M E M O R A N D U M

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DATE:	**September 13, 2022**
SUBJECT:	**Floyd and Johnson Counties** **FH02 036 0003** **KY 3 Corridor Study** **Mars # 1505507P** **Geotechnical Overview Report**

1.0 Project Description

The Kentucky Transportation Cabinet (KYTC) is conducting a study to identify and evaluate conceptual improvements for KY 3 between US 23 and Thunder Ridge Lane in Floyd County. Currently KY 3 begins at the intersection with US 23 (MP 0.0), southwest of Auxier, traverses' northeast across Levisa Fork (MP .85), follows the curve of Levisa Fork on the south and eastern banks, and once again turns northeast after its intersection with US 321 (MP 2.7). The study area is to include the area around the current KY 3 and north into the southernmost tip of Johnson County. This overview will be utilized to identify geotechnical considerations for the study area. The project location and corridor are presented on the drawing provided (Map 1).

2.0 Scope of Work

The scope of work for this study consists of performing a geotechnical overview for the proposed study area based upon research of available published data and the Geotechnical Office's experience with highway design and construction within the region. General geotechnical and geologic characteristics of the study area have been identified and are discussed in this report. The following sources were used to perform a literature search:

- USGS Professional Paper 1151-H: The Geology of Kentucky: Physiography;
- USGS Professional Paper 1151-H: The Geology of Kentucky: Pennsylvanian System;
- Geologic Map of the Prestonsburg Quadrangle (GQ# 641), by Charles L. Rice, published by the USGS, 1967;
- Geologic Map of the Lancer Quadrangle (GQ# 347), by Charles L. Rice, published by the USGS, 1964;
- USDA Web Soil Survey, https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm;
- Available KYTC Arcmap Datasets and Layers

- KYTC Projects Nearby (KYTC Geotechnical Report Number):
  - S-062-1990
  - R-020-1991

2.1 Topography and Drainage

The project study area is located within the Cumberland Plateau (Eastern Kentucky Coal Field) Physiographic Province. It is an area of intricately dissected rocks of Pennsylvanian age. The Cumberland Plateau is covered with wooded mountain crests that are carved by ravines eroded through thick, flat-lying sequences of coal-bearing elastic rocks.

Within the project area vertical relief varies from approximately 590' mean sea level at the valley bottoms to approximately 1220' mean sea level at the tallest mountain crest. Flatlands on the ridgetops are small in extent with most of the terrain in steep slopes. The valley bottoms along the Levisa Fork and its tributaries are flat and can span as much as a quarter mile in length.

Surface drainage is directed towards Levisa Fork and its many tributaries. Levisa Fork flows north through the project area where it eventually meets Tug Fork in Louisa to form the Big Sandy. The streams follow a dendritic pattern because of bedrock with fairly uniform resistance to erosion. The main tributaries in the project area include Little Paint Creek and Johns Creek.

2.2 Stratigraphy

Much of the study area is located in the northeast corner of the Prestonsburg Geologic Quadrangle (GQ# 641) and partially in the northwest corner of the Lancer Geologic Quadrangle (GQ# 347). Geologic mapping indicates the project area to be underlined, in descending order, by the Pennsylvanian aged Princess Formation, Four Corners Formation, Hyden Formation, and Pikeville Formation.

Princess Formation, Breathitt Group. Consists of siltstone, sandstone, shale, and coal. Sandstone is typically fine to coarse grained, massive, cross bedded; locally conglomeratic. Often the sandstone is cliff forming over the less weather resistant siltstones and coal. Siltstones can range from clayey to sandy and commonly interlaminated with very fine grained sandstone. This unit contains the Richardson coal bed (0-12'), an unnamed coal bed (0-5'), and the Broas coal zone (0-3').

Four Corners Formation, Breathitt Group. Consists of sandstone, siltstone, shale, and coal. Sanstone is fine to coarse grained, massive, cross bedded, locally contains zones of calcareous sandstone, and a prominent cliff former. Siltstone is sandy and is commonly interlaminated and interbedded with very fine grained sandstone. The unit contains the Peach Orchard coal zone (3 x 0-3' beds), Hazard coal bed (0-4'), an unnamed bed (0-2'), Haddix coal bed (0-3.5'), and the Taylor coal bed (0-4'). Also included is the Magoffin Beds of Morse which consists of dark greenish gray clay shale, fossiliferous limestone, and silty fossiliferous sandstone.

Hyden Formation, Breathitt Group. Consists of sandstone, siltstone, shale, and coal. Sandstone is very fine to medium grained, locally massive and cross bedded, locally interlaminated with siltstone, and grades laterally to siltstone. Siltstone is sandy to clayey and grades downward to clay shale. This unit contains the Kendrick Shale of Jillson that is comprised of clay shale and siltstone. Coal beds include the Hamlin coal bed (0-2.5'), Fire Clay rider bed (0-2'), Fire Clay coal bed (0-3'), Whitesburg coal bed (0-4'), and Williamson coal bed (0-2.5').

Pikeville Formation, Breathitt Group. Consists of sandstone, siltstone, and coal. Sandstone is very fine to medium grained, locally calcareous in the upper part, locally massive, in part cross bedded, and interbedded with siltstone and very fine grained sandstone. Siltstone is sandy to clayey and is commonly interlaminated with clay shale and very fine grained sandstone. Coal beds include the Upper Elkhorn No. 3 (0-3.5'), Upper Elkhorn No. 2 coal bed (0-3') and the Upper Elkhorn No. 1 coal bed (0-1').

2.3 Soils and Unconsolidated Materials

Residual soils are the predominant soil type found along the hill tops and hillsides. They are derived in-place from a weathering process of the sandstone, siltstone, shale, and coal. Generally, soil depths are particularly thin and contain weathered rock fragments from underlying bedrock. A previous geotechnical investigation (R-020-1991) was conducted approximately 3-4 miles south of the study area. Geologic conditions are similar between the two projects and data from the report can be assumed, in a general sense, for the type of soils in the study area. Using the USCS Classification System, one can expect soils to consist of lean silts (ML), silty sands (SM), clay-silt mixtures (CL-ML), and low plasticity clays (CL).

The hillsides may contain colluvium. Colluvium is a locally derived residuum that has accumulated and/or migrated downslope due to gravity. They typically form wedge shapes at the base of hillsides with a hummocky topography. Soil depths in these deposits can reach up to several tens of feet in depth. They consist of poorly sorted materials with indistinguishable soil horizons and are prone to slope instability.

Alluvium deposits occupy the modern stream channels and floodplains. They consist of unconsolidated sand, silt, clay, and gravel. Deposits tend to coarsen downward and have been reported to be as much as 90 feet thick south of Auxier along the Levisa Fork.

2.4 Geologic Structures and Hazards

According to geologic mapping (GQ#641) the structural contours drawn on the base of Magoffin Beds of Morse indicate the underlying bedrock is dipping down due north and east at less than 1 degree. There are no known fault systems within or around the project area. There may be some localized faulting that is not mapped or may be discovered during the geotechnical investigation or on construction.

Underground and household mining has been located in the project area. The Kentucky Mine Mapping Information System identifies two underground mines north of Auxier and Levisa Creek (Refer to Map 3). The Williamson, Haddix, Hamlin, and Hazard coal beds have been mined in this area. Locally, several caved adits have been identified in the Upper Elkhorn No. 3, Haddix, and Whitesburg coal beds.

The entirety of the project area is notorious for cut and fill slope stability failures. The driving force behind these instabilities can be attributed to groundwater movement, poor rock mass quality, deep colluvium accumulations, and the proximity to streams and potential high water levels.

3.0 Geotechnical Considerations

Geotechnical Office personnel performed a site investigation on 3-21-2022. This was to identify any geotechnical issues and concerns with roadways. The site visit combined with available resources (such as previously completed reports, previous experience in the region, and geologic mapping) help us to better anticipate geotechnical concerns that may affect a project alignment.

3.1 Cut Slope Considerations

A detailed geotechnical exploration will be required for areas that involve widening existing cuts or creating new cuts. Rock cut slope configuration is generally controlled by bedrock lithology, quality and the results of rock testing. The Slake Durability Index (SDI) test results in shales, siltstones and non-durable sandstones factor into rock cut slope design. Also taken in account for rock cut slope design geometry is the presence of fractures and joints in the rock mass. The bedrock underlying the area will more than likely consist of shales (of varying quality), siltstones, sandstones (durable and non-durable), and coal.

Rock cuts made in durable, or Type 1 non-durable rock generally range from 1H:4V (¼:1) or 1H:2V (½:1) presplit slopes on approximate 30-foot intervals (lifts) of vertical height, with 18' to 25 feet intermediate horizontal benches. Cuts constructed in non-durable material and shallow cuts may need to be placed on flatter slopes than described above, such as 1 ½ H:1V or 2H:1V slopes. Coal present in rock cut slopes may also affect the geometry of the cut slopes. Rock cut slopes containing coal may need to be modified during construction.

Cut slope recommendations in overburden and disintegrated rock are generally placed on 2H:1V slopes. However flatter slopes are occasionally required. In mountainous terrain where overburden depths are shallow. It is often necessary to steepen slopes to 3H:2V in places. Cut stability analysis are generally required when the depth of the overburden is greater than 10 feet. The cut stability analysis should be performed at the location where the overburden depth is the deepest. Also cut stability analysis may need to be performed near the end of a cut when problems in the cut-to fill transitions are anticipated. Please See pictures below of existing rock cuts on US 23 and KY 3

3.2 Embankment Considerations

New embankment construction may be required dependent on alignment selection. Embankments constructed of durable rock material generally exhibit adequate stability when using proper construction techniques on 2H:1V slope configurations or flatter up to 20-feet tall. Flatter embankment slopes may be required for embankments constructed from nondurable shales or in areas where embankments are founded on alluvial materials. Alluvial soils can be expected along creeks, valleys, and drainage swales. It can be anticipated that embankments in these areas may need to be partially constructed of granular material to achieve minimum factor of safety for stability.

3.3 Subgrade

Depending on alignment selection and rock cut slope geometry it is anticipated that enough durable rock will be available for a subgrade consisting of rock from roadway excavation. If there is insufficient durable rock from roadway excavation to construct a rock roadbed, a soil subgrade could be recommended with a Resilient Module and/or CBR value assigned to the subgrade after laboratory testing.

If any existing pavement is to be removed the material under the pavement is expected to be soft and saturated and may also require manipulation.

3.4 Water Wells and Springs

Springs may be present within the proposed area. Often springs are encountered on the down dip side of the hillside seeping from coal seams. These locations should be inventoried to verify their locations. Spring boxes and/or granular material may be required in the vicinity of springs. According to KYTC Arcmap datasets there are multiple water wells located in the project corridor . These locations when encountered shall be verified and inventoried. If water wells are encountered during construction, special construction considerations will be required to close those wells. All water wells or cisterns within the limits of construction, weather shown on the plans or not shall be plugged in accordance with Section 708 of the current Standard Specifications for Road and Bridge Construction.

3.5 Gas and Oil Well

Several gas and or oil wells are located within the proposed project corridor. If any wells are located within the proposed right-of-way limits they shall be treated in accordance with Mines and Minerals Specifications.

3.6 Ponds

Ponds are located within the project corridor. If these ponds are to be impacted by roadway construction due to alignment these ponds will require treatment. Such as removing soft and unstable material and stabilization of the area more than likely by use of Kentucky Corse Aggregate #2's, #3's or 23's and underlain by geotechnical fabric.

3.7 Landslide

Landslides are an issue in the area, while the Geotechnical Office only has a few landslide reports located within the project scoping area it is worth noting that some slides may have been repaired with recycled railroad rails by Maintenance crews in the District.

Roads in a side hill condition are prone to failures, most of these landslides can be mitigated by use of drilled-in recycled railroad rails due to the shallow depth of bed rock in most cases. However, landslides with deeper overburden may require a specialty contractor to mitigate. Side hill conditions should be avoided if possible.

3.8 Subsidence

Subsidence can occur in places where voids are created by extracting solids or liquid from beneath the surface. It is controlled by various factors such as: extraction rate, depth of extraction, mining methods, topography, and lithology properties of the rock strata. Subsidence can propagate to the surface and impact the roadway or road cuts causing instability in both.

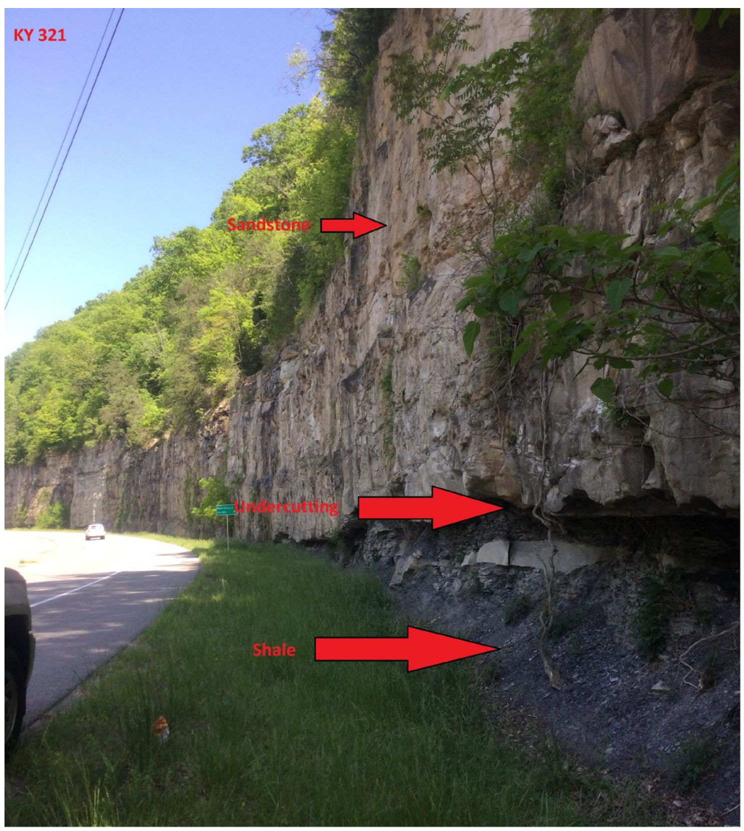
The Geotechnical Office has recommended at least 100-feet of bedrock coverage between the roadway grade and the ceiling of a mine cavern when the mines are located underneath the roadway. Mine grouting has been recommended in the past when 100-feet of coverage is not attainable and/or subsidence has already occurred. This is not economical of a large scale.

3.9 Mine Openings in Cuts

During the construction of cuts underground mines may be exposed at the face of a cut. While not unusual it may lead to cut instability and eventual intermediate bench loss. Typical treatment is to stabilize by pneumatically back stow the opening with quarry ran rock. Concrete structures have also been used in the past to stabilize mine openings when drained properly.

3.10 Rock Fall

The project corridor is in an area that is prone to rock falls. Special care should be taken in the rock cut slope design phase to minimize conditions that enhance the probability of rock fall conditions. Shales are highly weatherable, when underneath a more resistant sandstone bed undercutting can occur increasing rock fall potential. During a site visit to the scoping area there was evidence of relatively recent rock falls Along KY 321. This may be attributed to over steepening of the rock cut on a single lift. Under cutting was also evident between the shale and sandstone contact. Please see picture below.



Picture 1: KY 321 more resistant sandstone overlaying a less resistant shale.

3.11 Structures

There is a twin seven span bridge carrying KY 3 over the Levisa Fork (find report S-062-1990). There are multiple culverts within the project corridor, culverts with in the project corridor may need to be replaced or extended.

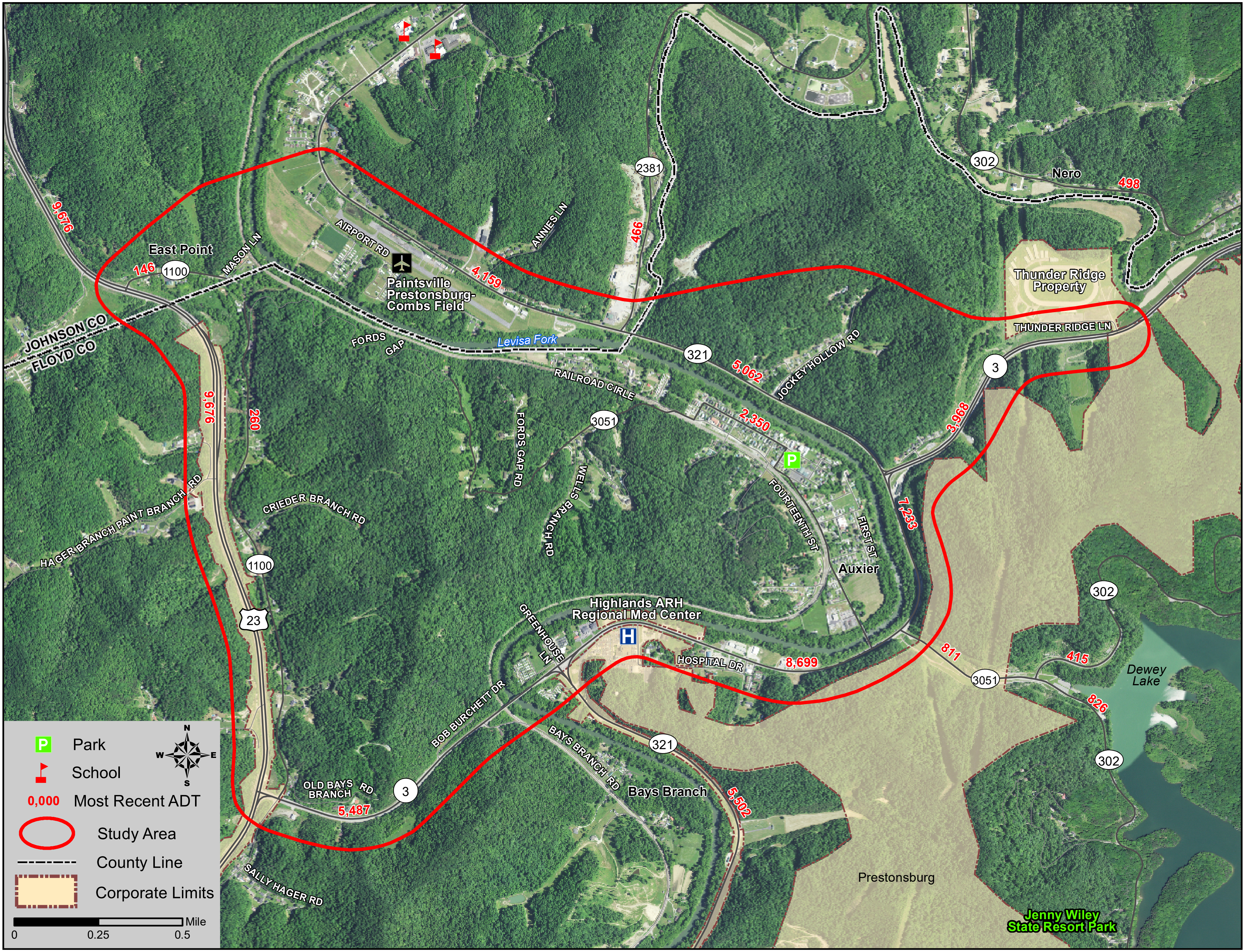
4.0 Conclusions

The purpose of this overview was to provide a general summary of the bedrock, soil, and geomorphic features likely to be encountered within the proposed alignment; and to identify geotechnical features that may have an adverse impact on the project.

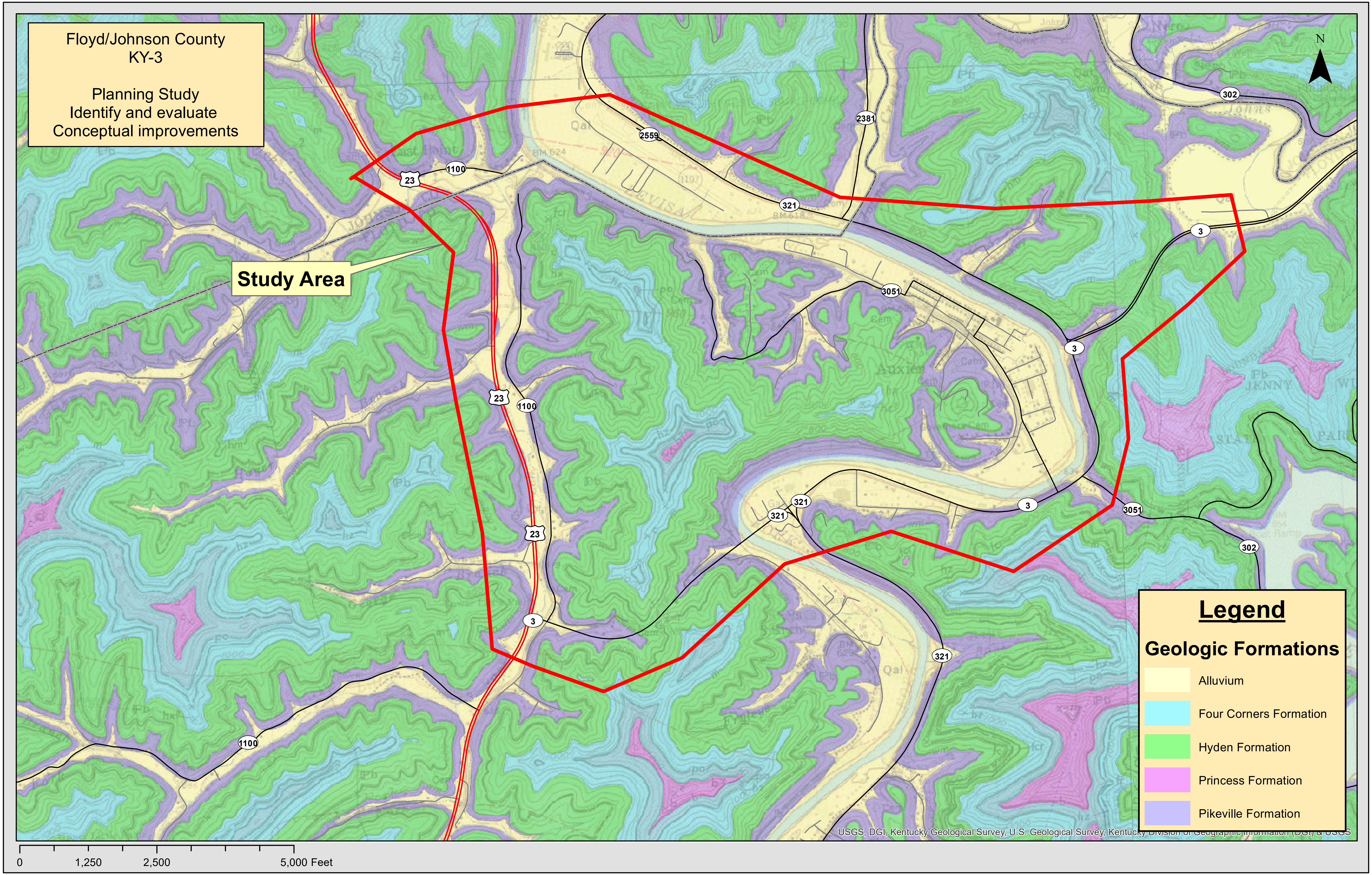
Geotechnical drilling will be needed for roadway cut/fills and structures. If a portion of this project will be a widening project, information on existing pavement structure should be obtained to assist the team in pavement design. Sampling of foundation soils should be performed for embankment situations.

The information presented in this overview should be reviewed in the general nature in which it was intended. A thorough geotechnical exploration of the proposed alignment and grade will be required to properly anticipate and plan for special requirements necessary for the design and construction of the proposed alignment.

MAP A (Study Area Corridor)
MAP B (Geologic Map)
MAP C (Mine Map)
MAP D (Water, Gas, and Abandoned Wells)



East Point
Paintsville Prestonsburg-Combs Field
AIRPORT RD
ANNIES LN
MASON LN
Levisa Fork
FORDS GAP
RAILROAD CIRLE
JOCKEY HOLLOW RD
Thunder Ridge Property
THUNDER RIDGE LN
Nero
JOHNSON CO
FLOYD CO
FORDS GAP RD
WELLS BRANCH RD
CRIEDER BRANCH RD
HAGER BRANCH PAINT BRANCH RD
FOURTEENTH ST
FIRST ST
Auxier
Highlands ARH Regional Med Center
GREENHOUSE LN
HOSPITAL DR
BOB BURCHETT DR
BAYS BRANCH RD
Bays Branch
OLD BAYS BRANCH RD
SALLY HAGER RD
Prestonsburg
Dewey Lake
Jenny Wiley State Resort Park
9,676
146
1100
2381
466
4,159
302
498
321
5,062
3
3,968
2,350
3051
260
7,233
23
8,699
811
415
826
5,487
321
5,502
Park
School
0,000 Most Recent ADT
Study Area
County Line
Corporate Limits
N
S
E
W
Mile
0
0.25
0.5



Floyd/Johnson County
KY-3

Planning Study
Identify and evaluate
Conceptual improvements

Study Area

Legend
Geologic Formations
Alluvium
Four Corners Formation
Hyden Formation
Princess Formation
Pikeville Formation

N

0
1,250
2,500
5,000 Feet

USGS, DGI, Kentucky Geological Survey, U.S. Geological Survey, Kentucky Division of Geographic Information (DGI) & USGS

23
1100
3
321
2559
2381
302
3051
Auxier

Floyd and Johnson Counties - KY 3 Corridor Study

Legend

- ● Cities
- Faults
- Thunder Ridge Ln
- US Highways
- State Roads
- Local Roads
- Active Railroad
- Lakes
- Streams
- Permitted Mine Boundaries
- Project Area

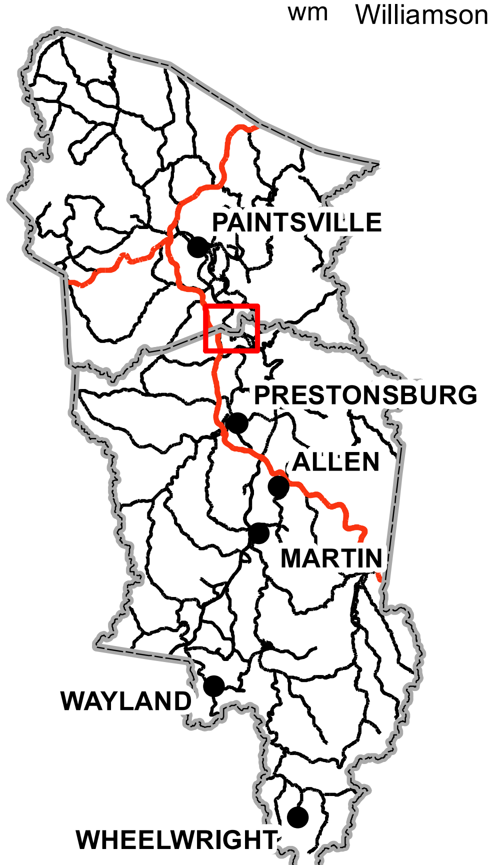
Mined Out Areas

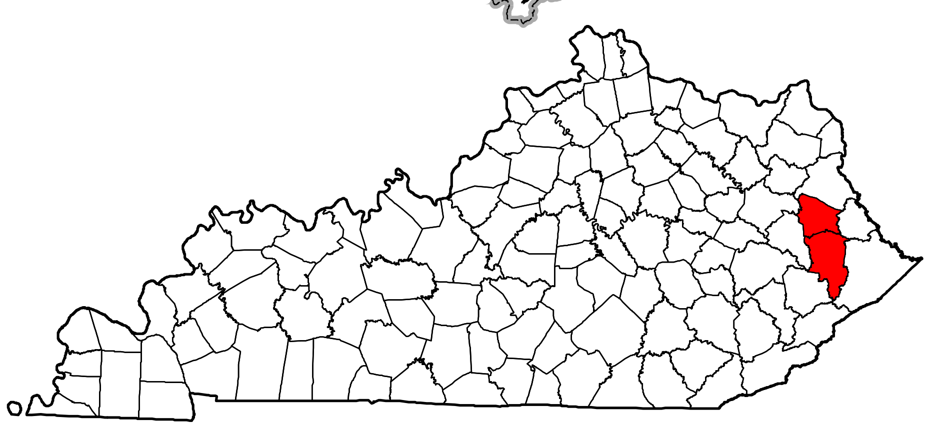
- Assumed Underground
- Underground

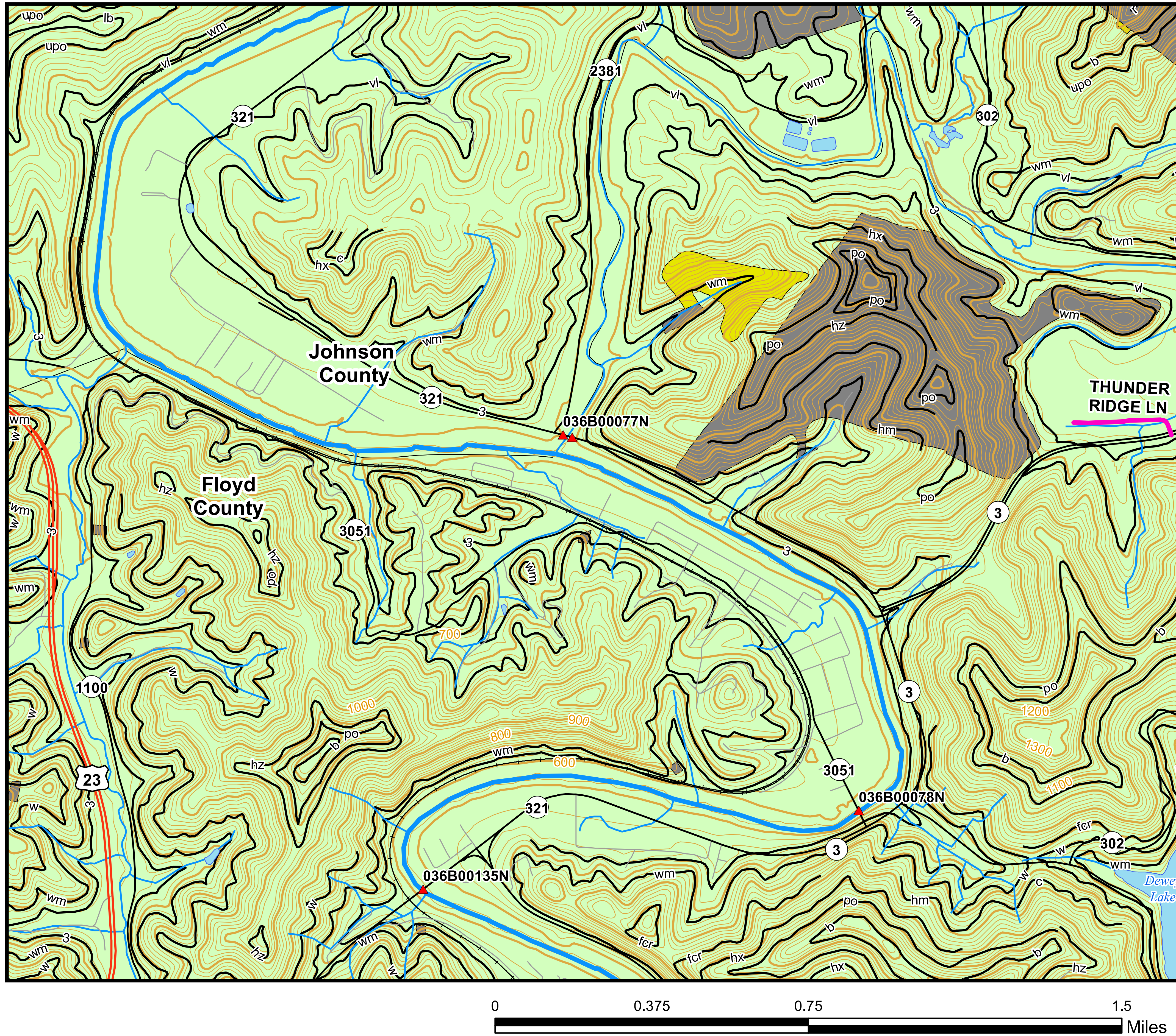
Mined Coal Seams

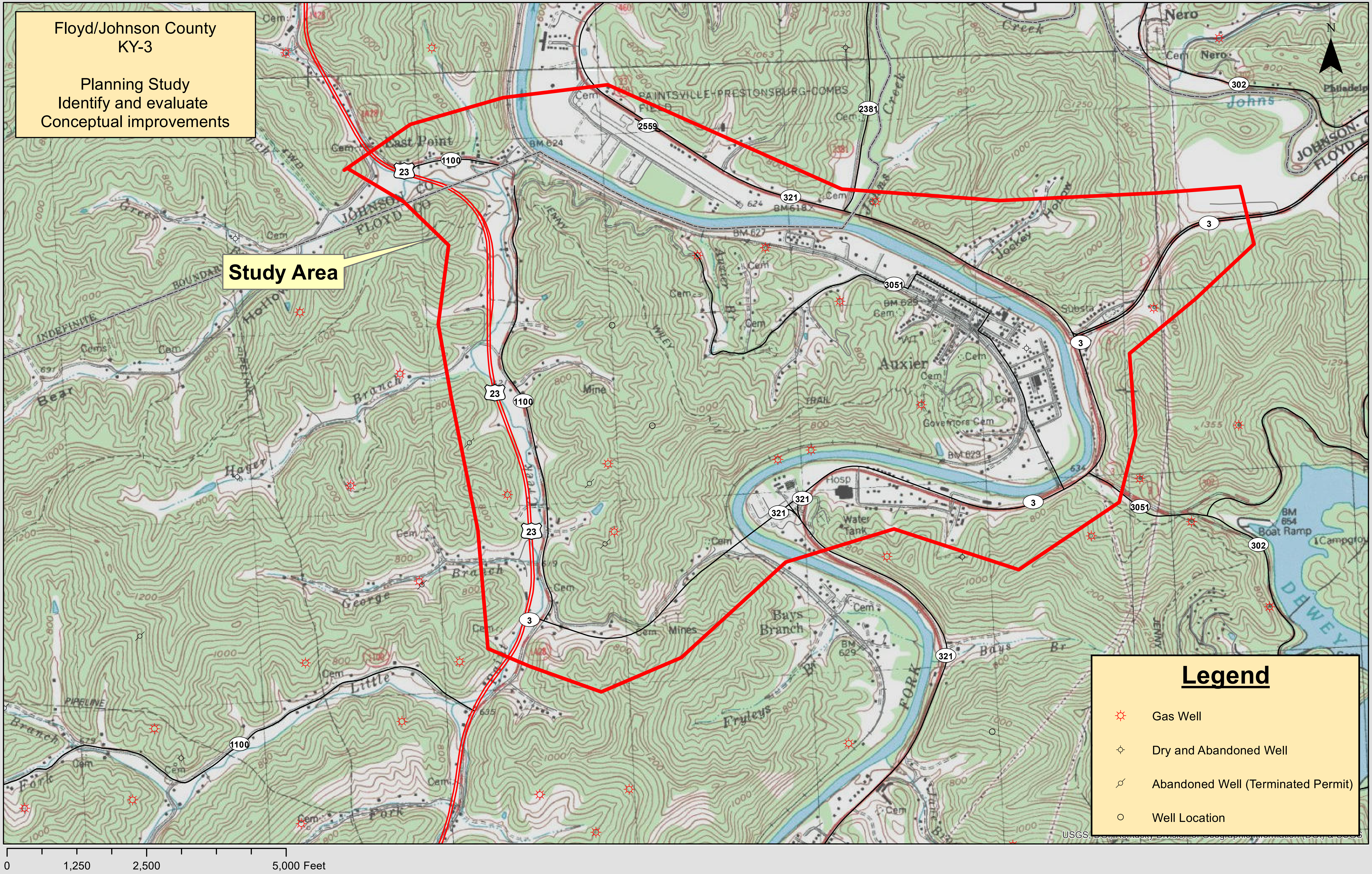
hx	Haddix
hm	Hamlin
hz	Hazard
3	Upper Elkhorn No. 3
po	Peach Orchard
wm	Williamson

N








Floyd/Johnson County
KY-3
Planning Study
Identify and evaluate
Conceptual improvements
Study Area
Legend
Gas Well
Dry and Abandoned Well
Abandoned Well (Terminated Permit)
Well Location
N
East Point
Auxier
Nero
Paintsville-Prestonsburg-Combs Field
Johnson Co
Floyd Co
Hosp
Water Tank
Governors Cem
Bays Branch
George Branch
Boat Ramp
0
1,250
2,500
5,000 Feet