UK UNIVERSITY OF KENTUCKY
Kentucky Geological Survey

KENTUCKY GEOLOGICAL SURVEY
James C. Cobb, State Geologist and Director
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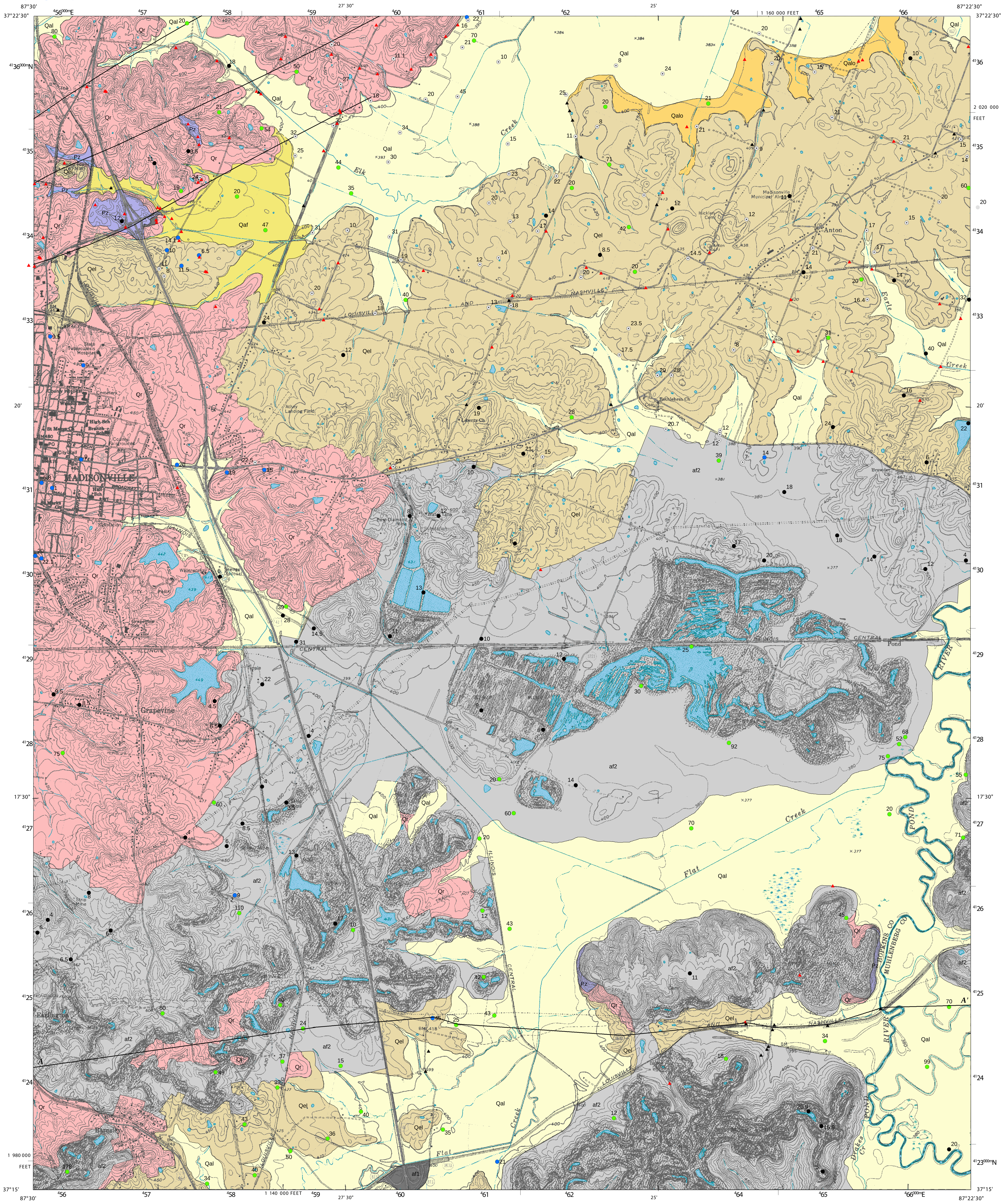
DRAFT GEOLOGIC QUADRANGLE
MADISONVILLE EAST QUADRANGLE, KY
Contract Report 46 Series XII, 2012
GQ-252
Version 1.0



Topographic basemap: Kentucky Raster Graphic (KRG) from the Kentucky Geography Network ftp://ftp.kymartian.ky.gov/krg

NAD 1983, Kentucky State Plane Single Zone, feet projection

Original coordinate system UTM, Zone 16, NAD27

2010 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

UTM GRID

SCALE 1:24 000

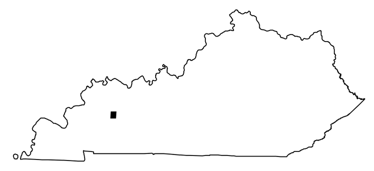
KILOMETERS

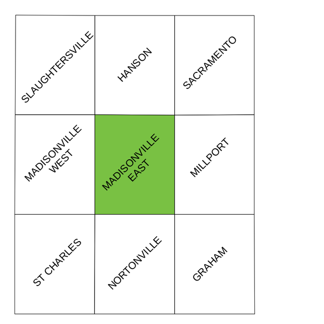
METERS

MILES

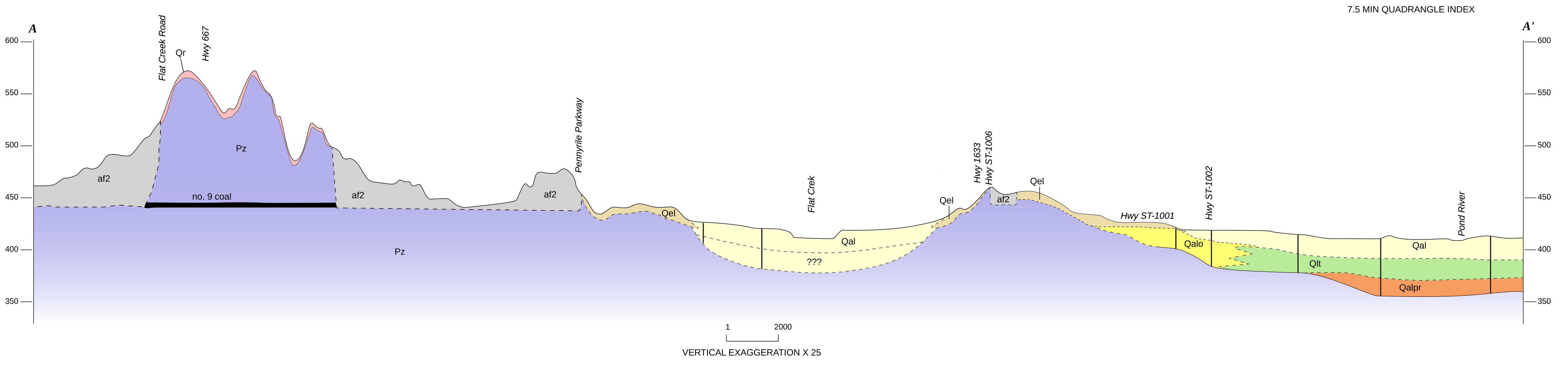
FEET

CONTOUR INTERVAL 10 FEET





7.5 MIN QUADRANGLE INDEX



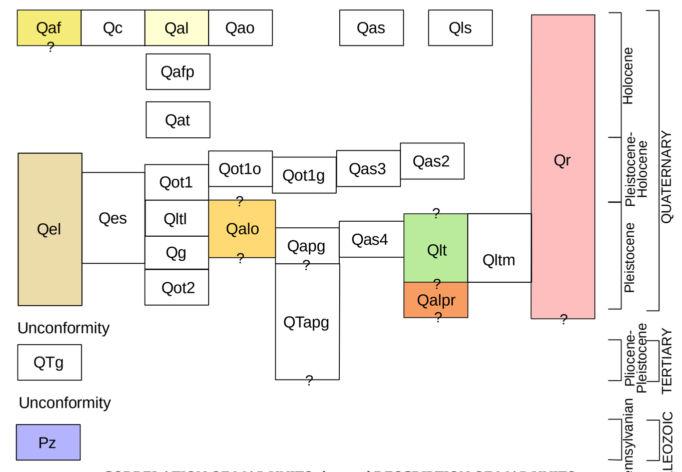
VERTICAL EXAGGERATION X 25

SURFICIAL GEOLOGIC MAP OF THE MADISONVILLE EAST QUADRANGLE, KENTUCKY

By
Ronald C. Counts

2012

CORRELATION OF MAP UNITS



CORRELATION OF MAP UNITS chart and DESCRIPTION OF MAP UNITS
Include map units from adjacent quadrangles. Only map units within the Madisonville East quadrangle have a color fill.

DESCRIPTION OF MAP UNITS

Qal — **Alluvium (Holocene)**
Brown (10YR 4/3), grayish brown (10YR 5/2), and light brownish gray (10YR 6/2) silt loam and silty clay loam underlain by reddish brown (5YR 4/4) to dark reddish brown (2.5YR 3/4), cross-bedded, moderately sorted, medium to fine sand (Fig. 1). Underlies the surfaces of broad, flat valley floors. Active channels commonly have pebble-gravel bars composed of sub-rounded, platy, micaceous sandstone fragments and shale pebbles; thickness is 5 to 25 feet (1.5 to 8 m); unit is inset into older alluvium (Qalo) and possibly lacustrine deposits (Qlt).

Qao — **Alluvium, natural levee deposits (Holocene)**
Sand and silty sand; deposited as levee ridges or overwash deposits on floodplains (Qafp) of major rivers and on Ohio River low outwash terraces (Qot1); grades into adjacent floodplain deposits; sandier than adjacent floodplain deposits, thickness 0 - 10 ft (0 – 3 m).

Qas — **Alluvium, active modern floodplain sloughs (Holocene)**
Organic, black and gray clayey silt, silty clay, and clay; found within low lying areas; poorly drained; areas that retain water year-round form bogs and cypress swamps.

Qaf — **Alluvium, alluvial fans (Holocene)**
Brown (10YR 4/3) to dark yellowish brown (10YR 4/6) silt loam to silty clay loam; forms a gently sloping fan shaped landform that eminates from several small valleys incised into the uplands in the northwestern corner of the quadrangle. Loess is conspicuously absent from these uplands, suggesting this unit is composed primarily of remobilized loess (Qel) and possibly residuum (Qr). Thickness where unit was observed near the contact with Qal was 3 ft (1 m), maximum thickness is unknown.

Qc — **Colluvium (Holocene)**
Silt, sand, clay, and rock fragments; unsorted; which has been transported downslope under the influence of gravity; primarily mantles steep slopes.

Qafp — **Alluvium, river floodplains (Holocene)**
Sand, silt, fine gravel, and clay; surface mantled by silty clay and sandy silt; surface forms the lowest well-developed terrace along major rivers; 30 to 45 feet (10 to 15 m) thick; overlies older unconsolidated deposits or bedrock; contact is sharp, drawn at scarp of next higher terrace; estimated to range in age up to 6,500 years.

Qas1 — **Alluvium, abandoned Green River meander (Holocene)**
Organic-rich, black and gray clayey silt, silty clay, and clay; deposited within recently abandoned meander of Green River; can retain standing water for months; areas that retain water year-round form bogs and cypress swamps.

Qat — **Alluvium, low terrace (Holocene)**
Silt, sand, and clay deposited by rivers; forms terrace above adjacent floodplain (Qafp); contact with adjacent units varies from sharp to poorly defined; locally inferred on the basis of topographic expression; distinguished by topographic expression from lower floodplain (Qafp), but found below Ohio River low outwash terrace (Qot1) and lacustrine terrace (Qlt).

Qas2 — **Alluvium, abandoned Green River channel (Pleistocene - Holocene)**
Clayey silt, silty sand, and silty clay; 30 to 45 feet (10 to 15 m) thick; forms arcuate, low-lying trough; represents an abandoned channel of Green River as it migrated across the low terrace (Qot1g); overlies older outwash deposits (Qot2); contact sharp, identified by surface topography; floods frequently.

Qoto1o — **Alluvium, reworked outwash, Ohio River scrollwork terrace (Pleistocene – Holocene)**
Fine to coarse sand and gravel, with local lenses of silt and clay; gravel includes chert, quartzite, sandstone, siltstone, igneous and metamorphic rocks, limestone, and coal; lithologically similar to adjacent outwash terraces; surface mantled with alluvial silty sand and sandy silt; 30 to 45 feet (10 to 15 m) thick; surface forms well-developed, swell-and-swale topography on Ohio River low terrace; reworked during postglacial adjustment of the Ohio River; overlies older outwash deposits (Qot2); contact is approximate, inferred from surface topography.

Qas3 — **Alluvium, abandoned Green River channel (Pleistocene - Holocene)**
Silty sand, clayey silt, and silty clay; 30 to 45 feet (10 to 15 m) thick; forms sinuous, low-lying trough (Katie Meadow Slough); represents an abandoned channel of Green River as it migrated across the low terrace (Qot1g); overlies older outwash deposits (Qot2); contact sharp, identified by surface topography; floods frequently.

Qot1g — **Alluvium, reworked outwash, Green River scrollwork terrace (Pleistocene – Holocene)**
Fine to coarse sand and gravel, with local lenses of silt and clay; gravel includes chert, quartzite, sandstone, siltstone, limestone, and coal; lithologically similar to adjacent outwash terraces; surface mantled with alluvial silty sand and sandy silt; 30 to 45 feet (10 to 15 m) thick; surface forms well-developed, swell-and-swale topography on Ohio River low terrace; deposited as point bar deposits by meandering postglacial Green River; overlies older outwash deposits (Qot2); contact is approximate, inferred from surface topography.

Qalo — **Alluvium (Pleistocene)**
Dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), and yellowish brown (10YR 5/6) silt loam to silty clay loam, commonly includes pebbles of sub-rounded, platy, micaceous sandstone or less frequently chert pebbles with a brown patina, and commonly has many large Mn and Fe concretions with a very well developed soil structure; Qal is inset into Qalo, and Qalo is inset into and/or interfingers with lacustrine deposits (Qlt); terraces underlain with Qalo are not well preserved and difficult to recognize. Qalo is overlain by loess (Qel), indicating it is older than the last glacial loess; thickness is 5 to 20 feet (1.5 to 6 m)

Qot1 — **Alluvium, outwash, low terrace (Pleistocene - Holocene)**
Fine to coarse sand and gravel, with local lenses of silt and clay; gravel includes chert, quartzite, sandstone, siltstone, igneous and metamorphic rocks, limestone, and coal; lithologically similar to high outwash terrace (Qot2); surface mantled with alluvial silty sand and sandy silt; 30 to 45 feet (10 to 15 m) thick; surface forms well-developed, low-relief terrace along Ohio River valley; deposited as glacial outwash reworked by late glacial or post-glacial Ohio River; overlies older outwash deposits (Qot2); contact is sharp, drawn at scarp of next higher terrace or upland; floods occasionally.

Qot2 — **Alluvium, outwash, high terrace (Pleistocene)**
Fine to coarse sand and gravel, with local lenses of silt and clay; gravel includes chert, quartzite, sandstone, siltstone, igneous and metamorphic rocks, limestone, and coal; lithologically similar to adjacent outwash terraces; surface mantled with eolian and alluvial silty sand and sandy silt; up to 170 feet (52 m) thick; surface forms well-developed, dissected terrace along Ohio River valley; deposited as glacial outwash; represents maximum valley filling by glacial outwash valley train deposits; overlies bedrock (Pz) or older alluvial deposits (not differentiated); contact is sharp, drawn at scarp of adjacent terrace or upland; age estimated to be 120,000 to 22,000 years old; most of terrace surface is above historic flood zone.

Qel — **Eolian silt, Undifferentiated (Pleistocene - Holocene?)**
Yellowish brown (10YR 5/4) to dark yellowish brown (10YR 4/6) silt loam and silty clay loam; near contact with underlying residuum (Qr) color changes to reddish brown (5YR 4/4) or red (2.5YR 4/8) and fine to medium sand percentages increase significantly (Fig. 2), which may represent what remains of the Loveland loess (Illinoian). Qel less than 5 ft (1.5 m) thick typically has a well developed fragipan (B_{tx}) horizon, whereas Qel greater than 5 ft (1.5 m) typically has no fragipan development (Fig. 3). Qel in bedrock upland areas is very thin and discontinuous; suggesting that loess deposited in upland areas eroded and accumulated as thicker deposits on lower, less-steep landscape positions; overlies bedock (Pz), residuum (Qr), and old alluvium (Qalo); typically less than 5 ft (1.5 m) cm thick; maximum thicnkess 6.25 ft (2 m).

Qes — **Eolian sand, (Pleistocene - Holocene)**
Very fine to fine sand; locally contains lenses of clayey silt; thickness uncertain, base not observed; deposited by wind in long, linear ridges; mantled by loess up to 15 ft (5 m) thick.

Qg — **Shoreline Gravels (Pleistocene)**
Gravel and medium to course sand; pebbles include light grey to brown, patina chert, quartz, and silicified fossils; unit is reworked Upland Gravel (QTg); forms low relief bars and spits extending from, and occasionally connecting upland areas.

Qltl — **Lake levee (Pleistocene)**
Silt, clayey silt, and fine sand deposited by water and wind. Formed where moving water entered quieter conditions and deposited layered mixed sediments across the mouth of tributaries forming low ridges. Sand dunes (Qes) occur on many while loess (Qel) generally blankets these ridges indicating that formation is contemporaneous with lacustrine deposition and terminated prior to final loess deposition

Qas4 — **Alluvium, abandoned Green River channel (Pleistocene)**
Clayey silt, silty clay, and silty sand; 30 to 45 feet (10 to 15 m) thick; forms sinuous, low-lying trough inset into Green River paleovalley (Qapg); represents an abandoned channel of Green River as it migrated across the high terrace (Qot2); overlies older outwash (Qot2); contact sharp, identified by surface topography; floods occasionally.

Qapg — **Alluvium, Green River paleovalley (Pleistocene)**
Silty sand, clayey silt and silty clay with minor chert gravel; 30 to 45 feet (10 to 15 m) thick; forms broad, linear trough inset into and overlying deposits of adjacent high outwash terrace (Qot2) and lacustrine terrace (Qlt); represents abandoned Pleistocene paleovalley of the Green River

Qltm — **Upland marginal lacustrine deposits (Pleistocene)**
Clayey silt, silt, and fine sand; thickness uncertain; surface forms moderate slope and benched upland areas bordering lacustrine deposits (Qlt); represents complex transition between lacustrine deposits and loess mantling upland; deposits include loess, loess-derived slopewash, colluvium, lacustrine silt and clay, and lacustrine shoreline deposits; contacts gradational and approximate, mapped on the basis of topographic expression.

Qlt — **Lacustrine slackwater deposits, (subsurface only), Undifferentiated (Pleistocene)**
Very dark gray 2.5Y 3/1) to dark olive brown (2.5Y 3/3) silty clay, clay, and sandy clay; observed only in boreholes within the Pond River valley; overlain by Qel and possibly Qalo, underlain by Qalpr; 20 ft (6.1 m) thick where observed, maximum thickness unknown.

Qalpr — **Alluvium (subsurface only), ancient Pond River deposits (Pleistocene)**
Dark gray 2.5Y 4/1) to olive brown (2.5Y 4/4) sandy gravel, sand, and clay; includes chert pebbles up to 2 inches (5 cm) in diameter with a brown patina, grayish brown (10YR 5/2), found in one borehole near the Pond River; 13 ft thick (4 m) where observed, maximum thickness unknown.

QTapg — **Alluvium, Abandoned Green River channel (Pliocene-Pleistocene)**
Gravel, sand, and clay facies present up to 100 feet thick (30 m) in the Paleovalley of the Green River. Subsurface unit only.

QTg — **Upland gravel (Pliocene-Pleistocene)**
Gravel and medium to coarse sand; pebbles include brown, patina chert, quartz, and silicified fossils; locally cemented by iron oxide; thickness uncertain; unit found on uplands, covered by loess and poorly exposed.

Qr — **Residuum, Undifferentiated (Pleistocene)**
Weathered Pennsylvanian siltstone, shale, and sandstone bedrock; near contact with loess (Qlt) sand content typically decreases and small rock fragments become less abundant; typically 1-5 ft thick (0.3-1.5 m).

Pz — **Bedrock and residuum (Paleozoic)**
Consolidated shale, sandstone, coal, and overlaid by poorly sorted regolith, comprising the core of the uplands in the study area; occurs mostly as highwalls, roadcuts, and construction cut sites most places is heavily weathered and included in Residuum unit (QR)

Qls — **Landslide (Modern)**
Landslides develop due to over-steepened slopes on hillsides and road-cuts and where man-made lakes have raised the water table.

af1 — **Artificial fill, engineered fill (Modern)**
Compacted material used as fill for the construction of roads, railroads, buildings, floodwalls, and other engineered structures. Present in all areas of development: mapped only where fill significantly changes the elevation.

af2 — **Artificial fill, mine spoil (Modern)**
Disturbed bedrock and regolith produced from mining operations .

af3 — **Artificial fill, other (Modern)**
Chaotic, unconsolidated fill material; includes material dredged from creeks to form artificial levees. Mapped only where fill is distinct.

EXPLANATION

Contact
Approximate Contact
Fault
Landform observation with sediment description
KGS Borehole
23 KGS Water well Database, number indicates depth to bedrock
23 KGS Coal Database, number indicates depth to bedrock
23 KGS Oil and Gas Database, number indicates casing depth
23 Confidential coal borehole data, number indicates depth to bedrock

GEOLOGIC SUMMARY

GEOLOGIC SETTING

The Madisonville East quadrangle lies within headwater regions of the lower Green River Valley and middle Tradewater River Valley. The landscape of the map area is characterized by very low to high-relief bedrock uplands that are separated by flat valleys. Although the area is south of the Pleistocene glacial limit, the Ohio River was a major glacial meltwater outlet for Pleistocene continental glaciers, and the rapid deposition of glacial outwash in the Ohio River valley blocked the mouths of its tributaries, creating an extensive network of slackwater lakes in most tributary valleys. This lake system eventually filled the tributaries with sediment that was then capped by a thin loess mantle. The uplands are underlain by faulted Pennsylvanian coal-bearing strata steeply dipping North to Northwest.

Coal has been mined from the quadrangle for more than 60 years by multiple mining companies. At least 30% of the quadrangle has been strip-mined, and some areas have been strip-mined multiple times. Effects of older mining operations before environmental reclamation laws were enacted are still visible on the surface today as barren landscapes, and acidic mine drainage still affects some regions of the quadrangle. Native plants and animals thrive in areas of reclaimed strip mining, and many of these areas are private hunting grounds or state Fish and Wildlife refuges (Fig. 4).

GEOTECHNICAL BEHAVIOR

The Quaternary deposits identified in the map area exhibit a wide range of grain size and geotechnical behaviors. Grain size distribution is one of the primary factors affecting the behavior of soils for geotechnical, hydrogeologic, and agricultural applications. The grain size distribution of unconsolidated sediments is dominantly controlled by the conditions under which the material was deposited. Low energy environments allow the deposition of fine-grained materials. High energy deposits limit deposition to only coarser grained materials. Eolian processes produce very well sorted (poorly graded) materials. Fluvial processes produce moderate sorting; colluvial processes produce poorly sorted deposits.

HAZARDS

Flooding is a nearly annual occurrence along the Tradewater and Pond Rivers. Floods in the late winter or early spring commonly inundate low-lying areas in the floodplain. Larger floods occur roughly every 5 to 10 years and cover parts of the alluvial deposits (Qal). The maximum flood of record in the valley was in 1937, flooding river towns throughout the valley. The impact of flooding is reflected in land-use patterns through the area. Older homes and businesses have survived on the higher parts of the lacustrine terrace (Qlt). The floodplain and lower parts of the slackwater lacustrine terrace (Qlt) are dominantly left as woodlands or are used for row-crop agriculture. Most livestock husbandry in the alluvial valleys has been abandoned and is now restricted to upland areas above the 10- to 20-year flood zone. Low-lying, flood-prone areas are very poorly drained but are typically tiled and ditched for agriculture.

The silt soils that dominate the loess-mantled uplands are highly erodible. Great care must be taken during agricultural operations not to mobilize and lose this valuable resource.

The map area is proximal to the Wabash Valley Seismic Zone, and is within the Rough Creek Fault Zone. Small to moderate earthquakes occur in the region relatively frequently. The significant thickness of unconsolidated sediments (locally as much as 150 feet in the regional map area) makes the region susceptible the amplification of seismic shaking and/or liquefaction. The variations in lithology and thickness between materials in different map units will likely cause different responses of these materials to seismic shaking.

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Smith, P.C., 2005, Spatial database of the Madisonville East quadrangle, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-252_12. Adapted from Kehn, T.M., 1964, Geologic map of the Madisonville East quadrangle, Kentucky: U.S. Geologic Survey Geologic Quadrangle Map GQ-252.

Figure 1. Alluvium (Qal) exposed in a straightened section of Elk Creek shows cross-bedded alluvium inset into a finer-grained, older alluvium. The sandy alluvium is buried by young silty alluvium that was likely mobilized during historic landuse.

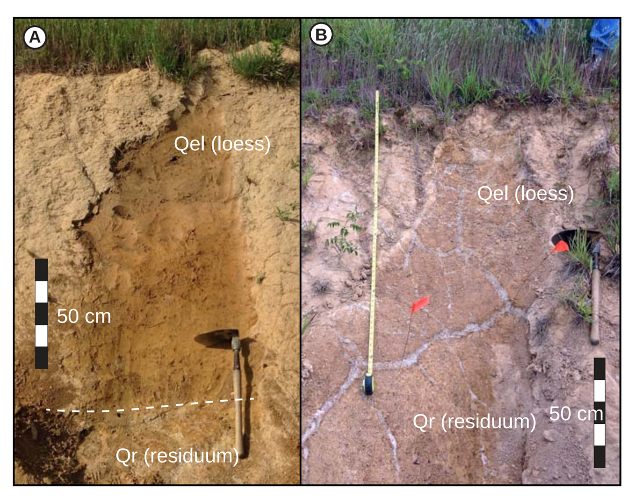

Figure 3. A) Loess (Qel) that is thicker than 5 ft (1.5 m) is less likely to form a fragipan soil horizon than thin loess. B) This loess with a well developed fragipan that is developed into the underlying residuum. The orange flags mark the boundary between loess and residuum. White soil polygons are filled with silt, which is the only route that water and roots can take to get through a fragipan. Well developed fragipans usually take significant time to form.

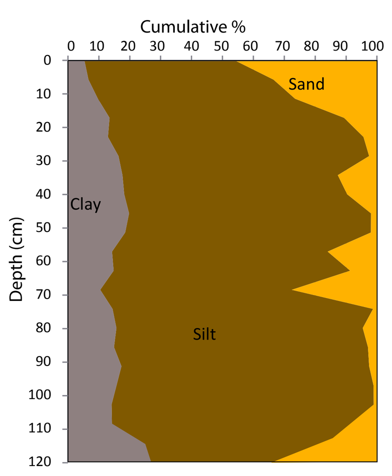

Figure 2. Cumulative plot of grain-size distribution of Qel (loess) with depth. Sand and clay content increase near the contact with underlying Qr (residuum). A core could not be recovered through the contact at this site by hand coring due to extremely dry conditions. Hand augering indicated the contact between Qel and Qr was at 140 cm.

Figure 4. At least 30% of the Madisonville East quadrangle has been strip mined. A) Unreclaimed strip mines still contain barren areas that cannot grow vegetation even after 30 or more years due to acidic drainage. B) Reclaimed strip mines grow trees, grasses, and can even become fertile farmland after a short period of time..

DISCLAIMER

ACKNOWLEDGMENTS

This map was funded in part by the U.S. Geological Survey National Cooperative Mapping Program under the STATEMAP Program, authorized by the National Geologica Mapping Act of 1992, Grant No. 12HQPA0003, and by the Kentucky Geological Survey. Data for the map was generated using new field mapping and from the compilation of previously published data.
Mapping was completed by Ronald Counts from July 2011 through July 2012 with field assistance from Matt McCauley (NRCS) and Steve Neyhouse (NRCS) in collecting shallow cores. Subsurface information was compiled from data on file at the Kentucky Geological Survey and confidential borehole data from the Alliance Coal Company.