



# Geology/Hydrogeology

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# Aquifer Definition:

A geologic formation that contains, transmits and yields a sustainable quantity of water relative to withdrawals and available recharge, such that the needs of its competing users are continually met.



# Aquifer:

## Three fundamental Concepts

1. Volume of water in Storage (Porosity)
  - [volume or percentage]
2. Hydraulic Conductivity (K)
  - How easily groundwater moves through the formation
3. Sufficient Recharge
  - If a formation is not sufficiently replenished relative to demand, nothing else really matters.

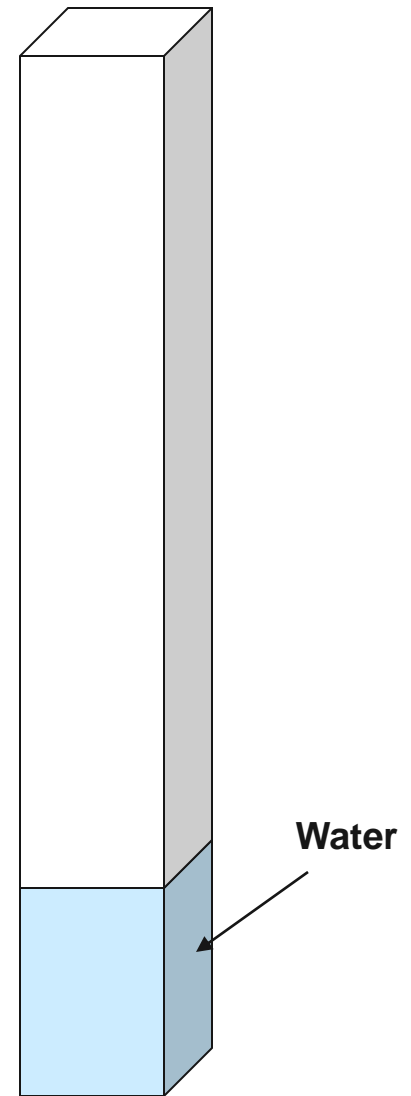
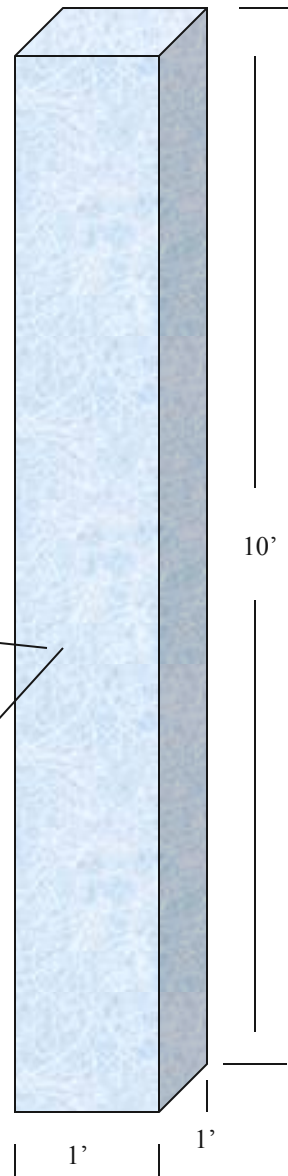
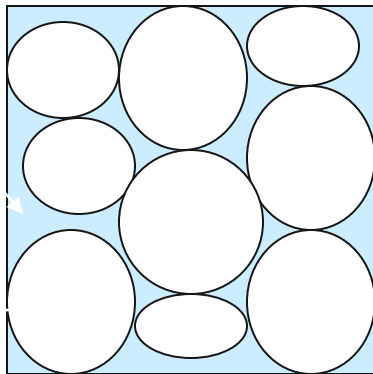
1, 2 and 3 sets the benchmark for a “Sustainable Yield” determination of an aquifer.

# Groundwater storage in stratified-drift deposits

10 cubic feet of well sorted, saturated sand with 20% porosity could store 2.0 cubic feet of water!

Pore space filled with water

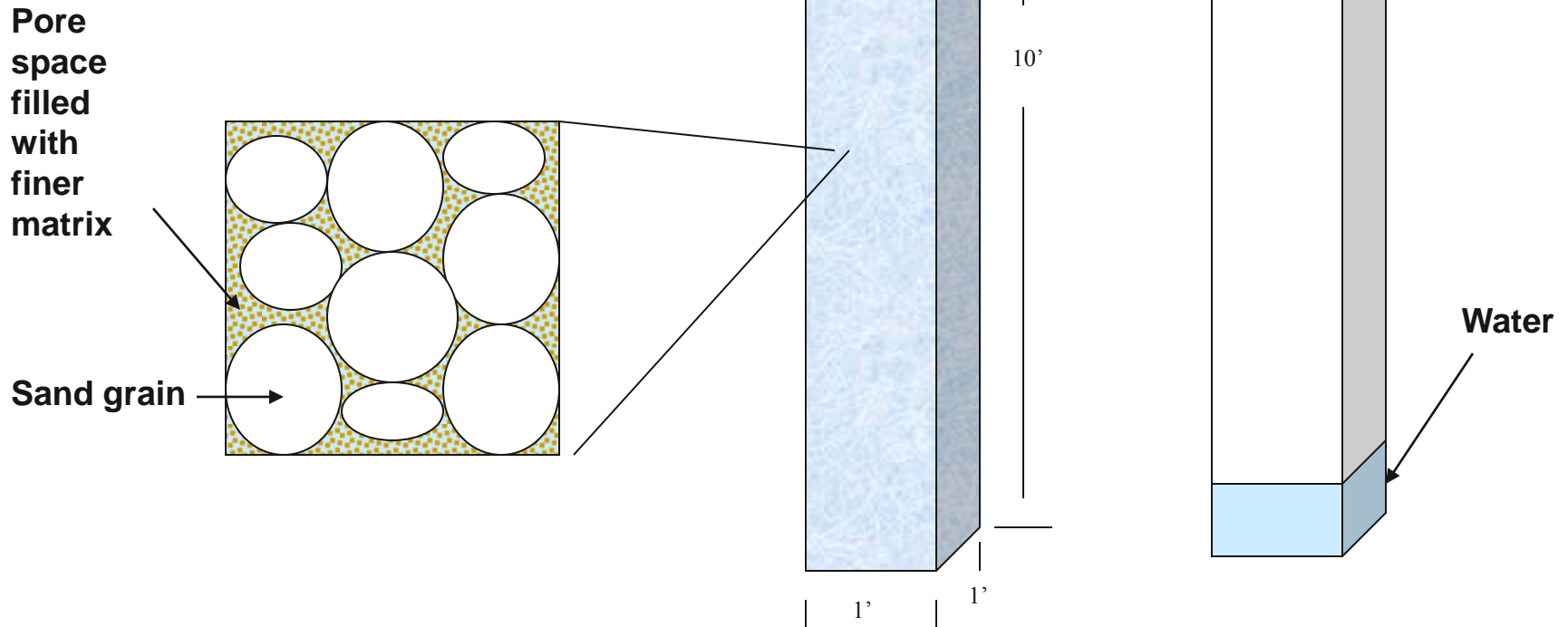
Sand grain



(NHGS, 2002)

# Groundwater storage in stratified-drift deposits

10 cubic feet of well sorted, saturated sand with 10% porosity could store 1.0 cubic feet of water!

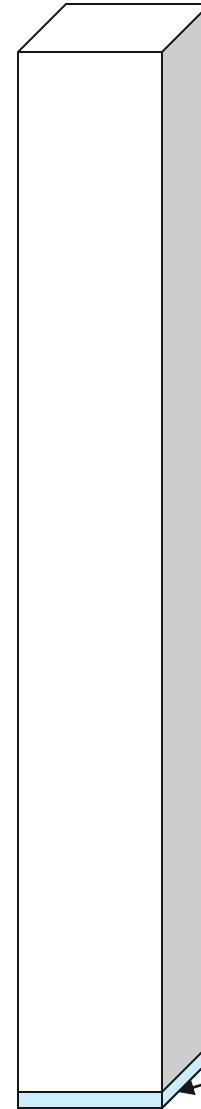
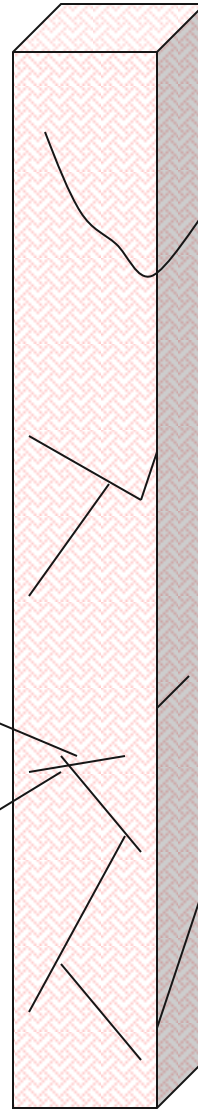
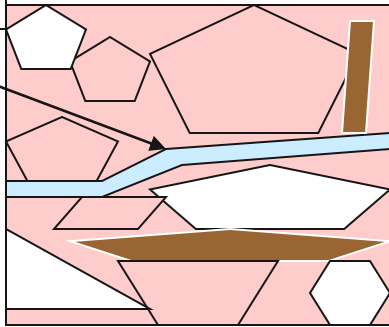


(NHGS, 2002)

# Groundwater storage in crystalline bedrock

10 cubic feet of fractured, saturated granite with 2 % porosity could only store 0.2 cubic feet of water

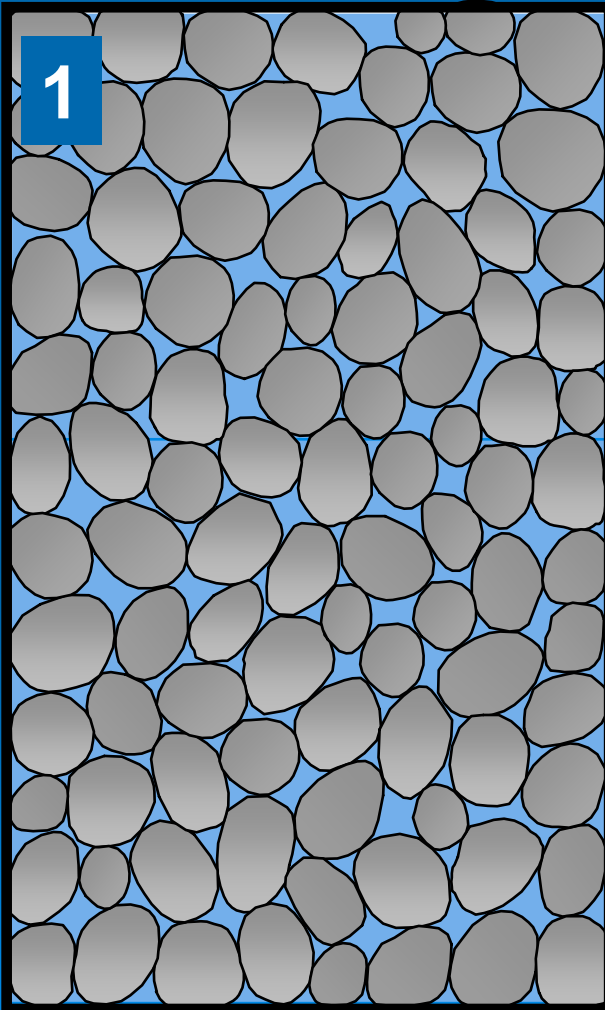
Fracture  
containing water



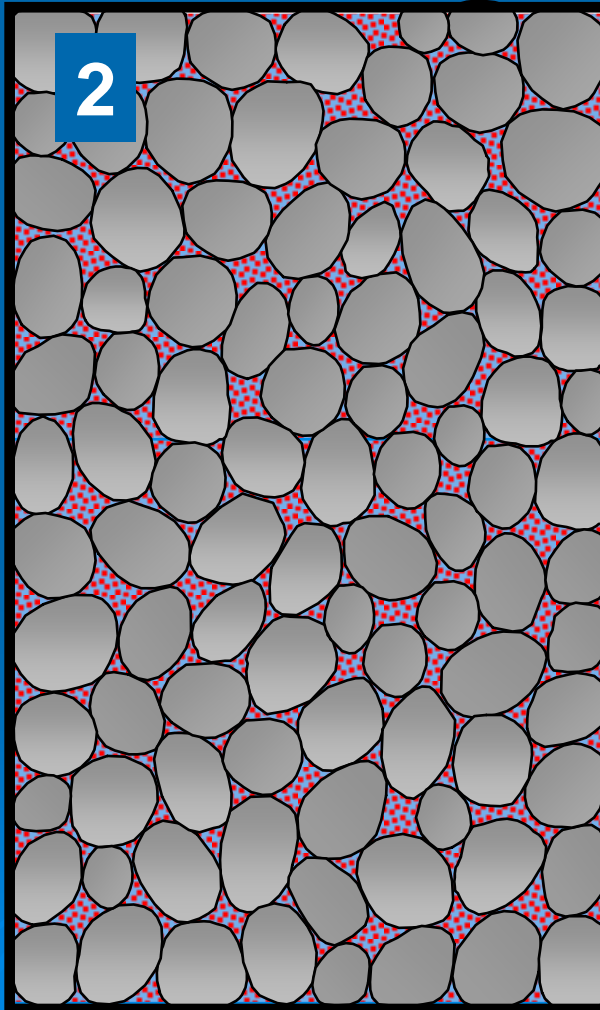
(NHGS, 2002)

# Hydraulic Conductivity - Granular Media Examples

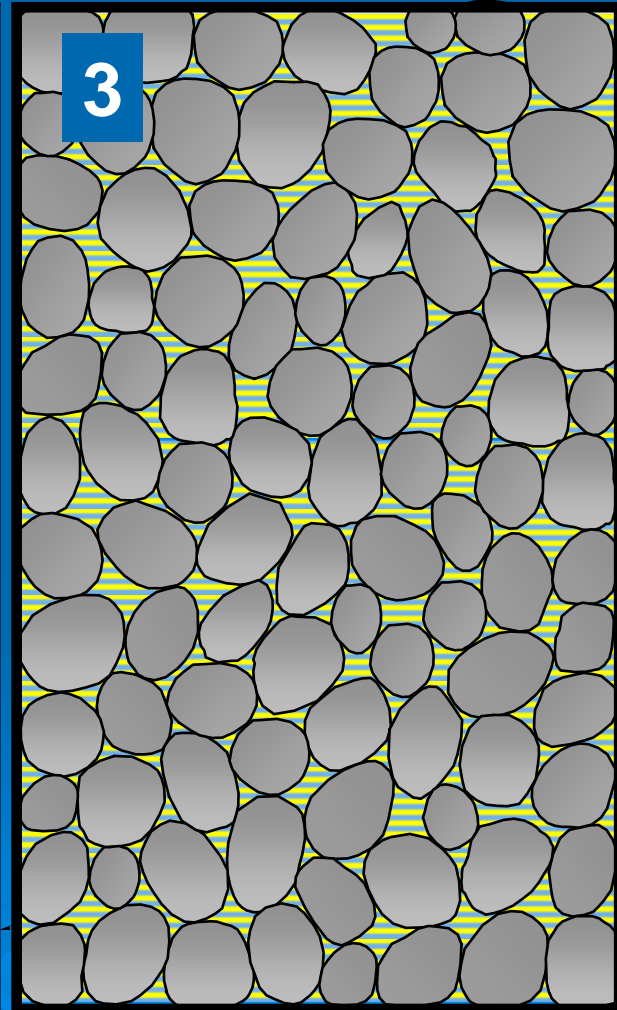
$K^1$



$K^1 > K^2$

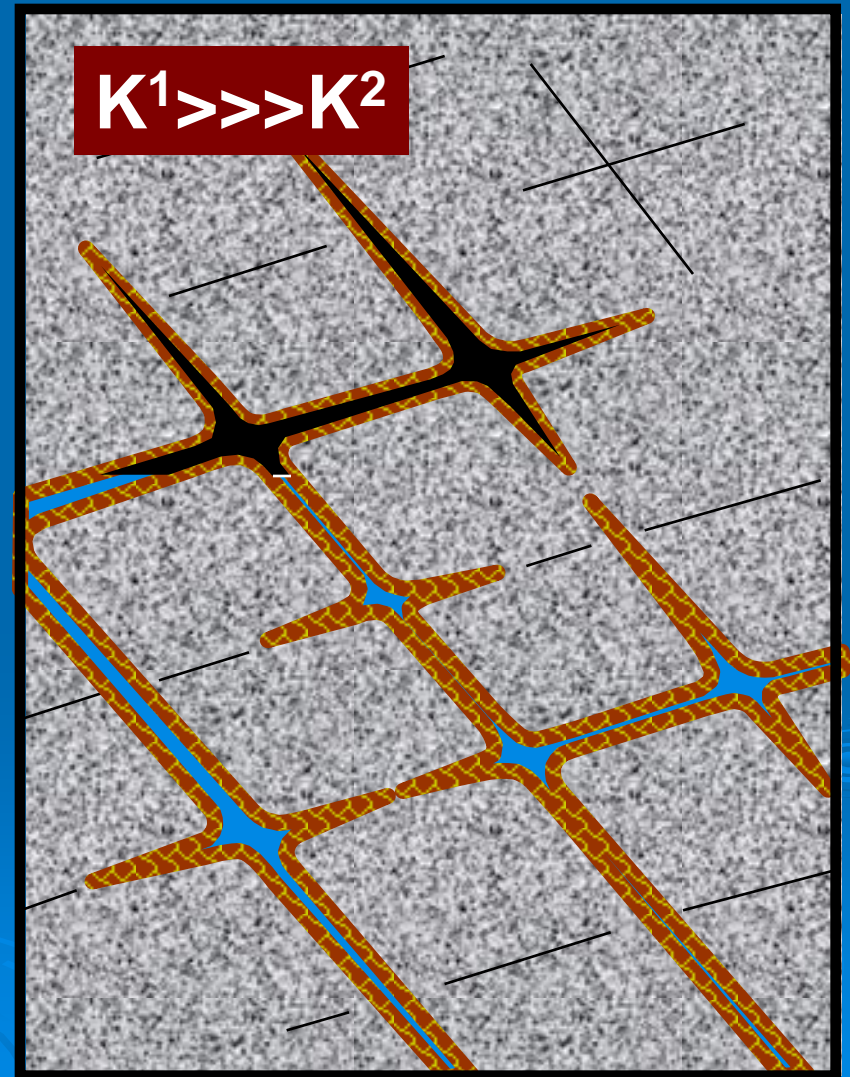
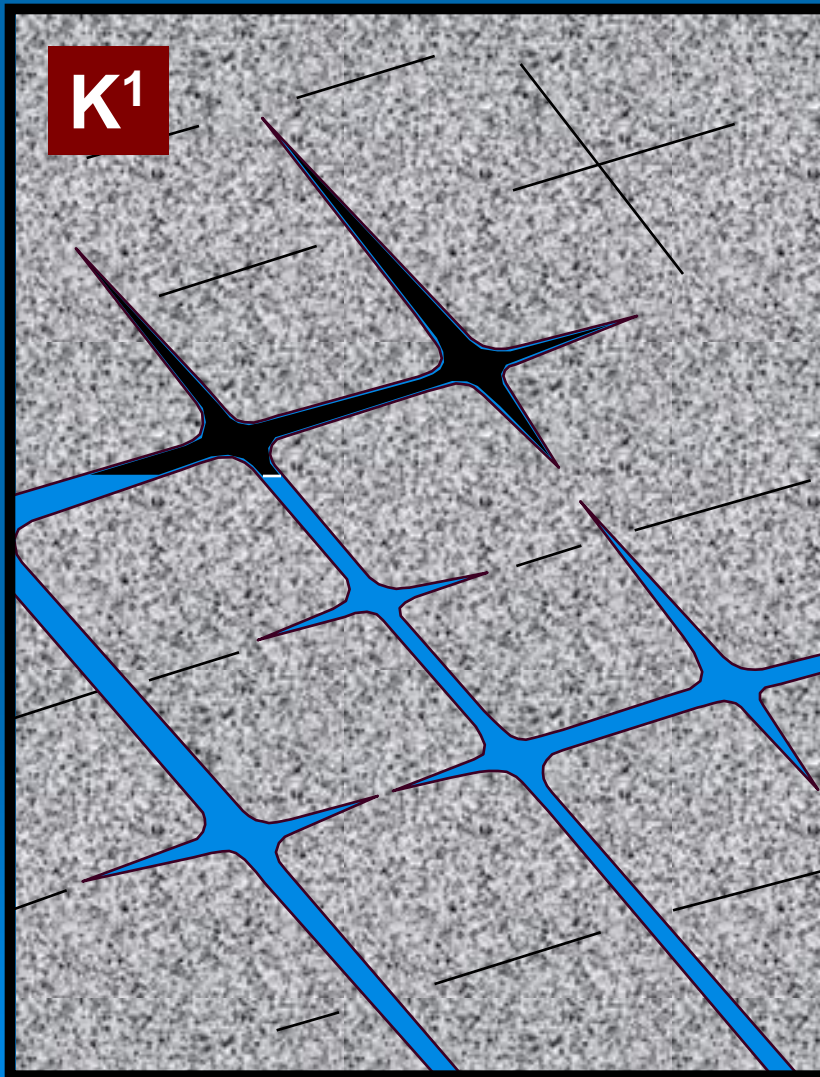


$K^2 > K^3$



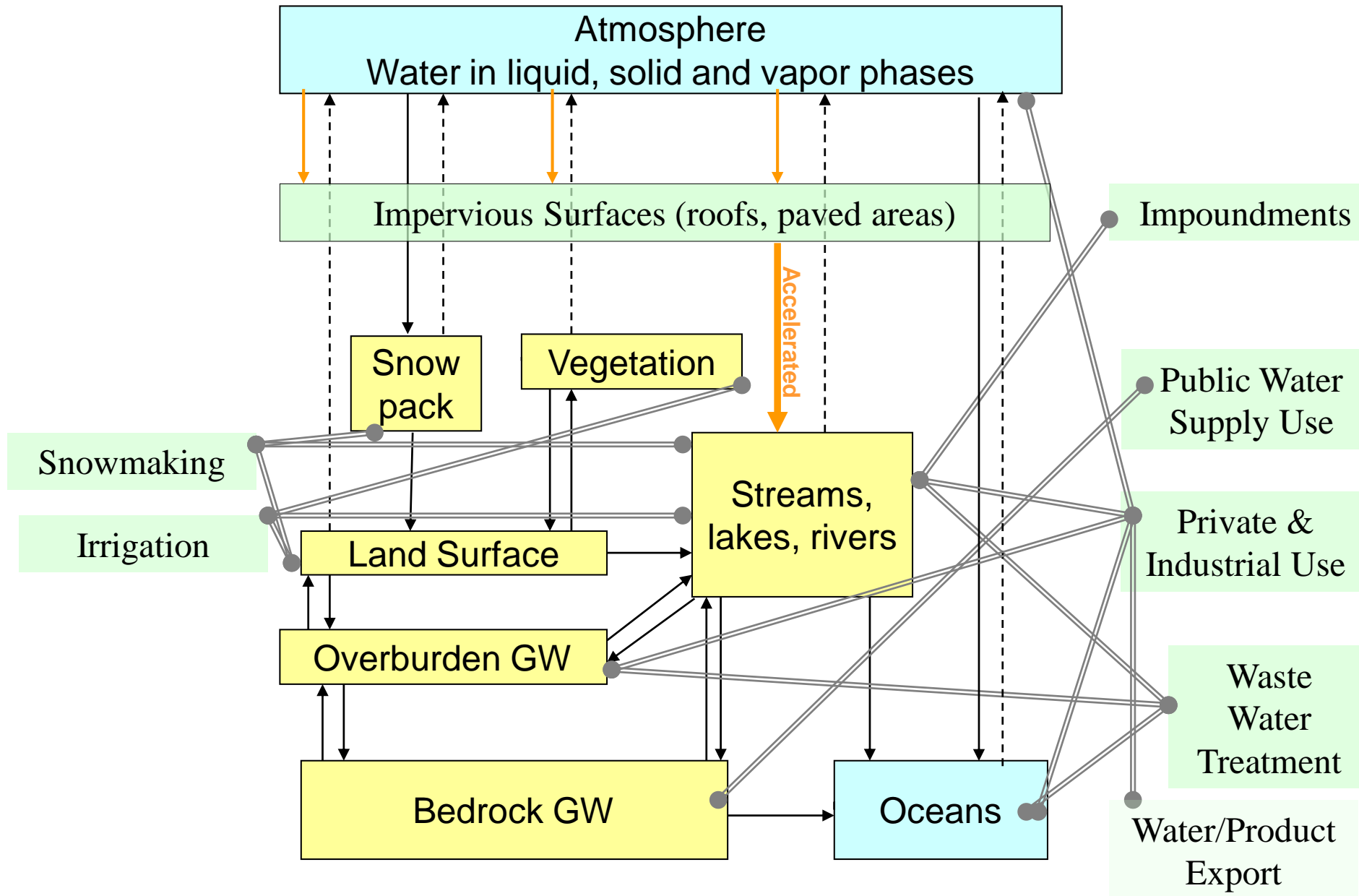


# Hydraulic Conductivity - Fractured Bedrock Examples



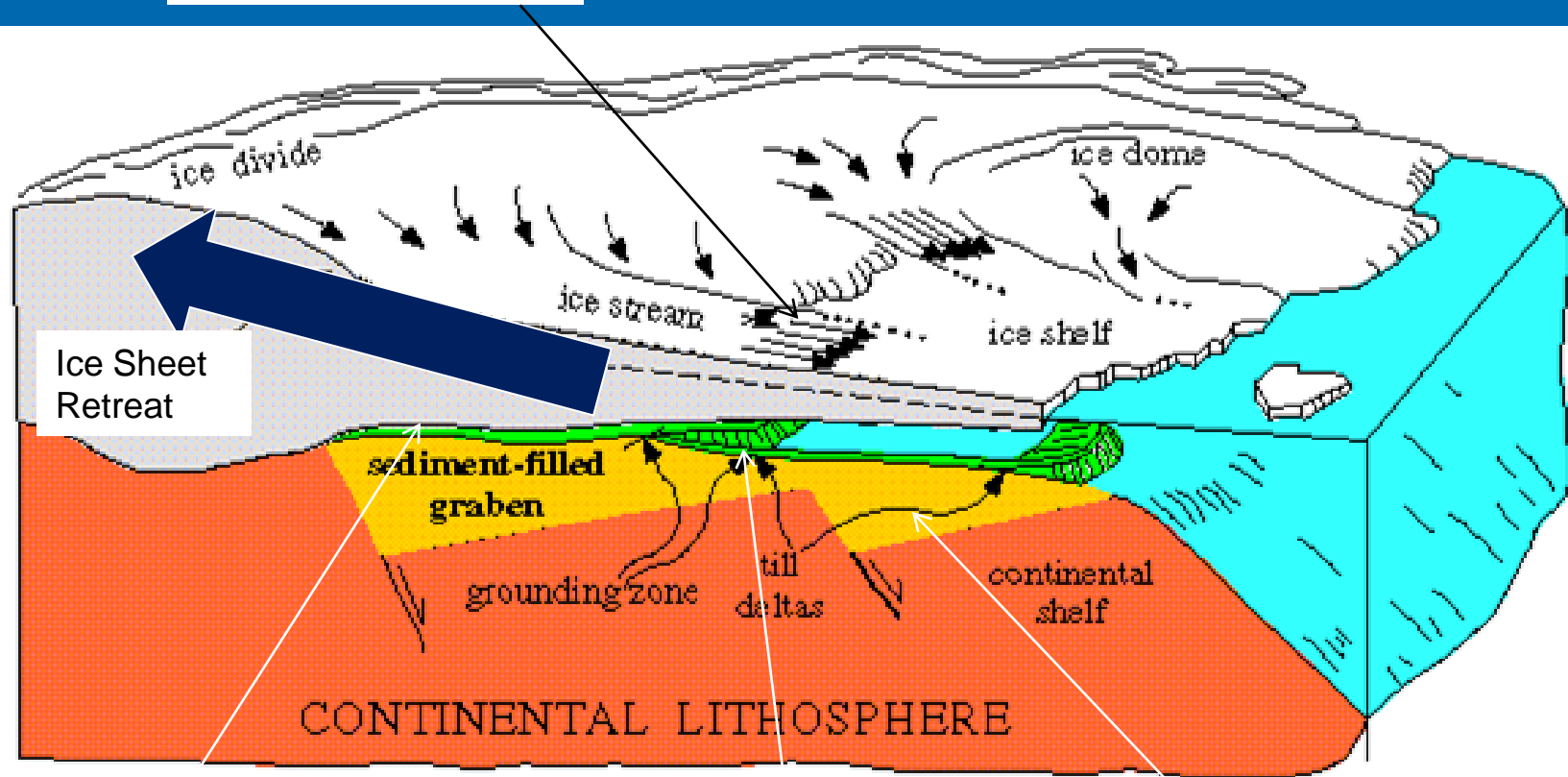


# RECHARGE : Generalized Hydrologic Cycle with Human Influence



# NH Coastal Landforms

Glacial Outwash /  
Meltout deposits



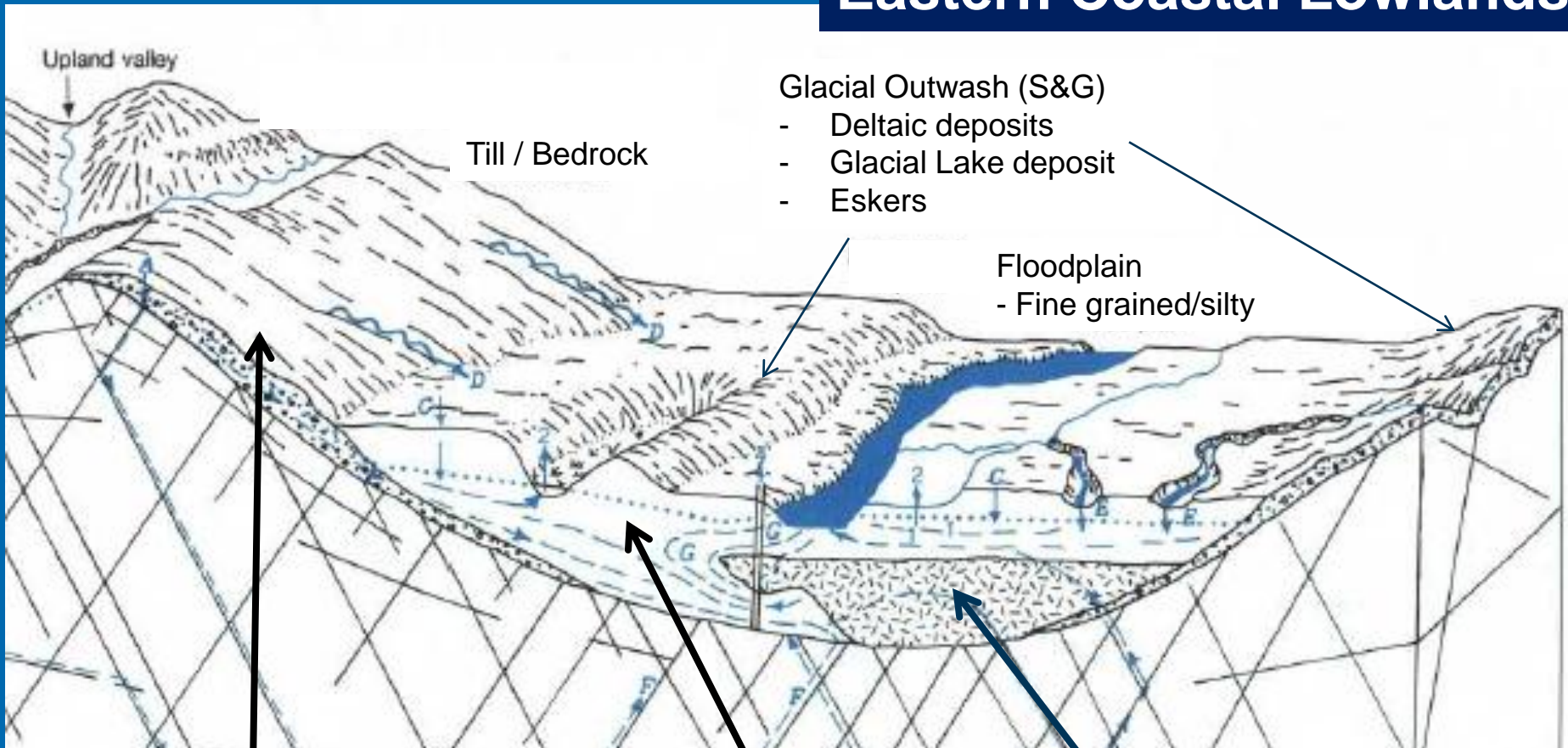
Ice Contact Deposits

Glacioestuarine,  
fluvial, lacustrine  
deposits

Shallow Marine Deposits

Src. Umaine/Geology

# Eastern Coastal Lowlands



## Glacial Till

- Thin and dense unit
- Clay to boulder range

## Stratified Drift

- Sands
- Sand and Gravels
- Glacioestuarine

## Glacial Outwash (S&G)

- Deltaic deposits
- Glacial Lake deposit
- Eskers

## Floodplain

- Fine grained/silty

## Marine Deposits

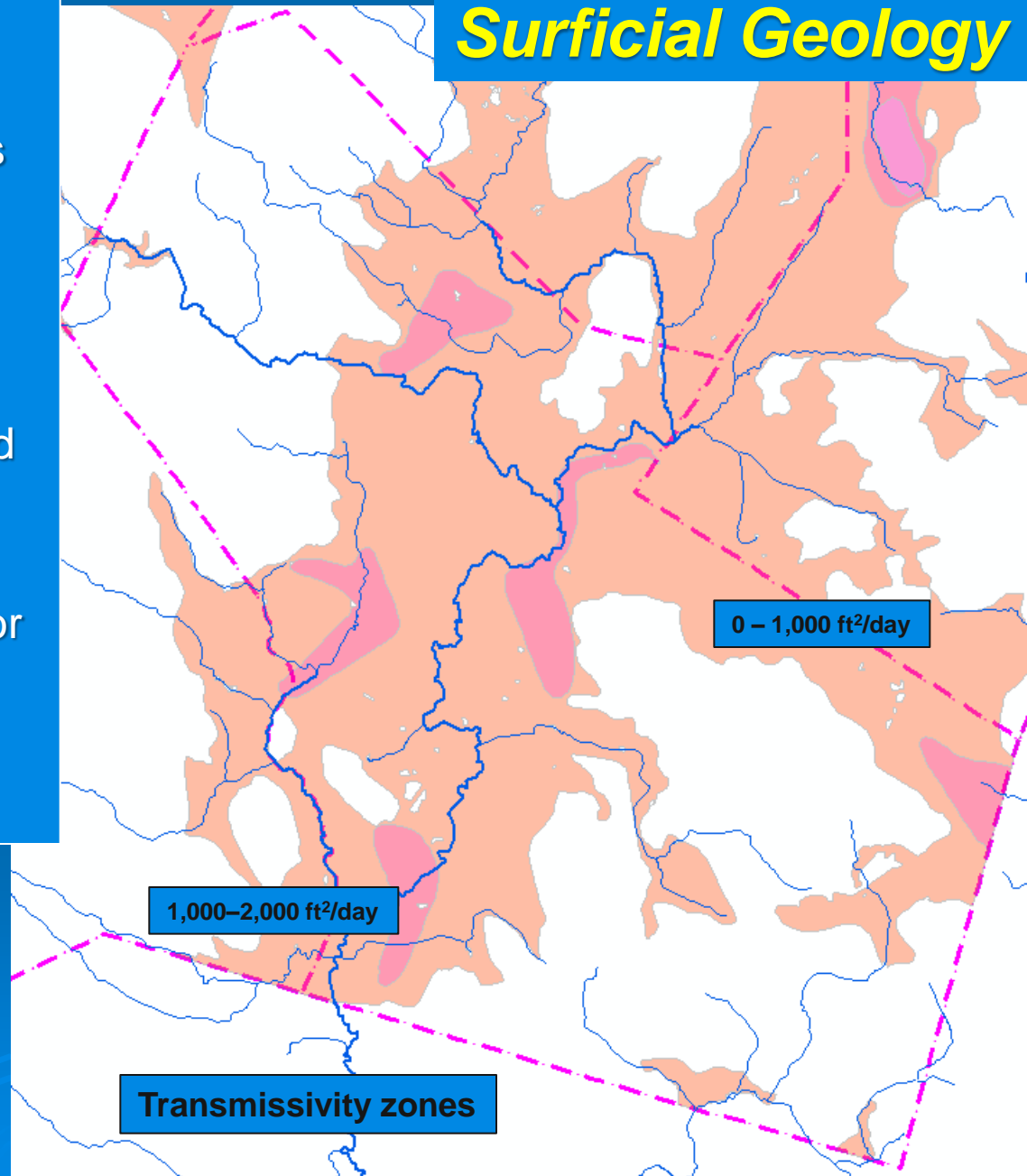
- Silts and Clays
- Sand and Silt

**Presumpscot Formation**

# USGS Stratified Drift Study

- Completed in early 1990s
- Defined areas of stratified sands and gravels that may be locally significant aquifers
- Used existing data, surveys and well drilling program
- Generated statewide reports and maps of predominant surficial deposits
- Maps generally starting points for more detailed regional studies
- Maps routinely use by municipalities in overlay districts

## *Surficial Geology*





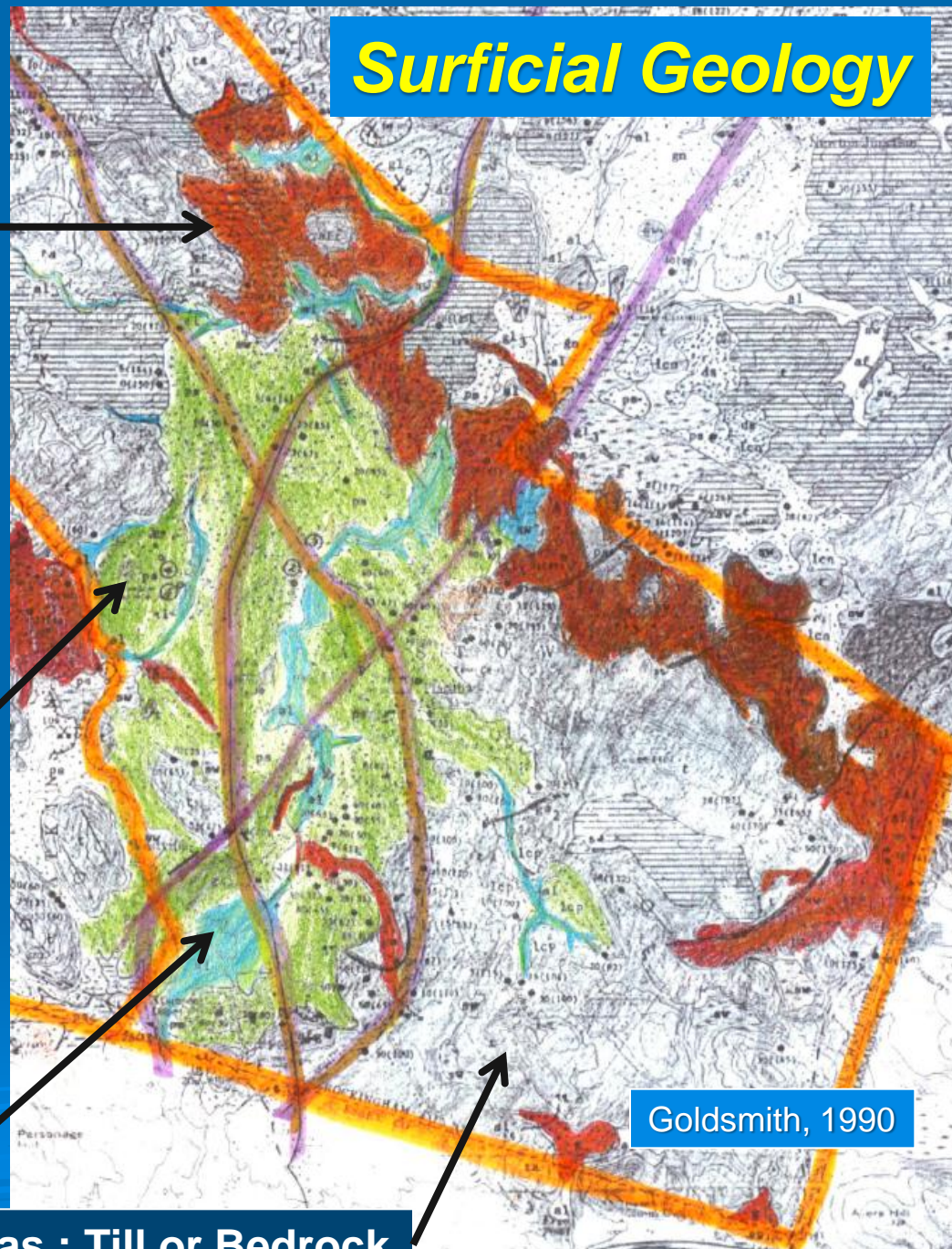
# Surficial Geology

Fine to Coarse Sand and Gravel along eastern portion of town. Largest esker in study area. Varies in saturation and thickness: Many areas <20 feet, some greater. (glacial outwash sands mixed with deltaic deposits, sometimes underlain Presumpscot Formation silts/clays)

Sand/Silt that gets grades to silt/clay – till at depth. Varies thickness : 20 to 40+/- feet (sandy member of **Presumpscot Formation** overlying silt/clay member)

Blue areas : Floodplain deposits

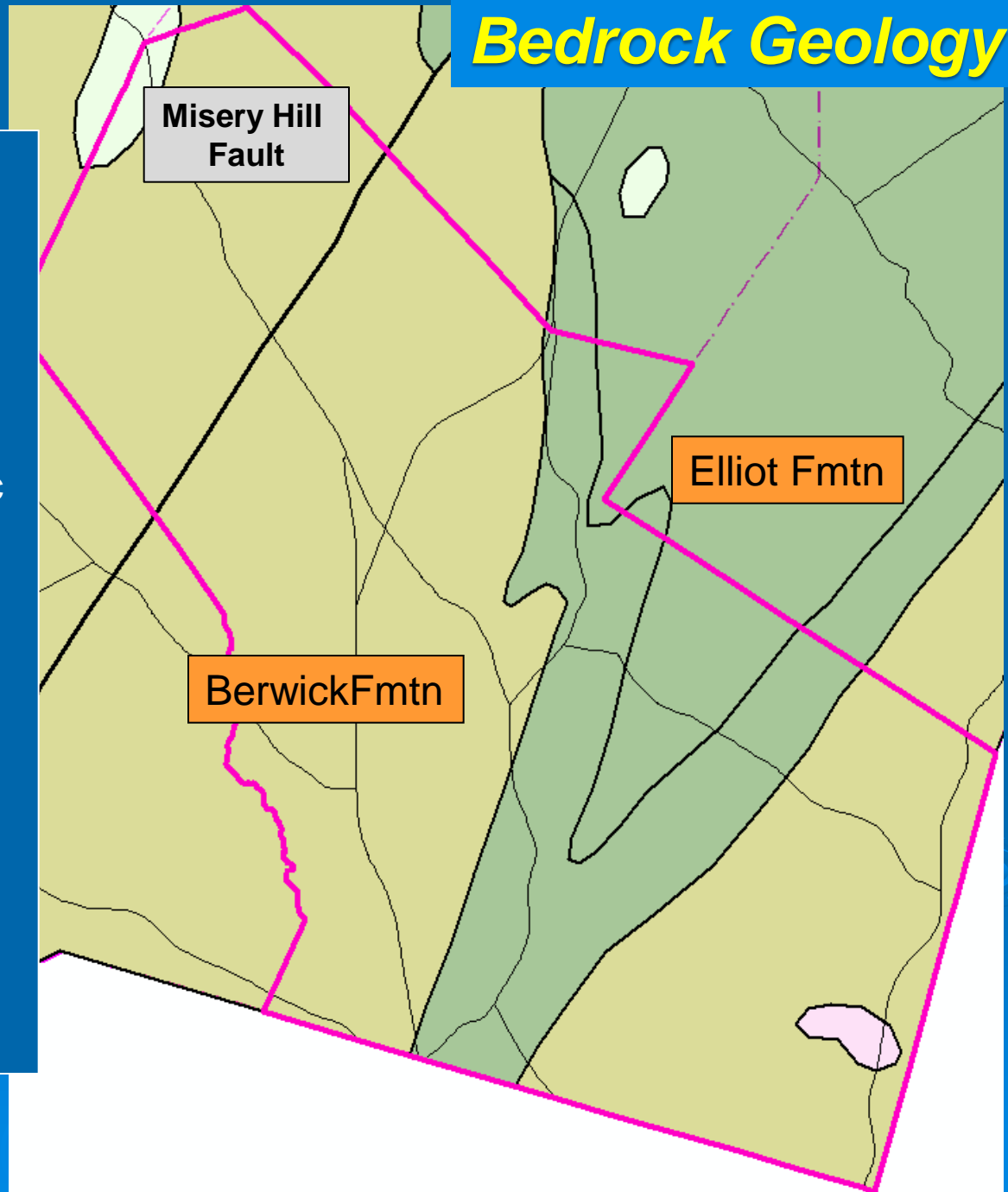
White areas : Till or Bedrock



## Bedrock Geology

### Bedrock Geology

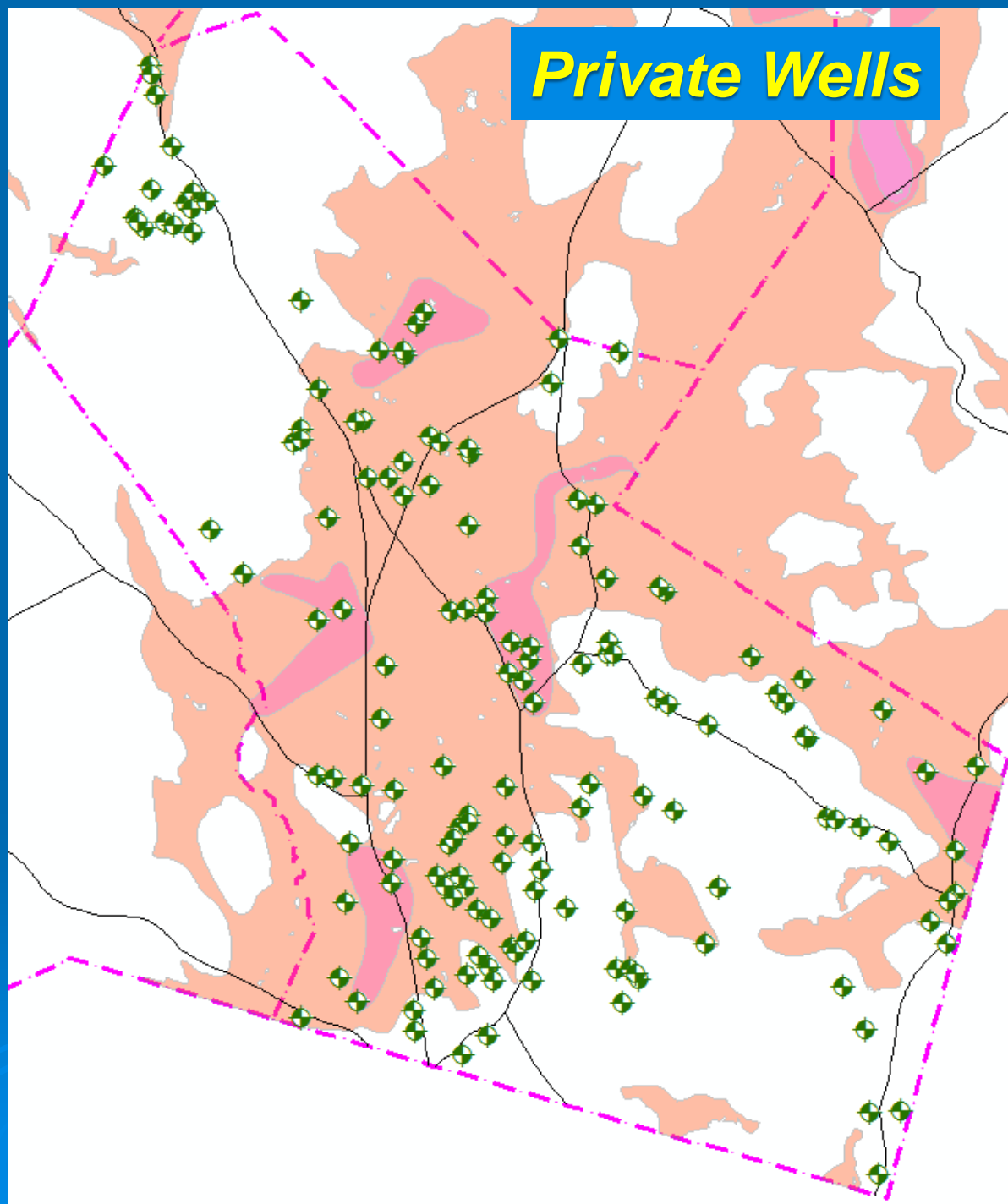
- Region is part of 'Merrimack Trough'
- Bedrock is dominated by a calc-rich Phyllite or Granitic Phyllite : a moderate grade metamorphic rock that is somewhere between a slate and mica.
- Dense, platy, folded rock with locally limited transmissive capacity
- Berwick Formation
- Elliot Formation



## Well Construction / Driller's Records

- Submitted starting 1984
- Statewide database
- Records info like:
  - Location-address
  - Total Depth
  - Casing
  - Yield estimate
  - Bedrock depth
  - Type (dom/comm)
  - Reason for

**Private Wells**

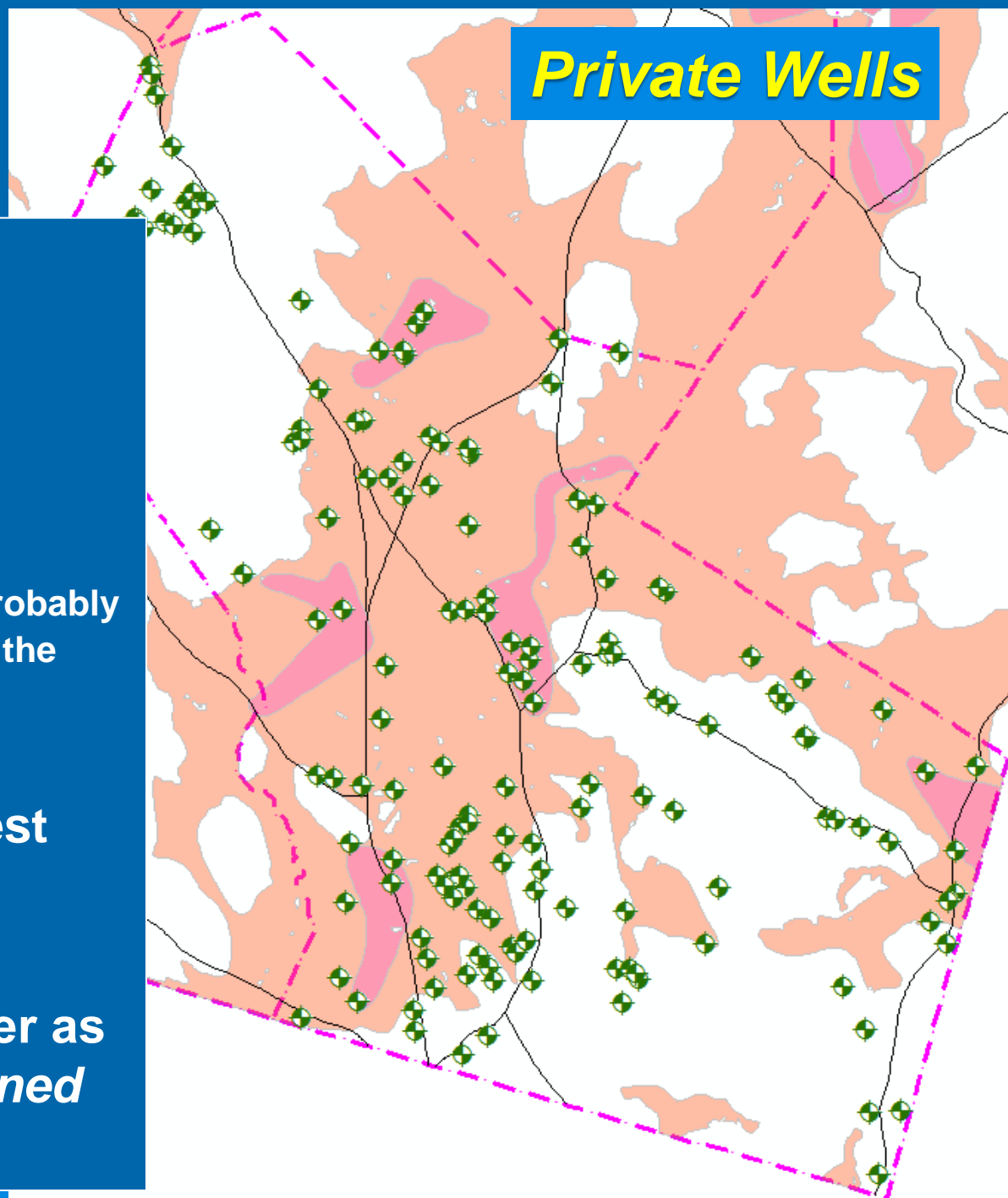




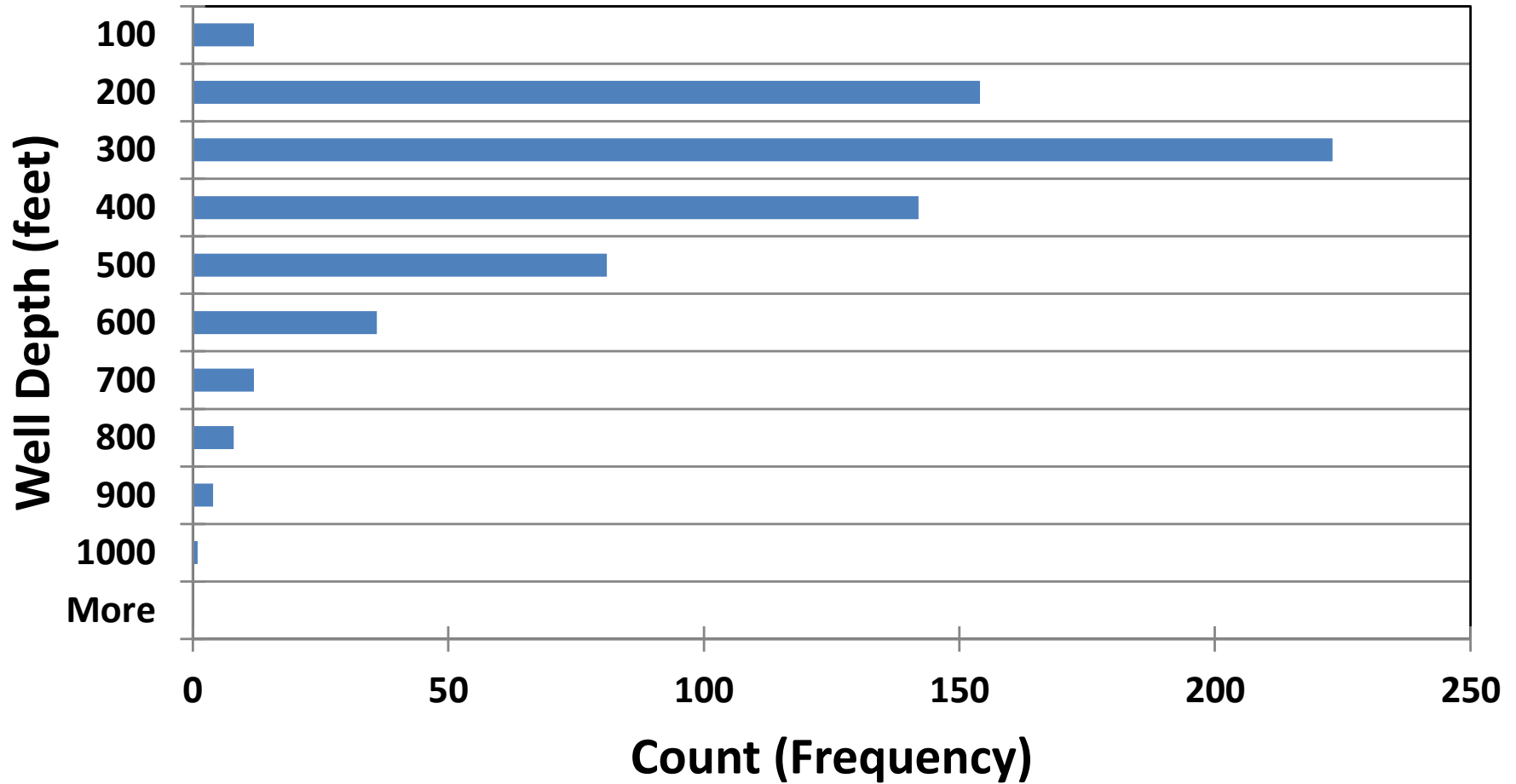
## Private Wells

### Plaistow Well Construction Record Statistics

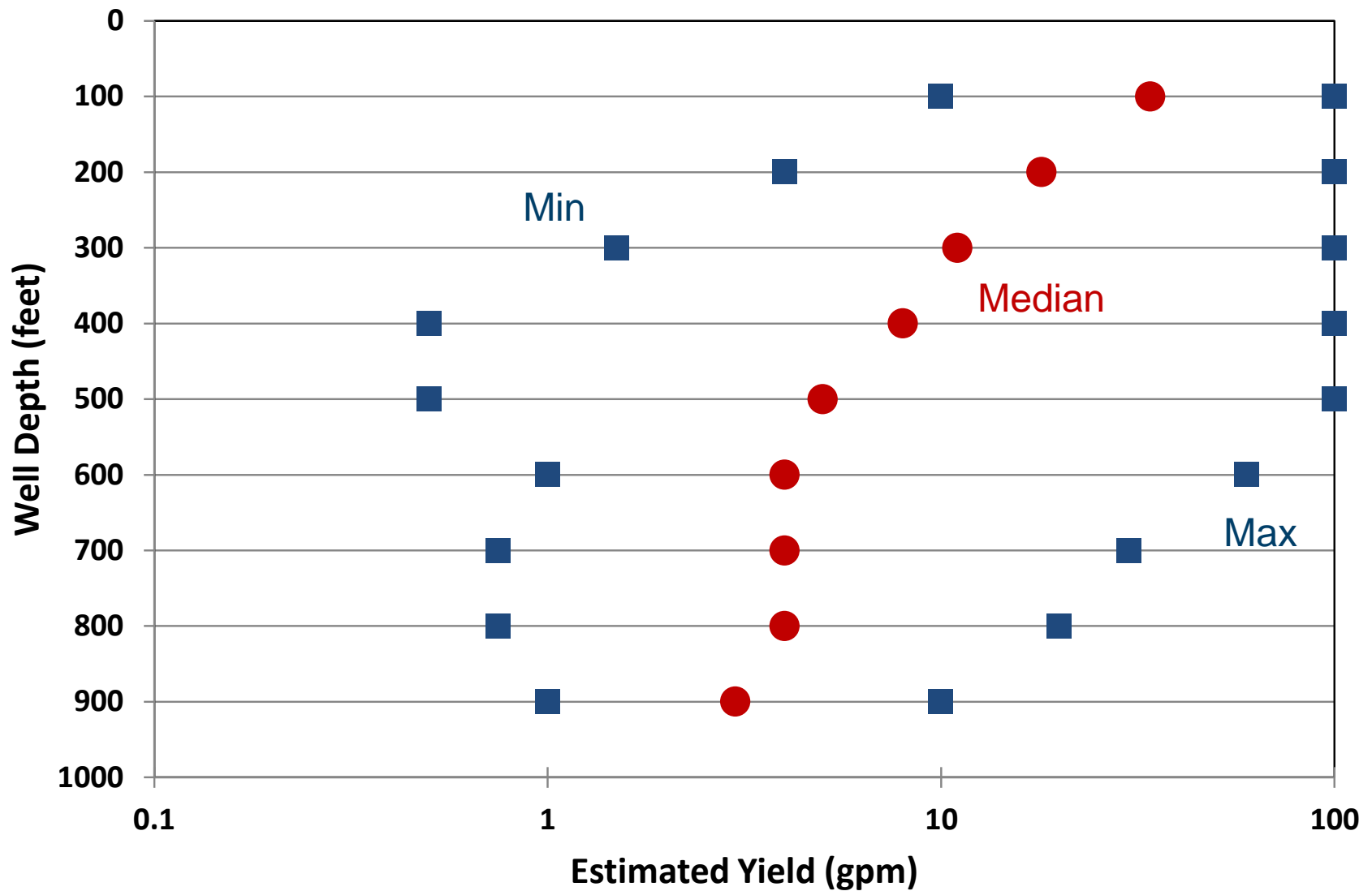
- 824 Total Records
- 681 Domestic Wells (probably represents about 30 to 40% of the private wells in town)
- Only 8 domestic wells identified as gravel, rest are drilled rock wells
- 187 identified under 'Reason' code by driller as *replacement or deepened* (~28%)



# Plaistow Private Well Depths



## Plaistow Private Well Yield Estimates



# Public Water Systems

Public Water System: a system of piped water for human consumption that serves at least 15 service connections or 25 people at least 60 days a year.

## Three Categories:

Community Water System (CWS): serves at least 15 service connections or 25 residents which use the system year round.

*20 active CWS in Plaistow – ex. Twin Ridge, Golden Hill, Rainbow Ridge*

Non-transient, Non-community Water System (NTNC): not a CWS but serves the same 25 or more people at least 60 days a year.

*16 active NTNC in Plaistow – ex. Pollard School, Timberlane, Market Basket*

Transient, Non-community Water System (TNC): not a CWS but serves at least 25 people in a transitory setting for at least 60 days a year.

*19 active TNC in Plaistow – ex. Dunkin Donuts Plaza, Plaistow F&G Club*

# Community Water Systems

Community Water System: serves at least 15 service connections or 25 residents which use the system year round.

## Three Types of CWS Ownership (generally):

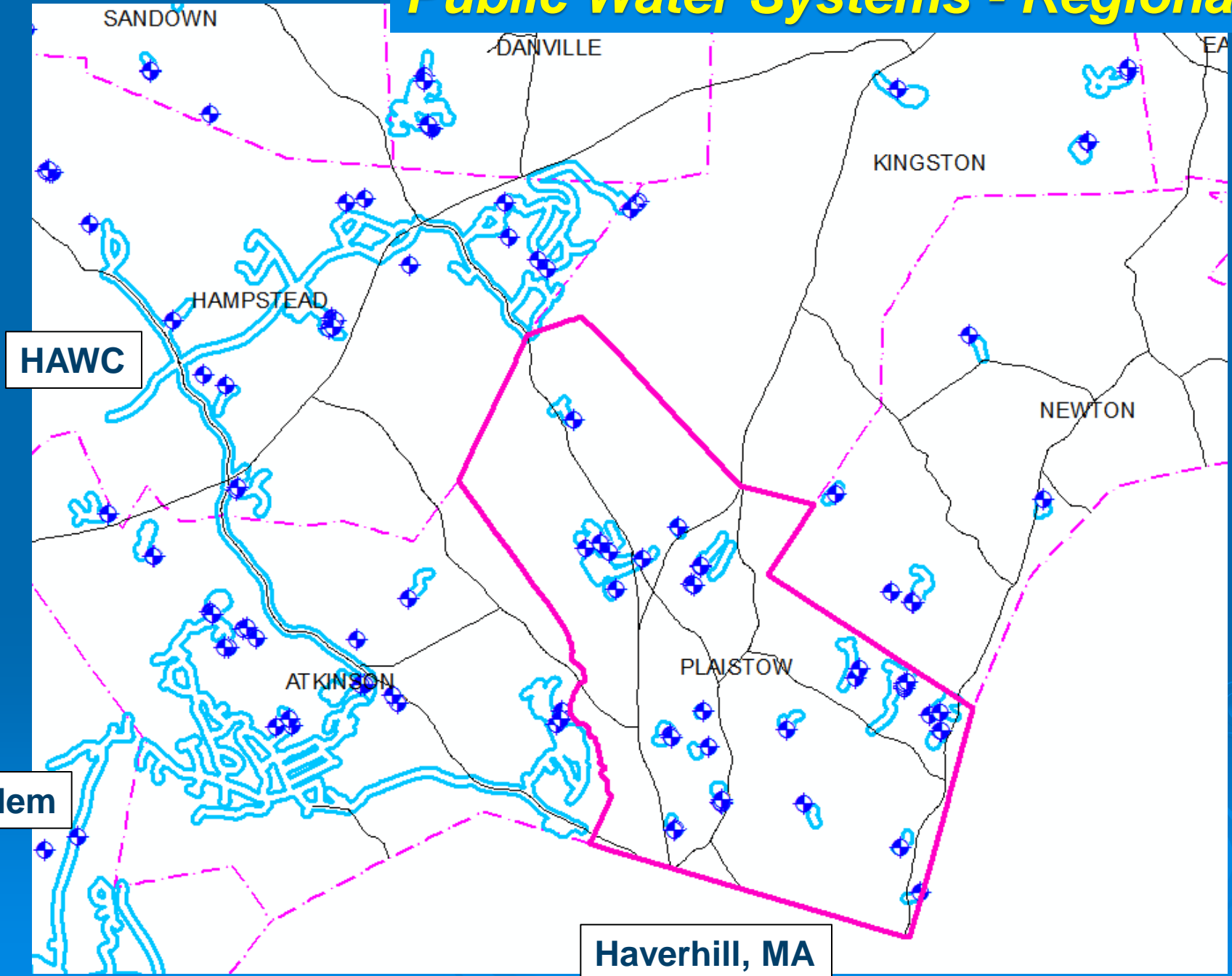
Local Government : Town/City, Village District, Village Precinct, etc.

Private Association : Condo/Homeowners Association, Apartment Owner

Privately Owned Regulated Public Utility: Pennichuck WW, HAWC, Aquarion

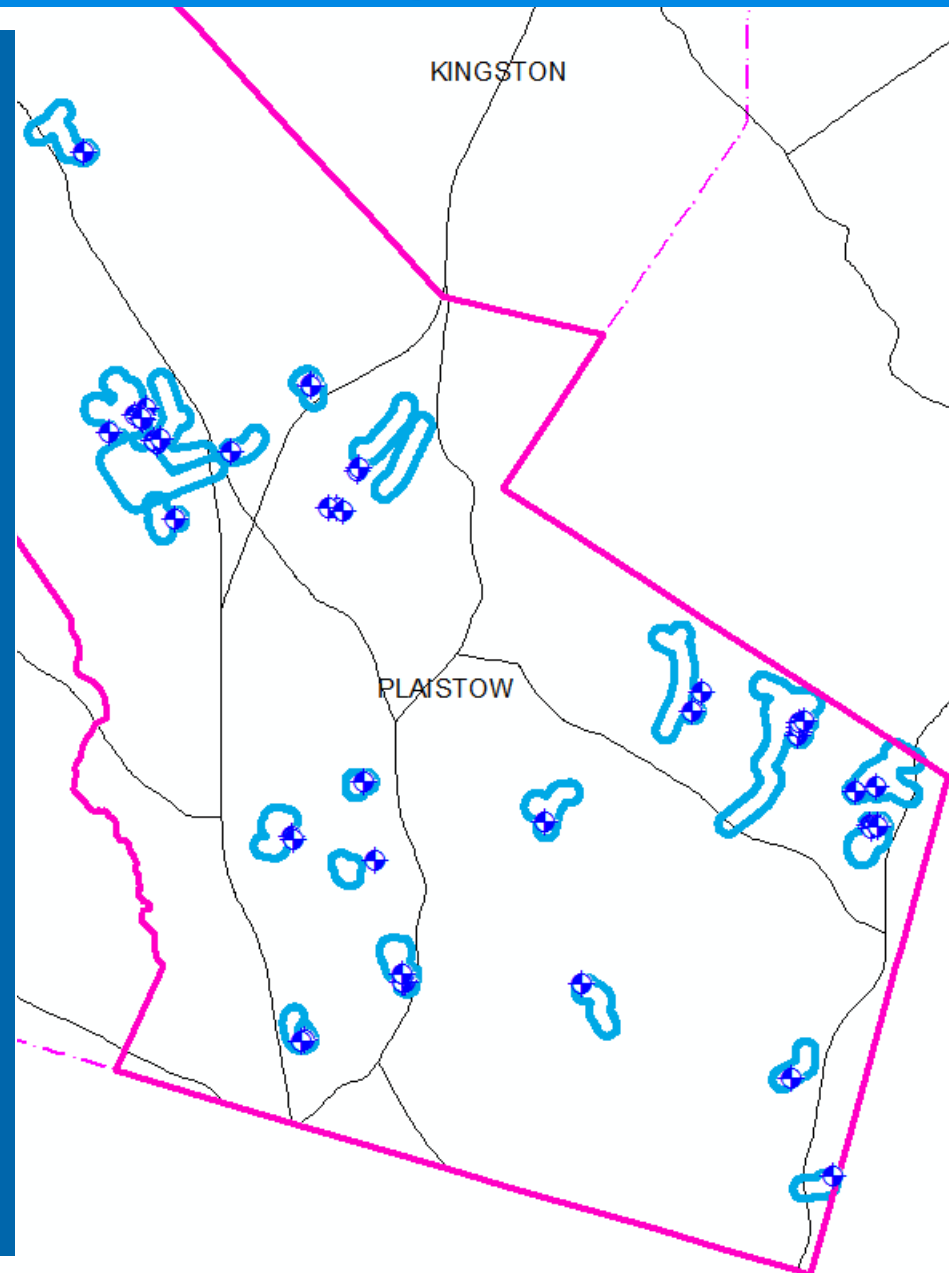
There are some *mixed* ownership type arrangements

# Public Water Systems - Regional



## **Plaistow Community Water Systems**

- 20 Small Community Water Systems
- 16 association owned, 4 owned by private utilities
- Serve ~ 700 connections; or ~1,850 people
- Total of 37 approved community wells – bedrock
- Almost all approved yields below 15 gpm
- Numerous known well yield declines/failures/replacements



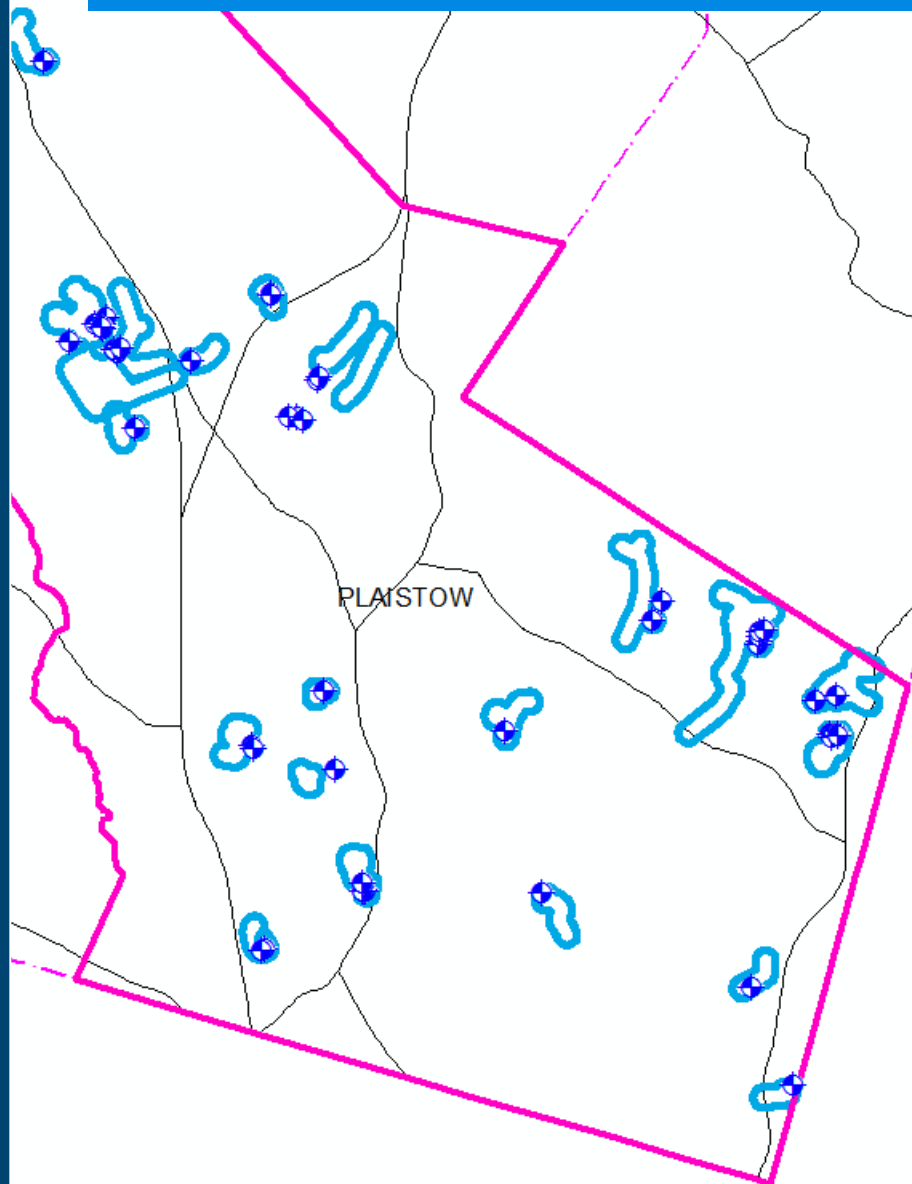


## Plaistow CWS cont..

- Fourteen (14) of 20 treat for naturally occurring constituents:
  - **Iron**
  - **Manganese**
  - **Arsenic**
  - **Radiological**
  - **Radon**
  - **Hardness**
- Twelve (12) of 20 have had detects of the following cultural constituents:
  - **Gasoline Constituents**
    - *BTEX/Ethers*
  - **Chlorinated Compounds**
    - Volatile Organics
  - **Semi. Vol. Organics**
    - Plasticizers/herbs/pests

*Many treat  
for 3 or more  
of these!!*

## Public Water Systems - Local



# Summary

- Sand and Gravel deposits are in Town, however, may be limited in potential by:
  - Limited thickness/saturation in most areas. i.e. Storage Limited;
  - Limited direct recharge due to nearby watershed boundary;
  - Limited induced recharge, no major regional surface water feature.
- Other surficial deposits in town are most likely too fine grained to be viable high yield formations.
- Apparent low yield bedrock is the local water source for the majority of town residents (like many other towns):
  - Bedrock may have little potential to be a high yield source.
  - Deeper, fine grained soil may limit recharge to bedrock.
  - Anecdotal information about replaced private well logs imply low yield bedrock may be relatively common and/or widespread.
  - NHDES experience with CWS is evidence of low yield bedrock.
  - Bedrock water quality is generally quite poor.