

APPENDIX F.
GEOTECHNICAL OVERVIEW REPORT

Prepared For

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Prepared by

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GEOTECHNICAL ISSUES FOR US 421

From KY 89 at McKee to Rockcastle County Line
Jackson County, Kentucky
Item No. 11-113.00
QORE Project No. 24302627
February 11, 2004

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Wilbur Smith Associates
465 East High Street, Suite 100
Lexington, KY 40507-1938

Attention: Mr. Carl Dixon, P.E.


Reference: **Geotechnical Issues for US 421**
From KY 89 at McKee to Rockcastle County Line
Jackson County, Kentucky
Item No. 11-113.00
QORE Project No. 24302627

Dear Mr. Dixon:

QORE personnel have reviewed the proposed corridor for the section of US 421 from KY 89 at McKee to the Rockcastle County Line. This report explains our understanding of the project, documents our findings, and presents our conclusions and engineering recommendations.

QORE appreciates the opportunity to be of service to you. We look forward to helping you through project completion. If you have any questions, please call.

Respectfully submitted,
QORE, Inc.


Bruce L. Hatcher, P.E.
Senior Geotechnical Engineer
Licensed KY 14527




Craig S. Lee, P.E.
Senior Engineer

24302627 GEO Report

Attachments: Figures (14)

GEOTECHNICAL ISSUES FOR US 421

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Introduction

QORE personnel have reviewed the proposed corridor for the section of US 421 from KY 89 at McKee to the Rockcastle County Line.

At present, the proposed corridor follows the existing roadway. Generally, the proposed corridor begins near Morrill, passes through Clover Bottom, Sandgap, Waneta, and terminates at the west edge of McKee. Please reference the attached Figure 1, Proposed Corridor map for details. Some minor deviations from the existing route are being considered, such as a possible by-pass around Sandgap.

General Topography

The proposed corridor lies almost entirely in Jackson County, just extending into Rockcastle County, Kentucky and generally has a northwest/southeast direction. This general area is characterized by moderately sloping terrain with narrow valleys. The terrain become steeper as you progress to the southeast along US 421. The project will be constructed across three USGS (United States Geologic Survey) quadrangle maps. General location and topographic information about the proposed corridor across each quadrangle is listed below:

<u>Quadrangle</u>	<u>Location on Quadrangle</u>	<u>Elevation Ranges</u>
Bighill	Southern portion	1260 to 1600 feet
Johnetta	Northeast corner	1190 to 1540 feet
Sandgap	Northern portion	1010 to 1520 feet

General Geology

We reviewed the geologic information along the proposed corridor from the three USGS Geologic Quadrangles.

Along the southern portion of the Bighill Quadrangle, the valley bottom is comprised of alluvium. The hillsides are underlain by the Newman Limestone, the Pennington Formation, and the Lee Formation. Coal beds are denoted in the Lee Formation. A small section of the Borden Formation exists north of US 421, just southeast of Morrill. However, the Borden Formation is beyond the top of the ridge line and lies within another watershed.

At the northeast corner of the Johnetta Quadrangle, the lower valley bottoms are comprised of alluvium. The hillsides are underlain by the Newman Limestone, the Pennington Formation, and the Lee Formation. Coal beds are denoted in the Lee Formation.

Along the northern portion of the Sandgap Quadrangle, the valley bottom is comprised of alluvium. The hillsides are underlain by the Newman Limestone, the Pennington Formation,

and the Breathitt and Lee Formations. Coal beds are denoted in the Breathitt and Lee Formations.

Please reference the attached Figure 2, Geology Map for details. Also, please reference the attached Figures 3A and 3B, Geology Column drawings for descriptions of the applicable geologic units.

The local dip varies by quadrangle and generalized dips within the project areas are listed below:

<u>Quadrangle</u>	<u>Dip Direction</u>	<u>Dip (percent)</u>	<u>Dip (feet per mile)</u>
Bighill	Southeast	0.9	40 - 50
Johnetta	Southeast	0.8	40
Sandgap	Southeast	0.7	20 - 60

We would expect that the coal seams act as aquifers, and thus allow groundwater flow. Therefore, the groundwater flow would likely be toward southeast, or until it reaches daylight where it would then flow downhill to the valley bottoms and creeks.

Acid mine drainage is a possibility due to previous coal mining activities. Caves (karst topography) and acidic soils are likely near the Rockcastle County line where Mississippian aged limestone is present. No faults were identified on the geologic maps.

Review of USGS Maps for Mining Activities

We also reviewed the USGS topographic and geologic maps for each of these quadrangles looking for mine adits (openings) or other signs of mining activities.

The review of the USGS **topographic maps** for each quadrangle revealed the following data:

Bighill Quadrangle – no adits observed

Johnetta Quadrangle – no adits observed, one quarry symbol observed

Sandgap Quadrangle – several adits were observed near Sandgap and a few adits were noted near, and south of, Waneta

The review of the USGS **geologic maps** for each quadrangle revealed the following data:

Bighill Quadrangle – no adits observed

Johnetta Quadrangle – no adits observed, one quarry symbol observed

Sandgap Quadrangle – numerous adits were observed near Sandgap and several adits were noted near, and south of, Waneta

Previous Surface Mining

Based on our review of the topographic and geologic maps, no strip mining has occurred on either the Bighill or Johnetta quadrangles.

Surface (strip) mining has occurred on the Sandgap Quadrangle according to the geologic map. It appears that the surface mining is contour stripping, located high on the mountains above the roadway, or on the back side of the ridge line (away from the proposed corridor). We have not visited these strip mine sites; therefore, we do not know if hollowfills have been constructed, or if there are slope instability problems.

Previous Deep Mining

The Kentucky Department of Mines and Minerals in Frankfort, Kentucky has published public records for underground coal mining. This data is available on the internet at the web site minemaps.ky.gov. We reviewed this data for three quadrangles - Bighill, Johnetta, and Sandgap. Please be aware that these maps have just become available and have not been cross referenced or checked against the paper maps.

We also visited the Kentucky Department of Mines and Minerals in Frankfort, Kentucky to review each of the paper maps for these three quadrangles. Please note that these paper maps do not include all of the previous underground mining activity since mapping did not become common place until the 1970's. As such, unmapped deep mining (especially augering) may exist in some areas. Generally, the paper maps corresponded to the information available on the internet. However, there was one underground mine near Waneta that was within the proposed corridor that was not included in the internet files. This mining area was added to the polygon map indicating underground coal mining areas. Please reference the attached Figure 4, Underground Openings map for areas shaded in blue which indicates limits of underground coal mining activity.

Other Underground Openings

We also observed two quarries at Clover Bottom and both appear to be active mining operations. The quarry on the south side of US 421 is an underground mine, while the quarry on the north side of US 421 is an open pit surface mine (based on our visual observations). We are not aware of the limits of the underground quarry operation; therefore, we had to approximate the mine on the attached Underground Openings map. We understand that both of these quarries are owned and operated by the same owner; therefore, researching the mineral ownership within this area will be important. Please reference the attached Figure 4, Underground Openings map for areas shaded in orange which indicates quarry activity.

We have also included twelve (12) possible cave openings on the attached Figure 4, Underground Openings map. These locations were supplied by the public attendees during the public comment meeting and have not been field verified. However, they do correspond with the Mississippian limestone mapped on the geological quadrangle maps.

Gas and Oil Wells

Gas and oil wells (active and abandoned) have been mapped based on available public records. This data indicated one well within the proposed corridor – between Waneta and McKee. This data has not been field verified. Please reference the attached Figure 5, Oil & Gas Wells map for details.

Geotechnical Issues

We drove the existing route of US 421 within the project area and have noted several geotechnical issues within, or near, this area.

Of particular interest is the new section of US 421 as you approach the Jackson County line from Bighill. Several slope areas have rock blankets, or rock fill, which are indicative of slope instability problems. We understand that these areas were remediated during construction, for the new section of roadway. According to the geologic mapping this section occurred in the Borden Formation and on the down-dip side. The Borden Formation is not mapped on the section of indexes for the project.

From Morrill and extending to near Sandgap, we saw evidence of Karst activity. Sinkholes were obvious from Morrill to Clover Bottom (KY 1955). Rock outcrops were common along this section of roadway.

Two rock quarries exist near Clover Bottom. One of these rock quarries is an underground mining activity, while the other is a surface, open pit mine. Nearby blasting will be of concern to the operation of the underground quarry (due to roof rock fall issues). Both of these quarries occur along the edge of US 421 and are less than one quarter mile apart.

Previous surface mined areas (strip mining) are a concern near Sandgap. If a bypass is proposed for Sandgap, there is a possibility that some surface mined areas may be encountered. Strip mined areas have inherent problems (poor backfilling practices, random fill particle size, inadequate fill placement/compaction procedures, and acid mine drainage).

Deep mined areas were noted near Sandgap. Underground mine works could be encountered if a bypass is proposed for Sandgap. These areas carry a risk of subsidence, or for encountering the old mine works associated with shallow deep mines.

There is also an oil or gas well located between Waneta and McKee. A well presents constructability (blasting, etc.) and monetary issues.

Conclusions

From a geotechnical and constructability standpoint, we believe that the proposed corridor should avoid certain problem areas or potential geotechnical problems discussed above. The project faces constructability issues which are inherent to the local terrain. However, these issues cannot be eliminated and sound engineering solutions are available to address them.

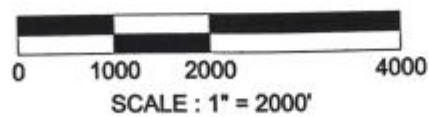
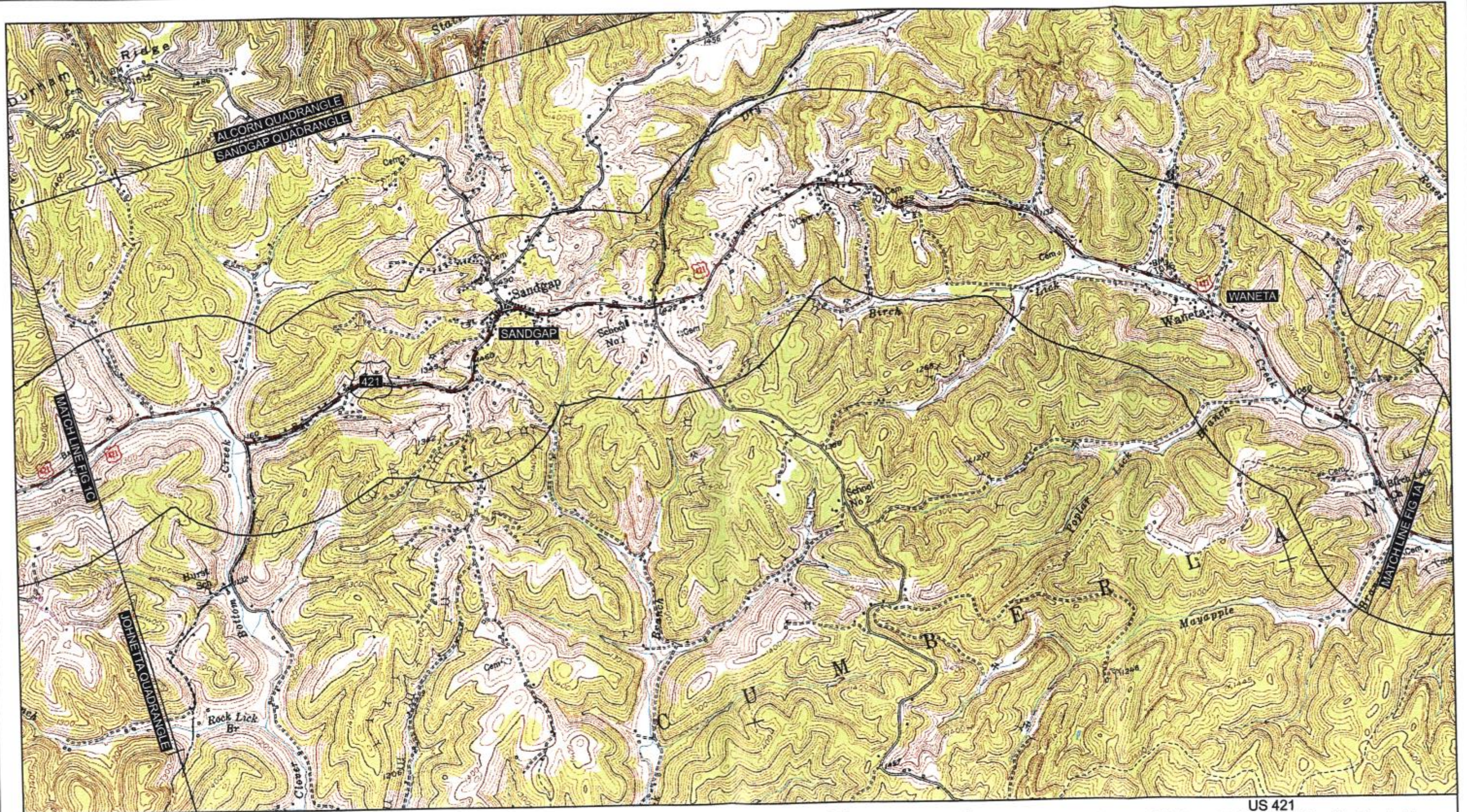
We believe that the most favorable corridor should avoid strip or deep mined areas due to the inherent problems associated with these types of areas. Additionally, we believe that the most favorable corridor should avoid the oil or gas well previously discussed. Additionally, the most favorable corridor should be along the up-dip side of side hill cut areas to lessen the possibility of groundwater and slope instability problems.

One alternate for this proposed project may include a by-pass around Sandgap. Since there is considerable underground coal mining within the area south of Sandgap, we recommend that you consider a by-pass on the north side of Sandgap. If the by-pass passes south of Sandgap, the grades may need to be adjusted so that the road cuts will extend to the depth of the bottom of the mined out coal seams in this area.

Recommendations

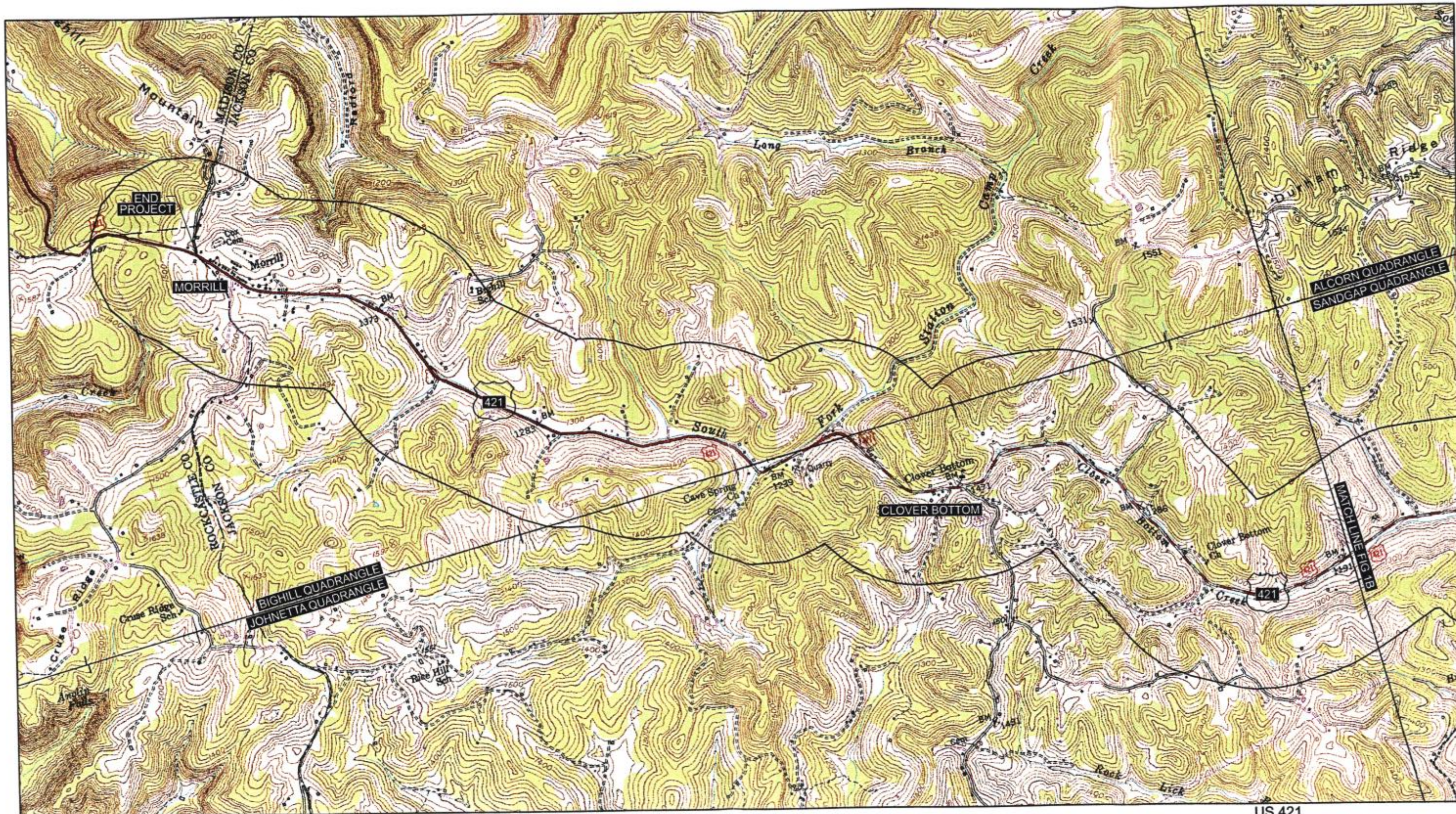
The following general recommendations are applicable to the proposed corridor:

1. Fill for embankments will likely consist primarily of shot rock from the Newman Limestone, the Pennington Formation, and the Breathitt and Lee Formations since soil overburden will be thin in most areas. Shot rock fill can be placed according to requirements as specified in the Kentucky Transportation Cabinet, Department of Highways, Standard Specifications for Road and Bridge Construction (latest edition).
2. Shrink/swell of newly placed fill should not be of significant concern in most areas. However, consolidation of soft, alluvial soils near the valley bottoms may present some settlement concerns for embankments or for box culverts or other drainage structures.
3. We expect that a mixture of soil and shot rock fill will be used for the majority of the roadway subgrade. The roadway subgrade could be constructed with durable rock if a more stable road base is desired. The local geology suggests that there may be some durable limestone or sandstone available within certain portions of the proposed corridor; however, we doubt that there will be sufficient volume to provide a durable rock roadbed without importing additional material.
4. We recommend that the selected corridor avoid contour strip or deep mined areas – if possible. Acid mine drainage is of concern for these areas and could be encountered - either from new cuts or from old mined areas. Special construction considerations such as limestone lined ditches may be required to mitigate the acid mine drainage. Additionally, cuts extending across deep mined areas may need to be over-excavated to the base of the coal seam elevation and backfilled to eliminate the possibility of future subsidence.
5. Groundwater seeps or springs should be expected in down-dip cut areas, especially those cuts that intersect a coal seam. As such, special construction considerations will likely be required to collect and pipe groundwater in these areas.
6. Steep cut slopes in massive, durable sandstone or limestone are typically stable with proper engineering of the cut slopes. Cut slopes in durable shale, poor limestone, or fractured sandstone are typically less stable than more durable rock and thus require less aggressive cut slopes. Cut slopes in non-durable shale will be even less stable, thus requiring even flatter cut slopes. Pre-splitting will likely be required once the rock disintegration zone (RDZ) has been encountered. An overburden bench and flattened cuts slopes will be required above the RDZ. Obviously, no geotechnical work has been performed for this project. Rock coring and a geologic evaluation will be required before specific cut slope recommendations can be presented.
7. We expect that a mixture of soil and shot rock fill will be used for fill slopes, thus the fill slopes will need to be engineered based upon the shear strength parameters of the applicable fill material. Rock toe buttresses may be required at the toe of fill slopes in deep alluvium soil areas.

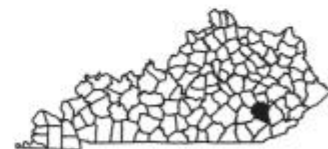


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US 421
From KY 421 at McKee to Rockcastle County Line
Jackson County, Kentucky
Item No. 11-113.00
PROPOSED CORRIDOR
FIGURE 1B



0 1000 2000 4000
SCALE: 1" = 2000'



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US 421
From KY 421 at McKee to Rockcastle County Line
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PROPOSED CORRIDOR
FIGURE 1C



0 1000 2000 4000
SCALE : 1" = 2000'



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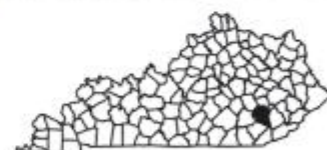
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PROPOSED CORRIDOR GEOLOGY
FIGURE 2A

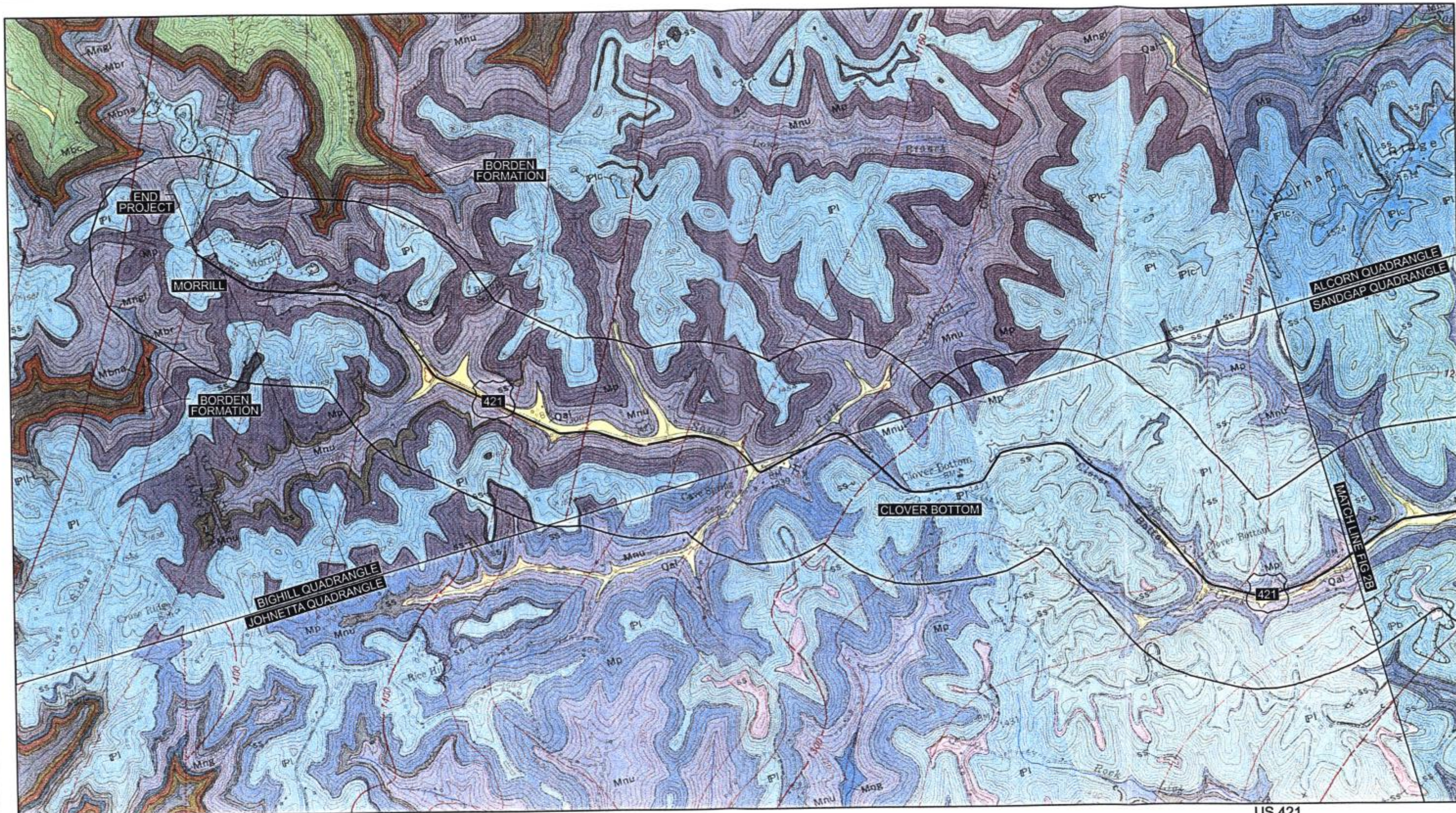


US 421
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PROPOSED CORRIDOR GEOLOGY
FIGURE 2B

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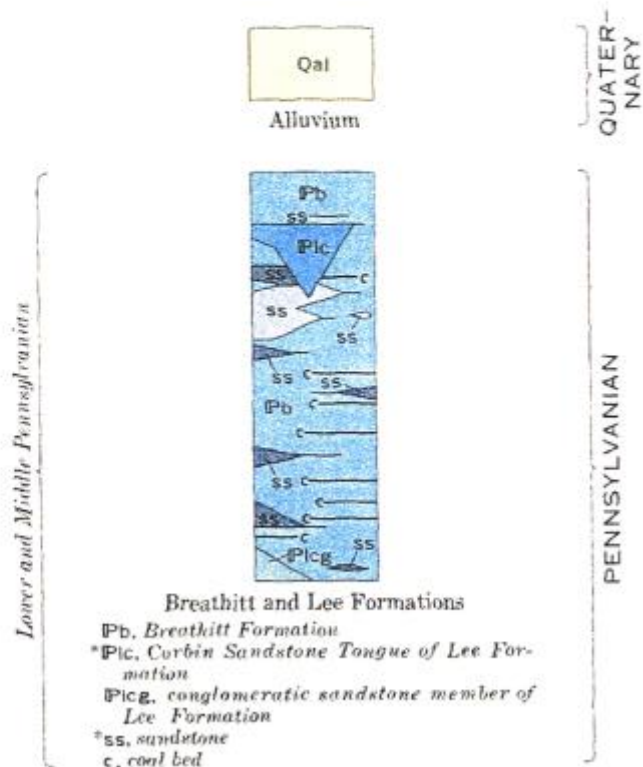


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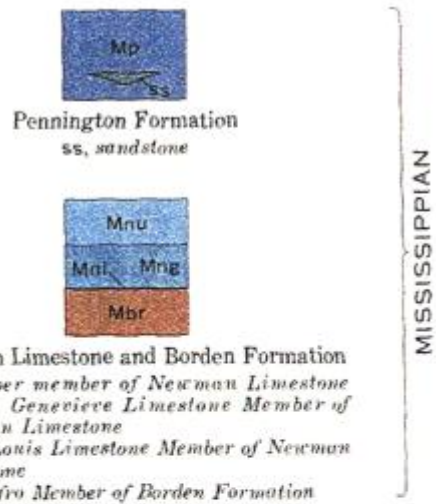
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PROPOSED CORRIDOR GEOLOGY
FIGURE 2C

EXPLANATION



UNCONFORMITY



*Shown by line where too thin to show color



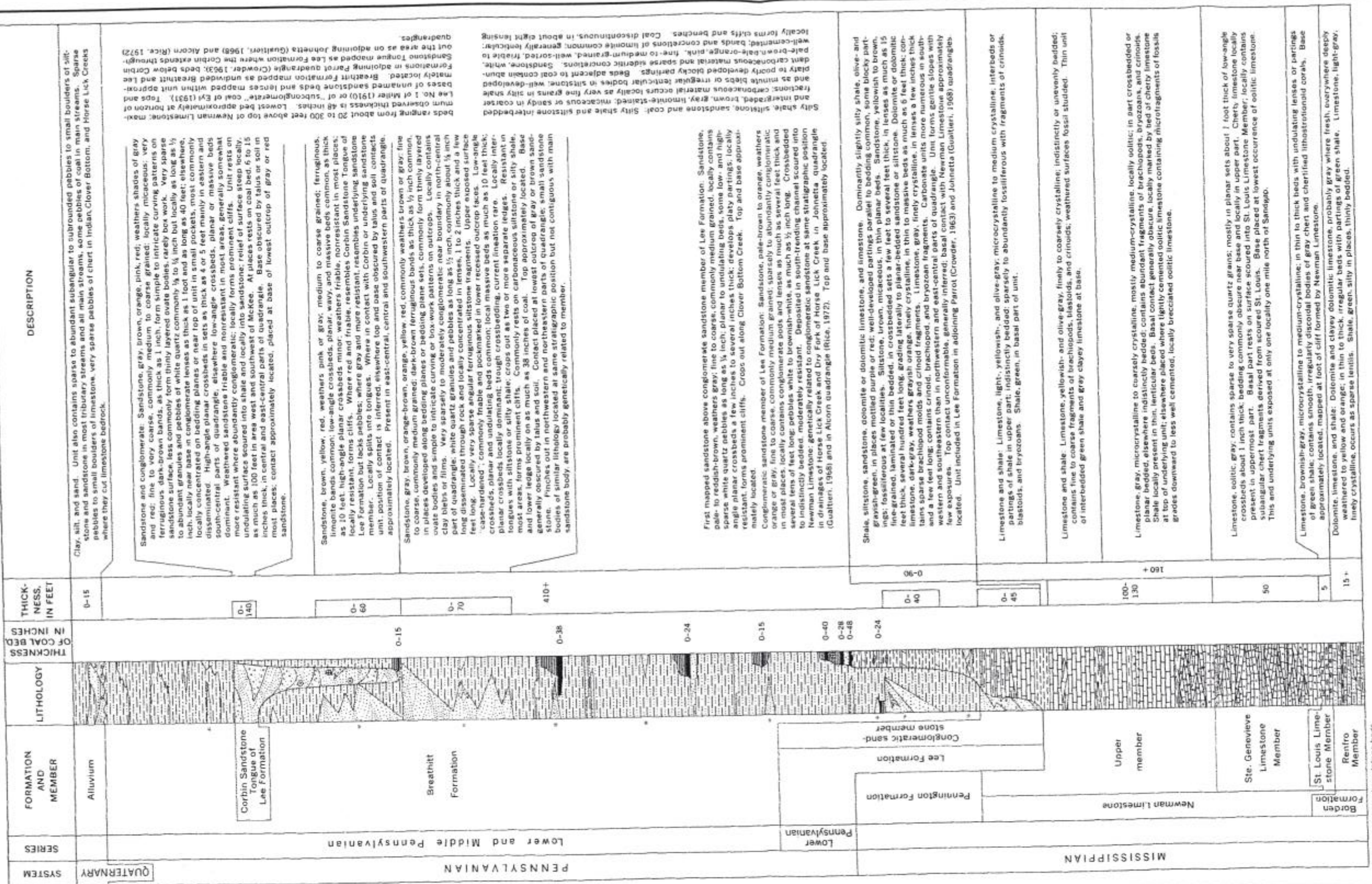
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PROPOSED CORRIDOR GEOLOGY COLUMN
FIGURE 3A

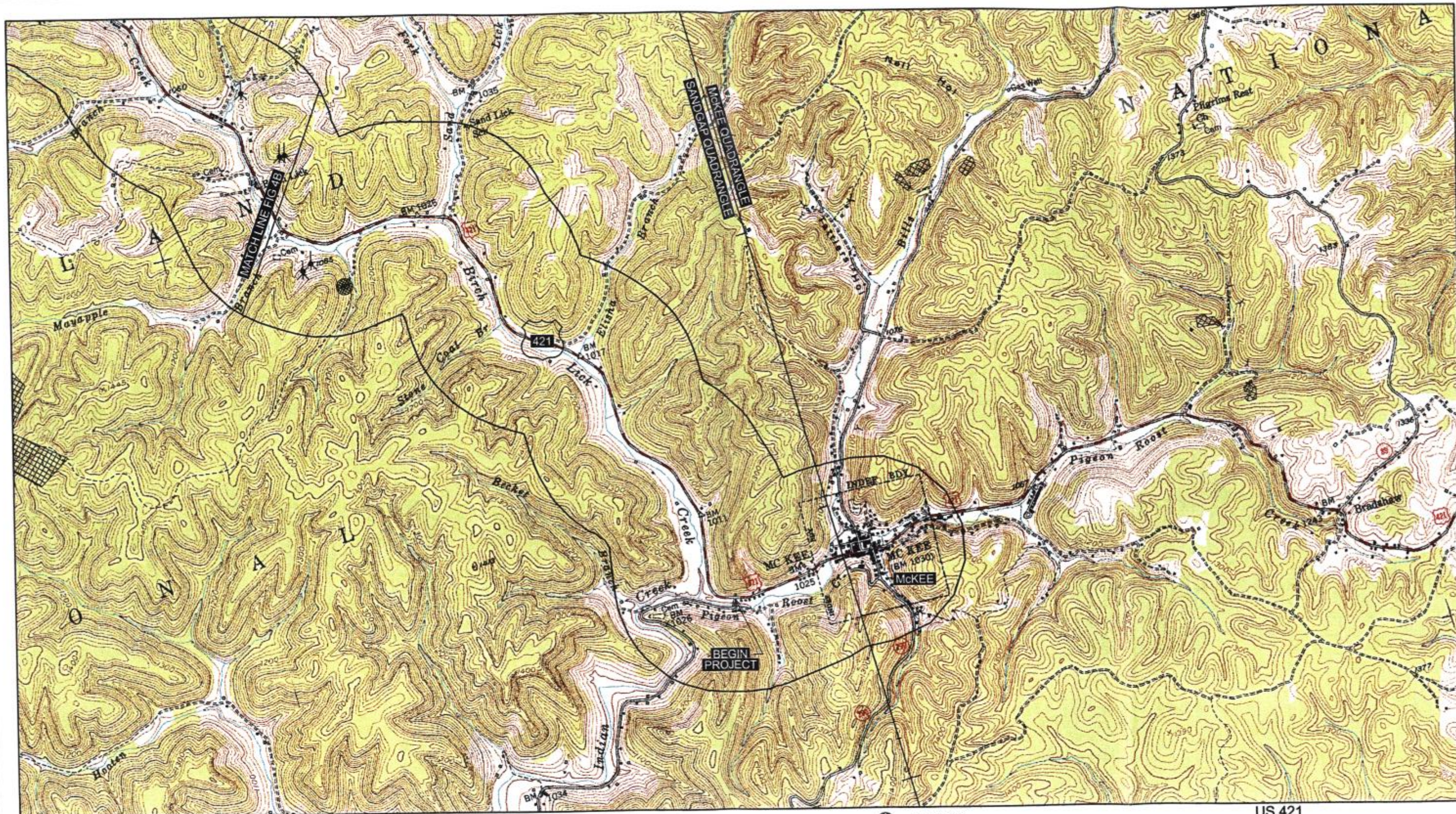


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PROPOSED CORRIDOR GEOLOGY COLUMN
FIGURE 3B



*mapped unnamed sandstone beds



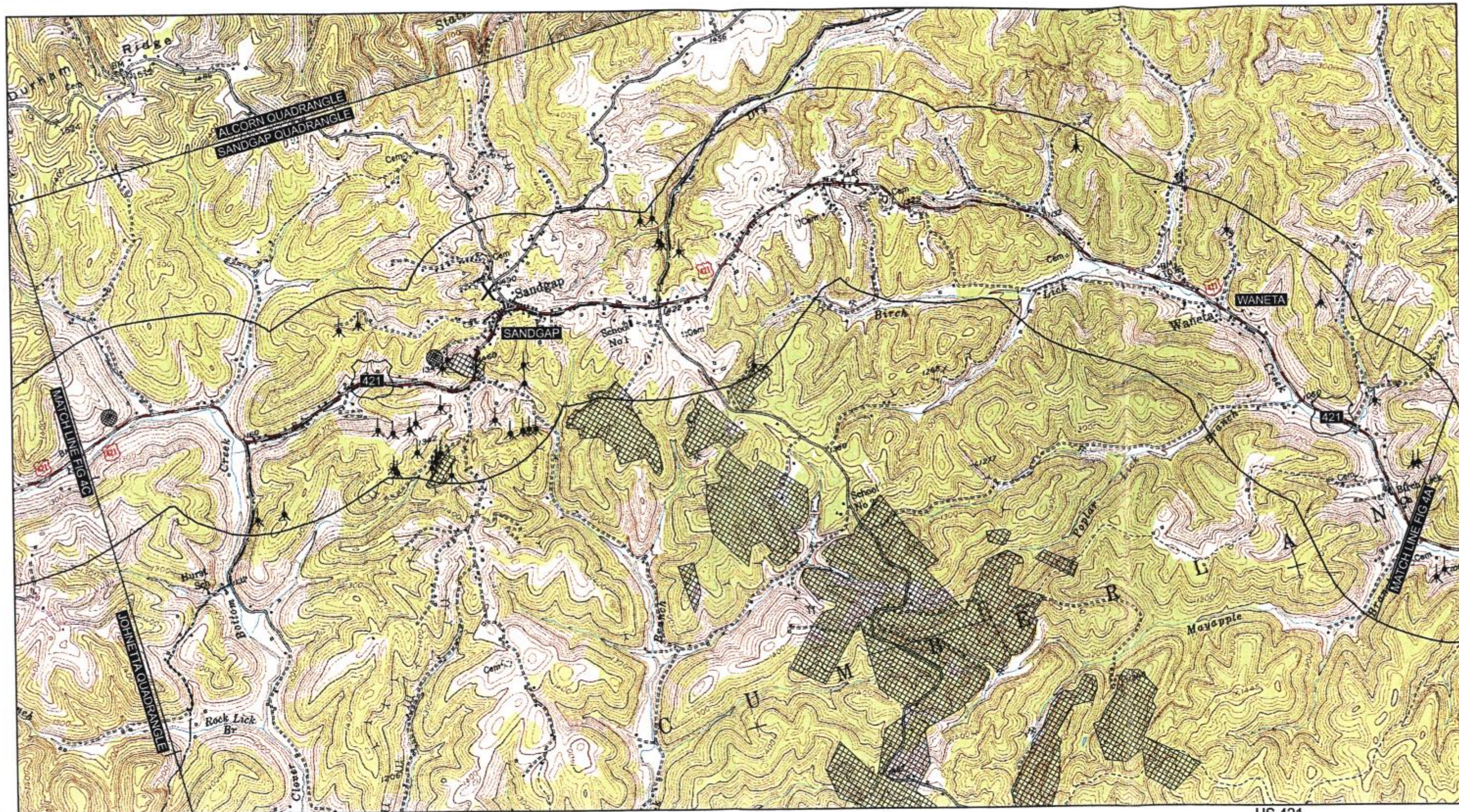
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- QUARRY
- POSSIBLE CAVE OPENING
- UNDERGROUND COAL MINING
- MINE ADIT

US 421
From KY 421 at McKee to Rockcastle County Line
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UNDERGROUND OPENINGS
FIGURE 4A



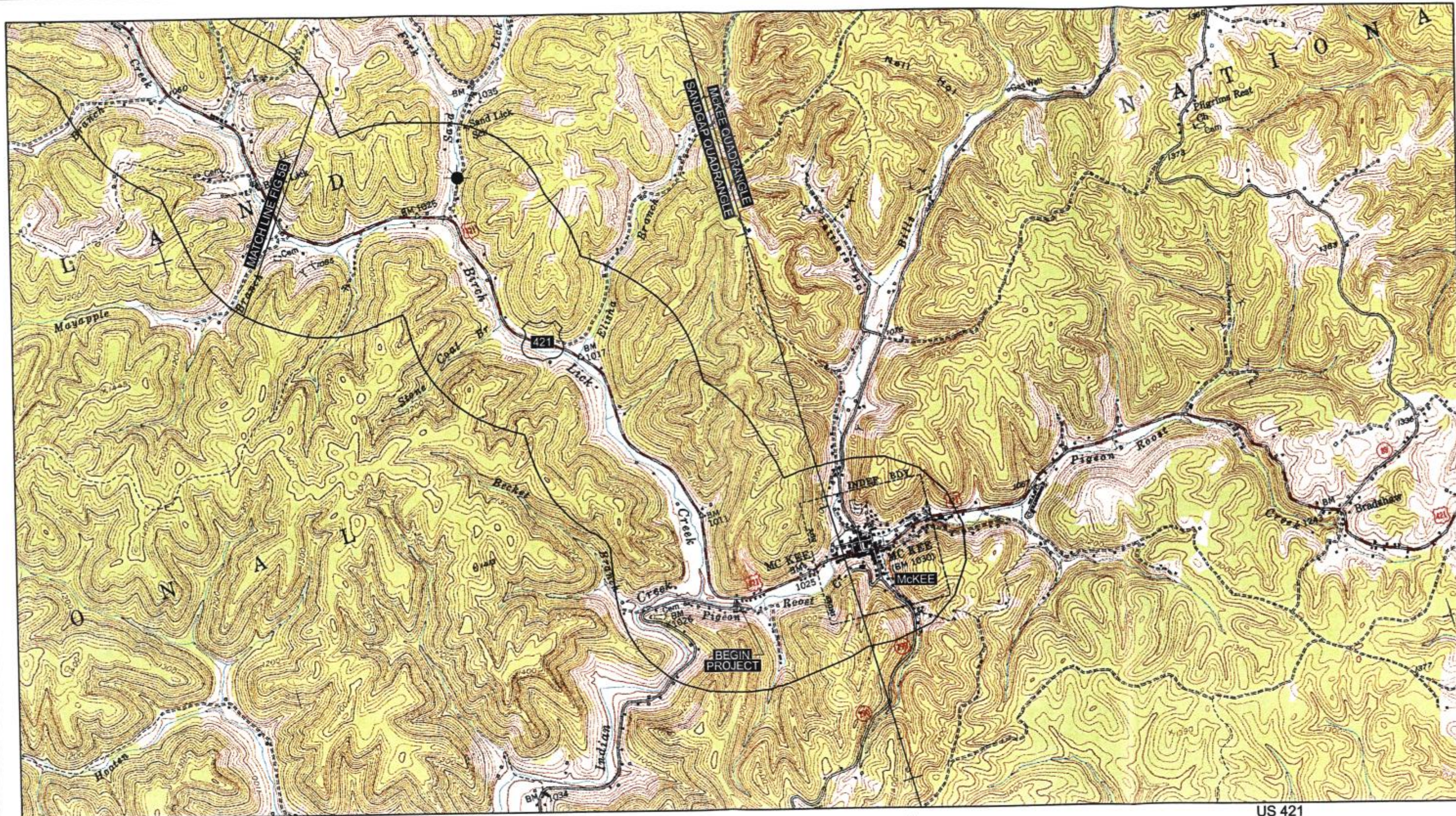
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- QUARRY
- POSSIBLE CAVE OPENING
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UNDERGROUND OPENINGS
FIGURE 4B



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OIL & GAS WELL

US 421
From KY 421 at McKee to Rockcastle County Line
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OIL & GAS WELLS
FIGURE 5A

