Sea-Level Rise Impacts on Drinking Water:

A Groundwater Modeling Study in Newmarket, NH

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Funded by: 2016 NHDES Local Source Water Protection Grant

NHCAW Climate Summit 6-20-2018

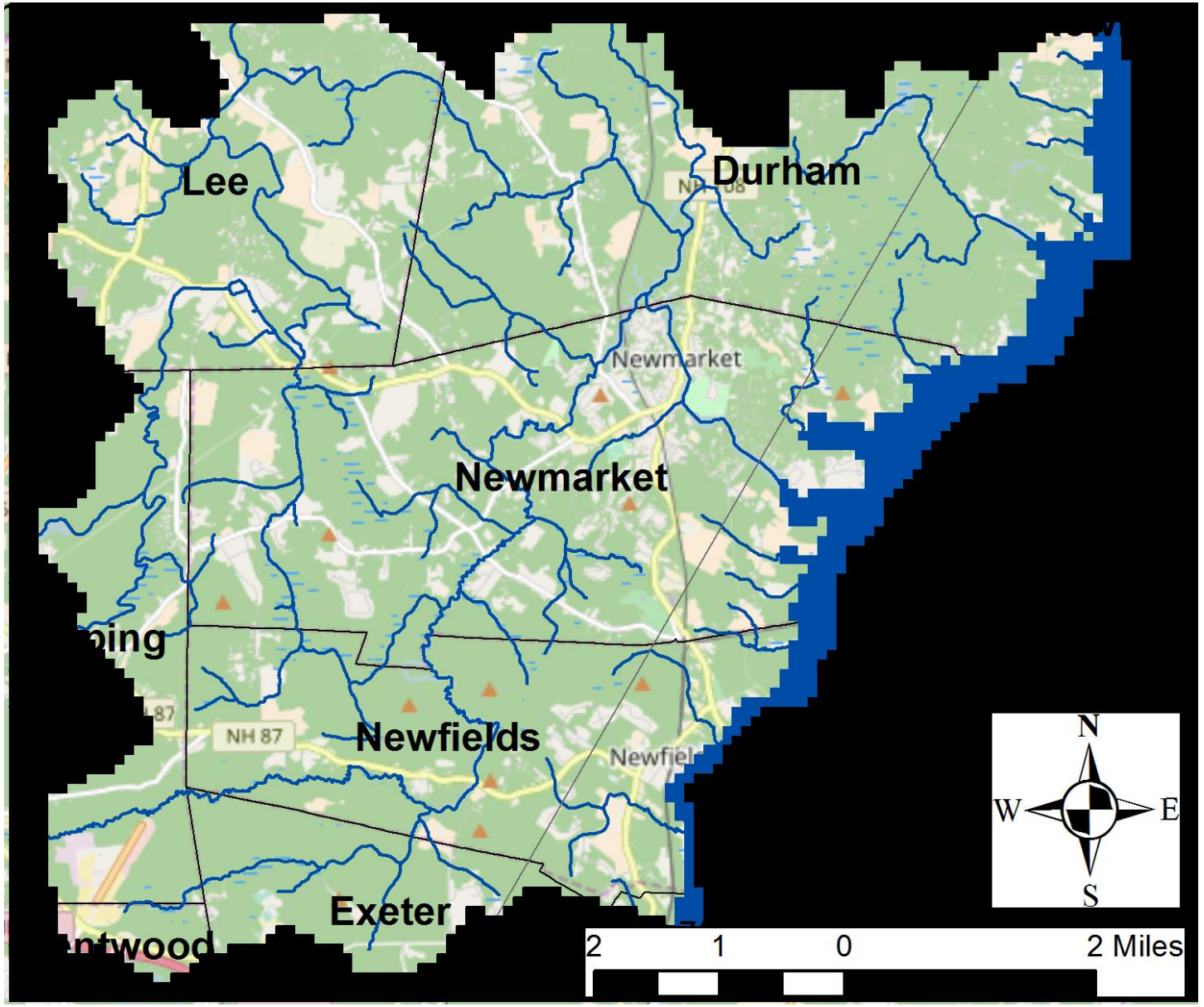
Project Goals

- Increase understanding of how sea-level rise (SLR) may impact groundwater (GW) sources of drinking water
- Identify areas in Newmarket that may be vulnerable from SLR-induced GW rise
- Provide the Newmarket town leaders with adaptation strategies for greater resiliency

Project Overview

- Funded by 2016 NHDES Local Source Water Protection Grant
- Engaged a Technical Advisory Committee
- UNH created a GW model to calculate changing GW levels and salinity distributions associated with SLR
- The modeling results were analyzed to assess local vulnerabilities and to suggest adaptation strategies

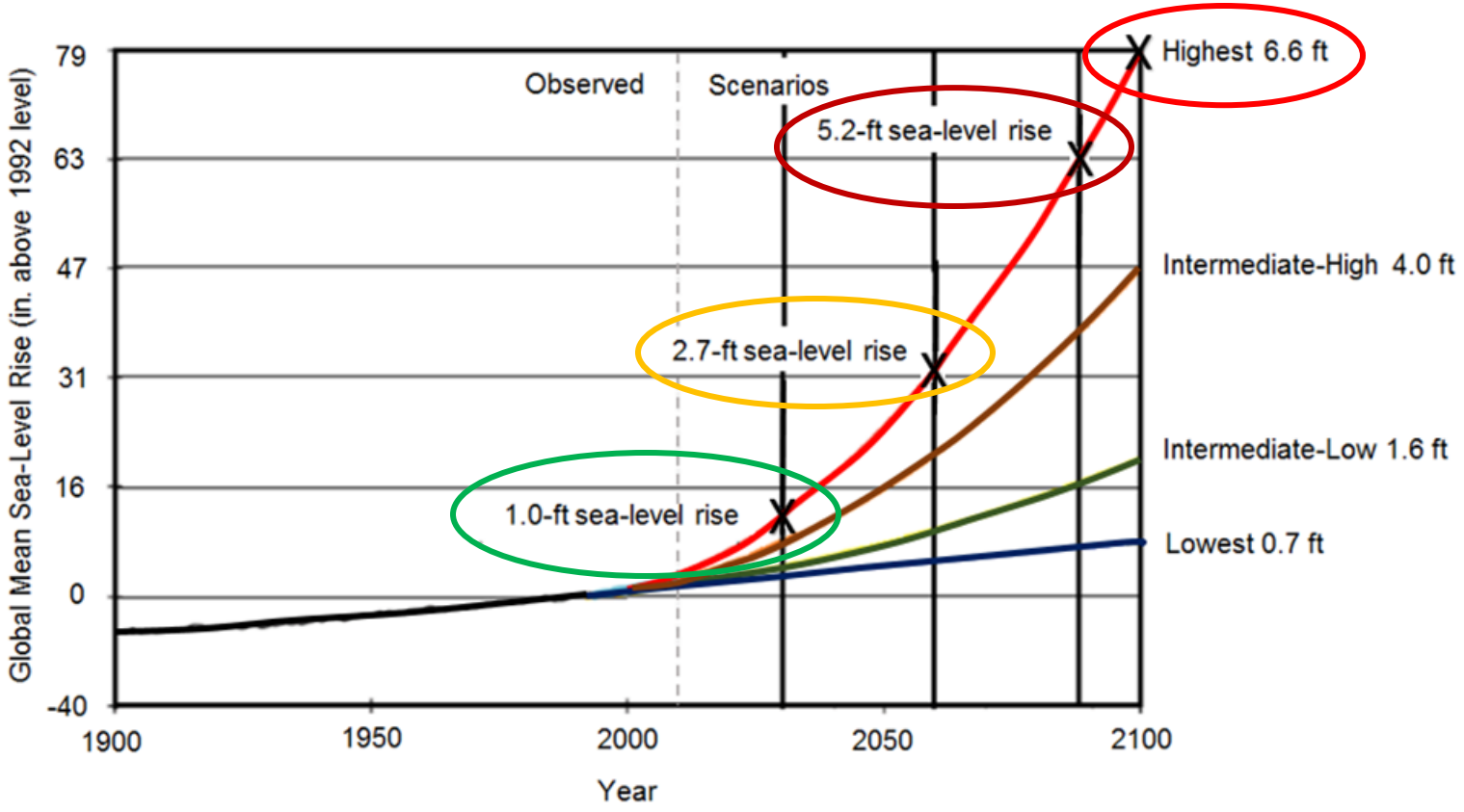
Model Study Area



Scenario-Based Approach

Sea-Level Rise (SLR) along the High Emissions Scenario:

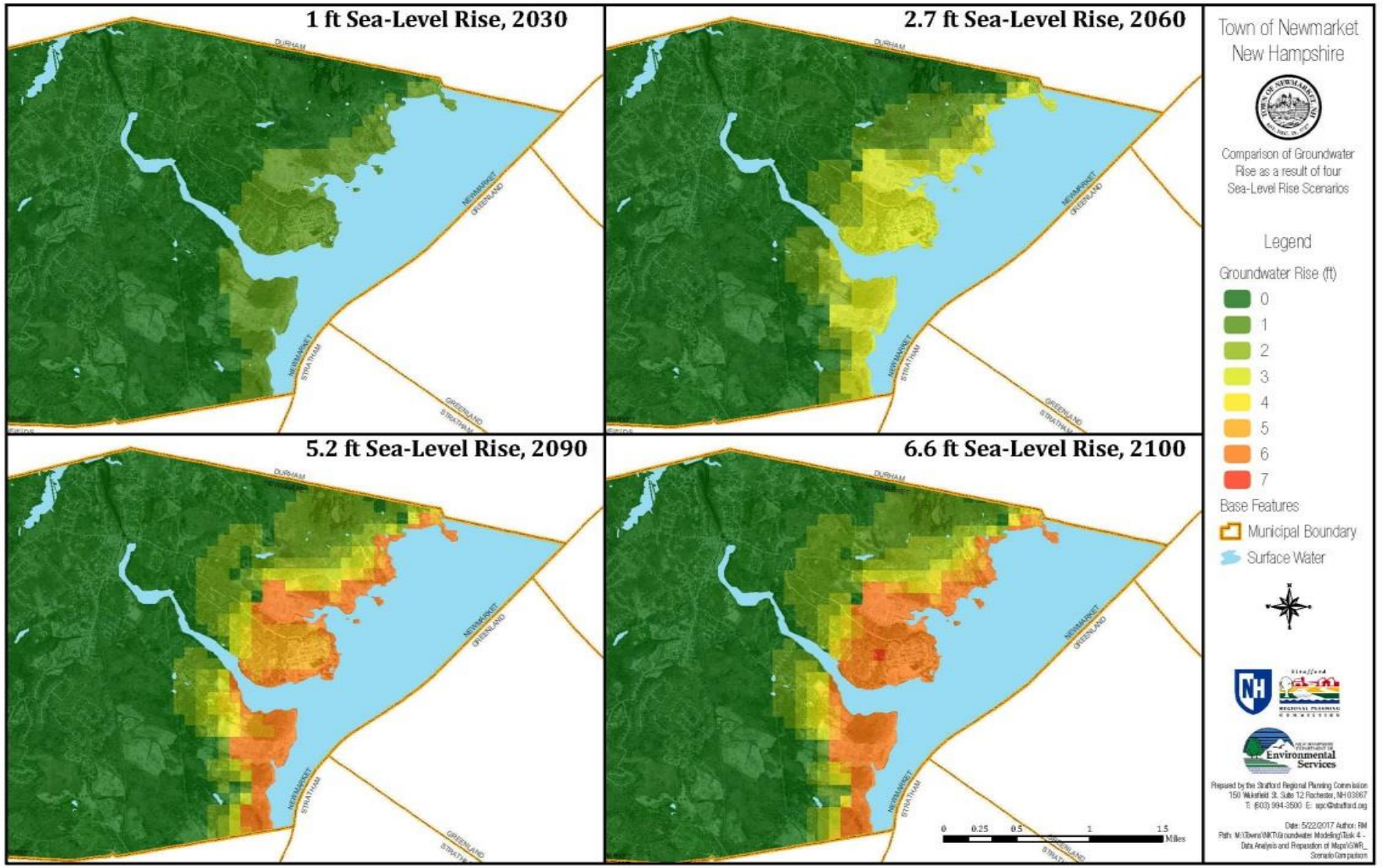
- 1.0 ft. SLR (Y: 2030)
- 2.7 ft. SLR (Y: 2060)
- 5.2 ft. SLR (Y: 2090)
- 6.6 ft. SLR (Y: 2100)



From: NOAA (Parris et al., 2012)

Project Results – Groundwater Rise

Increase in groundwater level with SLR

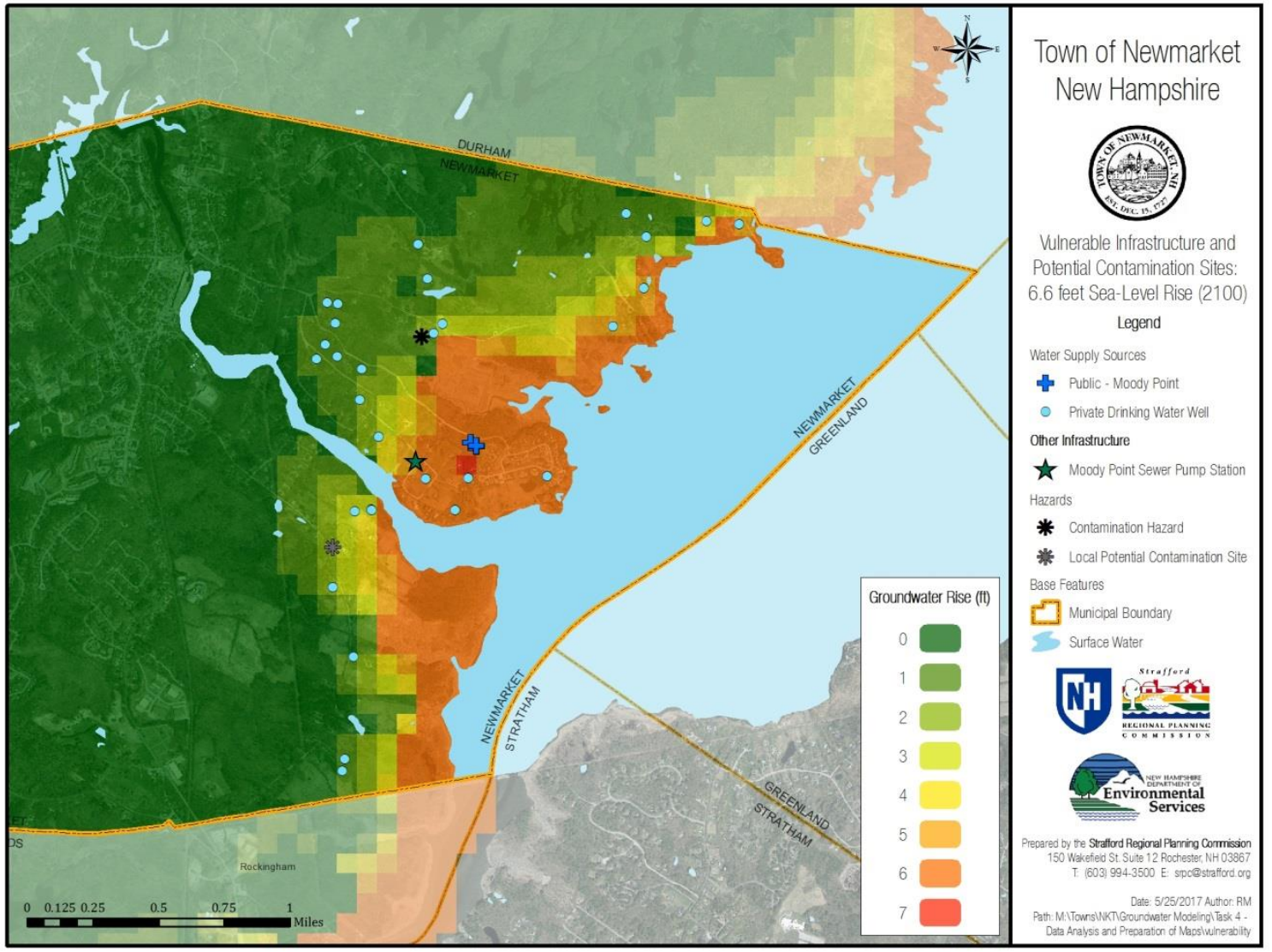


Vulnerable Infrastructure and Potential Contamination Sites

- GW rise: 1 to >6 ft within the GWRZ (0.8 mi. inland)

Within the GWRZ:

- 2 potential contamination sites
- 1 sewer pump station on Moody Point
- 30 private drinking water wells within the GWRZ



ICNet
INFRASTRUCTURE & CLIMATE NETWORK

UNH CIRC

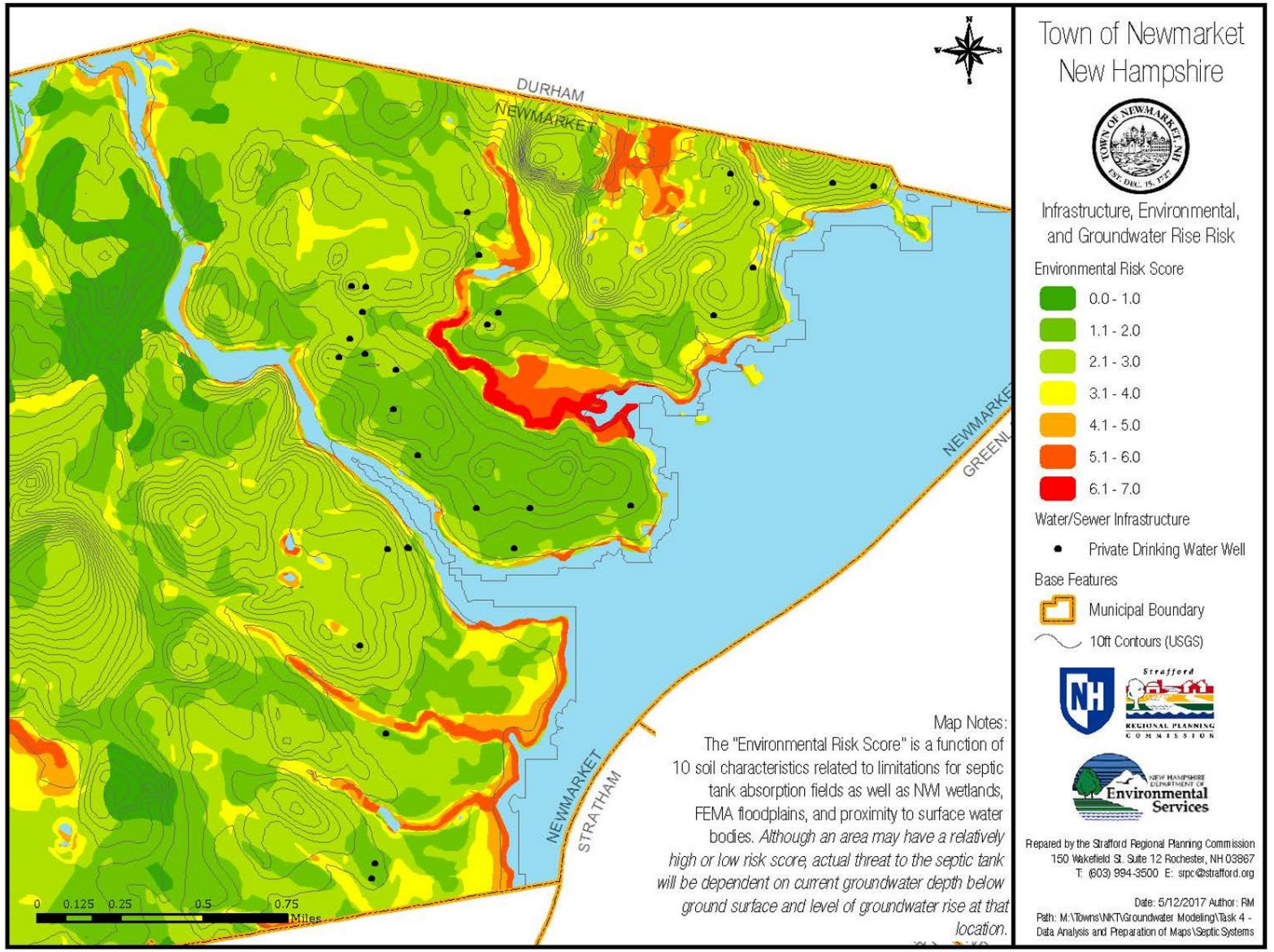
Environmental risk from septic tanks

Environmental Risk Score:

- Soil characteristics
- Proximity to surface water

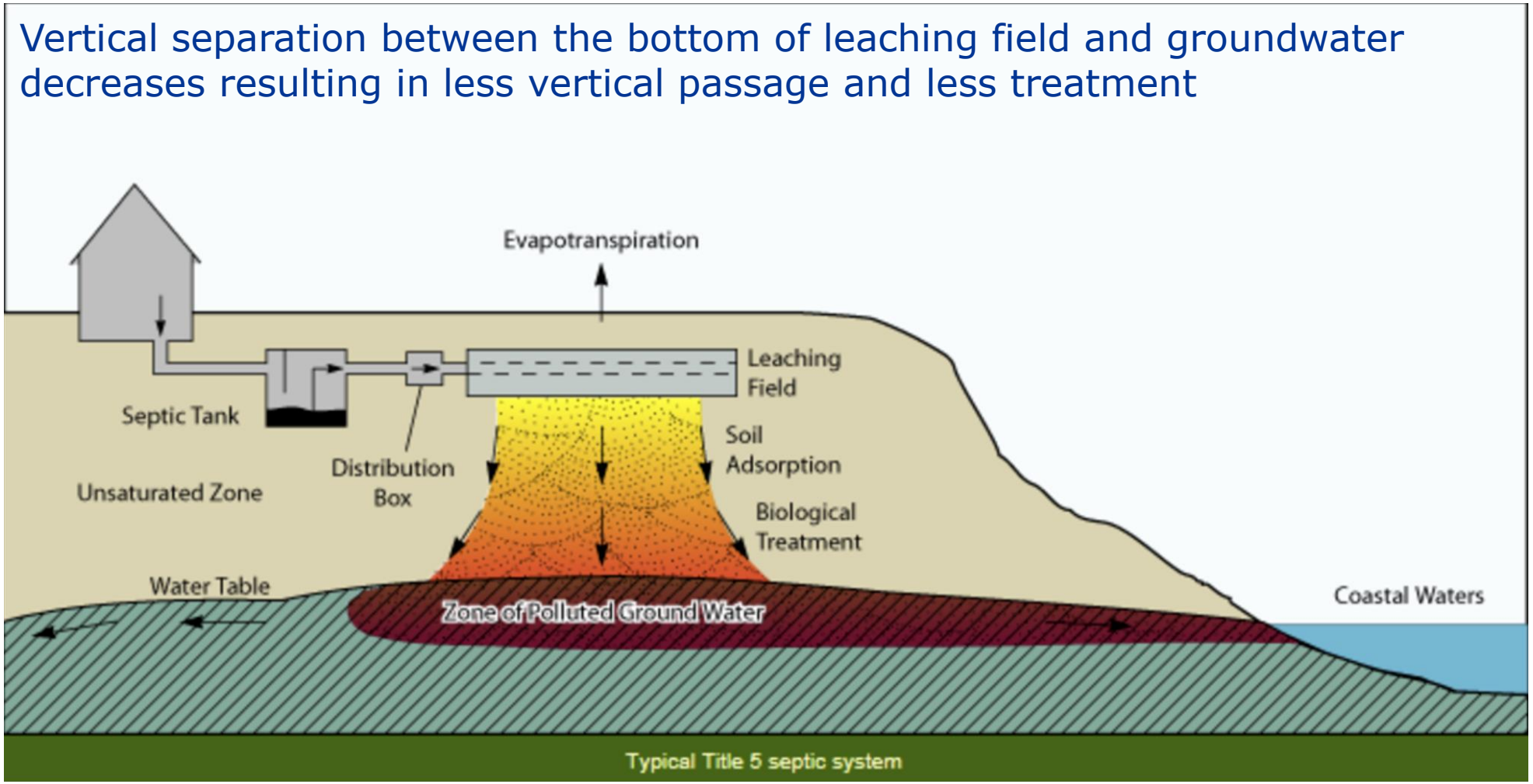
Also important for septic system performance:

- Current GW depth
- Future GW depth



Groundwater and surface water contamination from septic tanks

Vertical separation between the bottom of leaching field and groundwater decreases resulting in less vertical passage and less treatment



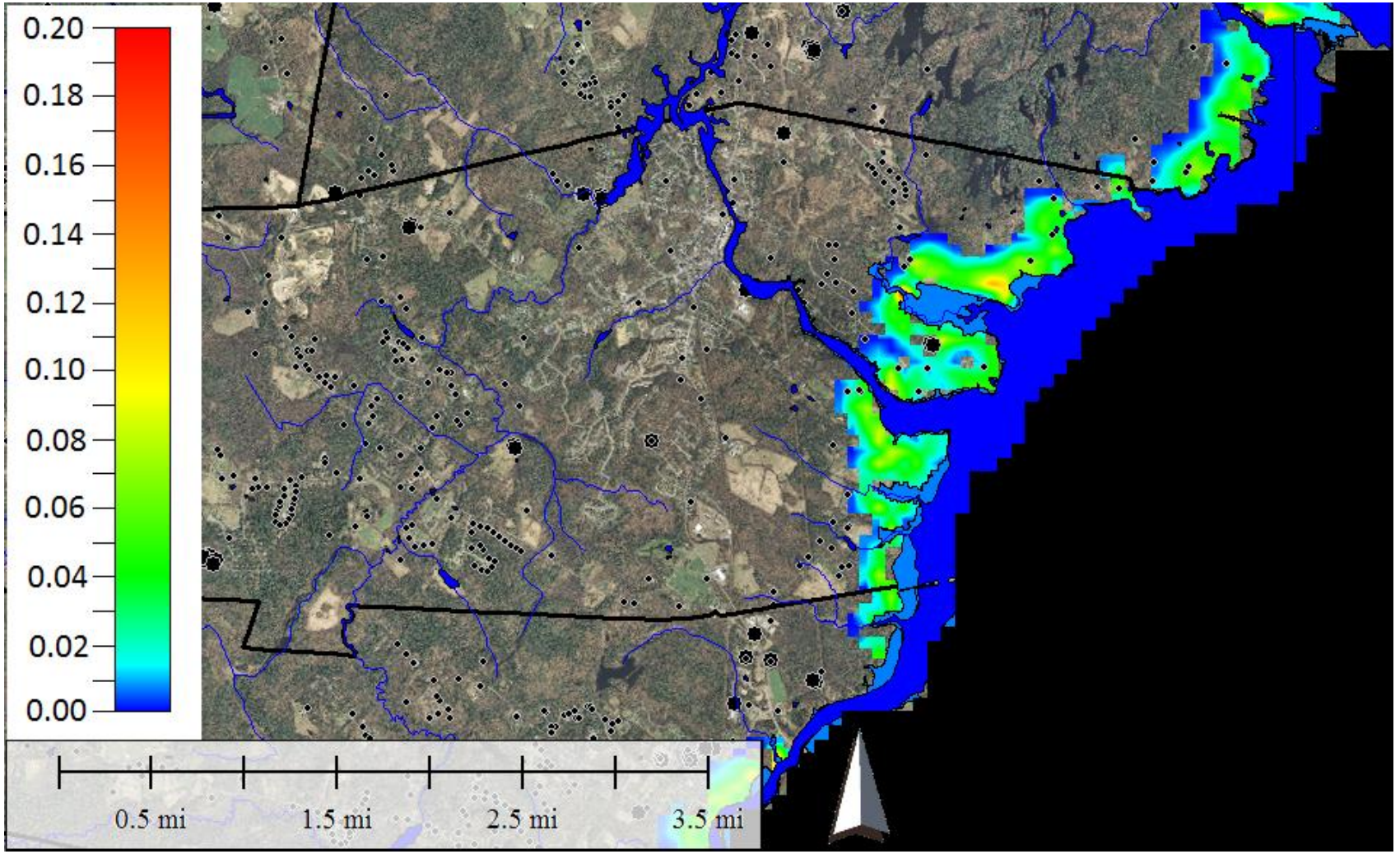
Source: https://www.mass.gov/service-details/smart-growth-smart-energy-toolkit-modules-wastewater-alternatives

Project Results – Salt Concentrations

Projected salt concentration increase in shallow groundwater with 6.6 ft. SLR

0 to 5 feet below MSL:

< 10% increase in salinity in most places

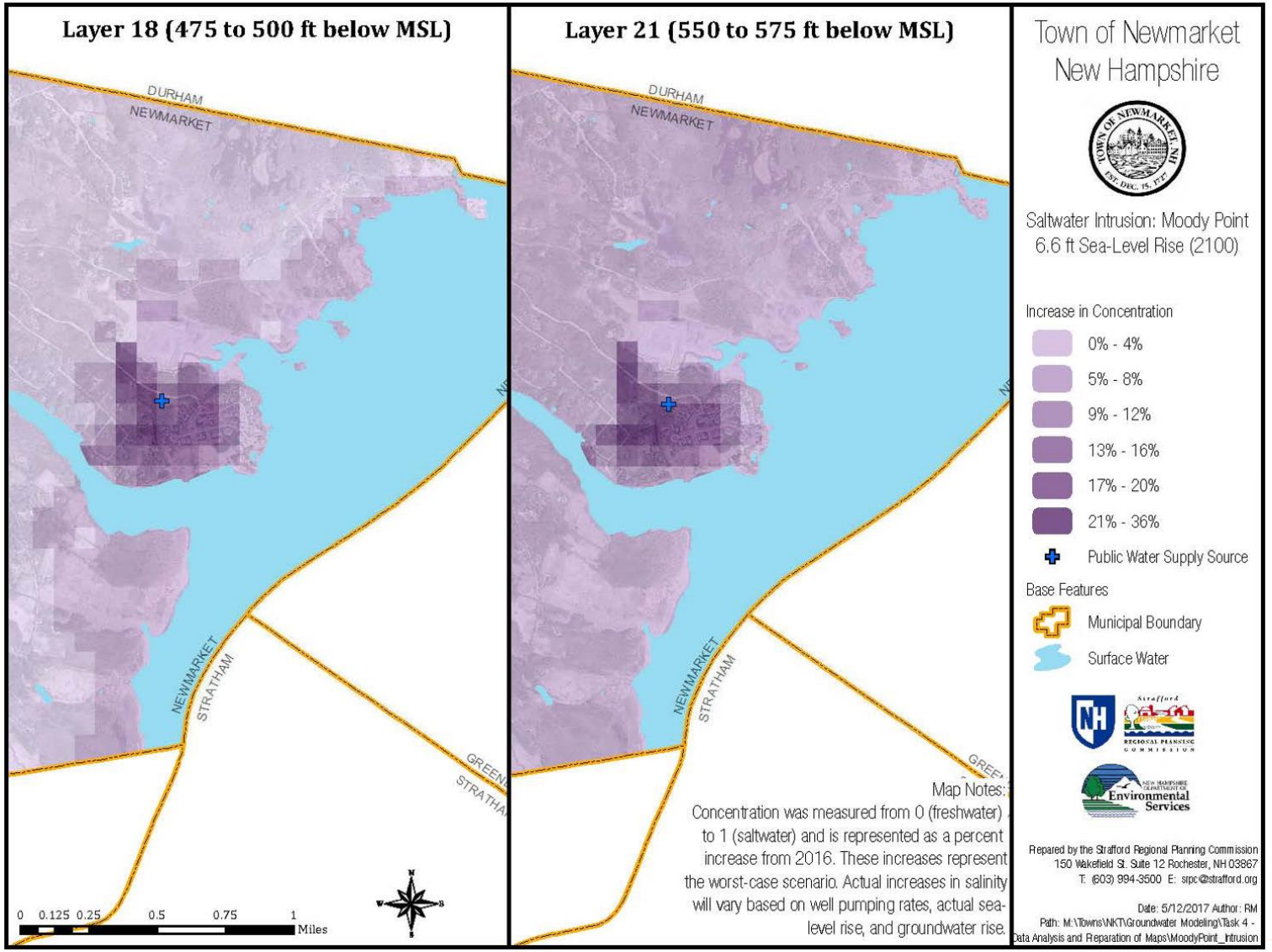


Surface water

Wetland

Projected salt concentration increase with 6.6 ft SLR

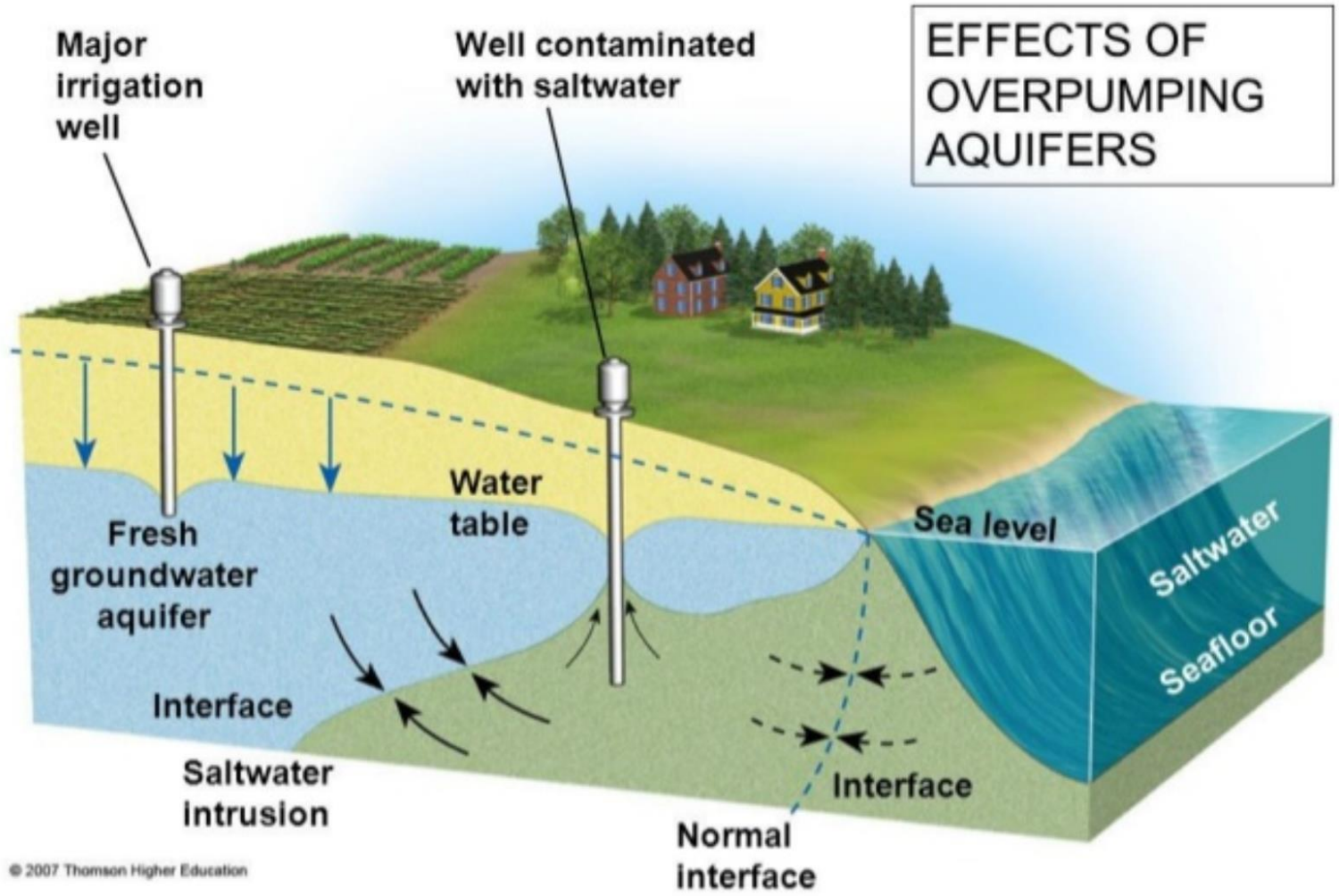
- Model predicts up to 16% increase in groundwater salinity
- Pumping rate is assumed constant
- Moody Point –already experiencing elevated total dissolved solids (TDS)



475 to 500 ft below MSL

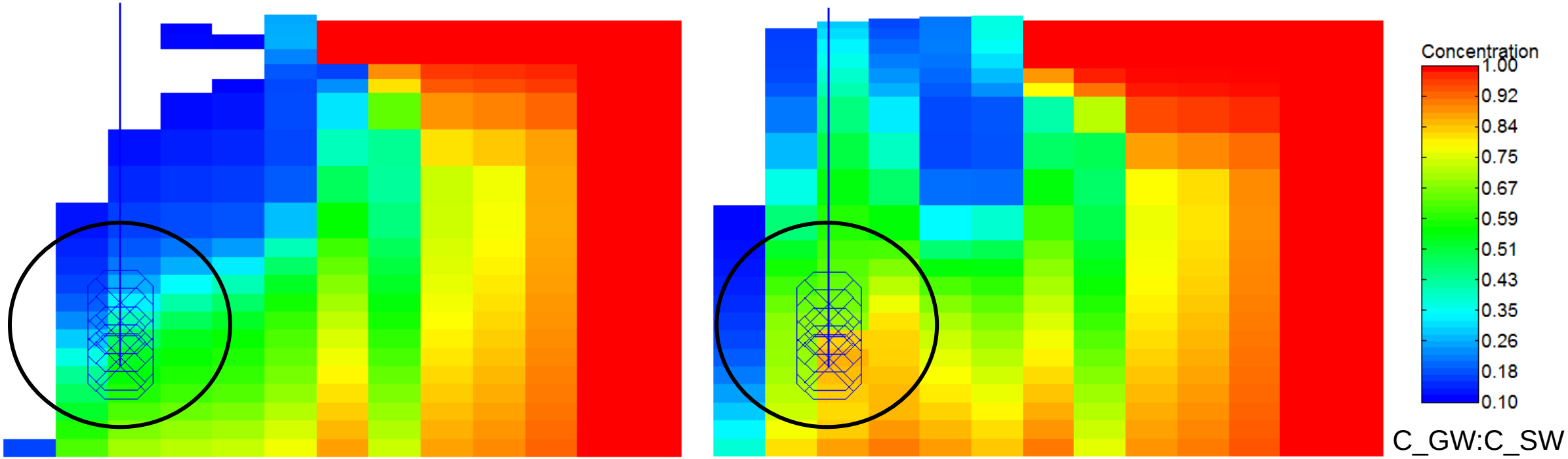
550 to 575 ft below MSL

Saltwater Intrusion into Drinking Water Wells



2007 Thompson Higher Education;
https://www.slideshare.net/prashantpkatti/sea-water-intrusion

Simulated concentrations in Moody Point drinking water wells



Current MSL

6.6 feet of SLR - Year 2100

	TDS (mg/l)
Rainwater:	<20
Brackish:	>1000
Saltwater:	35,000

Moody Point:	TDS (mg/l)
Well 1 (610 ft)	1000
Well 2 (510 ft)	240
Well 3 (607 ft)	1400

Lessons Learned

- The potential exists for **saltwater intrusion** to occur in drinking water wells near the coast as a result of pumping.
- SLR will **increase the risk** in some areas.
- **Infrastructure and natural resources** within the GWRZ may be vulnerable to damage in areas where the GW table is already shallow.
- **Groundwater modeling** is useful for examining changes in both hydrology and water quality.

Outcomes so far . . .

- Data and results have been included in **Newmarket's 2018 multi-hazard mitigation plan update**
- **Moody Point Homeowner's Association** is considering multiple options to address **saltwater intrusion** including connecting to municipal water; more study is needed.
- **Durham**, in partnership with SRPC and UNH, is seeking funding to do a similar analysis - focusing on **septic systems**, **drinking water**, and **contaminated sites**

Potential Next Steps

- Improve the model with additional **data collection**
- Investigate **changes in pumping and SLR rates** over time
- Investigate the effects of a **changing coastline**
- Detailed analyses focusing on **septic systems and/or wetlands**.
- **Other communities?**

Acknowledgements

We would like to thank:

Strafford Regional Planning Commission
The project's Technical Advisory Committee
NH Department of Environmental Services
NH Geological Survey
NH Granit
NH CAW

Limitations of the model – models are not perfect, but most are useful

1. Simplified representation of the geology

2. Limited data on material properties, saltwater concentrations, and piezometric heads in groundwater

3. Constant pumping rate throughout simulation

4. Changing coastline was not simulated with sea-level rise scenarios

5. Uncertainties in sea-level rise projections