ILLINOIS STATE GEOLOGICAL SURVEY
Prairie Research Institute
University of Illinois at Urbana-Champaign

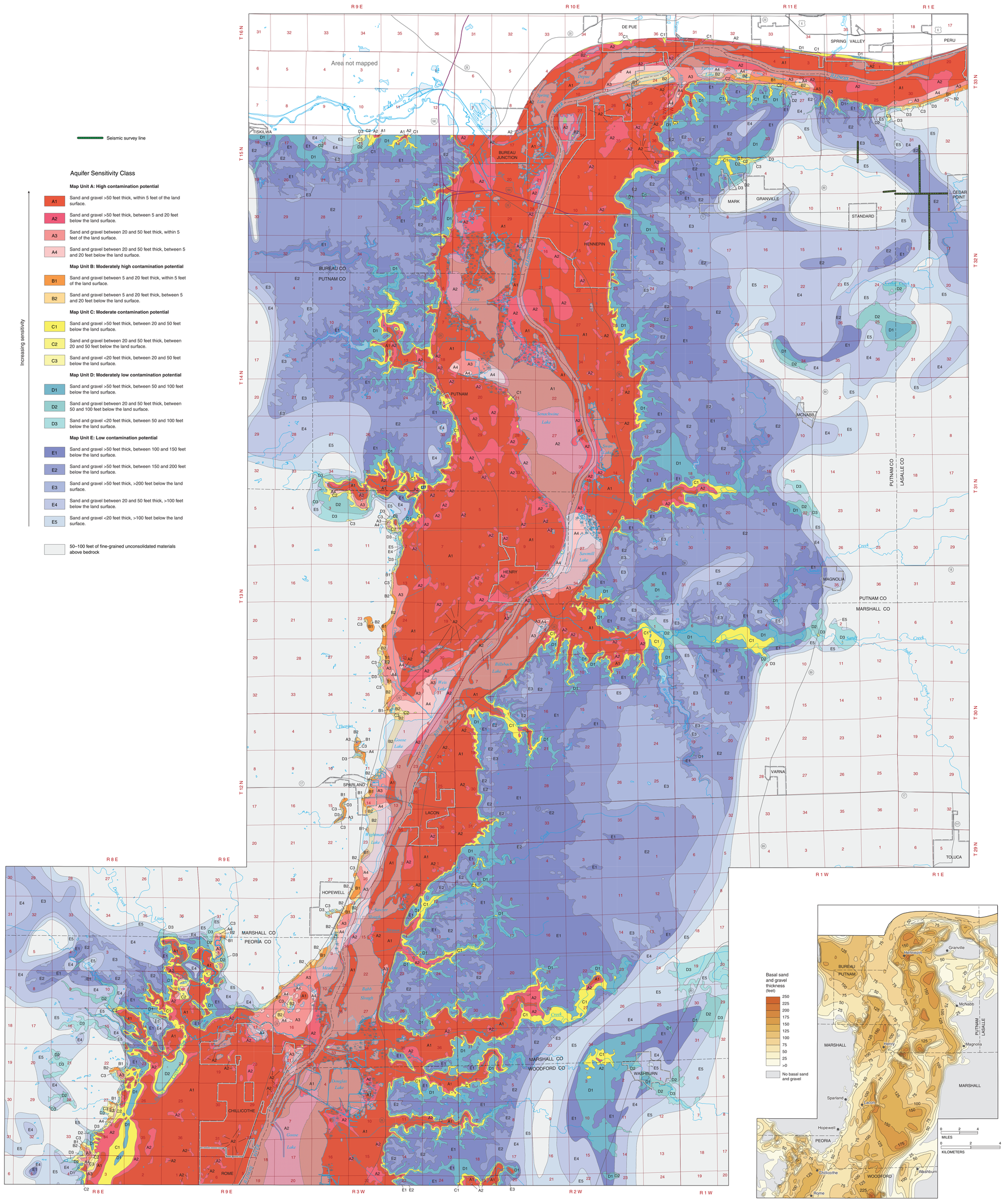
Illinois Map 20
2015

AQUIFER SENSITIVITY OF THE BASAL SAND AND GRAVEL OF THE MIDDLE ILLINOIS RIVER VALLEY

BUREAU, LASALLE, MARSHALL, PEORIA, PUTNAM, and WOODFORD COUNTIES, ILLINOIS

Richard C. Berg, E. Donald McKay III, and Barbara J. Stiff

2015



Seismic survey line

Aquifer Sensitivity Class

Increasing sensitivity

Map Unit A: High contamination potential

- A1 — Sand and gravel >50 feet thick, within 5 feet of the land surface.
- A2 — Sand and gravel >50 feet thick, between 5 and 20 feet below the land surface.
- A3 — Sand and gravel between 20 and 50 feet thick, within 5 feet of the land surface.
- A4 — Sand and gravel between 20 and 50 feet thick, between 5 and 20 feet below the land surface.

Map Unit B: Moderately high contamination potential

- B1 — Sand and gravel between 5 and 20 feet thick, within 5 feet of the land surface.
- B2 — Sand and gravel between 5 and 20 feet thick, between 5 and 20 feet below the land surface.

Map Unit C: Moderate contamination potential

- C1 — Sand and gravel >50 feet thick, between 20 and 50 feet below the land surface.
- C2 — Sand and gravel between 20 and 50 feet thick, between 20 and 50 feet below the land surface.
- C3 — Sand and gravel <20 feet thick, between 20 and 50 feet below the land surface.

Map Unit D: Moderately low contamination potential

- D1 — Sand and gravel >50 feet thick, between 50 and 100 feet below the land surface.
- D2 — Sand and gravel between 20 and 50 feet thick, between 50 and 100 feet below the land surface.
- D3 — Sand and gravel <20 feet thick, between 50 and 100 feet below the land surface.

Map Unit E: Low contamination potential

- E1 — Sand and gravel >50 feet thick, between 100 and 150 feet below the land surface.
- E2 — Sand and gravel >50 feet thick, between 150 and 200 feet below the land surface.
- E3 — Sand and gravel >50 feet thick, >200 feet below the land surface.
- E4 — Sand and gravel between 20 and 50 feet thick, >100 feet below the land surface.
- E5 — Sand and gravel <20 feet thick, >100 feet below the land surface.

50–100 feet of fine-grained unconsolidated materials above bedrock

Introduction

Aquifer sensitivity is a measure of the relative ease with which a contaminant applied on or near land surface can migrate to an aquifer. It is a function of the permeability and porosity of geologic materials constituting the aquifer as well as the properties of earth materials above and below it (Berg 2001). It is not dependent on contaminant characteristics or types of land use. According to the U.S. Environmental Protection Agency (1993), the term "aquifer sensitivity" is synonymous with the terms "groundwater contamination potential" and "aquifer susceptibility."

The lowermost (or basal) sand and gravel (Berg et al. 2015) is a regionally extensive and thick deposit that, based on evaluations of hundreds of water-well records in the study area, is a significant aquifer for residential, municipal, and commercial use. This aquifer sensitivity map illustrates the susceptibility of the basal sand and gravel to potential contamination from municipal or hazardous landfills, leaking underground storage tanks, fertilizers and pesticides applied to agricultural fields and residential lawns, septic systems, accidental chemical spills, and road salts.

Methodology

Detailed mapping of the basal sand and gravel was an outgrowth of geologic mapping for a proposed highway improvement project along Illinois Route 29, funded by the Illinois Department of Transportation, on the west side of the Illinois River north of Chillicothe (Berg et al. 2002). The thickness and extent of the basal sand and gravel were determined by evaluating logs of borings and seismic profiling records in concert with recent mapping of the middle Illinois River valley (MIV) region (McKay et al. 2010; Berg et al. 2015). A total of 621 logs of water wells, engineering borings, and coal test borings, as well as 21 Illinois State Geological Survey (ISGS) exploratory borings and some field-described outcrops, were used to determine the unit. For the northeastern portion of the map, seismic reflection profiles, recorded along 5.15 miles (8.3 kilometers) of roads, were used to determine the top of the unit within the Ticona Bedrock Valley (Murphey 2005). To interpret borehole and seismic information, numerous cross sections were constructed to best visualize the continuity of the basal sand and gravel between logs throughout the MIV region. The elevation of the unit (Berg et al. 2012) was hand contoured and digitized. The thickness of the unit was derived by subtracting the bedrock topography elevation (Berg et al. 2009) from its top elevation.

Discussion

Aquifers closer to land surface have a greater potential to become contaminated than do aquifers at depth because travel times for potential contaminants from the surface to the aquifer are faster. In addition, the thicker an aquifer, the more significant is its potential to serve a large population with water and the greater is the need for protection (Berg 2001). Therefore, aquifer sensitivity of the basal sand and gravel was determined by mapping its thickness (Fig. 1) as well as the thickness of overlying sediments (mostly fine-grained diamictons and lake sediments; Fig. 2), and then applying a classification scheme (Berg 2001) that ranked aquifer sensitivity map units in order of their decreasing probability of becoming contaminated. On the basis of this procedure, thick basal sand and gravel at land surface within terraces and the floodplain of the Illinois River and its tributaries is portrayed as red on the map, indicating a high sensitivity. Here, contaminants from various sources can move rapidly through porous sand and gravel to drinking water wells or to nearby streams. Basal sand and gravel buried beneath thick diamicton and other fine-grained sediments (which occur primarily beneath the uplands east of the Illinois River as well as above buried tributary bedrock valleys) is portrayed on the map as purple, indicating a low sensitivity. Although these regions have low potential for contaminating the basal sand and gravel, disposal of wastes above these groundwater-rich areas may still be politically unacceptable. Site-specific hydrogeological investigations should be required in all cases if a potentially contaminating land-use activity is being considered.

Acknowledgments

The authors thank the Illinois Department of Transportation for providing the funds to begin mapping of the MIV for transportation planning. We also thank landowners who allowed the ISGS access to their property for drilling and fieldwork, and local water-well contractors and county highway department personnel who provided new logs of water wells and engineering borings. Finally, the authors thank Jason Thomason and Andrew Phillips (both of the ISGS) for their thoughtful reviews and comments and Jennifer Carrell and Deette Lund (both of the ISGS) for their overall cartographic review.

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Figure 1 Generalized map of the basal sand and gravel thickness of the middle Illinois River valley (Berg et al. 2015).

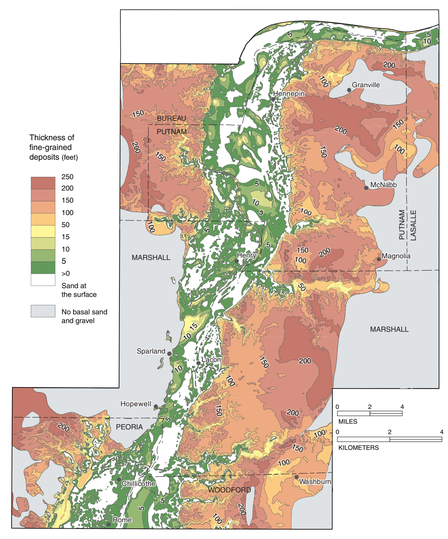

Figure 2 Thickness of deposits (primarily fine-grained) overlying the basal sand and gravel in the middle Illinois River valley.

Base map compiled by the Illinois State Geological Survey from digital and paper data provided by the United States Geological Survey.

North American Datum of 1983 (NAD 83)
Projection: Transverse Mercator

Recommended citation:
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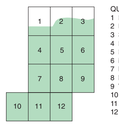
SCALE 1:62,500

1 0 1 2 3 4 5 MILES
1 0 1 2 3 4 5 6 7 KILOMETERS

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

For more information contact:
Prairie Research Institute
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6918
(217) 244-2414
http://www.isgs.illinois.edu



QUADRANGLES
1 Princeton South
2 DePue
3 Spring Valley
4 Putnam
5 Florid
6 McNabb
7 Lacon
8 Henry
9 Varna
10 Rome
11 Chillicothe
12 Washburn

APPROXIMATE MEAN DECLINATION, 2015

Geology based on fieldwork by E. Donald McKay III and Richard C. Berg, 2001–2011.

Digital cartography by Barbara J. Stiff, Brittany M. Walbright, and Jennifer E. Carrell, Illinois State Geological Survey.

Municipal boundary line
County line
Swampy lowland areas
Rivers and water bodies
Interstate route
U.S. route
State route