Protection of Wells from Individual Sewage Disposal Systems

3/8/2022 - GSOWA

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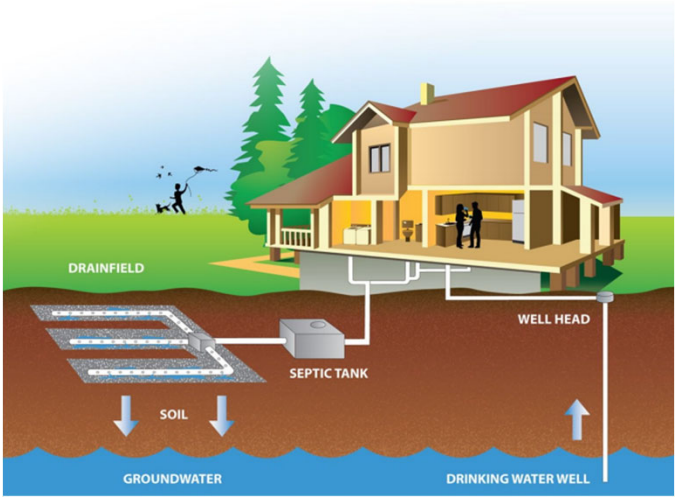
Hydrogeologist / Owner

EDGEWATER STRATEGIES
CLEAR SOLUTIONS

Groundwater Withdrawal Permitting – Public Water System Management – Shoreline Permitting – Public Outreach

1

Why are we here?



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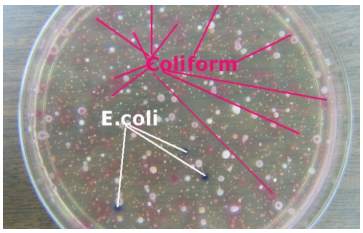
Common Contaminants

Bacteria: Coliform Bacteria - E.Coli Bacteria

Primary DW Standard: Absence / Presence



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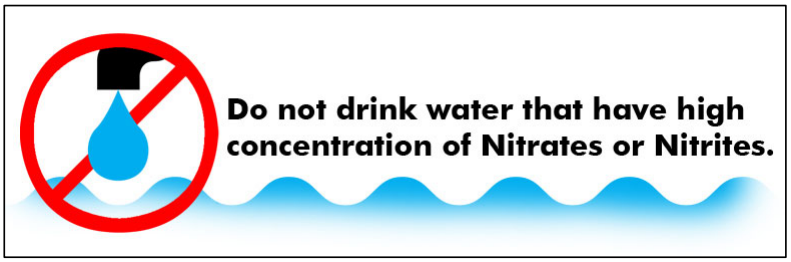
Common Contaminants

Nitrite / Nitrates

Primary DW Standard: Nitrite 1.0 mg/L Nitrate 10 mg/L



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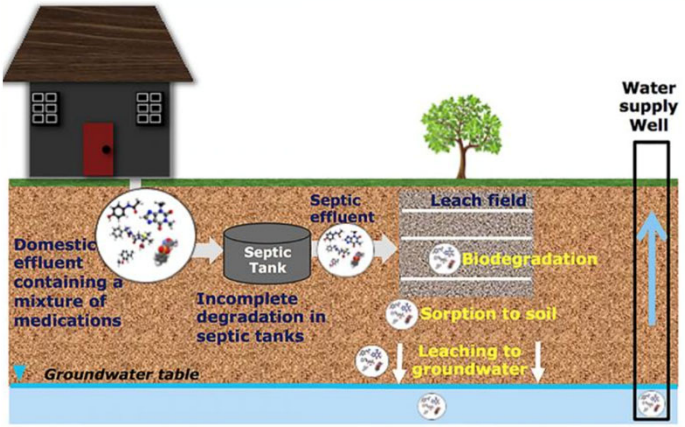
Contaminants

Pharmaceuticals / Cleaning Products

Unknown Standards



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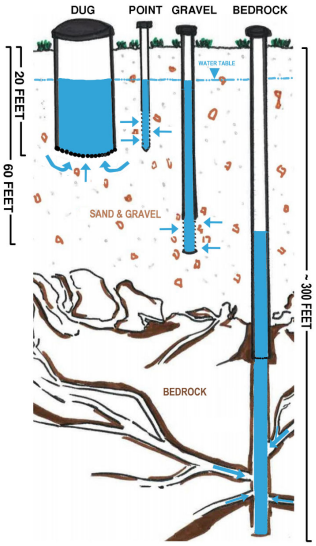
Groundwater Flow to Wells



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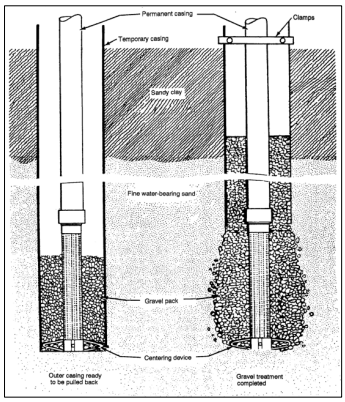
Well Basics – Overburden Wells

- **Water Supply Wells:**
  - **Sand and Gravel – gravel of naturally packed, water flow through screen**
    - **Dug wells and Springs**



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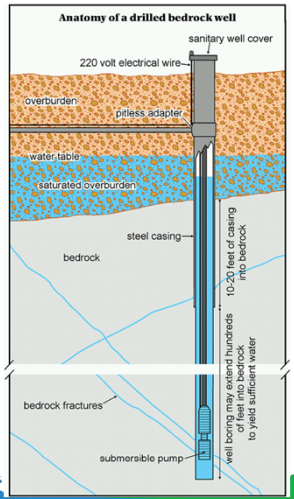
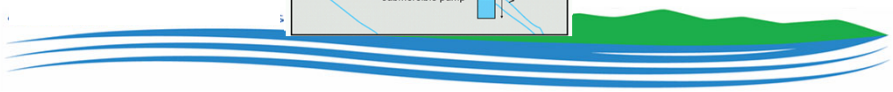
Well Basics – Bedrock Wells

- **Water Supply Wells:**
  - **Bedrock – casing installed into competent rock, water flow trough fractures**





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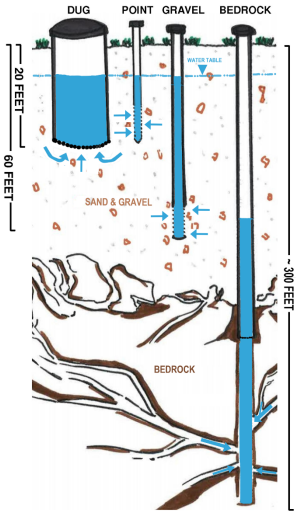
Proper Construction of a Well

- Select drilling method
- Install casing
  - At least 10 feet into competent rock
- Install screen
- Grout well (sanitary seal)
  - Required for Public Supplies
  - Required when setbacks are not met
- Develop well
  - **Maximize specific capacity**

Take note of alterations to well casings after installation!



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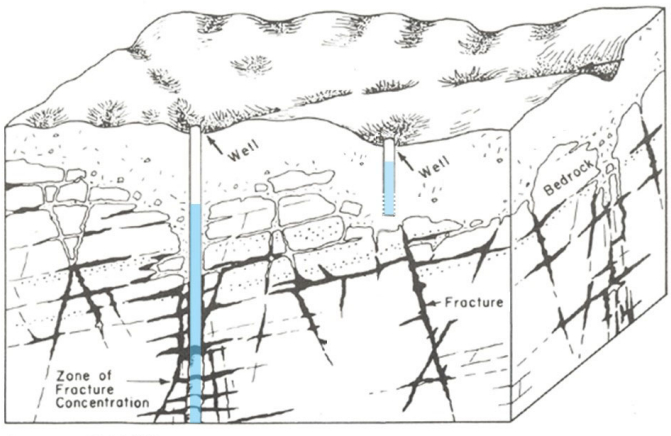
Groundwater Flow Basics



(After Lattman and Parizek 1964)

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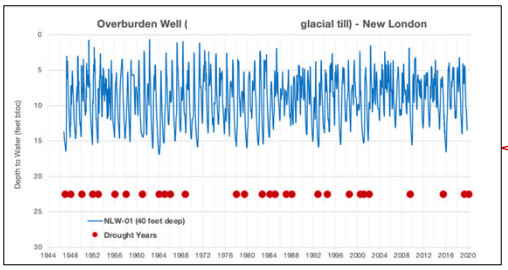
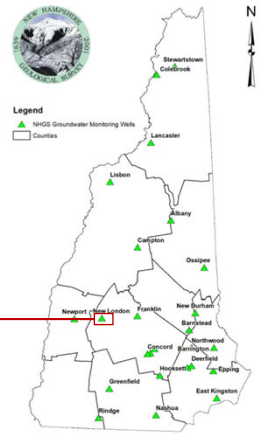
Groundwater Level Fluctuations

NH Geological Survey
Monthly Water Level Data

Ambient (non-pumping)
19 Overburden (Gravel) Wells
11 Bedrock Wells (9 with data back to 2009)

WLs fluctuate 3-7 feet annually





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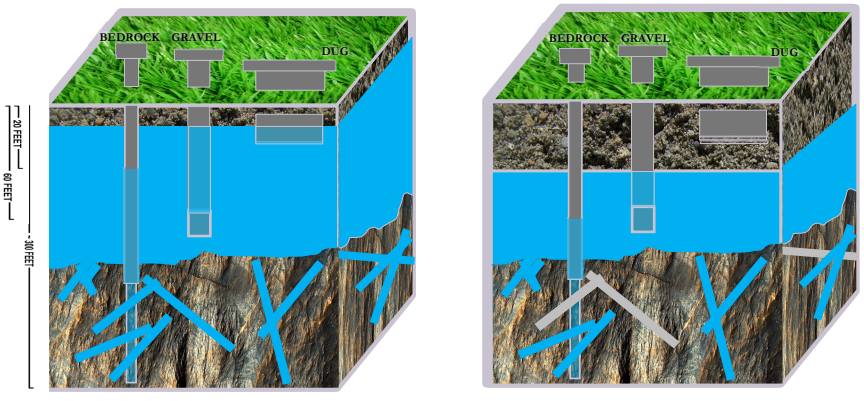
What happens when water levels drop?

Thick Sand and Gravel Deposits



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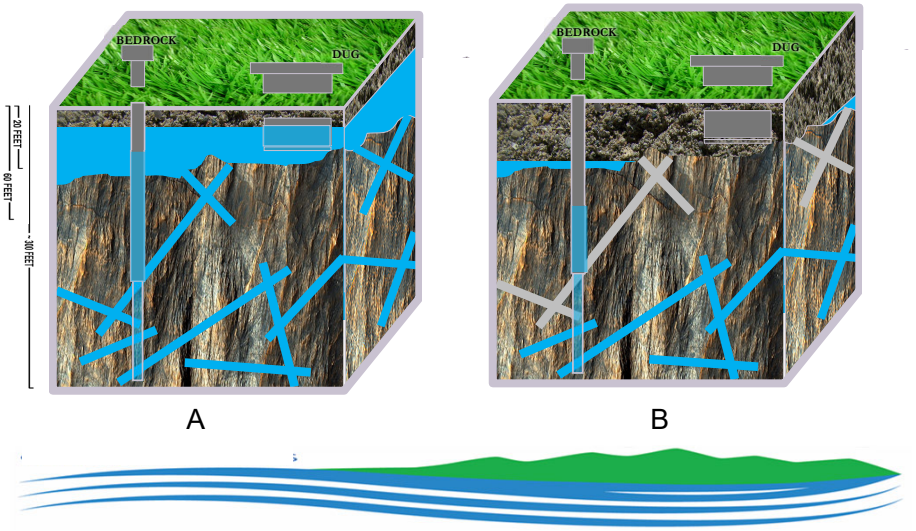
What happens when water levels drop?

Thin Sand and Gravel Deposits



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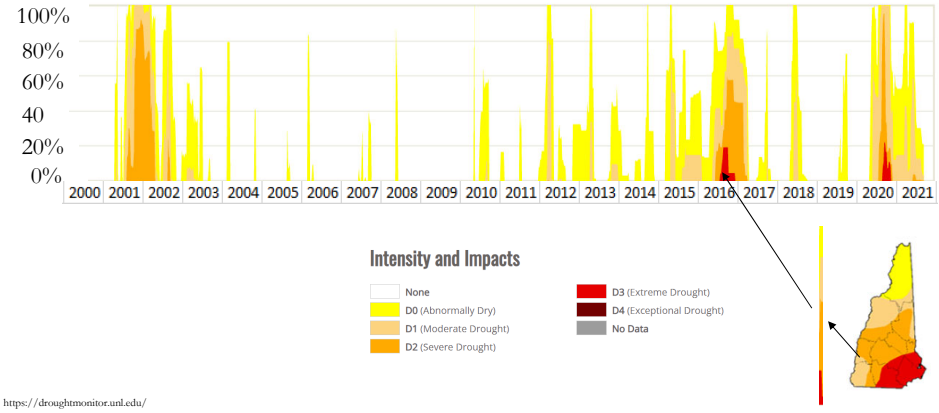
Occurrence of Drought

Occurrence of Drought: Percent of NH in Drought from 2000-2020



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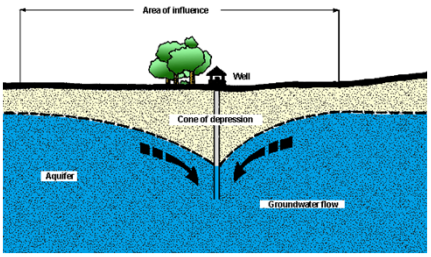
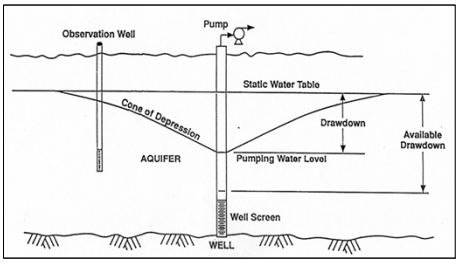
Pumping Conditions





- Extent of Cone of Depression dependent on
  - Pumping rate
  - Hydraulic conditions of soil
  - Hydraulic interconnections in bedrock
  - Construction of the well

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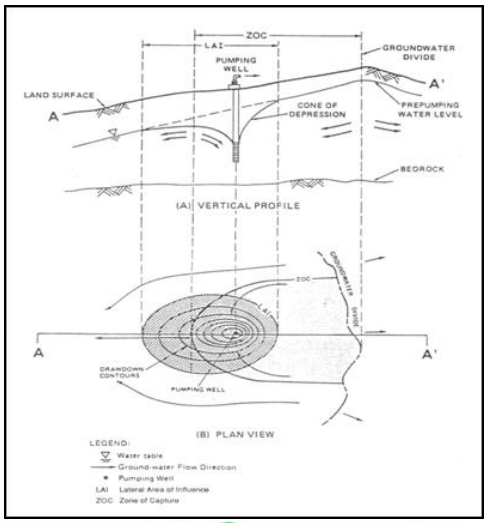
Science behind the Well Radius

The sanitary protective radius is a 75- to 400-foot radius around the well that under current law *must* be controlled by the water supplier through ownership or easements. The extent of the sanitary protective radius depends on the maximum daily amount of water withdrawn from the well. Know the extent of your sanitary protective radius, and be sure only activities that are both directly related to your water system and non-threatening to the water quality occur within the radius.



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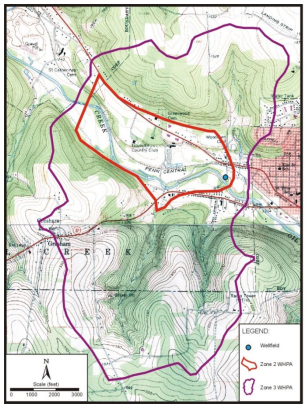
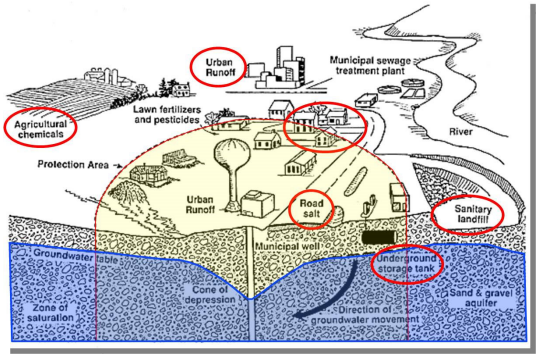
Zone of Contribution

Public Water Supply regulations Require us to determine where the water coming from. Know: SPA, ZOI, WHPA





What activities are being performed within?

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DES DWGB PWS Regulations

Public Water Supplies (PWS)

SANITARY PROTECTIVE RADIUS
Dependent on System Design Capacity
Majority of small PWSs are on septic systems

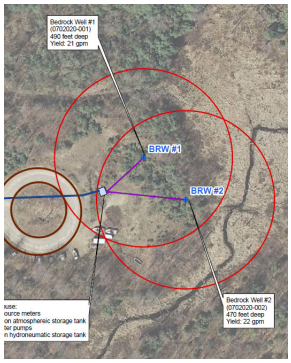

Table 302-1 Sanitary Protective Area Radii

Permitted Production Volume (gallons in a 24-hour period)	Radius
less than 14,400	150 feet
14,401 to 28,800	175 feet
28,801 to 57,599	200 feet
57,600 to 86,400	250 feet
86,401 to 115,200	300 feet
115,201 to 144,000	350 feet
greater than 144,000	400 feet

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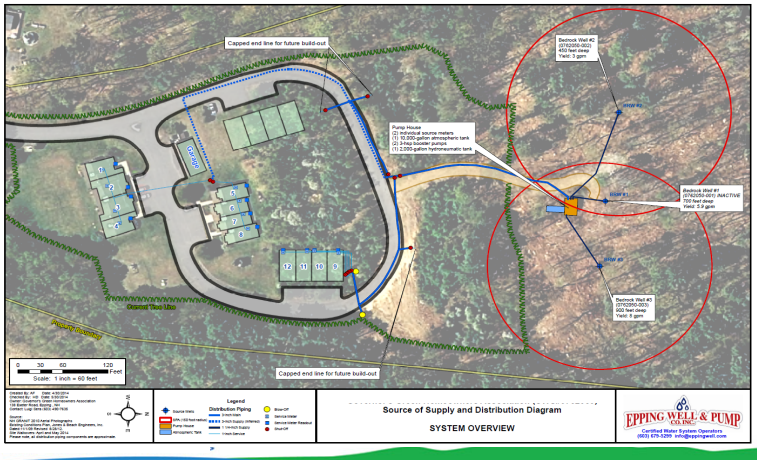
Public Well System / Distribution System

25 persons or 15 connections
2 bedrooms / home (2.5 people/bedroom). 1 bedroom home (1.5 persons)
Community / Non Community / Transient / Non-Transient



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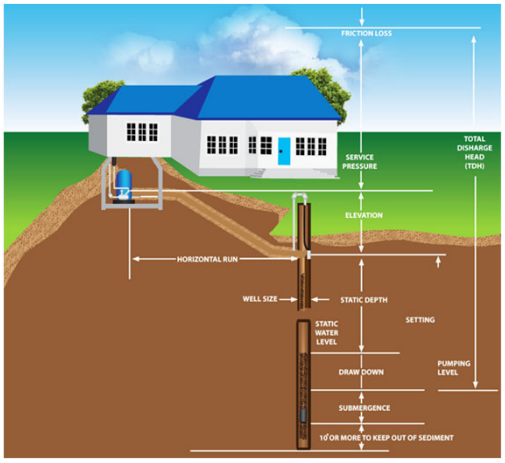
Private Well Pump System



The Water Well Board Regulations

Private Wells

75- Foot separation from septic systems

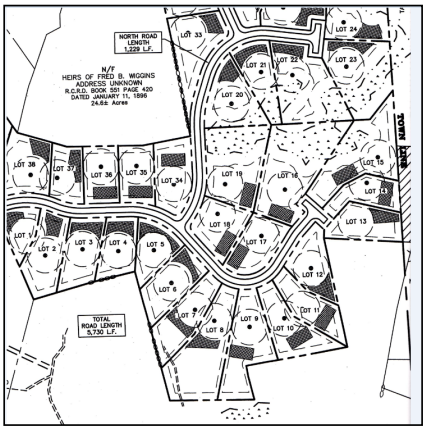
150-gallons per day per bedroom

Irrigation uses often double domestic uses

Other well setbacks

Special methods of construction

Retro-fit existing wells.



The WWB Regulations

RESIDENTIAL DRINKING WATER WELL LOCATION SETBACKS	
Entity	**Setback (ft.)**
Effluent Disposal Area (leach field/bed)	75[1]
Septic Tank	75[2]
Property Boundary	75
Livestock Pen	75 (100 for dug wells)
Automobile Salvage Yard	75
Underground Storage Tanks (containing gas or diesel fuel)	250
Storage of Regulated Substance (except gas or diesel fuel)	75
Solid Waste Disposal Site	75
Bulk Storage of Material (ex. fertilizer, manure, salt)	75
Stump Dump	75[3]
State Highway Right-of-Way	50[4]
Sewer Component	50[5]
Surface Water / Swamp	50[6]
Public Road Surface	75[7]
Other Sources of Contamination	75

Notes:

[1] NHDES site visit and approval required for wells within 25 feet of an effluent disposal area.

[2] Setback can be 50 feet if SDR 26 pipe is used and the tank is plastic or coated with a sealant to prevent infiltration and exfiltration.

[3] The burial of on-site tree stumps is not considered solid waste if greater than 75 feet from a well. As such, wells must be 75 feet from stump burial sites.

[4] A well that is constructed within 50 feet from a state highway right-of-way or in a location that does not allow or provide for adequate surface drainage is not eligible for DOTs well replacement program.

[5] Under certain conditions the distance to septic system components to water supply lines may less than 50 feet. Contact NHDES for site-specific information.

[6] 50-foot setback required from all surface waters including inundated wetlands, bogs, and swamps.

[7] Setback reduction requirements must be followed if a road surface is within 75 feet of the well.

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The WWB Regulations

Bedrock well installations that do not meet setbacks – For bedrock wells proposed to be installed on a property where setbacks cannot be met, and *all* efforts to meet the setbacks are not practicable, the well is to be installed one of the following ways:

OBTAIN SETBACK REDUCTION FORM:

1. **Obtain a written acknowledgement** from the property owner using the Setback Reduction Form and submit with the Well Completion Report.
2. Install no less than 40 feet of casing, with no less than 10 feet into competent rock.
3. Seal the annular space outside of the well casing with *grout* material.

Note: The Setback Reduction Form is not the Well Release Form required in the septic system approval process.

OR

USE SPECIAL METHODS OF CONSTRUCTION:

1. Inform the homeowner that setbacks are not met and the risks involved.
2. **Install a minimum casing length** per the tables defined in the We 600 rules (shown below, derived from the Pythagorean Theorem). The minimum casing length is from ground surface.
3. Seal the annular space outside of the well casing with *grout* material.

Minimum Casing Length (from ground surface) Where a 75-foot Setback is Required	
Horizontal Setback (ft.)	Minimum Casing Length (ft.)
75 or greater	20
70-74	27
65-69	37
60-64	45
55-59	51
50-54	56
45-49	60
40-44	63
35-39	66
30-34	69
25*-29	71

*NHDES must inspect any proposed well location within 25 feet of a septic system.

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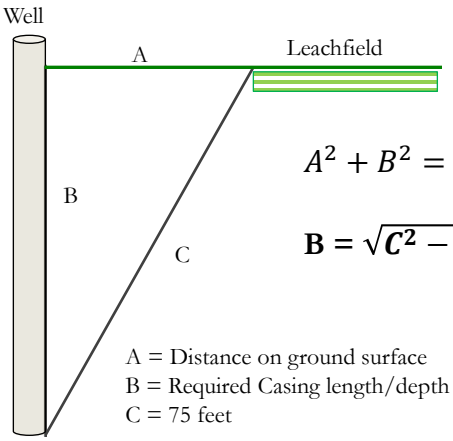
Special Methods of Construction

Pythagorean Theorem



$$A^2 + B^2 = C^2$$

$$\mathbf{B} = \sqrt{\boldsymbol{C^2 - A^2}}$$

A = Distance on ground surface
B = Required Casing length/depth
C = 75 feet

Minimum Casing Length (from ground surface) Where a 75-foot Setback is Required	
Horizontal Setback (ft.)	Minimum Casing Length (ft.)
75 or greater	20
70-74	27
65-69	37
60-64	45
55-59	51
50-54	56
45-49	60
40-44	63
35-39	66
30-34	69
25*-29	71
*NHDES must inspect any proposed well location within 25 feet of a septic system.	

Table 602-2 Minimum Casing Length Where a 50-foot Setback is Required

Horizontal Setback (ft.)	Minimum Length of Casing (ft.)
50 or greater	20
45-49	22
40-44	30
35-39	36
30-34	40
25-29	43

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Setback Reduction Form

Non-bedrock wells and/or not enough casing

STATE OF NEW HAMPSHIRE
WATER WELL BOARD
PO Box 95
Concord, NH 03302-0095
(603) 271-3574

Setback Reduction Form
Please Attach Copy to the Well Completion Report

REASON FOR SETBACK REDUCTION (Check appropriate box)

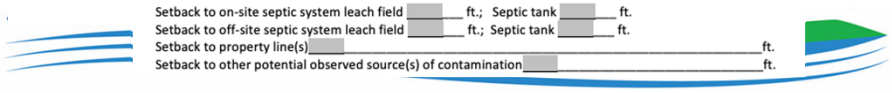
- ☐ The property size is not sufficient to allow for the required setback;
- ☐ Sufficient setbacks from other potential sources of contamination cannot be met;
- ☐ Excessive slopes prohibit access;
- ☐ The location of permanent structures would result in unreasonable impacts or damage to the structures;
- ☐ The location of lakes, ponds, streams or wetlands prohibits meeting the required setbacks;
- ☐ The presence of bedrock at or within four vertical feet of the surface would result in unreasonable offset trenching requirements; or
- ☐ Other (Explain) _____

ADDITIONAL CONSTRUCTION METHODS USED (Check appropriate boxes)

- ☐ Extra casing installed into bedrock: Casing depth _____ Depth to bedrock _____
- ☐ Casing annulus grouted with bentonite grout; Other grout _____
- ☐ Additional well seals:
  - ☐ Jaswell type; Depth setting _____feet below land surface; ☐ Annulus grouted
  - ☐ Shale packer; Depth setting _____feet below land surface; ☐ Annulus grouted
  - ☐ Other (Explain): _____
- ☐ Other Construction Methods: _____

SETBACK DISTANCES

Setback to on-site septic system leach field _____ ft.; Septic tank _____ ft.
Setback to off-site septic system leach field _____ ft.; Septic tank _____ ft.
Setback to property line(s) _____ ft.
Setback to other potential observed source(s) of contamination _____ ft.



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Setback Reduction Form

Non-bedrock wells and/or not enough casing

STATE OF NEW HAMPSHIRE
WATER WELL BOARD
PO Box 95
Concord, NH 03302-0095
(603) 271-3574

Setback Reduction Form
Please Attach Copy to the Well Completion Report

*** * * Property Owners Please Take Notice * * ***

Pursuant to RSA 228:34 Private Water Supplies: property owners who have wells constructed within 50 feet of State Highway rights-of-way, drainage ditches or where the location does not allow or provide for adequate surface drainage, lose the possibility of receiving compensation from the New Hampshire Department of Transportation for damages to their drinking water supply from construction or maintenance operations on the state highway systems.

Setbacks to Property Lines and Septic Systems: RSA 485-A:30-b and State regulations require a 75-foot setback from wells serving homes up to 5 bedrooms, to property lines and septic systems. Where site conditions prevent compliance with the required setback, special methods of construction, in accordance with We 602.14, must be used to protect the water supply. For lots developed after July 1989, a Standard Release form issued by the New Hampshire Department of Environmental Services (NHDES) must also be filed. Please note that reduced setbacks to septic systems are not recommended. For new construction, site plans may **not** be approved by NHDES where wells are located less than 75 feet from septic systems.

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DOT Well Replacement Program

Wells constructed within 50-feet of a state road right-of-way or in an area that does not allow for adequate surface drainage from the road is not eligible for DOTs well replacement program (salt contamination).

If a homeowner suspects salt contamination, DOT samples 4 quarters, if Na & Cl are deemed elevated, they cover the cost of well replacement/treatment.

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Common Contaminants

Salt: Sodium Chloride
Secondary Standard

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The WWB Regulations

Private Wells

New Lot development

- Drillers must install where shown
- Designers – be aware of limitations
- *Shoreland lots – well by the water

Replacement Wells

- Replaced within 5 feet of original well
- Replaced elsewhere without septic approval – may not be approvable when septic is replaced

Seasonal Conversion

- Get a septic plan with approved location

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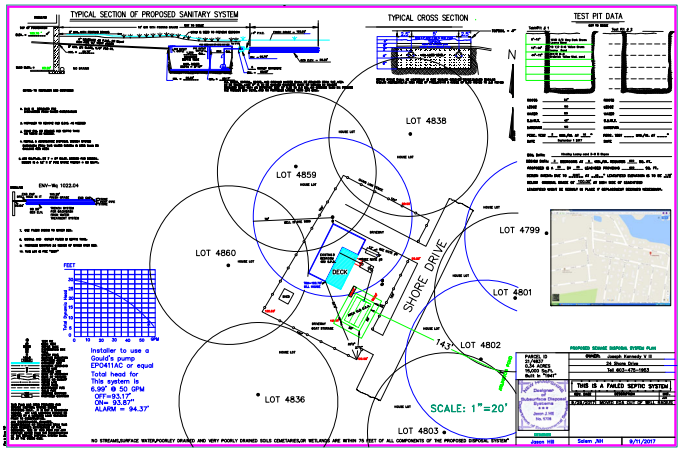
The Regulations

Private Wells

Overlapping Well Radii



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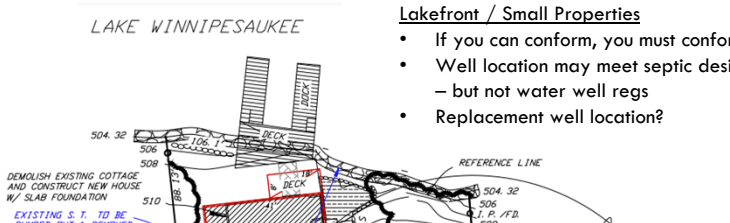

Lakefront / Small Properties

- If you can conform, you must conform
- Well location may meet septic design regs – but not water well regs
- Replacement well location?

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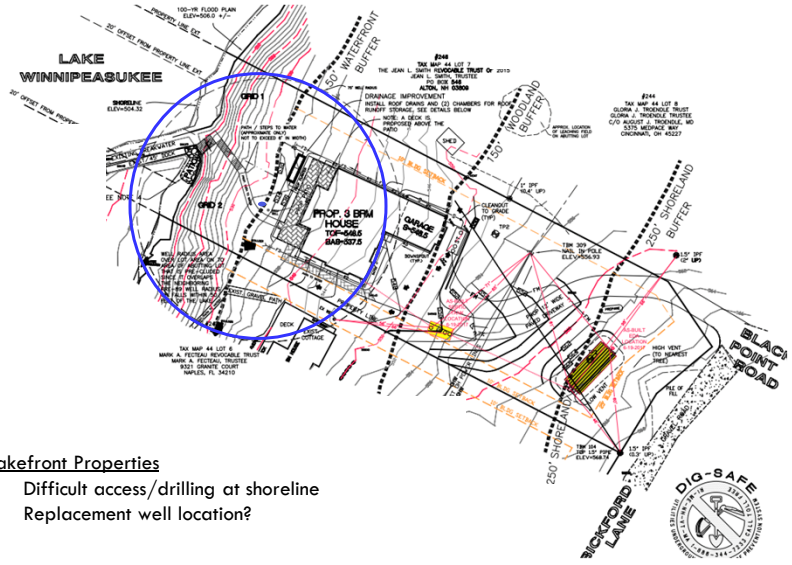

Lakefront Properties

- Difficult access/drilling at shoreline
- Replacement well location?

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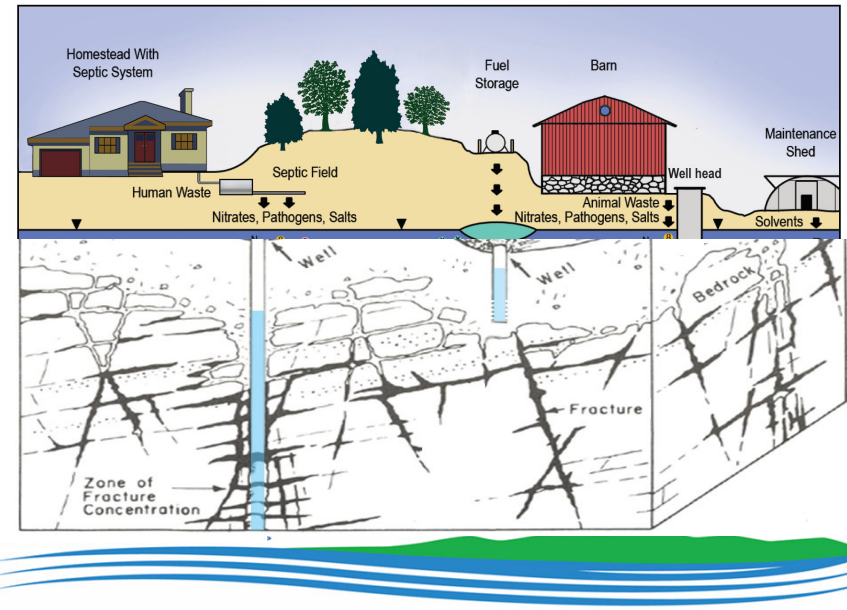
Common Contaminants



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How it gets back to the Well

Septic systems too close to poorly constructed (*broken*) well
Failed Septic Systems

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How it gets back to the Well

Breaks in the water supply offset / distribution lines / irrigation

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Case Study

Contributing Factors to Disease Outbreaks Associated to Untreated Groundwater

- Recent Study: NGWA. November –December 2014
- Reviewed 818 drinking water outbreaks reported to CDC from 1971-2008.
- 248 outbreaks resulted in illness (23,478), hospitalizations (390), death (13)
  - 90% of these outbreaks were from wells – mainly community systems
  - Majority (53%) in summer months – seasonal systems
- 172 outbreaks had information on contribution factors
- Leading contamination source was human sewage (31%)

- **Contamination facilitated by improper design, maintenance, location of water source and septic systems**

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Case Study

Contributing Factors for Untreated Groundwater Outbreaks—United States 1971 to 2008 ($n = 172$[1])

Contributing Factor	No. Outbreaks n (%)[2]	No. Cases Median (Range)	Total
Untreated groundwater contributing factors	169 (98.3%)	34 (2–2,823)	19,149
Source water or septic system construction or location	116 (67.4%)	33.5 (2–2,823)	14,363
Source water design and maintenance or location	83 (48.3%)	27 (2–1,450)	7,587
Source water design and maintenance	39 (22.7%)	33 (2–1,450)	4,808
Source water location	26 (15.1%)	19 (2–230)	1,241
Other source water issue[3]	27 (15.7%)	18 (4–750)	1,955
Septic system design and maintenance or location	40 (23.3%)	39 (2–1,450)	4,953
Septic system design and maintenance	30 (17.4%)	39 (4–1,450)	4,065
Septic system location	5 (2.9%)	55 (12–220)	401
Other septic system issue[3]	8 (4.7%)	43 (2–384)	778
Source or septic location[4]	34 (19.8%)	33 (4–2,823)	6,955
Sewage poisoning	73 (42.4%)	39 (4–2,823)	11,444
Underground seepage of sewage	44 (25.6%)	45.5 (4–2,823)	9,164
Overflow of sewage	13 (7.6%)	39 (11–89)	566
Other sewage poisoning[4]	16 (9.3%)	38.5 (5–390)	1,714
Vulnerable hydrogeology	45 (26.2%)	39 (5–2,823)	8,821
Flooding, heavy rains	36 (20.9%)	39.5 (2–2,823)	6,617
Contamination from wild or domestic animals[5]	26 (15.1%)	11 (2–1,450)	3,081
Groundwater Under the Direct Influence of Surface Water (GWUDI)	18 (10.5%)	54 (2–1,450)	2,572
Shallow well	16 (9.3%)	42.5 (2–2,823)	4,284
High water table	6 (3.5%)	50.5 (5–350)	561
Other	34 (19.8%)	37.5 (2–2,823)	6,330
Distribution system contributing factors	32 (18.6%)	39.5 (2–1,450)	4,305
Cross-connection with nonpotable water	23 (13.4%)	43 (7–1,450)	3,418
Contamination of storage facility	7 (4.1%)	40 (4–615)	886
Contamination of water mains during construction or repair	4 (2.3%)	26 (2–91)	145
Contamination in building/home	1 (0.6%)	2 (2–2)	2
Other	2 (1.2%)	24.5 (15–34)	49
No. of outbreaks with contributing factors	172		

[1]Contributing factors were not available for 76 outbreaks.
[2]Percentages were calculated based on the number of outbreaks with at least one contributing factor available. Since multiple contributing factors can be reported for a single outbreak, the percentages listed sum to greater than 100%.
[3]Source water or septic system implicated as contributing factor, however, specific location or construction issue was not specified.
[4]Sewage was implicated but route of contamination (above ground or underground) was unclear.
[5]Domestic animals were associated with 15 (57.7%) outbreaks, wild animals for six (23.1%) and domestic and wild animals for one (3.8%); four (15.4%) outbreaks did not specify the animal type. Specific animals included: cattle ($n = 10$, 38.5%), chickens ($n = 3$, 11.5%), rodents ($n = 2$, 7.7%), beavers ($n = 2$, 7.7%), pigs ($n = 1$, 3.8%), goats ($n = 1$, 3.8%), deer and elk ($n = 1$, 3.8%), and horses ($n = 1$, 3.8%).

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Case Study

Contributing Factors to Disease Outbreaks Associated to Untreated Groundwater

- **Water Source**
  - Construction: well pits / hand dug shallow wells
  - Rusted cracked casing
  - Cross connections / back siphonage
  - Hydraulic connects from surface water to groundwater
- **Septic Systems**
  - Sewage Line Breaks
  - Overflows of septic systems
  - Neglected septic systems
  - Illegal construction
  - Inadequately sized tanks (older construction)

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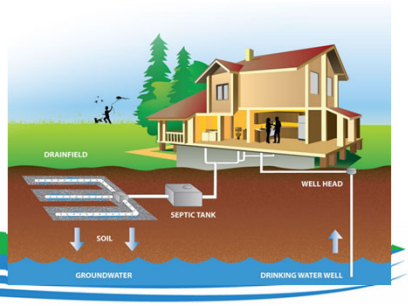
Closing Thoughts

Reduce the RISK of Contamination

- Understand groundwater flow to wells
- Know potential contamination sources within cone of depression
- Proper construction of well
- Proper Location, Construction, Maintenance of septic systems
- Identify cross –connections

- Confirm well location on plan is attainable
- Be proactive for replacement wells



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THANK YOU

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