Environmental Geology of Carroll County, Indiana

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This report was compiled from information available in a recent soil survey of the county and from 705 water well logs in the files of the Water Resources Division, Indiana Department of Natural Resources.

The post-glacial drainage pattern in Carroll County is similar to the pre-glacial drainage. Soil cover is generally thick enough to present few construction problems from excavations reaching bedrock. Groundwater is of satisfactory quality except for hardness and, in some wells, high iron content. There are many areas which are suitable for housing developments. However, developers should heed the soil type carefully. Not all areas are suitable for septic systems. Carroll County has a number of sites which appear to be acceptable for sanitary landfills.

Purpose and Scope

The purpose of this report was to document the geologic factors in Carroll County which will have an impact on future development of the land. The information we used has been from published records or from the open files of the Water Resources Divison in Indianapolis. The most frequently used published records for this paper were Ulrich (4) and Wayne *et. al.* (6). The Water Resources Division of the Indiana Department of Conservation allowed us to copy information from the water well logs in their files. A similar study was done for adjacent Howard County earlier by the senior author (1).

Setting

Carroll County is located in the north-central portion of Indiana. The county seat is Delphi which is approximately sixty-five miles northwest of Indianapolis. The population of the county is approximately 18,200 (3) and there are approximately 374 square miles of land within the county.

The land is nearly level to gently rolling over much of the county. Stream valleys are seldom more than thirty feet deep. The major exceptions to this are the valleys of the Tippecanoe and Wabash Rivers in the northwestern part of the county. Local relief in their valleys is one hundred feet or more at a number of points.

Geology

The whole county was covered by the Wisconsin-age glaciers (5). Most of the material deposited by the melt-waters of these huge ice masses is still covering the bedrock of the area. This debris of sand, gravel, and clay has completely buried the old, pre-glacial drainage ways. In only a few places along the valley walls of the Tippecanoe and Wabash Rivers, have these large rivers succeeded in washing away the mantle of glacial material to expose the bedrock.

The post-glacial drainage system is not significantly different from the pre-glacial drainage. The flow is still to the south and west as it was before the coming of the Wisconsin ice sheet. The pre-glacial drainage can easily be traced on the bedrock surface map (Figure 1). This cover is not of a uniform thickness. There are a few areas where it is quite thin (Figure 2). The only present rock quarries are just west of Delphi where the limestone is within a few feet of the surface. There are numerous small gravel pits mainly in river valleys. These appear to be isolated pockets and our study has not located any significant new sources of gravel.

The underlying bedrock ranges in age from the Upper Devonian New Albany Shale to the Middle Silurian Niagaran Series composed of carbonate rocks (limestones and dolomites) and siltstones. Figure 3 is the geological map we have made from the water well logs and from

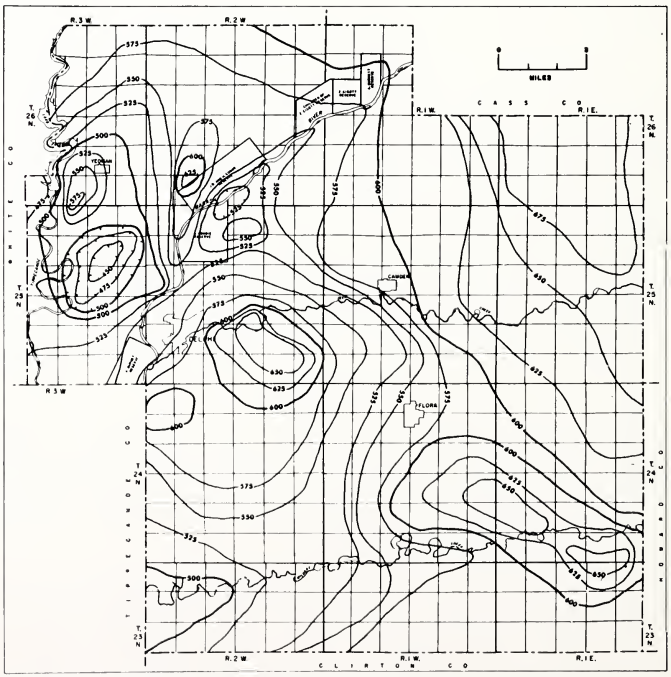

FIGURE 1. *Bedrock surface in Carroll County. The elevations are in feet above sea level.*

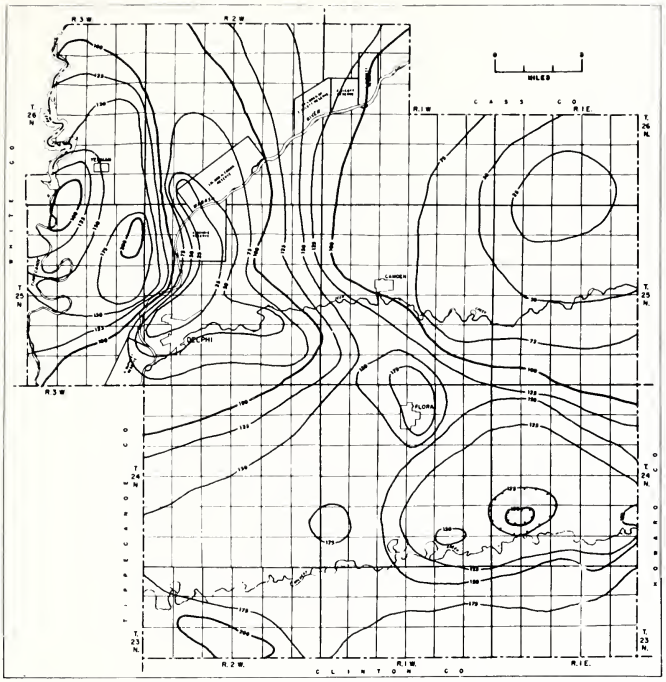

FIGURE 2. *Thickness, in feet, of glacial drift covering Carroll County.*

Wayne *et. al.* (6). Numerous wells have been drilled into the carbonate rocks with varying success. Some have produced water in excess of 100 gallons per minute. While others have flows of five or six gallons per minute. There seems to be no overall pattern to the groundwater flow in the limestones and dolomites. Undoubtedly, this is due to the characteristically tortuous nature of their joint patterns. There are no wells producing water from the New Albany Shale. This is a fissle, black shale which has limited permeability. Therefore, a water well must be drilled through the shale to the underlying carbonate rocks in order to obtain water. Generally the New Albany Shale is less than twenty feet thick in the county so the expense of drilling through it is not excessive. Many wells are drawing water from the sand and gravel layers located at irregular intervals within the mantle of glacial material overlying the bedrock. These wells have widely differing flow rates. Water quality generally is good. Table 1 illustrates hardness is a problem and iron is present in undesirable quantities in some wells.

We suggest that the most dependable water supply in the county is the larger rivers which flow through the area. A city seeking to increase its water delivery system or a company considering an expansion of its operations could obtain large amounts of water from the Wabash or Tippecanoe Rivers. Even Wildcat Creek or Deer Creek would supply more than enough water for any reasonable use.

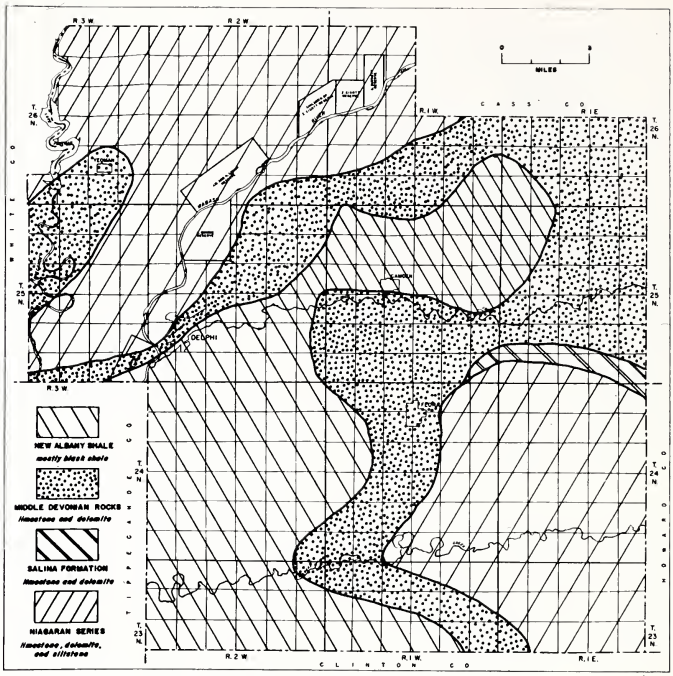

FIGURE 3. *Geological map of Carroll County.*

The flow of the groundwater is to the west and south (Figure 4) as is the surface water flow. An exception to this is an area southwest of Flora. There is a pocket toward which groundwater flows from all directions. We cannot account for this behavior since it does not

TABLE 1. *Raw water quality in Carroll County.*[1]

	Camden (2 wells)	Delphi (7 springs)	Delphi (2 wells)	Flora (1 well)
pH	7.2–7.5	7.6	7.2	7.4
Color s.u.	<5	0	0–<5	5
Turbidity s.u.	0.4–10	0	0.1–0.2	5
Hardness as $CaCO_3$	330–347	350	414–447	346
Calcium as Ca	83	95	89–108	94
Magnesium as Mg	31–34	28	43–47	27
Sodium as Na	11–15	4	10–13	4
Potassium as K	2	2	2–5	1
Iron as Fe	1.2–2.4	0	<0.03–0.6	1.8
Manganese as Mn	<0.05	0	0.01	0.1
Alkalinity as $CaCO_3$	342–348	278	313–342	290
Chlorides as Cl	4–7	5	10–14	8
Sulfates as SO_4	6	50	70–100	57
Nitrates as N	0–0.1	3.0	0.8–3.6	0.1
Fluorides as F	0.4	0	0–0.4	0.1

[1] Data from Indiana State Board of Health (2). All columns in milligrams per liter (mg/l) except pH, color, and turbidity.

appear to be a buried sinkhole. This type of map is particularly useful if any wells should become contaminated in the future. It will provide a reference as to the general direction from which the pollutants most likely came.

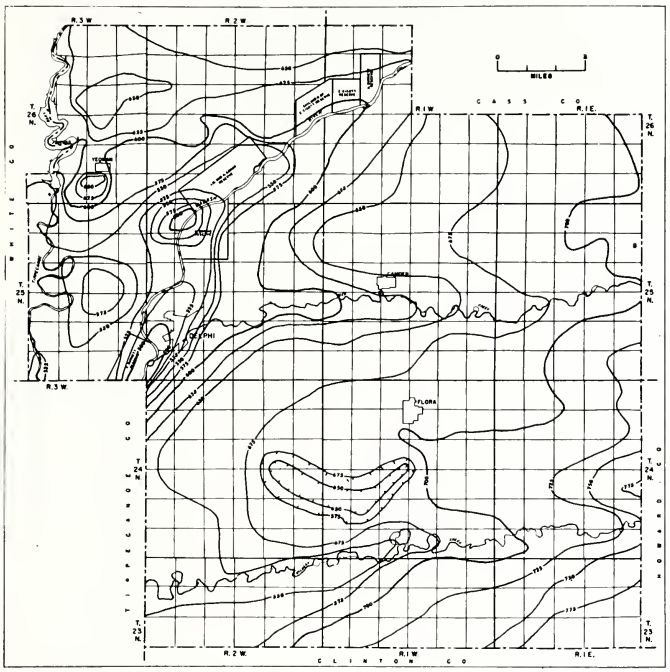

FIGURE 4. *Elevation, in feet above sea level, of groundwater pressure surface in Carroll County.*

We classified the soils in Carroll County into three main groups as to their suitability for septic system drainage fields (Figure 5). The good soils have no restrictions on the ability to absorb effluents from septic tanks. These soils are Fox (0-12% slope), Longlois, Meta, Miami (0-12% slope), Monitor, Ockley, Ross, and Russell (0-12% slopes). The fair soils have limitations on their capacity to absorb large amounts of water. Developers planning subdivisions on these soil types should consider a central waste treatment facility rather than individual septic systems. These fair soils are Abington, Brookston, Cope, Crosby, Fincastle, Homer, Kokomo, Sleeth, Sloan, Washtenaw, and Westland. Areas with soils classified as poor should not be used for tract housing. These soils have been placed in this category for a number of reasons. Soils having excessive slopes are: Fox (12%+ slope), Hennepin, Miami (12%+ slope), Rodman, and Russell (12%+ slope). Building structures on these soils will be difficult and septic systems are unlikely to be effective on such grades. The effluent is dispersed downslope too rapidly for the soil bacteria to destroy the wastes. Soils which are excessively

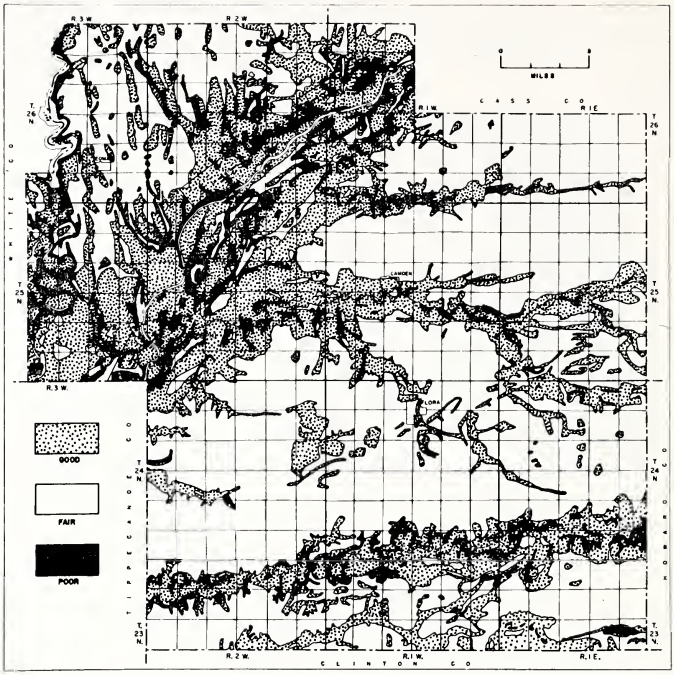

FIGURE 5. *Suitability of soils in Carroll County for septic tank filter fields.*

drained are Nineveh and Oaktown. These contain large amounts of sand and some gravel. Here again, the soil bacteria cannot detoxify the wastes of septic tanks due to their high rate of movement. The Carlisle, Edwards, Linwood, and Lyles are soils which have developed in depressional areas. Drainage is toward rather than away from these tracts and often there is a very high content of organic matter in the soil. Drainage is not the only problem for these soils. They also provide an unstable base for building foundations due to their high muck content. The Eel and Genesee soils have reasonably good drainage. But they are soils which develop on flood plains of rivers and are subjected to occasional flooding. We do not recommend that houses be built on flood plains. The Farmington, Millsdale, and Milton soils are very thin and developed in areas where bedrock is close to the surface. The excavations for building foundations would likely uncover bedrock. This would make housing development more costly; particularly if trenches had to be blasted in the bedrock for utility lines. Septic systems should not be used in these soils due to the likelihood of contaminating the groundwater by leakage into the neighboring bedrock.

There are a number of potential sites for sanitary landfills within the county. The areas shown in Figure 6 are the most likely sites due to their clay content. It is assumed that the trench method would be used in any landfill operation in Carroll County. The waste should

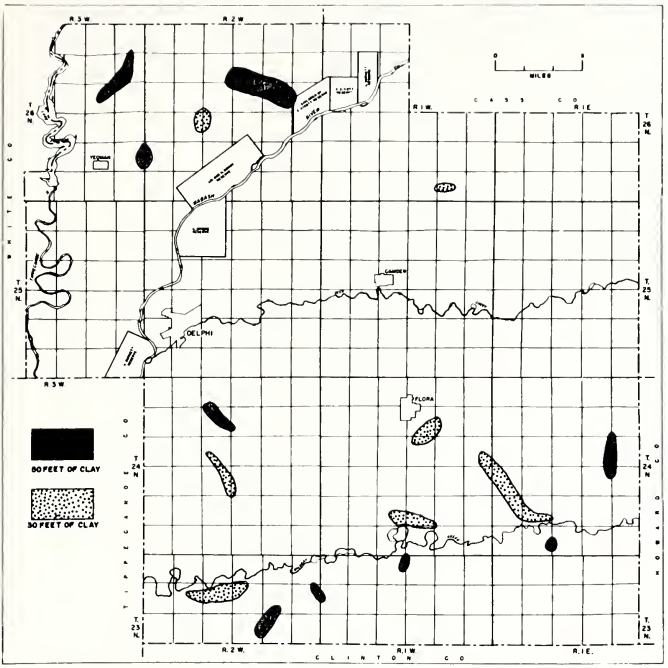

FIGURE 6. *Areas in Carroll County which are potential sites for sanitary landfills.*

be sealed as well as possible from any leakages into the groundwater. The best sites are those with fifty feet of clay measured from the surface downwards. Less desirable sites, but still acceptable, are those with a depth of thirty feet of clay. The Indiana State Board of Health recommends a minimum bottom seal of five feet of clay. However, ten feet of clay would be better since this standard may be revised upward at sometime in the future.

These are suggested localities based upon the clay content of the area. It would be necessary to do much more field work at a specific site before making a final decision on a sanitary landfill site. The depth of the watertable must be accurately measured and the direction of groundwater flow should be determined. Also, the contour of the land is critical since surface drainage should be carefully protected from contamination.

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