Regional Groundwater Modeling

Update for Northeast Illinois

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REMINDER

We are analyzing impacts, **not truly assessing availability**

Model runs used pumping rates from the various aquifers based on the proportional split of the 2005 pumping rates – **sources** were not shifted if a source ran out or levels went below a certain level

We used prescribed demand scenarios to evaluate impacts primarily in the form of drawdowns & critical water levels – **future impacts on streamflows are being assessed** – historical & current impacts follow

We have not assessed the shallow bedrock yet or all **model cells that went “dry”** – new info on deep bedrock follows
Streamflow capture occurs by two mechanisms:

(1) by diversion into shallow wells of recharge that would otherwise discharge to stream,
(2) by direct inducement of streamflow to leak from stream channels

Streamflow capture estimated by:

Calculating the difference between the simulated pre-development groundwater discharge and the simulated groundwater discharge for chosen post-development dates (e.g., 1985, 2005, 2025, 2050) for selected stream reaches
Groundwater discharge reductions may not be easily observed.

Discharges of wastewater effluent likely will compensate for base flow reductions on receiving streams (e.g., Fox River).

Reductions may be noticeable during low flow periods on perennial tributary streams that do not receive effluent. Such streams may potentially go dry more often and may do so already. For ephemeral streams, dry periods potentially may become more prevalent and/or extend for longer periods.

Other changes within the watershed that can influence streamflow are not being modeled (e.g., urbanization).
Change in Natural Groundwater Discharge (%)

Predevelopment (1864) to 2003

From Meyer et al., 2009. Kane County Water Resources Investigations: Simulation of Groundwater Flow in Kane County And Northeastern Illinois
Change in Natural Groundwater Discharge (%)

Predevelopment (1864) to 1985
Change in Natural Groundwater Discharge (%)

Predevelopment (1864) to 2005
“Old” Conclusions (December 2008)

- Regional groundwater flow model results have been produced for the 3 basic demand scenarios.
- Results for shallow sand/gravel aquifers within the Fox River Basin were presented - cones of depression are evident in major pumping centers – some Carpentersville wells apparently went dry in the Baseline and MRI scenarios.
- Stream flow impacts have not been examined yet – stream flow may be contributing significantly to sand/gravel wells.
- Results for Ironton-Galesville were presented and some future demand scenarios show significant impacts, esp. in areas near Aurora and Joliet.
- **Model results suggest future demands can largely be met only if the impacts are deemed acceptable.**
- There is time to make model improvements and plan alternatives, but not time to waste.
Aquifers of Northeastern Illinois

West

Cross-Section Modified from Bretz (1939)

East

Unconsolidated Aquifer System

Shallow Bedrock Aquifer

Deep Bedrock Aquifer System (Ancell and Ironton-Galesville sandstones)

Elmhurst-Mt. Simon Aq. (saline?)

Top of Ancell (St. Peter ss)

Top of Ironton-Galesville
Montgomery
Ironton-
Galesville
Unit
Simulated
Hydrograph

Simulated Heads (Historical)
Simulated Heads (LRI Scenario)
Simulated Heads (Baseline Scenario)
Simulated Heads (MRI Scenario)

Top of Ironton-Galesville Unit

Feet above mean sea level

11-County Simulated Deep Bedrock Withdrawals

Regional Water Supply Planning Demand Scenarios (LRI, BL, MRI)

11-County simulated historic deep bedrock withdrawals

Walton’s ~6-county 65 mgd estimated sustainable yield
2025
Drawdown Ancell Unit Baseline Scenario

Eleven-County Area

Unit Absent
2025
Available Head
Above the Ancell Unit
Baseline Scenario
2025
Available Head Above the Ancell Unit
Baseline Scenario

Available head not shown where ...
1. It is >200 ft
2. It was <200 ft before development
2050
Available Head Above the Ancell Unit Baseline Scenario

Eleven-County Area

Unit Absent

Available Head not shown where...
1. It is >200 ft
2. It was <200 ft before development

Available Head Above Top of Ancell Unit (feet)

Ancell completely desaturated
2050
Available Head Above the Ancell Unit MRI Scenario
2050
Available Head Above the Ancell Unit
LRI Scenario

Available head not shown where ...
1. It is >200 ft
2. It was <200 ft before development
Montgomery Ancell Unit
Simulated Hydrograph

Simulated Heads (Historical)
Simulated Heads (LRI Scenario)
Simulated Heads (MRI Scenario)
Simulated Heads (Baseline Scenario)

Top of Ancell Unit

Feet above mean sea level

Drawdown in the Ironton-Galesville Unit 2025 Baseline Scenario
Drawdown in the Ironton-Galesville Unit 2050 Baseline Scenario
2025
Available Head Above the I-G Unit
Baseline Scenario

Available head not shown where ...
1. It is >200 ft
2. It was <200 ft before development
2050
Available Head Above the I-G Unit Baseline Scenario

Available head not shown where...
1. It is >200 ft
2. It was <200 ft before development
2050
Available Head Above the I-G Unit
MRI Scenario

Available head not shown where ...
1. It is >200 ft
2. It was <200 ft before development
2050
Available Head Above the I-G Unit LRI Scenario

Available head not shown where...
1. It is >200 ft
2. It was <200 ft before development
Observed vs Simulated Heads in the Deep Aquifers

1) Observed water levels in northeastern Illinois deep wells are averages of heads in all units intercepted by the open borehole of the well

2) The model simulates individual model layers, and thus, the model-simulated heads will not be the same as the actual, field-observed composite water levels

3) Model results show approximate agreement between observed water levels and model-calculated heads in the aquifers to which the wells are reported to be open
Observed vs Simulated Heads in the Deep Aquifers

4) Difference between observed composite water levels and simulated heads in intercepted aquifers may be attributable to interformational transfer of groundwater, via open boreholes, between deep aquifers

5) Effect of transfers is not simulated by the regional model

6) The transfer of water along most deep boreholes is downward ⬇ from the Ancell Unit down to the Ironton-Galesville – similar to pumping from the Ancell and injecting into the I-G

7) Therefore, actual heads are likely to be lower ☹ in the Ancell and higher 😊 in the Ironton-Galesville than simulated heads
Updated Conclusions (March 2009)

- Regional groundwater flow model results continue to be analyzed for the 3 basic demand scenarios
- Stream flow impacts have been examined for historical and current conditions – stream flow appears to be contributing significantly to sand/gravel wells
- Results for Ancell & Ironton-Galesville show significant impacts, especially in areas from Aurora to Joliet
- Model results suggest the deep bedrock aquifers cannot be counted on to meet all future demand scenarios across the entire 11-county area
Remaining To-Do List for 2009

As Time Allows...

• Assess impacts on shallow bedrock aquifers
• Assess impacts of future scenarios on streamflow
• Evaluate how much demand is not being met by model cells going “dry”
• Model impacts of drought and climate change
Spring is Coming!

It Really Is...
Available Head Above Top of Ironton-Galesville

End of Summer Irrigation Season, 2025

Baseline Scenario
Available Head Above Top of Ironton-Galesville

End of Summer Irrigation Season, 2050

Baseline Scenario
Available Head Above Top of Ironton-Galesville

*End of Summer Irrigation Season, 2050*

*Less Resource-Intensive Scenario*
Available Head Above Top of Ironton-Galesville

End of Summer Irrigation Season, 2050
More Resource-Intensive Scenario

[Map showing available head above top of Ironton-Galesville unit with color scale and note: Available head not shown where... 1. It is >200 ft 2. It was <200 ft before development]