

Geological Features of the Proposed Cagle's Mill Flood Control Reservoir

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The purpose of this paper is to describe some of the geological features of the lower portion of Mill Creek valley and to point out the relationship between the geological phenomena exposed and the use of Mill Creek valley as a flood control reservoir. It is not the primary intent of this paper to justify or criticize the selection of this particular site nor to attempt to point out how it fulfills Lippincott's (2), p. 25) requisite conditions for a reservoir site, but rather to describe the unusual physiographic conditions in what is to be the first flood control project of its kind in Indiana. This report is the result of geological investigations made by the writer during the spring and summer of 1948 in order that a permanent record might be made of the features which are currently exposed in that area.

For a number of years the Corps of Engineers, United States Army, has had under consideration a project known as the Cagle's Mill Reservoir on Mill Creek. More recently funds were appropriated by Congress to begin work on this project. Since this is the first such project under construction in Indiana, tremendous interest has been shown by conservationists, engineers, naturalists, scientists, and others.

Cagle's Mill Reservoir is located along Mill Creek in northwestern Owen and southwestern Putnam counties, Indiana (figure 1). The proposed dam site is located near the east side of the resort and recreation area known as Hoosier Highlands, about two and one-half miles southeast of the confluence of Mill Creek with Big Walnut Creek. Together these two streams form Eel River. The name of the proposed dam and reservoir was transferred from a proposed dam site about one mile downstream from the present location, nearer the old Cagle's Mill. The height of the proposed dam is sufficient to impound water during flood times to the upper falls at Cataract at an elevation of 704 feet. A conservation pool will be maintained for recreation purposes at an elevation of 636 feet. This permanent pool will reach from the dam upstream to the foot of Lower Cataract Falls.

Physiographically, the proposed reservoir area lies in the northern portion of the Crawford Upland of southern Indiana, one of the most rugged sections of the state. However, with the exception of the areas immediately adjacent to the major streams the topography is neither as diverse nor as highly dissected as the area farther south. The more

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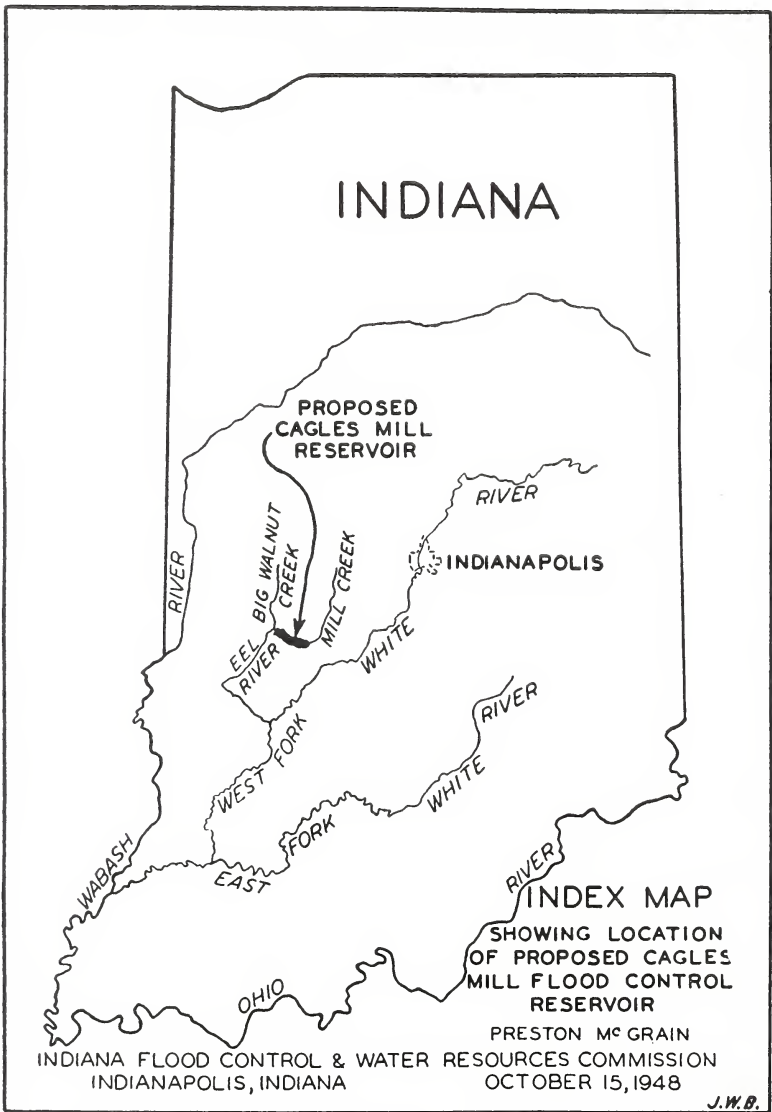


FIG. 1

gentle topography of the lower Mill Creek section of the Crawford Upland is the result of the presence of Illinoian glacial drift and the absence of much of the Chester section which thickens southward and thins northward. The highest hills and ridges are capped with Mansfield sandstone of basal Pennsylvanian age and the deeper valleys are generally cut into middle Mississippian limestones. The oldest exposed rocks are cherty limestone strata of St. Louis age which may be found at the lower falls at Cataract.

Associated with the proposed Cagle's Mill reservoir and encompassing a considerable portion of the watershed of Mill Creek are two glacial lakes which occupied portions of Owen, Morgan, Putnam, and Hendricks counties during Illinoian and Wisconsin times. Thornbury (5) proposed the names Lake Quincy and Lake Eminence for these lakes, presented in detail the early literature bearing upon them, and discussed the results of his own detailed studies as to their areal distribution, origin, and ages. The relationship of Lake Quincy, the western most of these lakes, to the Cagle's Mill Reservoir will be discussed in another paragraph.



Fig. 2. View of Lower Cataract Falls. The height of the main falls is about 18 feet. Photo by W. T. Powers.

Not only did the glacial lakes attract the attention of the earlier writers but also the two picturesque limestone falls (figure 2) near the village of Cataract, Owen County, have been described and discussed in geological literature on numerous occasions. Thornbury (5), p. 137-140) describes the relation of Cataract Falls to Lake Quincy. More recently Malott (4) presented a detailed study of the stratigraphy of the two falls. The stratigraphic units described and identified by Malott (4) were recognized by the present writer throughout the reservoir area.

Mill Creek rises in western Hendricks County and flows south and southwest across the glacial till and lacustrine plain to Cataract Falls. From Amo in Hendricks County to the top of Upper Cataract Falls, a distance of approximately 35 miles, Mill Creek falls 102 feet or about 3 feet per mile. At Cataract Falls within a distance of a mile, which includes both falls and the connecting rapids, Mill Creek rushes, cascades, and falls about 80 feet from an elevation of 715 feet at the top of the upper falls to an elevation of 635 feet at the foot of the lower falls. From the foot of the lower falls to the proposed dam site, a distance of approximately 8 miles, the drop is but 35 feet or a little over 4 feet per mile. According to planimetric measurements the drainage area of Mill Creek is 375 square miles, 284 of which lie above Hoosier Highlands.

After passing Upper Cataract Falls, Mill Creek encounters a buried bedrock valley which is believed to have been a tributary to the pre-

glacial course of Mill Creek. Here the valley expands greatly in width. Collett ((1), p. 308, Malott ((3), p. 210-211) and ((4), p. 322), and Thornbury ((5), p. 139) recognized the presence of a buried valley in the Mill Creek area but made no attempt to trace it in detail. An excellent exposure of lacustrine deposits was seen in the south bank of a tributary stream in the southwest corner of Section 25, T. 12 N., R. 4 W. The valley narrows again as it approaches the lower Cataract Falls and bedrocks is exposed in the channel and walls of the valley. Here the second bedrock barrier is encountered. From Lower Cataract Falls to the proposed dam site Mill Creek crosses bedrock ridges at numerous points. These exposures vary in expression ranging from small masses barely visible above the water level to hills up to 780 feet in elevation. Near Hoosier Highlands, Mill Creek encounters a bedrock upland mass through which it extends as a gorge for a mile or more. Here the elevation of bedrock on the south side of the creek is 780 feet and on the north side of the creek over 800 feet. The location of the exposures of bedrock and elevations are shown on figure 3. The areas between the partially exposed bedrock ridges and spurs are filled with glacial drift or lacustrine silts or both. Good exposures of these unconsolidated deposits are not common due to rapid weathering, slump, and vegetation and soil coverings. The glacial drift, where exposed, is dominantly till. Boulders and cobbles are present but not abundant. Glacial gravel was observed at three places in abandoned gravel pits. These exposures appear to be parts of a low morainic mass extending in a northwest-southeast direction on the west side of Cagle's Mill reservoir area. The lacustrine deposits consist of thinly laminated calcareous clays, silts, and very fine sands. These sands are described by water well drillers as quick sands. Thornbury ((5), p. 134) traced the lacustrine deposits down the valley of Mill Creek to the village of Cunot in Section 28, T. 12 N., R. 4 W. It was at this point that he placed a morainal dam which caused the ponding of ancient Mill Creek and created glacial Lake Quincy. The present writer has traced the lacustrine deposits still farther downstream thus indicating an early developmental stage of glacial Lake Quincy and a morainial dam somewhat farther downstream than had previously been considered. Excellent exposures of lacustrine silts and sands were observed near the center of the west side of Section 21, T. 12 N., R. 4 W., and in the east bank of a small tributary of Mill Creek in the extreme northwest corner of Section 20, T. 12 N., R. 4 W. The following is a stratigraphic section of the Illinoian deposits observed in the east bank of a small tributary of Mill Creek in the northwest corner of Section 20, T. 12 N., R. 4 W.:

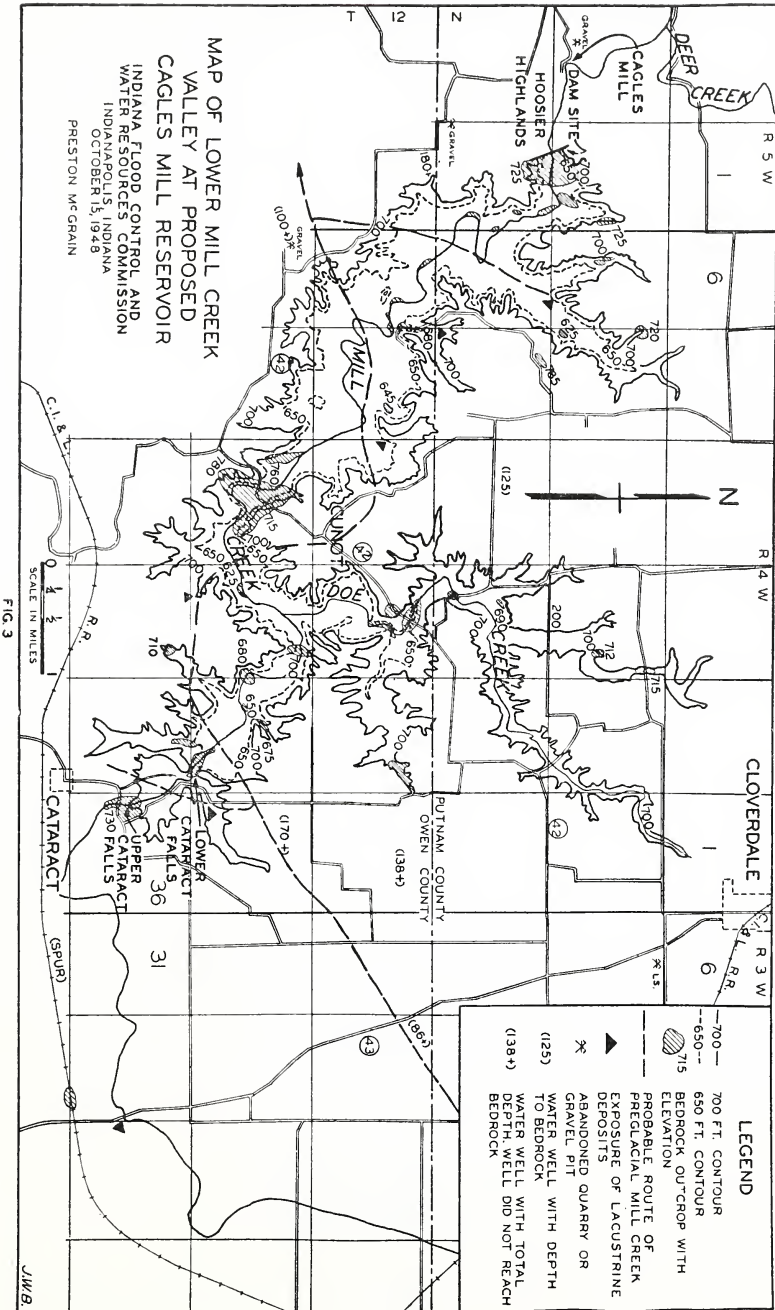
Glacial Drift

Waterlaid glacial sand and gravel—20 feet exposed.

Lacustrine Deposits

Gray and tan laminated, calcareous silt; basal part mostly fine sand in which lamination is indistinct—20 feet.

Gray, laminated, calcareous, sandy clay—4.5 feet exposed to creek bed.



Other silts were observed in the northeast quarter of Section 18, T. 12 N., R. 4 W., on the end of the spur formed by a south flowing tributary of Mill Creek on the west and a southwest flowing tributary on the east. Beyond this point Mill Creek enters a narrow, bedrock, gorge-like valley and evidence of lacustrine deposits disappear.

A possible route of the former channel of Mill Creek has been indicated in figure 3. This interpretation is based upon field data derived from a study of the physiography of the lower Mill Creek valley and the examination of a number of water well records. The presence of lacustrine deposits, absence of bedrock, and unusual depths to bedrock in water wells were the controlling factors in making this interpretation. It is believed that ancient Mill Creek roughly parallels and lies to the north of the present stream until reaching the vicinity of Lower Cataract Falls. Mill Creek crosses the buried valley just below this falls and apparently again three-fourths of a mile southeast of the village of Cunot in northwestern Owen County. A noticeable lack of detailed control occurred at Cunot. In this community domestic water supplies are derived from cisterns and shallow dug wells and, consequently, little bedrock data were available. Three-fourths of a mile west and a little north of Cunot, Mill Creek again intercepted the buried valley and generally followed it until it crossed a bedrock ridge at Mill Creek Valley Camp near the center of the west side of Section 20, T. 12 N., R. 4 W. From this point the buried valley appears to have turned west and northwest. Lack of well data and outcrops have prevented further detailed mapping of its route at this time.

The presence or absence of the bedrock ridges has a very striking effect upon the size and shape of the lower portion of present Mill Creek valley. Where the stream encounters bedrock, even though relatively low in elevation, the valley is narrow and in places even gorge-like. At the

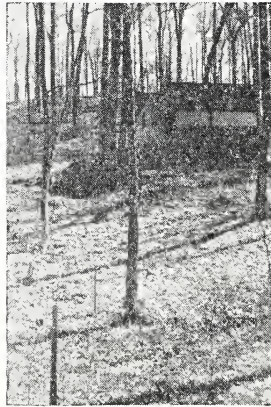


Fig. 4. View looking southwest along the center line of the proposed dam site. Photo by W. T. Powers.

proposed dam site only a suggestion of a valley flat exists. (figure 4). At this point Mill Creek exhibits the characteristics of a stream at

early maturity. Similar conditions exist at Mill Creek Valley Camp, at Croy's Mill southwest of Cunot, at a ridge in the northeast quarter of Section 27, T. 12 N., R. 4 W., and at Lower Cataract Falls. Where the present Mill Creek intercepts its buried ancestral valley or one of the buried tributaries, the profile assumes the shape of a broad, nearly flat-bottomed "U." The greatest development of this latter valley shape may be seen in Sections 19 and 20, T. 12 N., R. 4 W.,



Fig. 5. View of Mill Creek Valley where the present stream has intercepted its buried ancestral route. Photo by W. T. Powers.

immediately upstream from Mill Creek Valley Camp where the valley flat is fully three-fourths of a mile to a mile wide (figure 5). Other striking examples of these broad valley flats adjacent to the narrow bedrock valley were observed about a mile downstream from Mill Creek Valley Camp, immediately below Lower Cataract Falls and immediately below Upper Cataract Falls. From an engineering point of view the V-shaped, rock-walled valleys are most desirable for dam sites and the broad, flat valleys with high walls provide for the storage areas for impounding waters during periods of excess runoff. However, if there are prolonged periods during which the flood pool is high, objectionable leakage might occur through the coarser lacustrine sediments at points where the divides between Mill Creek and the King Creek watershed to the southwest are narrow, such as occurs in the southwest quarter of Section 19, T. 12 N., R. 4 W. As indicated in a previous paragraph, where exposed, the lacustrine deposits consist of thinly laminated calcareous clays, silts, and very fine sand which appear to be of very low porosity and permeability. Local water well drillers reported that this material is unsatisfactory as an aquifer for domestic water supply. Also, the lower portions of the lacustrine deposits were clays, while the sands seemed to be more common in the upper part of the deposit.

The bedrock stratigraphy of the Mill Creek valley area is relatively simple, however, exposures are not common. Malott ((4), p. 324) gives the following composite section at Upper and Lower Cataract Falls:

Chester

Paoli limestone and shale—17 ft., 6 in. exposed.

Aux Vases calcareous sandstone—3 ft., 9 in.

Ste. Genevieve

Levias limestone—22 ft.

Rosiclare calcareous sandstone—23 ft.

Fredonia limestone—30 ft., 6 in.

St. Louis limestone—9 ft. 6 in. exposed.

The following is a composite stratigraphic section measured by the writer in gulleys on the south side of Mill Creek near the proposed dam site.

PENNSYLVANIAN

Mansfield

Fine to medium-grained, massive sandstone; concentration of iron at base—50 ft. exposed.

Gray shale with many clay iron-stone concretions—0.22 ft.

MISSISSIPPIAN

Chester

Beaver Bend

Hard, gray, fine-grained limestone—5 ft.

Mooretown

Mostly covered with shows of gray and tan shale—17 ft.

Paoli

Single bed of dense, gray to tan limestone with small pyrite crystals; upper 6 inches rather coarsely crystalline limestone—3.5 ft.

Aux Vases

Soft, gray shale—1 ft.

Covered slope—3 ft.

Meramecian

Ste. Genevieve

Levias member

Cross-laminated, light to dark gray, oölitic limestone; rests unevenly upon lower limestone strata—10 ft.

Thin, even-bedded, hard, gray, semilithographic limestone—7.5 ft.

Tough, gray, rubbly limestone breccia; traces of glauconite—4.5 ft.

Rosiclare member

Generally even-bedded, fine-grained, light gray, calcareous sandstone—2.3 ft.

Cross-laminated, fine to medium-grained, light gray, calcareous sandstone; friable on weathered surface—3.3 ft.

Fredonia member

Covered slope—4.5 ft.

Porous, mottled, tan dolomite—1 ft.

Covered slope to Mill Creek—5 ft.

Excellent exposures of the upper part of the Ste. Genevieve formation and lowest Chester beds were observed in the very recent excavations for the diversion tunnel of the reservoir on the north side of Mill Creek at the proposed dam site. The interval correlated in the above composite section with the Aux Vases was represented at the intake end of the diversion tunnel by 4 feet of calcareous, blue-gray and green shale with oölitic limestone pebbles and sandstone pebbles and lenses. These Aux Vases beds are underlain by 2 to 3 feet of irregularly brecciated limestone with occasional quartz grains which this writer has recognized as a persistent lithologic facies of the Ste. Genevieve

formation throughout its outcrop area in southern Indiana. A cursory examination of other exposures at the site of the diversion tunnel revealed that other members of the Ste. Genevieve do not occupy their normal intervals at this locality and display a wide variation within short distances. However, these variations should have no influence upon the effectiveness of the proposed dam and reservoir.

According to borings made by the U. S. Army Engineers there is as much as 35 feet of valley fill material in the dam site area.

Prominent exposures of limestone are present in all the gorges listed in a previous paragraph, but the detailed stratigraphy is not always apparent. Unless the Rosiclare or Aux Vases sandy beds are developed and exposed, differentiation of the beds is difficult, as few fossils are present. The Rosiclare has been recognized at Croy's Mill but it is not exposed in either the bedrock ridge at Mill Creek Valley Camp or Cagle's Mill. At Mill Creek Valley Camp the top of the Ste. Genevieve may be identified by the presence of a rubbly, limestone breccia. At Cagle's Mill, one mile downstream from the proposed dam site, the Aux Vases is represented by 1 foot of fine-grained sandstone near the top of the limestone beds. The Rosiclare here is below drainage level.

Although limestone constitutes the biggest part of the bedrock section along Mill Creek, karst features are generally absent. An exception to this is a sink-hole area along Indiana Highway 42 near Doe Creek bridge high above Mill Creek at elevations near 730 feet. The absence of solution features in this normally karsted limestone formation can probably be explained at least in part by the protective cover of lacustrine silts since Illinoian times and the presence of the impervious bed of Pennsylvanian shale which overlies the limestone strata in the western part of the area. This latter feature is particularly well developed in the vicinity of the proposed dam site and has probably aided to a great extent in preventing the limestones from being made cavernous in this locality. Also, since the limestone strata at the dam site were exposed after Illinoian glaciation there has not been sufficient time for the formation of solutional features.

Although the writer has not tried to emphasize the applications of geology to sound engineering practices the facts pointed out in the above discussion cannot be minimized. First, if the present Mill Creek had encountered bedrock throughout its full distance, and not the soft, unconsolidated Pleistocene sediments, the valley would have been narrow, and would not impound sufficient water to justify a flood control reservoir site. Conversely, if this stream had not encountered bedrock the cost of a dam would have been multiplied many times and numerous difficult engineering problems would have been encountered. Thirdly, a protective blanket of Pleistocene and Pennsylvanian sediments has obstructed the downward percolation of meteoric waters into the well jointed and bedded, soluble Ste. Genevieve limestone. Thus, an unusual combination of physiographic and geologic features have produced an area which is probably unrivaled in Indiana for a flood storage reservoir.

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