

Water 101

Terms and Definitions

Aquifer

An **aquifer** is an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, or silt) from which groundwater can be extracted using a water well.

- ▶ Unconfined Aquifers: aquifers in vertical hydraulic continuity with land surface.

Water Table Aquifers = Unconfined Aquifers

- ▶ Confined Aquifers: aquifers that are separated from atmospheric pressures by impermeable zones or confining layers.

<http://en.wikipedia.org/wiki/Aquifer>

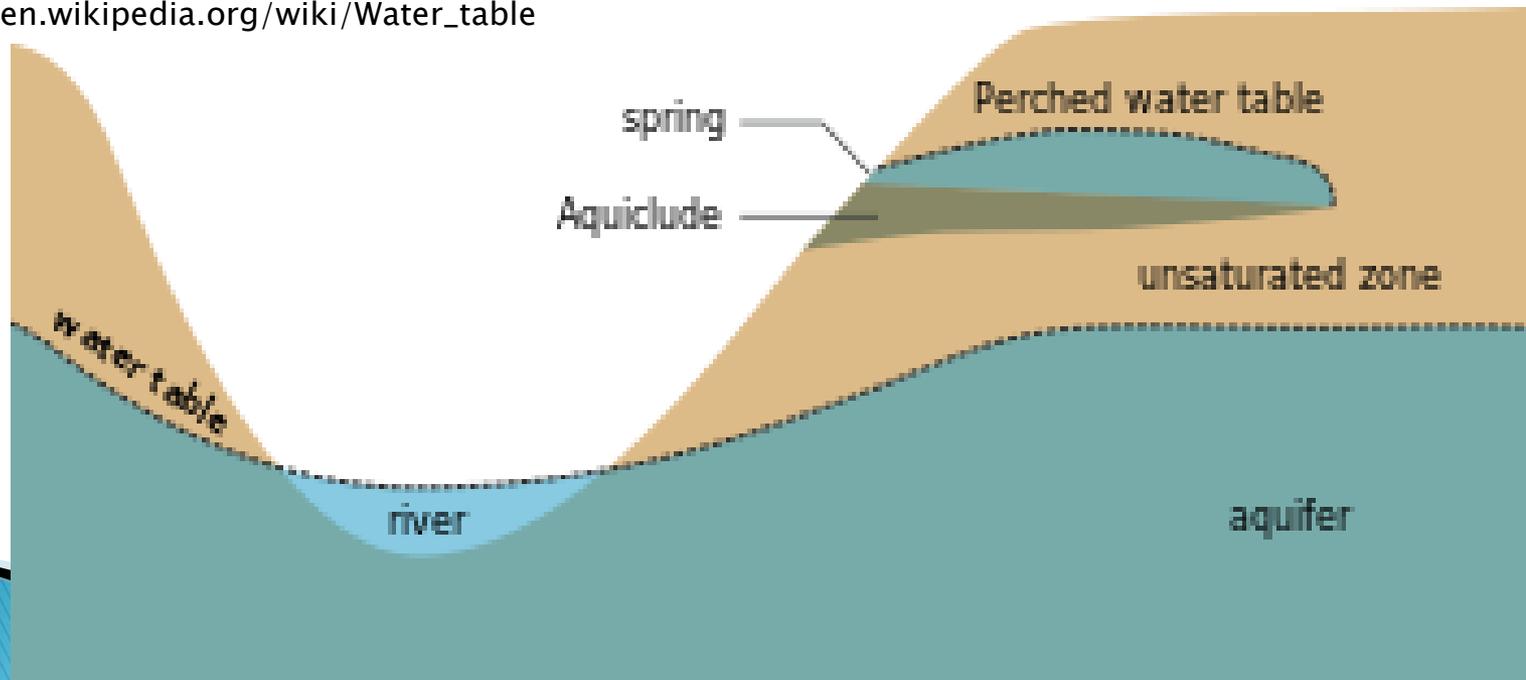
Aquifer Characteristics

- ▶ **Porosity:** the ratio of the volume of void space to the total volume.
- ▶ **Specific Yield:** the ratio of the total volume of water to the total volume.
- ▶ **Hydraulic Conductivity:** measure of the capacity of a porous material to transmit fluids. Closely linked to permeability.
- ▶ **Permeability:** Ability to transmit fluids. Permeability equals velocity of flow divided by hydraulic gradient

Water Table

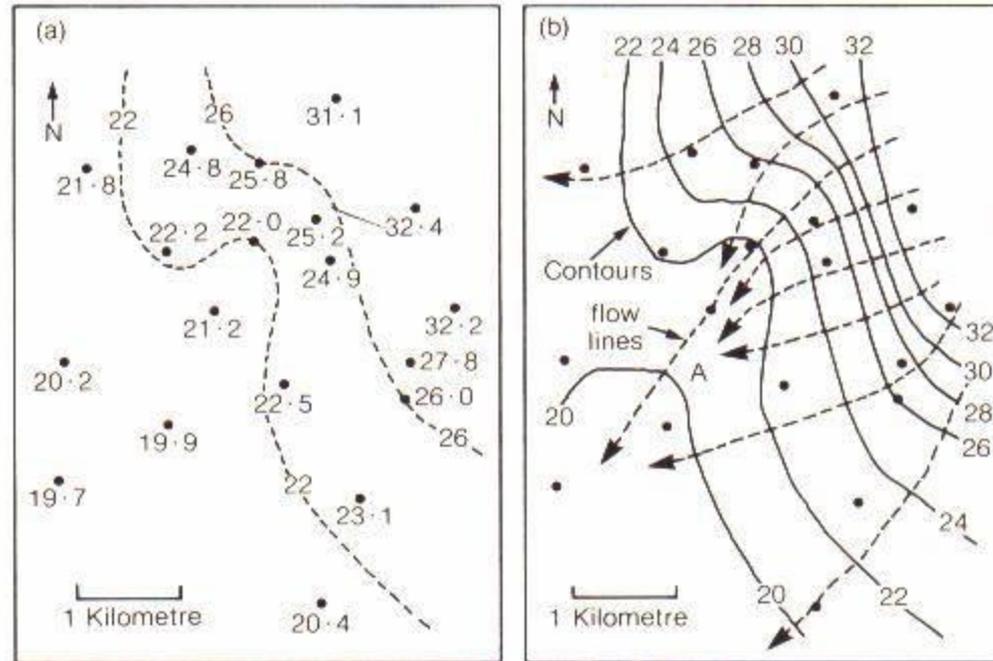
- ▶ The **water table** is the surface where the water pressure head is equal to the atmospheric pressure. It may be conveniently visualized as the "surface" of the underground materials that are saturated with groundwater.

http://en.wikipedia.org/wiki/Water_table

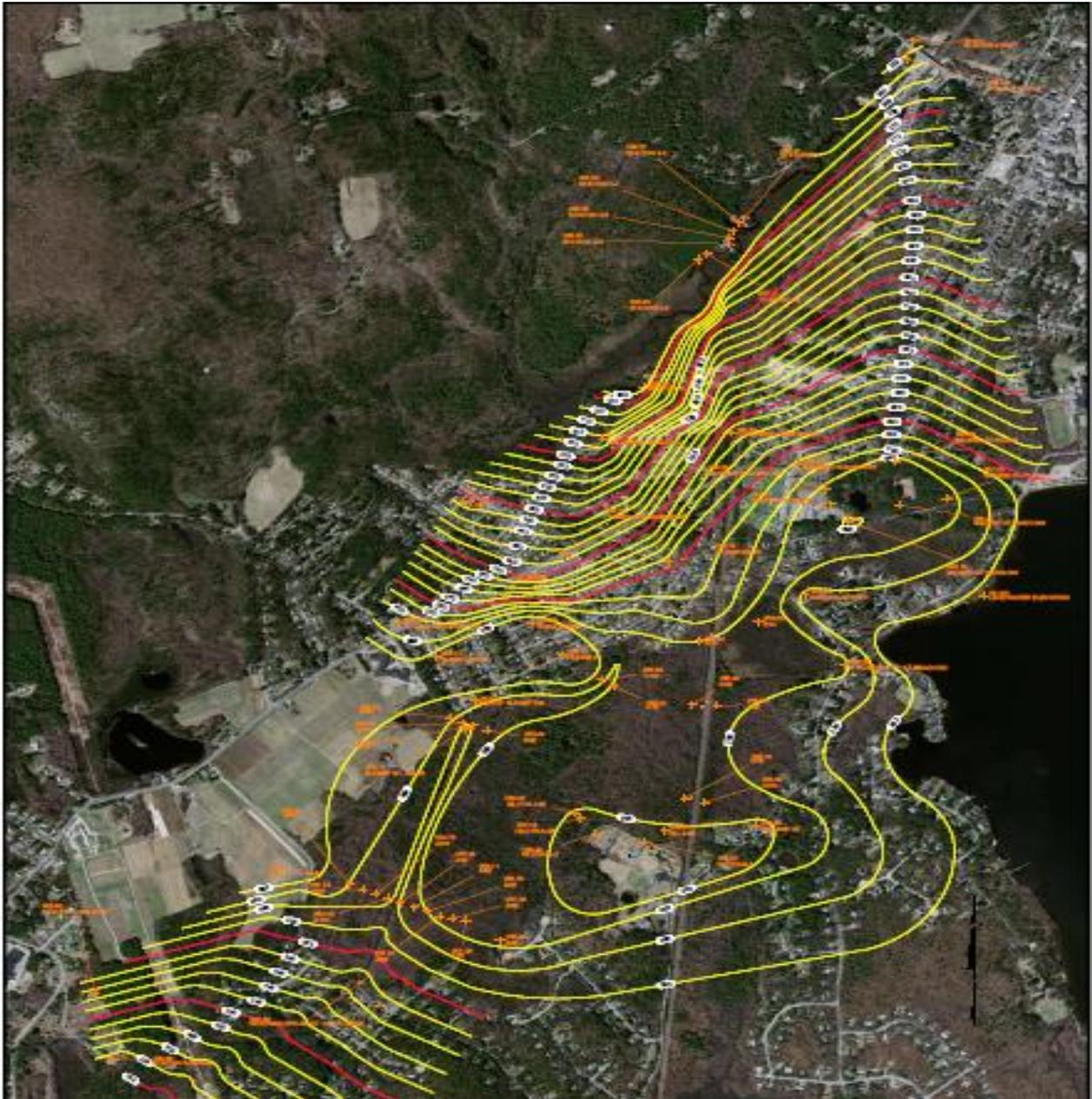


Groundwater Contour Map

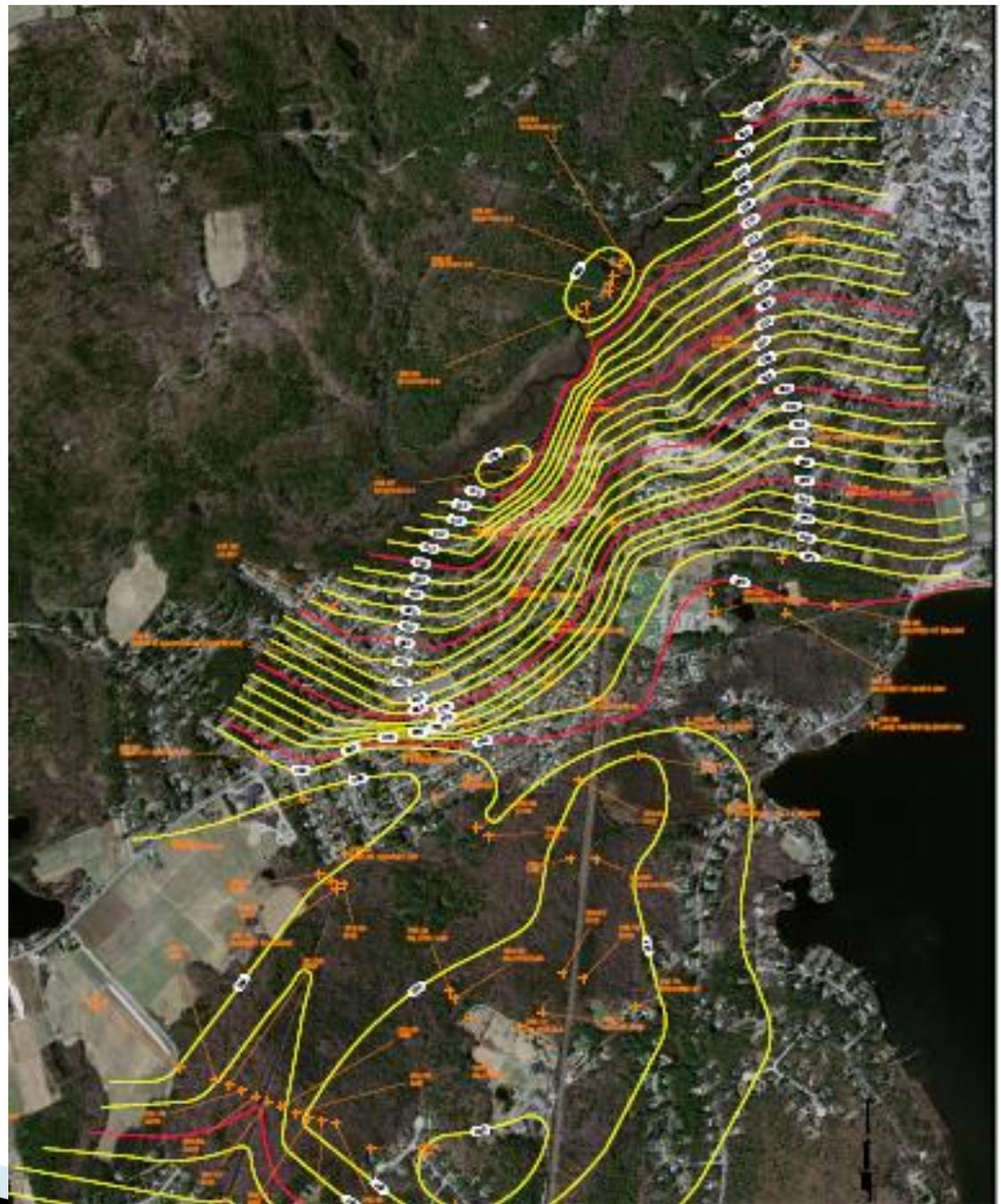
- ▶ A map having contour lines through points of equal elevation.



Groundwater Contour - Cedar Swamp April 2010



Groundwater Contour - Cedar Swamp August 2010



Watershed Drainage Area

- ▶ A watershed is the area of land where all of the water that is under it or drains off of it goes into the same place.

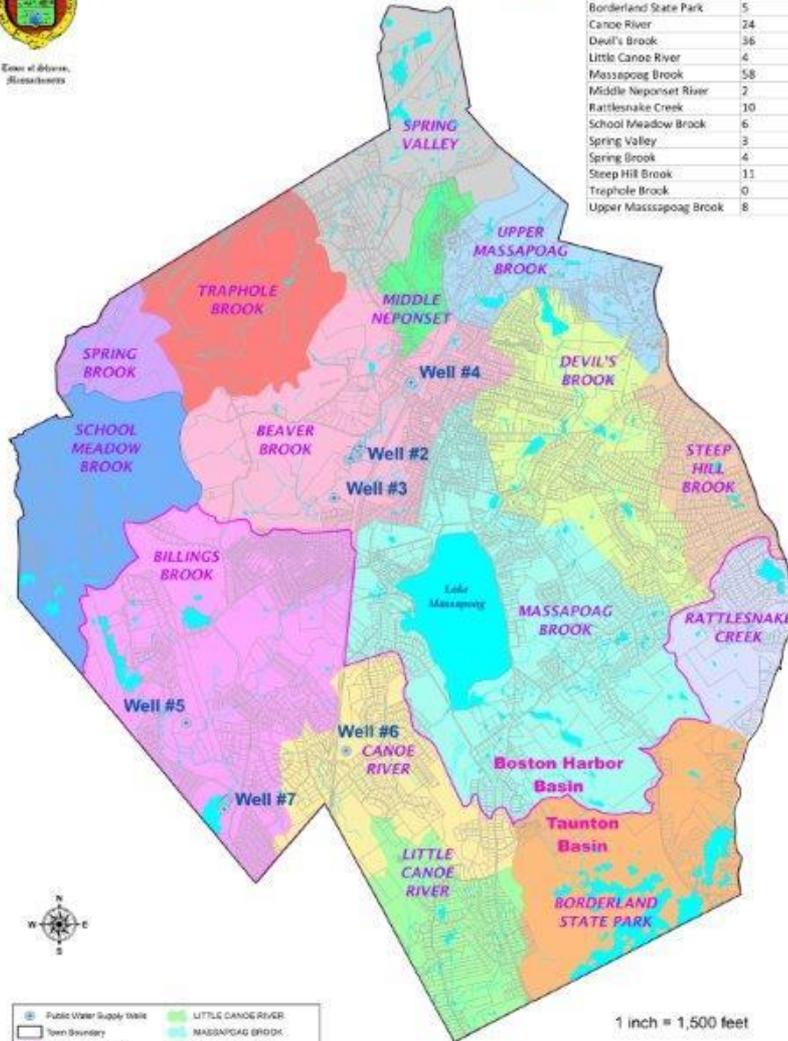




Town of Sharon,
Massachusetts

Sharon Drainage

Drainage Basin	# Outfalls
Beaver Brook	18
Billings Brook	47
Borderland State Park	5
Canoe River	24
Devil's Brook	36
Little Canoe River	4
Massapoag Brook	58
Middle Neponset River	7
Rattlesnake Creek	10
School Meadow Brook	6
Spring Valley	3
Spring Brook	4
Steep Hill Brook	11
Trephole Brook	0
Upper Massapoag Brook	8



Public Water Supply Well	LITTLE CANOE RIVER
Town Boundary	MASSAPOAG BROOK
Major Drainage Basin	MIDDLE NEPONSET
Parcel	RATTLESNAKE CREEK
Stream	SCHOOL MEADOW BROOK
Water Features	SPRING BROOK
BEAVER BROOK	SPRING VALLEY
BILLINGS BROOK	STEEP HILL BROOK
BORDERLAND STATE PARK	TRAPHOLE BROOK
CANOE RIVER	UPPER MASSAPOAG BROOK
DEVIL'S BROOK	

Map generated through GIS on the following systems:
Microsoft Office 2010, ArcGIS 10.0, AutoCAD 2010

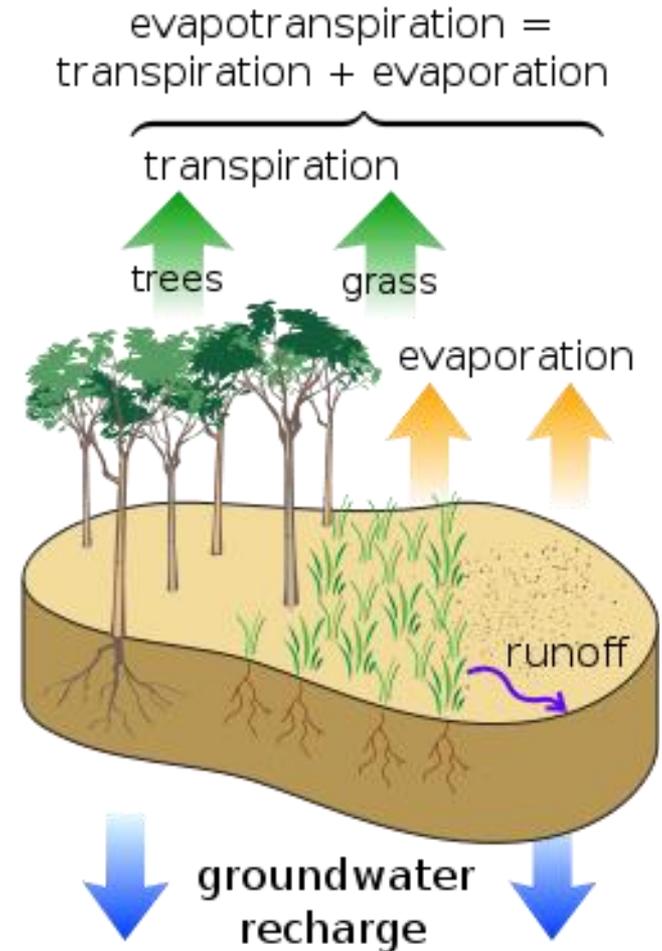
1 inch = 1,500 feet



Sharon, MA - 01946

Recharge

- ▶ A hydrologic process where water moves downward from the ground surface to groundwater. Recharge occurs both naturally and artificial groundwater recharge, where rainwater and/or reclaimed water (septic system wastewater) is routed to the subsurface.

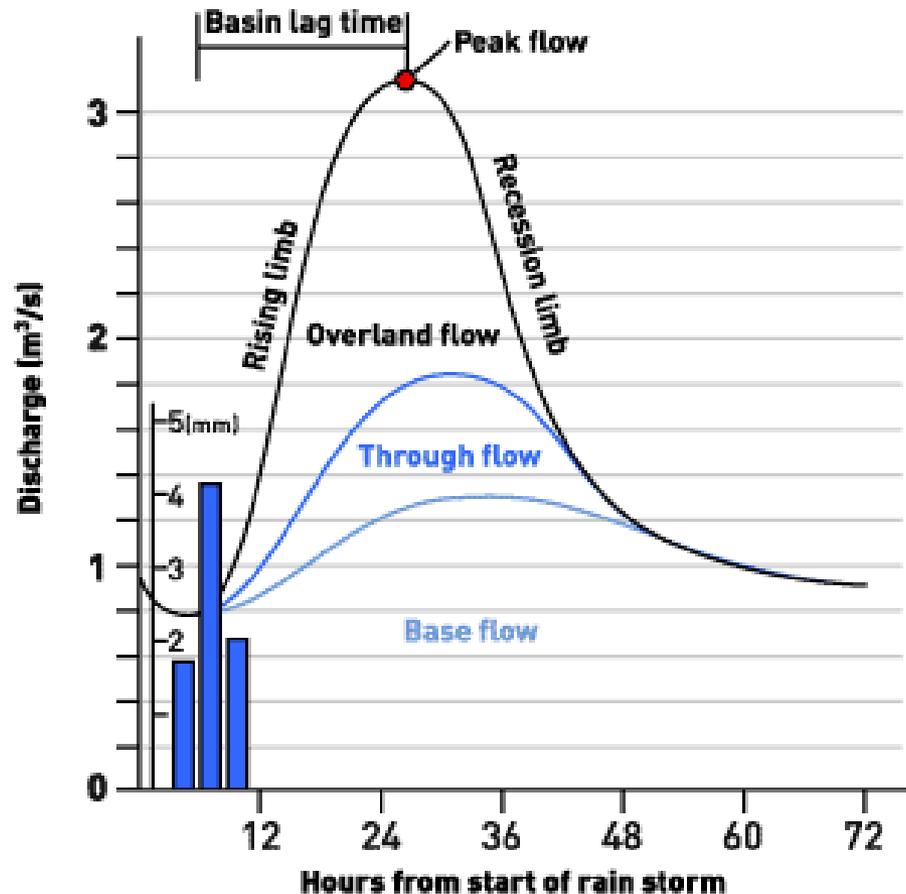


http://en.wikipedia.org/wiki/Groundwater_recharge

Flood Hydrograph

- ▶ A **hydrograph** is a graph showing the rate of flow (discharge) versus time past a specific point in a stream. The rate of flow is typically expressed in cubic feet per second (cfs).

<http://en.wikipedia.org/wiki/Hydrograph>

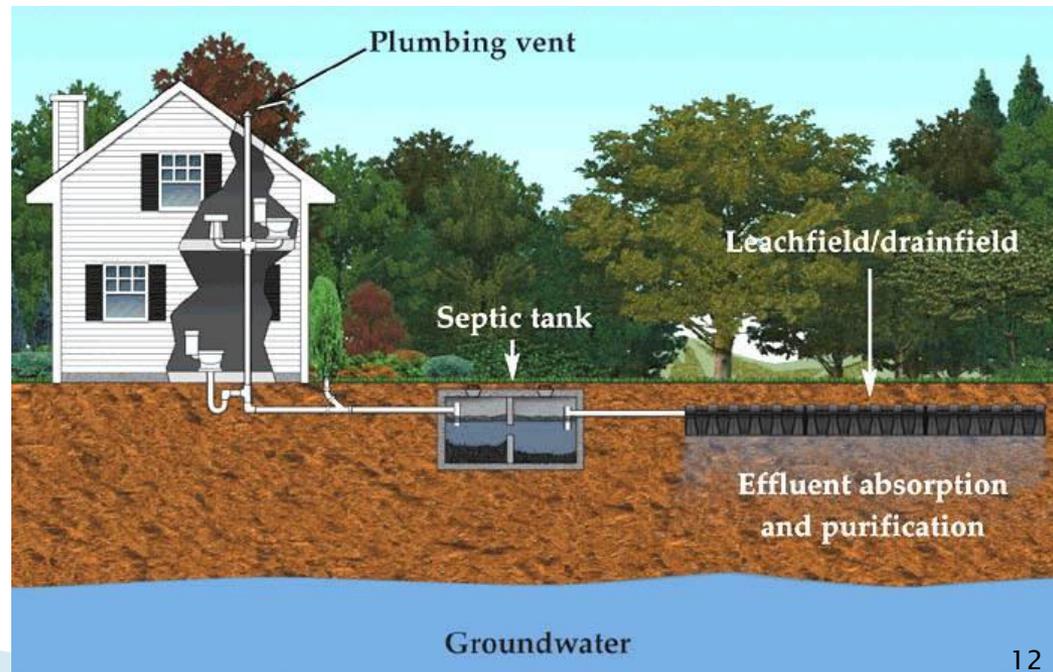


<http://www.bbc.co.uk/scotland/education/int/geog/rivers/hydrographs/>

Septic System

- ▶ A small-scale sewage treatment system generally comprised of a septic tank, a distribution box and leaching drain field. A key component is that the leaching field is located above the water table.

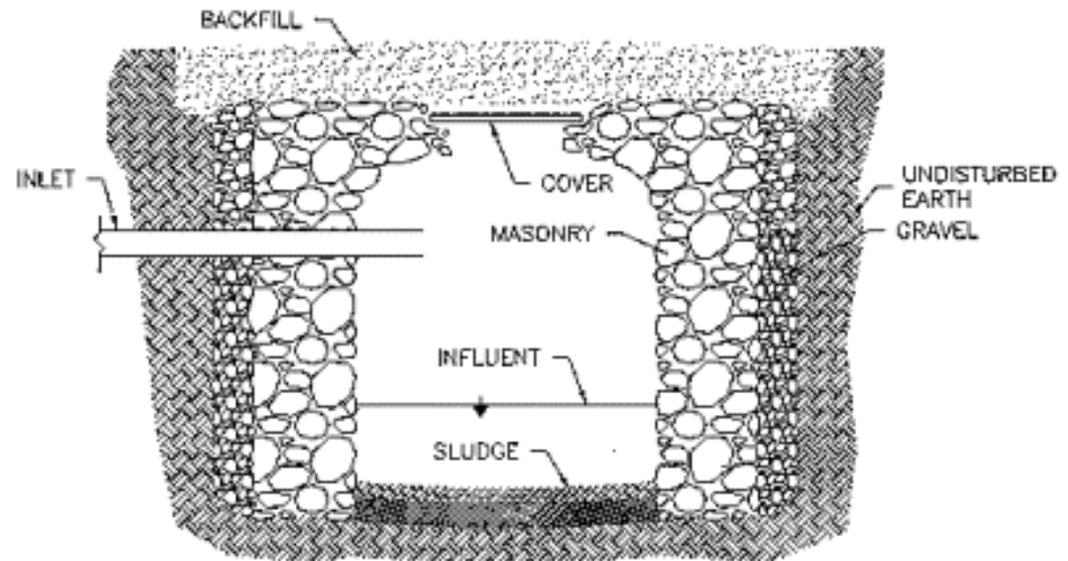
http://en.wikipedia.org/wiki/Septic_tank



Cess Pool

- ▶ A **cesspit**, or **cesspool**, is a pit, or covered cistern which can be used to dispose of sewage. It is a more antiquated solution than a sewer or septic system. Traditionally, it was a deep cylindrical chamber dug into the earth. A key difference is that a cesspool is in groundwater.

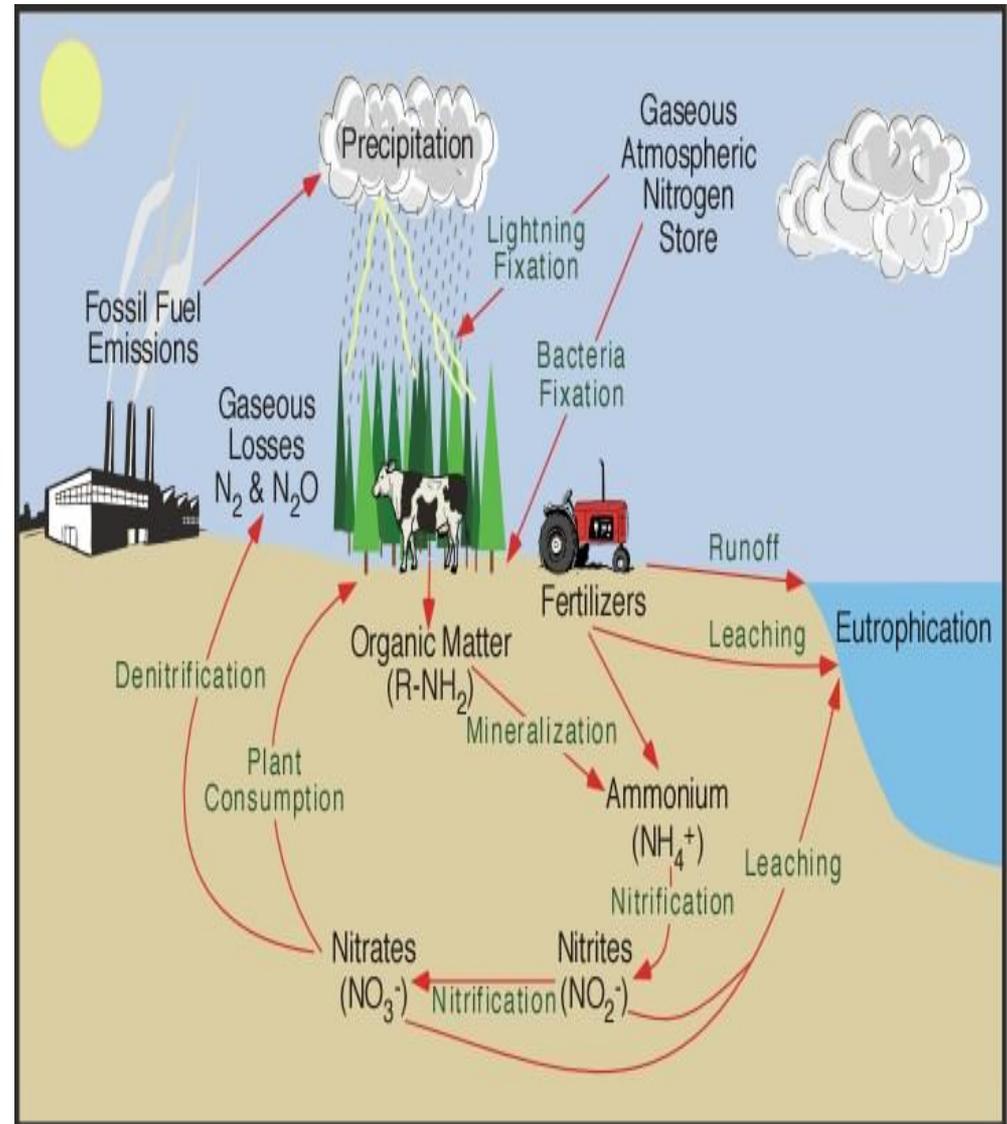
<http://en.wikipedia.org/wiki/Cesspit>



Nitrogen Cycle

- ▶ The **nitrogen cycle** is the process by which **nitrogen** is converted between its various chemical forms through both biological and physical processes. Important processes in the nitrogen cycle include **fixation**, **ammonification**, **nitrification**, and **denitrification**.

http://en.wikipedia.org/wiki/Nitrogen_cycle



Spring-fed Lake

- ▶ To varying degrees many, if not most lakes receive some water from ground water sources or are "spring fed." When swimming, one might notice colder, localized areas or areas of the lake might remain open along the shoreline during winter. Both are likely due to ground water flowing into the lake.

<http://www.dnr.state.mn.us/lakes/faqs.html>

Lake Massapoag



Lake Turnover

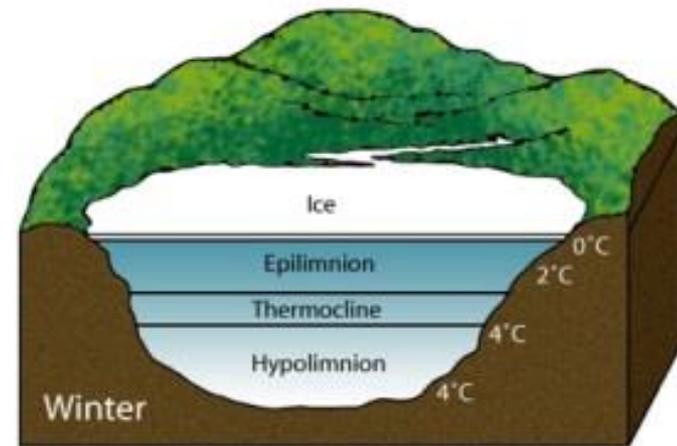
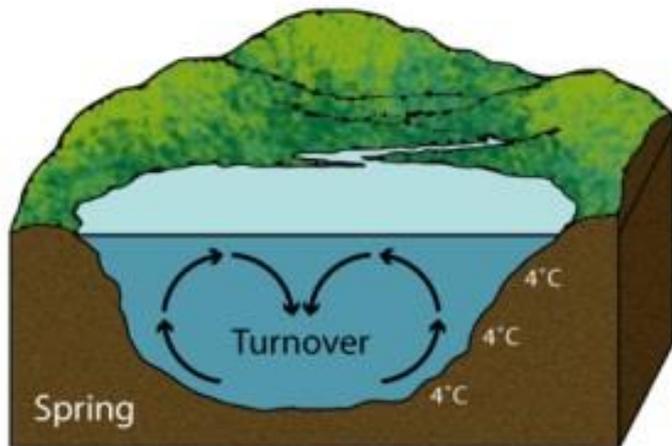
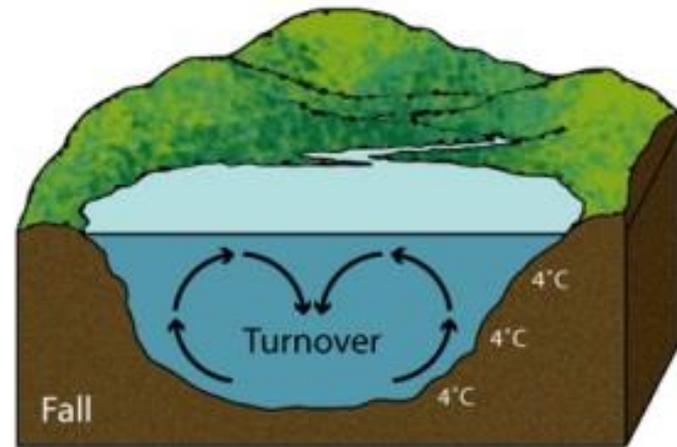
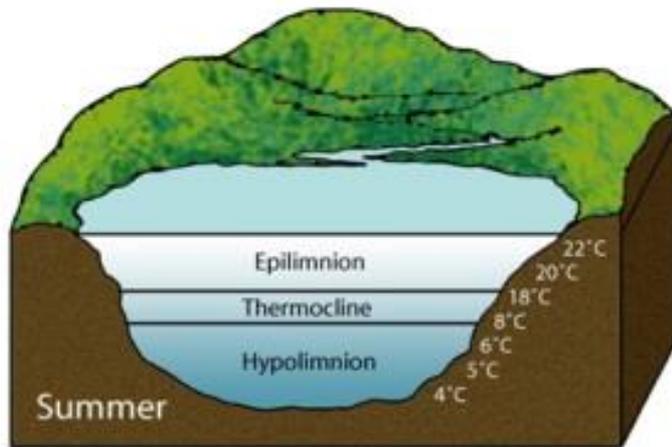
- ▶ Lake turnover is the process of a lake's water turning over from top (epilimnion) to bottom (hypolimnion). During the summer, the epilimnion, or surface layer, is the warmest. It is heated by the sun. The deepest layer, the hypolimnion, is the coldest. The sun's radiation does not reach this cold, dark layer.

During the fall, the warm surface water begins to cool. As water cools, it becomes more dense, causing it to sink. This dense water forces the water of the hypolimnion to rise, "turning over" the layers.

During spring, the process reverses itself. This time ice melts, and surface waters warm and sink until the water temperature at all depths reaches approximately 39° F. The sinking combined with wind mixing causes spring "turnover."

http://education.nationalgeographic.com/education/media/lake-turnover/?ar_a=1

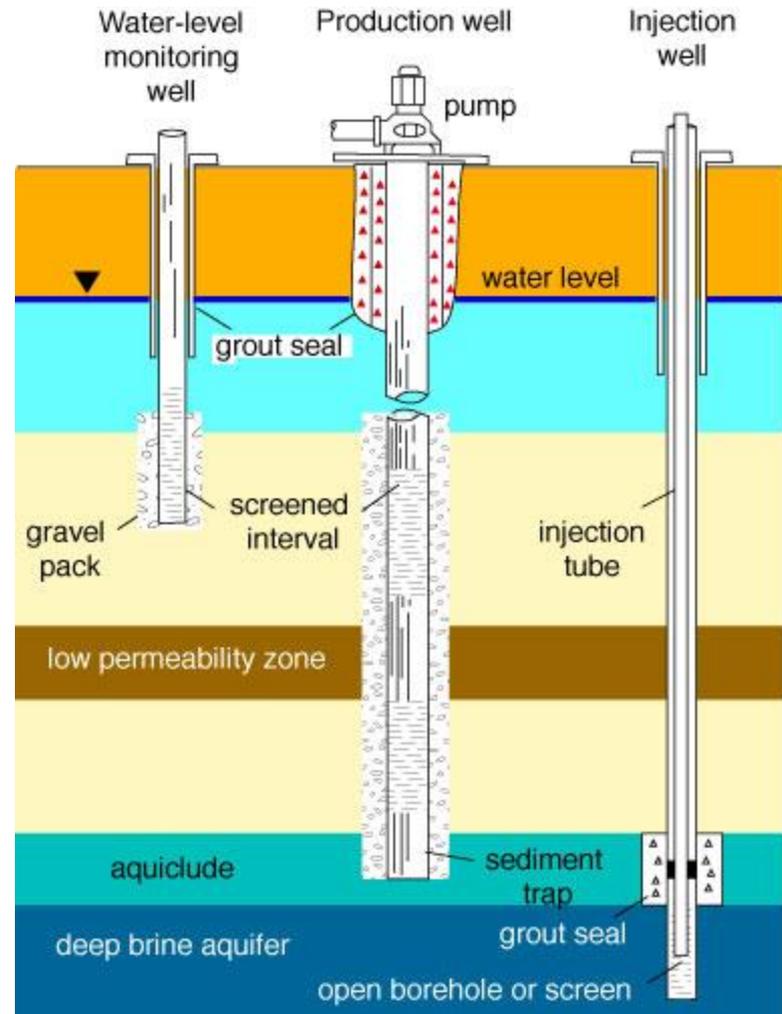
Lake Turnover



http://education.nationalgeographic.com/education/media/lake-turnover/?ar_a=1

Municipal Water Well

- ▶ A **water well** is an excavation or structure created in the ground by digging, driving, boring, or drilling to access groundwater in underground aquifers.



http://en.wikipedia.org/wiki/Water_well

http://www.kgs.ku.edu/Publications/Bulletins/ED10/06_wells.html

Wellhead Protection Areas

- ▶ **Zone I**

The protective radius required around a public water supply well or wellfield, generally 400 feet.

- ▶ **Zone II**

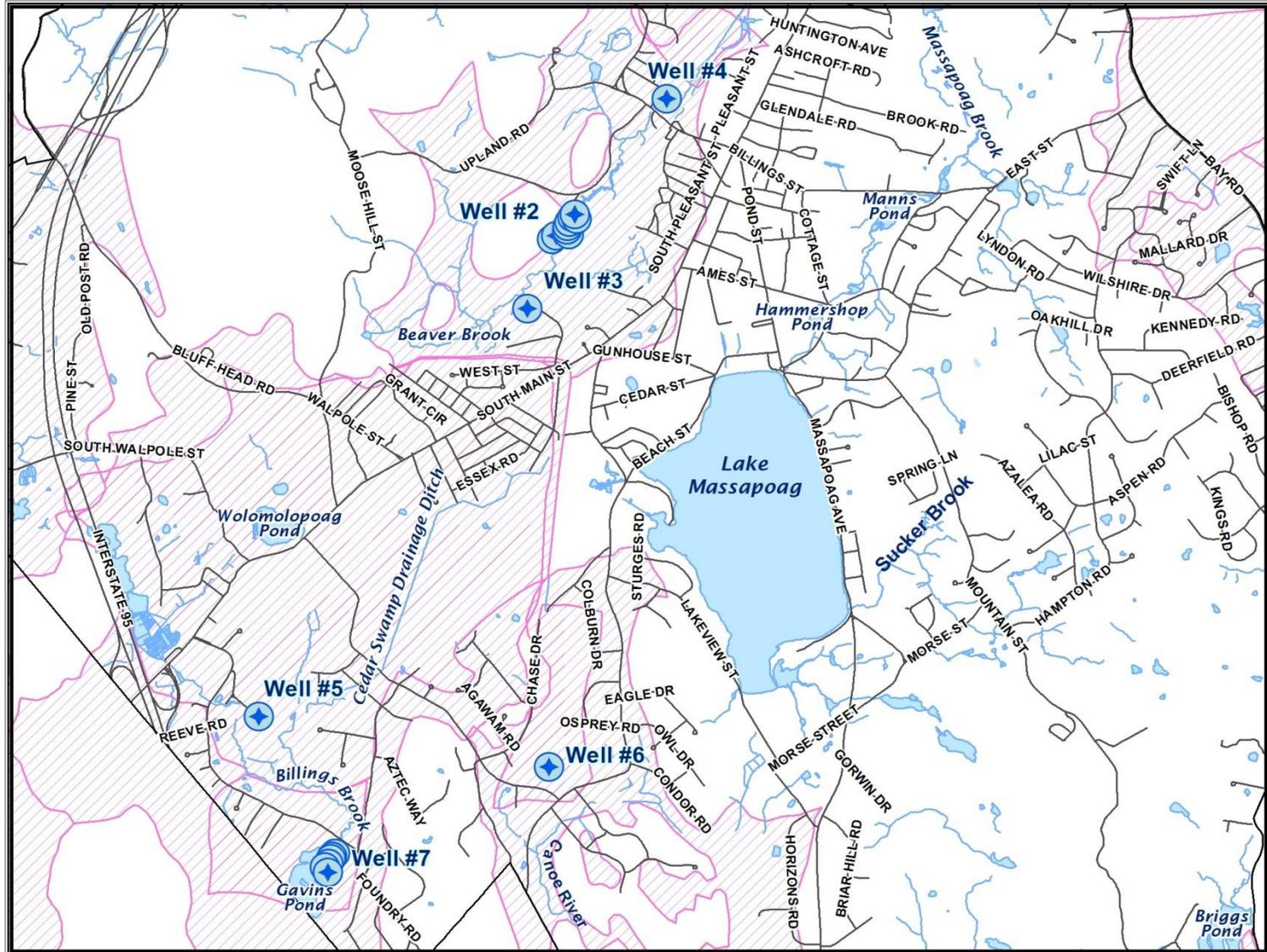
That area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at approved yield, with no recharge from precipitation.)

- ▶ **Zone III**

The land area beyond the area of Zone II from which surface water and groundwater drain into Zone II. The surface drainage area as determined by topography is commonly coincident with the groundwater drainage area and will be used to delineate Zone III.

<http://www.mass.gov/eea/docs/dep/service/regulations/310cmr22.pdf>

Sharon Municipal Wells



Natural Resource Management

- ▶ **Natural resource management** refers to the management of natural resources for both present and future generations (stewardship).
- ▶ Site and landscape factors strongly influence whether a given environmental feature will provide a particular function (e.g., trap nutrients) and whether that function will generate a service (e.g., improved water quality, improved fishing) and how much economic value that service will have (e.g., willingness to pay for more fishing opportunities).

http://en.wikipedia.org/wiki/Natural_resource_management

<http://www.ecosystemvaluation.org/Indicators/economvalind.htm>

Operating Policy

- ▶ Hueristic – Experience and knowledge gained over time.
- ▶ Stationarity – natural systems are expected to fluctuate, but within an unchanging and defined envelope.
- ▶ Mathematical Modeling.

Statistical Analysis

- ▶ Mathematical Modeling
- ▶ Optimization
- ▶ Stochastic (Statistical) Hydrology

Rainfall

- ▶ *Technical Report No. 40 Rainfall Frequency Atlas (TR40, 1961)*
- ▶ *Extreme Precipitation in New York and New England (v 1.12, 2013)*

Flood Planning

- ▶ Flood Routing
- ▶ FEMA

Drought Planning

- ▶ Reservoir Operations
- ▶ Release Minimums

Climate Change

- ▶ Rainfall Intensity Changes
- ▶ Drought Planning
- ▶ Flood Planning