

# Salt Contamination of Private Wells: It's Not as Simple as It May Seem

Presented by:

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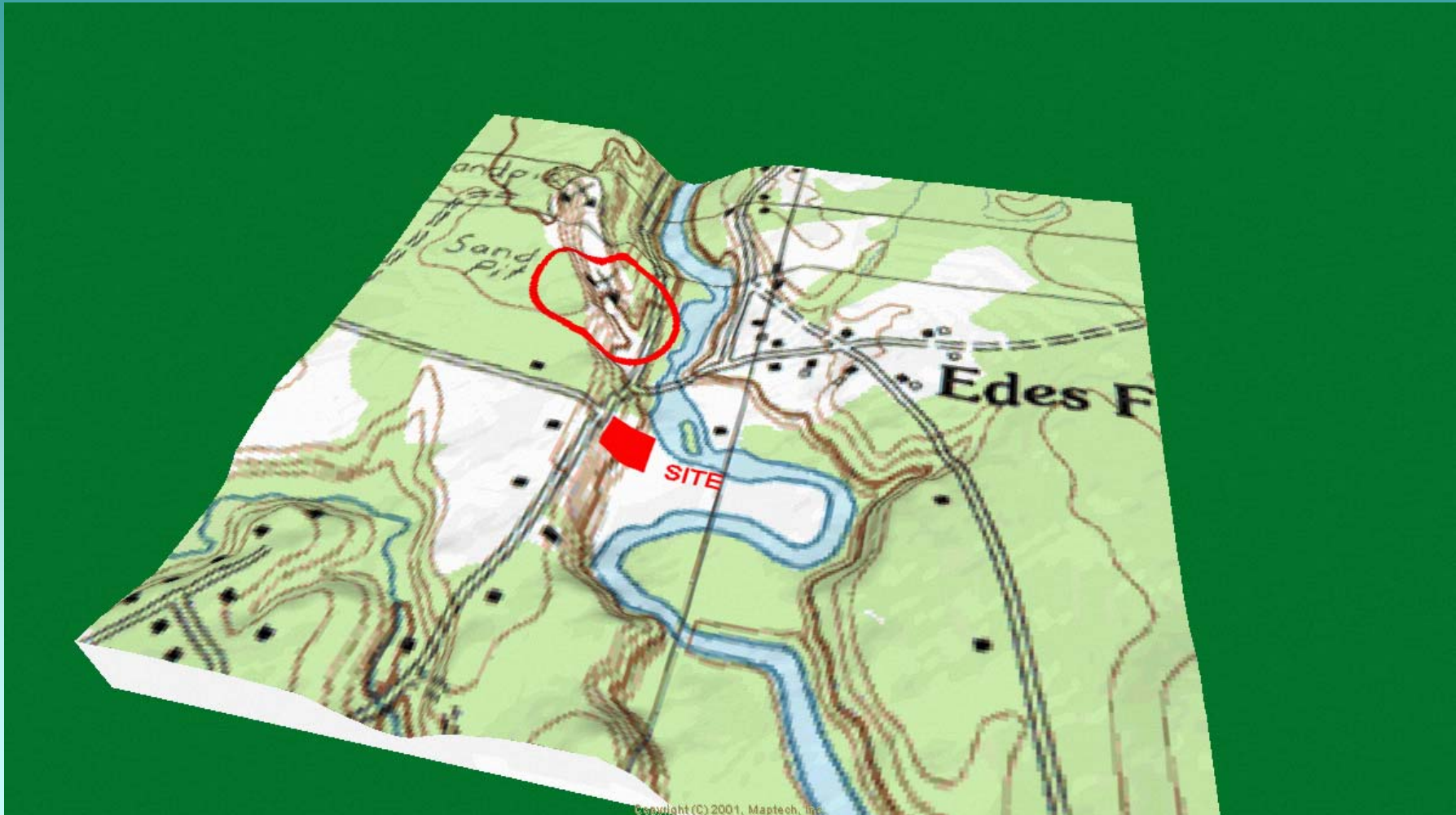
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# Case Studies (Naples)



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# Case Studies (Naples)



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# Case Studies (Naples)

- **Geology, Well Construction**

- Sand and gravel, 13' deep at well, overburden dry at well
- 100' well cased only to the bedrock

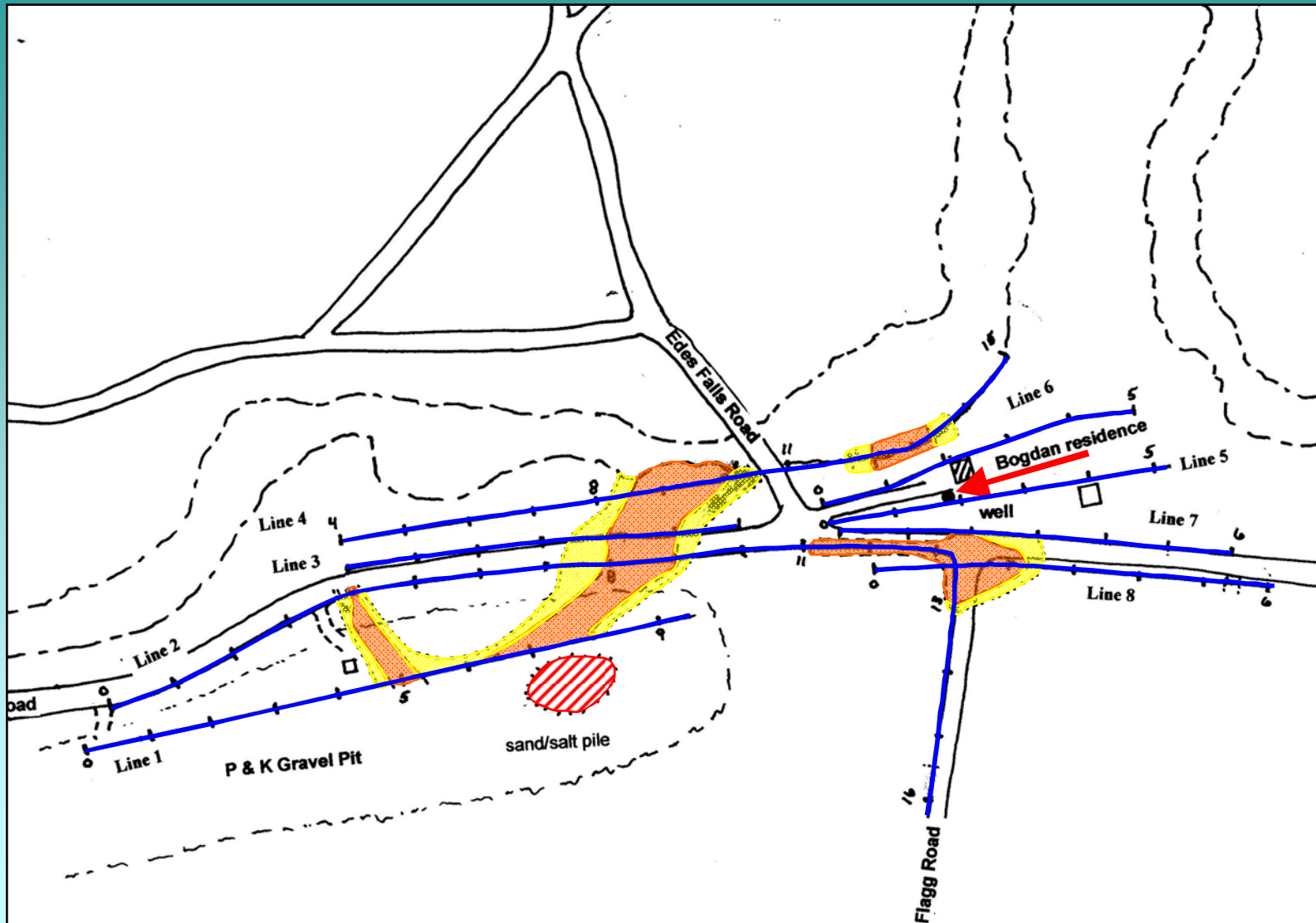
- **Water Quality History**

	Sep-02	Jan-03
Sodium	115	405
Chloride	190	902

- **Assessment Methods**

- Expanded sampling that included some additional parameters (K, Ca, Mg, Mn, Fe, SO<sub>4</sub>, etc.)
- Geophysical Surveys targeted salt storage, well area
- Geoprobe borings for geology, water quality

# Case Study (Naples)



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# Case Study (Naples)

- **Conceptual Model**

- Salt originated from road application (steep intersection), not storage site
- Ground water moved easily between bedrock and overburden
- Well had little casing and likely drew water from shallow bedrock

- **Solution is a new well**

- **Results**

- Bedrock at 37', casing to 50', water at 215'.
- Sodium = 14 ppm, Chloride = 10 ppm



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# Case Studies (Brunswick)

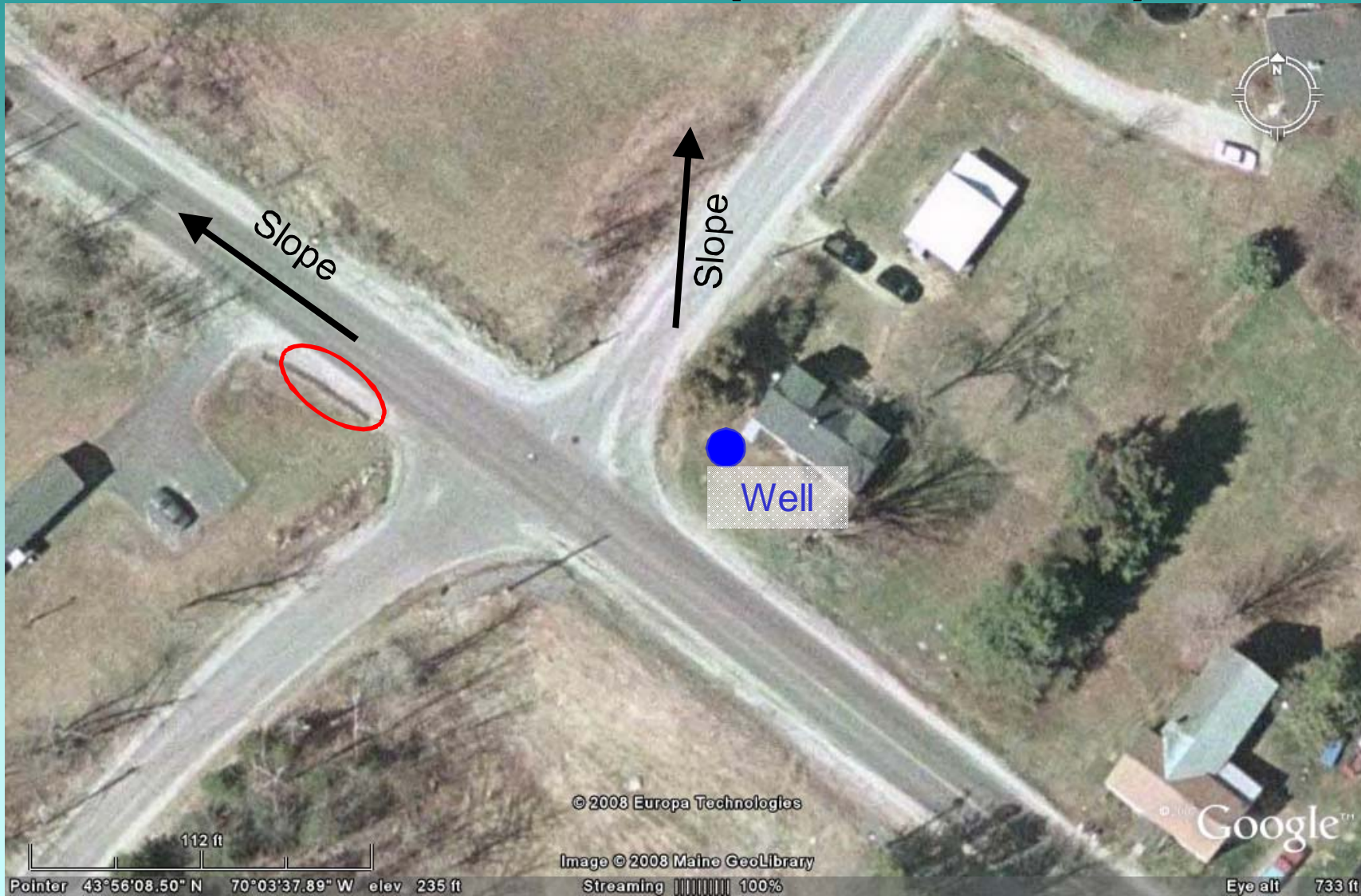


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# Case Studies (Brunswick)



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# Case Studies (Brunswick)

- **Geology, Well Construction**

- <10' till, bedrock exposed in area
- Well 220' deep, 20' casing

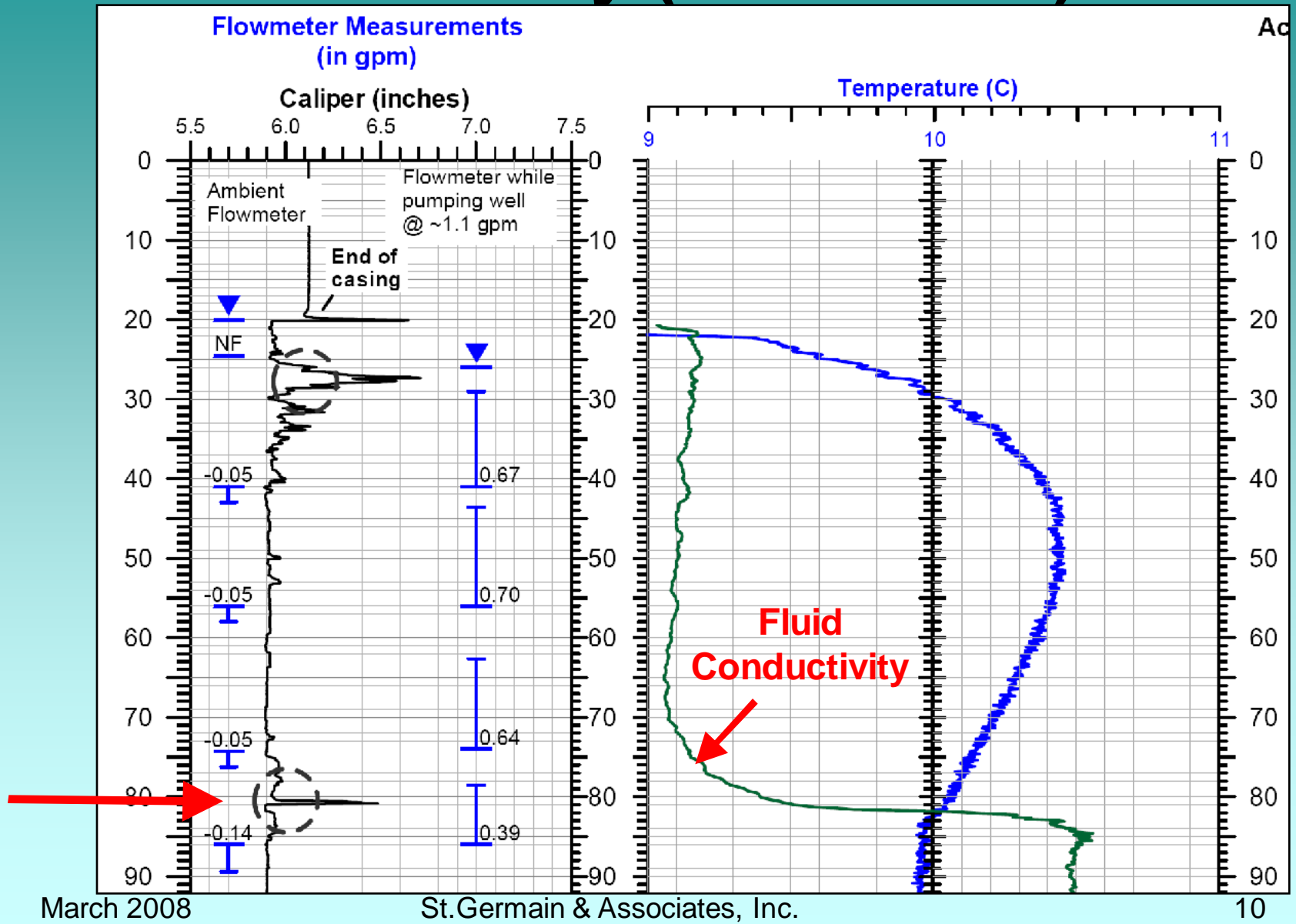
- **Water Quality History**

	7/14/04	11/8/04	12/9/04	4/11/05
<b>Sodium</b>	68	74	NA	55
<b>Chloride</b>	288	290	NA	250
<b>Nitrate</b>	<1.0	4.3	3.8	4.3

- **Assessment Methods**

- Expanded sampling that included some additional parameters
- Borehole geophysics

# Case Study (Brunswick)



# Case Study (Brunswick)

- **Conceptual Model**

- Increased conductivity, abrupt temperature change, increased flow at fracture at depth of 81'
- Orientation of 81' fracture puts it at the surface in the drainage ditch where bedrock was exposed
- Most or all of the salt is migrating from ditch to well via the 81' fracture

- **Solution**

- Replacement well not feasible due to small parcel and leachfield (100' setback required)
- Instead, installed a “jaswell” seal to a depth of 110' to isolate fracture

# Case Study (Brunswick)



- **Results**

- Seal prevented most of the salt from entering the well
- Sodium = 38 ppm, Chloride = 120 ppm (Nitrate still 5 ppm)
- Still higher than background but appears to have worked

# Case Studies (Windham)



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# Case Study (Windham)



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# Case Studies (Windham)

- **Geology, Well Construction**
  - <8' till, bedrock exposed on site, mostly unsaturated
  - 142' well, 10' of casing
- **Water Quality History**
  - Unusually high salt levels for road application source



	Nov-93	Apr-01	Apr-01	Aug-02	Sep-03	Nov-03	Feb-04
Sodium	NA	NA	NA	NA	620	493	325
Chloride	73	860	320	NA	1600	940	951
Calcium	NA	NA	NA	NA	NA	NA	90
Magnesium	NA	NA	NA	NA	NA	NA	14
Potassium	NA	NA	NA	NA	NA	NA	7.2
Alkalinity	NA	NA	NA	NA	NA	NA	36
Sulfate	NA	NA	NA	NA	NA	NA	19.5

# Case Study (Windham)

- **Assessment Methods**
  - Expanded Sampling
  - Geoprobe borings
    - Continuous soil sampling to bedrock
    - Ground water analysis for salt
    - Because only one location had water, analyzed soil for salt
  - Geophysical Survey
    - Borehole geophysics only partially successful because of existing Jaswell seal in place



# Case Study (Windham)

- **Conceptual Model**

- Very shallow overburden, mostly unsaturated, full of salt
- “Bowl” shape to bedrock surface; contains overburden ground water
- Salty runoff from road (no curbs or ditches) is captured in bedrock “bowl” and moves down rather than laterally

- **Solutions that Failed**

- Previous well driller tried Jaswell seal but it failed
- We moved Jaswell down to 125’ but salt returned
- Salt entering from bottom of well 😞

- **New well needed but...**

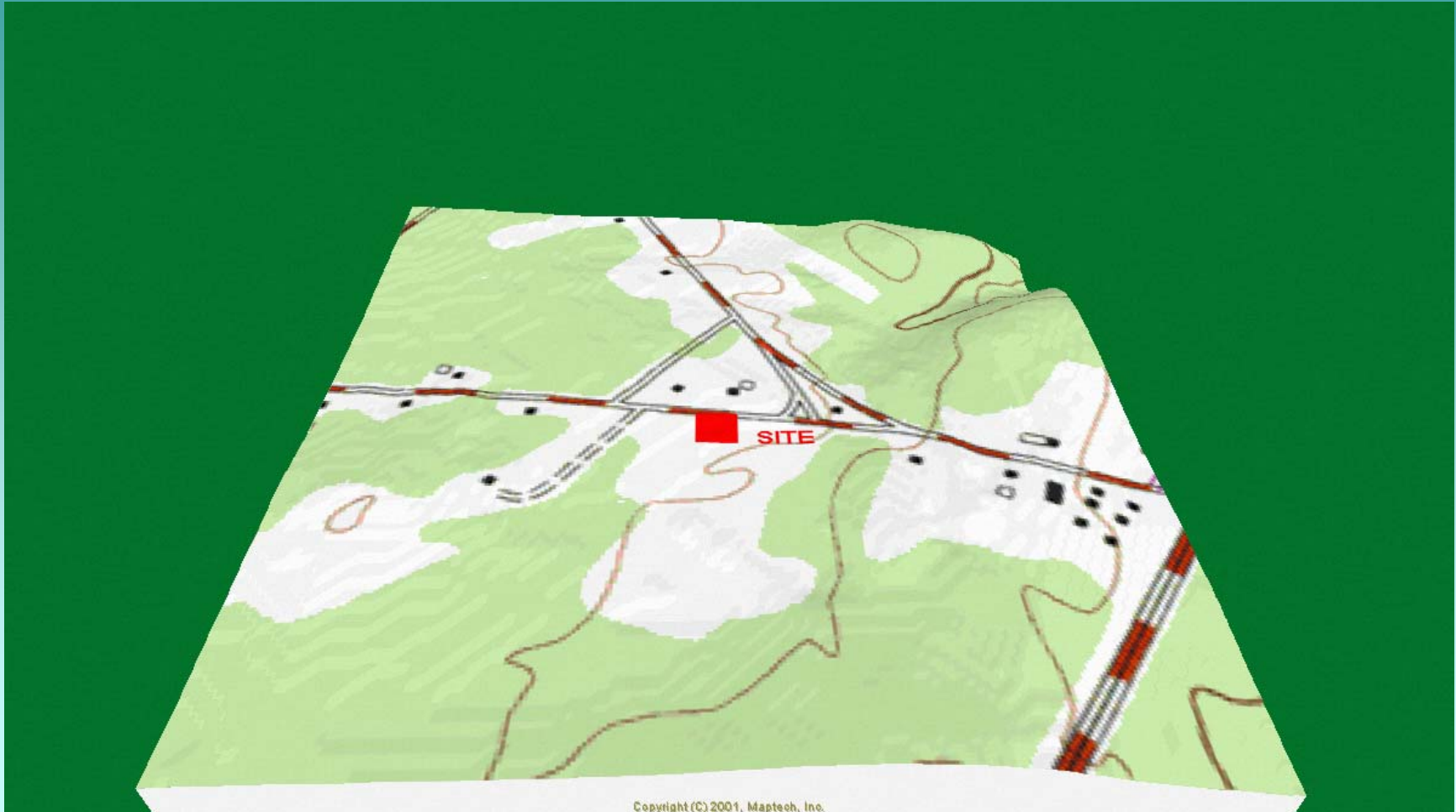
- Very little land
- No obvious location because of bedrock “bowl”

# Case Study (Windham)

- **Solution that worked**
  - Constructed well with 200' casing
  - 60 gpm at 450'; sodium = 10 ppm, chloride = 2 ppm



# Case Studies (Scarborough)



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# Case Study (Scarborough)



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# Case Studies (Scarborough)

- **Geology, Well Construction**
  - Shallow Till
  - Two wells
  - 10 Ash Swamp Road = 30' from road
  - 12 Ash Swamp Road = 150' from road
- **Water Quality History**

	10 Ash Swamp Road					
	7/21/05	12/28/05	4/12/06	7/11/06	10/24/06	1/4/07
<b>Choride</b>	188	74	101	232	57	66
<b>Sodium</b>	122	44	51	94	51	46

	12 Ash Swamp Road					
	7/21/05	12/28/05	4/12/06	7/11/06	10/24/06	1/4/07
<b>Choride</b>	---	77	116	126	36	58
<b>Sodium</b>	---	51	59	79	40	44

# Case Study (Scarborough)

- **Assessment Methods**

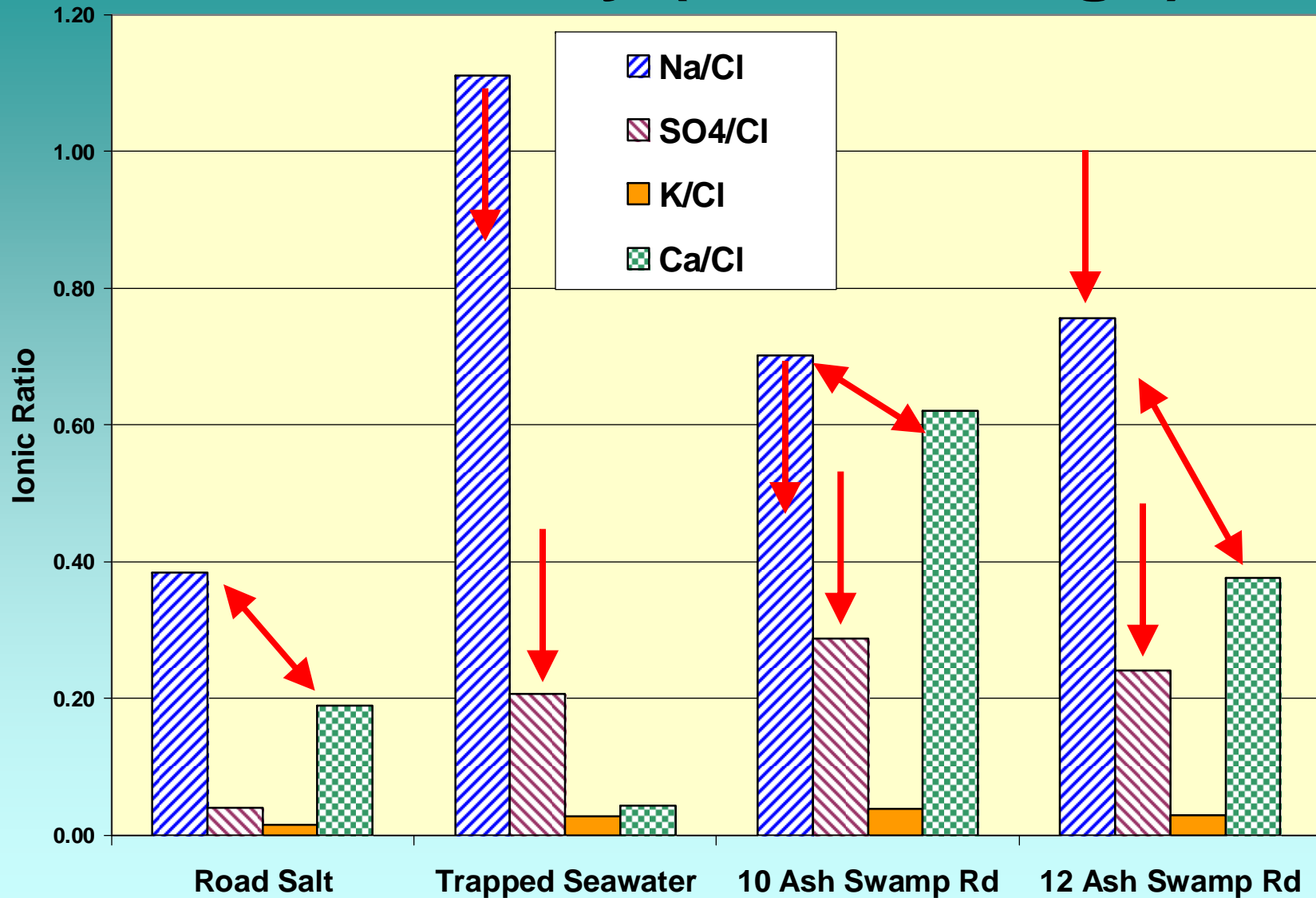
- Expanded Sampling and Geochemical Analysis

- A good example of where expanded suite of parameters very useful
    - Used simple ionic ratios to compare to Maine DOT 1990 study of **road salt, seawater intrusion**, and **relict salt water** sources
    - Seawater intrusion unlikely since closest brackish water (Scarborough Marsh) is about 2 miles away

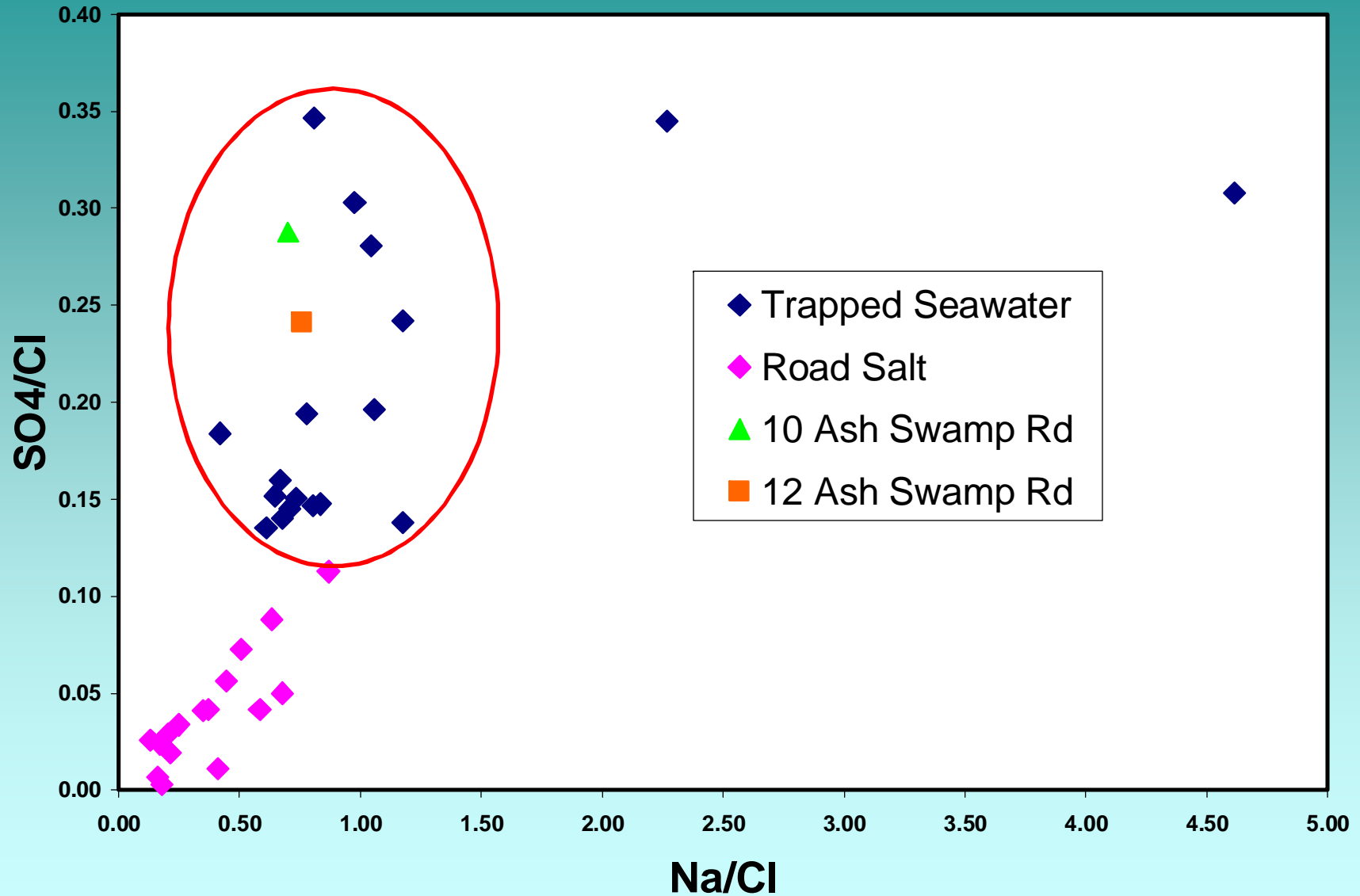
- **Results**

- No bromide, normally indicator of seawater (new or old)
  - But salt concentrations are low, maybe bromide too low to detect?
  - Focused on ionic ratios

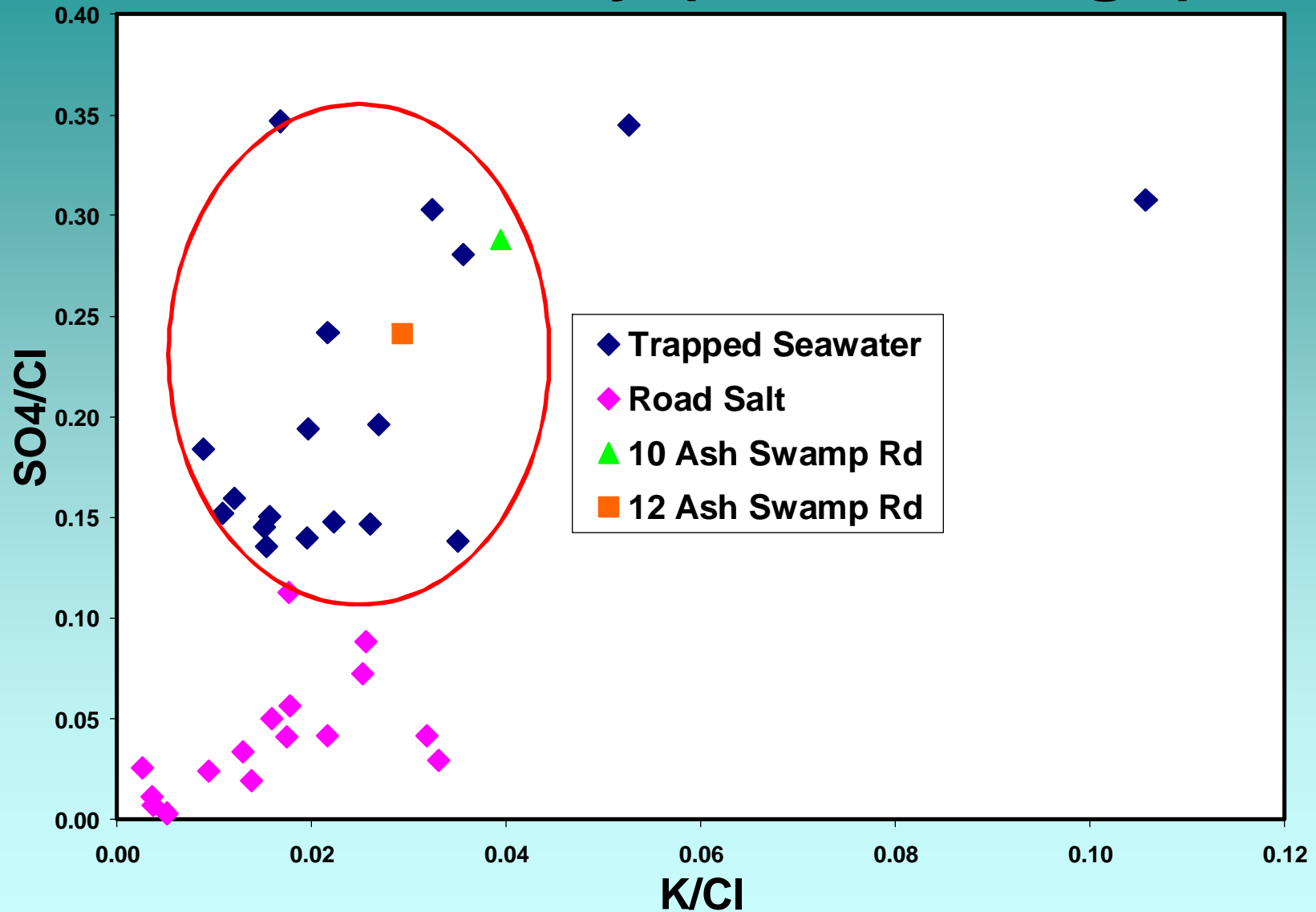
# Case Study (Scarborough)



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# Case Study (Scarborough)



# Case Study (Scarborough)

- **Conceptual Model**
  - Salt concentrations very similar in wells despite difference in distance from road
  - Road layout, topography not suggestive of high road salt area or runoff toward wells
  - Ionic ratios with  $\text{SO}_4$  strongly suggest relict seawater
- **No solution pursued since road salt not the source**
- **Good example of misleading clues**
  - Shallow overburden
  - No bromide detected
  - Initially suggests road salt

# Conclusions

- **Careful Assessment of Salt Source Needed**
  - **Surface Topography**
  - **Overburden Type and Thickness**
  - **Bedrock Type and Depth**
  - **Well Construction**
  - **Ground Water Depth and Flow**
  - **Bedrock Structure and Topography**
  - **Geochemistry**
- **Easy to be misled by one or two “obvious” conditions**



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