GEOTECHNICAL EVALUATION REPORT

Starfire Solar Project
Knott County, Kentucky

December 27, 2023

Table of Contents

Tables

Figures

Attachments

1 Introduction

ANS Geo has prepared this preliminary geotechnical desktop study for the Bright Night Starfire Solar project located in Knott, Perry, and Breathitt Counties, Kentucky. The purpose of this Study is to provide a high-level summary of the anticipated subsurface conditions across the project area using publicly available and in-house geologic data. **It should be noted that this Desktop Study is not intended to replace a conventional geotechnical investigation, proper engineering evaluation, and design.** ANS Geo is currently in the process of mobilizing to complete site-specific field investigations, and our Study is intended to provide early-stage information as an interim submission until site-specific information becomes available. While regional subsurface mapping provides general and useful information about the expected subsurface conditions and geohazard risks, a site-specific investigation must be conducted to confirm the assumptions and expected conditions match the information provided in this report.

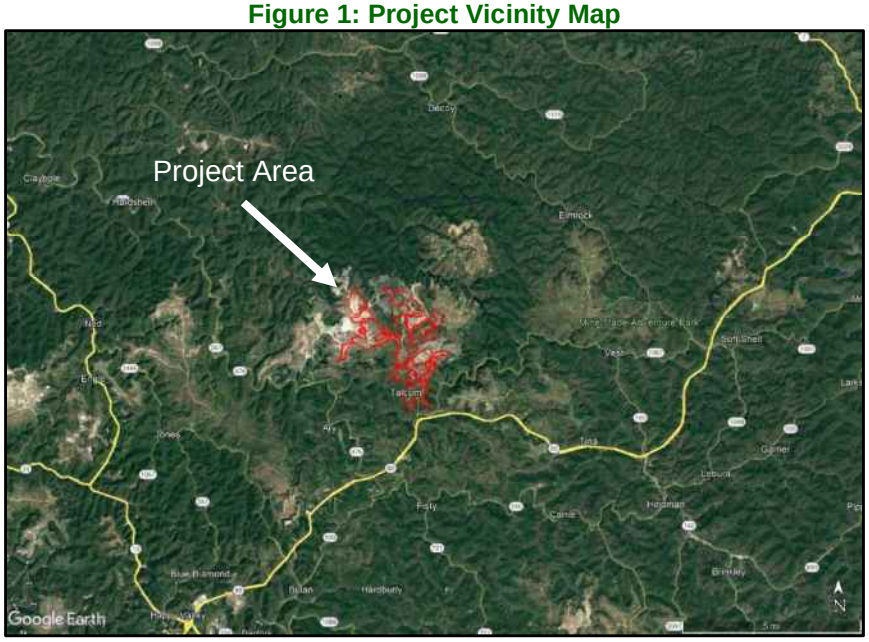
Based on the preliminary project information provided, we understand that the Starfire Solar project encompasses approximately 1,333.72 buildable acres of the inactive Starfire coal mine. The project is expected to consist of pre-drilled and driven steel post foundations (wide-flange I-beam or ground screws) within array areas, along with slab-on-grade and shallow foundations for lightly-loaded structures. Given the potential for uncontrolled backfilling and mine spoils, reinforced drilled piers and caissons may be necessary for heavily-loaded structures such as substation equipment and pole structures.

1.1 Location and Topographic Relief

The project is located in the location of the inactive Starfire coal mine across Knott, Perry and Breathitt Counties in Kentucky. The project area consists of abandoned coal mines and forested area. The majority of the site consists of moderately sloping or sloped topography (3-15% slope), the site is also surrounded by slopes averaging greater than 35%. Elevations range from approximately 1,149 feet above mean sea level (AMSL) to approximately 1,447 feet AMSL with an average of about 1,331 feet ASML. The project extents are bounded by approximate coordinates of 37.373195°N to 37.423012°N and 83.090240°W to 83.145785°W.

A Site Vicinity Map is provided as Figure 1. A Location Plan showing the project boundary along with various geological and site mapping has been provided within **Attachment A**.

Figure 1: Project Vicinity Map



2 Geologic References

ANS Geo conducted a desktop study of local geology within the project area using publicly available references including published maps, historic geotechnical investigations and well logs in the region, and online geologic databases. Maps based on publicly available, non-proprietary data are provided as **Attachment B**.

2.1 Mapped Surficial Geology

ANS Geo reviewed surficial geologic mapping made available by the United States Geological Survey (USGS), and the Library of Congress Kentucky general soil map which indicated the project area is mapped within the Eastern Coalfields which will include areas of mine workings and controlled and uncontrolled "man-made" fill and disturbed soil. In areas where mine workings have not been completed, or where areas remain untouched, those areas encompass the smaller soil units mentioned in the NRCS report. Soil properties in native condition are generally considered well-draining, moderately rapid permeability, highly sloped, channery loam soil; however, in areas with working, soil properties are expected to be heterogeneous and irregular. The site-specific investigation which is currently underway will be aimed at understanding the variation of soil properties across the project buildable areas.

ANS Geo additionally reviewed surficial soil mapping available from the Natural Resource Conservation Service (NRCS) Web Soil Survey application. The NRCS survey was initially created for agricultural purposes and is generally limited to the upper five feet BGS; however, the resource provides generalized information pertaining to the soil chemistry and properties. The NRCS mapping identifies the project area to be comprised of several soil units, but the largest four (4) were taken into consideration which comprise a total of 96.0% of the project area. A summary of predominant soil unit properties is provided as Table 1 and the full report is provided as **Attachment B**.

Table 1: NRCS Soil Properties

Soil Unit	Drainage Class	Hydrologic Soil Group	Percent of Area of Interest (%)	Available Water Supply	Erosion Hazard
Fiveblock and Kaymine Loam	Well drained to somewhat excessively drained	A	54.4	Low (5.4 in.)	Slight
Kaymine, Fairpoint, and Fiveblock Loam	Well drained to somewhat excessively drained	A	16.4	Low to moderate (4.3 – 7.2 in.)	Moderate
Fairpoint and Bethesda Loam	Well drained	C	13.0	Low (4.4 - 4.5 in.)	Severe
Fairpoint Loam	Well drained	C	12.2	Low (4.2 in.)	Moderate

Native soil mostly comprise of residual materials developed in alluvial sediments. They are generally discontinuous, or patchy in distribution, and are Holocene to Tertiary in age. ANS Geo notes that NRCS mapping indicates the native soil units generally present a low risk of corrosion of concrete and a low risk of corrosion of steel. Confirmatory sampling and testing will be completed during the geotechnical investigation which will provide data to complete our evaluation on these concerns.

2.2 Mapped Bedrock Geology

ANS Geo reviewed geologic maps made available by the United States Geological Survey (USGS) and Kentucky Geological Survey, which indicated the project area is mapped within the Breathitt Formation dating to the Pennsylvanian geologic subperiod. The majority of the site is within the Breathitt Formation, Middle Part which comprises of Sandstone and Shale, with Siltstone, coal, and limestone as minor components. Some portions in the East and South of the project site are within the Breathitt Formation, Upper Part which comprises of Sandstone and Siltstone with coal and limestone as minor constituents. Based on well data provided by the Kentucky Geological Survey, shallow bedrock has been observed South of the project site at depths between 5.5 and 22 feet BGS. It is expected, however, that the workings of the area as a former mine will lead to irregular presence of "cobbles", "boulders", and larger tailing remnants.

2.3 Historical Land Use

ANS Geo reviewed active mining permits and datalogging provided by the Mineral Resources Online Spatial Data from the United States Geological Survey (USGS), as well as project planning and site overview provided by Bright Night in the form of "BrightNight Starfire – Shareable Project Overview" dated September 16, 2022. The project site is located within the Starfire coal mine, which is in varying stages of reclamation as of the aforementioned project overview. The data provided by the USGS identifies 3 separate strip mine features within the project boundary, as well as two adits near the western portion of the site. As of September 16, 2022, the only remaining active area of the Starfire mine was in the northeast section of the project site and had begun back-stacking. The project site will consist of reclaimed coal mines, and thus on-site soil is anticipated to consist of mine spoil with some areas of fill. It is likely that the on-site conditions will contain bedrock at depths shallower than the surrounding area. According to oil and gas well data provided by the Kentucky Geological Survey, several oil and gas mines have been historically completed within the project boundaries, however the are no known active locations.

2.4 Geologic Impacts and Hazards

It is our professional opinion that the construction of the proposed solar farm development will not create significant impacts to the regional geology provided appropriate construction practices and proper soil erosion and sediment control measures are maintained. The potential impacts considered include, but are not limited to, shallow rock, subsidence - mining, and slope failure.

A summary of geologic conditions has been provided as Table 2. Based on our understanding of the expected site geology, ANS Geo has also prepared a summary of expected geologic hazards as Table 3.

Table 2: Geologic Summary

Hazard	Presence	Concern	Comment
Flooding/High Groundwater	No	Low	FEMA Flood Hazard mapping indicates the site has no mapped 100-year floodplains. Publicly available well data provided by the Kentucky Geological Survey shows an average groundwater depth of about 40 feet BGS South of the project site. Some instances of groundwater as shallow as 8.2 feet BGS were observed. It is possible that seasonal variations can lead to perched water conditions on site.
Frost Action	Yes	Low to Moderate	The average frost depth for Perry, Breathitt, and Knott counties in Kentucky is mapped at approximately 24 inches below grade. Foundations should be constructed at least 24 inches below grade.
Slope Failure	Yes	High	The site has a highly sloped topography that features sections with greater than 35% slope. The project boundary is surrounded by areas of >35% slope.
Subsidence – Pumping	No	Low	There is no known active oil and gas development in the project boundary, however many previously completed oil and gas wells are present within the project boundary
Subsidence – Mining	Yes	High	The proposed project site is located within the previously active Starfire coal mine. There are three main sections within the boundary designated by the USGS as strip mines in the north, east, and south of the site. These locations, along with known adits are present in the Mining Features map provided in **Attachment A**.
Subsidence – Caves/Karst	No	No	There are no known karst susceptible formations within the project area.
Earthquake – Seismicity	Yes	Moderate	The project area is mapped within a moderate hazard zone based on the USGS "2018 Long-term National Seismic Hazard Map".
Liquefaction	No	Low	There is a low susceptibility to liquefaction due to the moderate seismic activity in the area, and the near surface soil qualities such as high drainage and permeability, and the presence of cohesive soils underlain by shallow bedrock.
Swelling/Shrinking Soil	No	Low	Based on the "Swelling Clays Map of the Conterminous United States" provided by the USGS, the project area is mapped within material that contains generally less than 50 percent clays having slight to moderate swelling potential.

Hazard	Presence	Concern	Comment
Excessive Settlement	No	Low	Excessive settlement is not anticipated due to near surface soil qualities and shallow bedrock.
Tsunami/Hurricane/ High Winds	No	Low	FEMA national risk index rates the area as a very low risk for hurricanes and of no risk of tsunami. ASCE Chapter 7 hazard tool shows the project site outside of the hurricane zone and gives a wind speed of 105 Vmph.
Corrosive Soil	Yes	Moderate	NRCS mapping indicated a low risk of corrosion to concrete and low risk of corrosion to steel throughout the site; however, mine tailings and fractions of ore can increase corrosivity to a "moderate" condition.
Fill Soils/Made Ground	Yes	Moderate	The project area is located on an inactive coal mine that likely utilized fill in some areas of the site. The NRCS survey indicates 40.2 acres on site as "Dumps, mines and tailings".
Collapsible Soil	No	No	Collapsible soils are not mapped within the project boundaries.
Quick Clay	No	Low	Quick clays are not mapped within the project boundaries.

Table 3: Summary of Potential Impacts from Geologic Conditions

Hazard	Likelihood	Significance	Potential Mitigation Measures	Recommended Next Steps
Shallow Rock	High	Post embedment affected; burial of cabling affected; longer construction duration.	Pre-drill rock to install posts to target embedment within rock.	Geotechnical investigation and laboratory testing of soils collected during investigation.
Shrink/ Swell of Soils	Low	Expansive soils will affect foundation capacity.	Over-excavate expansive soils and replace with compacted structural fill or design foundations to withstand expected soil-induced shrink/swell pressures.	Geotechnical investigation and laboratory testing of soils collected during investigation.
Collapse Potential	Low	Upper zones of soil may provide limited axial and lateral capacity.	Remove, replace, or remediate material.	Geotechnical investigation and laboratory testing of soils collected during investigation.
Seismicity	Moderate	Increased seismic forces may be exerted onto foundations.	Incorporate seismic conditions into design.	Geophysical testing (MASW) in order to determine sheer wave velocities across site for seismic analysis.
Corrosive Soil	Low	Steel loss and decreased service life; additional cost.	Design and select concrete mix and cement type to accommodate corrosivity potential. Galvanized zinc coating for steel piles is anticipated.	Laboratory testing of soils collected during investigation.
Frost Action	Low to moderate	Soil ad-freeze and frost heave can affect foundation bearing capacities.	Extend foundations below frost depth. Install granular, free-draining fill beneath foundations.	Desktop evaluation of frost depth, depth of seasonal moisture, and type of overburden soils.
Re-use of Native Soils as Structural Fill	Low	Fine-grained soils (silts and clays) may not be re-usable as structural fill.	Import material for use as structural fill.	Geotechnical investigation and laboratory testing of soils collected during investigation.
Perched and Shallow Groundwater	Low	Presence of groundwater will require evaluation of foundations considering submerged condition, leading to increased cost.	Pumping or dewatering measures may be necessary within the project site	Geotechnical investigation should be performed to determine if water is present on site.
Use of Native Soil as Access Road Subbase	Low	Fine-grained soils (silts and clays) may not be re-usable as road subbase. Low CBR will require thicker section of access road stone.	Use of geotextile or geogrid (bi-axial or tri-axial) reinforcement to decrease the anticipated thickness of access stone.	Geotechnical investigation and laboratory testing of soils collected during investigation.
Soft Soils for Access Roads/ Crane Pads	Low	Soft soils (silts and clays) may create excessive rutting for access routes.	Cement or lime-stabilization of soil may be used to increase workability and decrease potential for ruts.	Geotechnical investigation and laboratory testing of soils collected during investigation.

3 Anticipated Subsurface Conditions

Based on the reviewed geologic data and our knowledge of the basic geologic conditions within the project areas, ANS Geo has generated a likely soil profile for the project site as Table 4 below.

Table 4: Generalized Subsurface Profile

Material	Description
Clay, Silt, Sand Mixture (Native Soil)	A mixture of sand/silt/clay from mine spoil derived from sedimentary rock is expected throughout the site in areas which were undisturbed based on review of available NRCS data, geological mapping, and ANS Geo's experience of the project area.
Mixed Granular Material (Mine Tailings/Spoil)	In areas where mine workings were completed, and/or where mine tailings and backfill were placed, a heterogeneous mixture of materials with various sizes will be encountered. This may include large cobbles and boulders, and even larger fragments of rock, down to clay, silt, and sand-sized particles intermixed. It is also possible that uncontrolled material (such as vegetative matter, wood, trash, or other debris) may also be encountered sporadically throughout the subsurface.

The thickness of soil layers will vary across the project site; therefore, ANS Geo has not provided a specific depth for layering within the project boundary. This will be evaluated on a per-boring basis. It should also be noted that the profiles represent an expected subsurface profile prepared by compiling and evaluating publicly available and nearby historic geotechnical records. While the profile is based on our professional opinion, it should not be relied upon for detailed design and should be confirmed by site-specific geotechnical investigations prior to design.

According to data provided through well records, as well as geologic mapping provided by the Kentucky Geological Survey, bedrock depth on site is anticipated to be shallow due to mining activities and nearby bedrock depths averaging 14 feet BGS.

3.1 Groundwater

ANS Geo reviewed available resources for groundwater depths near the site examining maps made using Kentucky Geological Survey well data. The mapped groundwater depth varied between 8.2 and 105 feet BGS within the general vicinity of the project, averaging around 40 feet BGS. No groundwater depth data was available within the project boundary, therefore it is possible that areas of shallow groundwater exist within the site. ANS Geo recommends being prepared to encounter shallow groundwater within the project site. It should be noted that the most prominent soils on site (Fiveblock, kaymine, fairpoint, and Bethesda) are known to be well-draining to somewhat excessively well-draining, however it is possible that perched water conditions may exist at times of high precipitation.

3.2 Wetlands

According to the National Wetlands Inventory, the project site contains several freshwater ponds and creeks. Kitchen Fork enters the western portion of the site and contains an emergent wetland area classified as Palustrine, seasonally flooded and impounded. These wetlands are described as nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per trillion (ppt) . On the East of the site there are two emergent wetlands that are classified as Palustrine, permanently flooded and excavated. The emergent wetlands documented on site are the result of mining operations. Additionally, based on the project information provided by Bright Night, there is no planned development within the delineated wetlands features identified on site.

4 Anticipated Design Parameters - Foundations

4.1 Foundation Considerations

The project is expected to consist of pre-drilled and driven steel post foundations (wide-flange I-beam or ground screws) within array areas, along with slab-on-grade and shallow foundations for lightly-loaded structures. Given the potential for uncontrolled backfilling and mine spoils, reinforced drilled piers and caissons may be necessary for heavily-loaded structures such as substation equipment and pole structures.

4.1.1 Solar Array Foundations

ANS Geo anticipates that, as typical with solar farm construction, conventionally-driven and embedded posts, such as W6x9 H-piles, will be difficult to install across the project site due to the presence of mine spoils and uncontrolled fill. If conventional techniques are used, it is expected and likely that a high number of refusals, damaged piles, and pile remediation will be encountered. Therefore, it is anticipated that pre-drilling using an over-sized hole, backfilling with native or imported soil, and the installation of conventional piles will be a primary method of array pile installation. Alternatively, a ground screw system or proprietary system such as “Ojjo” piles may be possible at the site to advance through the heterogenous mine spoil and shallow rock material.

Based on the expected stiff soil near the surface, pile embedments are anticipated to be around 10 feet below for standard single-axis, one-in-portrait (1P) systems. This embedment depth could be deeper if a larger system is used, or if a site-specific Hydrology Study indicates potential erosion across the site over the life of the project. This erosion would then increase the exposed height of the pile, requiring increased resistance to bending and embedment. If pull-out testing reveals capacities are achieved at a shallower embedment depth, this embedment depth can also be reduced; however, we expect that lateral fixity will not occur until approximately 6-feet below grade as a minimum embedment with a two-foot socket into rock or 7.5-feet if soil is encountered.

4.1.2 Substation and BESS Foundations

It is anticipated that traditional cast-in-place and slab-on-grade will be possible for the site. It is anticipated that the allowable soil bearing capacity on properly prepared, compacted, and proof-rolled material will be 1,500 psf. Over-excavation of native soil, placement of a geotextile separation fabric, and replacement with at least 12-inches of compacted, crushed stone fill may be required beneath foundations if soft or unstable subbase soil is encountered during construction. The purpose of the crushed stone is to provide a firm, unyielding and non-dissolving subbase, and reduce the concern of sulfate attack on buried concrete elements.

4.1.3 Transmission Line Poles

It is expected that transmission line poles can be installed using drilled caissons for transmission, dead-end, and H or A-frame structures. The use of casing may be required during the installation of pole structures, if groundwater is encountered in local portions of the site.

4.2 Frost Considerations

In Knott, Perry, and Breathitt Counties, Kentucky, frost depth is mapped at approximately 24 inches below grade. All structural foundations should be founded at least 24 inches below grade or deeper to ensure adequate protection from frost conditions which may affect the integrity of subgrade soils and associated substructure.

Small slab or isolated footing foundations supporting minor housekeeping structures with minimal loads and applied pressures (500 pounds per square foot or less) may be founded at shallower depths. However, measures such as free-draining, granular fill beneath the foundation, extending to at least 6 inches below the foundations, should be implemented.

4.3 Anticipated Soil Parameters

Based on our interpretation of the subsurface conditions observed within our limited study of geological references, ANS Geo has provided *preliminary* soil parameters for the site soils. It should be noted that these parameters may only be used to inform early-stage engineering design and should not be relied upon without a site-specific geotechnical investigation and geotechnical engineering. The soil parameters provided in Table 5 below may be adjusted based on the findings of a site-specific subsurface investigation.

Table 5: Preliminary Soil Parameters

Material	Unit Weight [lb/ft^3]	Cohesion	Angle of Internal Friction	Allowable Bearing Capacity	Allowable Side Resistance
Clay, Silt, Sand Mixture (Native Soil)	γdry = 105 - 110 γsat = 125-130	1,000 to 1,750 psf	32 - 34	2,000 – 2,500 psf	175 - 375 psf (increasing with depth)
Native Rock	γdry = 135 - 140 γsat = 140 - 160	-	39	3,000 psf	250 - 500 psf (increasing with depth)
Mixed Granular Material (Mine Tailings/Spoil)	γdry = 100 - 115 γsat = 120 - 140	1,000 to 1,750 psf	29 - 35	1,500 – 2,000 psf	150 - 350 psf (increasing with depth)

4.4 California Bearing Ratio

As the near-surface soils are expected to be a channery mix of sand, silt, and clay with shallow bedrock, we anticipate a CBR value of between 4 to 7 percent when stripped of topsoil, proof-rolled, and properly compacted to at least 95% Standard Proctor maximum dry density (per ASTM D698).

4.5 Anticipated Design Parameters – Thermal and Electrical Resistivity

ANS Geo has estimated the thermal and electrical resistivity of overburden soil based on our review of the geologic references, assumption of soil conditions, and our engineering judgement. It should be noted that the parameters in Table 6 have been provided for **preliminary** design only, to provide order-of-magnitude estimates and should not be used for design. The data provided in Table 6 is based on ANS Geo's experience for similar soil types and must be verified by a site-specific geotechnical investigation prior to final design.

Table 6: Preliminary Soil Parameters – Thermal and Electrical Resistivity

Material	Thermal Resistivity (°C-cm/W)	Optimum Moisture	Electrical Resistivity (Ohm-cm)
Clay, Silt, Sand Mixture (Native Soil)	100 – 300	7 - 11 %	4,000 – 15,000
Native Rock	225 - 275	-	20,000+
Mixed Granular Material (Mine Tailings/Spoil)	175 - 350	8 - 12 %	750 – 6,000

4.6 Seismic Site Classification

Based on our preliminary research of the local area, we anticipate a seismic site class C for "very dense soil and soft rock" should be utilized across the project site. The following Site Class C seismic ground motion values were obtained from the USGS Seismic Hazard Maps from ASCE 7-16 Standard, for this site:

- 0.2 second spectral response acceleration, S_S= 0.214 g
- 1 second spectral response acceleration, S_1= 0.083 g
- Maximum spectral acceleration for short periods, S_{MS}= 0.278 g
- Maximum spectral acceleration for a 1-second period, S_{M1}= 0.125
- 5% damped design spectral acceleration at short periods, S_{DS}= 0.185
- 5% damped design spectral acceleration at 1-second period, S_{D1}= 0.083

The designated seismic site class is anticipated based on the observed records of existing soil type from our review of public data. Seismic support data is provided as **Attachment F**. Based on our observation of subsurface conditions, estimated Site Class ratings, and review of USGS's 2018 National Seismic Hazard Map, ANS Geo concludes that there is a low to moderate risk of significant seismic activity which may impact the proposed solar facility.

5 Construction Considerations

5.1 Site Preparation

Substation, inverter pads, and other equipment areas will need to be cleared and scrubbed of existing vegetation and topsoil prior to construction of foundations. Vegetation and topsoil should be properly disposed of off-site, or re-purposed in landscaping areas away from proposed structures. Surfaces receiving foundations should be excavated and prepared to a level, stable surface.

During construction, weather, seasonal conditions, earthwork, stripping of vegetation, and other activities may cause the site to become wet and demonstrate poorer conditions. Stabilization, protecting exposed soil, dewatering, surface water management, soil improvement, moisture conditioning, and other activities may be required. Where grading is required, we anticipate a maximum permanent permissible slope of three horizontal-on-one vertical (3H:1V). Should steeper slopes be necessary, the use of erosion control blankets such as Curlex II should be implemented to prevent erosion and promote vegetative growth. Erosion control blankets or other fabric should be properly staked in accordance with manufacturer requirements and recommendations. Even with stabilization, we do not recommend slopes exceeding (be steeper than) 1.5H:1V.

5.2 Excavation

Depending on proposed foundation configurations, degree of earthwork, and depth of utilities, some excavations may extend deeper than four feet below grade. Excavations deeper than four feet should be shored or sloped and benched, in accordance with OSHA regulations, to ensure safe working conditions within the excavations. For benching purposes, cohesive material (clay and silt) identified on-site may be considered as "Type A" material and should be sloped no steeper than ¾H:1V (horizontal to vertical). The rest of the site is considered cohesive material designated as, "Type C" material and should be sloped no steeper than 4H:1V (horizontal to vertical). All OSHA soil classifications should be field-determined by the contractor's "competent person" prior to excavation.

5.3 Dewatering

As mentioned in **Section 3.1**, publicly available mapping show depth to ground water ranging from 8.2 to 105 feet below grade. A full scope geotechnical investigation including soil borings and/or test pits should be performed to determine depth to groundwater, or lack of for foundation design and construction considerations. Notwithstanding, given the topography of the site and anticipated poor-draining nature based on NRCS mapping, we anticipate the need to manage groundwater, perched water, and/or infiltrated stormwater using localized sump-and-pump or similar techniques to allow for concrete foundation construction in-the-dry. Water discharge should be managed in compliance with applicable state and local regulations. During construction, the contractor should be sure to grade the surface as necessary to divert stormwater away from open excavation to the extent possible.

In addition, ANS Geo notes that the presence of standing water or shallow water may exist across the site during construction and development. The presence of this shallow water or standing water may make the native soil subgrade softer, and it may require additional site preparation to allow vehicles and equipment to pass. Furthermore, based on the season and time of construction, precipitation may cause wetter soil conditions which need to be considered and managed. These conditions may increase the need for additional access stone and/or cement or lime for the stabilization of these conditions.

5.4 Fill Material

5.4.1 Re-use of Native Soils

ANS Geo has summarized throughout our Report that the site is expected to contain fine-grained soils such as a sand/silt/clay mixture, as well as mine tailings. When considering re-use, any native soils with considerable fine-grained content (more than 20 percent) may be difficult to handle, place, and compact without proper moisture conditioning and protection. This condition can be managed, when the following considerations are made to reduce the adverse impacts of moisture-sensitive soils:

- Positive measure is implemented and maintained to intercept and direct surface water away from moisture-sensitive subgrade surfaces.
- Subgrade surfaces are sloped and, as appropriate, seal-rolled to facilitate proper drainage.
- Surfaces are properly prepared in anticipation of inclement weather. Moisture should not be allowed to collect on subgrade surfaces.
- To the extent practical, the limits of exposed subgrade soils are minimized.
- Construction traffic is limited to properly constructed haul roads.
- Disturbed soils are removed and replaced with compacted controlled fill material.
- In place moisture contents are maintained with two percent wet/dry of the optimum moisture content as determined by the Modified Proctor Test (ASTM D1557).

Native fine-grained soil may be re-used across the project area for fill in landscaped areas and in cable trenches unless otherwise specified; however, native fill should not be used under or above foundations or load-bearing structures where typically imported structural fill is used. Native material used as backfill for cable trenches should be handled and placed at a moisture content at or above its optimum value to ensure representative thermal properties are maintained. In areas around and above installed foundations, large utilities, and other buried site features, ANS Geo would recommend native soils with less than 20 percent fine-grained content may be used as general backfill. Otherwise, imported material meeting these criteria should be used.

In all cases, general backfill should be placed in loose lift thicknesses not exceeding 12 inches. General backfill in cable trenches and in landscaped areas should be compacted to a minimum density of 85% Modified Proctor Density (ASTM D1557). In all other locations, such as adjacent to and above foundations and in structural areas, general backfill should be compacted to at least 95 percent of its Modified Proctor Density (ASTM D1557). Compaction should be confirmed at a minimum frequency of one test per 50 cubic yards, and at minimum two (2) tests per lift of backfill and compaction. Soil used as backfill should not be handled when frozen and should be free of excessive moisture, organics, and deleterious material.

5.4.2 Structural Fill

Prior to the installation of shallow (non-driven pile) foundations, ANS Geo would recommend over-excavating the subgrade by at least 12 inches, lining the exposed material with a geotextile separation fabric, and bringing the subgrade back up to the design foundation elevation with compacted structural fill as specified within Table 7. Native material beneath the separation fabric should be inspected for unsatisfactory conditions such as standing water, frozen soil, organics, protruding cobbles or boulders, or deleterious materials. Should any unsatisfactory conditions exist within the native subgrade, the excavation is expected to be undercut an additional six inches (18 total inches beneath proposed foundation depth), re-inspected, and proof-rolled and compacted prior to placement of the geotextile separation fabric and structural fill. Should the deeper, extended subbase continue to be soft or have unsatisfactory conditions, addition over-excavation should be considered.

Table 7: Recommended Gradation of Structural Fill

Sieve Size	Percent Passing
3-inch	100
1 ½-inch	60 – 100
No. 4	30 – 60
No. 200	0 – 10

5.5 Access Road Construction

ANS Geo understands that, as part of the work, access roads will be constructed to provide access for heavy equipment such as a main power transformer, poles, and other ancillary structures, as well as long-term access for site maintenance purposes. It is expected that new, unpaved paths will be constructed of aggregate material placed on native, compacted and proof-rolled subgrade stripped of topsoil and other organic material.

During construction, the delivery and movement of heavier loads such as transformers, inverters, delivery of steel and concrete, and transportation of cabling is expected. Construction loads and vehicles are larger

and heavier than the expected vehicles during long-term operation; however, the duration of these activities will be much shorter considering the access road life.

Designing for short-duration, construction-phase access road would require increased thickness of aggregate, the use of geogrid, or other soil improvement, but these increased roads would be over-designed for long-term operation including routine light-duty trucks, maintenance vehicles, and infrequent accessibility to emergency personnel including fire-fighting rigs. Therefore, it is typical for access road design to be completed considering the thickness of road base required for long-term use since it is expected that the site contractor will be able to maintain serviceable access roads throughout construction and at turn-over of the facility by backfilling ruts greater than two-inches, back-blading and re-compacting soft and rutted areas, re-shaping roads to promote drainage and safe passage of traffic.

Considering the above, ANS Geo has completed an initial evaluation of the expected thickness of aggregate access roads using the Giroud-Han method and assumption on the expected soil profile. Our assumption is based on a channery loam native soil subbase with minimum California Bearing Ratio of 5%, and infrequent emergency access for firefighting vehicles as well as occasional light vehicular traffic. Based on this consideration, ANS Geo has provided the following preliminary recommendations based on a variation of conditions (native subgrade, geotextile fabric, and geogrid reinforcement):

Table 8: Recommended Aggregate Thickness for Permanent Site Access Roads

Aggregate Construction	Access Road Cross Section
Aggregate with geotextile fabric	12 inches of Crushed Stone over HP270 non-woven geotextile
Aggregate with geogrid and geotextile fabric	8 inches of Crushed Stone over Mirafi BXG 110 biaxial geogrid atop HP270 non-woven geotextile

When using geogrid, it is recommended that a nonwoven geotextile fabric be placed between the loam subgrade and the geogrid to provide separation and avoid the stone aggregate to be blinded with fines. The geogrid should be placed in accordance with manufacturer's recommendations such as three-foot overlap, fastening or tying overlapping areas, and material storage and handling.

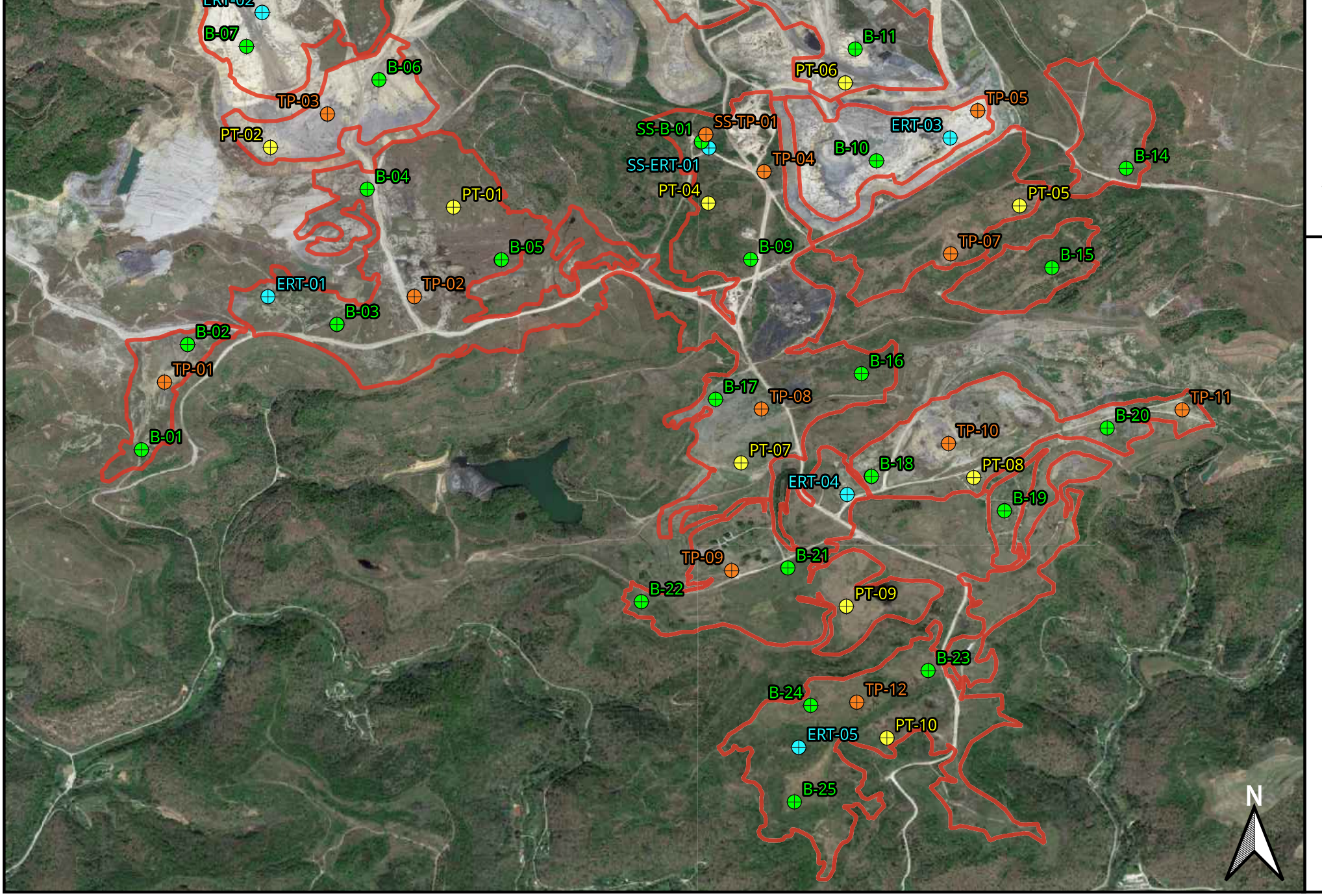
If required, additional stabilization may be obtained through installation of geotextile reinforcement ("geogrid", or similar) or chemical treatment of the subgrade including introduction of lime or cement. When chemical treatment is performed, the subgrade should be verified below the treatment depth to evaluate the CBR value of the subgrade prior to treatment. In addition, the site-wide application rate (ie. 8%) should be taken as an assumed *average*. The actual application rate should vary based on the tested and confirmed native subgrade CBR along the proposed roadway, the treatment depth required, and the moisture content. The application rate and treatment depth should be evaluated by performing several test strips at the project site prior to the start of construction, and testing the test strips in the field using a dynamic cone penetrometer or plate load test to confirm the CBR. Then, once the application rate and depth are evaluated, verification and calibration testing should be performed using the dynamic cone penetrometer at intervals of no less than 500-linear feet along the access roadway.

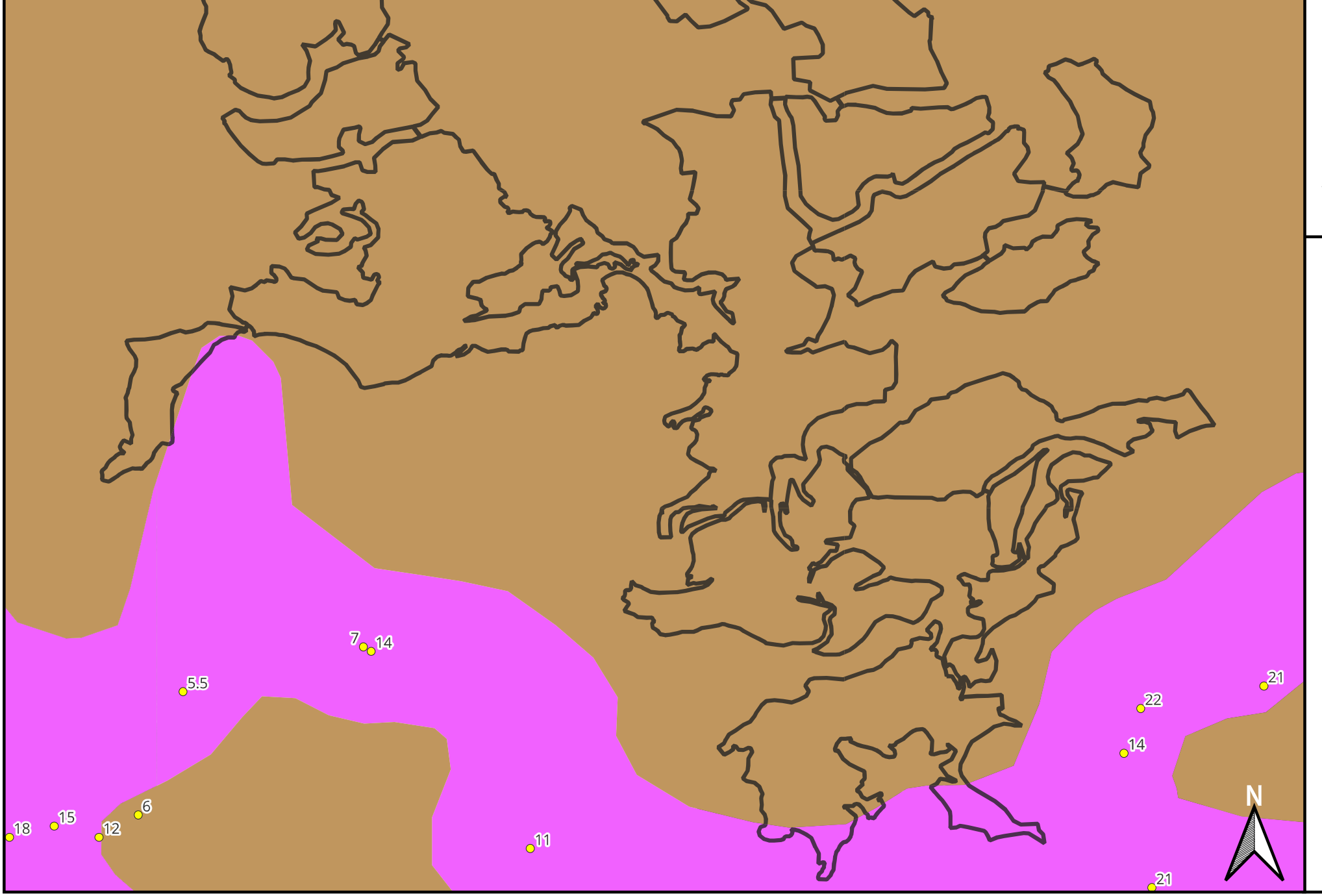
6 Limitations

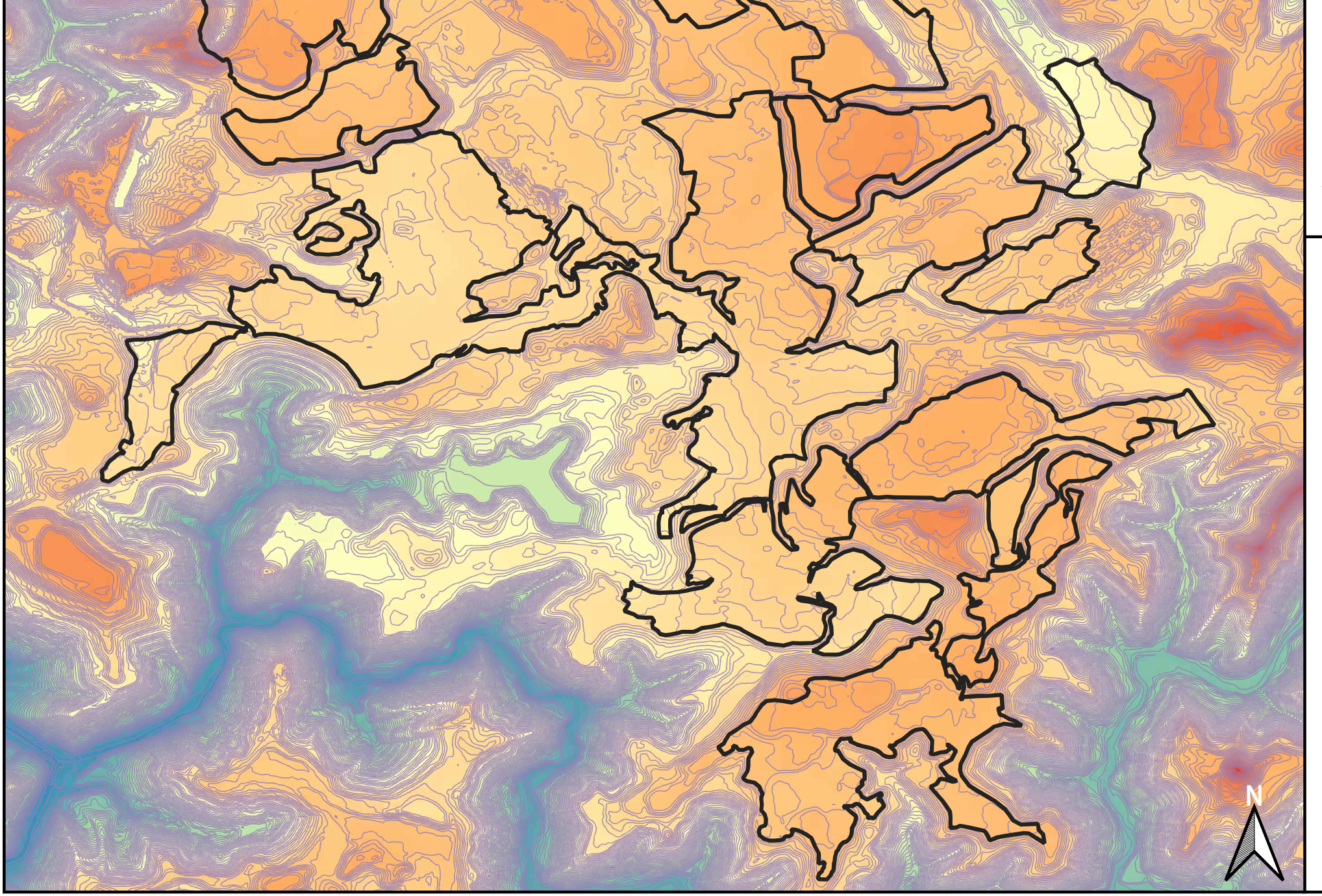
It should be noted that this Desktop Study is not intended to replace a conventional geotechnical investigation, proper engineering evaluation, and design. While regional subsurface mapping provides general and useful information about the expected subsurface conditions and geohazard risks, **a site-specific investigation must be conducted to confirm the assumptions and expected conditions match the information provided in this report.** The information presented within this Geotechnical Desktop Study is based on limited information reviewed from online databases, geologic maps, and historic investigations in the vicinity of the project area. As site-specific data is unavailable or highly generalized, all profiles, parameters, and recommendations presented herein are preliminary assumed values and should not be used for detailed or final designs. Should the scope of this project change, or new information become available, ANS Geo should be given the opportunity to update this document, as appropriate.

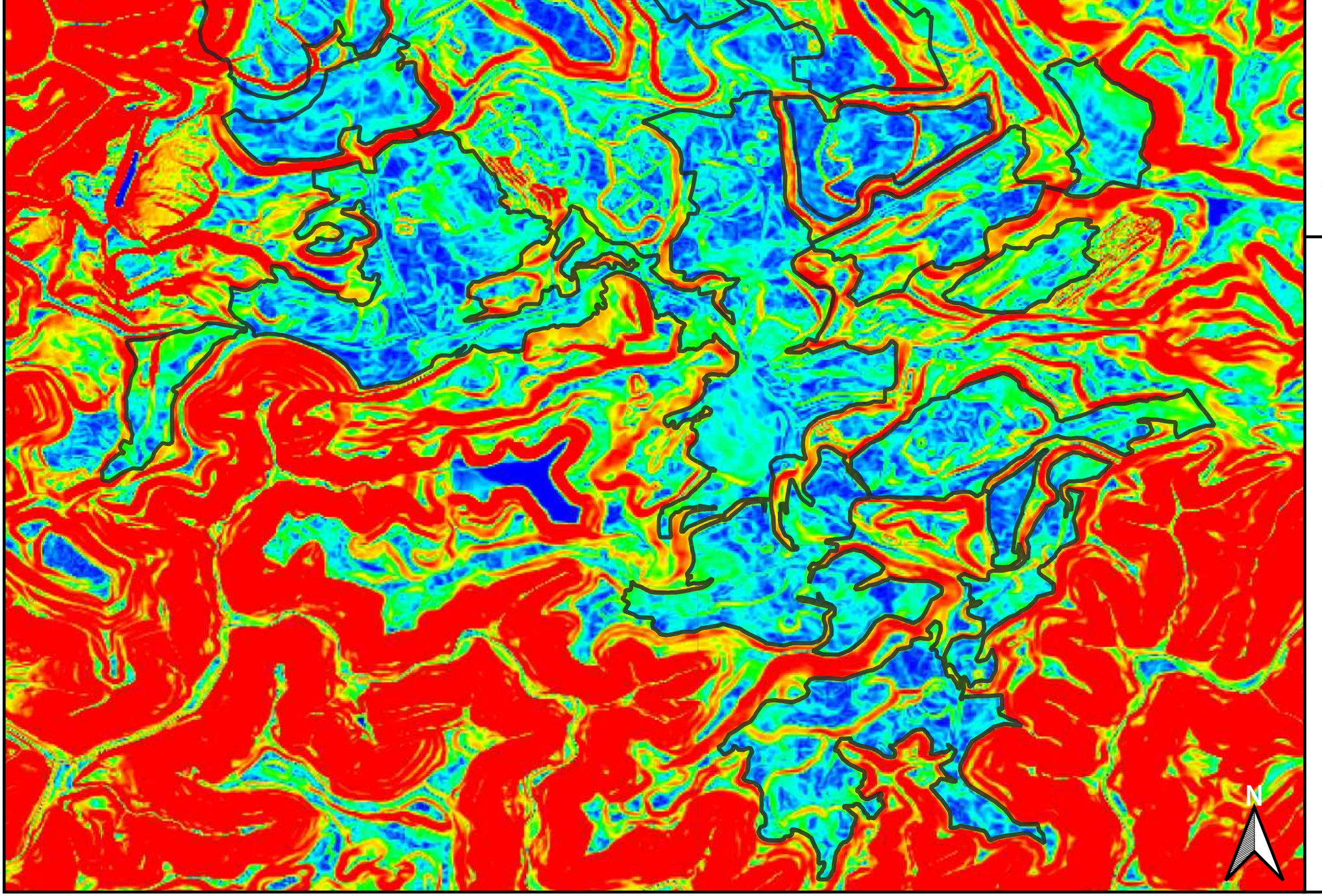
Attachment A

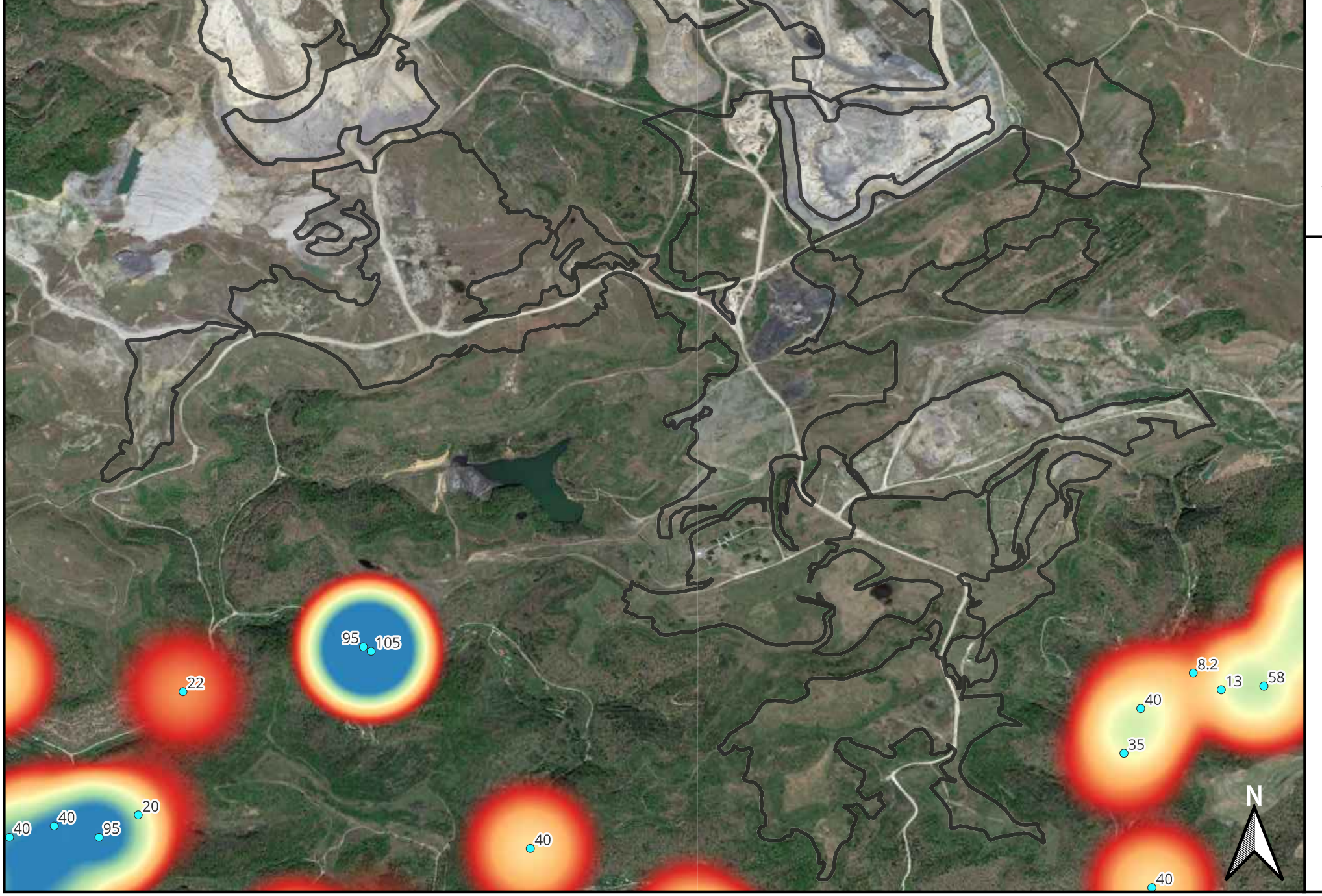
Project Mapping


B-07
B-06
TP-03
PT-02
B-04
PT-01
B-05
ERT-01
TP-02
B-03
B-02
TP-01
B-01
B-11
PT-06
TP-05
SS-B-01
SS-TP-01
ERT-03
B-10
SS-ERT-01
TP-04
B-14
PT-04
PT-05
TP-07
B-09
B-15
B-16
B-17
TP-08
TP-11
B-20
TP-10
PT-07
B-18
PT-08
ERT-04
B-19
TP-09
B-21
B-22
PT-09
B-23
B-24
TP-12
PT-10
ERT-05
B-25
N

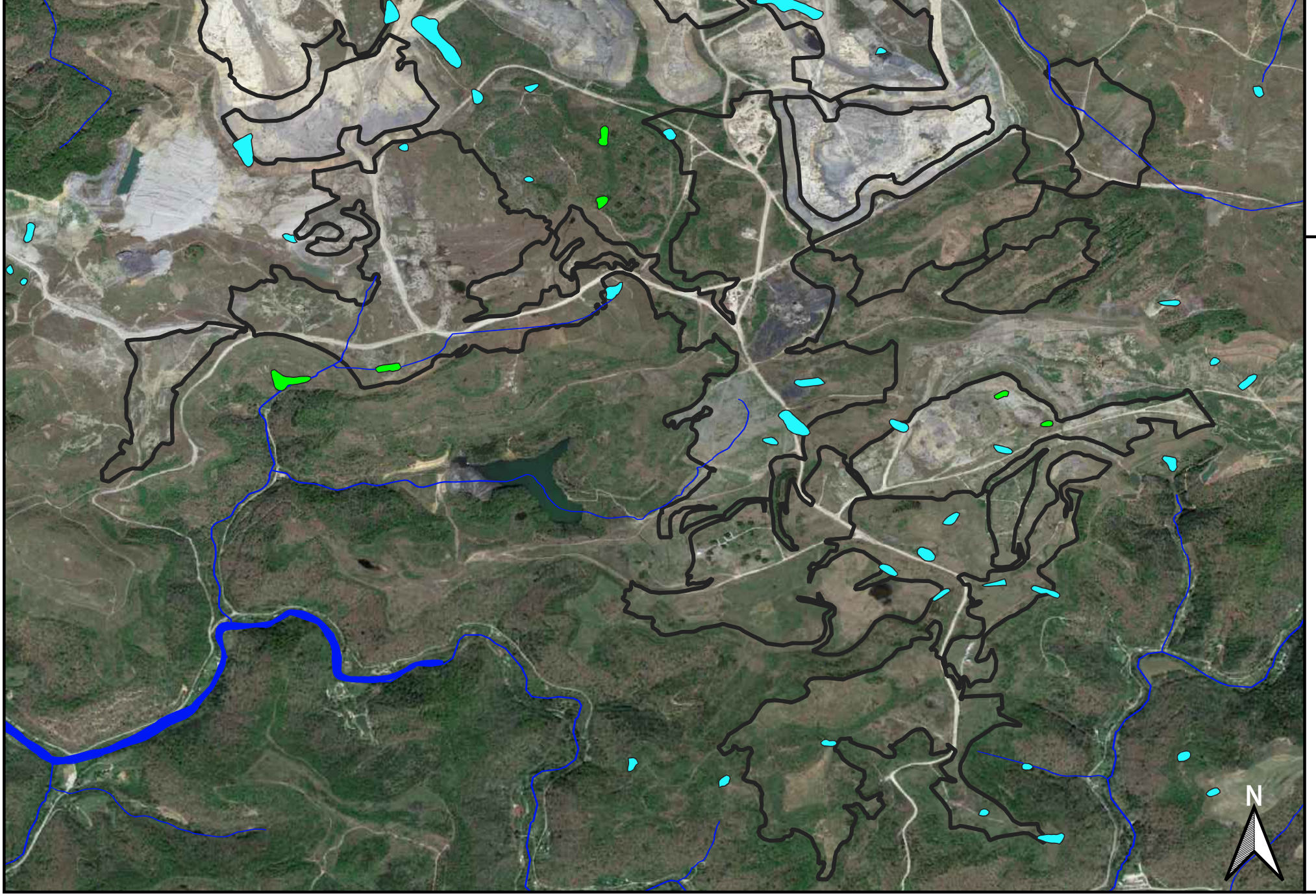

7
14
5.5
21
22
14
N
18
15
12
6
11
21

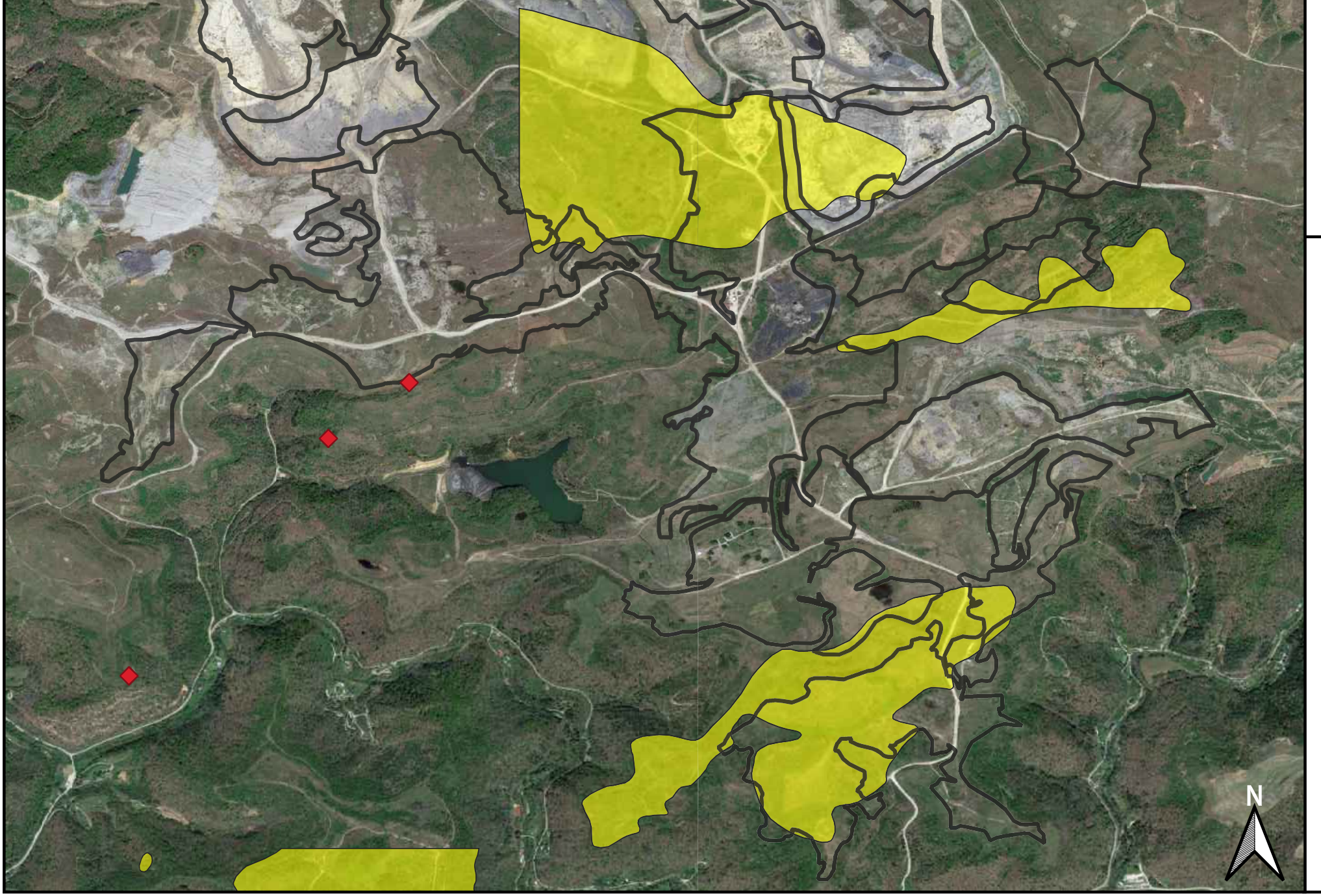

N


N


95
105
22
40
40
95
20
40
8.2
13
58
40
35
40
N


N

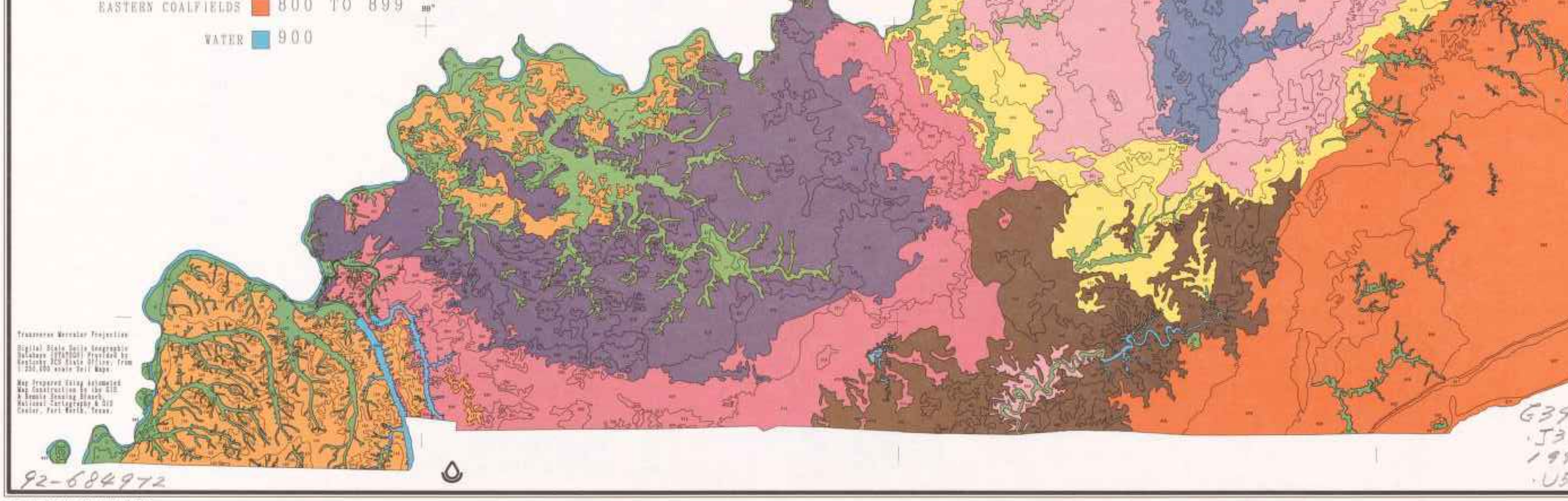

N


N


1978-01-03
2004-05-20
2010-06-09
2007-04-19
2004-04-15
2010-05-19
1976-07-17
1980-08-04
1977-10-21
2003-06-12
2010-05-26
2003-06-23
2011-08-15
2007-04-12
2011-09-06
2010-05-25
1958-12-05
1973-04-28
1977-07-01
1975-01-10
2011-08-22
1977-04-22
2011-08-08
1976-10-08
1977-03-13
1975-06-04
1975-06-10
2010-04-28
1974-02-08
1972-08-11
2009-08-11
2010-04-21
2010-06-16
1975-07-16
2011-08-18
1999-01-18
1989-05-08
1985-04-12
1974-02-15
1974-04-05
2010-04-28
1972-06-20
1975-10-03
1975-01-31
1975-10-20
1964-10-29
2009-02-20
1993-10-22
1979-01-29
1979-10-11
1977-08-06
1975-12-05
1988-08-19
1976-09-30
1975-05-02
1999-01-18
1975-10-15
1976-01-16
1975-10-26
2001-04-27
1998-11-02
1976-04-14
1977-03-31
2005-12-17
1980-12-10
1973-03-28
1974-08-20
2009-02-24
1971-09-15
1998-10-09
1998-09-18
1999-05-05
1964-08-06
2007-03-15
1970-12-11
1998-10-23
1998-10-28
2005-01-27
1970-12-11
2008-04-09
N

Attachment B

Geological References



USDA-SCS NATIONAL CARTOGRAPHIC CENTER FT. WORTH, TX 1992

MAP UNIT NUMBER	NAME	ACRES
	FLOOD PLAINS AND TERRACES	
1	COLLINS-FALAYA-WAVERLY-VICKSBURG	246358
2	NOLIN-NEWARK-LINDSIDE-ROBINSONVILLE	33550
3	COMMERCE-ROBINSONVILLE-CREVASSE	51573
4	SHARKEY-TUNICA	32260
5	ROSEBLOOM-WHEELING-DUBBS	19232
6	HENRY-OKAW-CALLOWAY	42183
7	HENRY-GRENADA-CALLOWAY	22834
8	BIRDS-CALLOWAY-PATTON	8978
9	HUNTINGTON-LINDSIDE-WEINBACH-NEWARK	47521
10	NOLIN-NEWARK-ELK	48776
11	HUNTINGTON-NEWARK-EGAM	72364
12	ELK-OTWELL-NEWARK-GINAT	139085
13	UNIONTOWN-PATTON-HENSHAW	115960
14	PATTON-WAKELAND-WILBUR	34846
15	KARNAK-MELVIN-MCGARY	220836
16	MCGARY-BELKNAP-OTWELL-WEINBACH	21651
17	BELKNAP-WAVERLY-COLLINS	184542
18	KARNAK-WAVERLY-MELVIN	30314
19	BONNIE-KARNAK-BELKNAP-NEWARK	37029
20	NEWARK-MELVIN-LINDSIDE	56863
21	NEWARK-NOLIN-WEIKERT	100705
22	FRONDORF-WEIKERT-STEFF	21750
23	ELK-NOLIN-GRIGSBY	28847
24	ELK-HUNTINGTON-WEINBACH	22808
25	LAWRENCE-OTWELL-NEWARK-HUNTINGTON	76454
26	NOLIN-ROBERTSVILLE-TAFT-LINDSIDE	42035
27	NOLIN-WELLSTON-SENSABAUGH-ELK	6542
28	MONTGOMERY-LAWRENCE-NEWARK-MELVIN	6058
29	LAWRENCE-NOLIN-ROBERTSVILLE-LINDSIDE	31128
30	MCGARY-MARKLAND-NOLIN	61289
31	OTWELL-ELK-NOLIN	77635
32	ASHTON-HUNTINGTON-ELK-FAIRMOUNT	11881
33	WHEELING-HUNTINGTON-OTWELL	59037
34	ALLEGHENY-NELSE-BONNIE	11706
35	ELK-HUNTINGTON-OTWELL	31335
36	NELSE-MYRA-NEWARK-MELVIN	17008
37	CUBA-MOREHEAD-WHITLEY	31947
38	GRIGSBY-COTACO-MOREHEAD-SHELOCTA	25440
39	STENDAL-BONNIE-WHITLEY-MOREHEAD	16299
40	MOREHEAD-GRIGSBY-ALLEGHENY-PEOGA	19807
41	TILSIT-CLIFTY-MOREHEAD	29162
42	HUNTINGTON-ALLEGHENY-LAWRENCE-NEWARK	21301
43	WHEELING-OTWELL-HUNTINGTON-CHAVIES	11945
44	NOLIN-MCAFEE-ELK-MAURY	24798
45	ELK-ASHTON-HUNTINTON	18422
46	NOLIN-ELK-OTWELL	20393
47	ALLEGHENY-RINEY-MONONGAHELA	9854
48	POPE-CUBA-ELK	34984
49	MYRA-NELSE-URBAN LAND-COMBS	13003
50	WHEELING-NOLIN-OTWELL	8453
51	ALLEGHENY-EDEN-NOLIN	4401
53	ALLEGHENY-CUBA-GRIGSBY	18746
54	ALLEGHENY-GRIGSBY-ORRVILLE	6203
55	HUNTINGTON-COTACO-ALLEGHENY-WHITLEY	36288
56	MOREHEAD-MONONGAHELA-CUBA-MUSE	24698
57	LICKING-OTWELL-NOLIN	23428
58	MYRA-BONNIE-URBAN LAND-GRIGSBY	2462
	THICK LOESS AND/OR COASTAL PLAIN	
100	GRENADA-LORING-CALLOWAY-COLLINS	400843
101	CALLOWAY-GRENADA-HENRY	39874
102	BRANDON-LORING-MEMPHIS	305821
103	LORING-BRANDON-MEMPHIS	30802
104	BRANDON-SAFFELL	21232
105	LORING-MEMPHIS-COLLINS	226129
106	MEMPHIS-LORING	61609
107	BRANDON-LAX-SAFFELL	36206
108	SAFFELL-BRANDON-BAXTER	53199
109	MEMPHIS-WILBUR-WAKELAND	112835
110	LORING-GRENADA-MEMPHIS-CALLOWAY	249522
111	LORING-MEMPHIS-BELKNAP	80460
112	MEMPHIS-WELLSTON-LORING-STEINSBURG	39528
113	MEMPHIS-LORING-ZANESVILLE-ROCKCASTLE	5349
	WESTERN COALFIELDS	
200	LORING-ZANESVILLE-FRONDORF-WELLSTON	333284
201	ZANESVILLE-CANEYVILLE-DEKALB-RAMSEY	29280
202	CANEYVILLE-VERTREES-FREDONIA-CRIDER	177151
203	CANEYVILLE-ROCK OUTCROP-FRONDORF-ZANESVILLE	114671
204	ZANESVILLE-FRONDORF-DEKALB-LORING	71386
205	ZANESVILLE-SADLER-BELKNAP	143436
206	FRONDORF-ZANESVILLE-WELLSTON	115050
207	BETHESDA-FAIRPOINT-ZANESVILLE	43140
208	ZANESVILLE-FRONDORF-LENBERG-BELKNAP	89405
209	LORING-WELLSTON-BELKNAP	185168
210	FRONDORF-ZANESVILLE-WELLSTON-WEIKART	227874
211	SADLER-ZANESVILLE-CANEYVILLE-FRONDORF	59716
212	SADLER-ZANESVILLE	119341
213	FAIRPOINT-BETHESDA-FRONDORF	90586
214	SADLER-HENSHAW-ZANESVILLE-CRIDER	10821
215	FRONDORF-RAMSEY-ZANESVILLE	21345
216	CANEYVILLE-FRONDORF-ZANESVILLE-WELLSTON	564614
217	FRONDORF-WELLSTON-ZANESVILLE-WELLSTON	882847
218	SADLER-ZANESVILLE-JOHNSBURG-GILPIN	42553
219	FREDONIA-VERTREES	67025
220	RINEY-CANEYVILLE-GRISGBY	37180
	WESTERN PENNYROYAL	
300	BAXTER-HAMMACK-BRANDON-LORING	179738
301	BAXTER-HAMMACK-NICHOLSON-LORING	47723
302	NICHOLSON-HAMMACK-MEMPHIS-NOLIN	36659
303	FREDONIA-PEMBROKE-CANEYVILLE	25054
304	NICHOLSON-CRIDER-LAWRENCE	43173
305	NICHOLSON-HAMMACK-BAXTER-CRIDER	157037
306	CRIDER-PEMBROKE	30684
307	PEMBROKE-CRIDER	509016
308	ROBERTSVILLE-LAWRENCE-NICHOLSON	8220
309	PEMBROKE-CRIDER-BAXTER-VERTREES	24922
310	BAXTER-PICKWICK-CRIDER	23766
311	PEMBROKE-ROBERTSVILLE-CRIDER-NEWARK	3661
312	ROBERTSVILLE-PEMBROKE-NICHOLSON	2245
313	BAXTER-CRIDER	149215
314	BAXTER-NICHOLSON-MOUNTVIEW	577730
315	LAWRENCE-NICHOLSON-BAXTER-ROBERTSVILLE	8612
316	MELVIN-DICKSON-CRIDER-BAXTER	34152
317	CRIDER-NOLIN-NEWARK	129638
318	VERTREES-CRIDER-NICHOLSON	155197
319	CRIDER-BAXTER-PEMBROKE	105848
320	SONORA-GATTON-RINEY	74196
321	RINEY-VERTREES-WAYNESBORO	73507
322	FREDERICK-MOUNTVIEW-DICKSON	6029
323	PEMBROKE-VERTREES-NOLIN	6778
324	HAMMACK-BAXTER	10161
	EASTERN PENNYROYAL	
400	TRIMBLE-MOUNTVIEW	290661
401	WAYNESBORO-BEWLEYVILLE	62071
402	GARMON-CANEYVILLE-FREDERICK	340621
404	FREDERICK-MOUNTVIEW	346802
405	SANGO-MOUNTVIEW-LONEWOOD-LAWRENCE	23243
406	HARTSELLS-GARMON-MOUNTVIEW-FREDERICK	44133
407	CANEYVILLE-FREDERICK-FREDONIA-MUSE	35973
408	LAWRENCE-HARTSELLS-BEDFORD-MOUNTVIEW	25118
409	FREDONIA-BROOKSIDE-CANEYVILLE-FREDERICK	49983
410	CUMBERLAND-FREDERICK-PEMBROKE-DECATUR	56080
411	FREDERICK-MOUNTVIEW-CANEYVILLE	362906
412	LONEWOOD-GILPIN-SANGO	42390
413	CANEYVILLE-FREDERICK-BAXTER-GARMON	85585
900	WATER	329173

KENTUCKY STATSGO TOTAL ACRES ------- 25848524

FOR MORE DETAILED INFORMATION CONTACT : SOIL CONSERVATION SERVICE
333 WALKER AVE., ROOM 305
LEXINGTON, KY 40504
(606) 233-2752

MAP UNIT NUMBER	NAME
	KNOBS
500	GARMON-CANEYVILLE-CRIDER-SENSABAUGH
501	GARMON-CARPENTER-FRANKSTOWN
502	GARMON-LENBERG-FREDERICK-CARPENTER
503	GARMON-VERTREES-CARPENTER
504	COLYER-TRAPPIST-CANEYVILLE-LENBERG
505	GARMON-MOUNTVIEW-CARPENTER-FREDERICK
507	GARMON-CRIDER-CANEYVILLE
508	PEMBROKE-CORYDON-SHROUTS-ROCK OUTCROP
509	TILSIT-TRAPPIST
510	WEIKERT-HARDEN-CANEYVILLE-COYLER
511	COLYER-FAIRMOUNT-SHROUTS
512	COLYER-TRAPPIST-SHROUTS-MUSE
513	MUSE-LATHAM-TRAPPIST-BERKS
514	TRAPPIST-BERKS-SHELOCTA-COLYER
	OUTER BLUEGRASS AND HILLS OF THE BLUEGRASS
600	FAYWOOD-LOWELL-SHELBYVILLE-FAIRMOUNT
601	CRIDER-LOWELL-CYNTHIANA-FAYWOOD
602	CRIDER-CANEYVILLE-NICHOLSON
603	BEASLEY-NICHOLSON-FAYWOOD-FAIRMOUNT
604	ZIPP-ROBERTSVILLE-MELVIN
605	LOWELL-FAYWOOD-EDEN
607	EDEN-CULLEOKA-LOWELL-FAYWOOD
608	LOWELL-FAYWOOD-NICHOLSON
609	SHELBYVILLE-NICHOLSON-LOWELL
610	NICHOLSON-LAWRENCE-ROBERTSVILLE-SHELBYVILLE
611	FAIRMOUNT-LOWELL-ROCK OUTCROP-BRASSFIELD
612	ROSSMOYNE-FAYWOOD
613	CINCINNATI-RYKER-BEASLEY-GRAYFORD
614	SHROUTS-BEASLEY-BRASSFIELD
615	LOWELL-SHELBYVILLE-FAYWOOD
616	BEASLEY-CYNTHIANA-FAYWOOD-NICHOLSON
617	CYNTHIANA-FAIRMOUNT-FAYWOOD-LOWELL
618	BEASLEY-OTWAY-FAIRMOUNT
619	LOWELL-FAYWOOD-EDEN-CYNTHIANA
620	EDEN-LOWELL
621	LOWELL-FAYWOOD
622	CYNTHIANA-FAYWOOD-LOWELL
623	BEASLEY-OTWAY-CRIDER
624	BEASLEY-NICHOLSON-LOUDON
625	BEASLEY-OTWAY-CORYDON-HAGERSTOWN
626	LAWRENCE-NICHOLSON-BEASLEY-OTWAY
627	LOWELL-SHELBYVILLE-FAYWOOD
628	FAIRMOUNT-SHROUTS-FAYWOOD
629	CAPTINA-LAWRENCE-HUNTINGTON-ELK
	INNER BLUEGRASS
700	MAURY-MCAFEE
701	MCAFEE-FAIRMOUNT-MAURY
702	CALEAST-MAURY-NICHOLSON
	EASTERN COALFIELDS
800	JEFFERSON-SHELOCTA-MUSE
801	MARROWBONE-DEKALB=FEDSCREEK-LATHAM
802	LATHAM-SHELOCTA
803	VANDALIA-UPSHUR
804	BERKS-CRANSTON-LATHAM
805	SHELOCTA-GILPIN-STEINSBURG-CUTSHIN
806	KIMPER-SHELOCTA-HAZLETON-GILPIN
807	KIMPER-SHELOCTA-HAZLETON-GUYANDOTTE
808	SHELOCTA-LATHAM-DEKALB
809	SHELOCTA-BROOKSIDE-CANEYVILLE
810	RIGLEY-LILY-ROCK OUTCROP
811	RIGLEY-CRANSTON-STEINSBURG-LATHAM
812	LATHAM-TILSIT-JOHNSBURG
813	CANEYVILLE-BLEDSOE-ROCK OUTCROP
814	CRANSTON-BERKS-GILPIN
815	SHELOCTA-GILPIN-RIGLEY
816	WERNOCK-LATHAM-SHELOCTA
817	JEFFERSON-GRIMSLEY-ALTICREST-SHELOCTA
818	CANEYVILLE-RIGLEY-ROCK OUTCROP-SHELOCTA

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

NOBLE QUADRANGLE
KENTUCKY
7.5-MINUTE SERIES

Produced by the United States Geological Survey

SCALE 1:24 000

KILOMETERS

METERS

MILES

FEET

CONTOUR INTERVAL 40 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

ROAD CLASSIFICATION

NOBLE, KY
2022


USGS
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
The National Map
US Topo
VEST QUADRANGLE
KENTUCKY
7.5-MINUTE SERIES
Deepn
Elmirock
Vest
Gray Horse
Rockhouse Holler
Cool Hollow
Pecans Knob
Produced by the United States Geological Survey
SCALE 1:24 000
CONTOUR INTERVAL 40 FEET
ROAD CLASSIFICATION
VEST, KY
2022

Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 17. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

Spatial Reference System Division
National Geodetic Survey, NOAA
Silver Spring Metro Center
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242** or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was provided in digital format by the State of Kentucky.

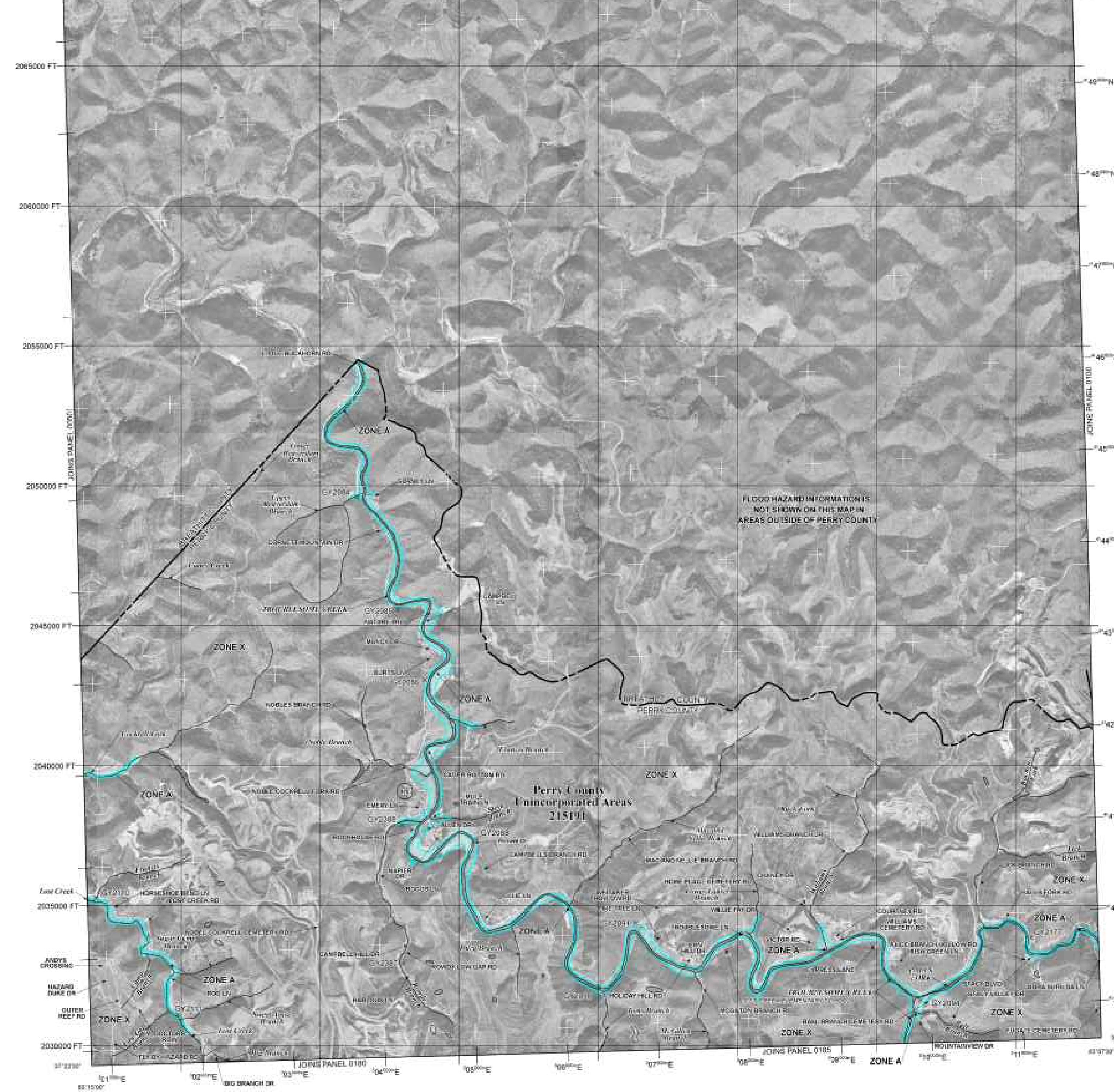
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the *Flood Insurance Study* report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a *Flood Insurance Study* report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.



Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Kentucky State Plane (FIPSZONE 1600). The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum.** For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242,** or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was derived from the U.S.D.A. Farm Service Agency National Agriculture Imagery Program (NAIP) produced at a scale of 1:12,000 from photography dated 2004.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the *Flood Insurance Study report* (which contains authoritative *hydraulic data*) may reflect stream channel distances that differ from what is shown on this map.

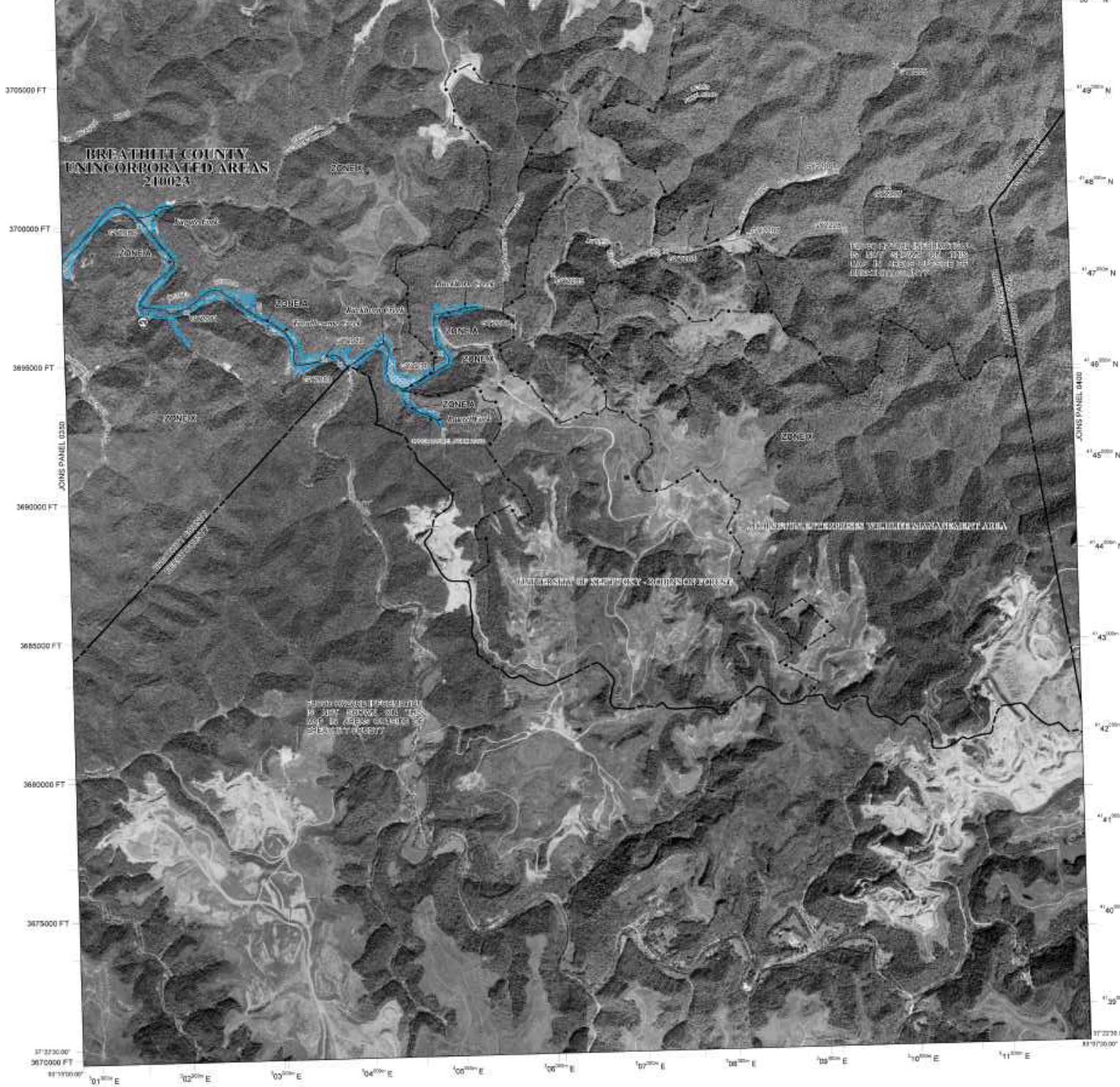
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance *Study report*, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.

The Profile baseline depicted on this map represents the hydraulic modeling baseline that matches the flood profiles in the FIS report. As a result of improved topographic data, this profile baseline, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.



Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 17. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the **same vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

Spatial Reference System Division
National Geodetic Survey, NOAA
Silver Spring Metro Center
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242** or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was provided in digital format by the State of Kentucky.

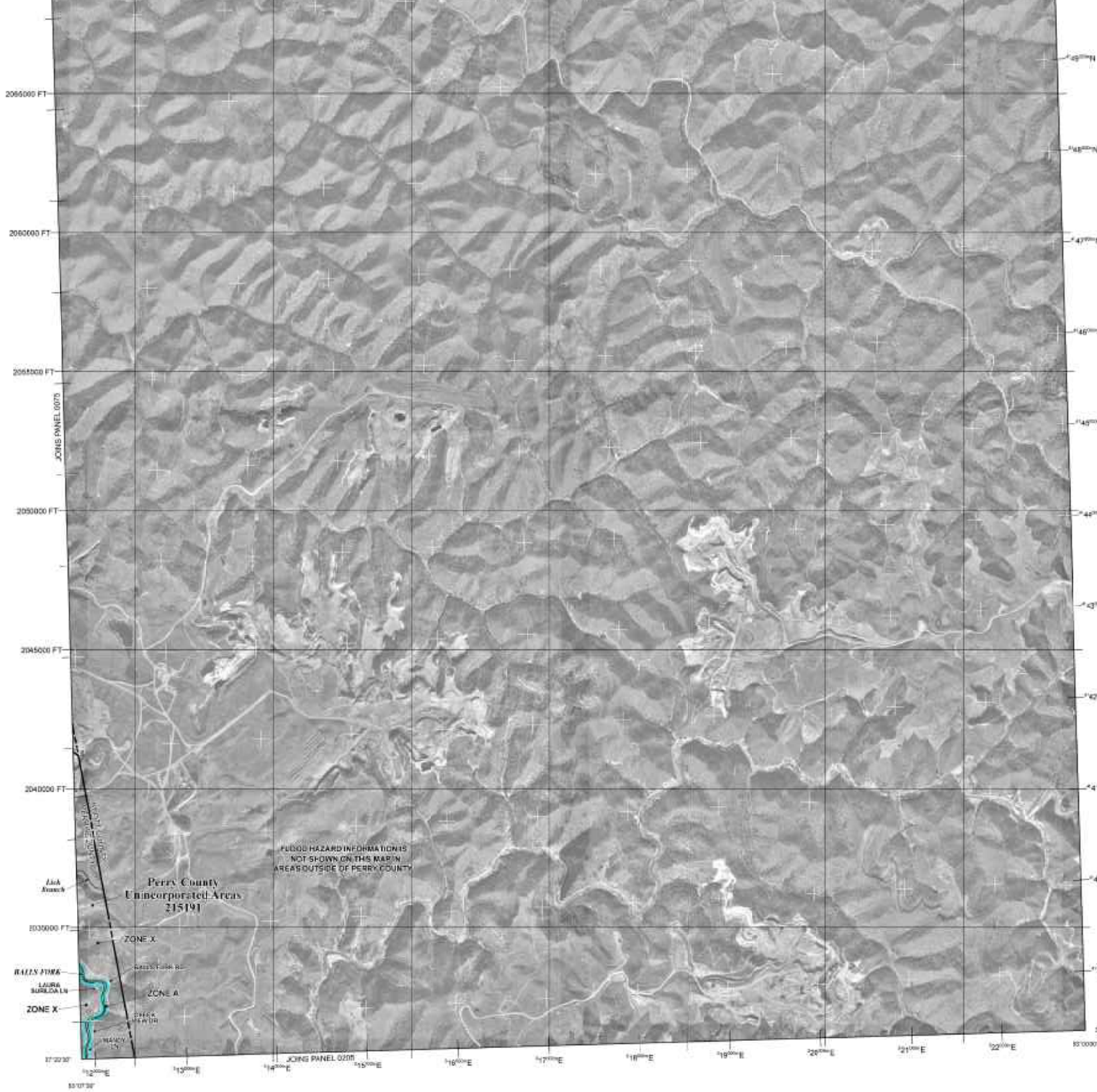
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

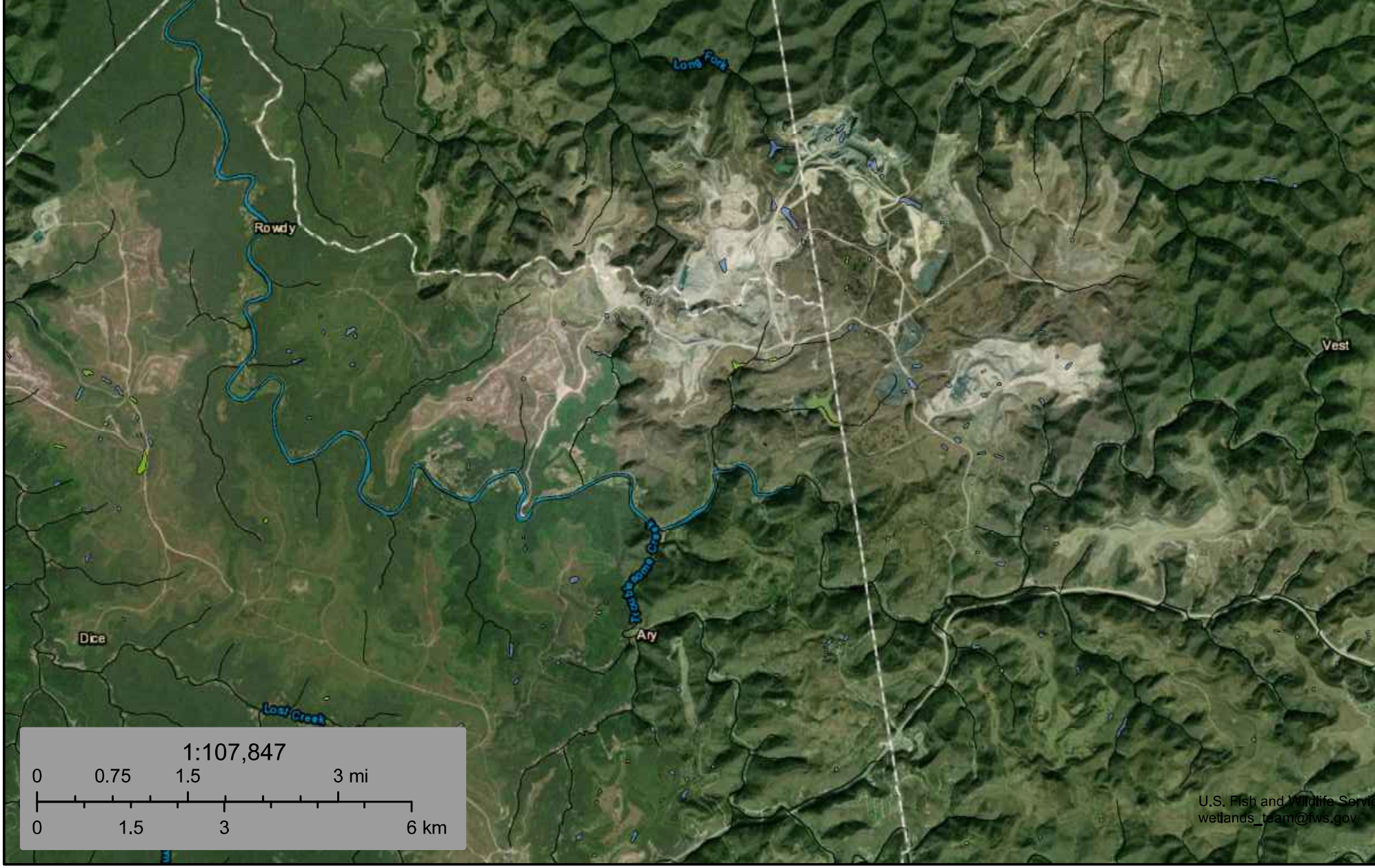
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on **available** products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.





December 21, 2023

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for ger
Service is not resp
base data shown c
be used in accorda
Wetlands Mapper v

U.S. Fish and Wildlife Servi
wetlands_team@fws.gov

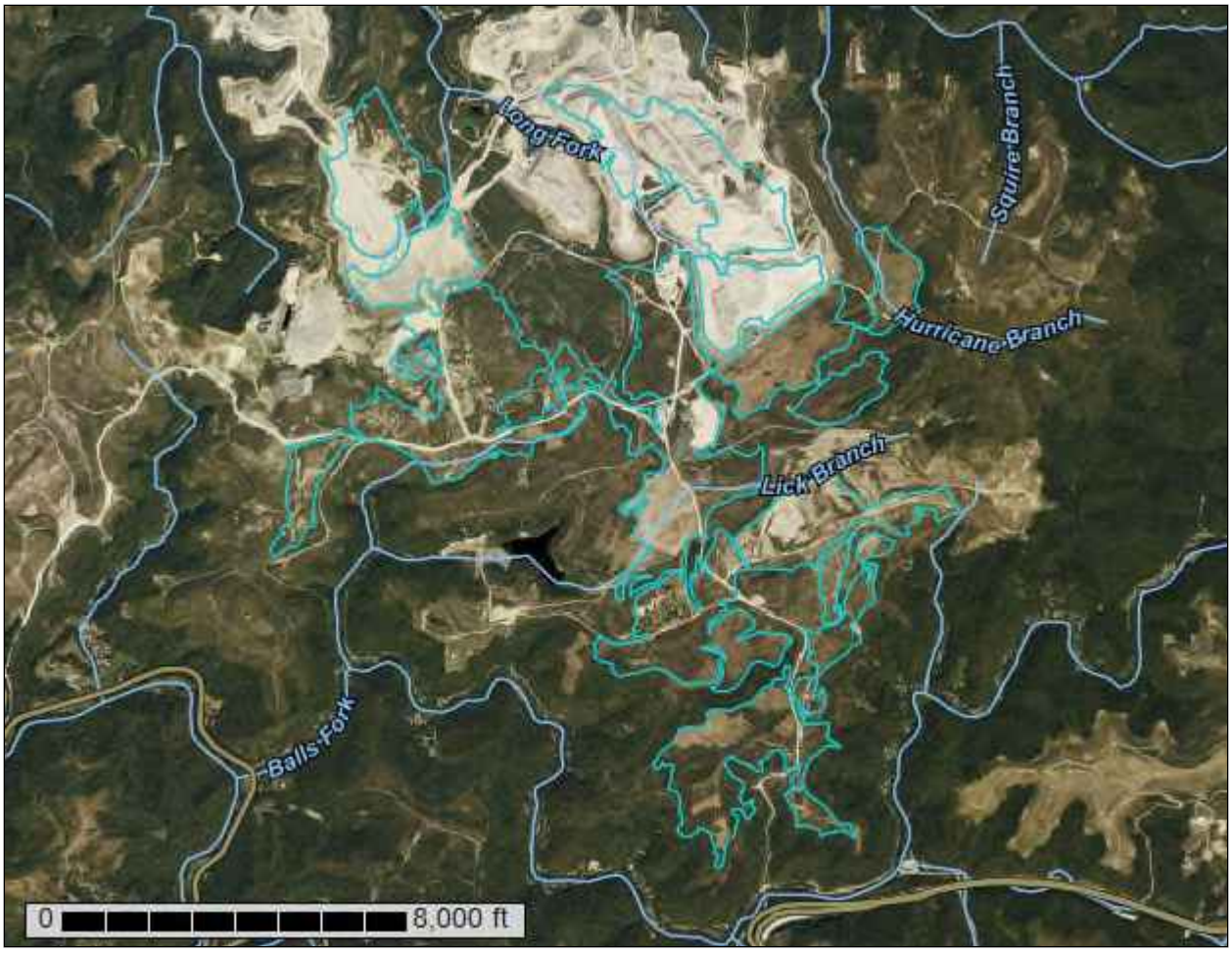
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Breathitt County, Kentucky, Knott and Letcher Counties, Kentucky, and Leslie and Perry Counties, Kentucky



December 21, 2023

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

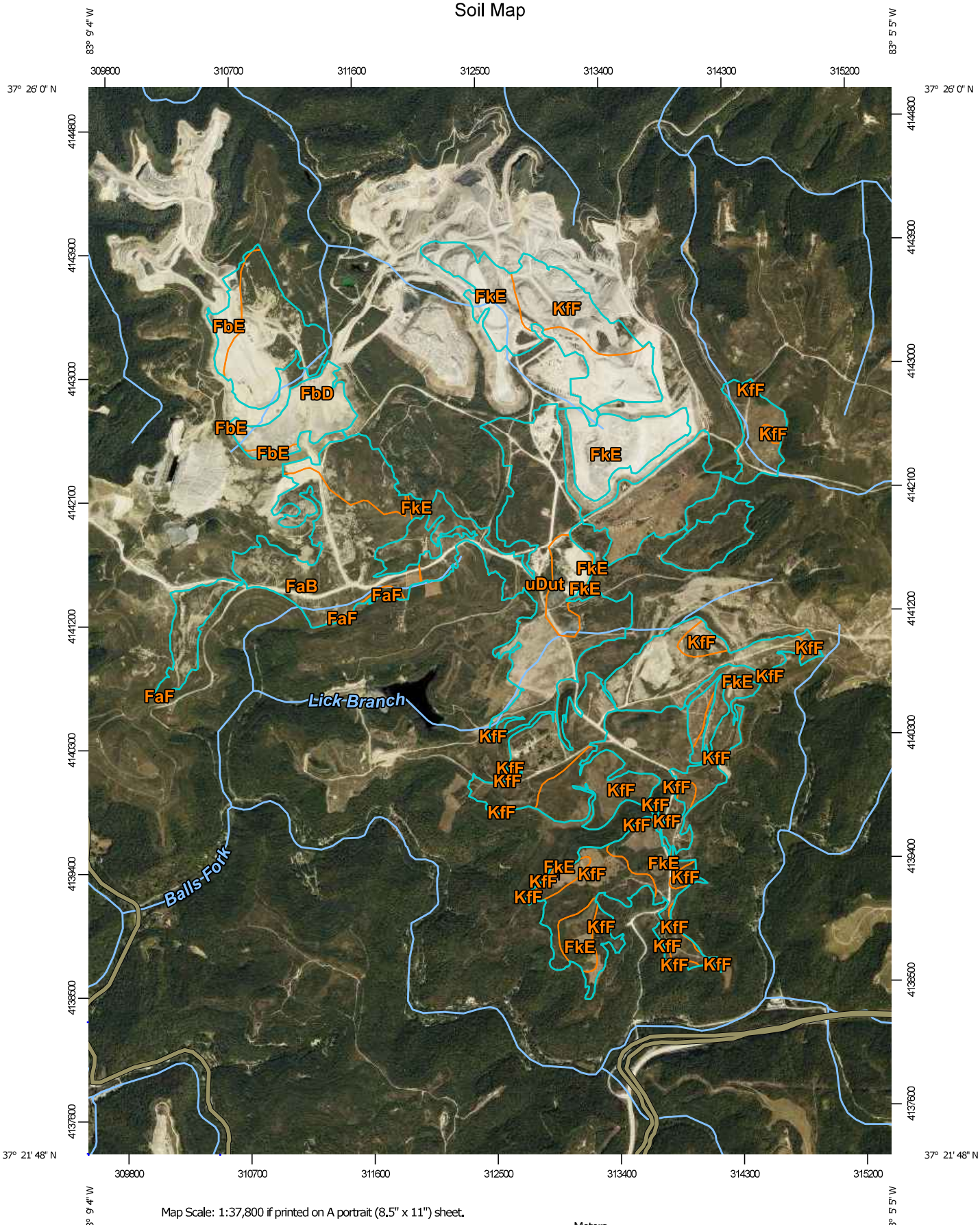
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

Please rely on the bar scale on each map
measurements.

Source of Map: Natural Resources Cons
Web Soil Survey URL:
Coordinate System: Web Mercator (EPS

Maps from the Web Soil Survey are based
projection, which preserves direction and
distance and area. A projection that prese
Albers equal-area conic projection, should
accurate calculations of distance or area a

This product is generated from the USDA-
of the version date(s) listed below.

Soil Survey Area: Breathitt County, Kent
Survey Area Data: Version 19, Sep 10, 2

Soil Survey Area: Knott and Letcher Cou
Survey Area Data: Version 19, Sep 10, 2

Soil Survey Area: Leslie and Perry Cour
Survey Area Data: Version 20, Sep 10, 2

Your area of interest (AOI) includes more
area. These survey areas may have been
scales, with a different land use in mind, a
different levels of detail. This may result in
properties, and interpretations that do not
across soil survey area boundaries.

Soil map units are labeled (as space allow
1:50,000 or larger.

Date(s) aerial images were photographed
2019

MAP LEGEND

MAP INFORMATION

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
FbD	Fairpoint and Bethesda soils, 0 to 20 percent slopes	244.1	13.0%
FbE	Fairpoint and Bethesda soils, 2 to 70 percent slopes, benched, stony	28.6	1.5%
Subtotals for Soil Survey Area		**272.7**	**14.5%**
Totals for Area of Interest		**1,881.4**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
FkE	Fiveblock and Kaymine soils, 0 to 30 percent slopes, stony	1,024.1	54.4%
KfF	Kaymine, Fairpoint, and Fiveblock soils, benched, 2 to 70 percent slopes, very stony	308.8	16.4%
uDut	Dumps, mine and tailings	40.2	2.1%
Subtotals for Soil Survey Area		**1,373.1**	**73.0%**
Totals for Area of Interest		**1,881.4**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
FaB	Fairpoint soils, undulating	230.0	12.2%
FaF	Fairpoint and Bethesda soils, 2 to 70 percent slopes, benched, stony	5.6	0.3%
Subtotals for Soil Survey Area		**235.6**	**12.5%**
Totals for Area of Interest		**1,881.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made

up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Breathitt County, Kentucky

FbD—Fairpoint and Bethesda soils, 0 to 20 percent slopes

Map Unit Setting

National map unit symbol: lgny
Elevation: 700 to 1,800 feet
Mean annual precipitation: 37 to 52 inches
Mean annual air temperature: 42 to 68 degrees F
Frost-free period: 175 to 222 days
Farmland classification: Not prime farmland

Map Unit Composition

Fairpoint, unstable fill, and similar soils: 50 percent
Bethesda, unstable fill, and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fairpoint, Unstable Fill

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Mountaintop
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy-skeletal mine spoil or earthy fill derived from sedimentary rock

Typical profile

H1 - 0 to 5 inches: channery loam
H2 - 5 to 60 inches: very channery loam

Properties and qualities

Slope: 0 to 20 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Bethesda, Unstable Fill

Setting

Landform: Ridges
Landform position (two-dimensional): Summit

Landform position (three-dimensional): Mountaintop
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy-skeletal mine spoil or earthy fill derived from sedimentary rock

Typical profile

H1 - 0 to 4 inches: channery loam
H2 - 4 to 65 inches: very channery loam

Properties and qualities

Slope: 0 to 20 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Dekalb

Percent of map unit: 2 percent
Hydric soil rating: No

Gilpin

Percent of map unit: 2 percent
Hydric soil rating: No

Marrowbone

Percent of map unit: 2 percent
Hydric soil rating: No

Cloverlick

Percent of map unit: 2 percent
Hydric soil rating: No

Hazleton

Percent of map unit: 2 percent
Hydric soil rating: No

Kimper

Percent of map unit: 2 percent
Hydric soil rating: No

Shelocta

Percent of map unit: 2 percent
Hydric soil rating: No

Other soils

Percent of map unit: 1 percent

Hydric soil rating: No

FbE—Fairpoint and Bethesda soils, 2 to 70 percent slopes, benched, stony

Map Unit Setting

National map unit symbol: 2tqhd
Elevation: 720 to 1,510 feet
Mean annual precipitation: 45 to 57 inches
Mean annual air temperature: 43 to 68 degrees F
Frost-free period: 169 to 203 days
Farmland classification: Not prime farmland

Map Unit Composition

Fairpoint, unstable fill, and similar soils: 55 percent
Bethesda, unstable fill, and similar soils: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fairpoint, Unstable Fill

Setting

Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy-skeletal coal extraction mine spoil derived from sandstone and shale

Typical profile

Ap - 0 to 11 inches: channery loam
C1 - 11 to 32 inches: very channery loam
C2 - 32 to 41 inches: extremely channery loam
C3 - 41 to 51 inches: extremely flaggy loam
C4 - 51 to 58 inches: extremely flaggy silt loam
C5 - 58 to 72 inches: extremely flaggy loam

Properties and qualities

Slope: 2 to 70 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Bethesda, Unstable Fill

Setting

Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy-skeletal coal extraction mine spoil derived from sandstone and shale

Typical profile

Ap - 0 to 12 inches: channery silt loam
C1 - 12 to 36 inches: very channery loam
C2 - 36 to 58 inches: very channery loam
C3 - 58 to 72 inches: very channery loam

Properties and qualities

Slope: 2 to 70 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Udorthents, unstable fill

Percent of map unit: 5 percent
Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Shelocta, very stony

Percent of map unit: 3 percent
Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Matewan, very stony

Percent of map unit: 3 percent
Landform: Ridges
Landform position (three-dimensional): Mountaintop
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Urban land

Percent of map unit: 2 percent
Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Dumps, mine (tailings & tipples)

Percent of map unit: 2 percent
Landform: Ridges
Landform position (three-dimensional): Mountaintop
Down-slope shape: Linear
Across-slope shape: Convex, linear
Hydric soil rating: No

Knott and Letcher Counties, Kentucky

FkE—Fiveblock and Kaymine soils, 0 to 30 percent slopes, stony

Map Unit Setting

National map unit symbol: lh2j
Elevation: 800 to 3,000 feet
Mean annual precipitation: 28 to 47 inches
Mean annual air temperature: 42 to 67 degrees F
Frost-free period: 159 to 199 days
Farmland classification: Not prime farmland

Map Unit Composition

Fiveblock, unstable fill, and similar soils: 41 percent
Kaymine, unstable fill, and similar soils: 39 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fiveblock, Unstable Fill

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Mountaintop
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy skeletal coal extraction mine spoil derived from interbedded sedimentary rock

Typical profile

H1 - 0 to 14 inches: channery sandy loam
H2 - 14 to 65 inches: very channery sandy loam

Properties and qualities

Slope: 0 to 30 percent
Surface area covered with cobbles, stones or boulders: 0.1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Kaymine, Unstable Fill

Setting

Landform: Ridges

Landform position (two-dimensional): Summit
Landform position (three-dimensional): Mountaintop
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy skeletal coal extraction mine spoil derived from interbedded sedimentary rock

Typical profile

H1 - 0 to 14 inches: channery silt loam
H2 - 14 to 80 inches: very channery silt loam

Properties and qualities

Slope: 0 to 30 percent
Surface area covered with cobbles, stones or boulders: 0.1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Cedarcreek, unstable fill

Percent of map unit: 5 percent
Hydric soil rating: No

Sewell, unstable fill

Percent of map unit: 5 percent
Hydric soil rating: No

Fairpoint, unstable fill

Percent of map unit: 5 percent
Hydric soil rating: No

Itmann, unstable fill

Percent of map unit: 3 percent
Hydric soil rating: No

Bethesda, unstable fill

Percent of map unit: 2 percent
Hydric soil rating: No

KfF—Kaymine, Fairpoint, and Fiveblock soils, benched, 2 to 70 percent slopes, very stony

Map Unit Setting

National map unit symbol: lh2w
Elevation: 800 to 3,800 feet
Mean annual precipitation: 28 to 47 inches
Mean annual air temperature: 42 to 67 degrees F
Frost-free period: 159 to 199 days
Farmland classification: Not prime farmland

Map Unit Composition

Kaymine, unstable fill, and similar soils: 40 percent
Fairpoint, unstable fill, and similar soils: 20 percent
Fiveblock, unstable fill, and similar soils: 15 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kaymine, Unstable Fill

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy coal extraction mine spoil derived from interbedded sedimentary rock

Typical profile

H1 - 0 to 14 inches: channery silt loam
H2 - 14 to 80 inches: very channery silt loam

Properties and qualities

Slope: 2 to 70 percent
Surface area covered with cobbles, stones or boulders: 1.5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Fairpoint, Unstable Fill

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy coal extraction mine spoil derived from interbedded sedimentary rock

Typical profile

H1 - 0 to 4 inches: channery silty clay loam
H2 - 4 to 72 inches: very channery silty clay loam

Properties and qualities

Slope: 2 to 70 percent
Surface area covered with cobbles, stones or boulders: 1.5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Fiveblock, Unstable Fill

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy coal extraction mine spoil derived from interbedded sedimentary rock

Typical profile

H1 - 0 to 14 inches: channery sandy loam
H2 - 14 to 65 inches: very channery sandy loam

Properties and qualities

Slope: 2 to 70 percent
Surface area covered with cobbles, stones or boulders: 1.5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained

Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Cedarcreek, unstable fill
Percent of map unit: 8 percent
Hydric soil rating: No

Bethesda, unstable fill
Percent of map unit: 7 percent
Hydric soil rating: No

Shelocta
Percent of map unit: 3 percent
Hydric soil rating: No

Sewell, unstable fill
Percent of map unit: 3 percent
Hydric soil rating: No

Udorthents, unstable fill
Percent of map unit: 2 percent
Hydric soil rating: No

Itmann, unstable fill
Percent of map unit: 2 percent
Hydric soil rating: No

uDut—Dumps, mine and tailings

Map Unit Setting
National map unit symbol: 2mtj7
Elevation: 720 to 1,510 feet
Mean annual precipitation: 45 to 57 inches
Mean annual air temperature: 43 to 68 degrees F
Frost-free period: 169 to 203 days
Farmland classification: Not prime farmland

Map Unit Composition

Dumps, mine (tailings & tipples): 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dumps, Mine (tailings & Tipples)

Setting

Landform: Hillslopes
Landform position (three-dimensional): Base slope

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Fairpoint, unstable fill

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Urban land

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (three-dimensional): Base slope
Hydric soil rating: No

Udorthents, unstable fill

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear, concave
Across-slope shape: Linear
Hydric soil rating: No

Leslie and Perry Counties, Kentucky

FaB—Fairpoint soils, undulating

Map Unit Setting

National map unit symbol: ljk2
Elevation: 820 to 2,460 feet
Mean annual precipitation: 43 to 54 inches
Mean annual air temperature: 42 to 67 degrees F
Frost-free period: 156 to 196 days
Farmland classification: Not prime farmland

Map Unit Composition

Fairpoint, unstable fill, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fairpoint, Unstable Fill

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Mountaintop
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy skeletal coal extraction mine spoil derived from interbedded sedimentary rock

Typical profile

H1 - 0 to 6 inches: very channery silt loam
H2 - 6 to 62 inches: very channery silt loam

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Shelocta

Percent of map unit: 4 percent
Hydric soil rating: No

Cutshin

Percent of map unit: 4 percent
Hydric soil rating: No

Dekalb

Percent of map unit: 4 percent
Hydric soil rating: No

Gilpin

Percent of map unit: 3 percent
Hydric soil rating: No

FaF—Fairpoint and Bethesda soils, 2 to 70 percent slopes, benched, stony

Map Unit Setting

National map unit symbol: 2tqhd
Elevation: 720 to 1,510 feet
Mean annual precipitation: 45 to 57 inches
Mean annual air temperature: 43 to 68 degrees F
Frost-free period: 169 to 203 days
Farmland classification: Not prime farmland

Map Unit Composition

Fairpoint, unstable fill, and similar soils: 55 percent
Bethesda, unstable fill, and similar soils: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fairpoint, Unstable Fill

Setting

Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy-skeletal coal extraction mine spoil derived from sandstone and shale

Typical profile

Ap - 0 to 11 inches: channery loam
C1 - 11 to 32 inches: very channery loam
C2 - 32 to 41 inches: extremely channery loam
C3 - 41 to 51 inches: extremely flaggy loam
C4 - 51 to 58 inches: extremely flaggy silt loam
C5 - 58 to 72 inches: extremely flaggy loam

Properties and qualities

Slope: 2 to 70 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Bethesda, Unstable Fill

Setting

Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy-skeletal coal extraction mine spoil derived from sandstone and shale

Typical profile

Ap - 0 to 12 inches: channery silt loam
C1 - 12 to 36 inches: very channery loam
C2 - 36 to 58 inches: very channery loam
C3 - 58 to 72 inches: very channery loam

Properties and qualities

Slope: 2 to 70 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Udorthents, unstable fill

Percent of map unit: 5 percent
Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Shelocta, very stony

Percent of map unit: 3 percent
Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Matewan, very stony

Percent of map unit: 3 percent
Landform: Ridges
Landform position (three-dimensional): Mountaintop
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Urban land

Percent of map unit: 2 percent
Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Dumps, mine (tailings & tipples)

Percent of map unit: 2 percent
Landform: Ridges
Landform position (three-dimensional): Mountaintop
Down-slope shape: Linear
Across-slope shape: Convex, linear
Hydric soil rating: No

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

Building Site Development

Building site development interpretations are designed to be used as tools for evaluating soil suitability and identifying soil limitations for various construction purposes. As part of the interpretation process, the rating applies to each soil in its described condition and does not consider present land use. Example interpretations can include corrosion of concrete and steel, shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping.

Corrosion of Concrete

ENG

Engineering

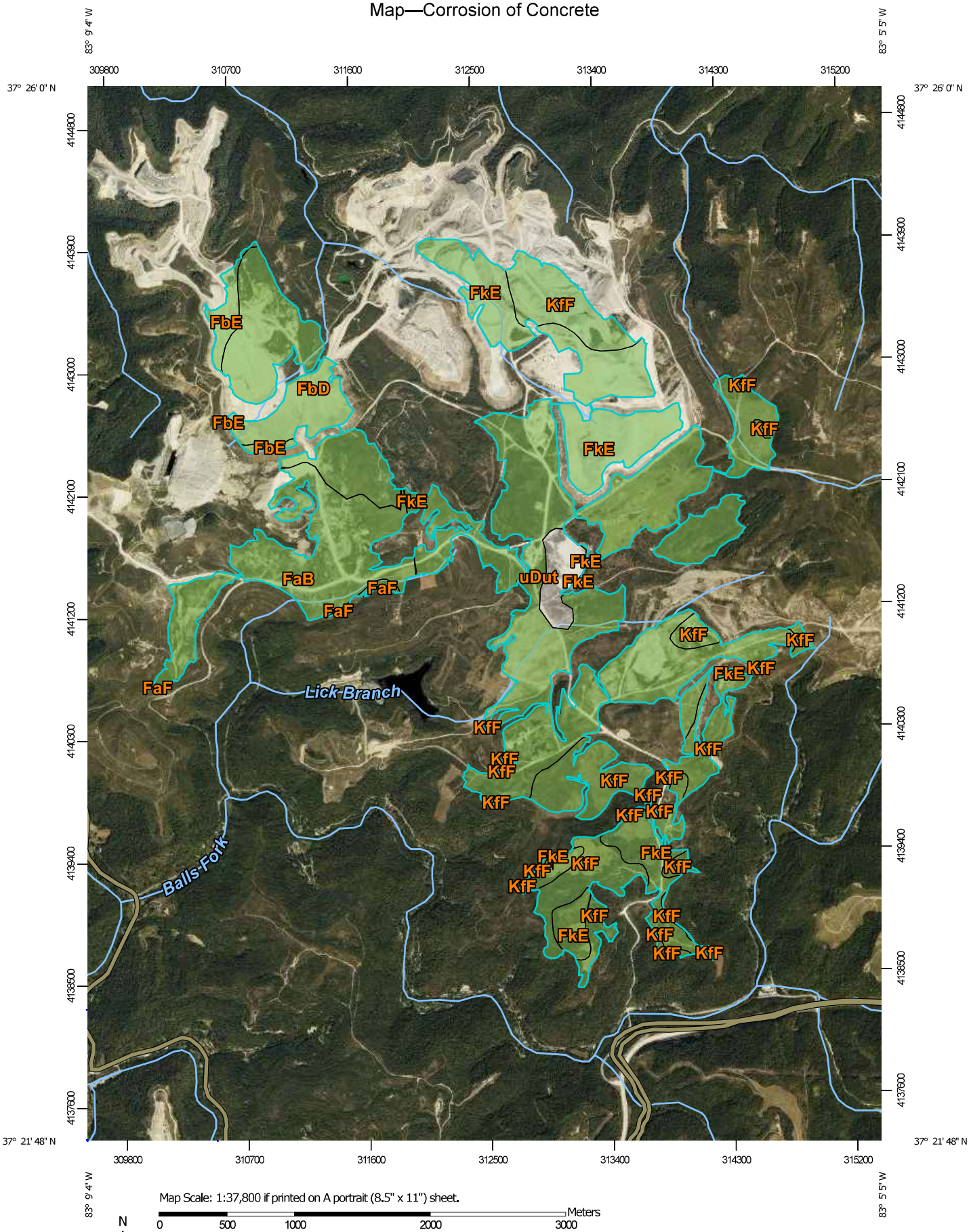
AGR

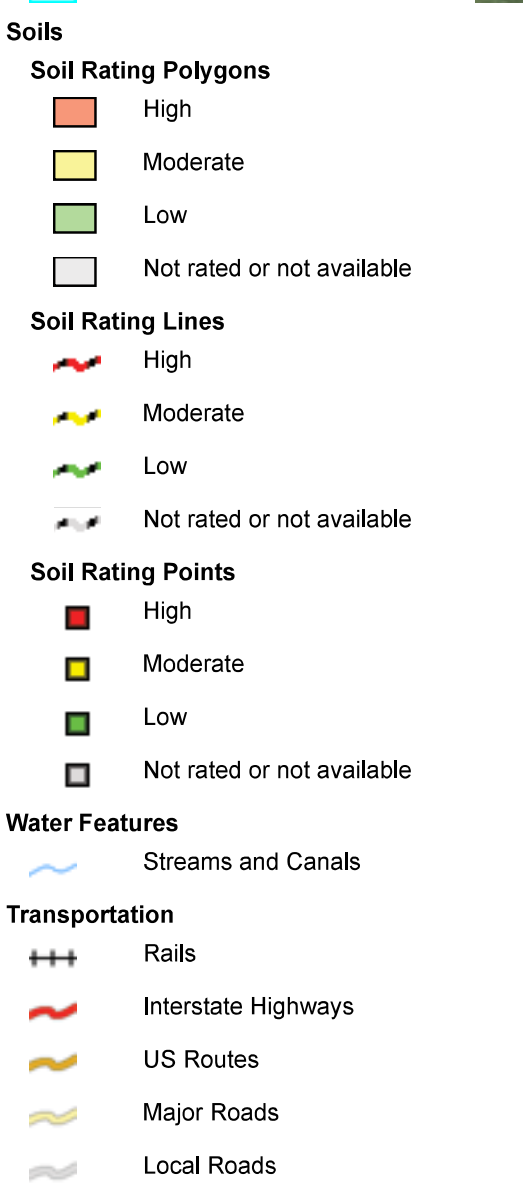
Agronomy

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens concrete. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the concrete in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Custom Soil Resource Report
Map—Corrosion of Concrete





Please rely on the bar scale on each map
measurements.

Source of Map: Natural Resources Cons
Web Soil Survey URL:
Coordinate System: Web Mercator (EPS

Maps from the Web Soil Survey are based
projection, which preserves direction and
distance and area. A projection that prese
Albers equal-area conic projection, should
accurate calculations of distance or area a

This product is generated from the USDA-
of the version date(s) listed below.

Soil Survey Area: Breathitt County, Kent
Survey Area Data: Version 19, Sep 10, 2

Soil Survey Area: Knott and Letcher Cou
Survey Area Data: Version 19, Sep 10, 2

Soil Survey Area: Leslie and Perry Cour
Survey Area Data: Version 20, Sep 10, 2

Your area of interest (AOI) includes more
area. These survey areas may have been
scales, with a different land use in mind, a
different levels of detail. This may result in
properties, and interpretations that do not
across soil survey area boundaries.

Soil map units are labeled (as space allow
1:50,000 or larger.

Date(s) aerial images were photographed
2019

MAP LEGEND

MAP INFORMATION

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Corrosion of Concrete

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FbD	Fairpoint and Bethesda soils, 0 to 20 percent slopes	Low	244.1	13.0%
FbE	Fairpoint and Bethesda soils, 2 to 70 percent slopes, benched, stony	Low	28.6	1.5%
Subtotals for Soil Survey Area			**272.7**	**14.5%**
Totals for Area of Interest			**1,881.4**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FkE	Fiveblock and Kaymine soils, 0 to 30 percent slopes, stony	Low	1,024.1	54.4%
KfF	Kaymine, Fairpoint, and Fiveblock soils, benched, 2 to 70 percent slopes, very stony	Low	308.8	16.4%
uDut	Dumps, mine and tailings		40.2	2.1%
Subtotals for Soil Survey Area			**1,373.1**	**73.0%**
Totals for Area of Interest			**1,881.4**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FaB	Fairpoint soils, undulating	Low	230.0	12.2%
FaF	Fairpoint and Bethesda soils, 2 to 70 percent slopes, benched, stony	Low	5.6	0.3%
Subtotals for Soil Survey Area			**235.6**	**12.5%**
Totals for Area of Interest			**1,881.4**	**100.0%**

Rating Options—Corrosion of Concrete

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Corrosion of Steel

ENG

Engineering

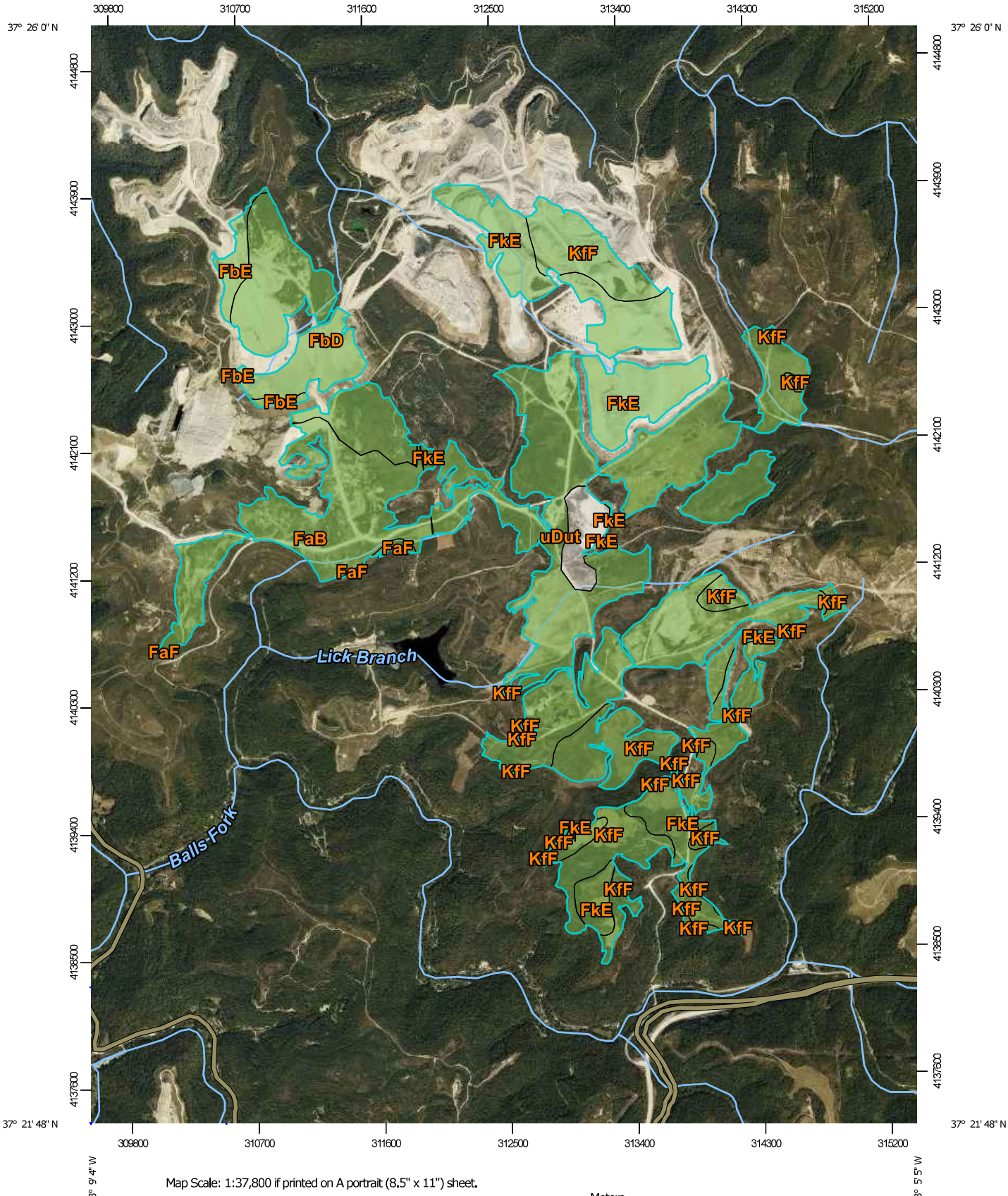
AGR

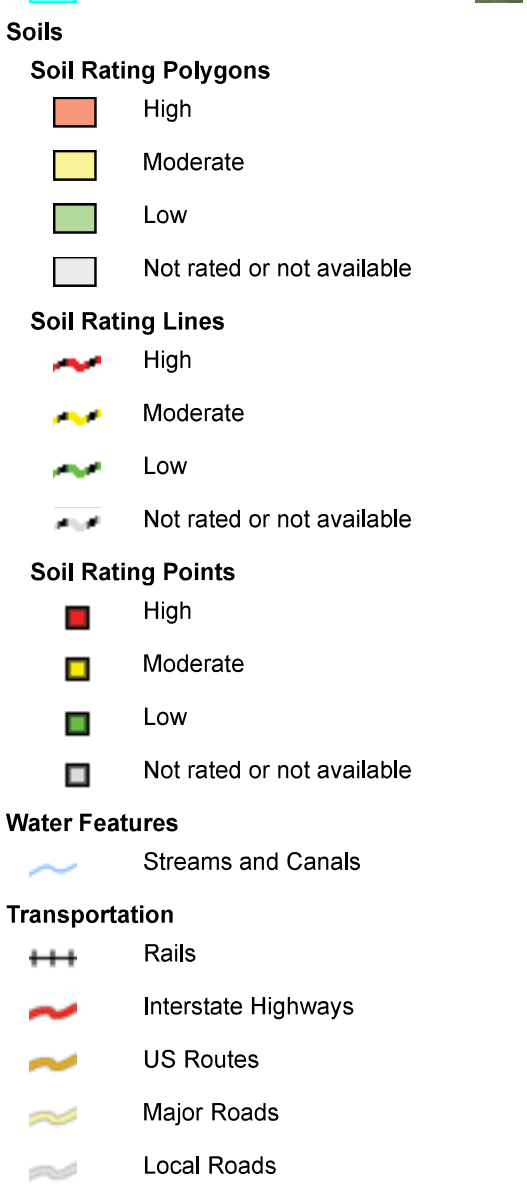
Agronomy

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Custom Soil Resource Report
Map—Corrosion of Steel





Please rely on the bar scale on each map
measurements.

Source of Map: Natural Resources Cons
Web Soil Survey URL:
Coordinate System: Web Mercator (EPS

Maps from the Web Soil Survey are based
projection, which preserves direction and
distance and area. A projection that prese
Albers equal-area conic projection, should
accurate calculations of distance or area a

This product is generated from the USDA-
of the version date(s) listed below.

Soil Survey Area: Breathitt County, Kent
Survey Area Data: Version 19, Sep 10, 2

Soil Survey Area: Knott and Letcher Cou
Survey Area Data: Version 19, Sep 10, 2

Soil Survey Area: Leslie and Perry Cour
Survey Area Data: Version 20, Sep 10, 2

Your area of interest (AOI) includes more
area. These survey areas may have been
scales, with a different land use in mind, a
different levels of detail. This may result in
properties, and interpretations that do not
across soil survey area boundaries.

Soil map units are labeled (as space allow
1:50,000 or larger.

Date(s) aerial images were photographed
2019

MAP LEGEND

MAP INFORMATION

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Corrosion of Steel

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FbD	Fairpoint and Bethesda soils, 0 to 20 percent slopes	Low	244.1	13.0%
FbE	Fairpoint and Bethesda soils, 2 to 70 percent slopes, benched, stony	Low	28.6	1.5%
Subtotals for Soil Survey Area			**272.7**	**14.5%**
Totals for Area of Interest			**1,881.4**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FkE	Fiveblock and Kaymine soils, 0 to 30 percent slopes, stony	Low	1,024.1	54.4%
KfF	Kaymine, Fairpoint, and Fiveblock soils, benched, 2 to 70 percent slopes, very stony	Low	308.8	16.4%
uDut	Dumps, mine and tailings		40.2	2.1%
Subtotals for Soil Survey Area			**1,373.1**	**73.0%**
Totals for Area of Interest			**1,881.4**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FaB	Fairpoint soils, undulating	Low	230.0	12.2%
FaF	Fairpoint and Bethesda soils, 2 to 70 percent slopes, benched, stony	Low	5.6	0.3%
Subtotals for Soil Survey Area			**235.6**	**12.5%**
Totals for Area of Interest			**1,881.4**	**100.0%**

Rating Options—Corrosion of Steel

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Land Management

Land management interpretations are tools designed to guide the user in evaluating existing conditions in planning and predicting the soil response to various land

management practices, for a variety of land uses, including cropland, forestland, hayland, pastureland, horticulture, and rangeland. Example interpretations include suitability for a variety of irrigation practices, log landings, haul roads and major skid trails, equipment operability, site preparation, suitability for hand and mechanical planting, potential erosion hazard associated with various practices, and ratings for fencing and waterline installation.

Erosion Hazard (Off-Road, Off-Trail)

FOR - Forestry

As of 9/30/2022, this rating is not working as intended. All components appear as not rated. This rating will be fixed on 10/01/2023.

The ratings in this interpretation indicate the hazard of soil loss from off-road and off-trail areas after disturbance activities that expose the soil surface. The ratings are based on slope, soil erosion factor K, and an index of rainfall erosivity (R). The soil loss is caused by sheet or rill erosion in off-road or off-trail areas where 50 to 75 percent of the surface has been exposed by logging, grazing, mining, or other kinds of disturbance.

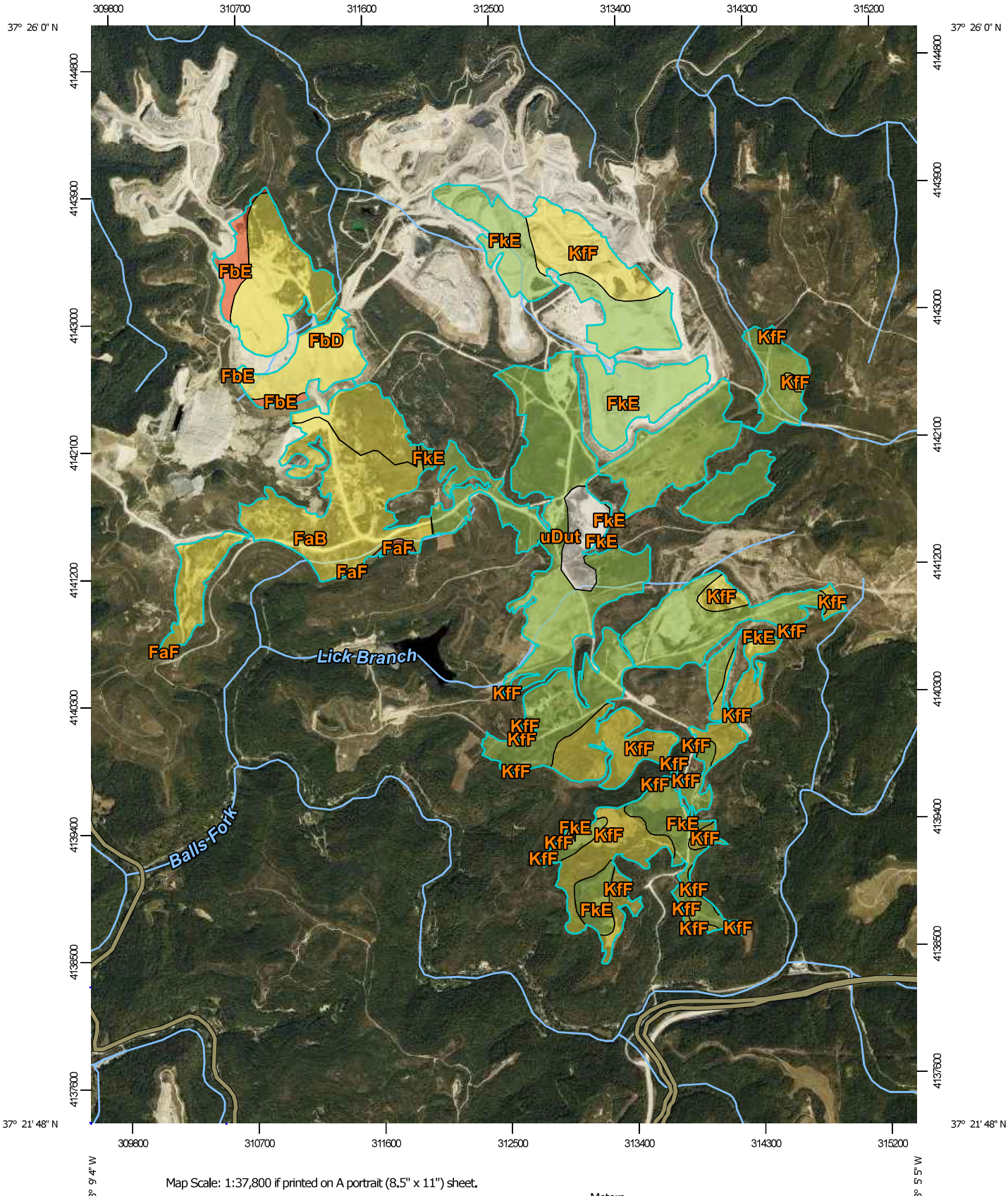
The ratings are both verbal and numerical. The hazard is described as "slight," "moderate," "severe," or "very severe." A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions; "moderate" indicates that some erosion is likely and that erosion-control measures may be needed; "severe" indicates that erosion is very likely and that erosion-control measures, including revegetation of bare areas, are advised; and "very severe" indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the specified aspect of forestland management (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Custom Soil Resource Report
Map—Erosion Hazard (Off-Road, Off-Trail)



Soils

Soil Rating Polygons

- Very severe
- Severe
- Moderate
- Slight
- Not rated or not available

Soil Rating Lines

- Very severe
- Severe
- Moderate
- Slight
- Not rated or not available

Soil Rating Points

- Very severe
- Severe
- Moderate
- Slight
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- Local Roads

Background

- Aerial Photography

Please rely on the bar scale on each map measurements.

Source of Map: Natural Resources Cons
Web Soil Survey URL:
Coordinate System: Web Mercator (EPS

Maps from the Web Soil Survey are based projection, which preserves direction and distance and area. A projection that prese Albers equal-area conic projection, should accurate calculations of distance or area a

This product is generated from the USDA- of the version date(s) listed below.

Soil Survey Area: Breathitt County, Kent
Survey Area Data: Version 19, Sep 10, 2

Soil Survey Area: Knott and Letcher Cou
Survey Area Data: Version 19, Sep 10, 2

Soil Survey Area: Leslie and Perry Cour
Survey Area Data: Version 20, Sep 10, 2

Your area of interest (AOI) includes more area. These survey areas may have been scales, with a different land use in mind, a different levels of detail. This may result in properties, and interpretations that do not across soil survey area boundaries.

Soil map units are labeled (as space allow 1:50,000 or larger.

Date(s) aerial images were photographed 2019

MAP LEGEND

MAP INFORMATION

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Tables—Erosion Hazard (Off-Road, Off-Trail)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
FbD	Fairpoint and Bethesda soils, 0 to 20 percent slopes	Moderate	Fairpoint, unstable fill (50%)	Surface kw times slope times R index (0.59)	244.1	13.0%
			Bethesda, unstable fill (35%)	Surface kw times slope times R index (0.65)		
FbE	Fairpoint and Bethesda soils, 2 to 70 percent slopes, benched, stony	Very Severe	Fairpoint, unstable fill (55%)	Surface kw times slope times R index (1.00)	28.6	1.5%
			Bethesda, unstable fill (30%)	Surface kw times slope times R index (1.00)		
			Udorthents, unstable fill (5%)	Surface kw times slope times R index (1.00)		
			Shelocta, very stony (3%)	Surface kw times slope times R index (1.00)		
Subtotals for Soil Survey Area					**272.7**	**14.5%**
Totals for Area of Interest					**1,881.4**	**100.0%**

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
FkE	Fiveblock and Kaymine soils, 0 to 30 percent slopes, stony	Slight	Fiveblock, unstable fill (41%)		1,024.1	54.4%
KfF	Kaymine, Fairpoint, and Fiveblock soils, benched, 2 to 70 percent slopes, very stony	Moderate	Kaymine, unstable fill (40%)	Surface kw times slope times R index (0.75)	308.8	16.4%
			Fiveblock, unstable fill (15%)	Surface kw times slope times R index (0.42)		
uDut	Dumps, mine and tailings	Not rated	Dumps, mine (tailings & tipples) (85%)		40.2	2.1%
			Urban land (5%)			
Subtotals for Soil Survey Area					**1,373.1**	**73.0%**
Totals for Area of Interest					**1,881.4**	**100.0%**

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
FaB	Fairpoint soils, undulating	Moderate	Fairpoint, unstable fill (85%)	Surface kw times slope times R index (0.14)	230.0	12.2%
FaF	Fairpoint and Bethesda soils, 2 to 70 percent slopes, benched, stony	Very Severe	Fairpoint, unstable fill (55%)	Surface kw times slope times R index (1.00)	5.6	0.3%
			Bethesda, unstable fill (30%)	Surface kw times slope times R index (1.00)		
			Udorthents, unstable fill (5%)	Surface kw times slope times R index (1.00)		
			Shelocta, very stony (3%)	Surface kw times slope times R index (1.00)		
Subtotals for Soil Survey Area					**235.6**	**12.5%**
Totals for Area of Interest					**1,881.4**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Slight	1,024.1	54.4%
Moderate	782.9	41.6%
Very Severe	34.2	1.8%
Null or Not Rated	40.2	2.1%
Totals for Area of Interest	**1,881.4**	**100.0%**

Rating Options—Erosion Hazard (Off-Road, Off-Trail)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Erosion Hazard (Road, Trail)

FOR - Forestry

The ratings in this interpretation indicate the hazard of soil loss from unsurfaced roads and trails. The ratings are based on soil erosion factor K, slope, and content of rock fragments.

The ratings are both verbal and numerical. The hazard is described as "slight," "moderate," or "severe." A rating of "slight" indicates that little or no erosion is likely; "moderate" indicates that some erosion is likely, that the roads or trails may require occasional maintenance, and that simple erosion-control measures are needed; and

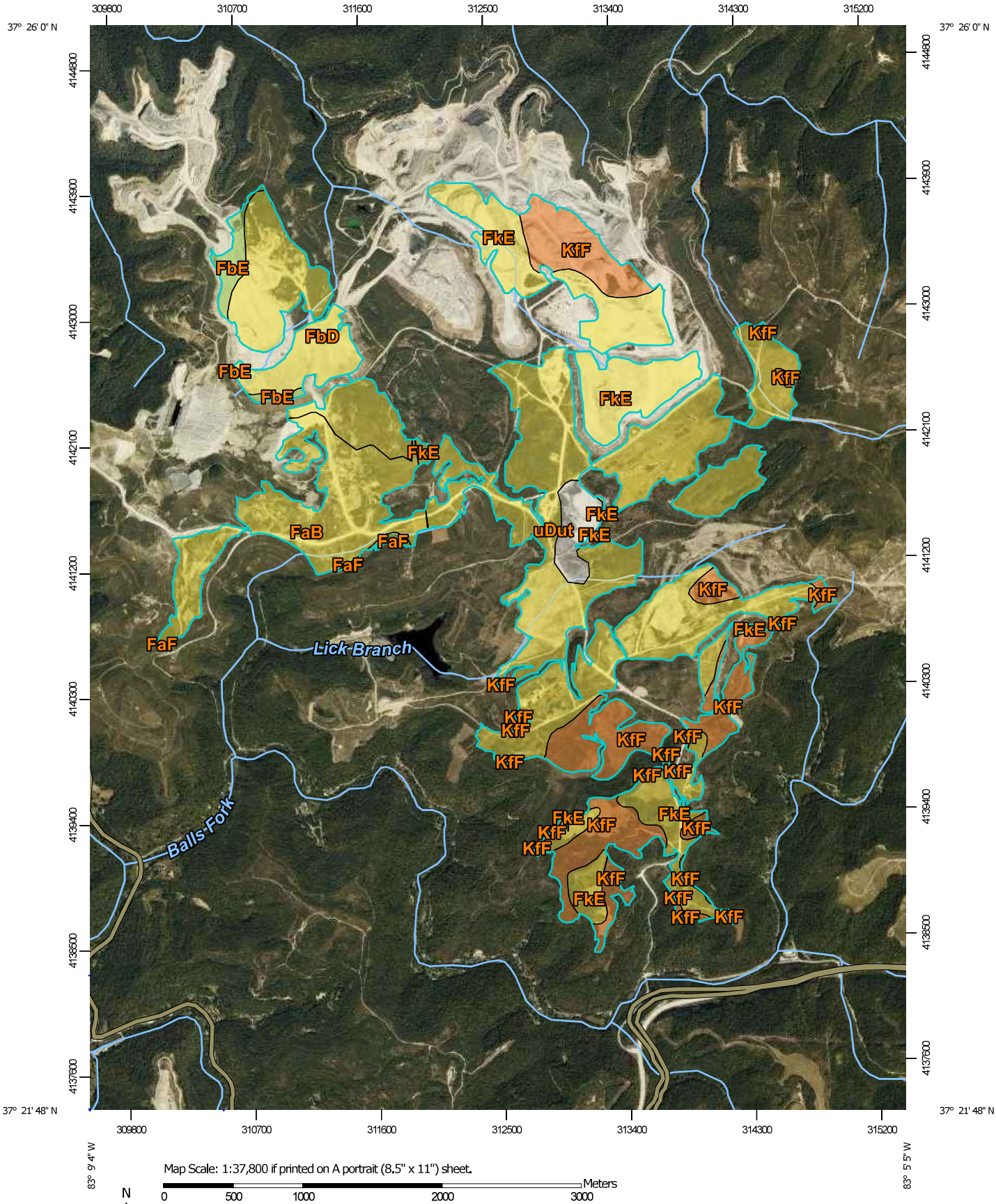
"severe" indicates that significant erosion is expected, that the roads or trails require frequent maintenance, and that costly erosion-control measures are needed.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the specified aspect of forestland management (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Custom Soil Resource Report
Map—Erosion Hazard (Road, Trail)



Map Scale: 1:37,800 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 500 1000 2000 3000

Feet: 0 1500 3000 6000 9000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

Soils

Soil Rating Polygons

- Very severe
- Severe
- Moderate
- Slight
- Not rated or not available

Soil Rating Lines

- Very severe
- Severe
- Moderate
- Slight
- Not rated or not available

Soil Rating Points

- Very severe
- Severe
- Moderate
- Slight
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- Local Roads

Background

- Aerial Photography

Please rely on the bar scale on each map measurements.

Source of Map: Natural Resources Cons
Web Soil Survey URL:
Coordinate System: Web Mercator (EPS

Maps from the Web Soil Survey are based projection, which preserves direction and distance and area. A projection that prese Albers equal-area conic projection, should accurate calculations of distance or area a

This product is generated from the USDA- of the version date(s) listed below.

Soil Survey Area: Breathitt County, Kent
Survey Area Data: Version 19, Sep 10, 2

Soil Survey Area: Knott and Letcher Cou
Survey Area Data: Version 19, Sep 10, 2

Soil Survey Area: Leslie and Perry Cour
Survey Area Data: Version 20, Sep 10, 2

Your area of interest (AOI) includes more area. These survey areas may have been scales, with a different land use in mind, a different levels of detail. This may result in properties, and interpretations that do not across soil survey area boundaries.

Soil map units are labeled (as space allow 1:50,000 or larger.

Date(s) aerial images were photographed 2019

MAP LEGEND

MAP INFORMATION

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Tables—Erosion Hazard (Road, Trail)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
FbD	Fairpoint and Bethesda soils, 0 to 20 percent slopes	Moderate	Fairpoint, unstable fill (50%)	Slope/erodibility (0.50)	244.1	13.0%
FbE	Fairpoint and Bethesda soils, 2 to 70 percent slopes, benched, stony	Slight	Fairpoint, unstable fill (55%)		28.6	1.5%
Subtotals for Soil Survey Area					**272.7**	**14.5%**
Totals for Area of Interest					**1,881.4**	**100.0%**

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
FkE	Fiveblock and Kaymine soils, 0 to 30 percent slopes, stony	Moderate	Fiveblock, unstable fill (41%)	Slope/erodibility (0.50)	1,024.1	54.4%
			Kaymine, unstable fill (39%)	Slope/erodibility (0.50)		
KfF	Kaymine, Fairpoint, and Fiveblock soils, benched, 2 to 70 percent slopes, very stony	Severe	Kaymine, unstable fill (40%)	Slope/erodibility (0.95)	308.8	16.4%
			Fairpoint, unstable fill (20%)	Slope/erodibility (0.95)		
				Slope/erodibility (0.95)		
			Fiveblock, unstable fill (15%)	Slope/erodibility (0.95)		
uDut	Dumps, mine and tailings	Not rated	Dumps, mine (tailings & tipples) (85%)		40.2	2.1%
			Urban land (5%)			
Subtotals for Soil Survey Area					**1,373.1**	**73.0%**
Totals for Area of Interest					**1,881.4**	**100.0%**

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
FaB	Fairpoint soils, undulating	Moderate	Fairpoint, unstable fill (85%)	Slope/erodibility (0.50)	230.0	12.2%

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
FaF	Fairpoint and Bethesda soils, 2 to 70 percent slopes, benched, stony	Slight	Fairpoint, unstable fill (55%)		5.6	0.3%
Subtotals for Soil Survey Area					**235.6**	**12.5%**
Totals for Area of Interest					**1,881.4**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Moderate	1,498.2	79.6%
Severe	308.8	16.4%
Slight	34.2	1.8%
Null or Not Rated	40.2	2.1%
Totals for Area of Interest	**1,881.4**	**100.0%**

Rating Options—Erosion Hazard (Road, Trail)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Attachment C

Seismic and Wind Support Data

ASCE 7 Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: C - Very Dense Soil and Soft Rock

Latitude: 37.399107
Longitude: -83.112831
Elevation: 1312.377050549214 ft (NAVD 88)

Wind

Results:

Wind Speed	105 Vmph
10-year MRI	73 Vmph
25-year MRI	80 Vmph
50-year MRI	85 Vmph
100-year MRI	90 Vmph

Data Source: ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed: Thu Dec 21 2023

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

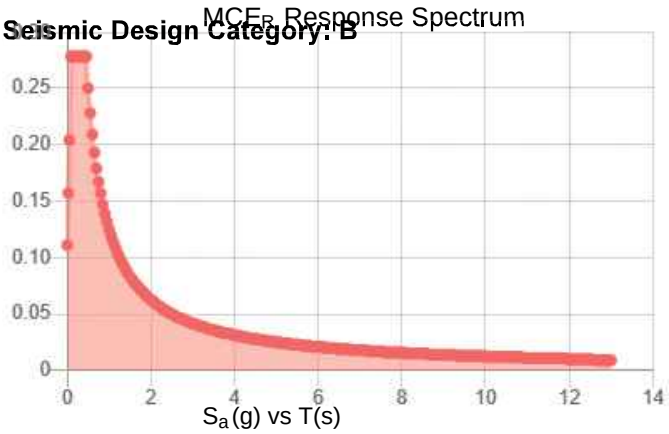
Seismic

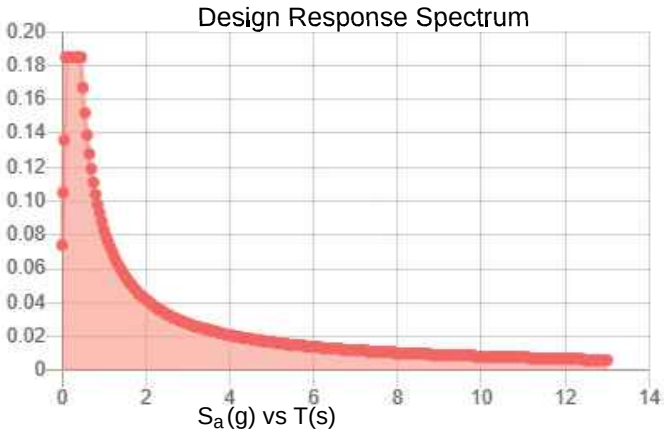
Site Soil Class: C - Very Dense Soil and Soft Rock

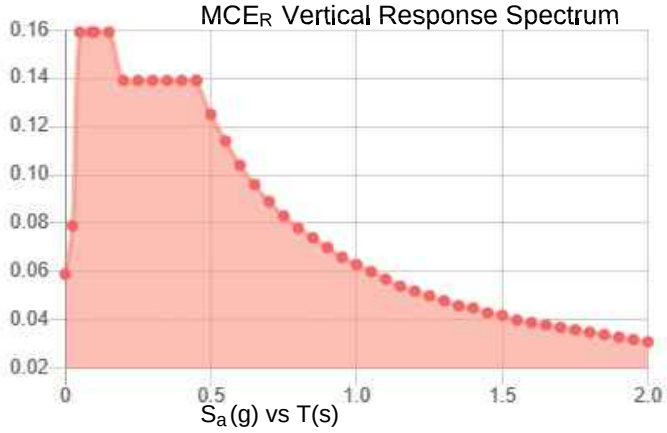
Results:

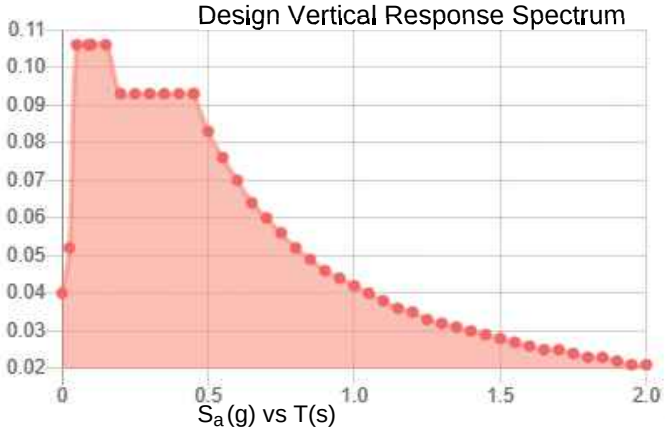
S_S :	0.214	S_{D1} :	0.083
S_1 :	0.083	T_L :	12
F_a :	1.3	PGA :	0.116
F_v :	1.5	PGA_M :	0.149
S_{MS} :	0.278	F_{PGA} :	1.284
S_{M1} :	0.125	I_e :	1
S_{DS} :	0.185	C_v :	0.714

Seismic Design Category: B









Data Accessed: Thu Dec 21 2023

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-16 and ASCE/SEI 7-16 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-16 Ch. 21 are available from USGS.

Tsunami

Results:

Tsunami:	Not in mapped tsunami design zone.

Data Source: ASCE Tsunami Design Geodatabase

Date Accessed: Thu Dec 21 2023

ANS GEO