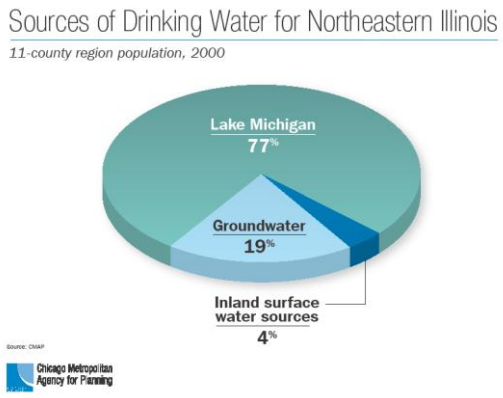
What Our Water's Worth

Advantages and challenges of shallow aquifers

Groundwater, water that lies below the land surface, is an extremely important resource. Twenty percent of the homes and businesses in the northeastern region of Illinois use groundwater to meet their domestic and industrial water supply needs. In other parts of Illinois and the U.S., groundwater is also an important source of potable water supply. According to the United States Geological Survey, of all the water used in the United States in 2000, about 21 percent came from ground-water sources.

For more than a century, groundwater has been used by homes and industries throughout the Chicago region. In Illinois, groundwater is developed from three principal aquifer types:

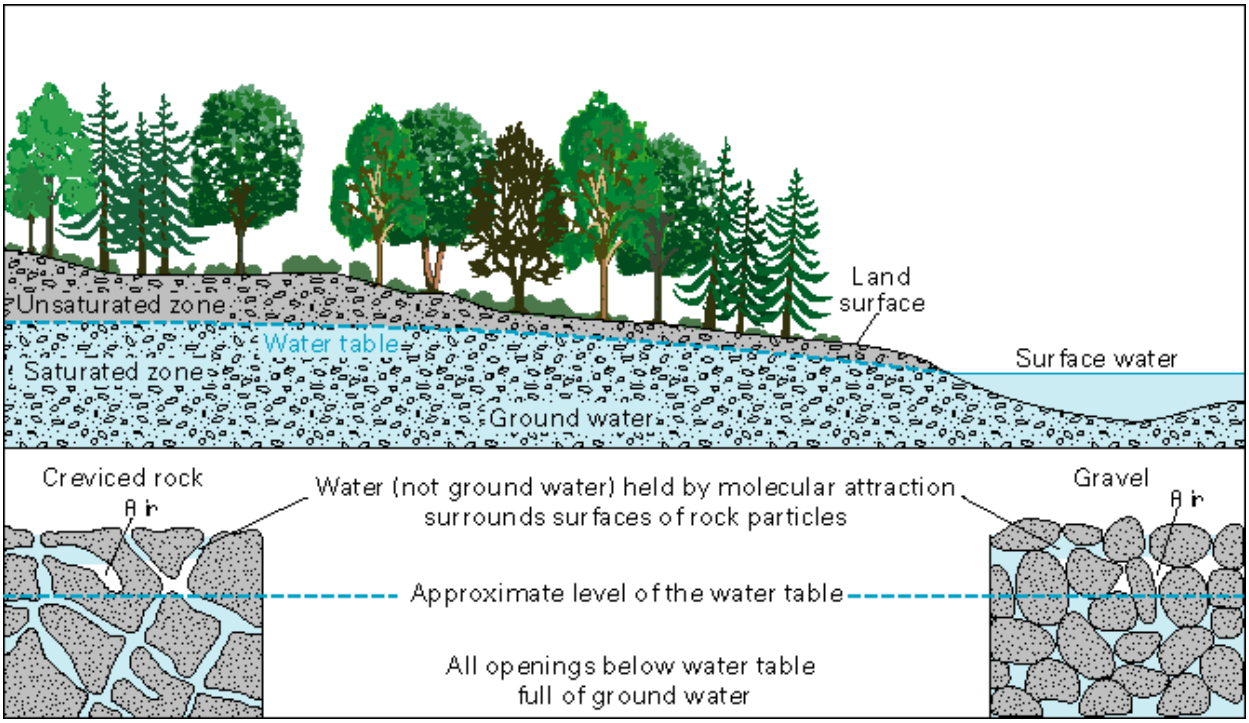
- Deep bedrock aquifers lying at depths of 500 feet or greater below the land surface; and
- Sand and gravel aquifers and shallow bedrock aquifers lying within 500 feet of land surface. These are often considered together as 'shallow aquifers.'



Because we can't see these vital resources, they can be misunderstood. Many people think of aquifers as underground lakes, when they're really more like sponges. Groundwater exists in the tiny spaces between sub-surface soil, sand and rock. If the ground is permeable (that is, if fluids like water are able to move through it), it will become saturated with water when it rains or water seeps in from lakes and rivers. When the ground is impermeable – perhaps because it is covered with pavement or concrete – it will not absorb water as readily, if at all.

Different kinds of rock have different degrees of permeability; water does not move through them at the same rate. When a water-bearing rock readily transmits water upwards to wells and springs, it is called an aquifer. Wells can be drilled into the aquifers and water can be pumped out.

Given enough time, rain and snow melt can recharge the porous rock of the aquifer. Recharge rates are not the same for all aquifers, however, and that must be considered when pumping water from a well. Pumping too much water too fast draws down the water in the aquifer and eventually causes a well to yield less and less water, and perhaps run dry. Even if a well does not become completely dry, reduced water levels are also associated with lower pressure, and it becomes more and more expensive to pump water. Some wells become too costly to operate even though they still contain water.



Take a quiz about groundwater!

What's special about shallow aquifers?

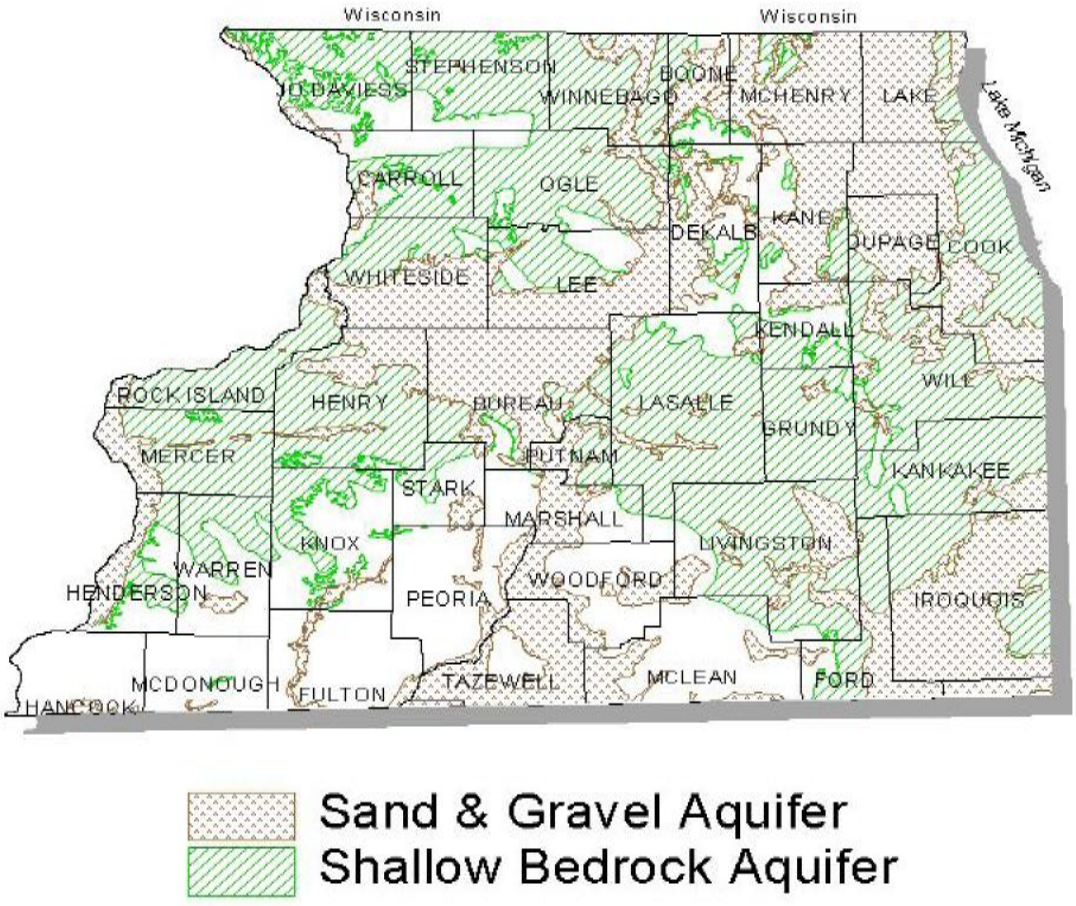
Unlike deep bedrock aquifers, shallow aquifers can recharge relatively quickly when rain falls and infiltrates the soil. This makes them a more sustainable resource, if managed effectively. However, they also are more susceptible to drought and pollution issues because of their dependence on rain and their close connections with stormwater runoff.

Illinois has two kinds of shallow aquifers, but they are generally considered together as one kind of water resource.

- An aquifer within the loose (unconsolidated) geologic materials, such as sand and gravel, above the bedrock; and
- Shallow bedrock aquifers that are within approximately 500 feet of land surface.

The following two diagrams show where the sand and gravel aquifer and shallow aquifer resources in the Midwest are located.

Sand and Gravel Aquifers and Shallow Bedrock Aquifers in Northern Illinois:



Source: [Illinois State Water Survey presentation, "Studying Water Availability in Illinois"]

Shallow aquifers are difficult to visualize. They exist when precipitation (rain or melted snow) seeps in to the pores and cracks in soils and rocks beneath the land's surface. Some of this water is consumed by plants. The remaining water makes its way to the water table, which marks the uppermost limit of groundwater. Water tables rise and fall depending on rates of withdrawal and recharge.

Water within shallow aquifers moves in different directions. There is substantial movement from aquifers into streams, springs, or wetlands, and vice versa. At the same time, water is pulled upward by wells. There are many private wells that tap directly into shallow aquifers at differing depths, and 9 to 10 percent of the public water supplies in Illinois come from shallow aquifers. The proximity of shallow aquifers to the surface allows for easy withdrawal. Sand and gravel aquifers can be accessed easily by drilling a small well. Bedrock shallow aquifers typically are a little deeper, but are still close enough to the surface to be accessed readily.

One concern in northeastern Illinois is that over-withdrawal of shallow aquifer water is reducing water levels in adjacent rivers and other environments, harming habitats in the process. This is already occurring in places. According to the Chicago Metropolitan Agency for Planning's (CMAP) Water 2050 report, "Shallow aquifer drawdown appears to be most

significant in northeastern Kane County and southeastern McHenry County… The next most vulnerable areas are located within a north-south corridor along the Fox River."[1]

The rate of recharge is an important characteristic of an individual aquifer. The amount of precipitation, rate of withdrawal, and inflow rate of water seeping into the aquifer all play a role in determining a sustainable management strategy.

It has been estimated, for example, that if the aquifer that underlies the High Plains of Texas and New Mexico--an area of slight precipitation--was emptied, it would take centuries to refill the aquifer at the present small rate of replenishment. In contrast, a shallow aquifer in an area of substantial precipitation may be replenished almost immediately. As well as feeding into streams, rivers and lakes, shallow aquifers also may be fed *by* streams, rivers and lakes. Interactions between these bodies of water are an important characteristic of shallow aquifers.

Aquifers also can be replenished artificially. For example, large volumes of ground water used for air conditioning are returned to aquifers through recharge wells on Long Island, N.Y. Artificially recharging aquifers is done in two main ways: One way is to spread water over the land and allow gravity to do the rest; the other way is to construct recharge wells and inject water directly into an aquifer. The latter is a more expensive method, but may be justified where the spreading method is not feasible. It also should be noted some artificial-recharge projects have been successful, while others have not achieved the desired results.

Who uses shallow aquifer water in Northeastern Illinois?

Approximately 10 percent of the region's population is served by shallow aquifer water resources. Some of their communities rely exclusively on shallow aquifer resources. Some communities use shallow aquifers in addition to other sources, such as deep aquifers or river water. The following table shows the communities in our region that use shallow aquifer water.

Illinois communities that use shallow aquifer water		
Algonquin	Herscher	Peotone
Antioch	Holiday Hills	Pingree Grove
Barrington	Homer Glen	Plano
Barrington Hills	Hopkins Park	Poplar Grove
Batavia#	Indian Creek	Port Barrington
Beecher	Inverness	Prairie Grove
Big Rock	Irwin	Richmond
Bonfield	Johnsburg	Richton Park
Buckingham	Kaneville	Ringwood
Bull Valley	Kildeer	Romeoville#
Burlington#	Lake Barrington	Sauk Village
Cabery	Lake in the Hills#	Seneca
Caledonia	Lake Villa	Shabbona
Carpentersville	Lakemoor	South Barrington

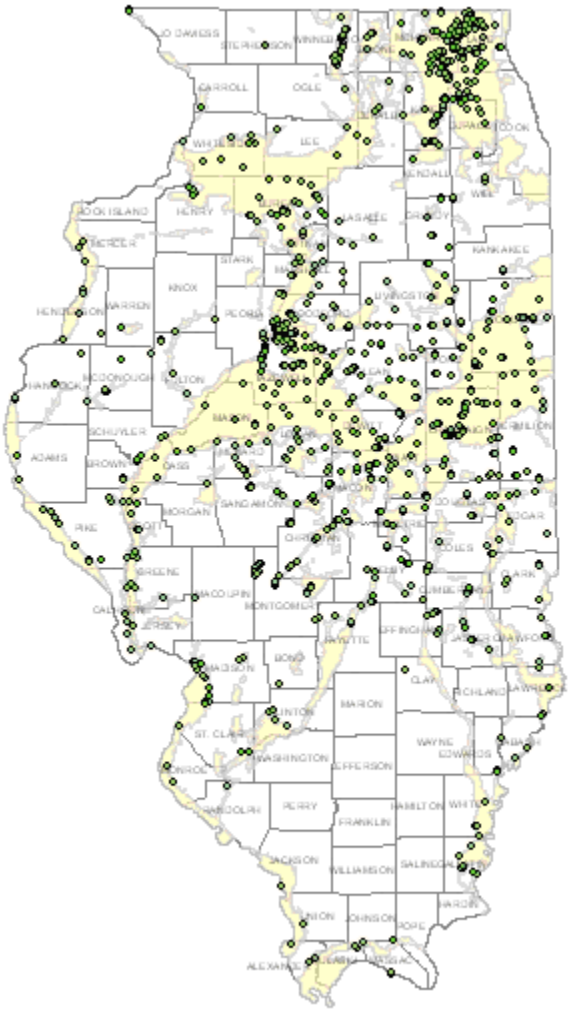
[1] Water 2050, page XI

Cary	Lakewood	South Elgin#
Chebanse	Lee	South Wilmington#
Cherry Valley	Lily Lake	Spring Grove
Crest Hill	Limestone*	St. Anne
Crete	Lindenhurst	St. Charles
Crystal Lake#	Lockport	Steger
Deer Park	Long Grove	Sun River Terrace
DeKalb#	Loves Park	Symerton
Dwight	Manteno*	Third Lake
East Brooklyn	Marengo	Timberlane
East Dundee	Mazon	Tower Lakes
Essex	McCullom Lake	Trout Valley
Fox Lake	McHenry	Union#
Fox River Grove	Mettawa	Union Hill
Frankfort	Millbrook	University Park
Geneva	Millington	Verona
Genoa	Minooka#	Virgil
Godley	Momence	Wadsworth#
Grant Park	Monee	Waterman
Hainesville	North Barrington	Wauconda#
Harvard	Oakwood Hills	Wayne
Hawthorn Woods	Old Mill Creek	Wonder Lake
Hebron	Park Forest	Woodstock

*** These communities use a combination of river and shallow aquifer water.**
 # These communities use a combination of deep and shallow aquifer water.

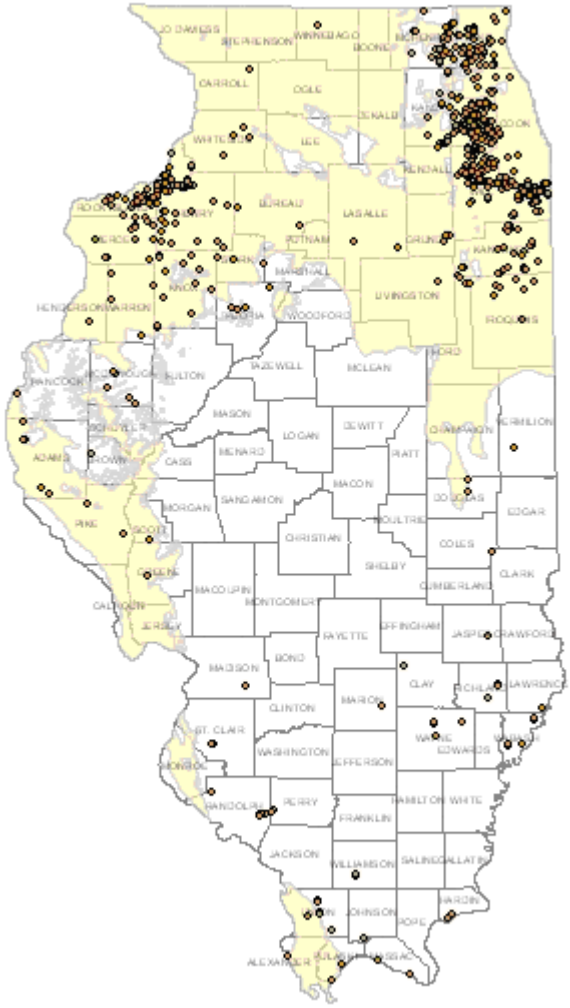
The maps below show the location of shallow aquifer water withdrawal wells in Illinois.

Sand and gravel community water supply wells:



Source: Illinois State Water Survey, Illinois Water Supply Planning: Groundwater

Shallow bedrock community water supply wells:



Source: [Illinois State Water Survey, Illinois Water Supply Planning: Groundwater]

What are the advantages and challenges to using shallow aquifer water?

Advantages

- Shallow aquifers are a relatively renewable source of water because they can be replenished by precipitation. Forced recharge by land application or direct pumping is also possible.

- Energy costs for pumping from a shallow aquifer are often less, as the water is less than 500 feet below the land's surface.

- Some shallow aquifers have the potential to be exploited to a greater degree. However, increased use of shallow aquifer water also would require a concerted effort to manage water levels in adjacent surface water bodies.

Challenges

- Shallow aquifers are more susceptible to drought. Water levels are more sensitive to rain conditions and will decline in response to dry weather. Water demand usually increases during drought, making the shallow aquifers even more vulnerable. When withdrawal outpaces recharge, pressure and supply decline, lowering the region's water table levels. For water to be withdrawn from the ground, water must be pumped from a well that reaches below the water table. If groundwater levels decline too far, the well owner might have to deepen the well or drill a new one. Also, as water levels decline, the rate of water the well can yield may decline and it will require more energy (and money) to operate.

- If withdrawals from shallow aquifers exceed the rate of recharge, effects also may be felt by adjacent water bodies. Groundwater pumping can alter how water moves between an aquifer and a stream, lake, or wetland by either intercepting groundwater flow that discharges into the surface-water body under natural conditions, or by increasing the rate of water movement from the surface-water body into an aquifer. Over-pumping of groundwater can reduce the amount of water in streams and lakes.

- Shallow aquifers are closer to the surface and, as a result, are more susceptible to contamination. One threat to fresh groundwater supplies is contamination from salt. Scientists have found high concentrations of chloride, a chemical that results when salt is dissolved in water. For example, chloride concentrations in shallow aquifer public water supplies in Kane County have been increasing in the past four decades[2]. The likely culprit is road salt, which washes into water supplies.

- Sometimes, when too much water is extracted from an aquifer, the land above it collapses. When subsurface water is removed, the soil above can drop. The photo below shows a fissure near Lucerne Lake in San Bernardino County, Mojave Desert, California[3]. The probable cause was declining ground-water levels.

- You can't manage what you can't measure. Illinois has few regulations on well usage. Private well owners historically have not been required to report annual pumpage, although that ended with the passage of SB2184 in 2009. State scientists are only now starting to receive the comprehensive data they need to fully assess the condition of our shallow aquifers.

- Out of sight, out of mind. Unlike rivers or Lake Michigan, which are visible and used by many people for recreational purposes, shallow aquifers are hidden away below our feet, and many consumers are not fully aware of the services, infrastructure and cost of sustainably managing shallow aquifer water.

[2] http://www.isws.illinois.edu/gws/pres/NEILwateruse.htm
[3] http://ga.water.usgs.gov/edu/earthgwlandsubside.html

What can you do to be a good steward of shallow aquifer water?

The best steward of shallow aquifer water supplies will make sure the amount of water taken does not exceed the amount of water replenished naturally, and be conscious of actions that may adversely affect the quality of the groundwater. If you know your home relies on water from shallow aquifers, you can take many measures to ensure you're doing your part to protect this resource.

- Conserve:
  - Check and replace leaky pipes and fixtures, especially toilets!
  - Invest in EPA WaterSense certified products.
  - Only run the dishwasher and laundry when they are full.
  - Turn off the faucet when brushing your teeth.
  - Wash your car at a professional carwash, which often recycle water.
- Collect:
  - Reduce your use of municipal water by disconnecting your down spout and using a rain barrel. (Click here for Instructions on how to use a rain barrel.) This has the added benefit of reducing stormwater runoff.
  - Homeowners also can use permeable pavement on their properties to ensure precipitation will make its way back down into the aquifer.
- Protect:
  - Don't flush contaminants down the drain.
  - Consider natural fertilizers and pesticides for your lawn and garden.
  - Find an alternative to rock salt for de-icing your driveway and sidewalks in the winter, or just use a shovel and ice breaker. It's great exercise!
- Inquire:
  - Does your community have a plan to responsibly manage your shallow groundwater resources? What about programs to assist homeowners with water-efficient retrofits or installing green infrastructure? Are there policies and programs in place to address aquifer recharge zones or manage demand? Most Illinois communities have very good web sites, including information on public works. Check it out, talk to your elected officials and neighbors, and, more importantly, take action.
  - Ask your elected officials about considering other water resources (surface rivers, Lake Michigan, treatment and reuse of effluent) that may be more cost-effective and easily replenished
  - What kind of road salt does your community use? Has it explored green alternatives to traditional salts?

Kane County depends on groundwater (in addition to water from the Fox River) for its water supplies. Facing concerns about supply and contamination, the county has created a Strategy for Developing a Sustainable Water Supply Plan as part of its larger planning efforts, represented in their 2030 Land Resource Management Plan. Click here for the Water Resources section of the plan.

For more information:

General Educational Information

- Water 2050: The Northeastern Illinois Regional Water Supply/Demand Plan
  - For relevant information on groundwater, see pages 18 and 73 and be sure to read Chapter 4.
- MPC and Openlands' *Before the Wells Run Dry: Ensuring Sustainable Water Supplies for Illinois* (2009)
- Groundwater in Northeastern Illinois
- United States Geological Survey information on Groundwater
- Illinois Groundwater Fact Sheet

Water Quality Information

- Centers for Disease Control – private groundwater wells and health information
- Fact Sheet on Groundwater Contamination
- Shallow Bedrock Aquifer Sources of Contamination

Water Supply Information

- Temporal Changes in Shallow Groundwater Quality in Northeastern Illinois
- ISWS Analysis of Groundwater Use to Aquifer Potential Yield in Illinois
- 'Is Illinois becoming tapped out?'

Local Case Study

- Barrington Area Aquifer Resource Analysis