Slide 1

Groundwater in Bedrock Aquifers: Development Considerations

Pelham, New Hampshire

October 3, 2016

SANBORN HEAD

Building Trust. Engineering Success.

Slide 2

OUTLINE

- Background on groundwater in bedrock aquifers
- Overview on the effects of pumping groundwater from a bedrock well and concept of adequate yield
- Steps that could be taken to anticipate potential impacts of groundwater pumping from development

SANBORN HEAD

Slide 3

My Background

- Degrees in both geology and civil engineering; graduate degree in groundwater engineering
- Co-founded Sanborn, Head & Associates, Inc. 23 years ago; firm has grown to 120 people in six offices in New England and Midwest
- Key areas of my professional practice are clean water hydrogeology, contaminant hydrogeology, site assessment, and site remediation
- Chair of the Hopkinton Village Water Precinct for 10 years

SANBORN HEAD

Slide 4

"Fractured-bedrock aquifers in crystalline bedrock are among the least understood and quantified groundwater resources in the Nation. A major problem in evaluating groundwater availability in fractured bedrock is its extreme variability in water-bearing properties."

Factors Related to Well Yield in the Fractured-Bedrock Aquifer of New Hampshire; Moore et. Al.; USGS Professional Paper 1660; 2002)

SANBORN HEAD

4

Slide 5

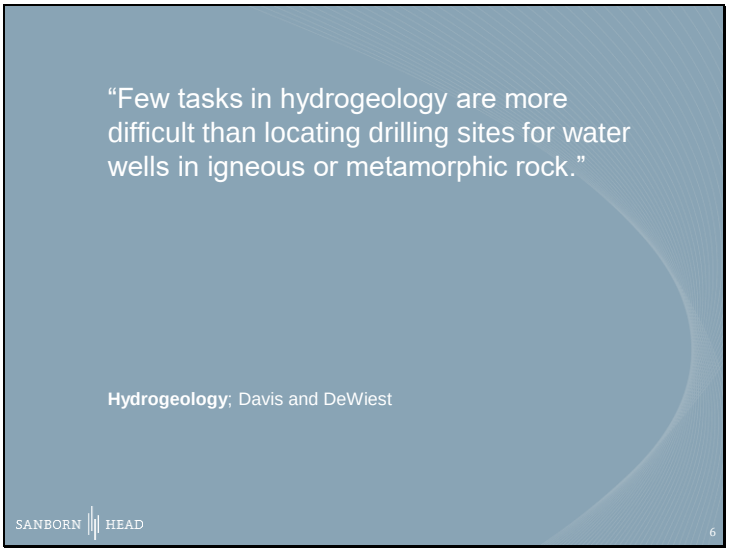
"Understanding the occurence and distribution of fractures in crystalline bedrock and associated water movement…cannot be determined statewide or regionally with the present state of the science."

Factors Related to Well Yield in the Fractured-Bedrock Aquifer of New Hampshire; Moore et. Al.; USGS Professional Paper 1660; 2002)

SANBORN HEAD

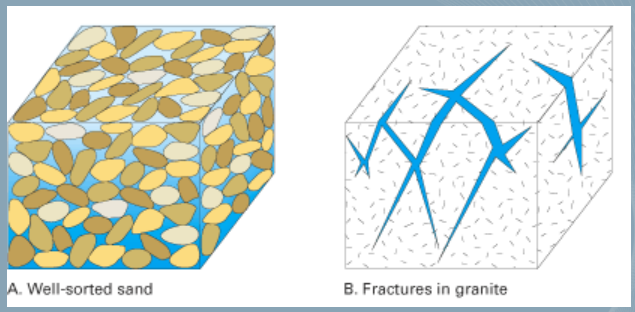
5

Slide 6


"Few tasks in hydrogeology are more difficult than locating drilling sites for water wells in igneous or metamorphic rock."
Hydrogeology; Davis and DeWiest
SANBORN HEAD
6

Slide 7

TYPES OF AQUIFERS

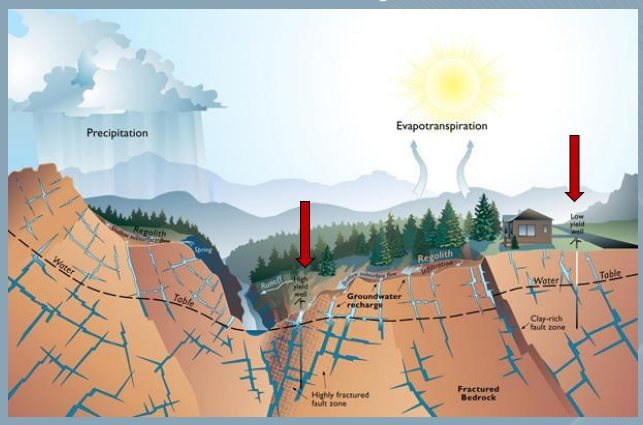


http://pubs.usgs.gov/circ/2003/circ1262/images/fig04_opt.gif

SANBORN HEAD

Slide 8

BEDROCK AQUIFERS



http://coloradogeologicalsurvey.org/apps/wateratlas/chapter7_5page2.html

SANBORN HEAD

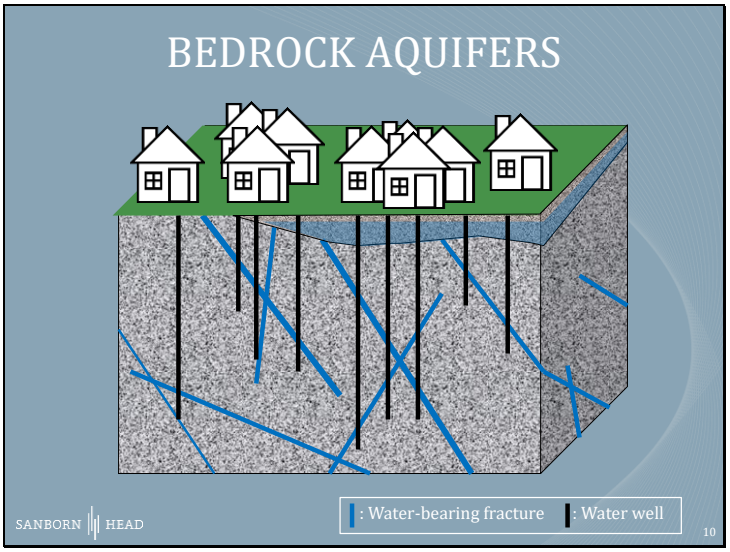
Slide 9

WATER YIELD CAN DEPEND ON INDIVIDUAL FRACTURES

http://www.maine.gov/dacf/mgs/explore/water/facts/water.htm

SANBORN HEAD

Slide 10


BEDROCK AQUIFERS
: Water-bearing fracture
: Water well
SANBORN HEAD
10

Slide 11

Bedrock Well Yield

- 600 gallons within 2 hours is “adequate”
- 900 gallons within 4 hours is “optimum”
- Good rule of thumb for adequate supply is 5 gpm
- Medial yield of bedrock wells in NH is 6 gpm
- About 25% of all bedrock wells in NH are less than 3 gpm
- Leachfields return a considerable percentage of water back to the ground

SANBORN HEAD

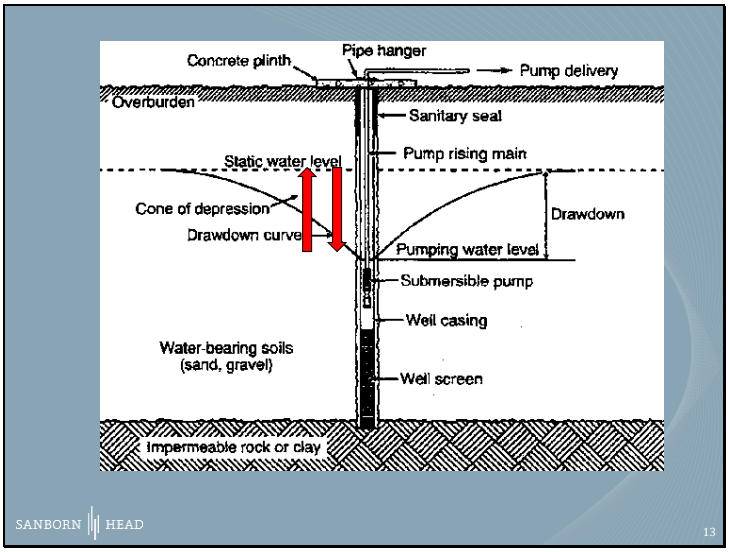
Slide 12

Case Study

- Residential development in central Massachusetts
- 1 to 2 acre lots
- About 46 homes with bedrock supply wells
- Located at top of a hill; yields are on the low side
- Wells generally located within 150 to 300 feet of each other

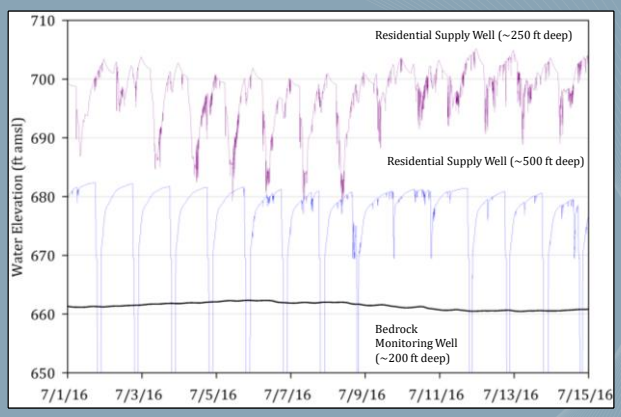
SANBORN HEAD

Slide 13


Concrete plinth
Pipe hanger
Pump delivery
Overburden
Sanitary seal
Pump rising main
Static water level
Cone of depression
Drawdown curve
Drawdown
Pumping water level
Submersible pump
Well casing
Water-bearing soils
(sand, gravel)
Well screen
Impermeable rock or clay
SANBORN HEAD
13

Slide 14

RESIDENTIAL WELL PUMPING



SANBORN HEAD

Slide 15

It is highly improbable and very atypical that pumping from residential bedrock wells in a development with acre-type zoning would materially impact other nearby wells.

Chances of impact increase some with larger-scale groundwater withdrawals and high-density development; but there is no easy and inexpensive way to determine this

SANBORN HEAD

15

Slide 16

Large-Scale Groundwater Withdrawals

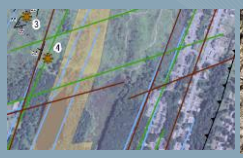
- State defines as > 40 gpm (57,600 gpd)
- Requires a permit per NH Part Env-Wq 403
- Involvement of a "qualified professional" (typically PE or PG)
- Extensive multi-part testing

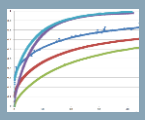
SANBORN HEAD

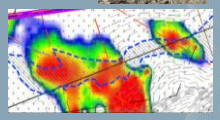
Slide 17

CHARACTERIZING IMPACT

- Development of a conceptual hydrogeologic model and "potential impact area:"
  - Fracture trace analysis
  - Geophysics
  - Monitoring wells
  - Pumping Tests
  - Water level monitoring
- Definition of potential impact area and inventory of water users
- Evaluate withdrawal effects on water resources







Referenced from NH RSA 485-C:21;
http://www.gencourt.state.nh.us/rsa/html/L/485-C/485-C-21.htm

SANBORN HEAD

Slide 18

Large-Scale Groundwater Withdrawal Permit Process

- A major undertaking
- The only viable way to estimate impact due to more intensive development
- Costs are dependent on many factors, but done right, can be in excess of $100,000

SANBORN HEAD