Lake County:

Groundwaters and Inland Surface Waters

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Presentation Outline

Primary focus: Water Quantity

The Hydrologic Cycle

Aquifers
  Shallow
  Deep Bedrock

Surface Water

Climate Change
The Hydrologic Cycle

Climate, surface water, and groundwater are linked
Precipitation

Evaporation & Transpiration

Surface Runoff

Soil

Subsurface Runoff

Water Table

Base Flow

Recharge
Aquifers

- What is an aquifer?
- It is not an underground:
  - river
  - stream
  - lake

It is a water saturated geologic formation capable of yielding water.
Porous Systems

Groundwater sits in or flows through pore spaces between grains
Fractured Systems
# Groundwater Flow Velocities

<table>
<thead>
<tr>
<th>Material</th>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly fractured limestone</td>
<td>10-1000’s feet/day</td>
</tr>
<tr>
<td>Gravel</td>
<td>5-10 feet per day</td>
</tr>
<tr>
<td>Clean sand</td>
<td>1 – 5 feet per day</td>
</tr>
<tr>
<td>Sandstone</td>
<td>&lt; 0.5 feet per day</td>
</tr>
</tbody>
</table>
Aquifers

Land Surface

Water Table

Unconfined Aquifer

Confining Layer

Confined Aquifer

Unsaturated

Saturated

Bedrock
Aquifers of Northeastern Illinois

Cross-Section Modified from Bretz (1939)
Major Sand & Gravel Aquifers
Major Shallow Bedrock Aquifers
Shallow Aquifers Withdrawals in 2000

% of Estimated Yields

Source: Jaffe
Major Deep Bedrock Aquifers
Recharge to the Deep Bedrock System

Area of Maquoketa Cover

Recharge Area

20 0 20 40 Miles
Distribution Of Deep Bedrock Aquifer Pumpage

Source: Jaffe
NE Illinois Deep Bedrock Withdrawals, 1900-2000

182.9 mgd (1979)

Estimated Practical Sustained Yield (Ideal Well Distribution) = 65 mgd

71.9 mgd (2000)

Estimated Practical Sustained Yield (1958 Well Distribution) = 46 mgd
Aquifers & Artesian Wells

- Land surface
- Flowing artesian well
- Water table
- Unconfined aquifer
- Confined aquifer
- Confining layer
Potentiometric Surface of the Deep Bedrock Aquifer System, Fall 2000

From Burch, ISWS, 2002
Groundwater Flow Modeling: NE Illinois Regional Model Grid

- 226 rows
- 174 columns
- 18 layers
- 707,832 nodes
- Minimum grid spacing of 2500’
- Maximum grid spacing of 80,000’
Water Sources for Public Supply in Northeastern Illinois

Legend:
- Lake Michigan
- Inland surface water*
- Ground water

*Groundwater is also used within these areas in some cases.

Source: Chicago Metropolitan Agency for Planning
Fox River Watershed
Factors affecting surface water availability

1. Climate variability & change
2. Water withdrawals & wastewater effluent
3. Reservoirs, diversions, navigation works
4. Indirect impacts on base flow (groundwater-surface interactions)
5. In-stream flow needs
10-Year Low Flows along the Fox River

- Present-day condition
- Unaltered flow

FLOW

- Algonquin
- Elgin
- Aurora
- Yorkville

10-Year Low Flow, mgd
Low flows in the Fox River are impacted mostly by releases from Stratton Dam.
Flows from Stratton Dam

- Flow into the Chain of Lakes has been augmented by wastewater effluents, most coming from the Waukesha, WI area.
- A minimum gate opening, releasing 57 mgd was established in 1988.
- Raising the summer pool elevation since 1965 has greatly reduced the frequency of low flows occurring downstream.
Fox River at Algonquin

7-day low flow (mgd)

Instream Flow Needs

- Aquatic habitat / biological health
- Assimilation of waste waters (dilution)
- Recreation/Aesthetics

Instream flow needs can be in conflict with one another.
Surface Water Accounting Tool for the Fox River Basin

- Evaluate flow quantity
- Examine impacts of future water use scenarios on streamflows.
- Future application: evaluate impacts from climate change scenarios and surface–groundwater interaction as they become better understood.
Fox River Issues

- Wastewater discharges will increase substantially as water use in the watershed increases, increasing flow.

- Assimilation of wastewaters and improving wastewater treatment technology will likely define to what degree the Fox River can be a source for additional water withdrawals.

- Increased use of shallow groundwater may reduce flow, particularly in tributaries, due to groundwater-surface water interaction.
CLIMATE

- CLIMATE CONDITIONS ARE A MAJOR OR FACTOR IN WATER SUPPLY
DEFINITION of CLIMATE

- The statistical aggregate of weather conditions over a period of time.
- "Normal" Climate is set over 30 year periods.
- Current "normal" period is 1971-2000.
- This will change to 1981-2010 in 2011.
CLIMATE VARIABILITY: Definition

- Variations in climate on time scales of months, years, decades, centuries, and millennia. Includes droughts and floods.
CLIMATE CHANGE: Definition

- A statistically significant change in climate over a period of time.
  - From one 30-year period to another
  - From one century to another
  - From one millennium to another
- You can’t have climate change over less than a 30-year period.
- Climate change can be a change in the mean, in extremes, or in frequencies.
Conclusions: Water Sources

- Shallow Aquifers
- Deep Bedrock Aquifers
- Fox River
Conclusions: Broad Issues

Research & Planning Are Needed:

- What will the demand for water be?
- How much water is available?
- What are the impacts after combining demand & availability?
- How resistant is supply to drought & climate change?
Thank You!

Look for more information and updates:
http://www.sws.uiuc.edu/wsp

E-mail me with questions:
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