DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
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PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF KENTUCKY, UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
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HYDROLOGIC INVESTIGATIONS
ATLAS HA-179

GENERALIZED COLUMNAR SECTION AND WATER-BEARING CHARACTER OF GEOLOGIC FORMATIONS

System	Series	Group	Formation	Section	Thickness in feet	Lithology	Topography and geologic setting	Hydrology
Quaternary	Pleistocene and Recent		Alluvium		0-40±	Clay or silt near the surface, grading downward into clayey sand or silt with clayey gravel and (or) clean gravel (about 5 to 10 feet thick in large creeks) near the base.	Present in the larger stream valleys and their tributaries. As thick as 40 feet in the valley of Obion Creek. About 30 to 35 feet thick in the valleys of Hopewell and Guess Creeks. Estimated to be about 30 feet thick in the valley of Russell Creek. The alluvium in the valley of West Fork Mayfield Creek is about 30 to 35 feet thick; about 5 to 25 feet thick in its tributaries.	Water bearing in most of the quadrangle. Will furnish a sufficient supply for domestic use in the valleys of the large streams and their tributaries. Presently very slightly used because of lack of habitation in the valleys. Could supply sufficient water for stock use from shallow bored wells. In some areas, where drilled wells tap the Eocene sand must be deep, domestic needs could be supplied from shallow wells. Shallow wells for human use should be protected from contamination. A shallow bored well in the center of the valley of West Fork Mayfield Creek is reported to yield water of good quality. Its amount of contamination is unknown.
Quaternary	Pleistocene		Loess		0-20±	Tan to gray unstratified silt or clay.	Covers all upland areas and the gently sloping sides of stream valleys.	Not an aquifer. When saturated by rainfall transmits water to lower aquifer.
Quaternary	Pliocene(?)		Gravel[1]		0-40±	Tan, red, or brown chert gravel, commonly sandy and clayey grading upward to gravelly sand, sand with chert pebbles, or sand.	Overlies Eocene sediments in most of the quadrangle. Well exposed in a gravel pit and in ruggedly eroded land about one mile from Kentucky Highway 80, near the west edge of the map, along a north-northeast-trending county road.	The water table is below the base of the Pliocene(?) gravel in the entire quadrangle; therefore, the gravel is not an aquifer. Cemented zones at the base of the gravel or Eocene clay beds below the gravel may perch water locally, but no wells are known that tap such a perched zone.
Tertiary	Eocene		Sand and clay		100-300±	Red, tan, to white fine- to coarse-grained sand and soft to very hard white, blue-gray, to black clay. The clay is lignitic at places and contains sand beds of variable thicknesses. Thickest water-bearing sand beds are in the northwest and southwest parts of the quadrangle.	Underlies Pliocene(?) gravel, loess, or Quaternary alluvium in all of the quadrangle. Exposed in the deeper creek beds and road cuts in all of the quadrangle except south of Obion Creek where it is concealed by surficial loess and gravel.	Sand beds in parts of this unit are water bearing in all of the quadrangle. The thickest water-bearing sands known are in the upper part of the unit in the southwest and northwest. Thinner sands above the clay beds and sands within the clays furnish sufficient water for domestic use in all of the quadrangle. In part of the north-central area the sand above the clay beds has been reported to be non-water bearing; however, these upper sands probably contain water but do not yield water readily. Several springs and seepage horizons are known in this area where the underlying clay beds are exposed at the surface. In such areas large-diameter bored wells may yield sufficient water owing to their large storage capacity. Drilled wells will probably have to be drilled to the deeper Eocene sand below the clay. The water is soft and slightly acidic. The iron content appears variable. In order to sample water that was not in contact with steel or iron well casings, water samples 4 and 8 were taken from wells with plastic casings. Well 4 obtains water from sand at the top of the clay sequence and contains 0.36 ppm (parts per million) of iron. This water should be treated for iron removal for many uses. Well 8 obtains water from sand within the clay sequence. Its iron content of 0.06 ppm is very low and treatment would not be required for almost all uses. An iron content of more than 0.3 ppm imparts a disagreeable taste to water and may cause staining of clothes and utensils.
Tertiary	Eocene		Sand and clay		500-800±	Brown to white coarse- to fine-grained sand with thin beds of clay.	Underlies clay of Eocene age in all of the quadrangle. Not exposed, but penetrated by a few wells mostly in the northern part of the quadrangle.	Supplies sufficient water for domestic use to wells tapping the upper part of the unit in the north and central parts of the quadrangle. Wells fully or deeply penetrating the unit should yield more than 1,000 gallons per minute in all of the quadrangle. The water is soft and is slightly acidic. The only sample collected from this unit that does not have the iron content affected by steel well casing is sample number 5 which is from a well with plastic casing. This water has an iron content of 1.5 ppm. This well obtains water from the upper part of the unit. Wells tapping the deeper part of the unit may have a lower iron content; however, water from this unit will probably need iron-removal treatment for many uses.
Tertiary	Eocene		Sand and clay		300-400±	Brown to white coarse- to fine-grained sand with thin beds of clay.	Underlies clay of Eocene age in all of the quadrangle. Not exposed, but penetrated by a few wells mostly in the northern part of the quadrangle.	Supplies sufficient water for domestic use to wells tapping the upper part of the unit in the north and central parts of the quadrangle. Wells fully or deeply penetrating the unit should yield more than 1,000 gallons per minute in all of the quadrangle. The water is soft and is slightly acidic. The only sample collected from this unit that does not have the iron content affected by steel well casing is sample number 5 which is from a well with plastic casing. This water has an iron content of 1.5 ppm. This well obtains water from the upper part of the unit. Wells tapping the deeper part of the unit may have a lower iron content; however, water from this unit will probably need iron-removal treatment for many uses.
Tertiary	Eocene		Sand and clay		100±	Gray to black clay, probably lignitic, and fine-grained sand; grades downward to coarse-grained sand near the base.	Not exposed, but probably underlies the entire quadrangle.	The water-bearing character of the formations below the upper part of the overlying sand has not been tested or penetrated by drilling in the Milburn quadrangle. No wells in this quadrangle tap this unit. The sand near the base may supply water for domestic use, but probably will not supply large yields because of its thinness.
Tertiary	Paleocene	Midway	Porters Creek Clay		200±	Light- to dark-gray or black, slightly to very micaceous clay with fine- to medium-grained, commonly glauconitic sand beds in the upper part. Black clay and glauconitic sand or glauconitic clay at the base.	Not exposed, but underlies Eocene sediments throughout the quadrangle.	Generally not an aquifer. The clay is the base of the zone of ground-water circulation in the overlying Eocene sediments and confines ground water in the underlying McNairy Formation.

[1]Age undetermined; estimates of age range from Pliocene or older to Pleistocene.

EXPLANATION

Gravel, Sand, Clay, Silt, Loess, Mica, Glauconite, Lignite

AVAILABILITY OF GROUND WATER IN THE MILBURN QUADRANGLE, JACKSON PURCHASE REGION, KENTUCKY

Sufficient supplies of ground water for domestic, public, and industrial needs are available in the area of the Milburn quadrangle, Kentucky. Deposits capable of yielding large amounts of water for industrial or public-supply uses underlie the entire quadrangle and are largely undeveloped. This atlas, one of a series being prepared to describe in as much detail as possible the ground-water conditions in the Jackson Purchase region in western Kentucky, presents information about the ground-water resources near Milburn for use by well drillers, landowners, and other well users.

Methods of obtaining ground water in the Milburn quadrangle range from developed springs on hillsides to drilled wells as deep as 290 feet. Drilled wells of varying depths are common, especially in upland areas. Bored or dug wells are common near major drainageways and often are satisfactory for obtaining ground water for domestic use. Almost all wells obtain water from sand of Eocene age.

The water-availability map presents information on the occurrence of the shallowest aquifer that may yield an adequate supply of water for domestic use. The map explanation and the columnar section briefly describe the water-yielding properties of the aquifer. The availability of ground water at a particular location may be determined by the area pattern on the map. Depths of nearby wells are an aid in estimating the depths required to complete a satisfactory well. However, since almost all of the drilled wells shown have 2-inch diameter casings and are equipped with low-yielding cylinder pumps (locally called "sucker rod" pumps), a new well with a larger-yielding pump in the same area may not obtain sufficient water from fine sand beds at the same horizon as the 2-inch wells. It may be necessary in such cases to drill deeper to a coarser sand to satisfactorily complete a well for a modern home. The approximate depth to water can be calculated by subtracting the altitude of the water level (as shown by the water-level contours) from the altitude of the land surface. In some areas, where contours are not shown and water-yielding sands occur at various horizons, the altitude of the measured water level is shown as part of the well symbol. Chemical composition of water from wells is represented on the map by circular diagrams.

Deposits of sand and clay several hundred feet in thickness are near the surface in most of the quadrangle. Sufficient drilling records are not available to describe the apparently complex lateral changes from sand to clay within the deposits, but the deposits appear to change abruptly from sand to clay in short distances. A formation of coarser sand of great potential importance lies beneath the several hundred feet of presently tapped Eocene sand and clay. This coarser formation may be 300 to 400 feet thick. Its upper surface may lie as deep as 350 feet at Milburn, but is shallower in the northern part of the quadrangle.

In general, ground water for domestic and some municipal and industrial uses occurs at two depth zones in the quadrangle. One zone is in sand beds that are either above or near the top of the clay beds of the shallower deposits. At places these sands may be within the clay sequence. The other zone is in the thick coarser sand below the clay sequence.

Wells tapping sand above or near the top of the clay sequence are mainly in the central and southern part of the quadrangle. The largest yield known from this zone is at Arlington, 1 mile west of the Milburn quadrangle, where a 101-foot city-supply well is reported to have yielded 415 gpm during test pumping. Equivalent yields from this sand may be possible in the southwestern part of the quadrangle, but yields in the central part of the quadrangle probably are sufficient only for domestic uses because the sand there is thin.

Wells that are believed to tap sand beds within the clay sequence are mainly in the central and northwestern parts of the quadrangle; however, some of these wells may tap sand beds deposited in channels eroded in the clay. The largest yield known from these sand beds is at Bardwell immediately northwest of the Milburn quadrangle where a city-supply well 107 feet deep is reported to yield about 200 gpm. Such a yield may be possible in the northwestern part of the quadrangle if sand of suitable quality is found.

Wells tapping the upper part of the coarser sand body below the clay sequence are in the northern and central parts of the quadrangle. These wells are indicated by the symbol, "Tud" on the water-availability map. The sands should be 300 to 400 feet thick, based on drilling data in adjacent quadrangles, and should be capable of supplying more than 1,000 gpm to properly constructed wells. At present, few wells tap this unit.

In the upland, the water table in the shallow Eocene aquifers ranges from slightly above 400 feet altitude along the northwest-southeast trending ridge through Milburn to about 340 feet altitude at the edge of the valley of Obion Creek. The water table slopes toward the major drainages and is about at 310 feet altitude in the alluvium and in the shallow Eocene sands at the southwest corner of the map. This shallow water discharges into Obion Creek and West Fork Mayfield Creek which are perennial streams.

In most of the area, the water table in the deeper Eocene aquifer below the clay sequence is lower than the shallow water table. It slopes in a westerly direction, from about 350 feet altitude at the east edge of the quadrangle to about 325 feet altitude at the west edge. Near West Fork Mayfield Creek where the clays are thin, the water table of the deeper sand appears to merge with the shallow water table. It slopes toward the major drainage and conforms more to the local topography. The area where the two water tables merge is an area of shallow ground-water discharge into streams and it is also a potential area of ground-water recharge to the deeper Eocene aquifer. This deeper aquifer now is filled to capacity and discharges toward the alluvium along the Mississippi River.

The water from the Eocene aquifers is of good quality. The water is soft, slightly acidic, and commonly contains less than 100 ppm (parts per million) dissolved solids. The iron content appears to vary with geographic location and depth of penetration into the aquifer. It may be sufficiently high in some areas to require iron-removal treatment for many uses.

Excessive iron in the water (see table below) is a common cause for complaint by many well owners in the area. Part of this problem probably is the result of the corrosive action of the slightly acidic ground water on the 2-inch diameter steel and galvanized well casings and the "sucker rod" pumps used in the area. Most wells sampled were of this construction. However, in wells where plastic casing is used the iron content is higher than 0.3 ppm in 2 of 3 wells sampled.

The shallow water-bearing Eocene sand may be contaminated by sewage effluent in the vicinity of the community of Milburn. Sample 11, collected in August 1954, from a shallow well at Milburn, contained 91 ppm of nitrate. Water containing more than 45 ppm of nitrate may cause a type of methemoglobinemia in infants ("blue baby" disease), sometimes fatal, and should not be used in infants' formulas.

The temperature of ground water from the Eocene sand is about 59° to 60°F.

The following table shows the iron content, in parts per million, and the hydrogen-ion concentration, expressed as pH, of the water analyzed and shown by circular diagrams on the map. A pH of 7.0 indicates neutrality of a solution. Values higher than 7.0 denote alkalinity; values lower than 7.0 indicate acidity. Corrosiveness of water generally increases as pH decreases.

Analysis number	1	2	3	4	5	6	7	8	9	10
Iron content	0.14	0.31	2.0	[1]0.36	[2]1.5	0.44	6.3	0.06	0.67	2.4
pH	6.3	—	6.1	6.1	6.2	6.6	6.2	6.1	6.2	6.2

Analysis number	11	12	13	14
Iron content	0.77	2.0	0.70	0.12
pH	5.6	6.2	6.0	6.4

[1]Contained 0.35 ppm manganese
[2]Contained 0.30 ppm manganese

89°00'
36°52'30"
36°45'
88°52'30"
57'30"
55'
50'
47'30"
(BLANDVILLE)
CUNNINGHAM 2.4 MI.
CARLISLE CO.
HICKMAN CO.
Obion
Mayfield
Creek
West Fork
Little
Qal
Tu
Tud
Tpc
Qal-11
Qal-4
Qal-17
Qal-9
Tu-12
Tu-33
Tu-13
Tu-19
Tu-10
Tu-16
Tu-18
Tu-40r
Tu-37
Tu-60
Tu-32
Tu-30
Tu-5
Tu-40
Tu-36
Tu-56r
Tud-40r
Tud-57
Tud-112r
Tud-125
Tud-196
Tud-214
Tu-100r
Tu-138r
Tu-25r
Tu-15r
Tu-50r
Tu-55r
Tu-25r
Tu-90
Tu-85
Tu-146
Tu-145
Tu-100
Tu-90r
Tu-30r
Tu-95r
Tu-80
Tu-106
Tu-195
Tu-152
Tu-85r
Tu-68
Tu-196
Tu-37
Tu-18r
Tu-26
Tu-56r
Tu-50
Tud-112r
Tud-125
Tud-196
Tud-214
Tud-57
Tud-172