

MEMORANDUM

P-004-2023

TO: Tom Hall, P.E.
Transportation Engineer Supervisor
District 5 Planning Section

FROM: Christian Wallover, P.G.
Branch Manager
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BY: Taylor Hancock, P.G.
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DATE: August 15, 2023

SUBJECT: Jefferson County
FD04 056 1531 008-009
KY 1531/I-64 Intersection
M.P. 8.0 – 9.0
Item No. 05-80000.00
Mars No. 1578301P
Geotechnical Overview Report for New Interchange

1.0 General Overview

This planning study focuses on the central eastern portion of Jefferson County, Kentucky, focusing on the intersection of I-64 and KY 1531 – between the I-64/I-265 interchange and the Jefferson/Shelby County line.

The purpose of the study is to identify any geological or geotechnical hazards or concerns in the provided project area that could be problematic for the construction of a new interchange at the intersection of I-64 and KY 1531.

1.1 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 Branch'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:

- Kepferle, Roy C. "Geologic Map of the Fisherville Quadrangle, North-Central Kentucky." Kentucky Geological Survey: USGS. GQ 1321. 1976.
<<https://kgs.uky.edu/kgsweb/download/24k/gq/FISHERVILLE.pdf>>

- Moore, F., Kepferle, R., & Peterson, W. “Geologic Map of the Jeffersontown Quadrangle, Jefferson County, Kentucky.” Kentucky Geological Survey: USGS. GQ 999. 1972. <<https://kgs.uky.edu/kgsweb/download/24k/gq/JEFFERSONTOWN.pdf>>
- “I-64 Interchange and New Connector, Jefferson and Shelby Counties: Alternate Planning Study.” Qk4. 2006.
- USGS Professional Paper 1151-H: The Geology of Kentucky: Physiography
- Available KYTC ArcMap Datasets and Layers
- KYTC Projects Nearby (see Section 6.0 – Past [Relevant] Geotechnical Reports)

2.0 Physiography and Topography

The project area is contained within the Outer Bluegrass physiographic region. This region is characterized as an upland area primarily consisting of interbedded limestones and shales. The limestones are less karstic, thus producing/resulting in fewer sinkholes. The shales are more easily eroded than those of the Inner Bluegrass, which can impede groundwater flow, thus there are fewer wells and springs.

The topography of eastern Jefferson County is variable, ranging from approximately 400’ at the Ohio River to 890’ elevation in the southwestern portion of the county where the Knobs are encountered. Within the project area, the elevation varies from approximately 580’ elevation in the floodplains to approximately 770’ near the eastern boundary of the project area.

2.1 Drainage

Approximately 60 intermittent streams have been identified within the project area that flow into Long Run and Floyd’s Fork (Qk4. 2006). In the project area, Long Run predominately flows northeast to south/southwest, flowing into Floyd’s Fork approximately 2.2 miles south of the intersection of I-64 and KY 1531. Floyd’s Fork flows north to south/southwest, eventually flowing into the Salt River. The drainage pattern is dendritic; in this case indicative of homogenous underlying sedimentary bedrock that is unfolded, yet erodes relatively equally in all directions.

3.0 Geology & Stratigraphy

Available mapping by the Kentucky Geologic Survey (KGS) Geologic Map Service indicates the project area is primarily underlain by bedrock belonging to the Drakes Formation and Grant Lake Limestone of the Upper Ordovician. The western edge of the expanded project area is underlain by the Louisville Limestone, Waldron Shale, and Laurel Dolomite of the Middle Silurian (see Geologic Maps).

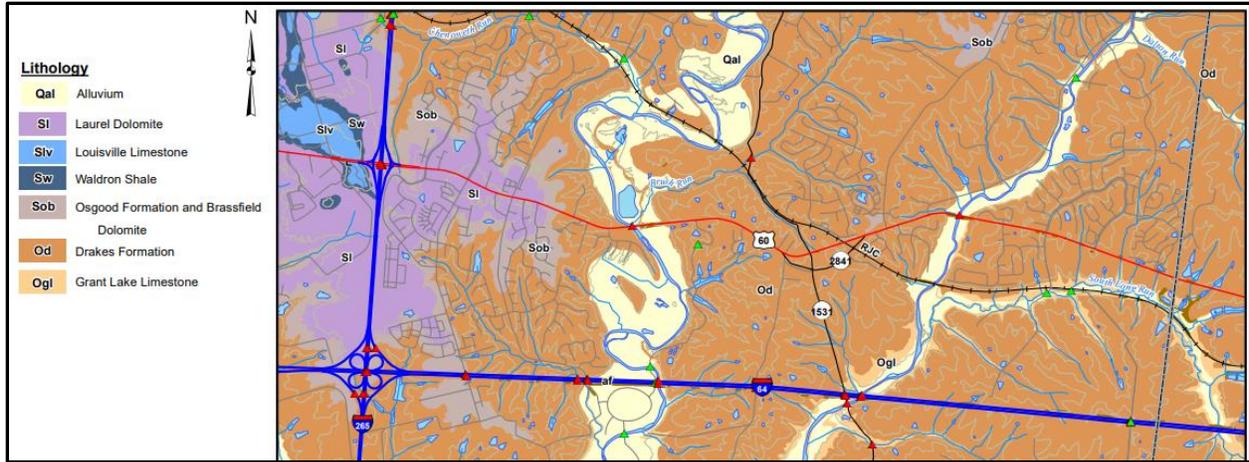


Figure 1: Excerpt from the Geologic Map (attached). Refer to Appendix.

3.1 Bedrock

The project is underlain by Quaternary [age] Alluvium that contains silt, clay, sand and gravel ranging from 0 to 20' thick. The alluvium is found mainly along streams and flood plains associated with the Long Run tributary of Floyd's Fork.



Figure 2: Looking west (downstream) along Long Run. Note the exposed bedrock – thin limestone beds interbedded with shale.

The Drakes Formation – of Ordovician age, typically consists of limestone, dolomite, and shale. In the project area, limestone and shale will be the primary rock type encountered – the Rowland

Member of the Drakes Formation being the dominant unit in this area. The limestone is medium gray and greenish-gray to bluish-gray, weathering to pale olive and yellowish-gray. Typical limestone of the Rowland Member is dolomitic and argillaceous, fossiliferous to fossil-fragmental (including colonial corals, brachiopods, ostracods, and bryozoans), and streaked with irregular burrows filled with easily weathered glauconitic material. Dominant shale is shades of olive gray to shades of dark greenish-gray, primarily clayey, and calcareous, weathering to yellowish-gray. This shale is persistent in two beds, each five to seven feet thick, one at the base of the member and one above the intensely fossiliferous zone. Thin interbeds of brown to black, fossiliferous, carbonaceous shale distinguish the Rowland Member from overlying members. In the project area, the Drakes Formation is between 30' and 105' thick.

The Grant Lake Limestone, locally between 20' and 40' thick, consists of limestone and shale. Limestone is typically medium gray, containing fossil fragments and whole fossils in greenish-gray calcareous mudstone or a medium to very coarse grained calcarenite cemented by sparry calcite. Limestone beds are typically irregular, uneven to nodular, commonly less than 0.2 foot thick, though some thin continuous beds have been identified. Shale is olive-gray to dark greenish-gray, calcareous, sparsely fossiliferous, and weathers to light olive-gray to brownish-yellow. Shale occurs in partings and thin beds commonly less than 0.6 foot thick.

3.2 Soils and Unconsolidated Material

Soil samples obtained from the borings during previous geotechnical investigations (see Jefferson S-090-2007 through S-094-2007), were found to consist of a variety of soil types including clayey and silty gravels, clayey sands, and inorganic clays of low to intermediate plasticity. The samples were designated as A-2-4, A-2-6, A-6 and A-7-6 in the AASHTO Classification System and as GC, GM-GC, SC and CL in the Unified Classification System. Depths to rock varied from 6.1 ft. to 35.0 ft. Rock fragments and boulder material were encountered in the overburden soil in the core borings.

4.0 Geologic Hazards and Considerations

4.1 Karst

Available mapping indicates the bedrock beneath KY 1531 at I-64 is prone to karst development (see attached Karst Map). Bedrock conditions in karst-prone areas favor sinkhole development, subsurface drainage, and promote ponding. Extreme or prolonged precipitation events can result in extremely wet soils, ponding, flooding of low-lying areas, and sinkhole formation and/or growth.

4.2 Faults

There are no faults mapped in the project area.

4.3 Mining/Quarry Activity

There are no reported mines or quarries in the project area.

4.4 Landslides

No landslides have been reported in the project area.

4.5 Wells and Springs

Mapping indicates no wells or springs are present near the intersection of I-64 and KY 1531 (see attached Wells and Springs Map).

5.0 Design Expectations and Expected Foundation Considerations

5.1 Embankments

Generally, embankments built from the native soils and bedrock can be constructed to a height of 20 feet with 2H:1V side-slopes – if the foundation is suitable and proper compaction methods are used. Any embankment built 20 feet or taller will require a stability analysis, which could necessitate a flatter slope be used. If built on alluvium, embankments may require settlement analyses.



Figure 3: Notice the bridge embankments, each constructed on a 2H:1V slope on artificial fill.

5.2 Cut Slopes

Cut slope configurations in rock are generally controlled by bedrock lithology, bedrock quality, results of Slake Durability Index (SDI) tests in shales and siltstones, and by the presence of any fractures and/or joints. Slope configurations for rock cuts in durable bedrock can generally be 1H:2V or 1H:4V presplit slopes on approximate 30-foot intervals of vertical height with 18 to 20-foot intermediate benches or 15-foot overburden benches. Slope configurations for non-durable bedrock or soils are generally constructed on a range of 2H:1V to 3H:1V slopes or flatter based on the height of the slopes and content of the material.

Typical slopes in the project area have been constructed on 2H: 1V or flatter due to the presence of non-durable shales and thinly, irregularly to nodular bedded limestones. These conditions promote accelerated weathering, which could undermine any roadway or structure built on/in local bedrock. Should rock cuts be required in the project area, a detailed cut stability analysis will most likely be necessary.



Figure 4: Typical cut slopes in the project area are constructed on slopes of 2H:1V or flatter.

5.3 Structures

Previous reports (see S-090-2007 through S-094-2007) along I-64 at and around KY 1531 indicate shallow to moderately deep (0 to 20-foot deep) soils around structure foundations, though soil depths can be greater when sinkholes are encountered. Bridges in the study area are generally rock bearing (spread footings). Smaller structures such as retaining walls and box culverts may be constructed on soil or bedrock.

5.4 Saturated, Soft, or Unstable Soils

California Bearing Ratio (CBR) values in the area are generally low (in the range of 1-3). If rock roadbed is not available other methods of improving subgrade can be considered. Chemical stabilization is the preferred method of subgrade improvement. In areas where lanes are being added or chemical stabilization is not feasible (such as cross-overs, tie-ins, etc.) the subgrade can be constructed with Kentucky Coarse Aggregate No. 2, No. 3, or No. 23 sized stone with geotextile fabric.

Low and high plasticity clays can be very moisture sensitive. Working platforms may be necessary for cut and/or fill situations where soft and/or saturated soil is encountered. In these areas a working platform consisting of Kentucky Coarse Aggregate #2's, 3's, or 23's or limestone from roadway excavation wrapped with Geotextile Fabric may be required.



Figure 5: Piers for 056B00492N (I-64 over KY 1531) utilized drilled shafts (see SA-018-2009).

5.5 Sinkholes

Available mapping indicates very few sinkholes in the expanded project area. However, working in areas effected by karst can prove to be unpredictable. Due to the abundance of karst features, rockline depths/elevations can vary greatly in a relatively short distance. Karst terrain can likely be a critical factor to any new construction in the project area.

All open sinkholes and/or solution cavities within the limits of construction, whether shown on the plans or not, will require an investigation as outlined under Section 215, Treatment of Open Sinkholes, of the standard specifications for road and bridge construction (see attached Standard Drawing No. BGX-018).

Any sinkhole to be used for drainage purposes shall incorporate sufficient measures to minimize water infiltration into the subgrade and erosion control measures to minimize siltation of exposed sinkholes – as outlined in section “Drainage to Significant Resources” in the current edition of the Drainage Manual. Such measures may include the use of vegetated channels, grass-lined swales, interceptor ditches, containment basins, etc. as designated in the Manual.

5.6 Ponds

Multiple ponds have been identified within the project corridor. Should these ponds be impacted by roadway construction due to alignment, they will require treatment – such as draining and removal of soft and/or unstable material and stabilization of the area by use of Kentucky Corse Aggregate #2’s, #3’s or 23’s and underlain by geotechnical fabric (typical treatment).

6.0 Past [Relevant] Geotechnical Reports

<u>Planning</u>	<u>Roadway</u>	<u>Structure</u>
P-008-2006	R-032-2006	S-090-2007
	R-009-2007	S-091-2007
		S-092-2007
		S-093-2007
		S-094-2007
		SA-018-2009

7.0 Conclusion

This is a general overview of the geotechnical considerations that need to be taken in to account during alignment selection and construction. This includes the bedrock, soil, and geotechnical hazards that are expected to be encountered in the project corridor. These features may have adverse impacts on the project.

A complete Geotechnical investigation including drilling, sampling, and testing of materials will be needed to anticipate and plan for any special treatment of issues encountered during that phase. This may include the taking of pavement cores were directed by the project team. Analysis of rock core and soil sample testing will be compiled and presented in a Geotechnical Engineering Roadway Report and a Structure Report if needed.

Attachments:

- Site Map
- Geologic Map
- Springs and Wells Map
- Karst Potential Map
- Sepia 024 – Treatment of Open Sinkholes

Jefferson P-004-2023 - Geologic Map

Legend

Bridges

-  City/County Maintained
-  State Maintained
-  Structure Contour

Roads & Rail

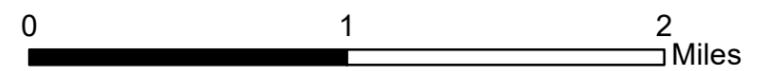
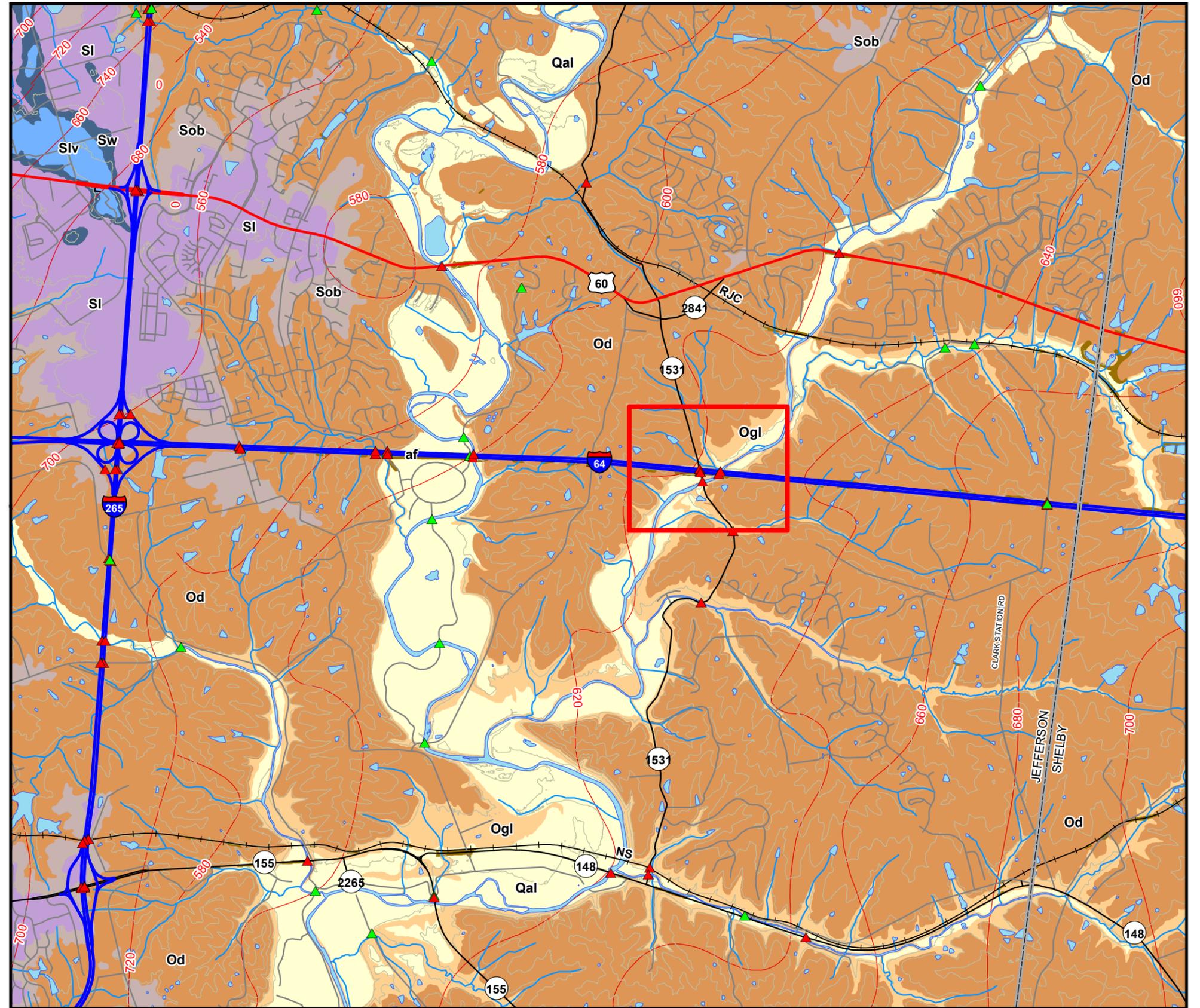
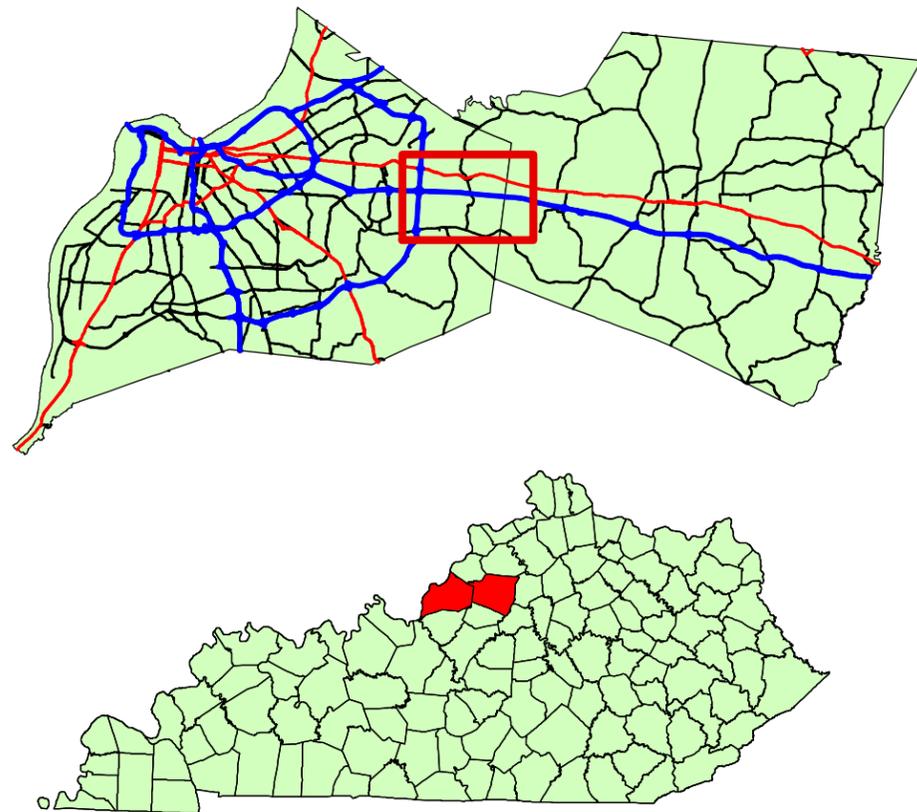
-  Interstates
-  Highways
-  State Roads
-  Local Roads
-  Active Rail

Hydrology

-  Rivers & Streams
-  Waterbodies

Lithology

-  Qal Alluvium
-  Sl Laurel Dolomite
-  Slv Louisville Limestone
-  Sw Waldron Shale
-  Sob Osgood Formation and Brassfield Dolomite
-  Od Drakes Formation
-  Ogl Grant Lake Limestone



Jefferson P-004-2023 - Geologic Map

KY 1531



Legend

Bridges

▲ State Maintained

Roads & Rail

— Interstates

— Highways

— State Roads

Hydrology

— Rivers & Streams

— Waterbodies

■ Building Footprints

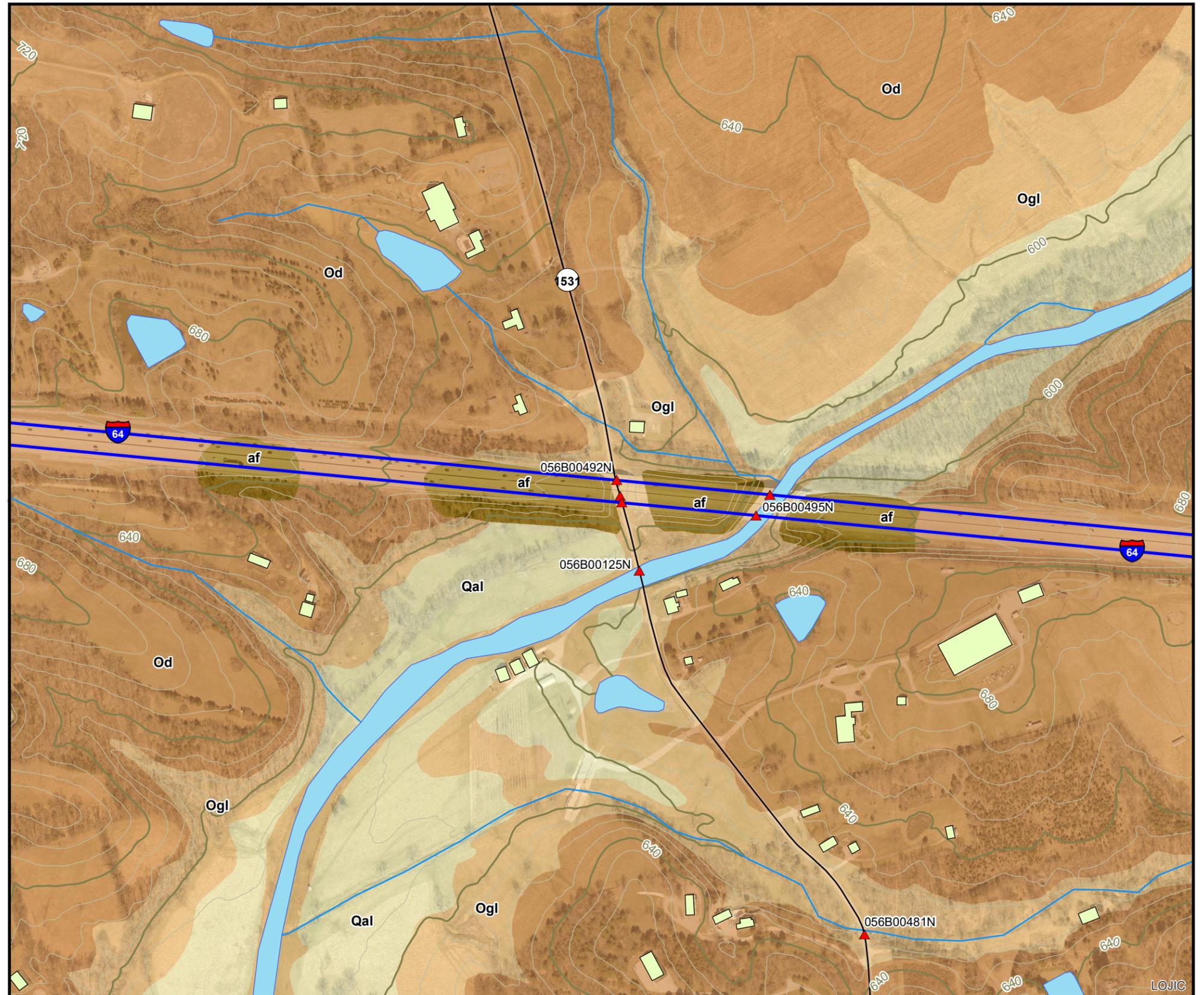
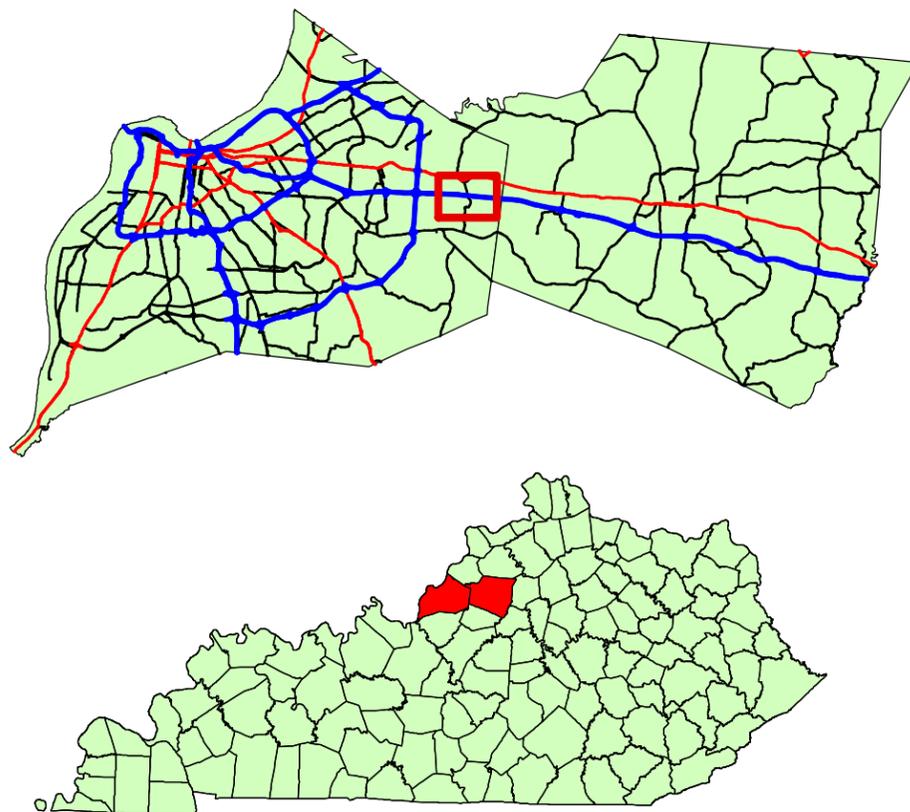
Geology

■ Qal Alluvium

■ af Artificial Fill

■ Od Drakes Formation

■ Ogl Grant Lake Limestone

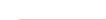


0 0.1 0.2 Miles

Jefferson P-004-2023 - Wells and Springs Map

Legend

Roads & Rail

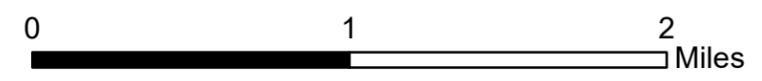
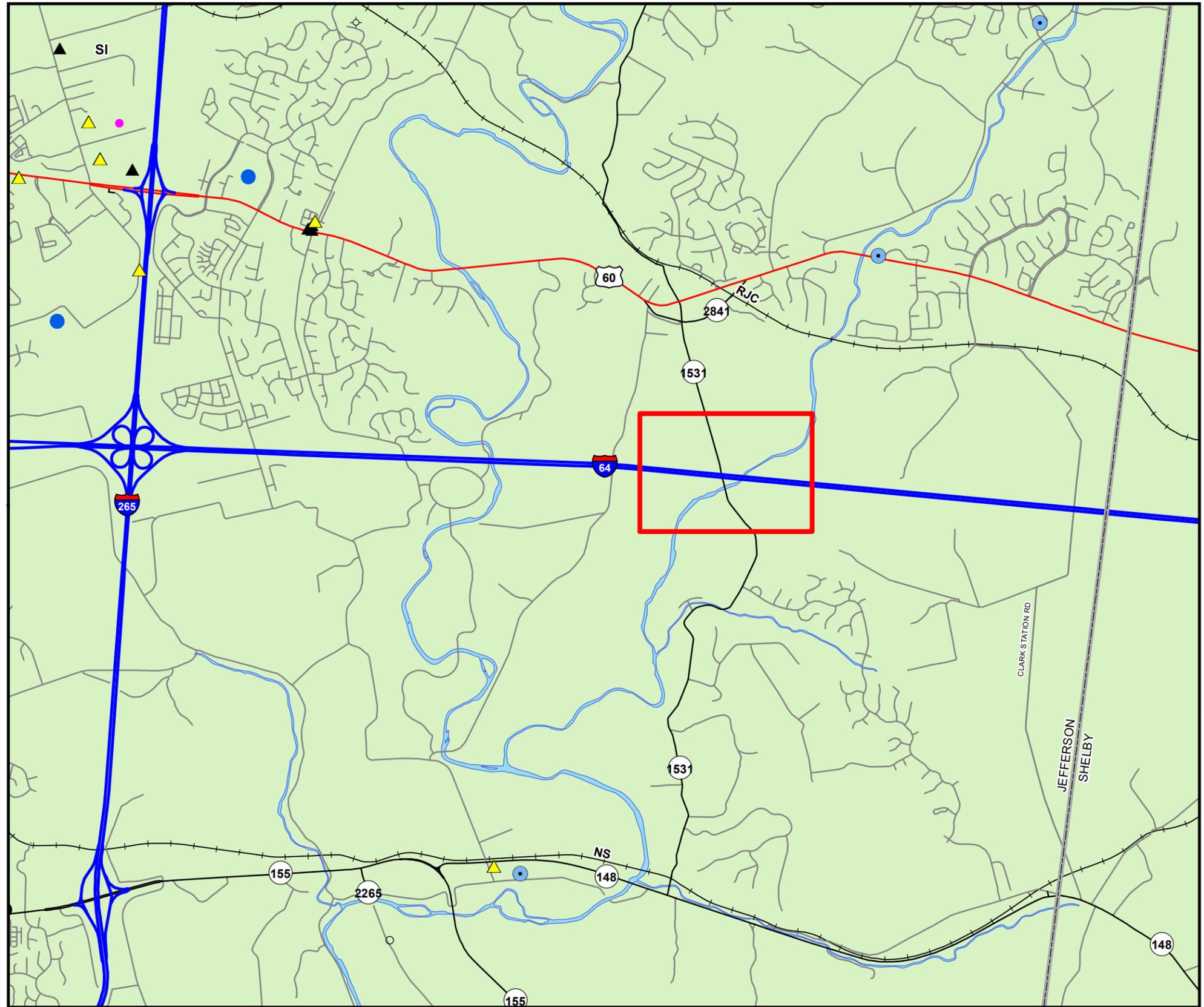
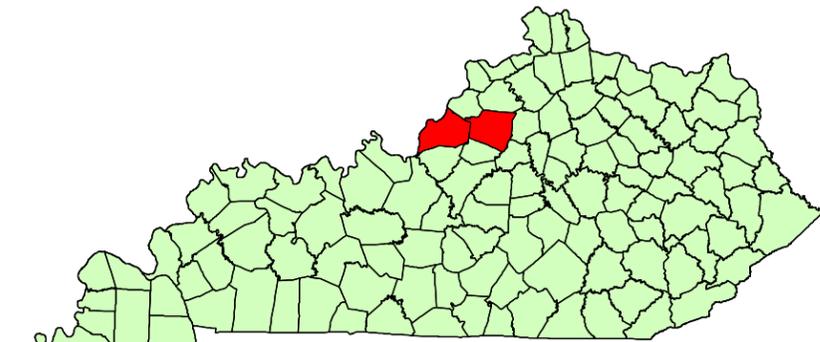
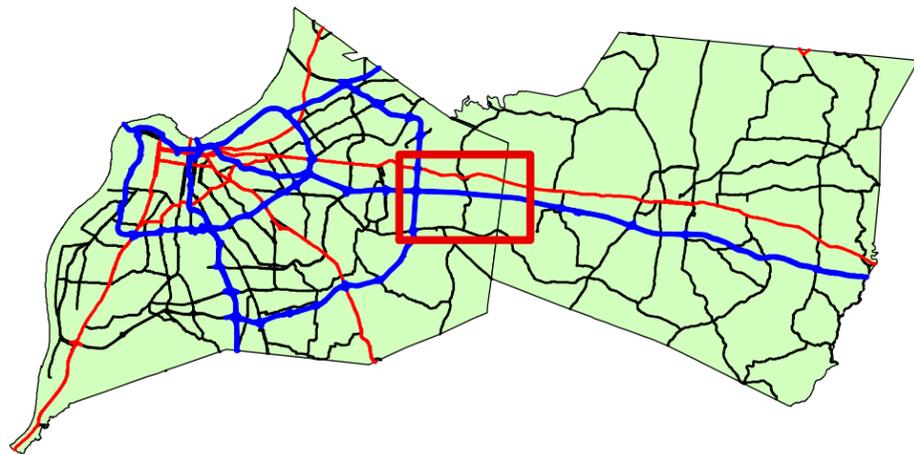
-  Interstates
-  Highways
-  State Roads
-  Local Roads
-  Active Rail

Wells & Springs

-  Domestic Water Wells
-  Monitoring Wells
-  Plugged Monitoring Wells
-  Dry and Abandoned Well
-  Miscellaneous Well
-  Well Location
-  Springs

Hydrology

-  Rivers & Streams
-  Waterbodies



Jefferson P-004-2023 - Karst Potential Map

Legend

Bridges

- ▲ City/County Maintained
- ▲ State Maintained
- Structure Contour

Roads & Rail

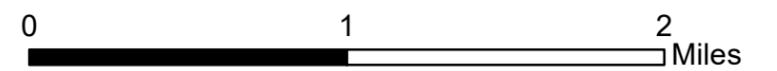
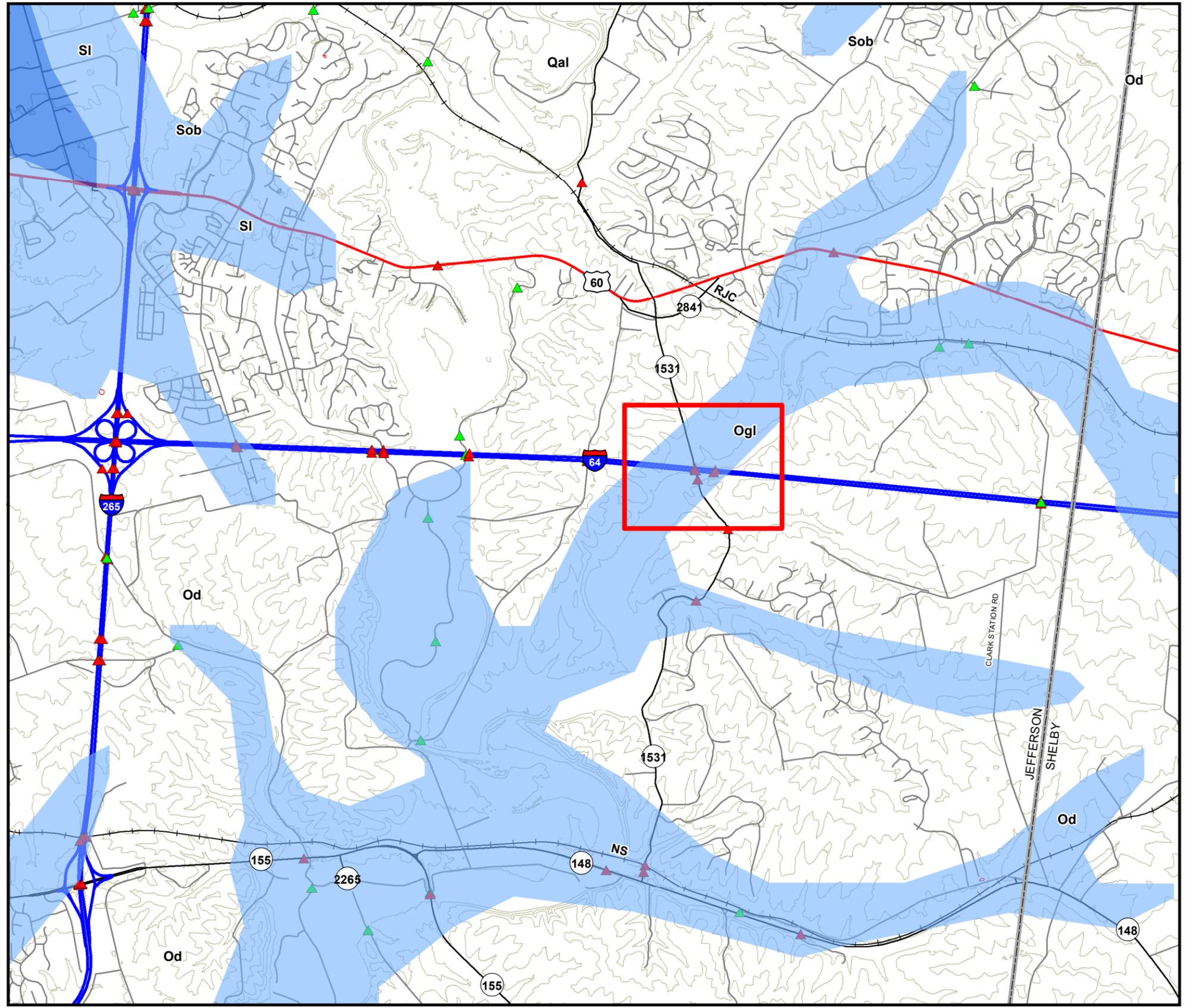
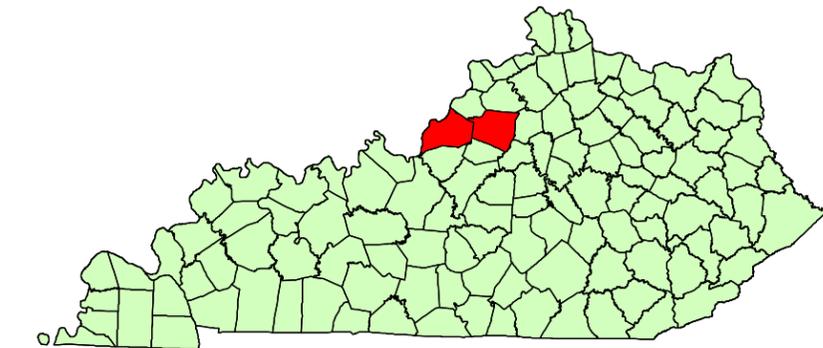
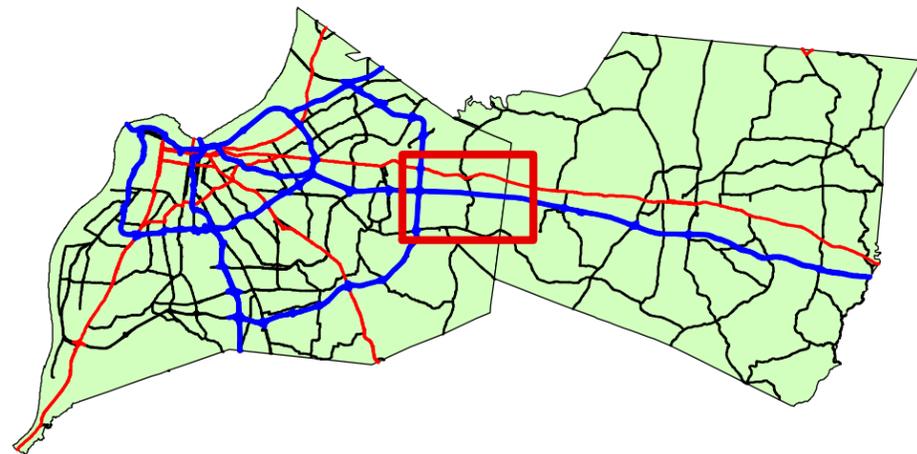
- Interstates
- Highways
- State Roads
- Local Roads
- +— Active Rail

Karst Potential

- INTENSE
- PRONE
- PRONE

Hydrology

- Rivers & Streams
- Waterbodies



Jefferson P-004-2023 - Karst Potential Map

KY 1531

Legend

Roads & Rail

Interstates

Highways

State Roads

Local Roads

Active Rail

Hydrology

Rivers & Streams

Waterbodies

Building Footprints

Karst Potential

INTENSE

PRONE

NONE

