Case Study

Northeast Illinois and Multi-Aquifer Wells

Geographic Context

There are a variety of water sources in the Chicago metropolitan area. This case study focuses on Kane County in northeastern Illinois on the western edge of the Chicago metropolitan area (Figure 1). Drinking water for northeast Illinois is either surface water piped from Lake Michigan or sourced from the Fox and Kankakee rivers, or groundwater used by municipal public water systems and private wells.

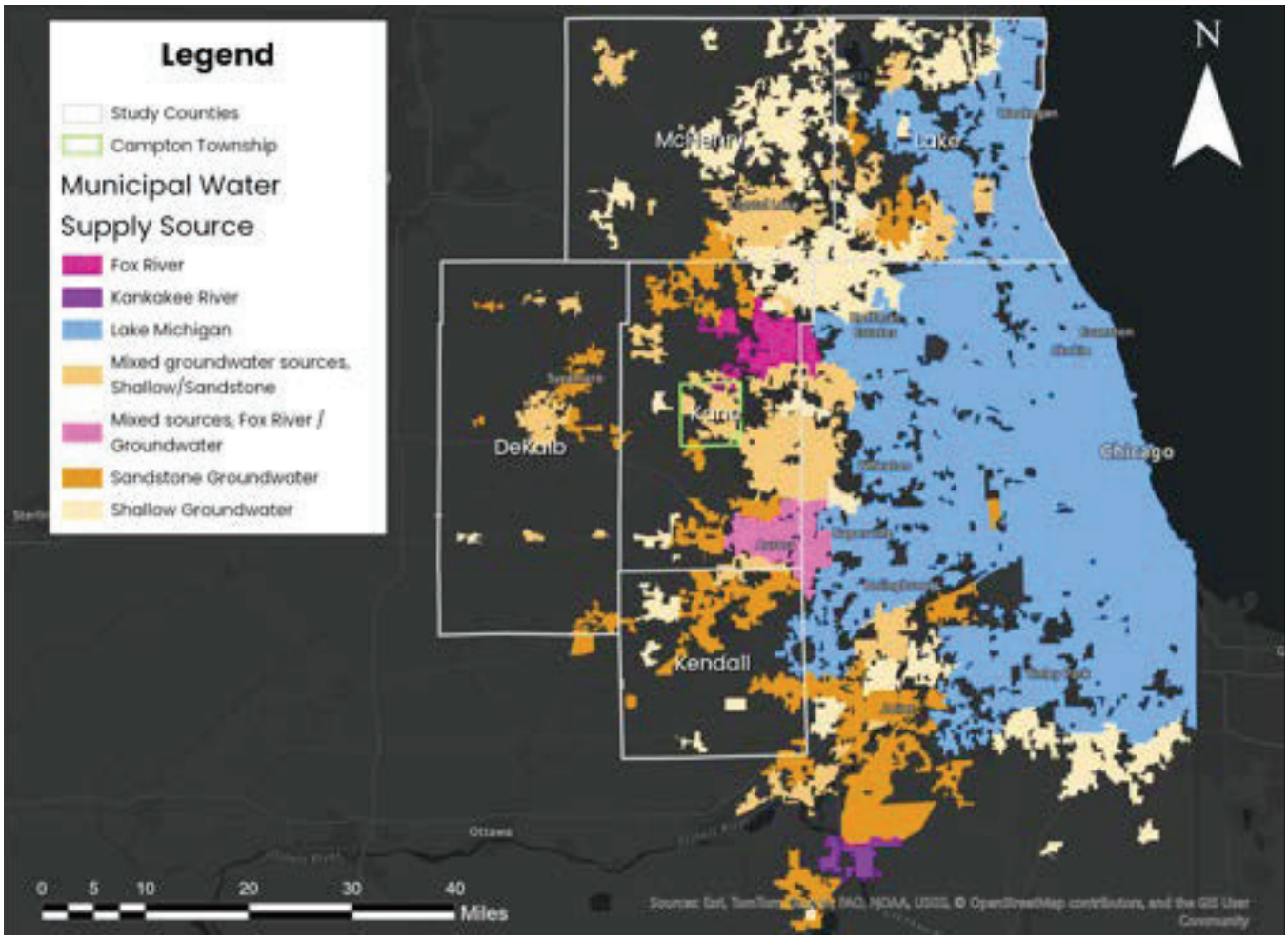

Figure 1. Northeast Illinois

Kane County is a transitional county between rural and suburban at the western fringe of metropolitan Chicago. Campton Township is highlighted in Kane County. Data sourced from ESRI, Chicago Metropolitan Area Planning (CMAP), and DeKalb County.

Residents and businesses in Kane County receive water through either community water suppliers or are self-supplied through private wells.[1] Residents may have individual private wells or share private well access with a neighbor or neighbors in their area as part of non-community water supply in a subdivision.[2] Wells in this area use groundwater from four major geologic units: 1) the unconsolidated glacial sand and gravel aquifer; 2) the Silurian-Maquoketa aquifer; 3) the Galena-Platteville aquifer; and 4) Ironton-Galesville sandstones of the Glenwood Formation and historically, the St. Peter Sandstone (the Ancell aquifer).[3] Due to collective withdrawals, the St. Peter Sandstone layer was observed to be partially desaturated and is no longer considered to be a useable aquifer in Kane County.[4]

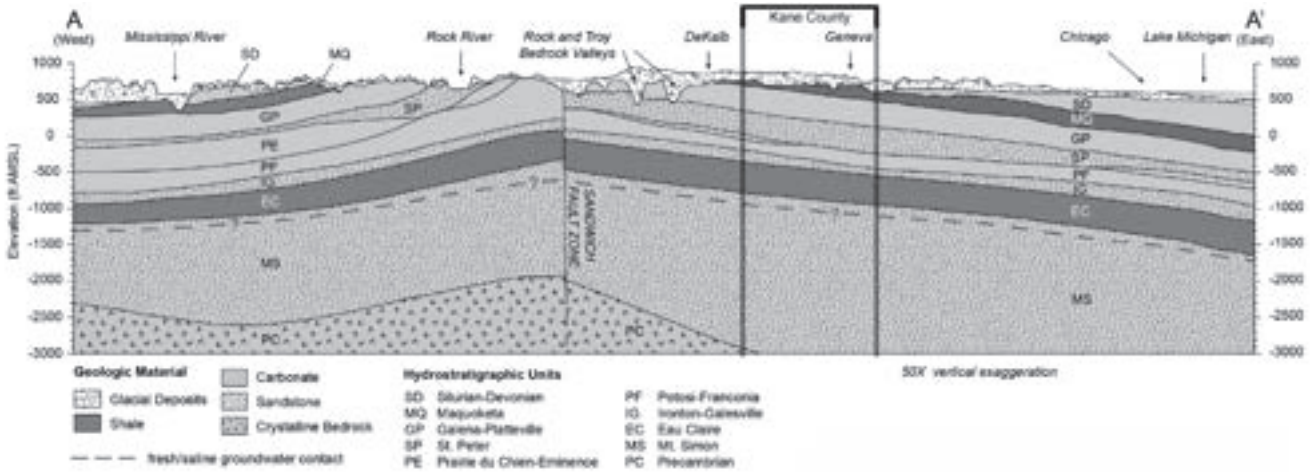

Figure 2. Cross Section of Geologic Units Across Northeast Illinois

Cross section of the geologic units across northeast Illinois with Kane County highlighted. Layers SP, IG, and MS are water-bearing sandstone aquifers; layers SD, GP, PE, and PF are water-bearing carbonate aquifers; layers MQ and EC are fine-grained (shale) confining layers that originally separated the water-bearing layers. The primary aquifers accessed in Campton Township are glacial sand and gravel (surface), the dolomite of Silurian to Devonian age, the dolomitic portion of the Galena and Platteville formations, and the St. Peter Sandstone, which is now partially dewatered locally.[5] Data adapted from Abrams et al, 2015.

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1 "Kane County Water Resources Investigations: Simulation of Groundwater Flow in Kane County and Northeastern Illinois." University of Illinois at Urbana-Champaign. Illinois State Water Survey, May 2009, 2. https://www.isws.illinois.edu/pubmore/ISWSCR2009-07/ISWSCR2009-07.pdf.

2 Hadley, Daniel R., Daniel B. Abrams, Devin H. Mannix, and Cecilia Cullen. "Establishment of a Groundwater Monitoring Network And ..." Northwest Water Planning Alliance, August 2020. http://www.nwpa.us/uploads/1/2/9/8/129889926/campton_letter_report_final_publicversion.pdf.

3 Hadley, Daniel R., Daniel B. Abrams, Devin H. Mannix, and Cecilia Cullen. "Establishment of a Groundwater Monitoring Network And ..." Northwest Water Planning Alliance, August 2020. http://www.nwpa.us/uploads/1/2/9/8/129889926/campton_letter_report_final_publicversion.pdf.

4 Abrams, Daniel B., Daniel R. Hadley, Devin H. Mannix, George S. Roadcap, Scott C. Meyer, Kenneth J. Hlinka, Kevin L. Rennels, Kenneth R. Bradbury, Peter M. Chase, and Jacob J. Krause. Rep. Changing Groundwater Levels in the Sandstone Aquifers of Northern Illinois and Southern Wisconsin: Impacts on Available Water Supply. Illinois State Water Survey, September 16, 2015. https://www.isws.illinois.edu/pubdoc/CR/ISWSCR2015-02.pdf.

5 Abrams, Daniel B., Daniel R. Hadley, Devin H. Mannix, et al. Rep. Changing Groundwater Levels in the Sandstone Aquifers of Northern Illinois and Southern Wisconsin: Impacts on Available Water Supply. Illinois State Water Survey, September 16, 102, 2015. https://www.isws.illinois.edu/pubdoc/CR/ISWSCR2015-02.pdf.

Water in Kane County

Water use in Kane County has evolved over time as the population has grown. Kane County has never sourced water from Lake Michigan, unlike surrounding communities. Beginning in the late 1980s, the eastern communities of Elgin and Aurora moved to source public water from the Fox River.[6] Drinking water in the region is now sourced from three groundwater aquifers and from the Fox River as a surface water source.[7] As the western suburbs of Chicago expand, the region is attempting to manage resource allocation sustainably when demand outpaces supply.

There is a finite amount of water and land, as predetermined by geology and available recharge. Since the mid-1990s, the U.S. Geological Survey (USGS), the Illinois State Water Survey (ISWS), Northwest Planning Alliance (NWPA), and Illinois Department of Natural Resources (IDNR) have worked with Kane County to model groundwater flow, map the impacts of well density, and track the impact of multi-aquifer wells on water quality and quantity. The 2009 and 2015 ISWS studies indicate three pressures on shallow groundwater aquifers: drought, seasonal irrigation, and multi-aquifer wells. [8] [9]

During droughts and points of seasonal irrigation, groundwater models show a lowering of the water surface in shallow aquifers. Shallow aquifers also impact surface water stream flow where communities source drinking water. Multi-aquifer wells present a challenge because they allow in-ground exchange of formerly separated waters. Deep multi-aquifer wells also show impact to shallow wells as a deeper aquifer (e.g. the St. Peter Sandstones or the Galena-Platteville Sandstones) can depressurize and allow the nearby shallow aquifer (e.g. the Maquoketa and Silurian-Devonian dolomites) to drain into the deeper one. [10] [11] Shallow aquifers also impact surface stream flow where communities source drinking water.

6 Meyer, Scott C., George S. Roadcap, Yu-Feng Lin, and Douglas D. Walker. Rep. Kane County Water Resources Investigations: Simulation of Groundwater Flow in Kane County and Northeastern Illinois. Champaign, Illinois: Illinois State Water Survey, 2009, 2.

7 *Ibid*.

8 Meyer, Scott C., George S. Roadcap, Yu-Feng Lin, and Douglas D. Walker. Rep. Kane County Water Resources Investigations: Simulation of Groundwater Flow in Kane County and Northeastern Illinois. Champaign, Illinois: Illinois State Water Survey, 2009.

9 Abrams, Daniel B., Daniel R. Hadley, Devin H. Mannix, et al. Rep. Changing Groundwater Levels in the Sandstone Aquifers of Northern Illinois and Southern Wisconsin: Impacts on Available Water Supply. Illinois State Water Survey, September 16, 2015. https://www.isws.illinois.edu/pubdoc/CR/ISWSCR2015-02.pdf.

10 Meyer, Scott C., George S. Roadcap, Yu-Feng Lin, and Douglas D. Walker. Rep. Kane County Water Resources Investigations: Simulation of Groundwater Flow in Kane County and Northeastern Illinois. Champaign, Illinois: Illinois State Water Survey, 2009.

11 Cullen, Cecelia, and Daniel R. Hadley. Rep. KANE COUNTY SHALLOW GROUNDWATER QUALITY 2023: A TWENTY-YEAR RETROSPECTIVE. Champaign, Illinois: Illinois State Water Survey, 2024.

Campton Township in Kane County has one of the highest densities of both private wells and multi-aquifer wells in Illinois.[12] [13] As of 2020, there were 2,638 domestic well records found in ISWS/ISGS databases for Campton Township, though only 2,113 of the records were had enough data to analyze if they were multi-aquifer wells.[14] Of the 2,113 domestic wells, approximately 54% of those were multi-aquifer wells.[15] Very few of the deep wells were open to only a single geologic unit, and the well records were defined by the deepest aquifer a well was open to. Approximately 18 percent of Maquoketa wells were considered multi-aquifer, approximately 84 percent of Galena-Platteville wells were considered multi-aquifer, and all the St. Peter wells were considered multi-aquifer.

What is a Multi-Aquifer Well?

In Illinois, a minimum of 40 feet of casing must be used to protect the well from surface contaminants.[16] Some states in EPA Region 5 only allow one aquifer to be screened. Historically, Illinois has allowed screened intervals to cross formerly separated aquifers.[17] These "cross-connected," multi-aquifer wells can pull groundwater from different geological units and allows the mixing of groundwater between those layers.[18] [19]

To access groundwater, a hole is drilled until water is reached and a well is constructed within that hole. A well has multiple components which include casing or the solid pipe that lines the hole and spans the sediment and rock layers that are not of interest; grout that seals the annular space between the solid pipe and the drilled hole; a screened interval near the bottom that allows water to flow in from the water-bearing layer(s) being accessed, and a gravel pack which fills the annular space around the well screen to maintain access to the groundwater while keeping sediment out of the well (Figure 3). It is believed that a properly constructed groundwater well can last between 25 to 100 years.[20]

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12 "Campton Township Monitoring, Kane County," n.d. https://www.isws.illinois.edu/groundwater-science/gs-archive/campton-township-monitoring-kane-county.

13 Hadley, Daniel R., Daniel B. Abrams, Devin H. Mannix, and Cecilia Cullen. "Establishment of a Groundwater Monitoring Network And ..." Northwest Water Planning Alliance, August 2020, 24. http://www.nwpa.us/uploads/1/2/9/8/129889926/campton_letter_report_final_publicversion.pdf.

14 *Ibid*, 6.
Note: This amount and availability of data is typical for both the county and the state.

15 *Ibid*, 8.

16 Illinois Water Well Construction Code. § 920.70 (1973).

17 Abrams, Daniel B., Daniel R. Hadley, Devin H. Mannix, George S. Roadcap, Scott C. Meyer, Kenneth J. Hlinka, Kevin L. Rennels, Kenneth R. Bradbury, Peter M. Chase, and Jacob J. Krause. Rep. Changing Groundwater Levels in the Sandstone Aquifers of Northern Illinois and Southern Wisconsin: Impacts on Available Water Supply. Illinois State Water Survey, September 16, 2015, 17. https://www.isws.illinois.edu/pubdoc/CR/ISWSCR2015-02.pdf.

18 *Ibid*, 67.

19 Hadley, Daniel R., Daniel B. Abrams, and Devin H. Mannix. Rep. Changing Groundwater Levels in the Sandstone Aquifers: Synoptic Measurement of Deep Sandstone Wells in 2021 throughout Northern Illinois, June 8, 2024. https://storymaps.arcgis.com/stories/6a8ff45c39134e168da93b45626fef36.

20 "Groundwater Monitoring Well Network," Illinois Department of Agriculture. https://agr.illinois.gov/environment/groundwater.html.

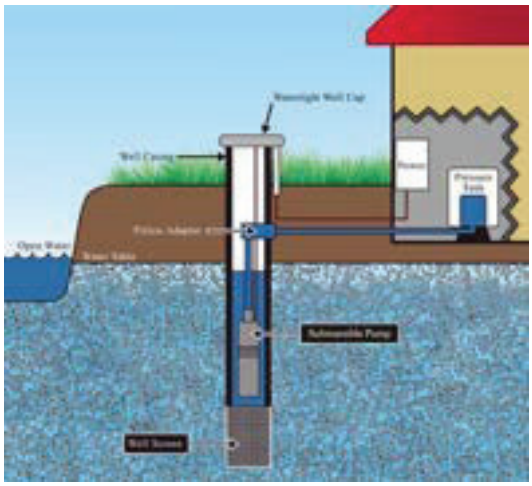

Figure 3. Single-Aquifer Well

Simplified diagram of a single-aquifer well. The casing extends from above the surface to the water-bearing layer of interest. The aquifer being accessed has a screened interval to allow water to flow into the casing and rise to its natural level which varies with topography and water pressure. A submersible pump is typically submerged below the normal water table level.[21]

At this time, private wells are required to be permitted by the local county health department, drilled by a registered well driller, and reported to the Illinois Department of Health.[22] All private wells must also be constructed according to the state well code.[23] The 1983 Water Use Act also sets forth "reasonable use" groundwater withdrawal rules for the state and requires the registration of high-capacity wells and requires data be supplied to Soil and Water Conservation districts (SWCDs) by the land occupier.[24] This data allows ISWS to conduct analysis on well conflicts and well interference. At this point, well inference analysis is not robust. This could be improved by requiring land occupiers to report data to local SCWDs, and by improving support to local SCWDs and to ISWS through funding and staffing capacity to provide data collection and management, and well interference models and reports.

A records review of domestic wells found that between 1989 and 2002, eight wells in Kane County were redrilled, with five of those eight deepened from the Galena-Platteville Dolomite to the St. Peter Sandstone.[25] Currently, Illinois allows for the construction of multi-aquifer wells under certain conditions. Well drillers are expected to evaluate which aquifer(s) will be available to satisfy the proposed well-water system.[26] If the system is designed for a shallow aquifer, and the shallow aquifer cannot provide sufficient water, the system may be in violation of the Water Well Construction Code and may need to be sealed abandoned, or a variance may be required.[27] According to the Design Factors section of the Illinois State Water Well Construction Code, if "multiple water-bearing formations of different static water levels are penetrated in the construction of a water well and the lower water-bearing formation has sufficient yield for the water well, the upper water-bearing formation shall be excluded by installing casing or a liner and properly sealing to prevent dewater of the upper water-bearing formations." [28] At this time, enforcement mechanisms for this are unclear.

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21 "Well Basics - What Is a Well? - Well Water Testing." The Groundwater Foundation, October 7, 2022. https://groundwater.org/wells/.

22 Illinois Water Well Construction Code. § 920.70 (1973).

23 *Ibid*.

24 Illinois Water Use Act of 1983 § 3(c) (1973).

25 Hadley, Daniel R., Daniel B. Abrams, Devin H. Mannix, and Cecilia Cullen. "Establishment of a Groundwater Monitoring Network And …" Northwest Water Planning Alliance, August 2020, 9. http://www.nwpa.us/uploads/1/2/9/8/129889926/campton_letter_report_final_publicversion.pdf.

26 Ilinois Department of Health. "THE 'HOW TO' MANUAL CONSTRUCTION OF WATER WELL SYSTEMS ACCORDING TO ILLINOIS CODES," 5-6. https://dph.illinois.gov/content/dam/soi/en/web/idph/files/publications/ww-contractor-studyguide-042716.pdf.

27 *Ibid*.

28 Illinois Water Well Construction Code. § 920.40.c (1973).

What is Campton Township Doing?

Municipal governments allocate and manage land, water, energy, and the distribution of residents and industries through zoning and management plans. To better understand the available resources in a region, and to more effectively distribute those resources, studies are often used by municipalities. Over the past decade, multiple studies have been conducted in the township with support from Kane County. These studies have focused on the sustainability of shallow aquifers, expanded groundwater monitoring, and examined conservation efforts.

The ongoing assessment of shallow groundwater sustainability has three components: 1) community discussions and modeling to define sustainability methodology and constrain metrics for the shallow aquifer system; 2) real-time telemetry to monitor water level throughout Kane County; 3) repeat water quality studies in Kane County wells and homeowner wells to determine if water quality has changed over time.[29] This assessment should allow for greater understanding of current water needs and community desires, while supporting community members and decision makers with the information for planning based on available groundwater in the area. This process also provides the community with knowledge of how behavior and actions impact resources, and links water quantity to water quality.

Campton Township is part of a greater effort to expand the monitoring network throughout Kane County.[30] Another nearby township, Sugar Grove, also has monitoring wells. This network supports assessments of seasonal and long-term trends that are used in county-wide water supply planning efforts.[31]

As part of broader conservation efforts and awareness of water sustainability planning, Campton Township also is receiving technical assistance through Kane County.[32] Support includes community water conservation plans, water loss audits, reviewing or updating water conservation ordinances, and other public education campaigns or programs. Technical assistance includes direct assistance with tools and technology, financial support for expert consultants, or purchase of water efficiency devices.

Campton Township has a high density of both private wells and multi-aquifer wells. Industrial, agricultural and residential users all compete for this limited water supply. As water levels in the deep aquifers decline, the question is how to move forward to manage both long-term availability of remaining deep groundwater, the shallow groundwater, and the surface water to ensure all residents have a shared sustainable future.

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29 Hadley, Daniel R., Cecelia Cullens, and Daniel B. Abrams. "Kane County Energy and Environmental Committee Agenda: Kane County Shallow Groundwater Sustainability Kickoff Meeting.", June 16, 2023. https://www.kanecountyil.gov/Lists/Events/Attachments/6627/AG%20PKT%2023-05%20Administration.pdf.

30 "ArcGIS Web Application," Illinois State Water Survey. https://univofillinois.maps.arcgis.com/apps/webappviewer/index.html?id=e364cd4c39d847f3ba4f794986a85883.

31 "Kane County Groundwater Monitoring Network," Illinois State Water Survey, 2025. https://www.isws.illinois.edu/groundwater-science/groundwater-monitoring-well-networks/kane-county.

32 "Home - Conserve Water for Kane County | Technical Assistance. " Conserve for Kane, 2025. https://conservewaterforkane.org/.