GEOLOGIC MAPPING FOR TRANSPORTATION PLANNING IN CENTRAL-NORTHERN ILLINOIS

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Figure 1: Location Map

Problem: To prepare for a proposed highway improvement project, the Illinois State Geological Survey (ISGS) was contracted by the Illinois Department of Transportation to conduct geological mapping along a 24-mile (39 km) segment of Illinois Route 29 in central-northern Illinois (Figure 1). The mapping will help in addressing varying construction conditions along the right of way, predicting areas of possible landslides and mine subsidence, and locating groundwater supplies for rest areas and other development that may follow highway construction. The mapping also supports preparation of the Environmental Impact Statement for the project. By characterizing hydrological conditions, slope stability, erosion and sedimentation, and showing how geology potentially impacts ecological systems.

The Geologic Map: The present and projected Illinois Route 29 right of way is located on the west side of the Illinois River, mostly at the base of a steep and highly dissected bluff (~200 ft (61m) high) composed of Pennsylvanian bedrock (mainly shale, limestone, and coal) overlain by thin (mostly <50ft/15m) glacial deposits along the southern 8.6 miles (13.8 km) of the highway, and thick (>200 ft/60m) glacial deposits along the northern 5.0 miles (8.1 km) of the highway. The middle and extreme southern portions of the route traverse the Illinois River's floodplain and Wisconsin Episode outwash terrace deposits for 10.4 miles (16.7km). A cross section (Figure 2) shows the above features. A surficial geologic map covering the entire study area was prepared at a scale of 1:48,000. A portion of that map, from the 1:24,000-scale Chillicothe 7.5-minute Quadrangle, was selected and is shown as Figure 3.

The succession of Quaternary deposits reflects the interactions of multiple glacial advances with the ancestral Mississippi River that drained much of the upper midwestern United States during the Quaternary. Glaciers from the Lake Michigan Lobe of the Laurentide ice sheet advanced westward across the study area at least four times during the Quaternary. The southward-flowing present-day Illinois River overlies and generally parallels a bedrock valley that last carried the ancestral Mississippi River about 20,500 years ago, when the maximum glacial advance of the Wisconsin Episode diverted the ancestral Mississippi River into its present course more than 80 miles to the west. Where these multiple glacial events impinged on the river in an area of significant bedrock relief, the result was a succession of glacial, fluvial, eolian, and alluvial deposits, reflecting numerous complexly superimposed episodes of erosion, deposition, and stability.

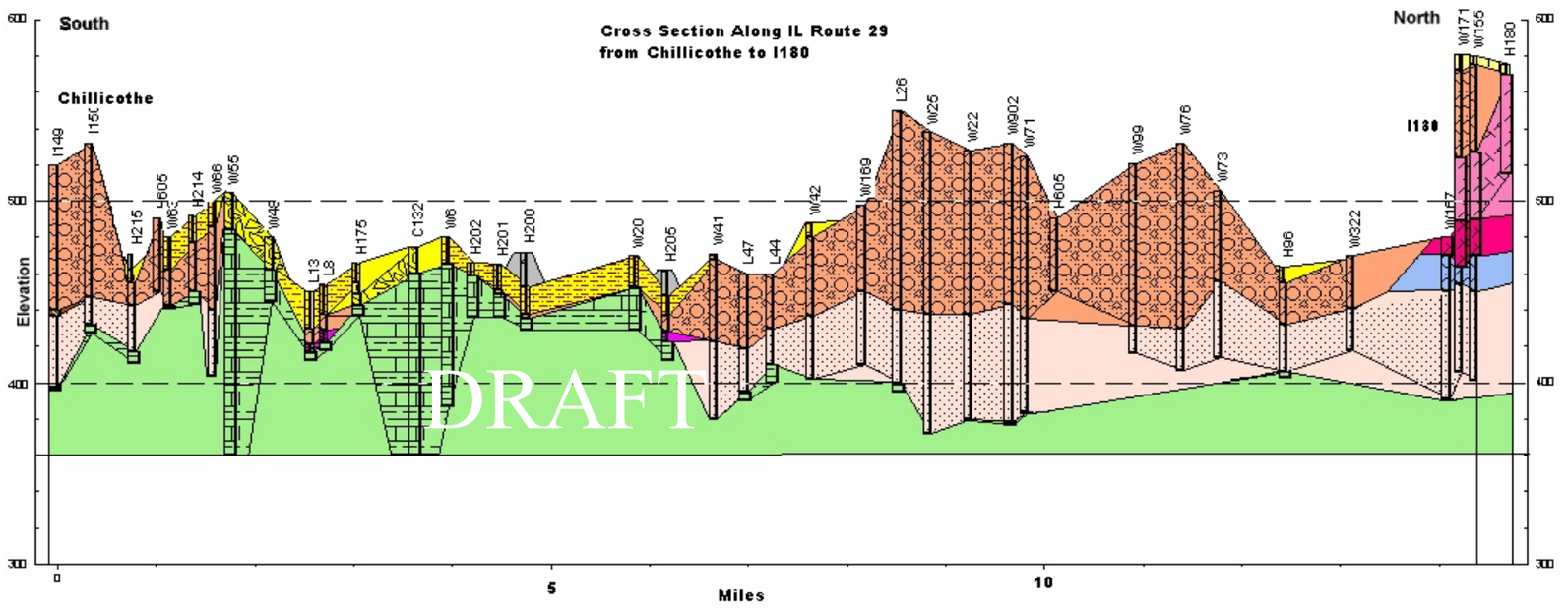

Figure 2. Well-to-well cross section on the west side of the Illinois River along Illinois Route 29 (green = bedrock; pink, orange, and blue = sand and gravel; red and pink = diamicton; yellow=alluvium and colluvium; gray=fill).

Applying the geologic map: Because of the deeply dissected topography, flat lying glacial and bedrock units in the subsurface in the uplands are exposed in the slopes (Figure 3). Two major tills were deposited on the uplands during the Wisconsin Episode:(1) The older Tiskilwa Formation is shown on the map in pink, and (2) the overlying Batestown Member is shown in green. Variations in the thickness of the blanketing loess that covers the tills in the uplands are shown with darker shades of pink or green where the loess overlying the till is greater than 5 feet thick. Thick deposits of colluvium, composed mostly of redeposited “loess”, occur where they have accumulated at the base of slopes. Also shown on the slopes are exposures of shale and limestone bedrock (in black on the map) that characterize this portion of the IL29 study area. Earlier Wisconsin Episode loess and pre-Wisconsin outwash and diamicton are exposed locally along slopes of Rattlesnake Hollow, a tributary valley to the Illinois River. From the base of the western bluff eastward to the Illinois River, sand and gravel terraces and floodplain deposits characterize the surficial geology. Pre-Wisconsin Episode glacial deposits have been eroded and the underlying bedrock surface slopes toward the thalweg of the buried bedrock valley.

Discussion: The surficial geologic map helps identify construction conditions that underlie the existing highway route and may be encountered while upgrading the highway. Geologic conditions along the lower slope of the bluffs vary dramatically over short distances. The bedrock may be at land surface on the west side of the highway, but buried by 50 feet of colluvium, including slopewash, landslide debris, and alluvium, over sand and gravel outwash on the east side. Areas where the bedrock is close to the surface will require blasting and ripping to widen the right of way. Retaining walls may be needed to stabilize slopes and curtail landsliding, particularly where water is seeping from contacts between glacial or colluvial materials and the bedrock, from sand and gravel aquifers in the glacial materials that daylight, from thin sand seams between tills, from coal seams, or from abandoned coal mines. Seeps also create unique local habitats on and at the base of slopes. The geologic map helps to identify the areas where such hydrologic conditions are likely to occur. On the east side of the Illinois River at the base of the slope the upper portion of the Ashmore-Sankoty aquifer, a substantial water resource for the region, is exposed. The exposure of the aquifer suggests that seeps may occur in that area and that the aquifer may be sensitive to contamination. Figure 2 shows that thick Wisconsin Episode outwash directly overlies the highly productive Ashmore-Sankoty aquifer. With no clay-rich till to protect it, as shown in the northern half of the cross section, the aquifer in that area is highly vulnerable to contamination from spills, agricultural chemicals, landfill waste or other sources.

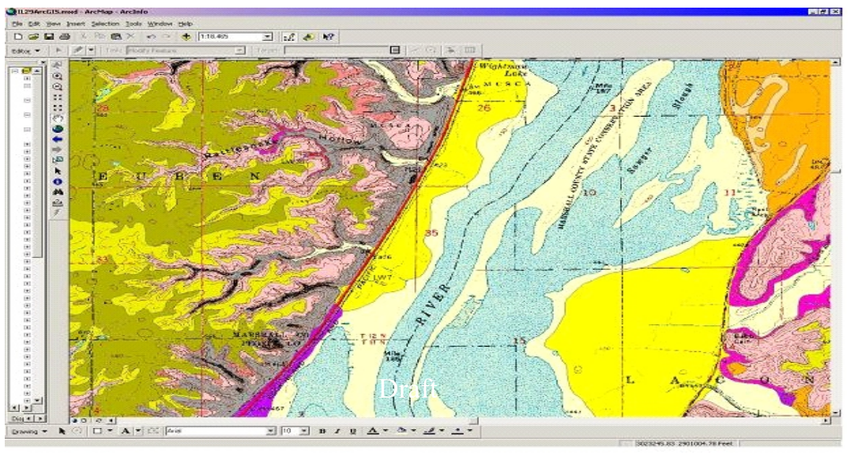

Figure 3. Surficial Geologic Map of the northwest portion of the Chillicothe 7.5-minute Quadrangle, Illinois.

Conclusion: Highway planners assessing alternative routes and engineers designing measures to handle or avoid marginal soil and slope conditions are better prepared when they have modern geologic maps. The presence of the shallow bedrock, unstable, low-strength colluvial deposits, till, or sand and gravel in the right of way pose different challenges for highway construction. A detailed surficial geologic map like the Chillicothe Quadrangle,can be used to anticipate construction conditions and identify areas of potential earth hazards early in the highway planning process, thus ensuring that a stable roadbed can be constructed in the most cost-efficient manner.