Excellent outcrop of soft-sediment deformation in the Point Pleasant Tongue of Clays Ferry Formation (see Fig. 14)
Felicity quad.
Brooksville quad.
13.5 to 13.2 Contact: Kope Formation (Ok) and Fairview Formation (Of). Junction with Ky. 1109 at 13.5
Of
Interbedded limestone and shale
Ok
Interbedded shale and limestone; shale dominant
10.5 Kope Formation
12.2 and 12.0 Kope Formation
Butler quad.
Brooksville quad.
11.3 Contact: Fairview Formation Kope Formation
9.4 Kope Formation
North
0
1 Mile
SCALE
10.2 Junction with Ky. 1159. Turn southbound on Ky. 1159 to observe outcrop of Point Pleasant Tongue of Clays Ferry Formation (Ocp) and contact with overlying Kope Formation (Ok).
Ok
Interbedded shale and limestone; shale dominant
Ocp
Interbedded limestone and shale
Walcott covered bridge (see Fig. 13)
EXPLANATION
13.5
Mileage
Outcrop location
Quaternary
Upper part of Ordovician

Figure 13. Walcott covered bridge adjacent to the AA Highway at mile 10.2 of Ky. 9, Bracken County. This bridge was used from 1824 to 1954 and is listed in the National Register of Historic Places.

Figure 14. Soft-sediment deformation in the Point Pleasant Tongue of the Clays Ferry Formation, 0.2 mile north of the AA Highway on Ky. 1159. Junction of Ky. 1159 and AA Highway is at Bracken County mile 10.2.


4.2 Contact: Grant Lake Limestone (Ogl) and Fairview Formation (Of)
Ogl
Nodular-bedded limestone; contains fossils
Of
Interbedded limestone and shale
7.2 and 7.0 Fairview Formation
5.5 Junction with Ky. 19
3.7 Junction with Ky. 2370
7.8 Junction with Ky. 875
6.7 Fairview Formation
6.2 to 6.0 Contact: Fairview Formation (Of) and Kope Formation (Ok)
Of
Interbedded limestone and shale
Ok
Interbedded shale and limestone; shale dominant
5.0 to 4.8 Fairview Formation
Brooksville quad.
Germantown quad.
4.6 Kope Formation
EXPLANATION
6.7
Mileage
Outcrop location
Upper part of Ordovician
North
0
1 Mile
SCALE


3.3 Fairview Formation
Interbedded limestone and shale with deformed bed. Deformed bedding is restricted to the upper part of the Fairview Formation. This zone of deformed bedding occurs throughout the Maysvillle area.
1.9 to 1.8 Contact: Fairview (Of) and Kope Formataions (Ok)
Of
Interbedded limestone and shale; abundant Strophomena brachiopods at base of unit
Ok
Interbedded shale and limestone; shale dominant
2.1 Kope Formation
1.6 and 1.0 Fairview Formation
0.3 Kope Formation
16.7, 16.4 to 16.2, and 16.0 Grant Lake Limestone
Nodular-bedded limestone; contains minor shale
0.0 Mileage markers change to 19.6 at Bracken-Mason County boundary.
19.5 Note the change in landscape from the hilly topography of the Eden Shale Belt to an upland limestone terrain with low relief and occasional sinkholes characteristic of the Outer Bluegrass (see Fig. 5).
17.1 Junction with Ky. 435
EXPLANATION
2.1 Mileage
Outcrop location
Quaternary
Upper part of Ordovician
North
0
1 Mile
SCALE
16.1 Junction with Ky. 10
15.9 Junction with Ky. 3056
Germantown quad.


15.0 Excellent views of the gently rolling topography developed on the resistant Grant Lake Limestone (see Fig.15, p. 29)
12.4 Junction with North U.S. 62; Maysville, Kentucky, bypass to Ohio (see p. 28 to 30)
11.1 Grant Lake Limestone
10.3 Junction with North U.S. 68 and Ky. 10 to Maysville, Ky.
14.9 Junction with Slack Pike
Germantown quad.
Maysville West quad.
10.6 Grant Lake Limestone
Nodular-bedded limestone; minor irregularly bedded shale
Maysville West quad.
Mays Lick quad.
10.3 Junction with South U.S. 62 and U.S. 68. Exit to Blue Licks Battlefield State Park (23 miles to park on U.S. 68). The park, named for the salt springs of Blue Licks, has attracted prehistoric animals, Indians, pioneers, settlers, and in 1782, Revolutionary War soldiers. The Battle of Blue Licks was the last of the Revolutionary War in Kentucky. The park offers camping, cottages, museum and gift shop, hiking trails, miniature golf, swimming pool, playground, and picnic shelters.
10.1 Grant Lake Limestone
0
1 Mile
SCALE
North
EXPLANATION
11.1 Mileage
Outcrop location
Abandoned quarry
Upper part of Ordovician

MAYSVILLE, KENTUCKY, BYPASS:

U.S. 62 from the Alexandria-Ashland Highway
To the Ohio River

The longest continuous exposure of Upper Ordovician rocks in Kentucky, Ohio, and Indiana. Rocks of the upper part of the Kope Formation, the Fairview Formation, and the lower part of the Grant Lake Limestone are exposed in this 0.8-mile roadcut.

Figure 15. Gently rolling topography of the Outer Bluegrass physiographic region. This area is underlain by limestone with minor shale of the Grant Lake Limestone, Mason County mile 15.

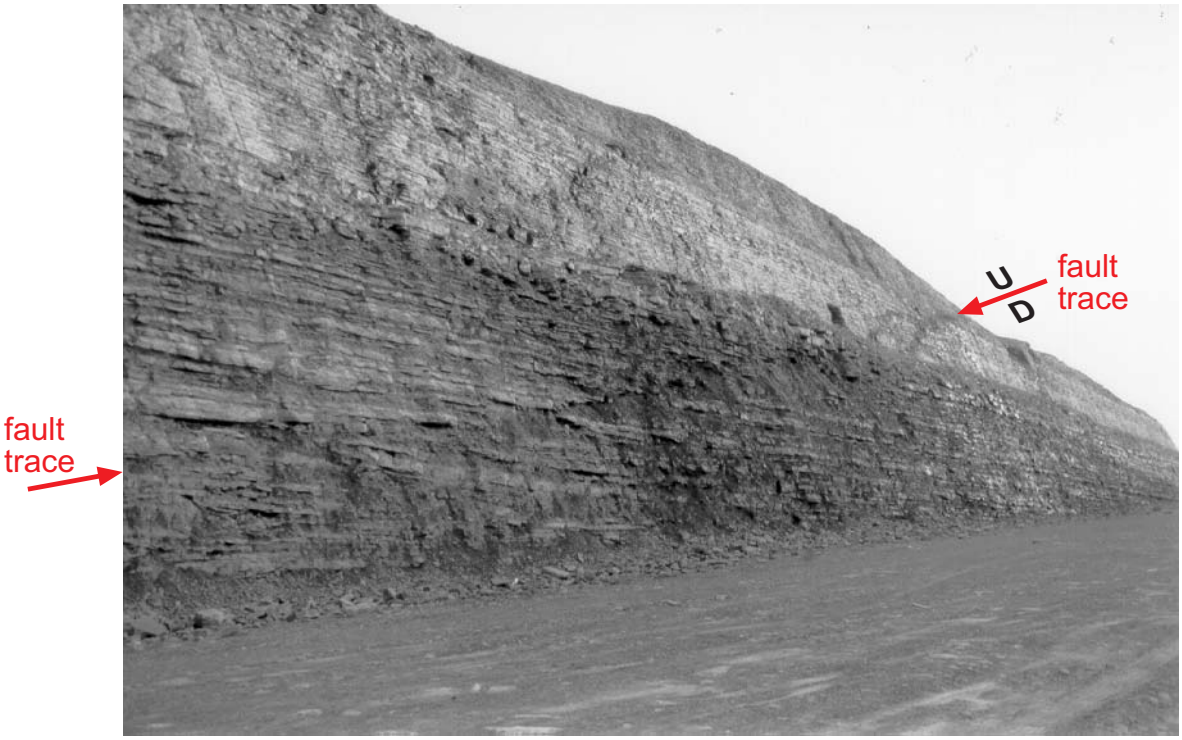


Figure 16. Low-angle fault in the Fairview Formation at mile 2.2 of U.S. 62, Mason County. View is to the south; east wall of roadcut is shown. See Potter and others (2001) for more details.

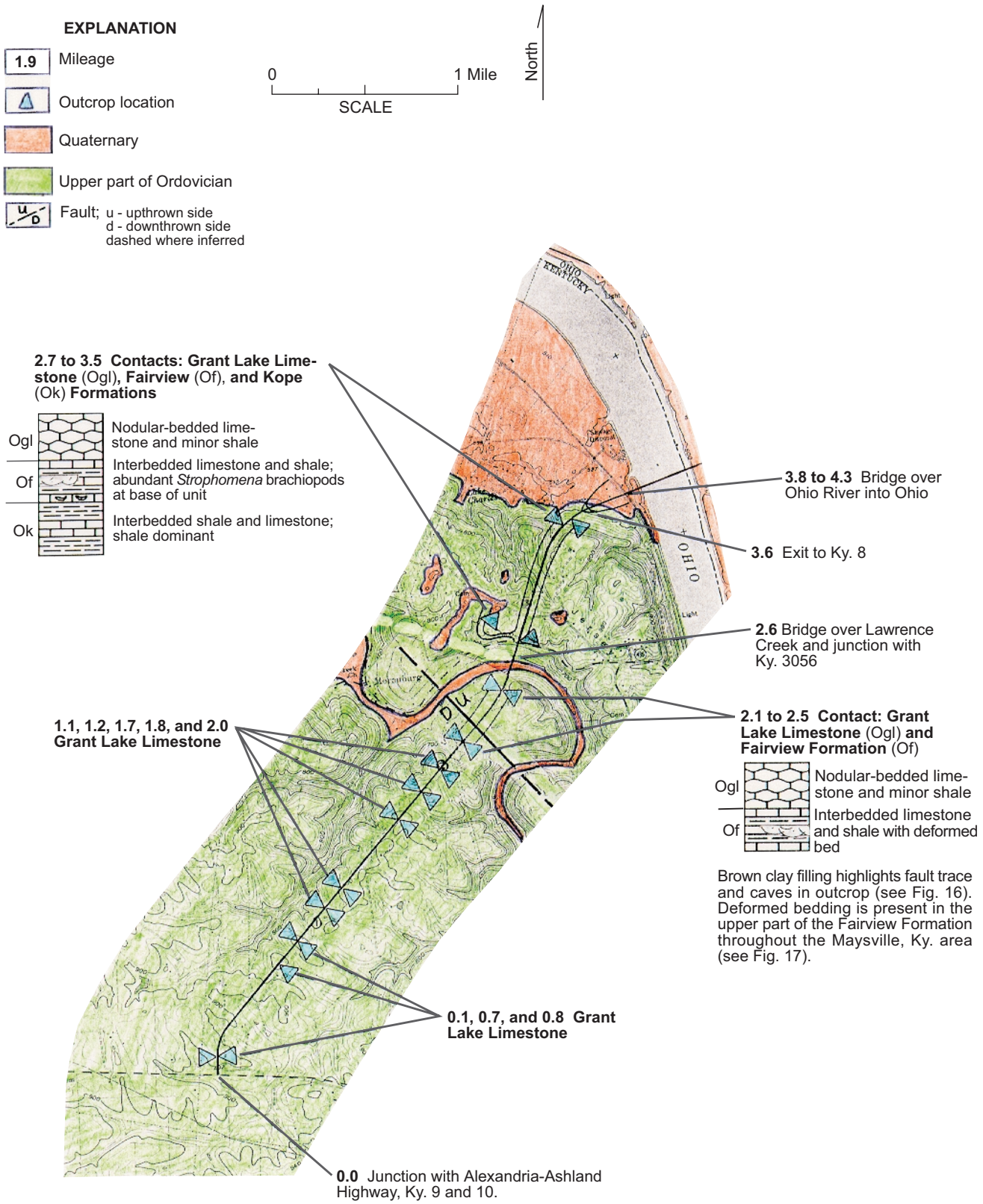
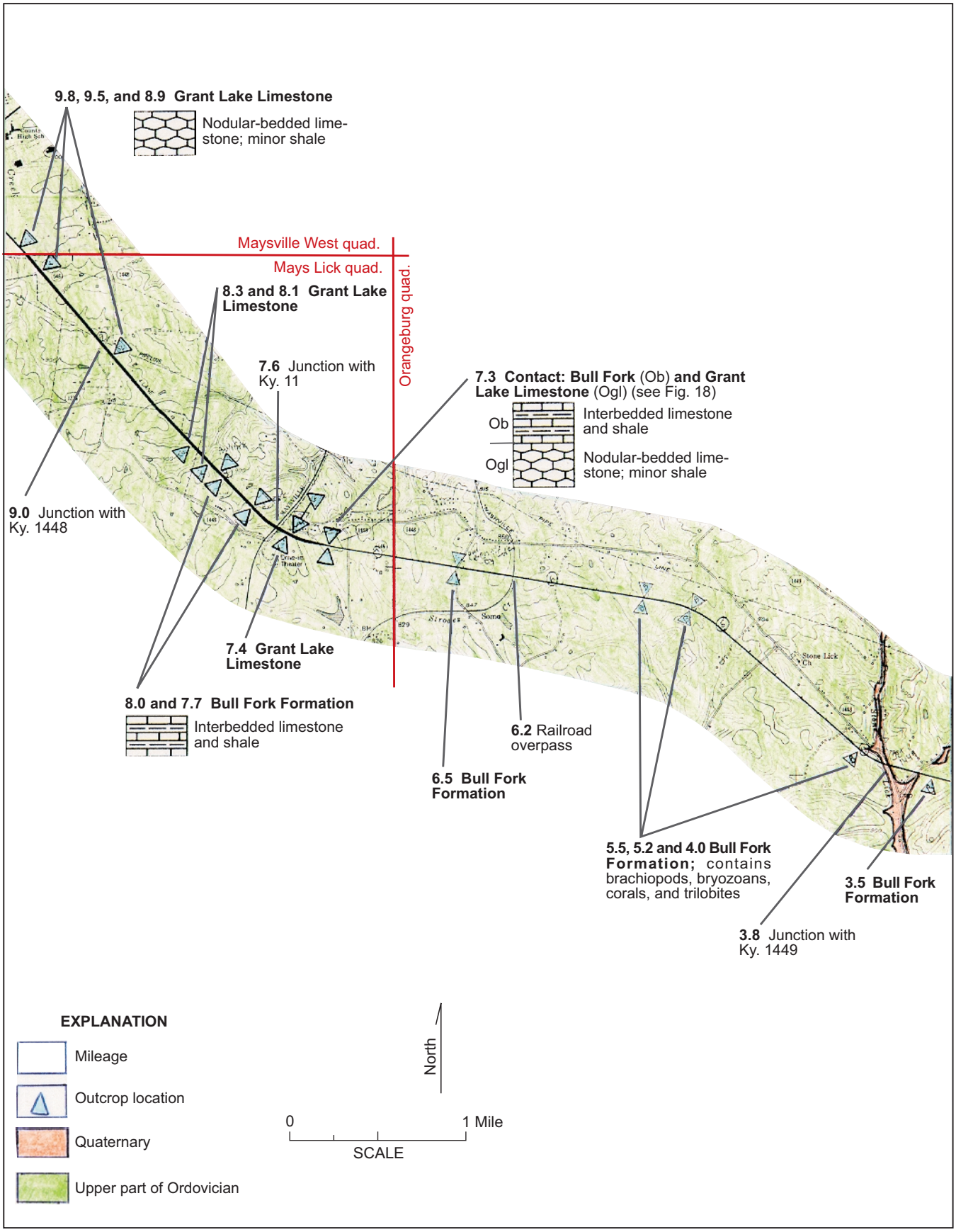
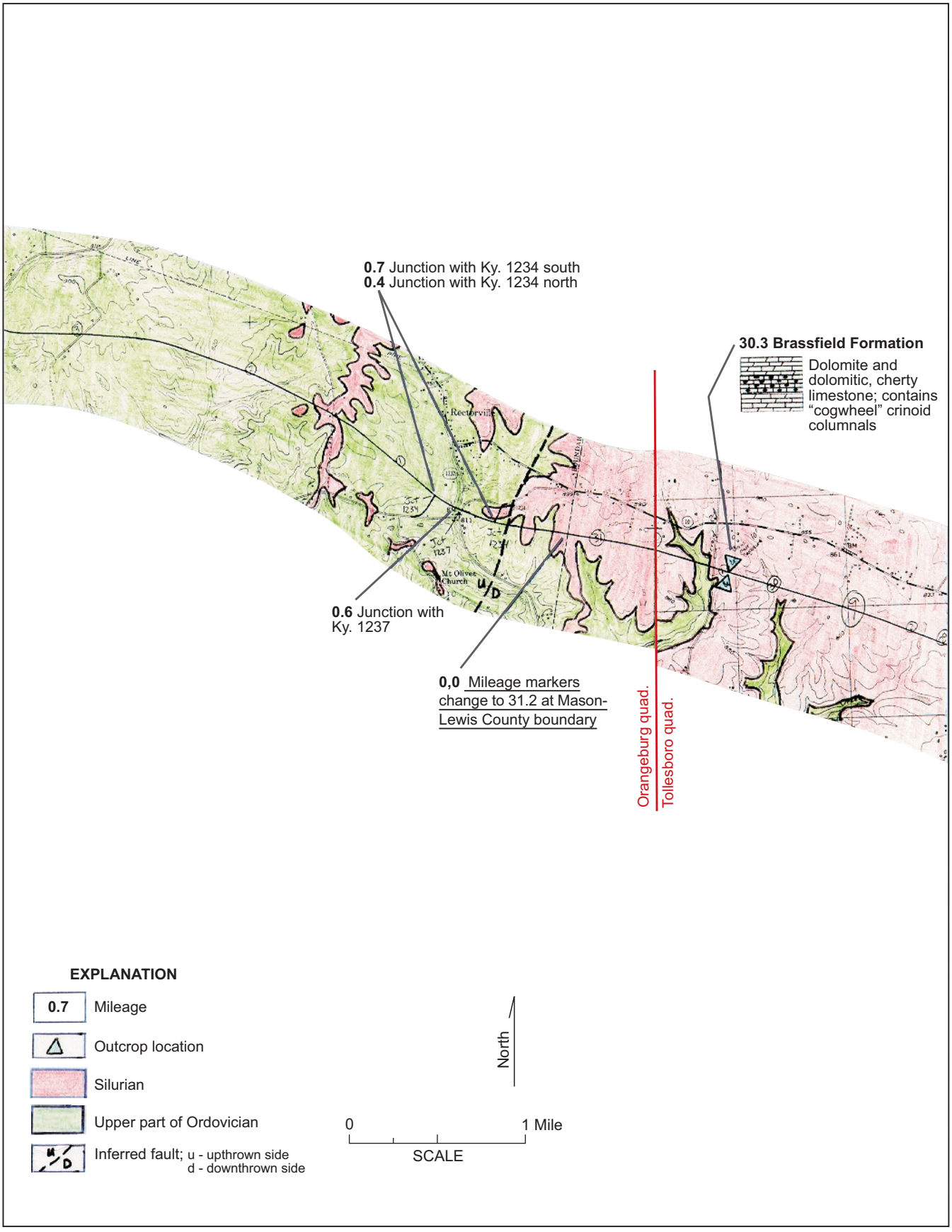
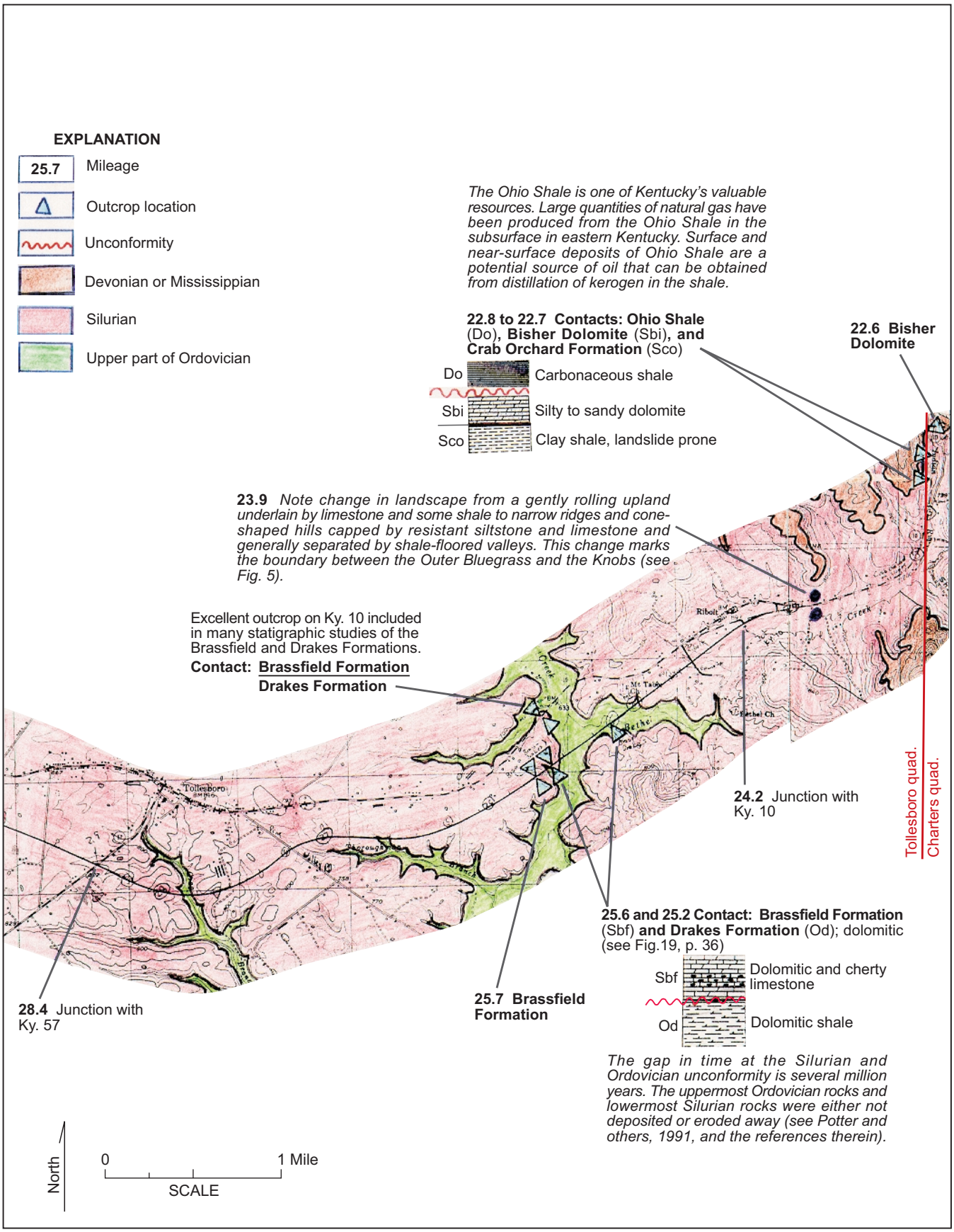

EXPLANATION
1.9 Mileage
Outcrop location
Quaternary
Upper part of Ordovician
Fault; u - upthrown side
d - downthrown side
dashed where inferred
0
1 Mile
SCALE
North
OHIO
KENTUCKY
2.7 to 3.5 Contacts: Grant Lake Limestone (Ogl), Fairview (Of), and Kope (Ok) Formations
Ogl
Nodular-bedded limestone and minor shale
Of
Interbedded limestone and shale; abundant Strophomena brachiopods at base of unit
Ok
Interbedded shale and limestone; shale dominant
3.8 to 4.3 Bridge over Ohio River into Ohio
3.6 Exit to Ky. 8
2.6 Bridge over Lawrence Creek and junction with Ky. 3056
2.1 to 2.5 Contact: Grant Lake Limestone (Ogl) and Fairview Formation (Of)
Ogl
Nodular-bedded limestone and minor shale
Of
Interbedded limestone and shale with deformed bed
Brown clay filling highlights fault trace and caves in outcrop (see Fig. 16). Deformed bedding is present in the upper part of the Fairview Formation throughout the Maysville, Ky. area (see Fig. 17).
1.1, 1.2, 1.7, 1.8, and 2.0 Grant Lake Limestone
0.1, 0.7, and 0.8 Grant Lake Limestone
0.0 Junction with Alexandria-Ashland Highway, Ky. 9 and 10.

Figure 17. Deformed bed in the upper part of the Fairview Formation between miles 2.1 and 2.5 of U.S. 62 in Mason County. Bed is located in west wall of roadcut.

Figure 18. Contact of the Bull Fork Formation and Grant Lake Limestone on the north side of the AA Highway at mile 7.3, Mason County.


9.8, 9.5, and 8.9 Grant Lake Limestone
Nodular-bedded limestone; minor shale
Maysville West quad.
Mays Lick quad.
Orangeburg quad.
8.3 and 8.1 Grant Lake Limestone
7.6 Junction with Ky. 11
7.3 Contact: Bull Fork (Ob) and Grant Lake Limestone (Ogl) (see Fig. 18)
Ob
Interbedded limestone and shale
Ogl
Nodular-bedded limestone; minor shale
9.0 Junction with Ky. 1448
7.4 Grant Lake Limestone
8.0 and 7.7 Bull Fork Formation
Interbedded limestone and shale
6.2 Railroad overpass
6.5 Bull Fork Formation
5.5, 5.2 and 4.0 Bull Fork Formation; contains brachiopods, bryozoans, corals, and trilobites
3.5 Bull Fork Formation
3.8 Junction with Ky. 1449
EXPLANATION
Mileage
Outcrop location
Quaternary
Upper part of Ordovician
North
0
1 Mile
SCALE


0.7 Junction with Ky. 1234 south
0.4 Junction with Ky. 1234 north
30.3 Brassfield Formation
Dolomite and dolomitic, cherty limestone; contains "cogwheel" crinoid columnals
Rectorville
Mt Olivet Church
U/D
0.6 Junction with Ky. 1237
0,0 Mileage markers change to 31.2 at Mason-Lewis County boundary
Orangeburg quad.
Tollesboro quad.
EXPLANATION
0.7 Mileage
Outcrop location
Silurian
Upper part of Ordovician
Inferred fault; u - upthrown side
d - downthrown side
North
0
1 Mile
SCALE


EXPLANATION
25.7
Mileage
Outcrop location
Unconformity
Devonian or Mississippian
Silurian
Upper part of Ordovician
The Ohio Shale is one of Kentucky's valuable resources. Large quantities of natural gas have been produced from the Ohio Shale in the subsurface in eastern Kentucky. Surface and near-surface deposits of Ohio Shale are a potential source of oil that can be obtained from distillation of kerogen in the shale.
22.8 to 22.7 Contacts: Ohio Shale (Do), Bisher Dolomite (Sbi), and Crab Orchard Formation (Sco)
Do
Carbonaceous shale
Sbi
Silty to sandy dolomite
Sco
Clay shale, landslide prone
22.6 Bisher Dolomite
23.9 Note change in landscape from a gently rolling upland underlain by limestone and some shale to narrow ridges and cone-shaped hills capped by resistant siltstone and limestone and generally separated by shale-floored valleys. This change marks the boundary between the Outer Bluegrass and the Knobs (see Fig. 5).
Excellent outcrop on Ky. 10 included in many statigraphic studies of the Brassfield and Drakes Formations.
Contact: Brassfield Formation
Drakes Formation
24.2 Junction with Ky. 10
Tollesboro quad.
Charters quad.
25.6 and 25.2 Contact: Brassfield Formation (Sbf) and Drakes Formation (Od); dolomitic (see Fig.19, p. 36)
Sbf
Dolomitic and cherty limestone
Od
Dolomitic shale
25.7 Brassfield Formation
28.4 Junction with Ky. 57
The gap in time at the Silurian and Ordovician unconformity is several million years. The uppermost Ordovician rocks and lowermost Silurian rocks were either not deposited or eroded away (see Potter and others, 1991, and the references therein).
North
0
1 Mile
SCALE

The Ohio Shale (Do) of Late Devonian age unconformably overlies the Bisher Dolomite of Middle Silurian age. The missing Middle and Lower Devonian and Upper Silurian units that are present in the subsurface of eastern Kentucky represent an interval of about 30 million years (see Fig. 3).

NOTE: The Bedford Shale and Berea Sandstone are included in rocks of the Devonian System. Geologic mapping along Ky. 9-10 indicates that these units may be Devonian and/or Mississippian. Exact placement of the boundary between these systems is unknown.

22.5 to 22.2 Contacts: Ohio Shale (Do)**, Bisher Dolomite** (Sbi)**, and Crab Orchard Formation** (Sco); see Fig. 20

Do — Carbonaceous shale with tongues of green shale

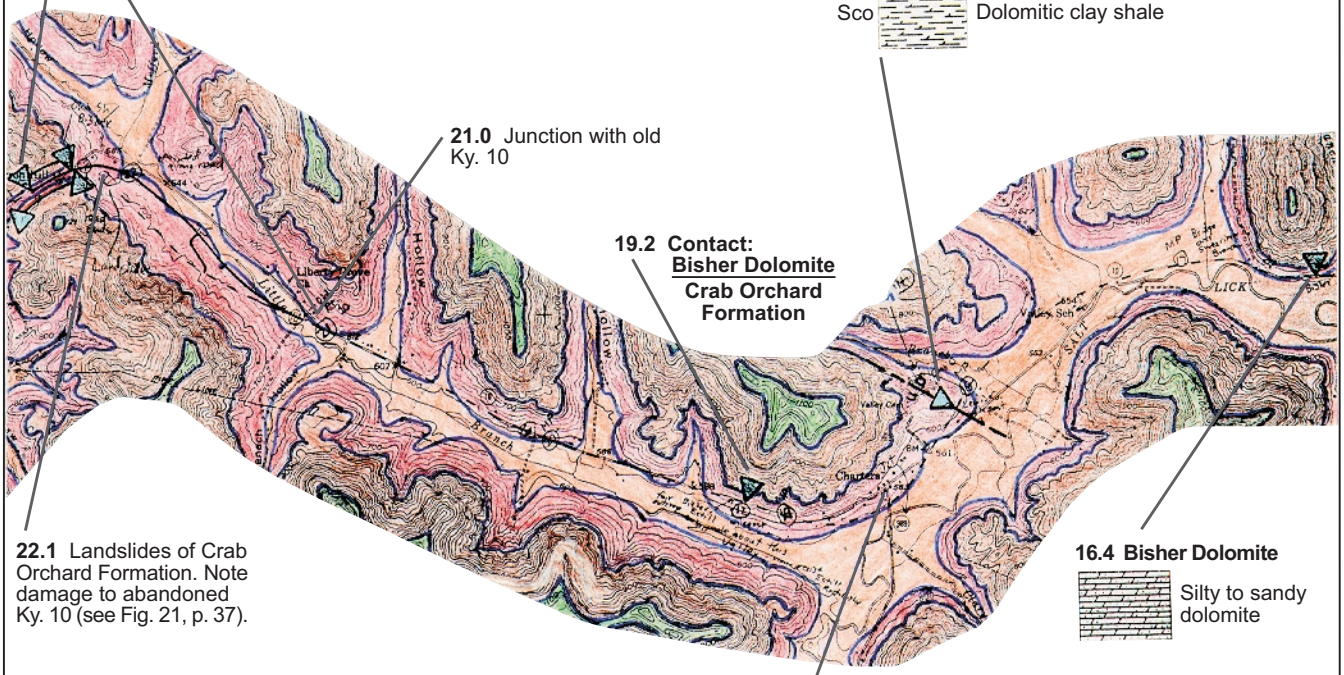
Sbi — Silty to sandy dolomite; contains heavy oil stains

Sco — Clay shale, landslide-prone

18.1 Contact: Bisher Dolomite (Sbi) **and Crab Orchard Formation** (Sco) (see Fig. 22, p. 37)

Sbi — Shaly dolomite

Sco — Dolomitic clay shale



21.0 Junction with old Ky. 10

19.2 Contact: Bisher Dolomite / Crab Orchard Formation

22.1 Landslides of Crab Orchard Formation. Note damage to abandoned Ky. 10 (see Fig. 21, p. 37).

16.4 Bisher Dolomite

Silty to sandy dolomite

18.6 Junction with Ky. 989

EXPLANATION

- **21.0** Mileage
- Outcrop location
- Unconformity
- Fault; u - upthrown side, d - downthrown side
- Quaternary
- Mississippian
- Devonian
- Silurian

North

0 — 1 Mile

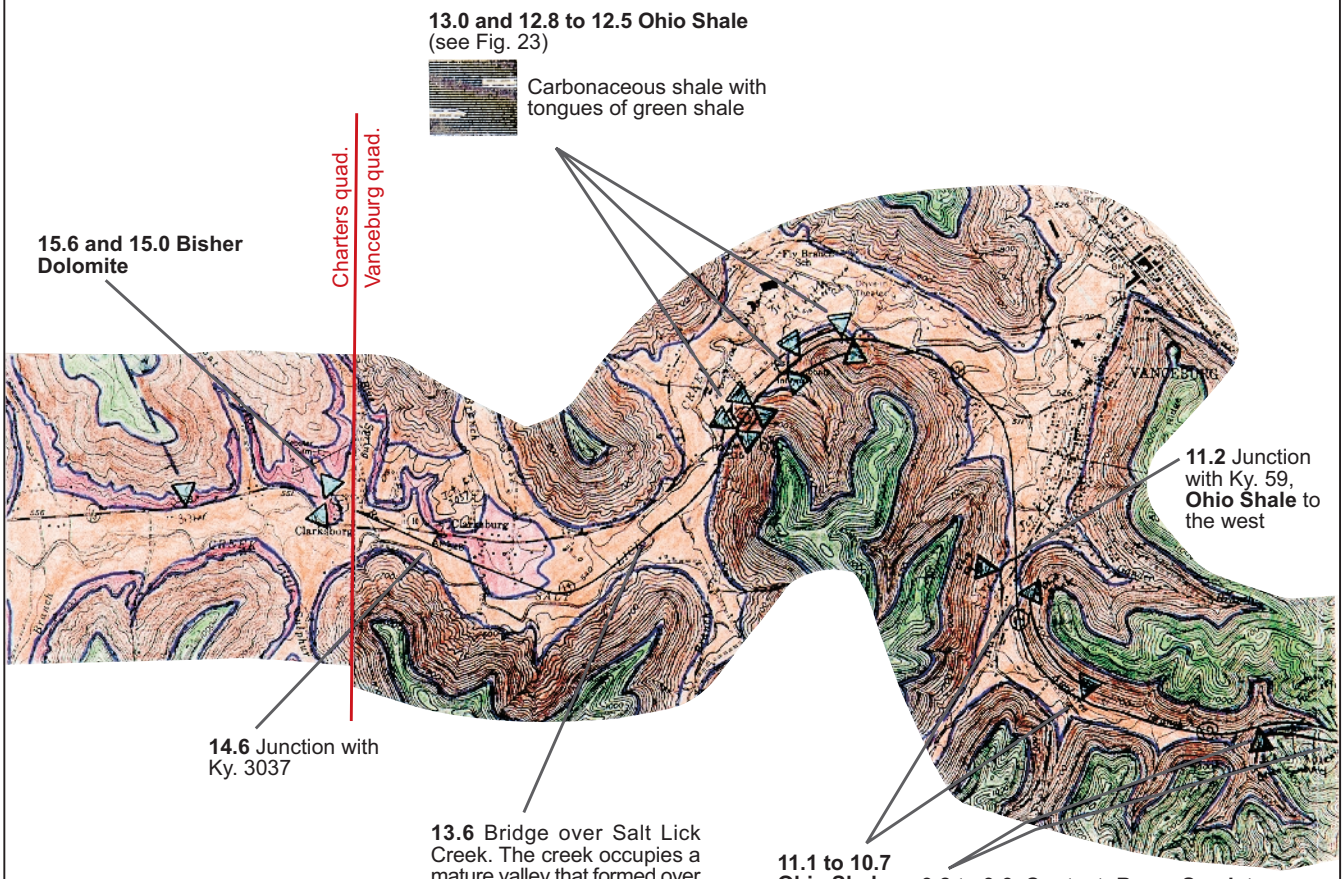
SCALE

Figure 19. Contact of the Brassfield Formation and the Drakes Formation at mile 25.6 of Ky. 9, Lewis County. The Silurian-Ordovician unconformity is present just above the bench in this outcrop.

Figure 20. Contact of the Bisher Dolomite and the Ohio Shale, Herron Hill, miles 22.5 to 22.2 of Ky. 9/10, Lewis County. The Silurian-Devonian unconformity is located at the top of the first bench.

Figure 21. Landslide damage to abandoned Ky. 10, just east of Herron Hill at mile 22.1 of Ky. 9/10, Lewis County. The road was constructed on fill material and colluvium derived from the Crab Orchard Formation. When saturated with water, the fill and colluvium lose strength and slide downslope toward the AA Highway in the background.

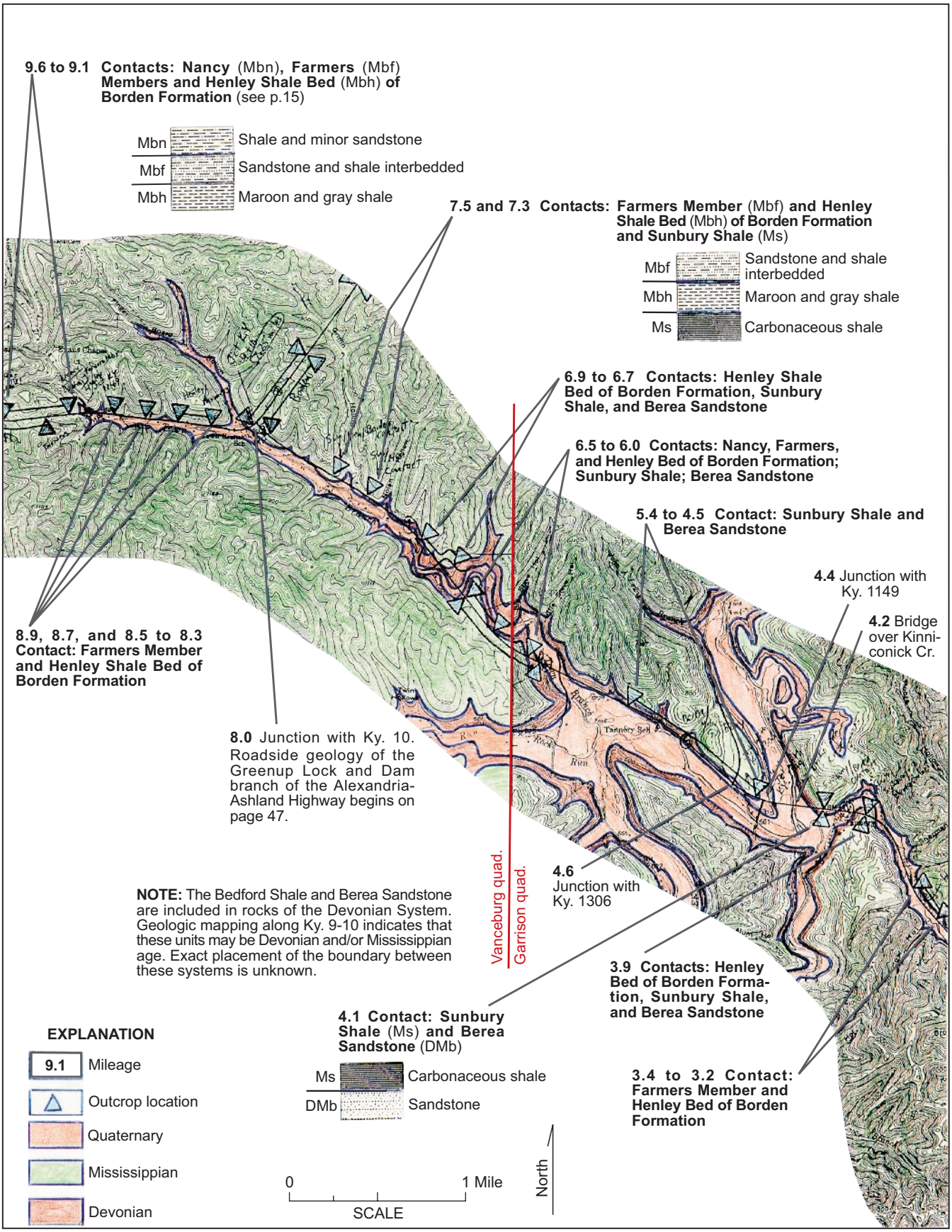
Figure 22. Contact of the Bisher Dolomite and the Crab Orchard Formation at mile 18.1 of Ky. 9/10, Lewis County. A fault is present in the center of this roadcut.

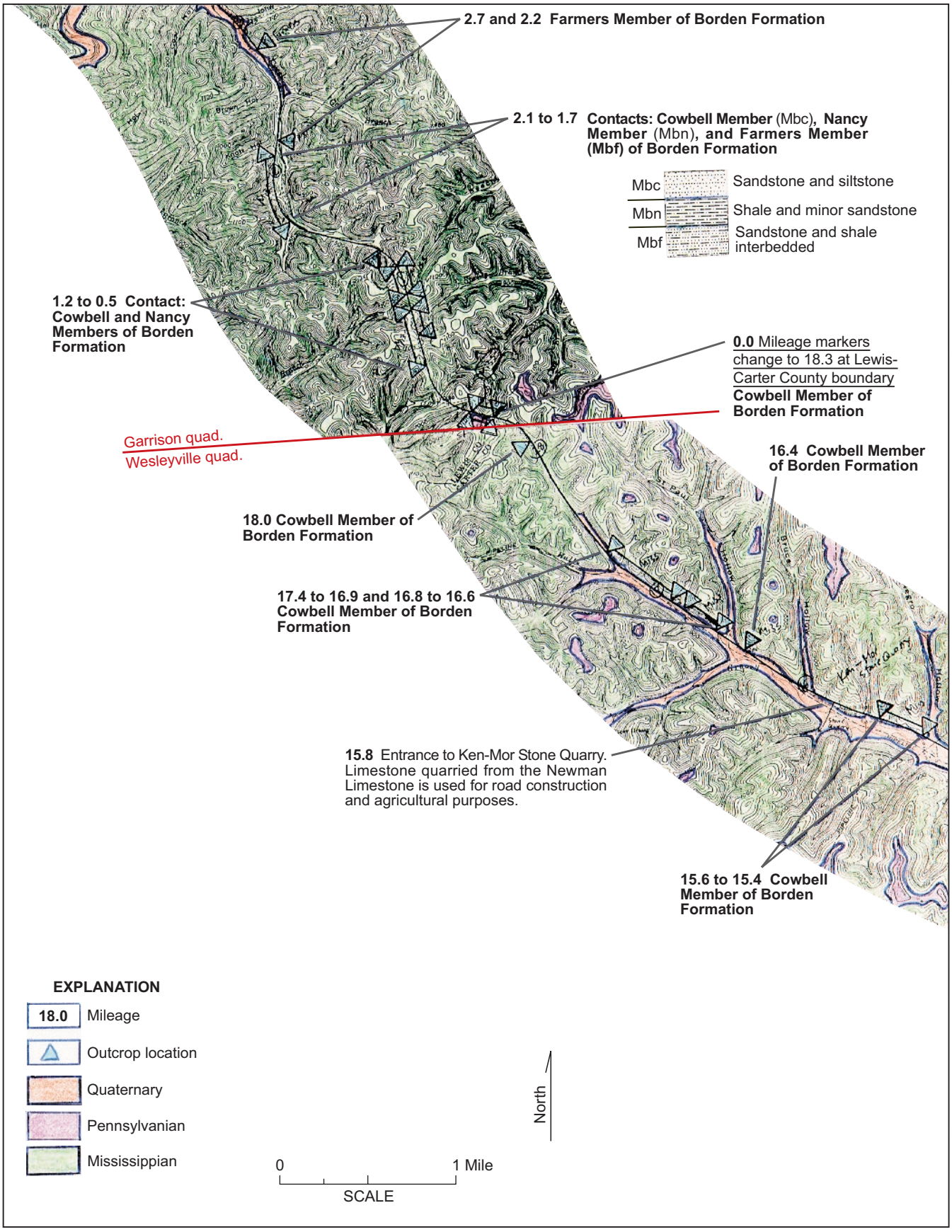


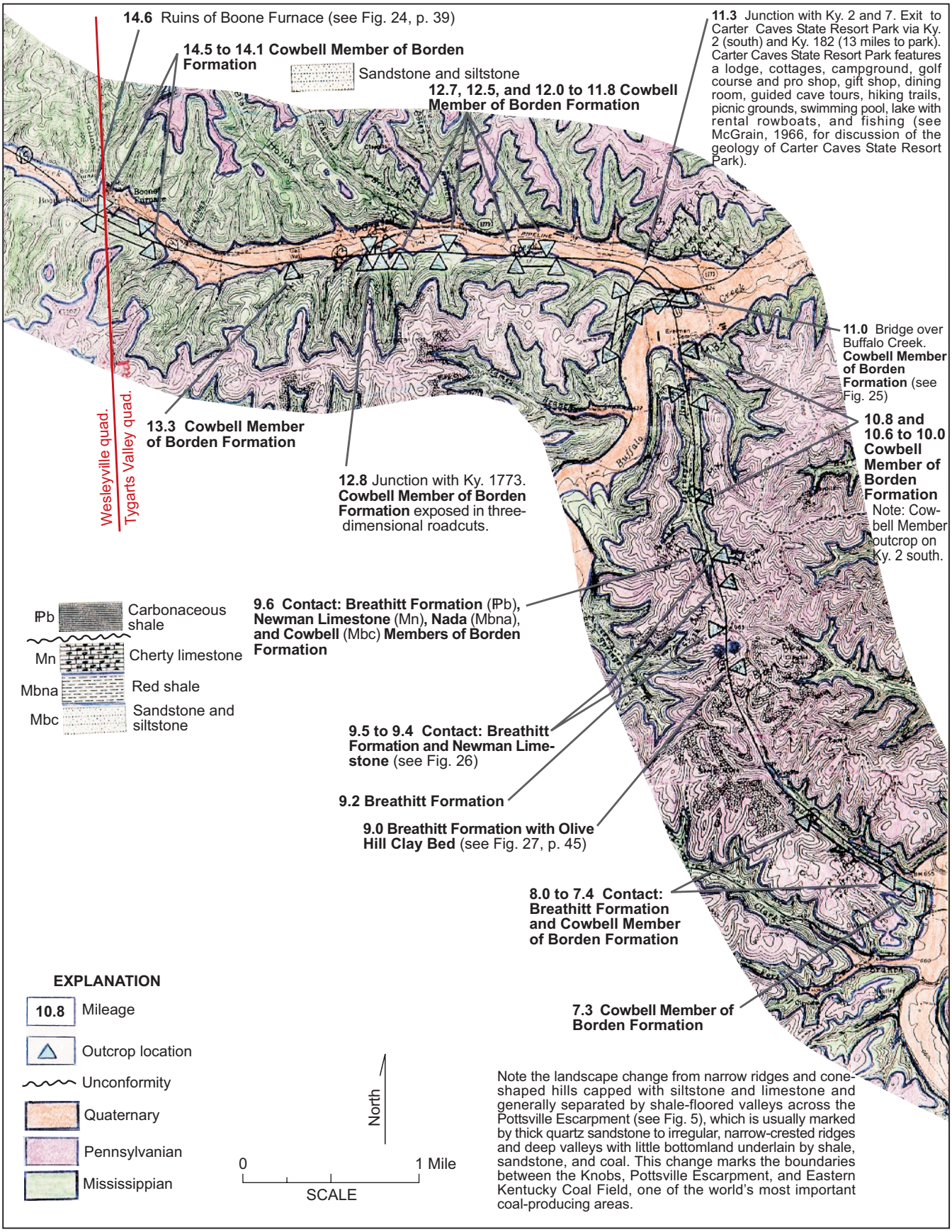
NOTE: The Bedford Shale and Berea Sandstone are included in rocks of the Devonian System. Geologic mapping along Ky. 9-10 indicates that these units may be Devonian and/or Mississippian age. Exact placement of the boundary between these systems is unknown.

Figure 23. Spectacular roadcut exposing much of the Ohio Shale between miles 12.8 and 12.5 of Ky. 9/10, Lewis County. Distinctive thin beds near top are called the Three Lick Bed.

Figure 24. Ruins of the Boone iron furnace at mile 14.6 of Ky. 9, Carter County, north of AA Highway. This furnace, built in 1856, was one of hundreds of charcoal-fired furnaces of the Hanging Rock Iron District of southern Ohio and northeastern Kentucky. Daily consumption of pig iron ranged from 10 to 15 tons, used for the manufacture of railroad equipment. Iron ore used by this furnace was mined from an ore bed of 15 to 24 inches thick within the Slade Formation outcropping on nearby ridgetops.


9.6 to 9.1 Contacts: Nancy (Mbn), Farmers (Mbf) Members and Henley Shale Bed (Mbh) of Borden Formation (see p.15)
Mbn Shale and minor sandstone
Mbf Sandstone and shale interbedded
Mbh Maroon and gray shale
7.5 and 7.3 Contacts: Farmers Member (Mbf) and Henley Shale Bed (Mbh) of Borden Formation and Sunbury Shale (Ms)
Mbf Sandstone and shale interbedded
Mbh Maroon and gray shale
Ms Carbonaceous shale
6.9 to 6.7 Contacts: Henley Shale Bed of Borden Formation, Sunbury Shale, and Berea Sandstone
6.5 to 6.0 Contacts: Nancy, Farmers, and Henley Bed of Borden Formation; Sunbury Shale; Berea Sandstone
5.4 to 4.5 Contact: Sunbury Shale and Berea Sandstone
4.4 Junction with Ky. 1149
4.2 Bridge over Kinniconick Cr.
8.9, 8.7, and 8.5 to 8.3 Contact: Farmers Member and Henley Shale Bed of Borden Formation
8.0 Junction with Ky. 10. Roadside geology of the Greenup Lock and Dam branch of the Alexandria-Ashland Highway begins on page 47.
Vanceburg quad.
Garrison quad.
4.6 Junction with Ky. 1306
NOTE: The Bedford Shale and Berea Sandstone are included in rocks of the Devonian System. Geologic mapping along Ky. 9-10 indicates that these units may be Devonian and/or Mississippian age. Exact placement of the boundary between these systems is unknown.
3.9 Contacts: Henley Bed of Borden Formation, Sunbury Shale, and Berea Sandstone
4.1 Contact: Sunbury Shale (Ms) and Berea Sandstone (DMb)
Ms Carbonaceous shale
DMb Sandstone
3.4 to 3.2 Contact: Farmers Member and Henley Bed of Borden Formation
EXPLANATION
9.1 Mileage
Outcrop location
Quaternary
Mississippian
Devonian
0
1 Mile
SCALE
North


2.7 and 2.2 Farmers Member of Borden Formation
2.1 to 1.7 Contacts: Cowbell Member (Mbc), Nancy Member (Mbn), and Farmers Member (Mbf) of Borden Formation
Mbc
Sandstone and siltstone
Mbn
Shale and minor sandstone
Mbf
Sandstone and shale interbedded
1.2 to 0.5 Contact: Cowbell and Nancy Members of Borden Formation
0.0 Mileage markers change to 18.3 at Lewis-Carter County boundary
Cowbell Member of Borden Formation
Garrison quad.
Wesleyville quad.
16.4 Cowbell Member of Borden Formation
18.0 Cowbell Member of Borden Formation
17.4 to 16.9 and 16.8 to 16.6 Cowbell Member of Borden Formation
15.8 Entrance to Ken-Mor Stone Quarry. Limestone quarried from the Newman Limestone is used for road construction and agricultural purposes.
15.6 to 15.4 Cowbell Member of Borden Formation
EXPLANATION
18.0 Mileage
Outcrop location
Quaternary
Pennsylvanian
Mississippian
North
0
1 Mile
SCALE


14.6 Ruins of Boone Furnace (see Fig. 24, p. 39)
14.5 to 14.1 Cowbell Member of Borden Formation
Sandstone and siltstone
12.7, 12.5, and 12.0 to 11.8 Cowbell Member of Borden Formation
11.3 Junction with Ky. 2 and 7. Exit to Carter Caves State Resort Park via Ky. 2 (south) and Ky. 182 (13 miles to park). Carter Caves State Resort Park features a lodge, cottages, campground, golf course and pro shop, gift shop, dining room, guided cave tours, hiking trails, picnic grounds, swimming pool, lake with rental rowboats, and fishing (see McGrain, 1966, for discussion of the geology of Carter Caves State Resort Park).
11.0 Bridge over Buffalo Creek. Cowbell Member of Borden Formation (see Fig. 25)
10.8 and 10.6 to 10.0 Cowbell Member of Borden Formation Note: Cowbell Member outcrop on Ky. 2 south.
13.3 Cowbell Member of Borden Formation
12.8 Junction with Ky. 1773. Cowbell Member of Borden Formation exposed in three-dimensional roadcuts.
Wesleyville quad.
Tygarts Valley quad.
IPb Carbonaceous shale
Mn Cherty limestone
Mbna Red shale
Mbc Sandstone and siltstone
9.6 Contact: Breathitt Formation (IPb), Newman Limestone (Mn), Nada (Mbna), and Cowbell (Mbc) Members of Borden Formation
9.5 to 9.4 Contact: Breathitt Formation and Newman Limestone (see Fig. 26)
9.2 Breathitt Formation
9.0 Breathitt Formation with Olive Hill Clay Bed (see Fig. 27, p. 45)
8.0 to 7.4 Contact: Breathitt Formation and Cowbell Member of Borden Formation
7.3 Cowbell Member of Borden Formation
EXPLANATION
10.8 Mileage
Outcrop location
Unconformity
Quaternary
Pennsylvanian
Mississippian
North
0
1 Mile
SCALE
Note the landscape change from narrow ridges and cone-shaped hills capped with siltstone and limestone and generally separated by shale-floored valleys across the Pottsville Escarpment (see Fig. 5), which is usually marked by thick quartz sandstone to irregular, narrow-crested ridges and deep valleys with little bottomland underlain by shale, sandstone, and coal. This change marks the boundaries between the Knobs, Pottsville Escarpment, and Eastern Kentucky Coal Field, one of the world's most important coal-producing areas.

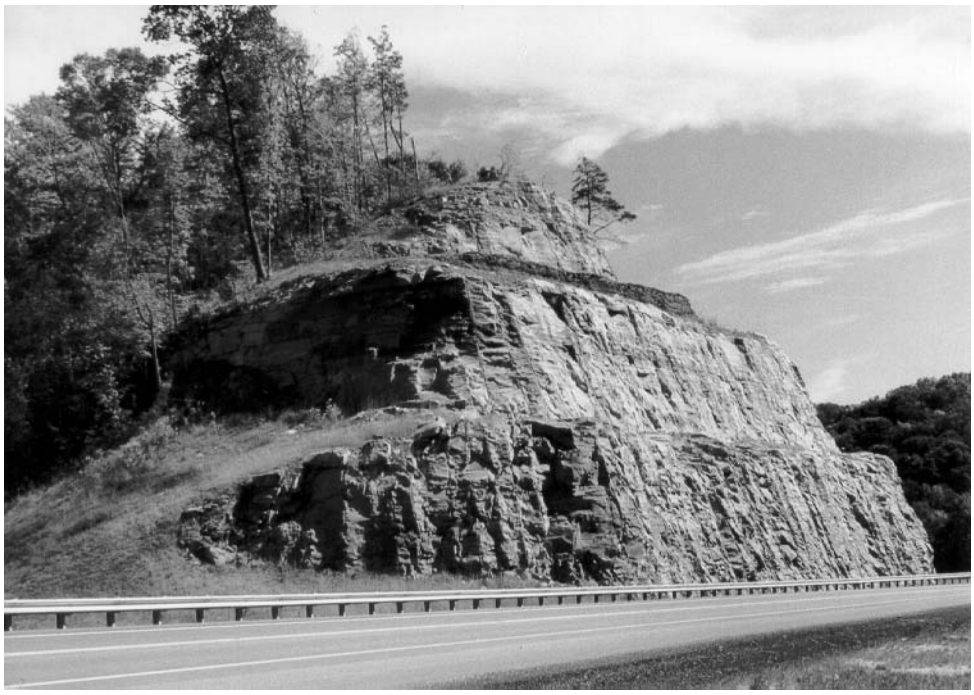


Figure 25. Cowbell Member of the Borden Formation, mile 11.0 of Ky. 9, Carter County.

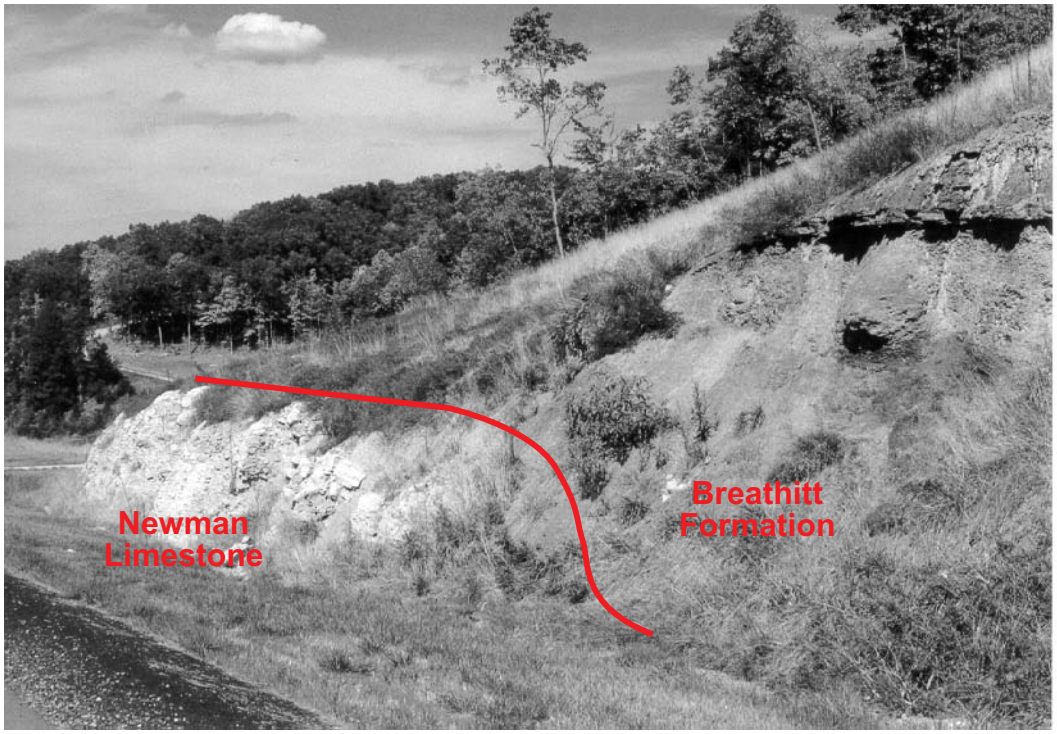


Figure 26. Erosional contact (unconformity) of the Breathitt Formation of Pennsylvanian age and the Newman Limestone of Mississippian age at mile 9.5 of Ky. 9, Carter County.

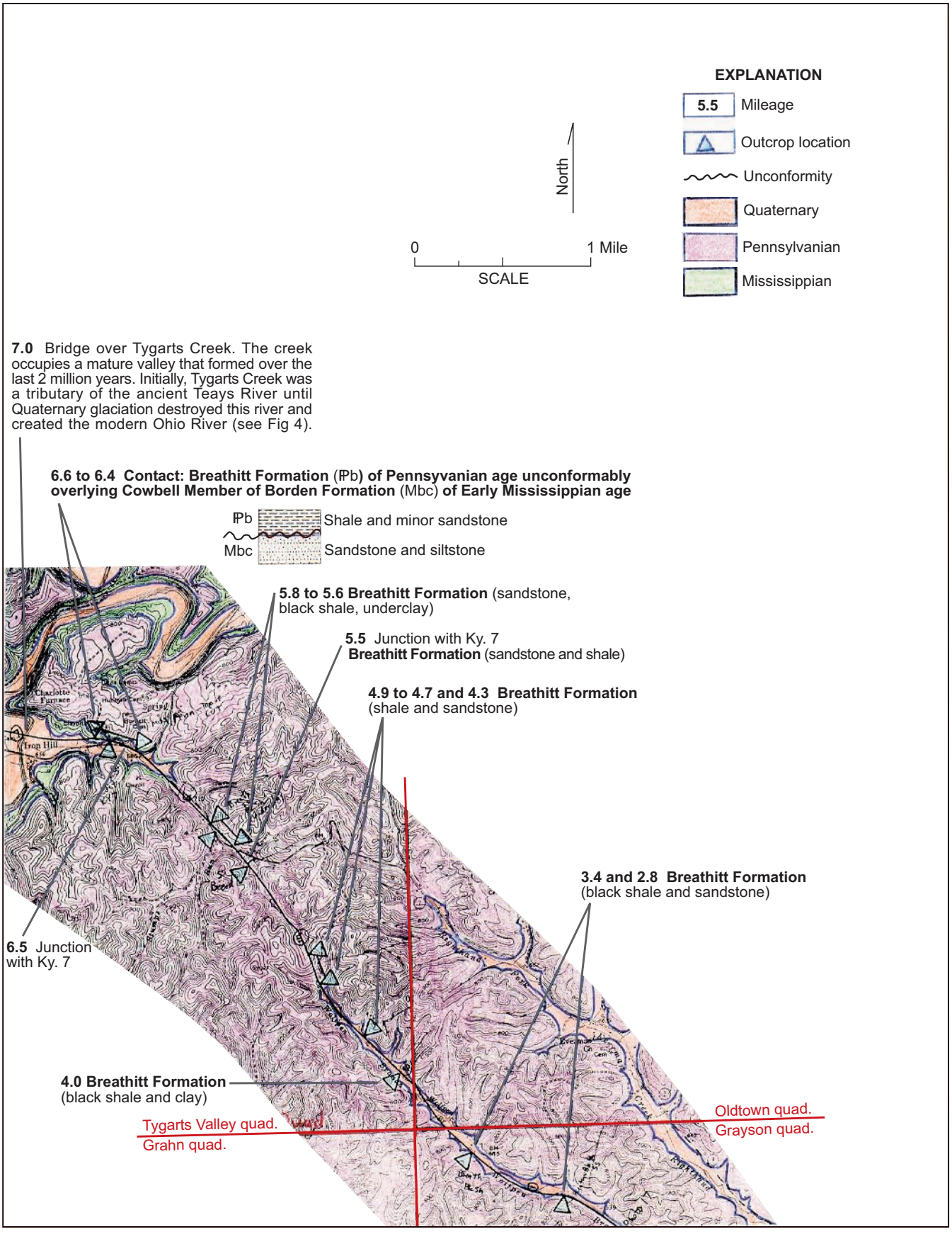
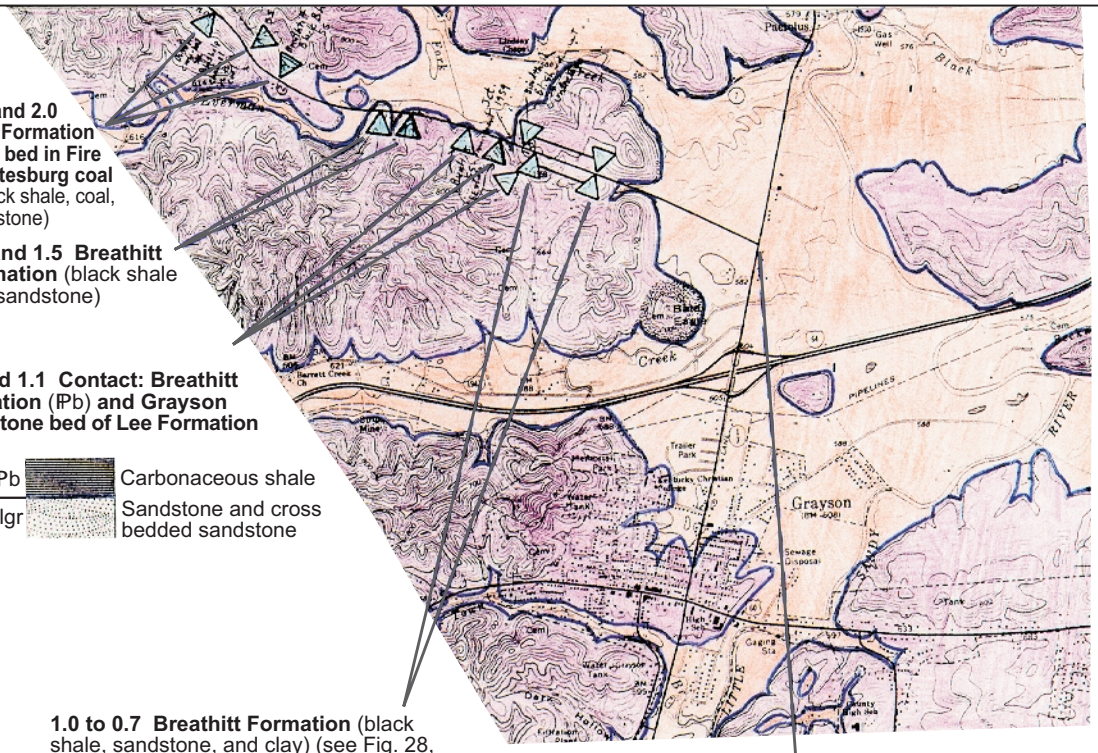

EXPLANATION
5.5 Mileage
Outcrop location
Unconformity
Quaternary
Pennsylvanian
Mississippian
North
0
1 Mile
SCALE
7.0 Bridge over Tygarts Creek. The creek occupies a mature valley that formed over the last 2 million years. Initially, Tygarts Creek was a tributary of the ancient Teays River until Quaternary glaciation destroyed this river and created the modern Ohio River (see Fig 4).
6.6 to 6.4 Contact: Breathitt Formation (Pb) of Pennsyvanian age unconformably overlying Cowbell Member of Borden Formation (Mbc) of Early Mississippian age
Pb
Shale and minor sandstone
Mbc
Sandstone and siltstone
5.8 to 5.6 Breathitt Formation (sandstone, black shale, underclay)
5.5 Junction with Ky. 7
Breathitt Formation (sandstone and shale)
4.9 to 4.7 and 4.3 Breathitt Formation
(shale and sandstone)
3.4 and 2.8 Breathitt Formation
(black shale and sandstone)
6.5 Junction with Ky. 7
4.0 Breathitt Formation
(black shale and clay)
Tygarts Valley quad.
Grahn quad.
Oldtown quad.
Grayson quad.

Figure 27. Olive Hill Clay Bed of the Breathitt Formation, which underlies sandstone fill of an ancient river channel, mile 9.0 of Ky. 9, Carter County. Flint Hill Clay Bed is mined throughout northeastern Kentucky to produce bricks used in high-temperature furnaces.

Figure 28. Angular unconformity between the inclined sandstone beds and the overlying black shale and sandstone of the Breathitt Formation, mile 1.0 of Ky. 9, Carter County.



2.4, 2.2, and 2.0 Breathitt Formation with coal bed in Fire Clay-Whitesburg coal zone (black shale, coal, and sandstone)

1.6 and 1.5 Breathitt Formation (black shale and sandstone)

1.3 and 1.1 Contact: Breathitt Formation (IPb) **and Grayson Sandstone bed of Lee Formation** (IPlgr)

IPb — Carbonaceous shale

IPlgr — Sandstone and cross bedded sandstone

1.0 to 0.7 Breathitt Formation (black shale, sandstone, and clay) (see Fig. 28, p. 45)

0.0 Junction of Ky. 1 and Ky. 9.
End of Alexandria-Ashland Highway. Turn left on North Ky. 1 to Greenbo Lake State Resort Park (17 miles to park). Picturesque lake nestled in the beautiful hills of eastern Kentucky. The park offers 36 lodge rooms, dining room, gift shop, meeting facilities, camping, hiking, fishing, marina with boat rental, bicycle rental, swimming pool, picnic grounds, 18-hole golf course near park, and tennis courts. Turn right on South Ky. 1 to I-64 (½ mile to Interstate).

EXPLANATION

2.0 Mileage

Outcrop location

Quaternary

Pennsylvanian

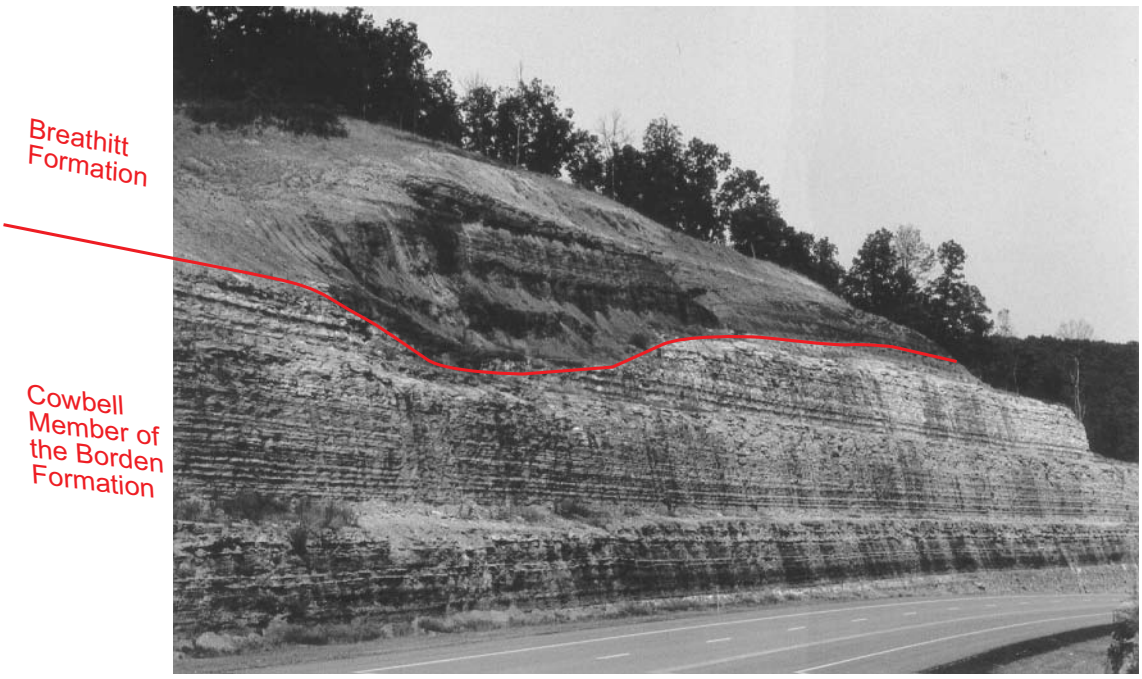
North

0 — 1 Mile

SCALE

ALEXANDRIA TO ASHLAND HIGHWAY:

KENTUCKY 10
From the Intersection of Kentucky 9 and 10
To Greenup Locks and Dam on the Ohio River



Ancient river channel cut into the Mississippian Cowbell Member of the Borden Formation. This channel is filled with shale and sandstone of the Pennsylvanian Breathitt Formation, Greenup County miles 11.0 to 11.3.

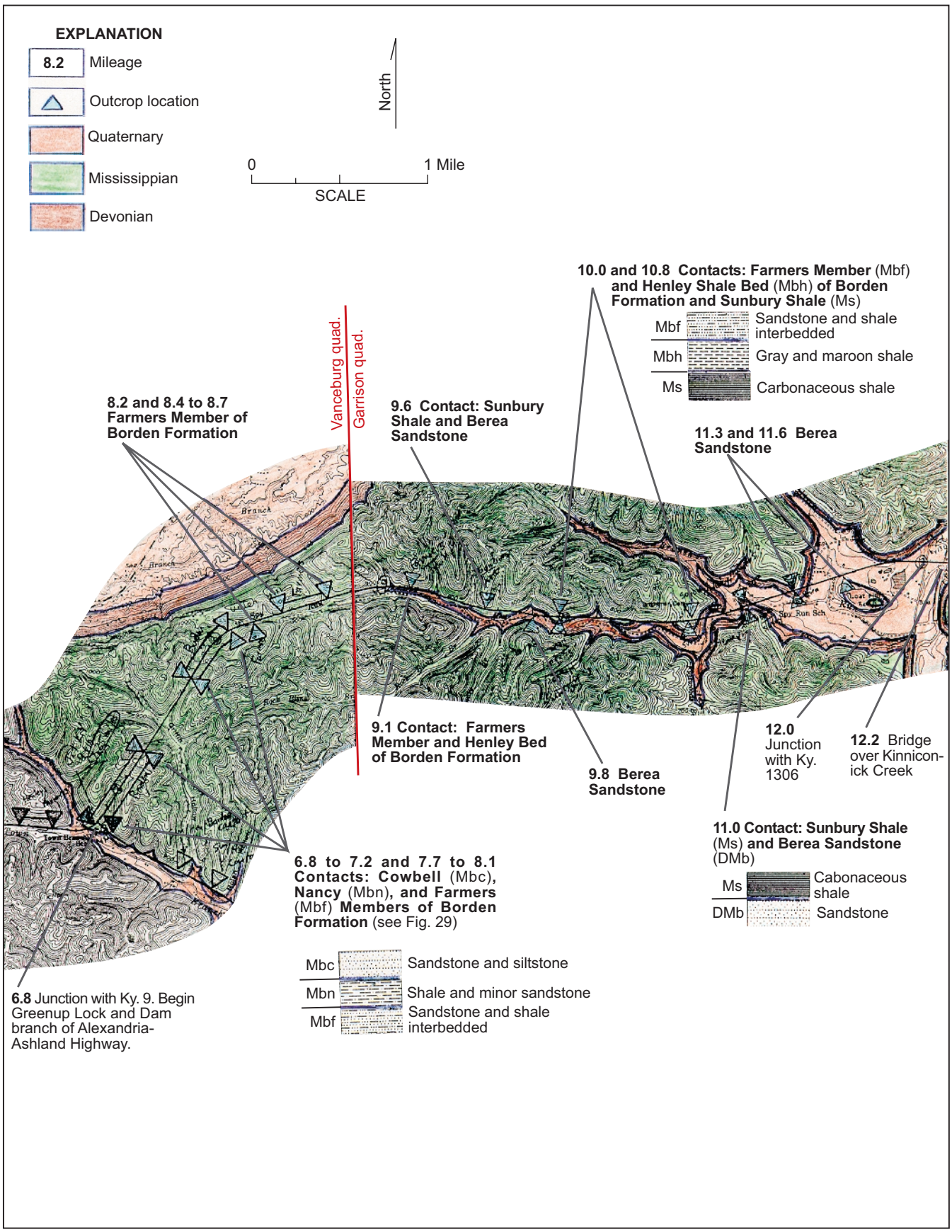

EXPLANATION
8.2 Mileage
Outcrop location
Quaternary
Mississippian
Devonian
North
0
1 Mile
SCALE
10.0 and 10.8 Contacts: Farmers Member (Mbf) and Henley Shale Bed (Mbh) of Borden Formation and Sunbury Shale (Ms)
Mbf Sandstone and shale interbedded
Mbh Gray and maroon shale
Ms Carbonaceous shale
Vanceburg quad.
Garrison quad.
8.2 and 8.4 to 8.7 Farmers Member of Borden Formation
9.6 Contact: Sunbury Shale and Berea Sandstone
11.3 and 11.6 Berea Sandstone
9.1 Contact: Farmers Member and Henley Bed of Borden Formation
9.8 Berea Sandstone
12.0 Junction with Ky. 1306
12.2 Bridge over Kinniconick Creek
11.0 Contact: Sunbury Shale (Ms) and Berea Sandstone (DMb)
Ms Cabonaceous shale
DMb Sandstone
6.8 to 7.2 and 7.7 to 8.1 Contacts: Cowbell (Mbc), Nancy (Mbn), and Farmers (Mbf) Members of Borden Formation (see Fig. 29)
Mbc Sandstone and siltstone
Mbn Shale and minor sandstone
Mbf Sandstone and shale interbedded
6.8 Junction with Ky. 9. Begin Greenup Lock and Dam branch of Alexandria-Ashland Highway.

Figure 29. Farmers, Nancy, and Cowbell Members of the Borden Formation, from miles 7.7 to 8.1 of Ky. 10, Lewis County. Note progressive, stepwise downcutting into the top of the Farmers Member.

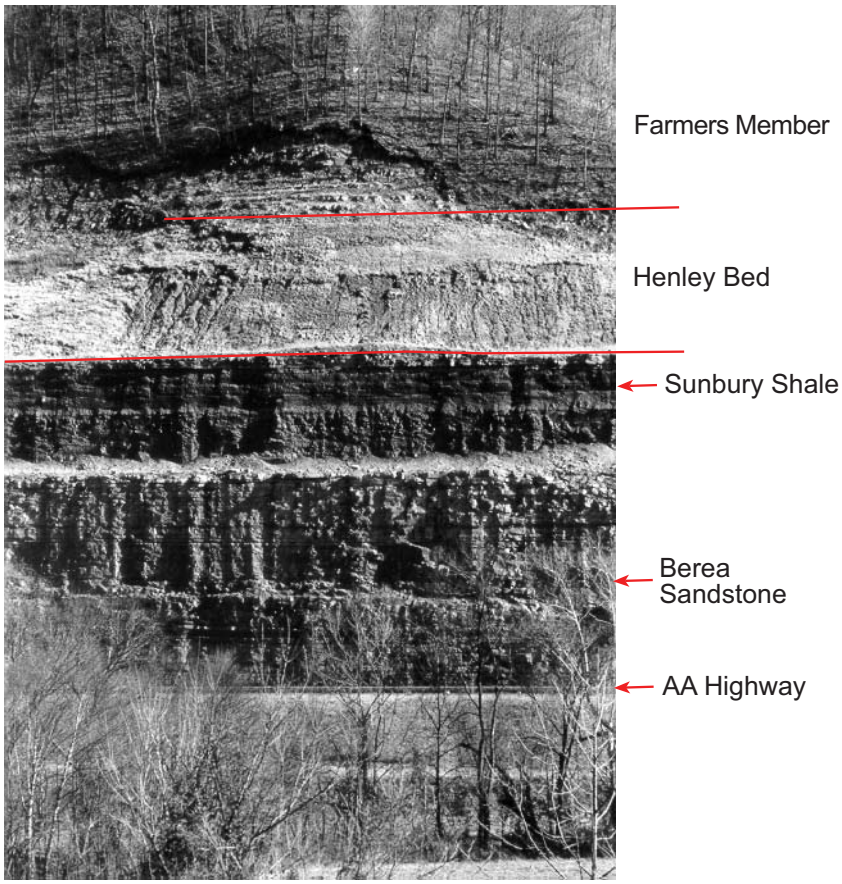
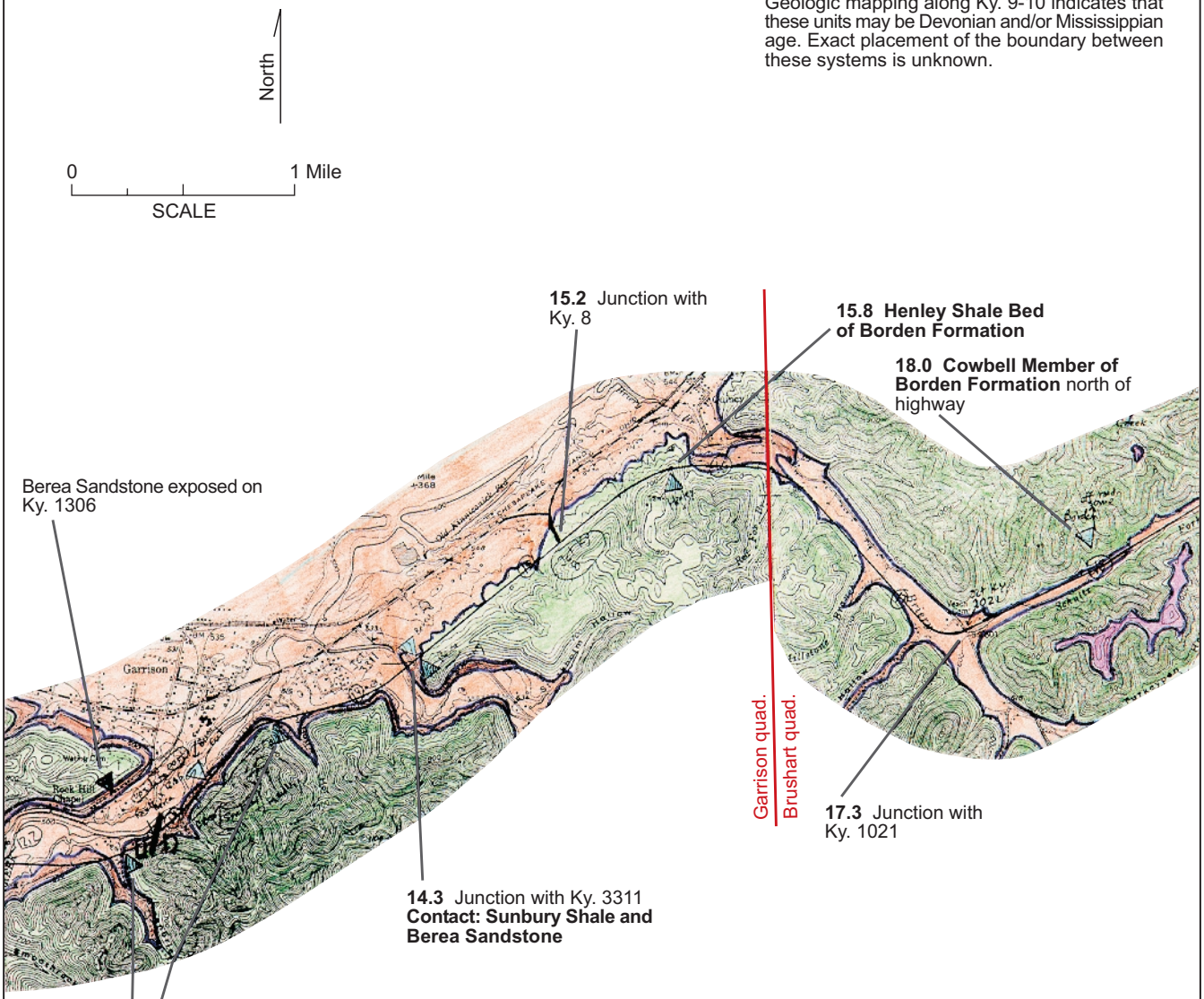
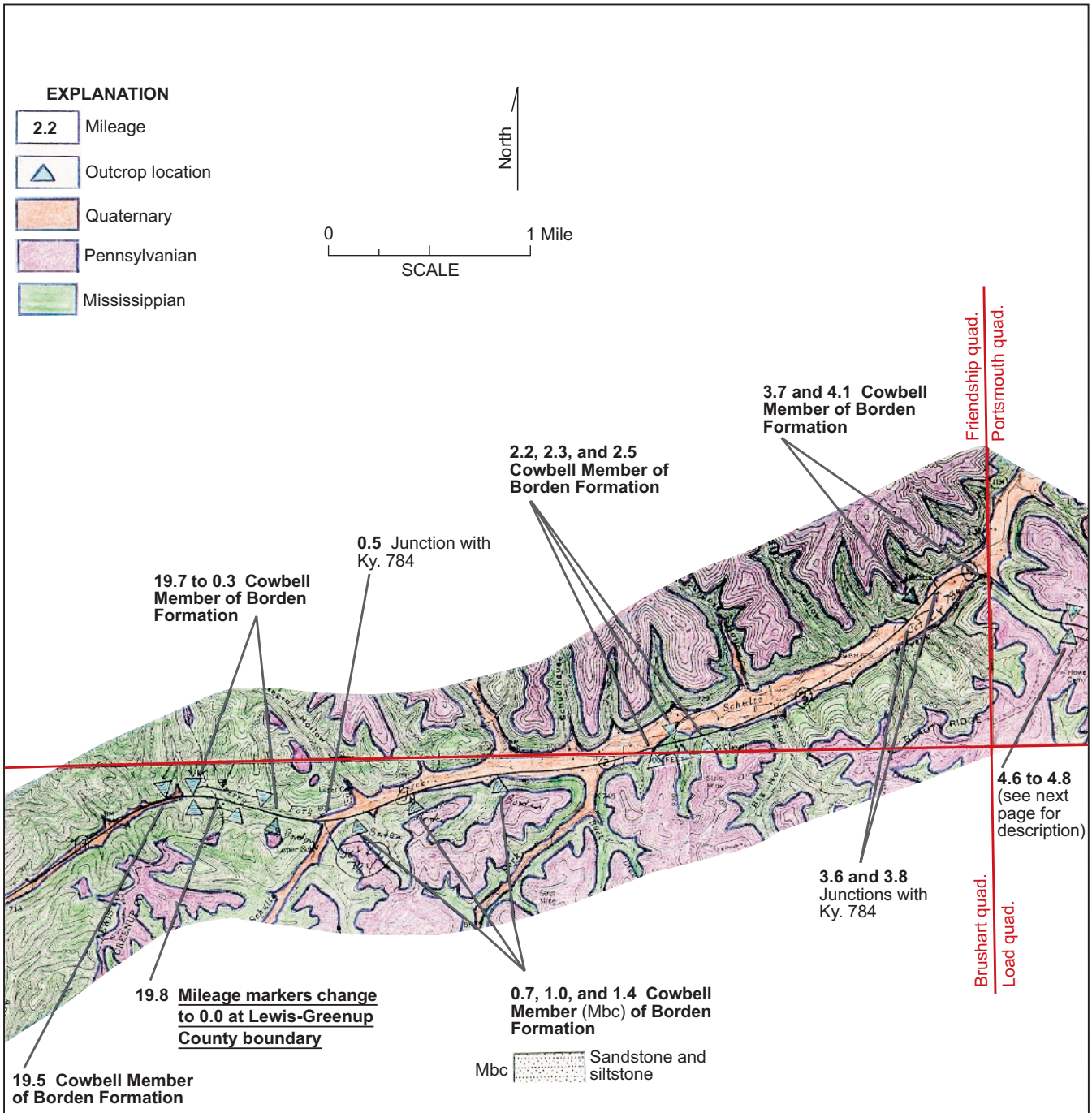


Figure 30. Berea Sandstone, Sunbury Shale, Henley Bed, and Farmers Member of the Borden Formation, from miles 12.7 to 13.6 of Ky. 10, Lewis County.

NOTE: The Bedford Shale and Berea Sandstone are included in rocks of the Devonian System. Geologic mapping along Ky. 9-10 indicates that these units may be Devonian and/or Mississippian age. Exact placement of the boundary between these systems is unknown.




EXPLANATION
2.2 Mileage
Outcrop location
Quaternary
Pennsylvanian
Mississippian
North
0
1 Mile
SCALE
Friendship quad.
Portsmouth quad.
3.7 and 4.1 Cowbell Member of Borden Formation
2.2, 2.3, and 2.5 Cowbell Member of Borden Formation
0.5 Junction with Ky. 784
19.7 to 0.3 Cowbell Member of Borden Formation
4.6 to 4.8 (see next page for description)
3.6 and 3.8 Junctions with Ky. 784
Brushart quad.
Load quad.
19.8 Mileage markers change to 0.0 at Lewis-Greenup County boundary
0.7, 1.0, and 1.4 Cowbell Member (Mbc) of Borden Formation
Mbc
Sandstone and siltstone
19.5 Cowbell Member of Borden Formation

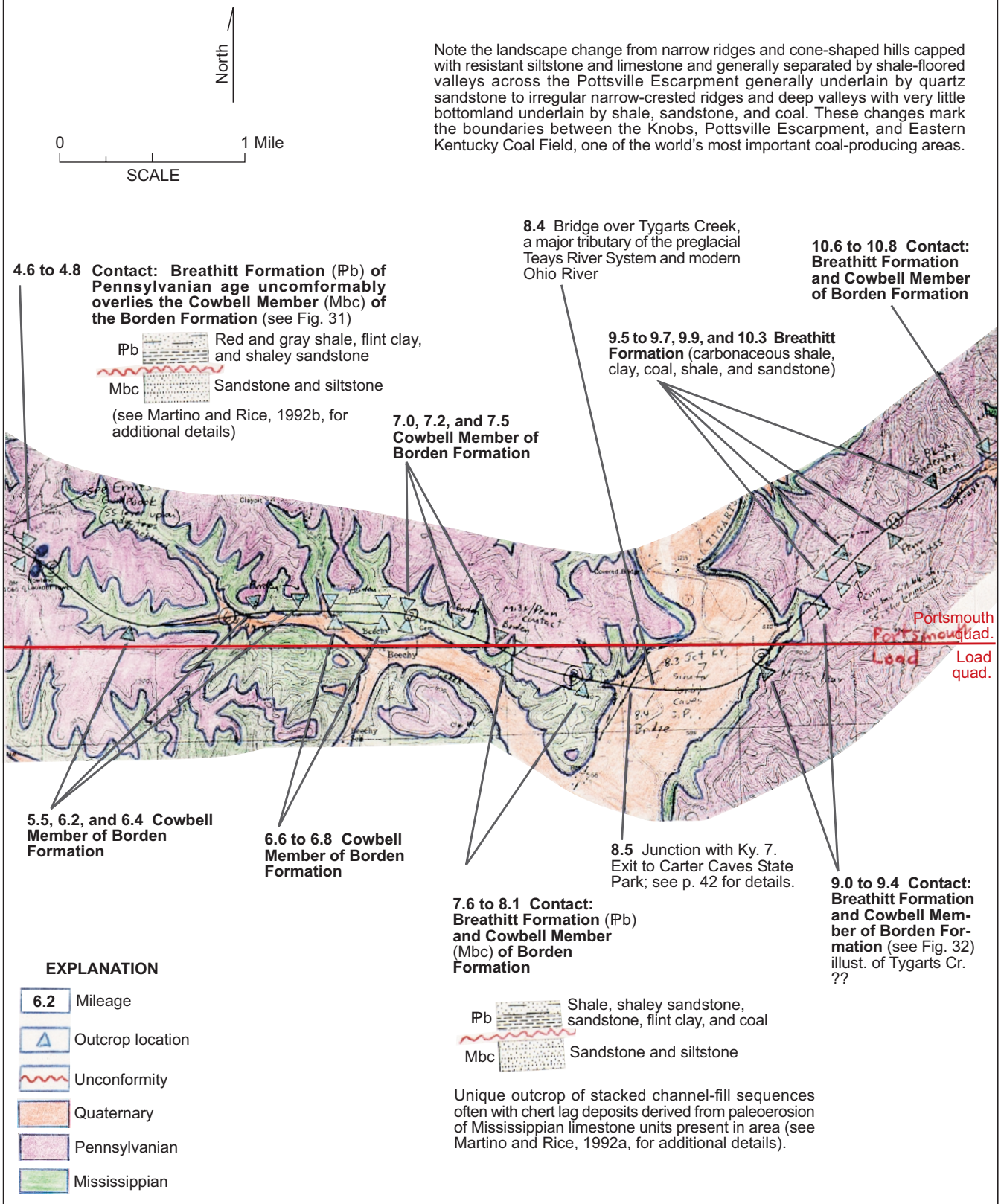

North
0
1 Mile
SCALE
Note the landscape change from narrow ridges and cone-shaped hills capped with resistant siltstone and limestone and generally separated by shale-floored valleys across the Pottsville Escarpment generally underlain by quartz sandstone to irregular narrow-crested ridges and deep valleys with very little bottomland underlain by shale, sandstone, and coal. These changes mark the boundaries between the Knobs, Pottsville Escarpment, and Eastern Kentucky Coal Field, one of the world's most important coal-producing areas.
8.4 Bridge over Tygarts Creek, a major tributary of the preglacial Teays River System and modern Ohio River
10.6 to 10.8 Contact: Breathitt Formation and Cowbell Member of Borden Formation
4.6 to 4.8 Contact: Breathitt Formation (Pb) of Pennsylvanian age uncomformably overlies the Cowbell Member (Mbc) of the Borden Formation (see Fig. 31)
Pb
Red and gray shale, flint clay, and shaley sandstone
Mbc
Sandstone and siltstone
(see Martino and Rice, 1992b, for additional details)
9.5 to 9.7, 9.9, and 10.3 Breathitt Formation (carbonaceous shale, clay, coal, shale, and sandstone)
7.0, 7.2, and 7.5 Cowbell Member of Borden Formation
Portsmouth quad.
Load quad.
5.5, 6.2, and 6.4 Cowbell Member of Borden Formation
6.6 to 6.8 Cowbell Member of Borden Formation
8.5 Junction with Ky. 7. Exit to Carter Caves State Park; see p. 42 for details.
9.0 to 9.4 Contact: Breathitt Formation and Cowbell Member of Borden Formation (see Fig. 32) illust. of Tygarts Cr. ??
7.6 to 8.1 Contact: Breathitt Formation (Pb) and Cowbell Member (Mbc) of Borden Formation
Pb
Shale, shaley sandstone, sandstone, flint clay, and coal
Mbc
Sandstone and siltstone
Unique outcrop of stacked channel-fill sequences often with chert lag deposits derived from paleoerosion of Mississippian limestone units present in area (see Martino and Rice, 1992a, for additional details).
EXPLANATION
6.2 Mileage
Outcrop location
Unconformity
Quaternary
Pennsylvanian
Mississippian

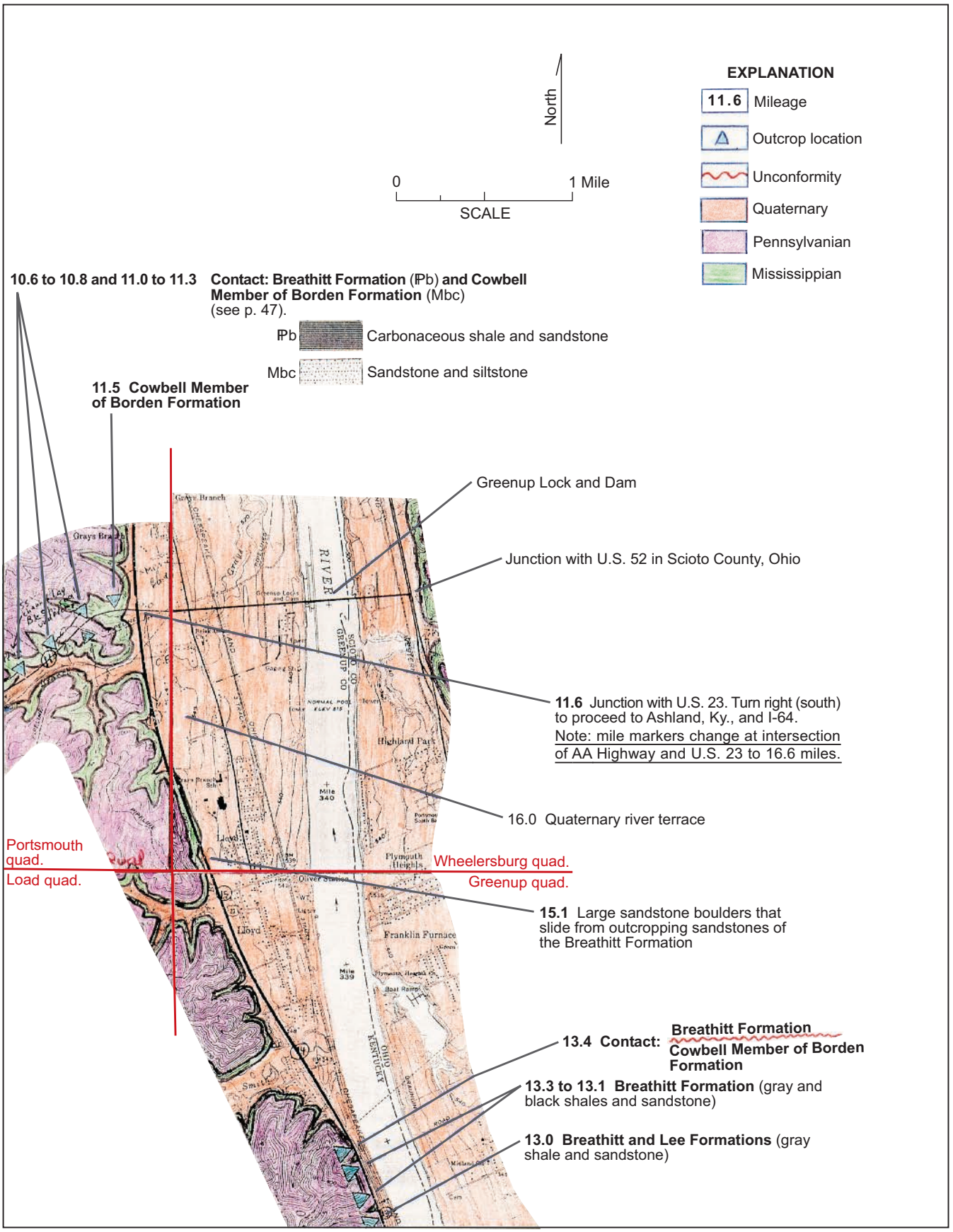
Figure 31. Mississippian–Pennsylvanian systemic boundary in large roadcut between miles 4.6 and 4.8 of Ky. 10, Greenup County. This unique roadcut exposes the entire Olive Hill Clay Bed of the Breathitt Formation (OH), and illustrates over 50 feet of erosion into the Cowbell Member of the Borden Formation by ancient rivers present during the Pennsylvanian Period.

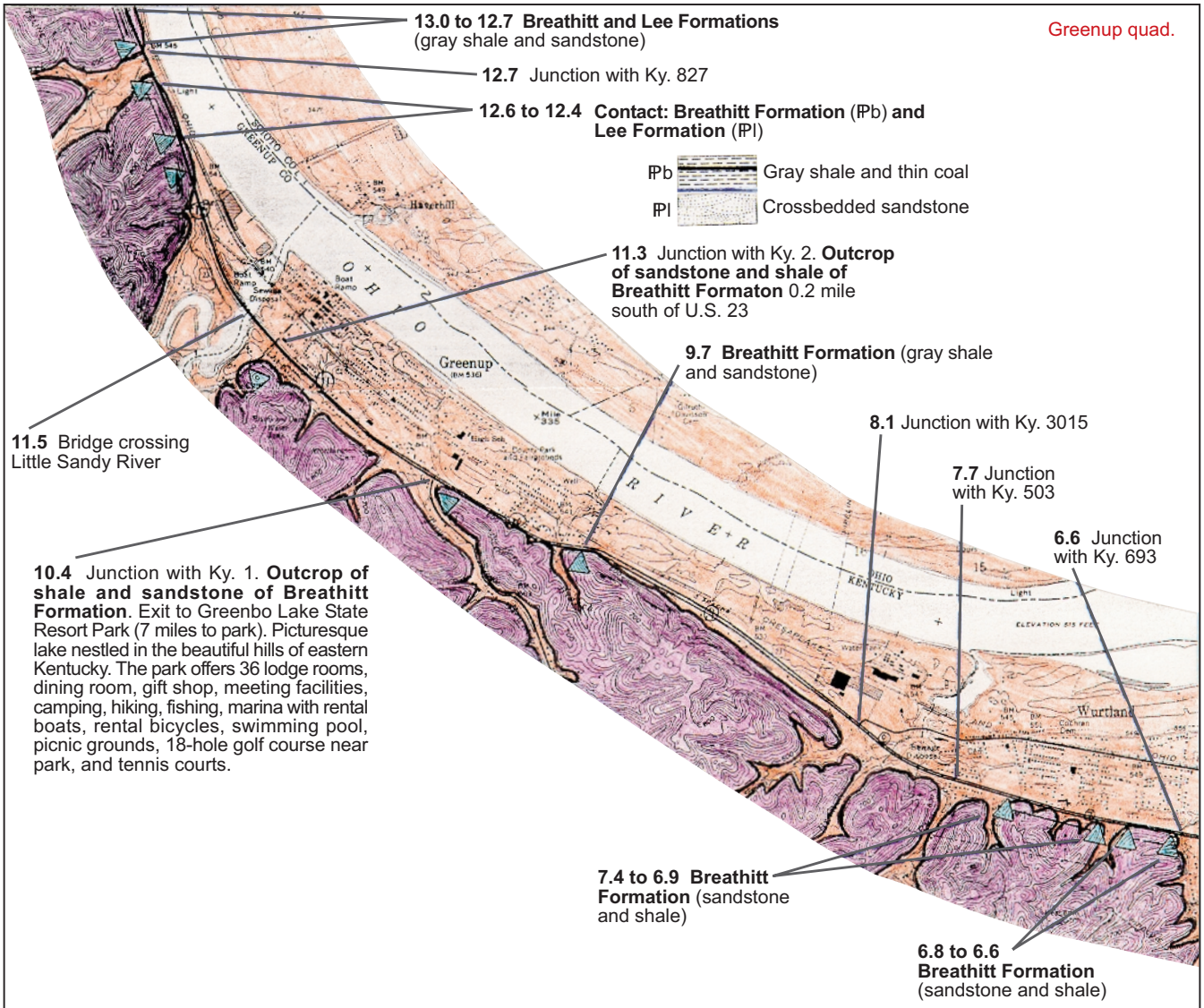
Figure 32. Terrace of modern Tygarts Creek, displaying abandoned meander currently used as a farm pond, mile 9.0 of Ky. 10, Greenup County; view to the north.

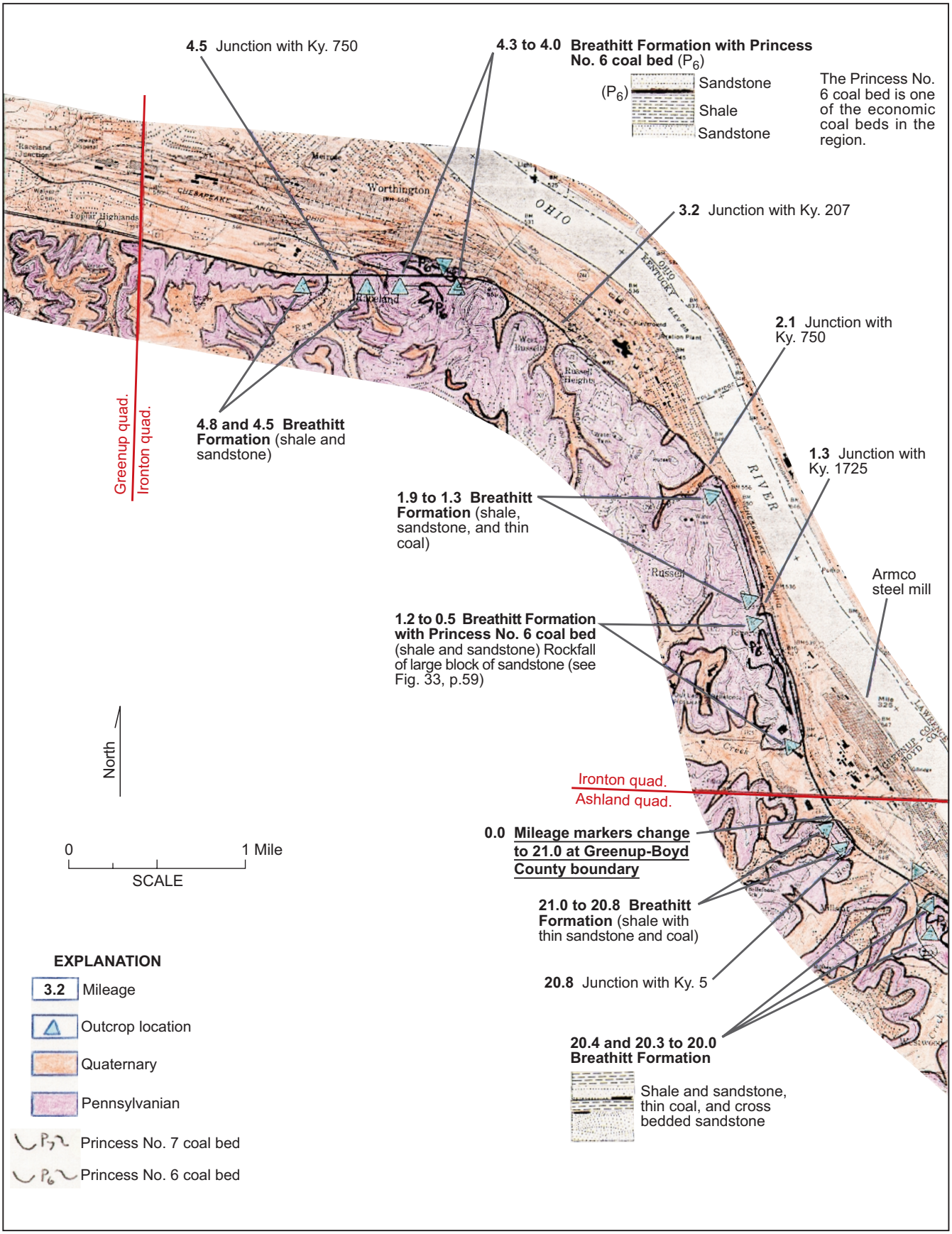
U.S. 23:

From Greenup Locks and Dam
through Ashland, Kentucky,
To Interstate 64

Breathitt Formation between Boyd County miles 19.9 and 19.6.


North
0
1 Mile
SCALE
EXPLANATION
11.6 Mileage
Outcrop location
Unconformity
Quaternary
Pennsylvanian
Mississippian
10.6 to 10.8 and 11.0 to 11.3 Contact: Breathitt Formation (Pb) and Cowbell Member of Borden Formation (Mbc) (see p. 47).
Pb Carbonaceous shale and sandstone
Mbc Sandstone and siltstone
11.5 Cowbell Member of Borden Formation
Greenup Lock and Dam
Junction with U.S. 52 in Scioto County, Ohio
11.6 Junction with U.S. 23. Turn right (south) to proceed to Ashland, Ky., and I-64.
Note: mile markers change at intersection of AA Highway and U.S. 23 to 16.6 miles.
16.0 Quaternary river terrace
Portsmouth quad.
Load quad.
Wheelersburg quad.
Greenup quad.
15.1 Large sandstone boulders that slide from outcropping sandstones of the Breathitt Formation
13.4 Contact: Breathitt Formation / Cowbell Member of Borden Formation
13.3 to 13.1 Breathitt Formation (gray and black shales and sandstone)
13.0 Breathitt and Lee Formations (gray shale and sandstone)
Grays Branch
RIVER
SCIOTO CO
GREENUP CO
Highland Park
Mile 340
Mile 339
Lloyd
Plymouth (Heights)
Franklin Furnace
OHIO
KENTUCKY


Greenup quad.
13.0 to 12.7 Breathitt and Lee Formations (gray shale and sandstone)
12.7 Junction with Ky. 827
12.6 to 12.4 Contact: Breathitt Formation (Pb) and Lee Formation (Pl)
Pb Gray shale and thin coal
Pl Crossbedded sandstone
11.3 Junction with Ky. 2. Outcrop of sandstone and shale of Breathitt Formaton 0.2 mile south of U.S. 23
9.7 Breathitt Formation (gray shale and sandstone)
11.5 Bridge crossing Little Sandy River
8.1 Junction with Ky. 3015
7.7 Junction with Ky. 503
6.6 Junction with Ky. 693
10.4 Junction with Ky. 1. Outcrop of shale and sandstone of Breathitt Formation. Exit to Greenbo Lake State Resort Park (7 miles to park). Picturesque lake nestled in the beautiful hills of eastern Kentucky. The park offers 36 lodge rooms, dining room, gift shop, meeting facilities, camping, hiking, fishing, marina with rental boats, rental bicycles, swimming pool, picnic grounds, 18-hole golf course near park, and tennis courts.
7.4 to 6.9 Breathitt Formation (sandstone and shale)
6.8 to 6.6 Breathitt Formation (sandstone and shale)
Greenup
Wurtland
OHIO
KENTUCKY
RIVER
EXPLANATION
11.3 Mileage
Outcrop location
Quaternary
Pennsylvanian
North
0
1 Mile
SCALE


4.5 Junction with Ky. 750
4.3 to 4.0 Breathitt Formation with Princess No. 6 coal bed (P_6)
(P_6)
Sandstone
Shale
Sandstone
The Princess No. 6 coal bed is one of the economic coal beds in the region.
3.2 Junction with Ky. 207
2.1 Junction with Ky. 750
1.3 Junction with Ky. 1725
Armco steel mill
Greenup quad.
Ironton quad.
4.8 and 4.5 Breathitt Formation (shale and sandstone)
1.9 to 1.3 Breathitt Formation (shale, sandstone, and thin coal)
1.2 to 0.5 Breathitt Formation with Princess No. 6 coal bed (shale and sandstone) Rockfall of large block of sandstone (see Fig. 33, p.59)
Ironton quad.
Ashland quad.
0.0 Mileage markers change to 21.0 at Greenup-Boyd County boundary
21.0 to 20.8 Breathitt Formation (shale with thin sandstone and coal)
20.8 Junction with Ky. 5
20.4 and 20.3 to 20.0 Breathitt Formation
Shale and sandstone, thin coal, and cross bedded sandstone
North
0
1 Mile
SCALE
EXPLANATION
3.2 Mileage
Outcrop location
Quaternary
Pennsylvanian
P_7 Princess No. 7 coal bed
P_6 Princess No. 6 coal bed

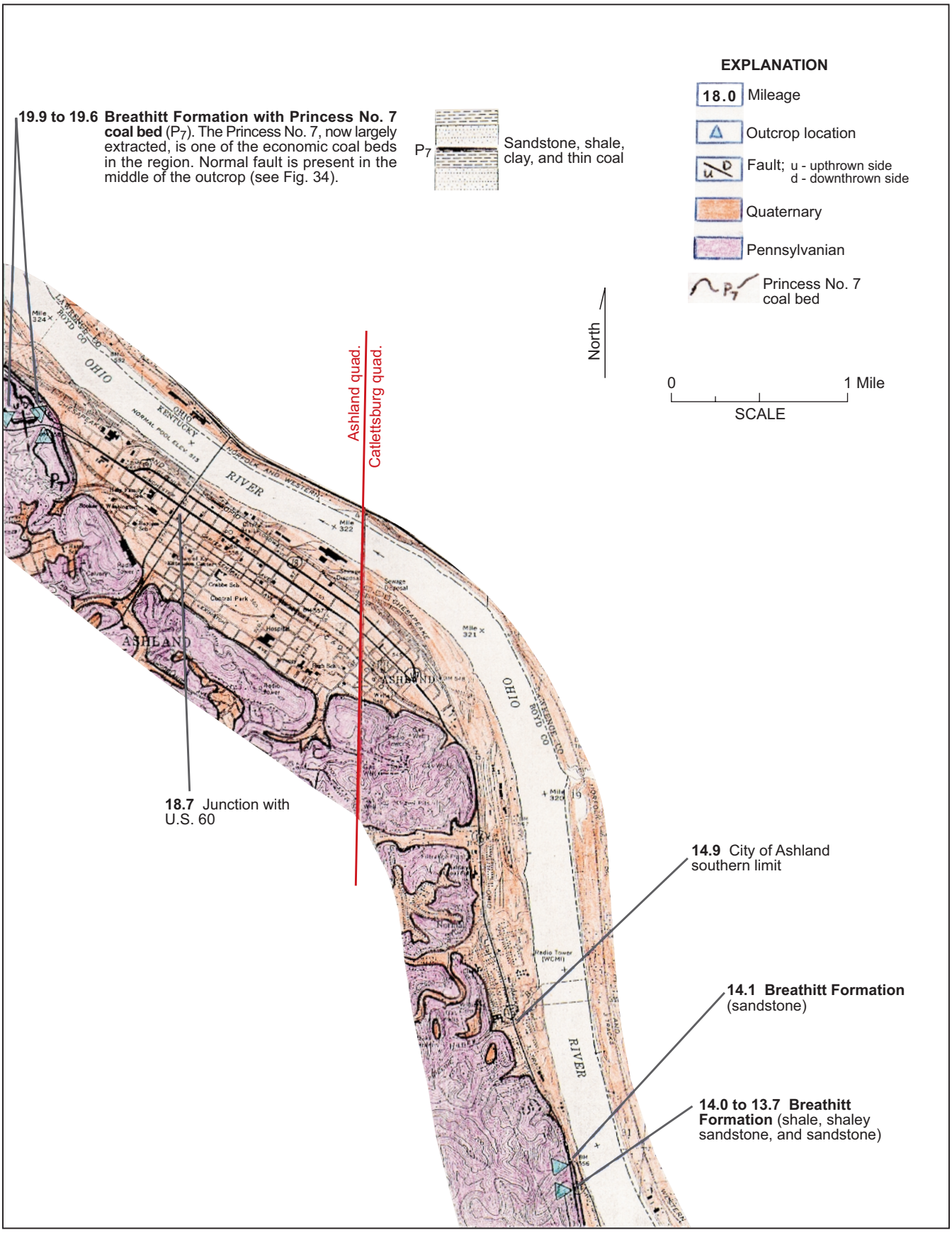
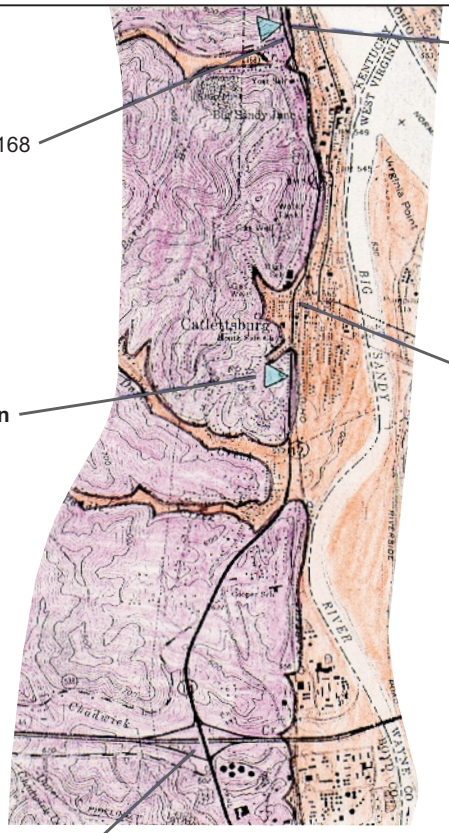

EXPLANATION
18.0 Mileage
Outcrop location
Fault; u - upthrown side
d - downthrown side
Quaternary
Pennsylvanian
Princess No. 7 coal bed
P7
Sandstone, shale, clay, and thin coal
North
0
1 Mile
SCALE
19.9 to 19.6 Breathitt Formation with Princess No. 7 coal bed (P7). The Princess No. 7, now largely extracted, is one of the economic coal beds in the region. Normal fault is present in the middle of the outcrop (see Fig. 34).
Ashland quad.
Catlettsburg quad.
18.7 Junction with U.S. 60
14.9 City of Ashland southern limit
14.1 Breathitt Formation (sandstone)
14.0 to 13.7 Breathitt Formation (shale, shaley sandstone, and sandstone)
OHIO
KENTUCKY
RIVER
ASHLAND

Figure 33. Rockfall of large sandstone block from thick sandstone beds exposed near top of roadcut. Rockfalls occur rapidly and without warning, leading to property damage and loss of life. Overhanging rocks should be removed, where possible, and areas below avoided. Mile 0.6 of U.S. 23, Greenup County.

Figure 34. Sandstones, shales, clays, and thin coals of the Breathitt Formation, between miles 19.9 and 19.6 of U.S. 23, Boyd County. The Princess No. 7 coal bed is poorly exposed in this roadcut. Fault present in the middle of outcrop has displaced the prominent sandstone bed downward from its original position.


14.0 to 13.7 Breathitt Formation
(shale, shaley sandstone, and
sandstone
13.6 Junction with Ky. 168
12.5 Junction with U.S. 60
12.3 Breathitt Formation
(sandstone and shale)
10.9 Junction with I-64
Catlettsburg
Chadwick
BIG SANDY RIVER
WAYNE CO.
EXPLANATION
12.6 Mileage
Outcrop location
Quaternary
Pennsylvanian
North
0
1 Mile
SCALE

The Changing Transportation Corridor of Northeastern Kentucky

The route the AA Highway follows today did not become an important transportation route with the building of that highway in the 1980's. Rather, it is the latest incarnation of a route that has ebbed and flowed in importance to the region and country since Europeans first crossed the Appalachian chain.

Those first explorers found the Ohio River a relatively easy and safe way to move west. The Ohio was the dominant "road," and along its path Ashland, Portsmouth, Vanceburg, Maysville, Augusta, Cincinnati, and many smaller settlements developed. For the first hundred years of Kentucky's history this stretch of river was the introduction to the West for most settlers. The importance of the river increased with the introduction of steam power in 1811. In the next decades two canals, the Ohio and Erie and the Miami and Erie, tied this part of the Ohio River to the Great Lakes through the state of Ohio. The river's importance is indicated by the concentration of people along it. Mason County was a population center when Kentucky became a state in 1792. Northern Kentucky remains one of the three major urban areas of the Commonwealth.

Although the river would remain important for travel, trade, and even entertainment, the mid 19th century became the age of railroads. The railroad between Ashland and northern Kentucky, the Chesapeake and Ohio, was completed in 1888. Streets in many of the river towns such as Vanceburg and Augusta were replaced with rail lines, and distinctive depots were built in nearly every town. Soon most travelers and goods were transported on the railroads. Their premier position as the transportation system of choice would not last as long as the Ohio River's had.

Northeastern Kentucky had always been on the edge of being a center for roads. The first road of macadam in Kentucky was built at Maysville. A spur of the National Road called Zanes Trace went through Maysville and tied into the road built on the buffalo trace to Lexington. A road in the region was even part of a national debate, when President Andrew Jackson vetoed Maysville Road legislation in 1830. Nevertheless, good roads were not built. It even took violence (people destroying toll houses in 1896, in what was called the Tollgate Wars) to get counties and the State to take over Kentucky's road system.

The roads that were built followed the path of least resistance around and over hills. Kentucky 8 followed the Ohio River and the C & O rail line. It went through the towns that had developed along the earlier transportation systems. As early as the 1940's, local residents called it the Mary Ingles Highway, after the pioneer woman who followed approximately the same route east when she escaped from the Shawnees in 1755. "Highway" was a term that flattered Kentucky 8, however. Most people traveling in either direction along the river took the highway in Ohio. The Interstate system initiated in the 1950's touched each end of what would become the AA Highway but bypassed the area in between. As the nation increasingly became a mobile society dependent on the automobile, poor roads in northeastern Kentucky preserved the rural nature of the region. Migration and pockets of poverty were two consequences that were attributed at least partially to the lack of good roads.

Such was the situation when John Y. Brown Jr. became governor of Kentucky in 1979. Despite recession and a tight budget, he promoted one significant road-building project in the state. Coming to the governor's office as an outsider to traditional politics, he concluded that the state needed a good highway between northern Kentucky and the Ashland region. That the population base there did not indicate such a road was necessary was only proof to him that the project was important. He believed the road would be a stimulus to the local economies along it.

The results are mixed. Many rural roads bisect the AA Highway. That fact and excessive speed has led to many accidents and deaths on the highway. The road has changed the landscape, particularly in northern Kentucky and the Maysville area. Hoped-for developments in spots between those areas and along the eastern wings of the road have not materialized. But the road has pulled the areas along it closer together for housing, shopping, and education. The first decade of the road's history indicate it will remain the dominant transportation system in the region for years to come.

Counties of the AA Highway

County	Order of Formation	Year Established	Population (1990)	Formed From	Area (Square Miles)	County Name Origin	County Seat
Boyd	107	1860	51,150	Greenup, Carter, Lawrence	160	Linn Boyd, U.S. congressman from Paducah, who died in 1859 after being elected lieutenant governor of Kentucky.	Catlettsburg
Bracken	23	1796	7,766	Mason, Campbell	206	William Bracken, surveyor in the 1770's; trapper and pioneer	Brooksville
Campbell	19	1794	83,866	Harrison, Mason, Scott	152	John Campbell, fur trader, land speculator, representative in the Virginia legislature, member of convention that framed Kentucky's constitution, state senator.	Alexandria
Carter	88	1838	24,340	Greenup, Lawrence	397	State Senator William Grayson Carter, who served in the legislature when the county was created in 1838. The county seat, Grayson, is named for his wife, Hebe (Grayson) Carter.	Grayson
Greenup	45	1803	36,742	Mason	350	Christopher Greenup, fourth governor of Kentucky	Greenup
Lewis	48	1806	13,029	Mason	484	Meriwether Lewis, who accompanied William Clark in the exploration of the Louisiana Territory	Vanceburg
Mason	8	1788	16,891	Bourbon Co., Va.	241	George Mason of Virginia; statesman, author of Virginia bill of rights	Maysville
Pendleton	28	1798	12,036	Bracken, Campbell	281	Edmund Pendleton, member of Virginia House of Burgesses, member of Continental Congress	Falmouth