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Groundwater on Fire Island and its relation to human and environmental needs

The Health & Science of our Bays: A Fire Island Perspective
August 17, 2018—Village of Saltaire

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In cooperation with National Park Service

U.S. Department of the Interior
U.S. Geological Survey

Problem

- About 2.2 million people visit Fire Island each year. The arrival of summer residents and vacationers increases the population 50-fold
- Wastewater from most septic systems discharges directly into the shallow (water-table) aquifer. The associated nutrients, pathogens, and organic compounds can eventually seep into back-barrier estuaries and threaten their ecological health
- Elevated concentrations of nutrients in groundwater that discharges to surface waters can lead to increased production of phytoplankton and macroalgae; these, in turn, can cause oxygen depletion, declines in estuarine fish and shellfish communities, and loss of submerged seagrass habitat

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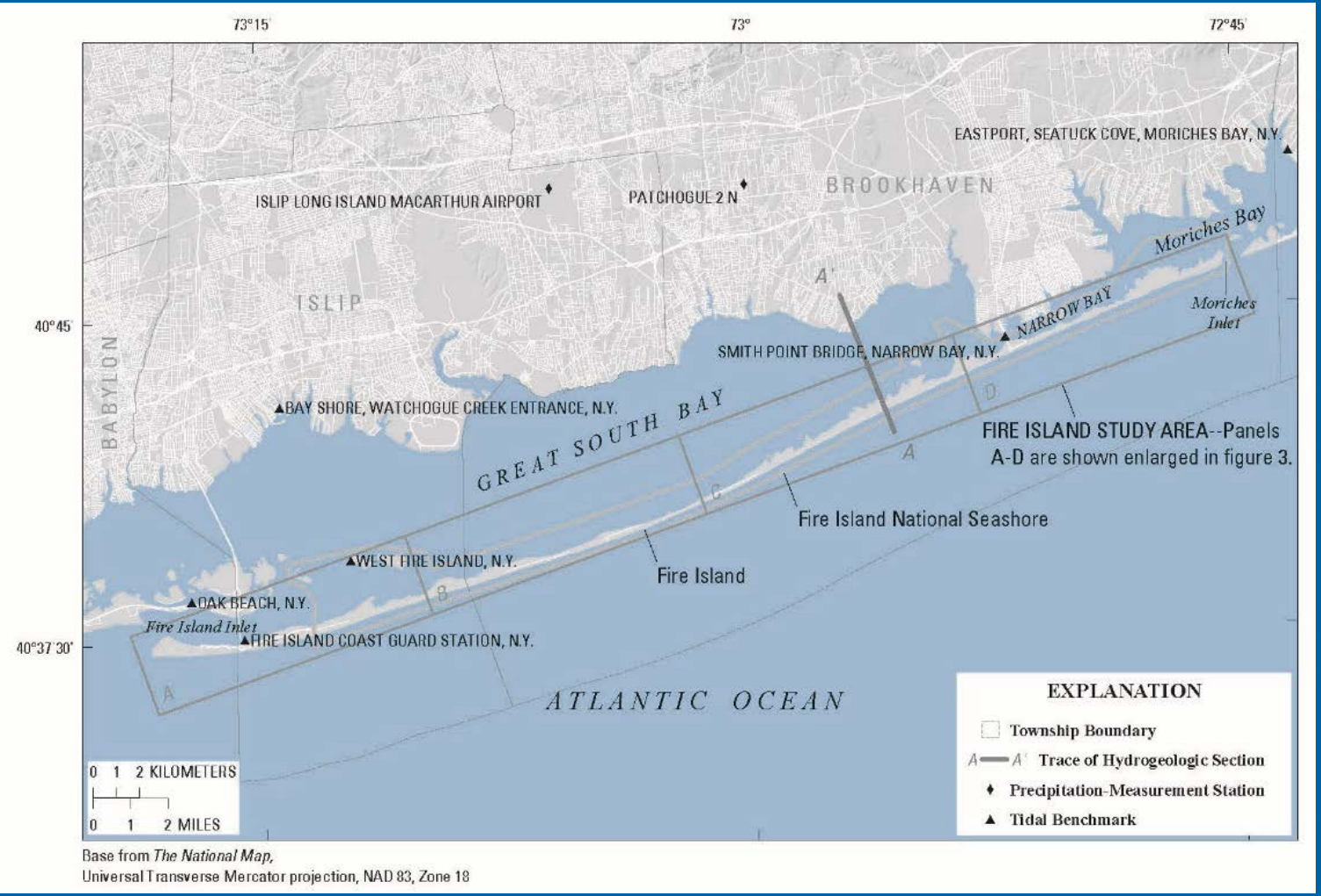
Fire Island study area



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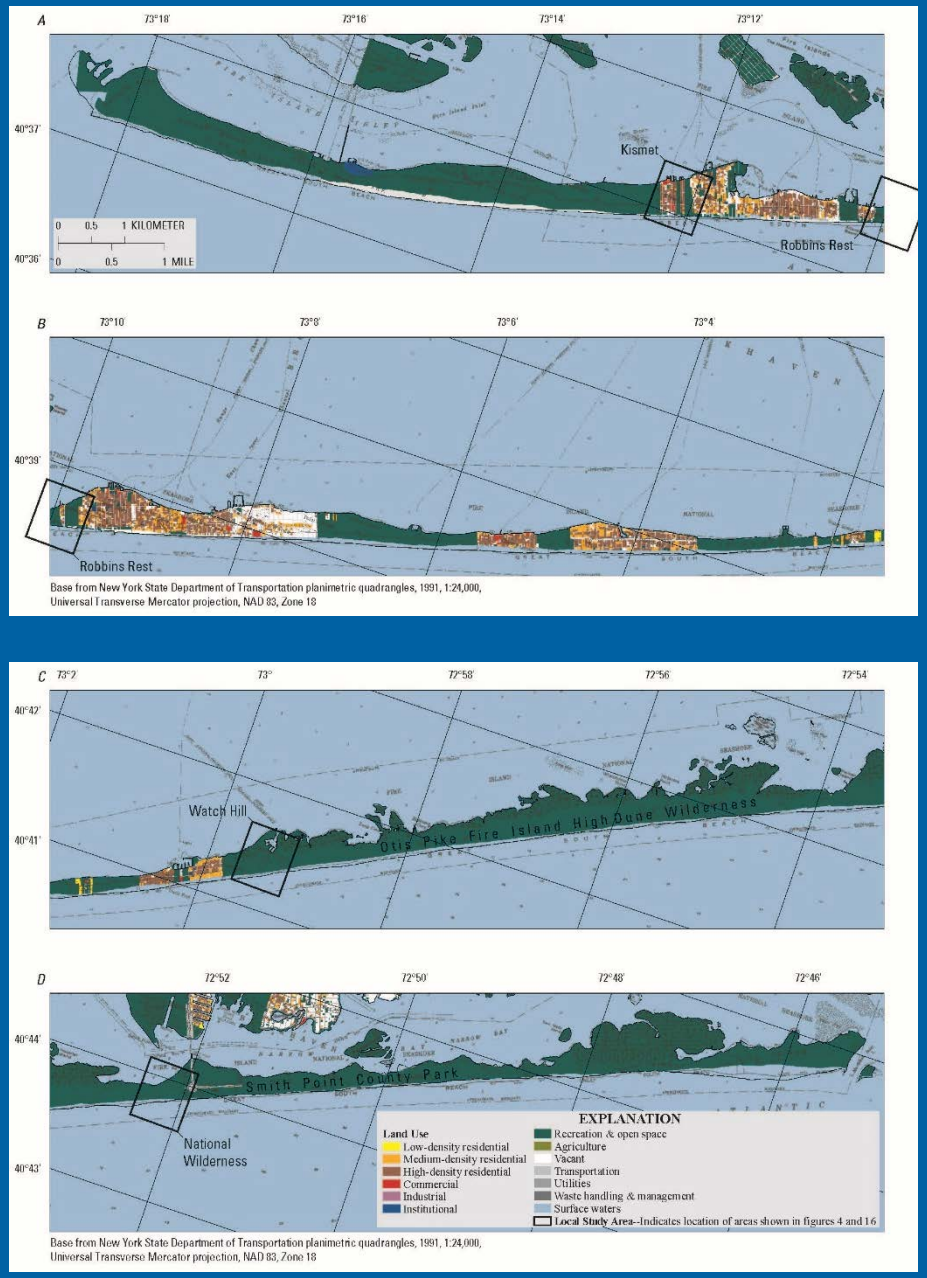
Land use

Four local study areas

- Kismet
- Robbins Rest
- Watch Hill
- National Wilderness



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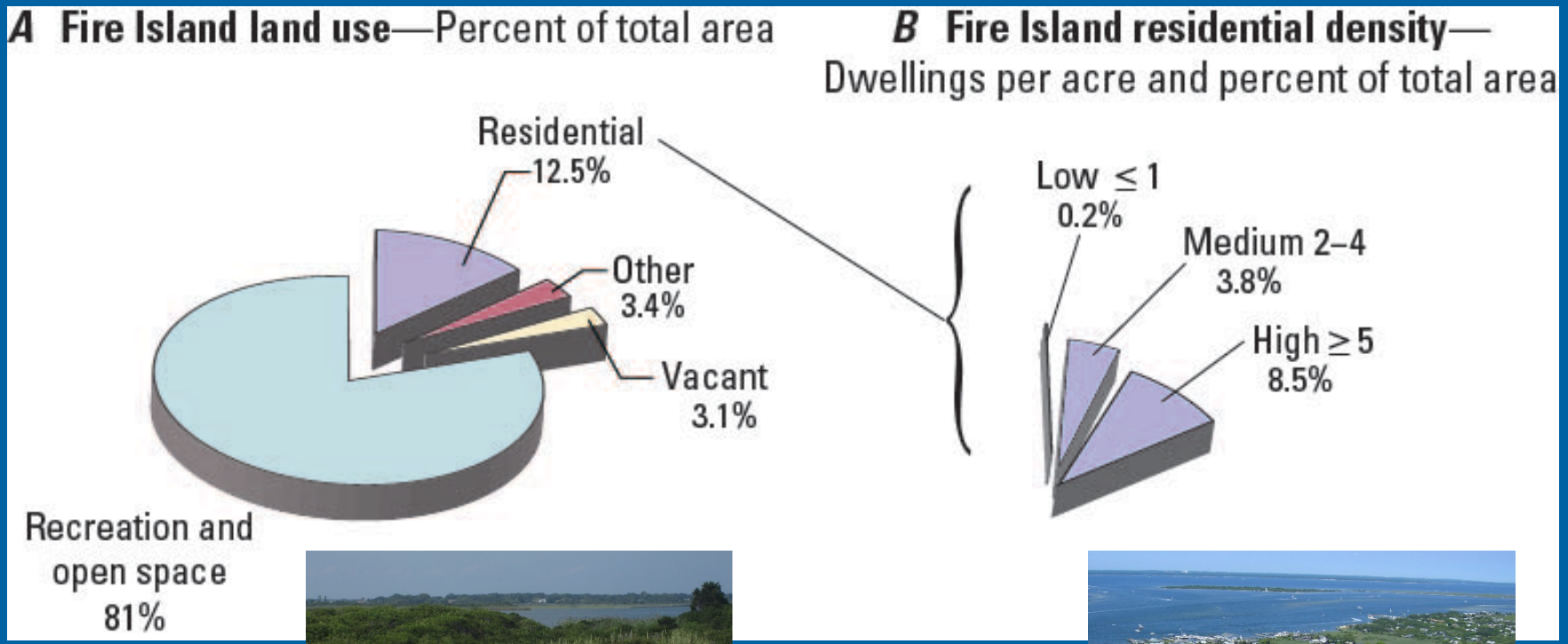
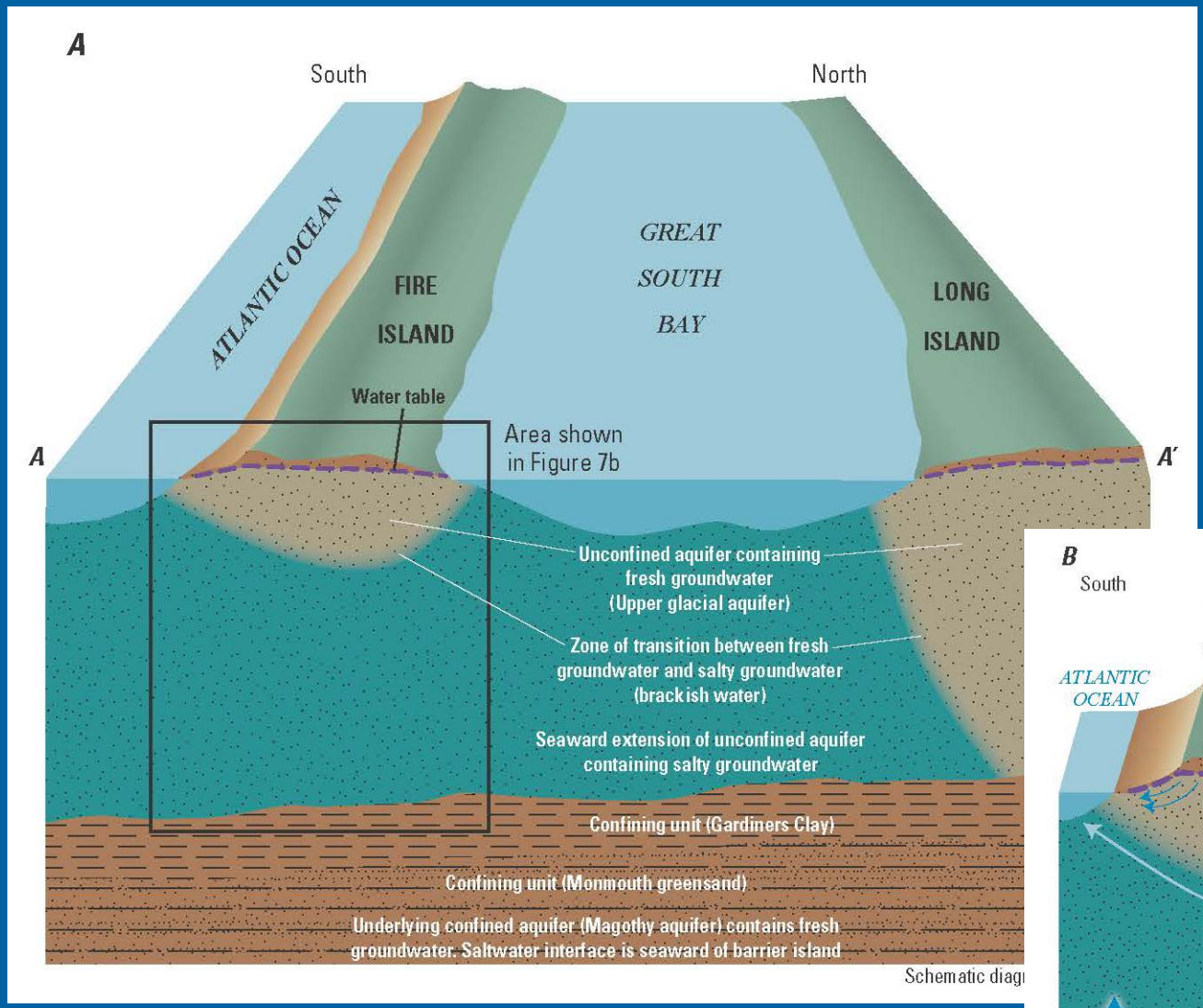
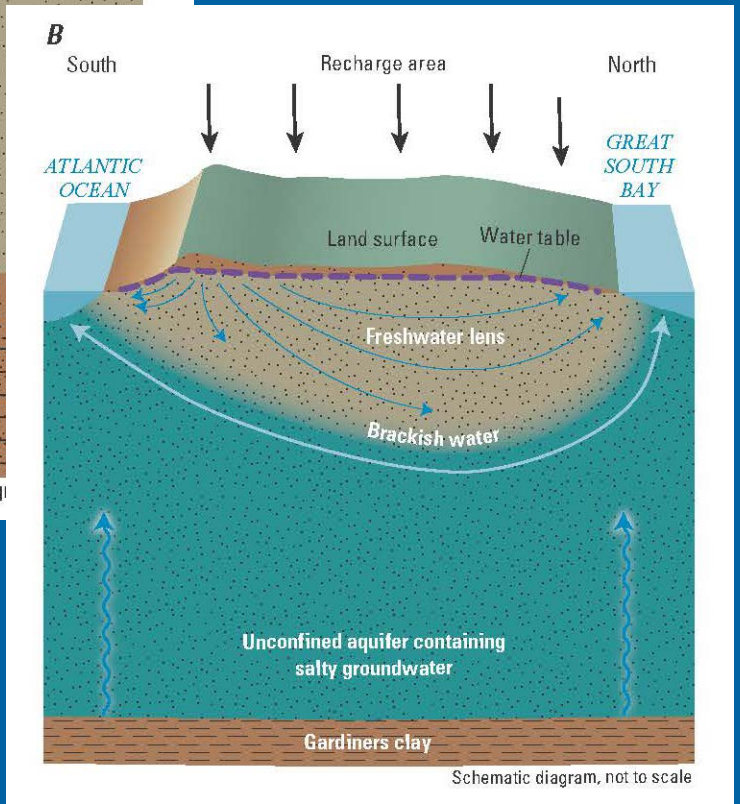
Land use

Percent of total area



Shallow aquifer system





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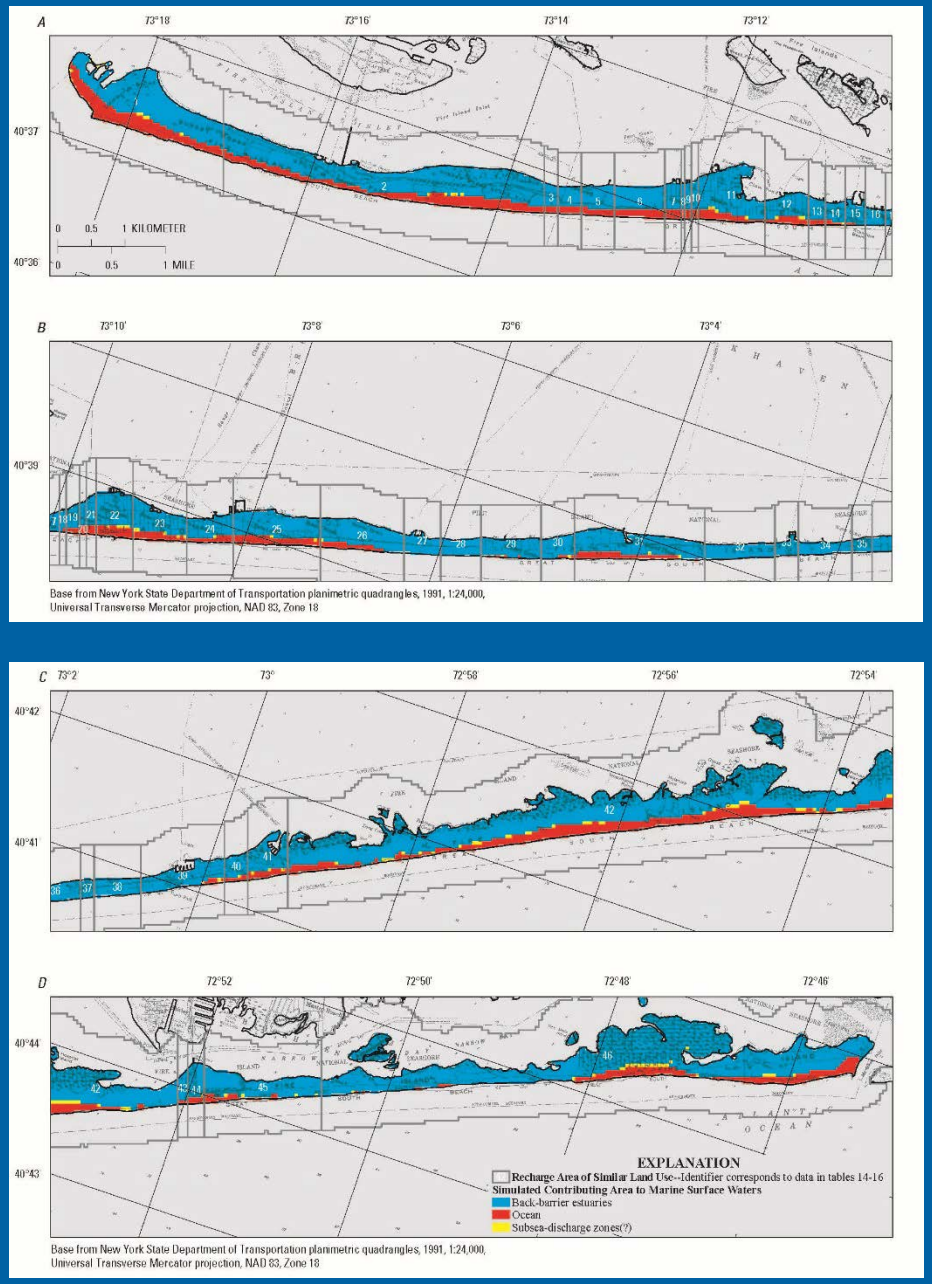
Fire Island study area

- Modeled recharge areas (numbered in white) to marine surface waters under 2005 mean annual conditions
- Results show that most freshwater from the shallow aquifer system discharges toward the back-barrier estuaries (recharge areas in blue)



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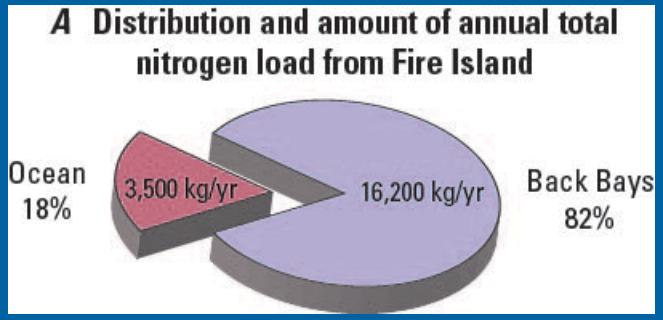
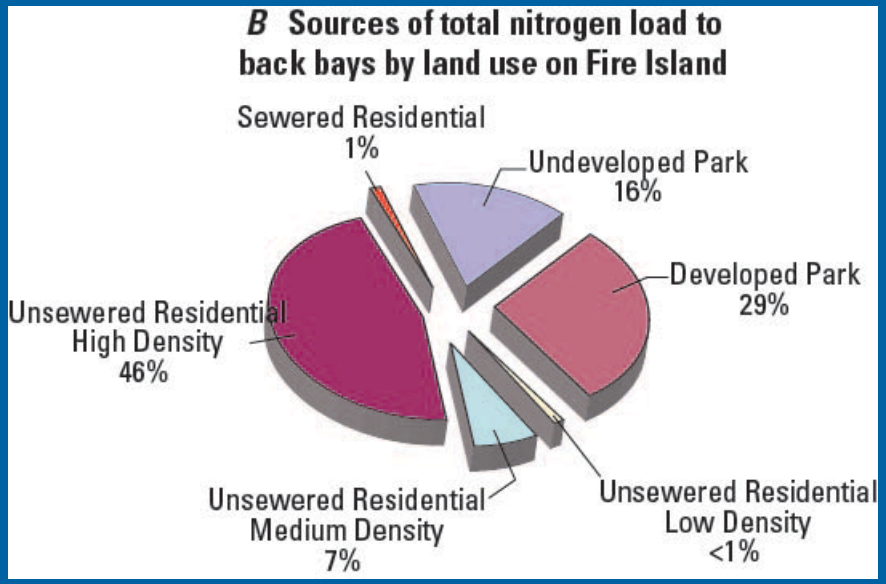
Fire Island study area

Total nitrogen (TN) load in groundwater discharge

- **(A) distribution by percent and kilograms per year (kg/yr) to back bays and the ocean**
- **(B) sources of TN load to back bays by percent of contributing land-use area**





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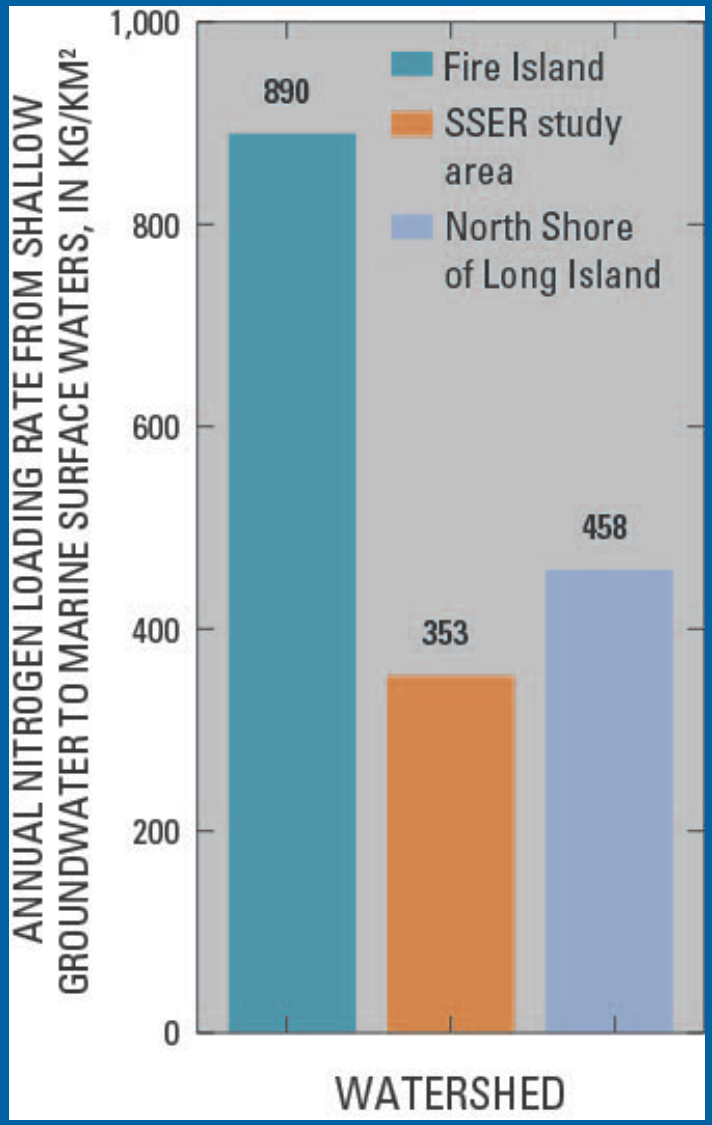
Nitrogen loading rates by watershed

Rate of annual discharge of nitrogen from shallow groundwater to marine surface waters

- **Fire Island**
- **South Shore Estuary Reserve (SSER)**
- **North Shore of Long Island**



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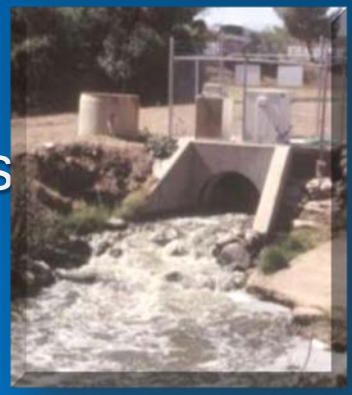
What are CECs?
"umbrella term"

- Pharmaceuticals
- 1,4-dioxane
- PAHs
- Fragrances
- Detergents
- Algal toxins
- Microplastics
- Hormones
- PFAS
- Phytoestrogens
- Illicit drugs
- Fire retardants
- Pathogens
- Pesticides

1. Not currently regulated
2. Incomplete knowledge of fate or effects



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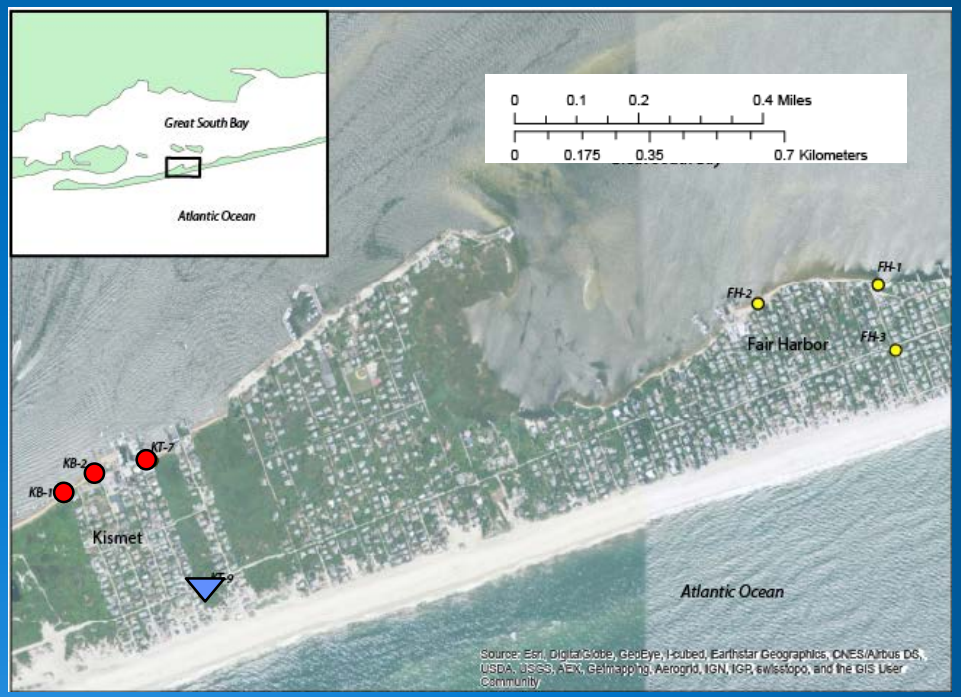
CECs in Groundwater at Fire Island

- Monitoring since 2011
- Dense residential, mixed use setting
- Seasonal changes in population
- unsewered

Shallow groundwater, along with contaminants, ultimately discharges to the Great South Bay

2015-18 study: assess (seasonal) variation in concentrations and types of pharmaceuticals in the shallow groundwater of Fire Island.



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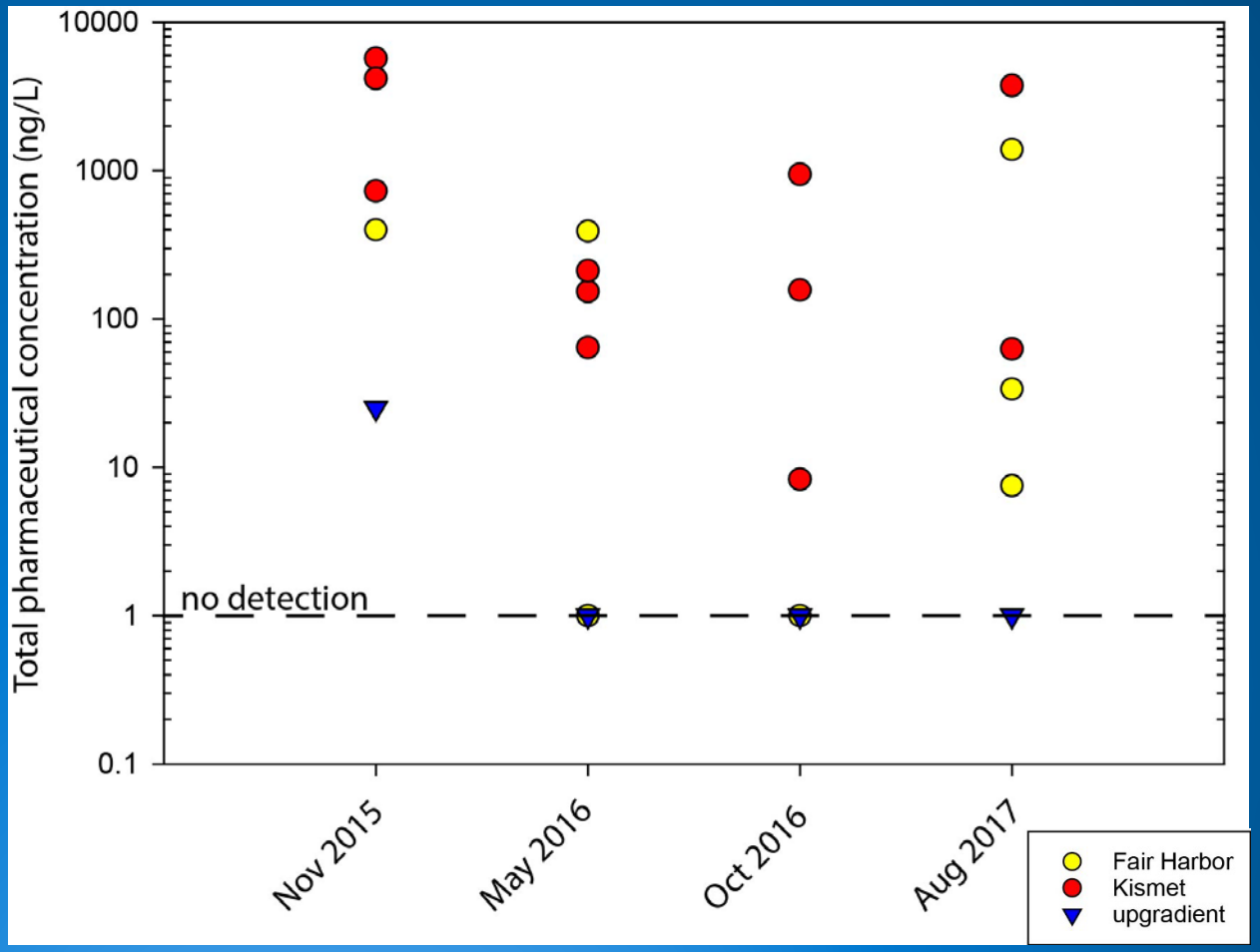
Fire Island Data 2015-2017

Pharmaceuticals detected at every location sampled

Number & concentration of pharmaceuticals varies between each sampling event

Consistent detection and maximum total concentrations >100 ng/L



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Fire Island Data

33 different pharmaceuticals were detected in Fire Island groundwater

- **Antidepressants**
- **Antihistamines**
- **Antivirals**
- **Heart medications/beta-blocker**
- **Antacid/anti-diabetic**
- **Pain medications**
- **Antifungals**
- **Topical anesthetic**
- **Anti-anxiety**
- **Muscle relaxants**
- **Anticoagulant (blood thinner)**
- ***…plus many others***

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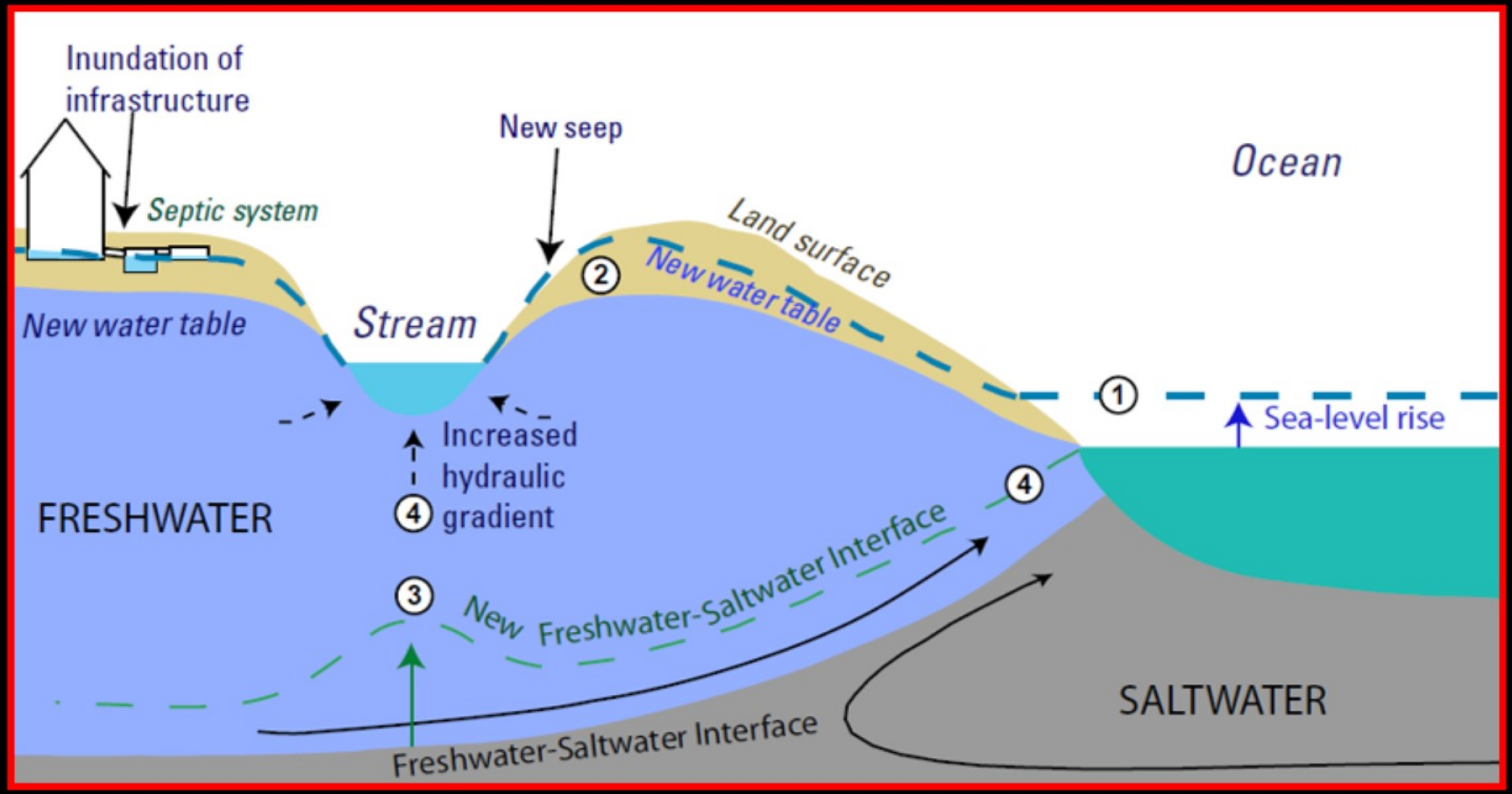
SLR Effects on GW Flow



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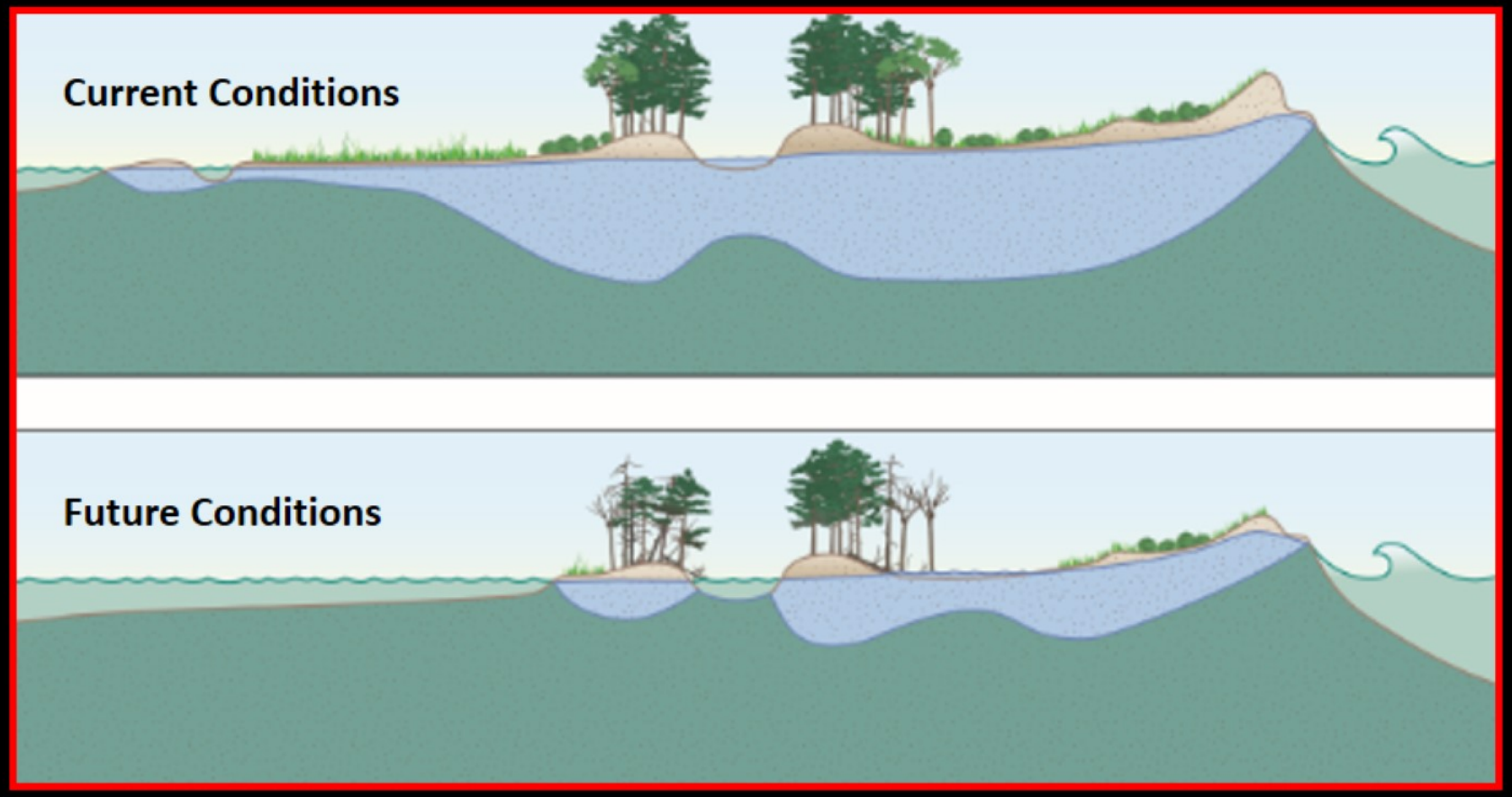
SLR Effects on Groundwater Dependent Ecosystems



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