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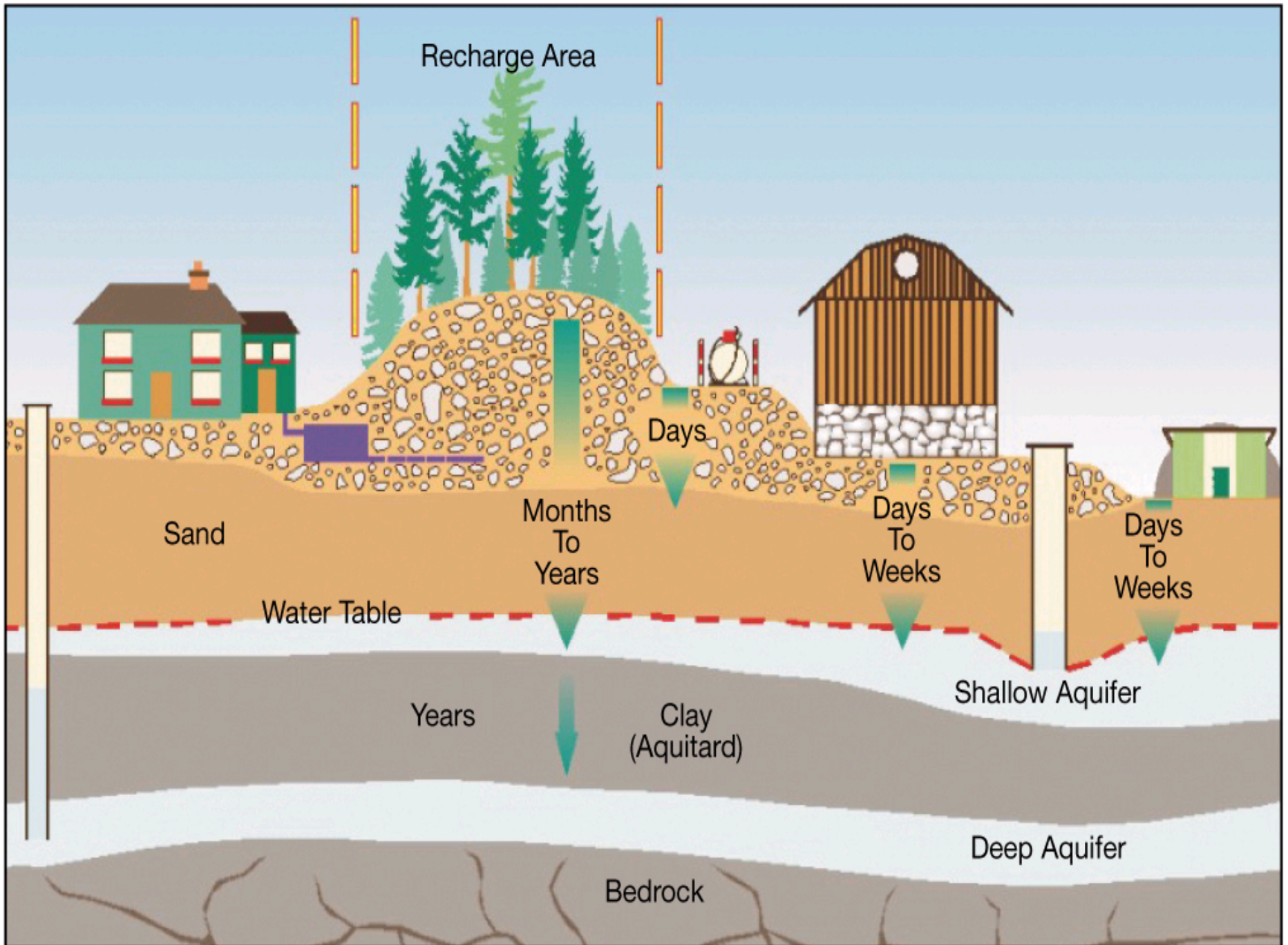
Optimal Well Siting for Groundwater Supply

Department of Environment and Conservation
Drinking Water Conference
March 25, 2015

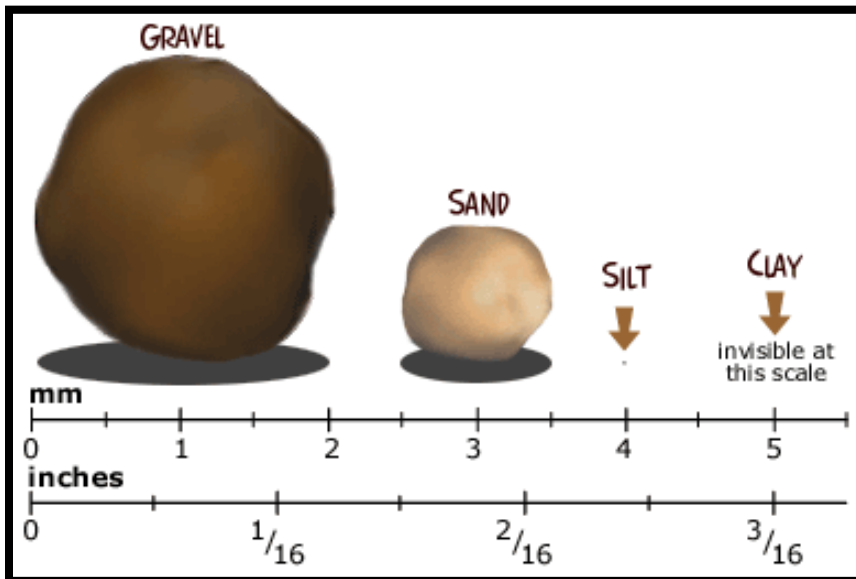


Outline

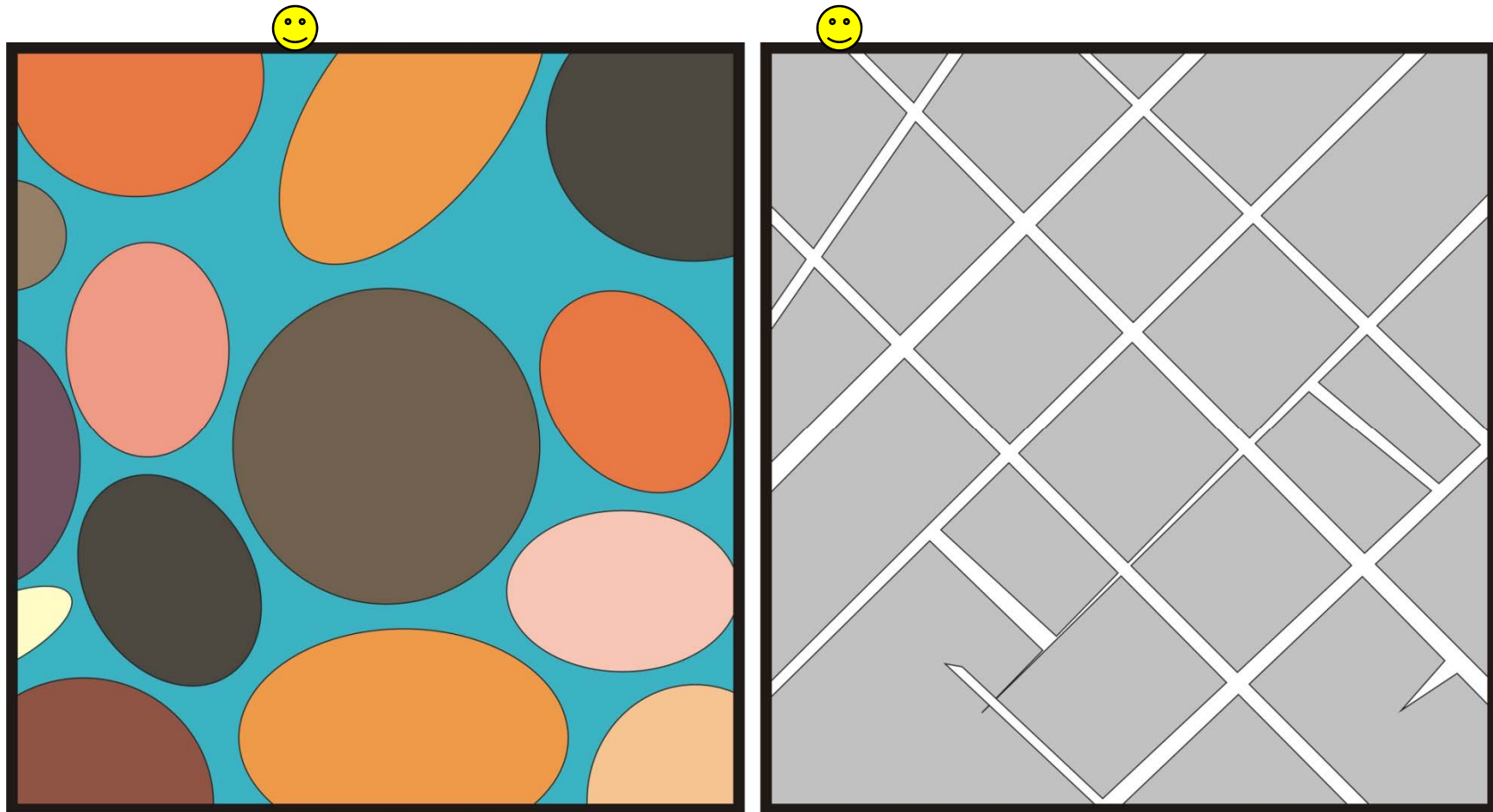
1. Groundwater Basics
2. Hydrogeology of Newfoundland
3. Physiography and Geology
4. Well Data
5. Water Quality
6. Local Land Uses
7. Source Water Protection
8. Choosing the Well Location
9. Well Completion



Groundwater Basics



Porous Media vs. Fractured Rock



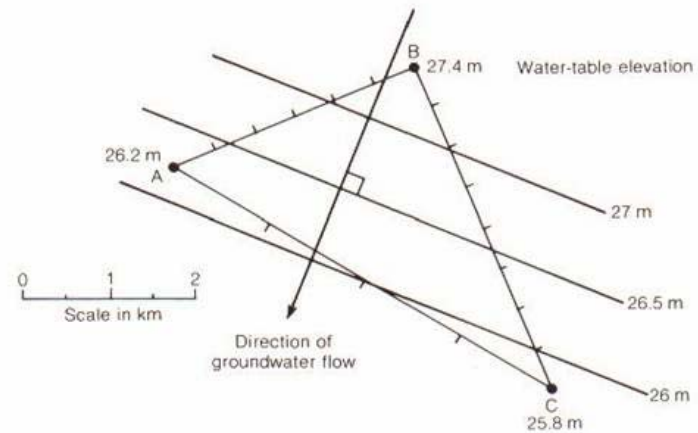


Groundwater Flow Direction

Groundwater flows from high pressure head to low pressure head

Generally follows topography

Important for understanding how contaminants can affect a drinking water well



Finding Groundwater

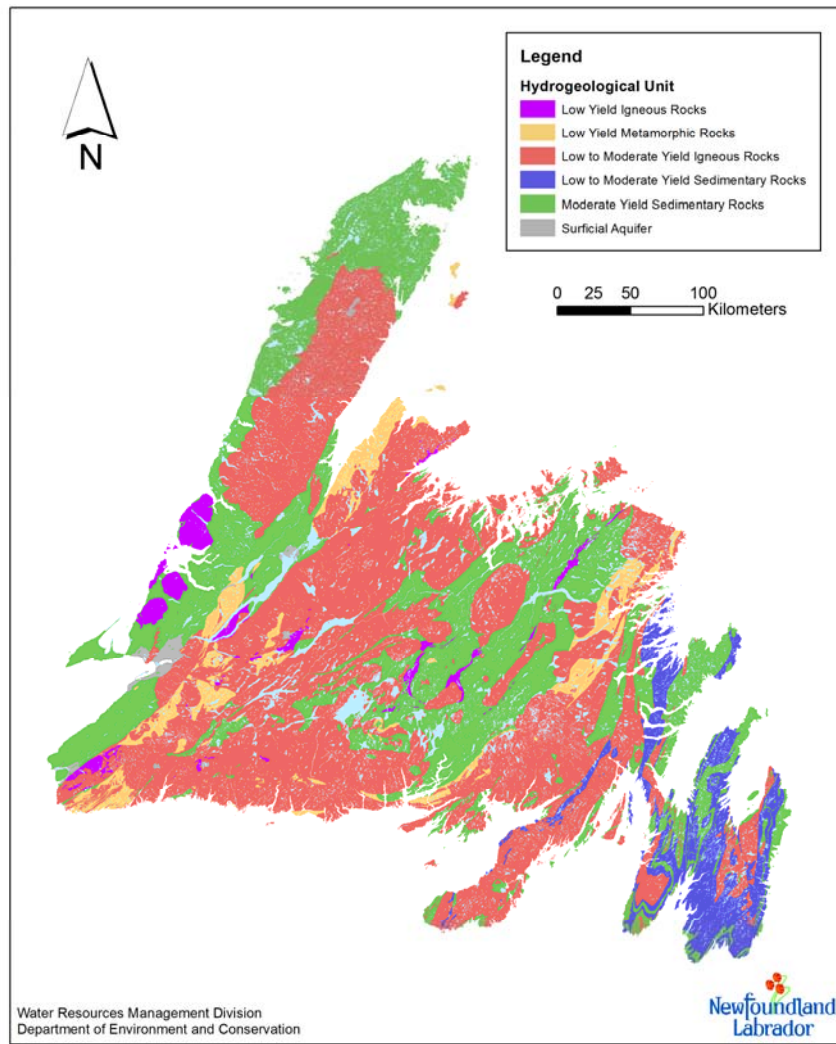
What yield are we looking for?

What will the well yield?

**What is keeping us from finding
the amount of water we need?**



Hydrogeology of Newfoundland



Hydrogeological Unit

- Low Yield Igneous Rocks
- Low Yield Metamorphic Rocks
- Low to Moderate Yield Igneous Rocks
- Low to Moderate Yield Sedimentary Rocks
- Moderate Yield Sedimentary Rocks
- Surficial Aquifers

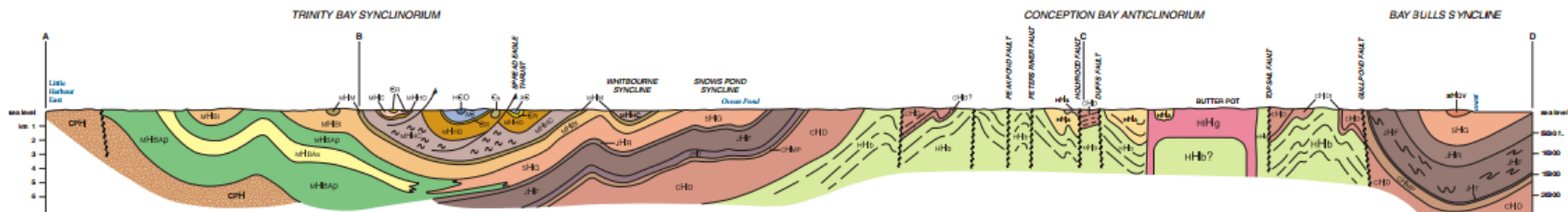
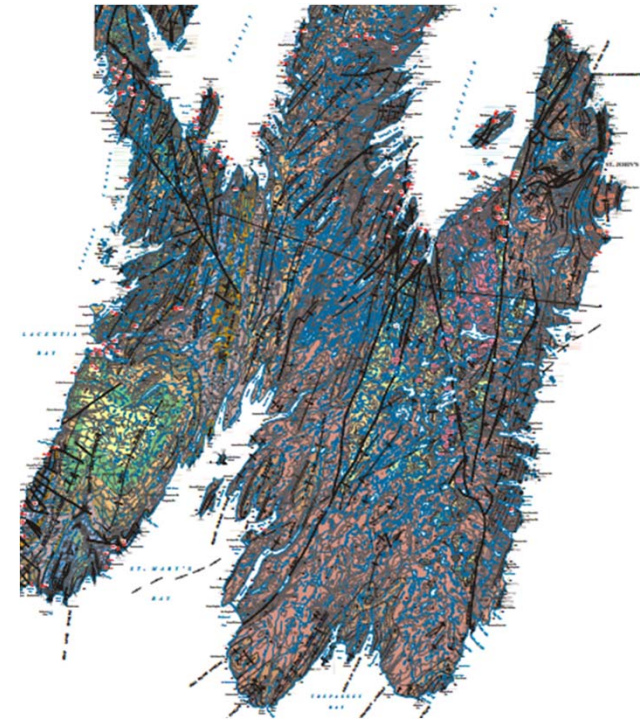


Geology of the Avalon Peninsula

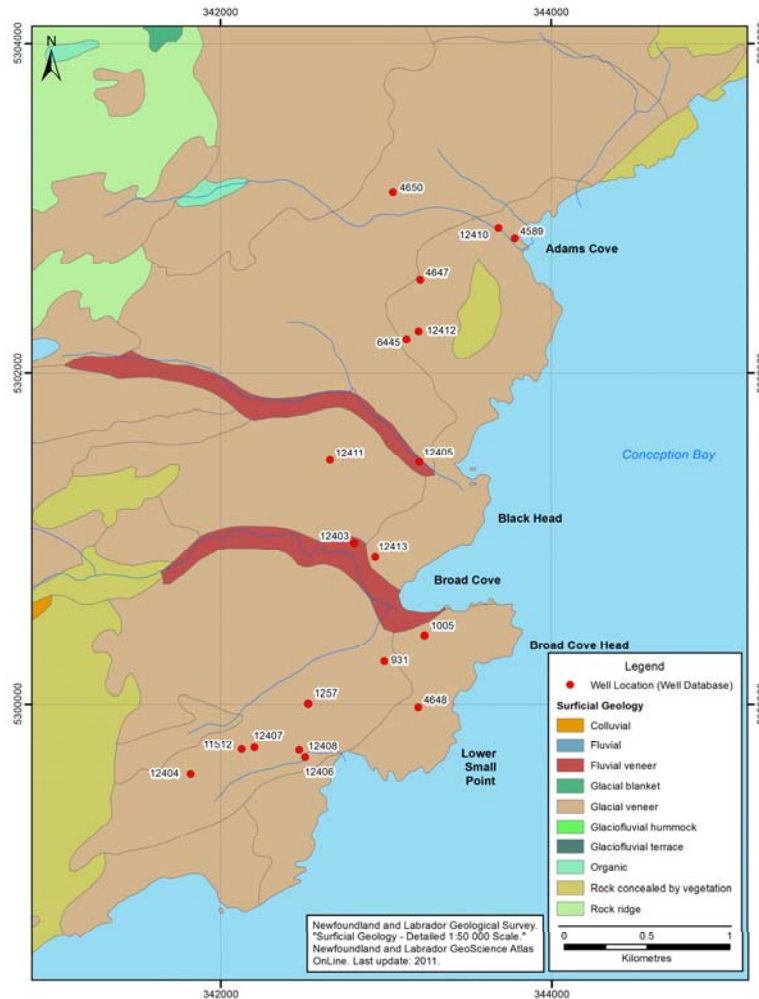
Mainly Sedimentary Rocks
Highly Folded and Faulted
Igneous Intrusions

= not flat lying

Hard to predict fracture
locations!



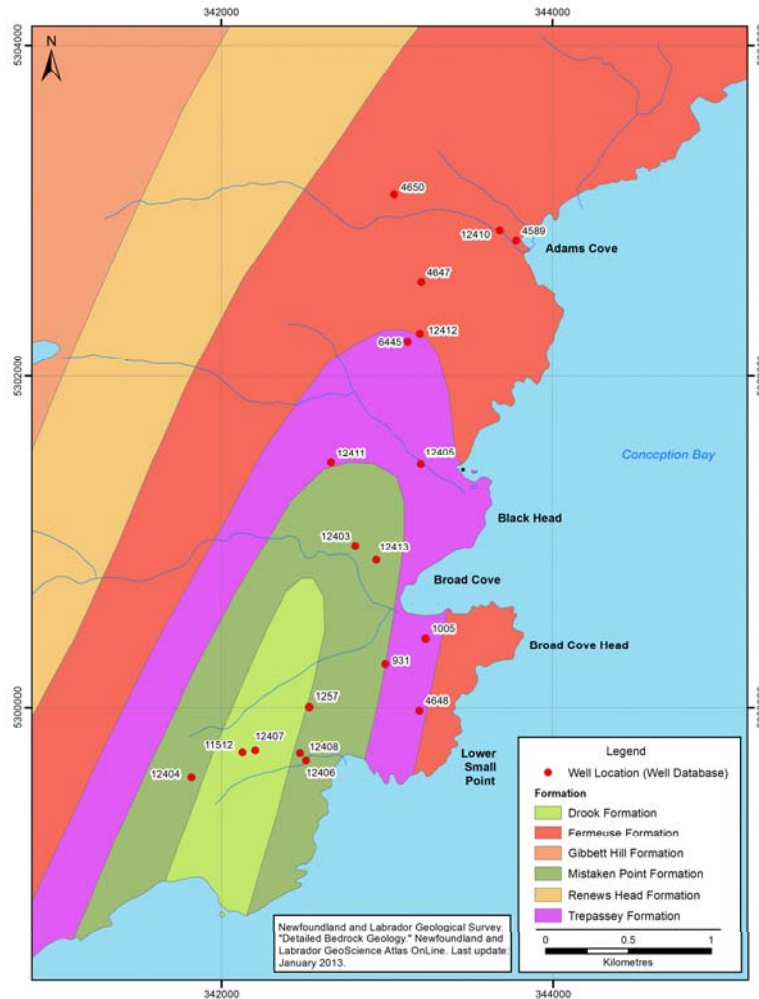
Local Surficial Geology



Different deposits have different water bearing capacity

- **Fluvial deposit near river valleys can have sand layers**
 - Can produce lots of water
- **Much of Eastern Newfoundland doesn't have much surficial cover**
 - Need to drill into the rock aquifer
- **Tills can be compacted with many different soil types**
 - Don't always produce a lot of water

Local Bedrock Geology



Different rock types have different probabilities for water yielding capabilities

Contacts between rock layers can produce higher yields

Results of well records can show areas with higher yielding water bearing zones



Well Data

Well records provide very useful data on:

- Local well yields
- Depth to bedrock
- Depth(s) to water bearing zones
- Local geology
- Well completion details

Province provides full database

Newfoundland Labrador
Department of Environment and Conservation
Water Resources Management Division
Well Construction Record

Well Identification Number (WIN) []
Measurements: Metric Imperial

Well Owner Information (must be the final owner of well) []

GPS Coordinates Latitude N 47°40'42.9" Longitude W 053°13'05.4"

Sketch of Well Location

Water Bearing Zones		Depth	Rate	Type
<input checked="" type="checkbox"/>	Fresh	17m	2 L/min	
<input checked="" type="checkbox"/>	Cloudy	68m	9 L/min	
<input checked="" type="checkbox"/>	Other (Specify)	119m	18 L/min	

Type of Water Encountered
 Fresh Odorous Salt
 Cloudy Clear Coloured
 Other (Specify) _____

Depth	Colour	Lithology
0m - 4m		Loose fill (surface water)
4m - 121m		(soft) Red & Green
33m - 38m		Red sandstone (very soft)
58m (68m)		

Depth to Bedrock: 4M Depth of borehole containing casing: 14M Total depth of borehole: 18M

Casing Information - recommended Sch 40, .280 Wall				Annular Space and Sealant	
Casing should be finished 0.60 metres (2 feet) above grade				The annulus of the well should be sealed with an impermeable sealant from the bottom of the casing/drive shoe to the surface.	
From	To	Inside Diameter	Type	Thickness	Depth
0M	14M	6"	steel		0M - 14m
Height of the casing finished above grade: <u>2'</u>				Reason why annulus was not sealed: _____	

Screen Information
 Was a screen installed? Yes No From: To: Slot: Diameter: Material:

Drilling Method			Final Status of Well/Borehole			
<input checked="" type="checkbox"/> Rotary (Air)	<input type="checkbox"/> Hammer	<input type="checkbox"/> Reverse Rotary	<input type="checkbox"/> Domestic	<input checked="" type="checkbox"/> Municipal	<input type="checkbox"/> Exploration	<input type="checkbox"/> Sealed Well
Drive Shoe installed? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Dewatering	<input type="checkbox"/> Geothermal	<input type="checkbox"/> Observation	<input type="checkbox"/> Other _____

Pumping Test Results
 Flowing Well: Yes No Pump Intake at: Pumping Rate:

Water Quality



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Department of Environment & Conservation
Water Resources Management Division

Source Water Quality for Public Water Supplies Nutrients and Metals

Sample Date	Ammonia	DOC	Nitrate(Ne)	Kjeldahl Nitrogen	Total Phosphorus	Aluminum	Antimony	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Guidelines for Canadian Drinking Water Quality			10				0.005	0.01	1.0	0.005	0.05	1.0	0.3	0.01		0.05	0.001
Aesthetic(A) Parameter or Contaminant (C)			C				C	C	C	C	C	A	A	C		A	C
Community Name:																	
Service Area:																	
Source Name:																	
Nov 17, 2010	0.000	0.0	0.000	0.000	0.000	0.000	0.00070	0.000	0.010	0.00000	0.00000	0.000	0.000	0.000	4.000	0.000	1.0000
Dec 02, 2008	0.000	0.0	0.000	0.000	0.000	0.000	0.00000	0.000	0.010	0.00000	0.00000	0.000	0.000	0.000	4.300	0.000	1.0000
Mar 06, 2008	0.000	0.0	0.000	0.000	0.000	0.000	0.00000	0.000	0.010	0.00000	0.00000	0.000	0.000	0.000	4.600	0.000	1.0000
Aug 16, 2006	0.000	1.1	0.000	0.000	0.000	0.000	0.00000	0.017	0.000	0.00000	0.00000	0.000	0.000	0.000	4.000	0.000	1.0000
Jan 25, 2006	0.000	0.7	0.000	0.110	0.020	0.000	0.00000	0.017	0.010	0.00000	0.00000	0.000	0.000	0.000	4.000	0.000	1.0000
Oct 27, 2004	0.000	0.0	0.000	0.140	0.080	0.000	0.00300	0.020	0.010	0.00000	0.00000	0.000	0.000	0.000	4.000	0.000	1.0000
May 26, 2004	0.000	0.0	0.000	0.000	0.030	0.000	0.00200	0.022	0.000	0.00000	0.00000	0.000	0.000	0.000	5.000	0.000	1.0000
Oct 28, 2003	0.010	0.3	0.050	0.025	0.040	0.005	0.00050	0.014	0.010	0.00005	0.00100	0.001	0.005	0.001	5.000	0.008	1.0000

Water Quality

Source water quality all available on the Water Resources Website

<http://maps.gov.nl.ca/water/#PublicWater>

Can be used to predict water quality in nearby wells

For example important for:

- **Naturally occurring arsenic**

Local Land Uses

What land uses occur in the proposed well area?

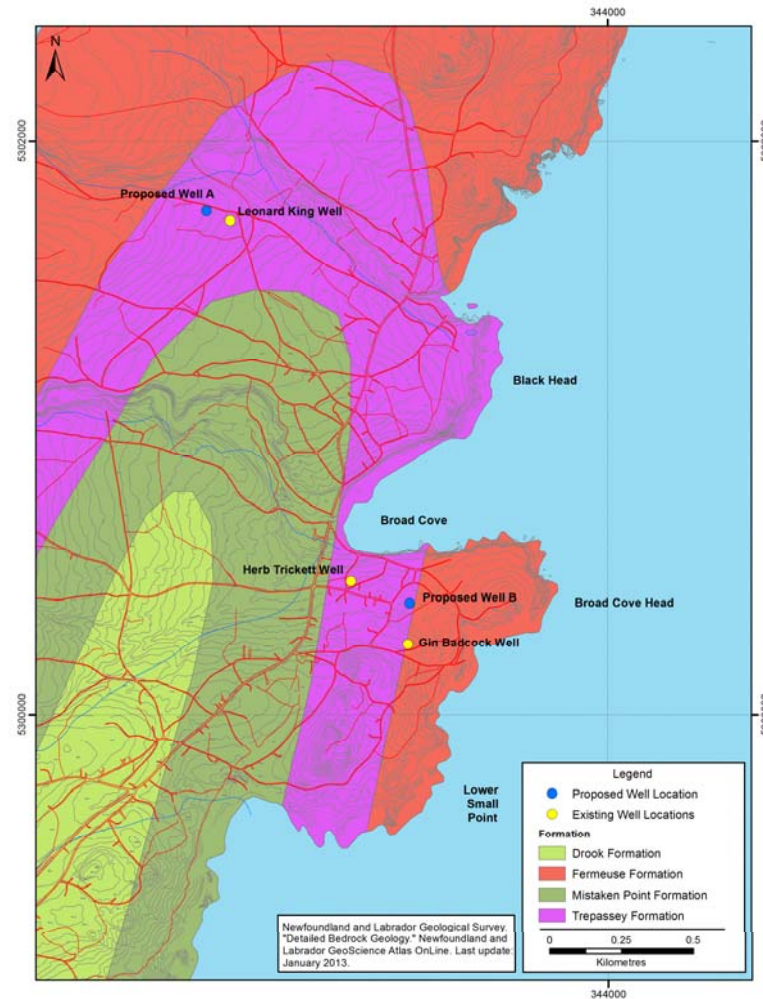
- **Agriculture**
- **Septic tanks**
- **Landfill**
- **Gas station**
- **Dry cleaners**
- **Mining**
- **Sea water intrusion**



Local Land Uses



Choosing the Well Location



Need land

Surrounding well uses

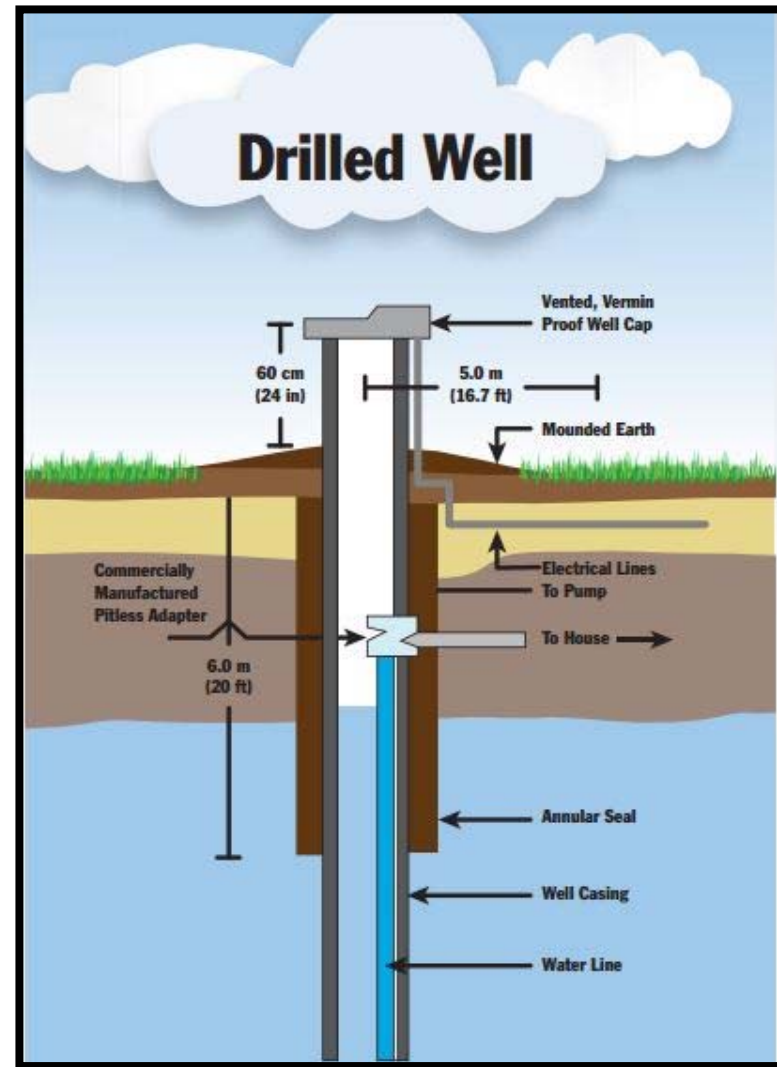
Geology data

Well Completion

Well completion can help ensure good water quality

Protects from bacteria

Protects from surface water inflow



Conclusions

Geology

Hydrogeology

Well data

Water quality

Local land uses

Putting it all together!



Contact us



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