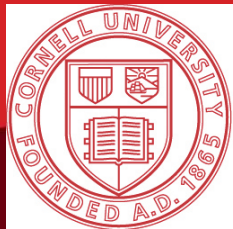


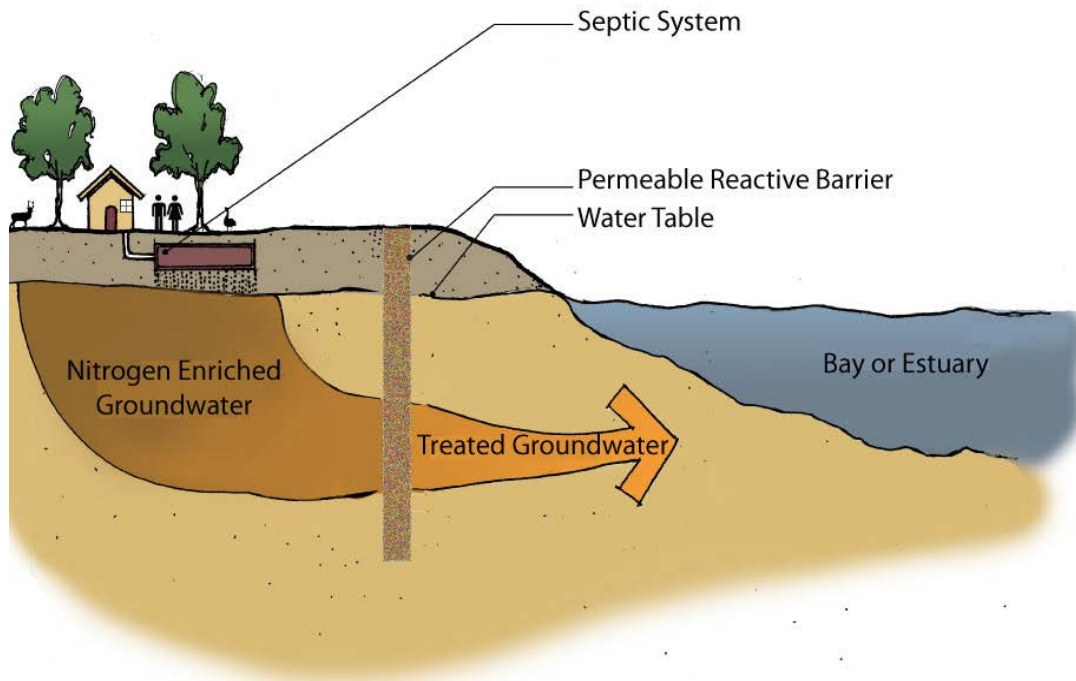
Permeable Reactive Barriers (PRBs)

Collaboration with Cornell
Cooperative Extension



Cornell University
Cooperative Extension

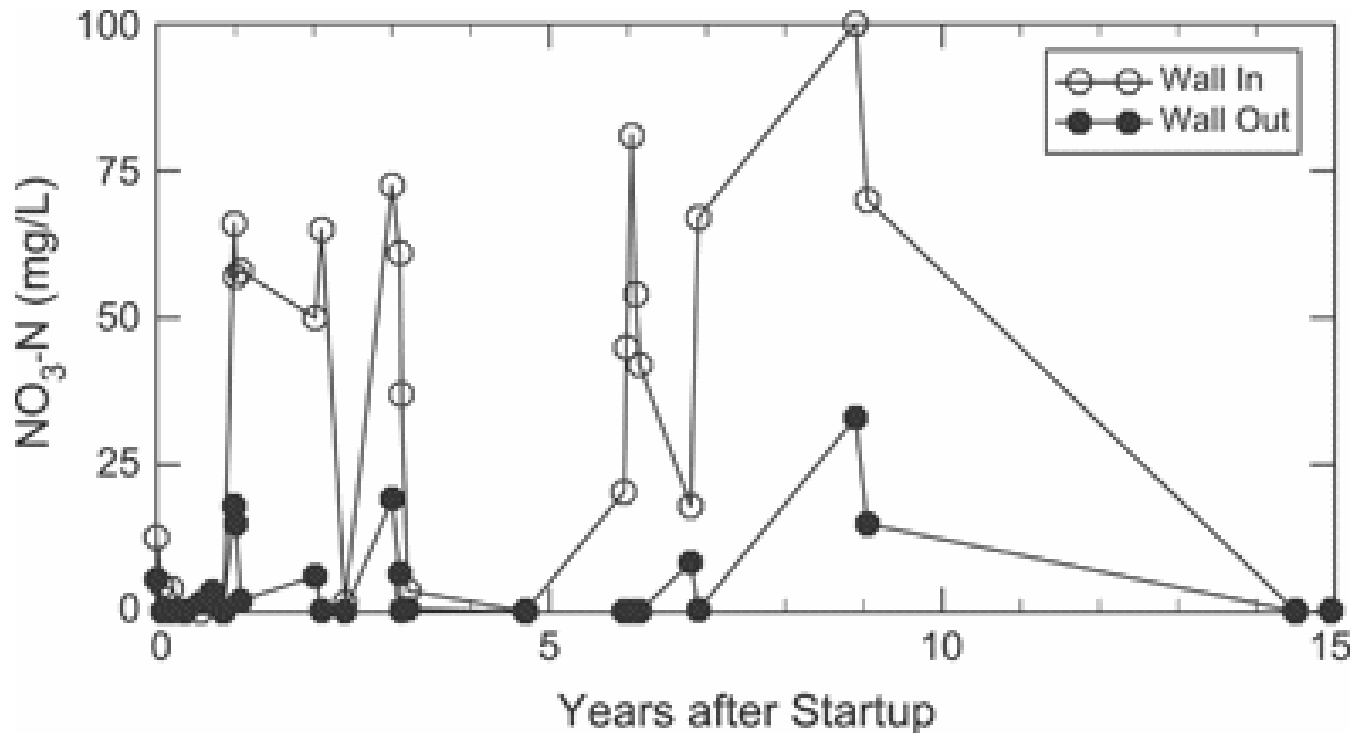
PRB Technology



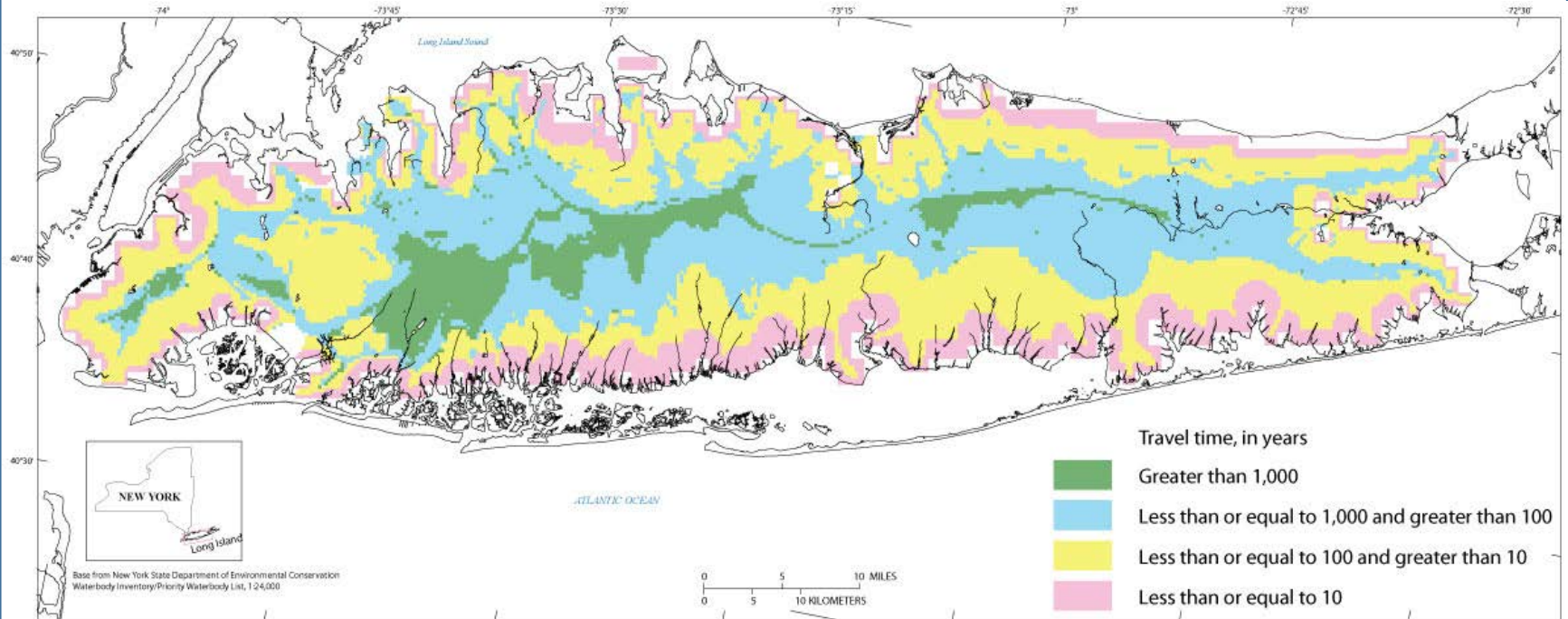
- Passive below ground treatment
- Woodchip matrix provides conditions that promote nitrate removal through denitrification
- PRB dimensions are site-specific and depend on concentration of contaminant plume, hydraulic setting and estimated nitrate removal rate

PRB Longevity

- 80% of carbon remained after 15 years
- Less than 1.5% of carbon was used per year
- If only half of the total carbon is available to microbes, PRB longevity would exceed 30 years without any maintenance



Long Island Groundwater Travel Time

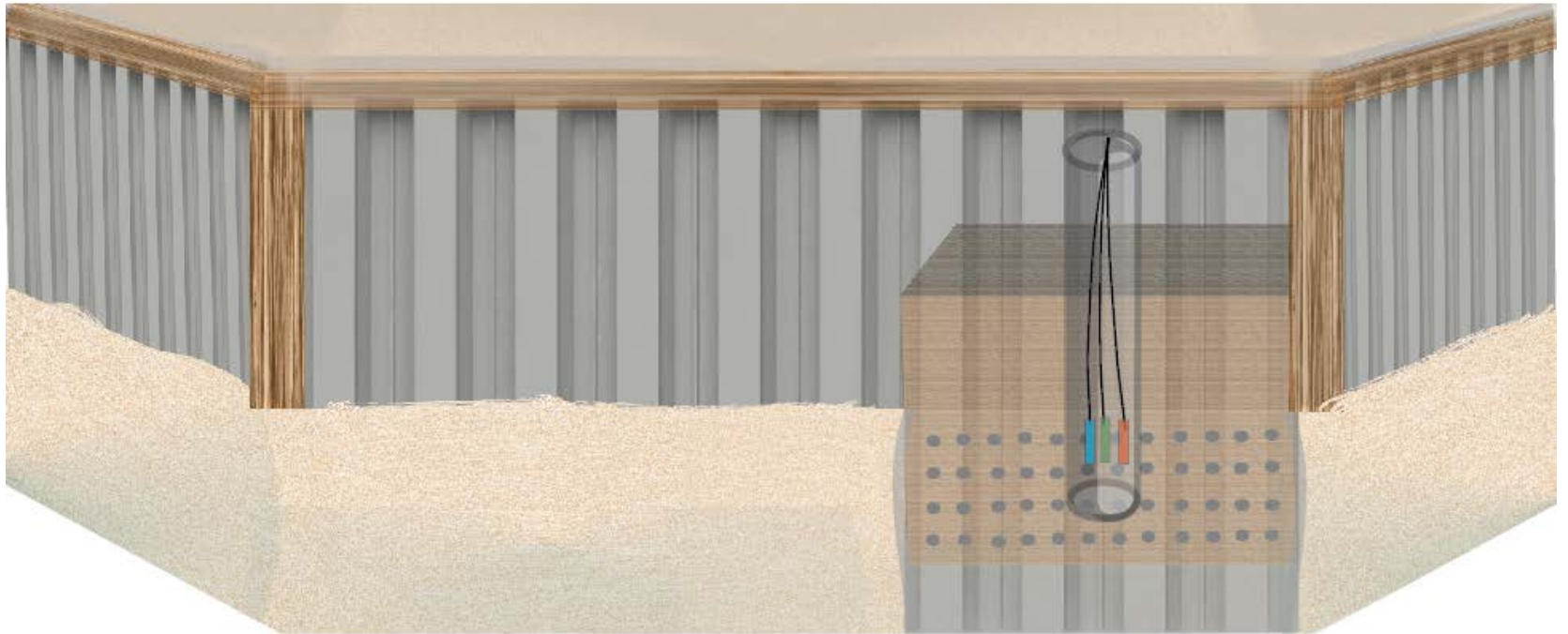


Modified from Misut and Monti 2016

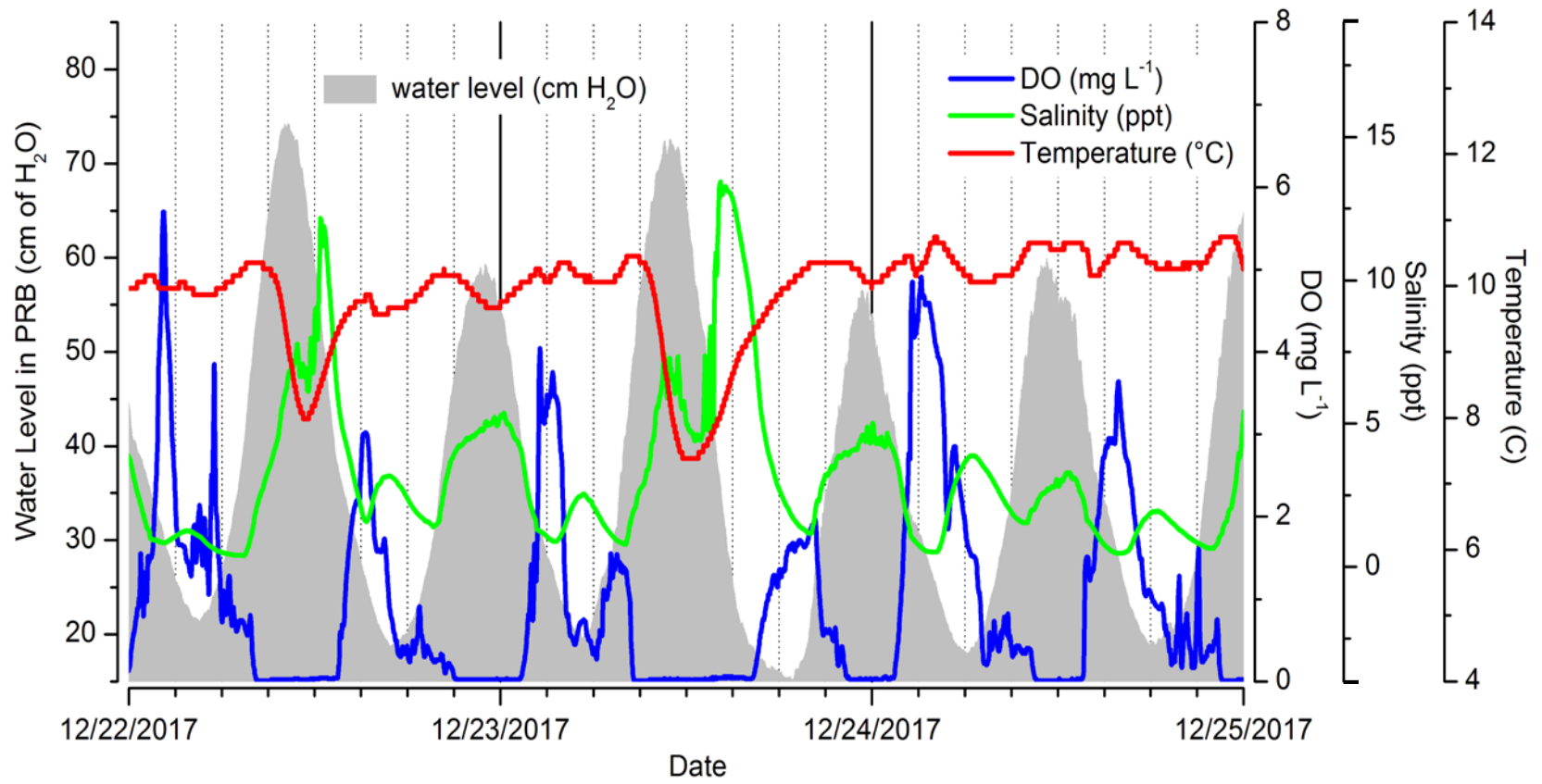


Bulkhead PRB Schematic

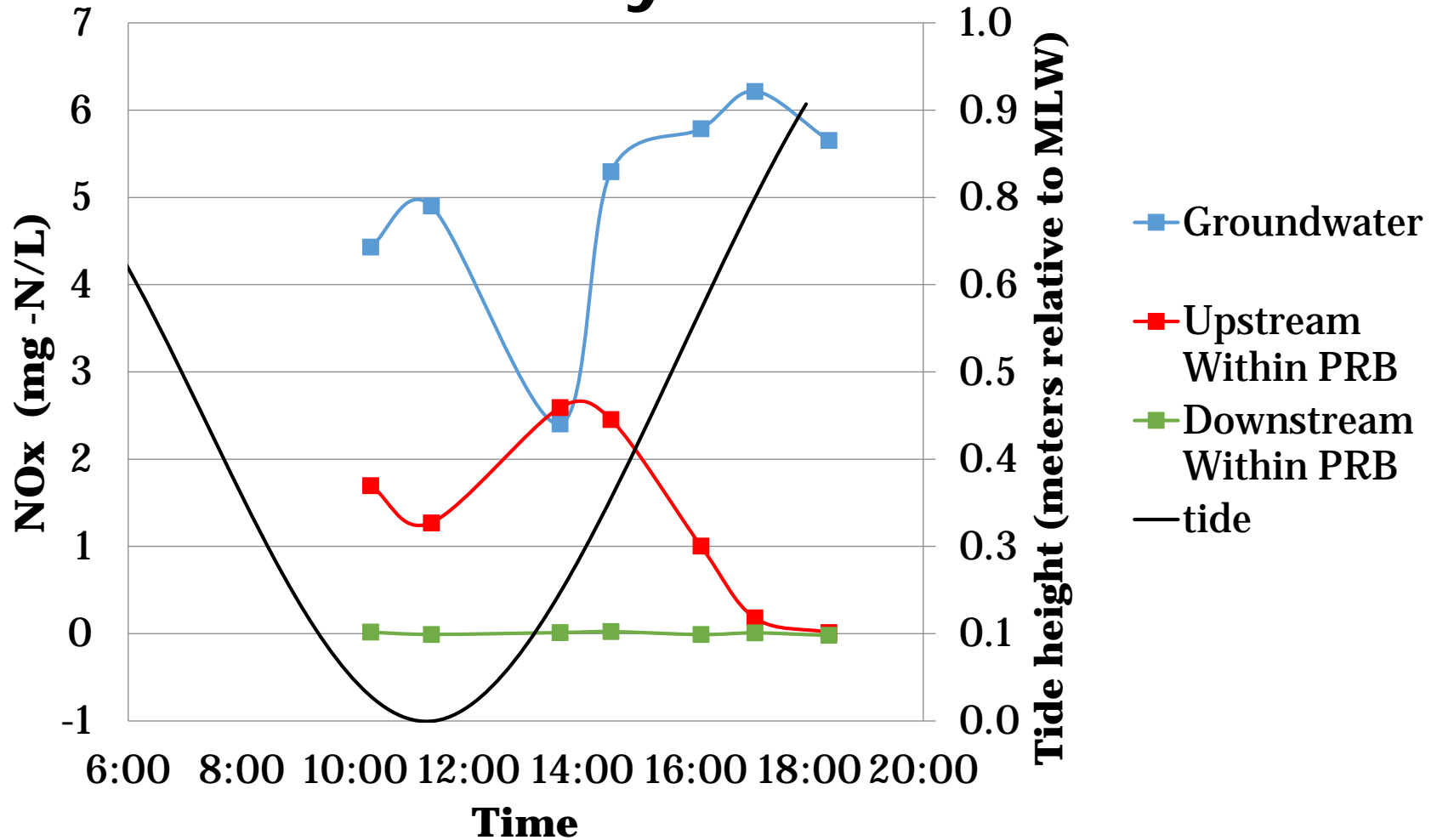
- Approximately 1 meter long x 2 meters deep x 1 meter wide
- Filled with woodchip + gravel mixture
- Multiple sampling ports and PVC pipe for multi-sensor deployment



Sensor Deployment Indicates Bulkhead PRB is a Dynamic System

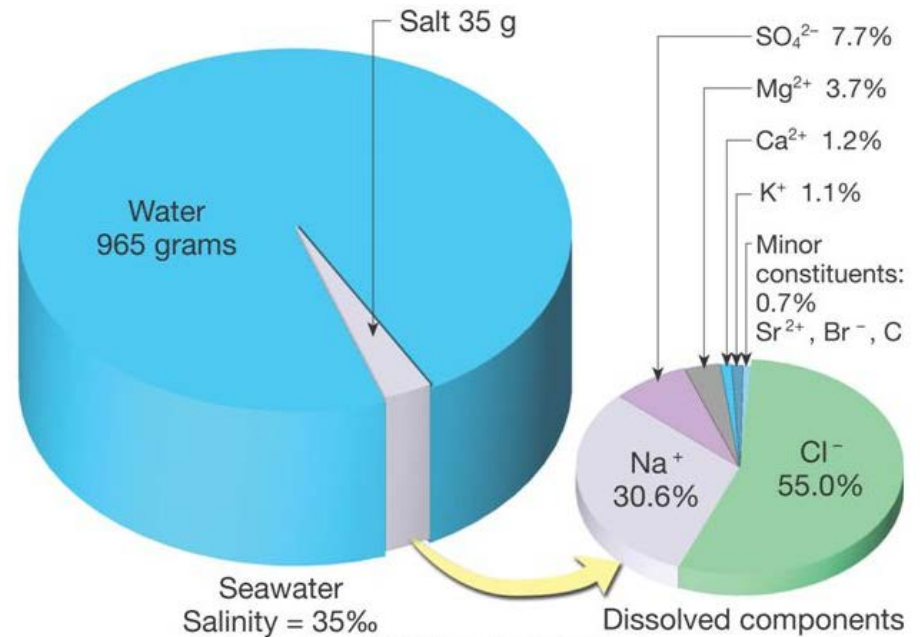


Complete Nitrate Removal Over a Tidal Cycle

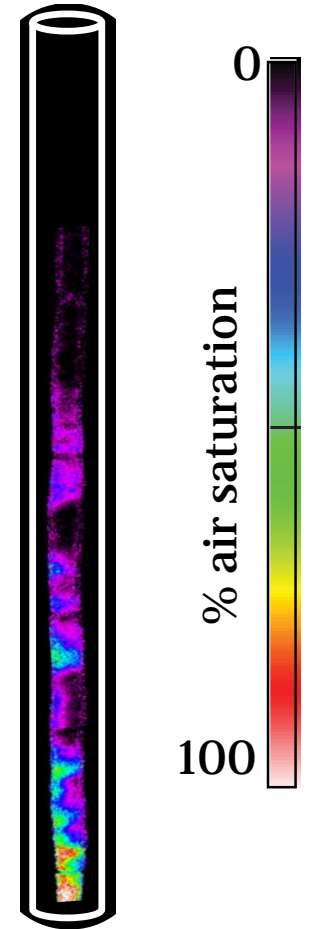
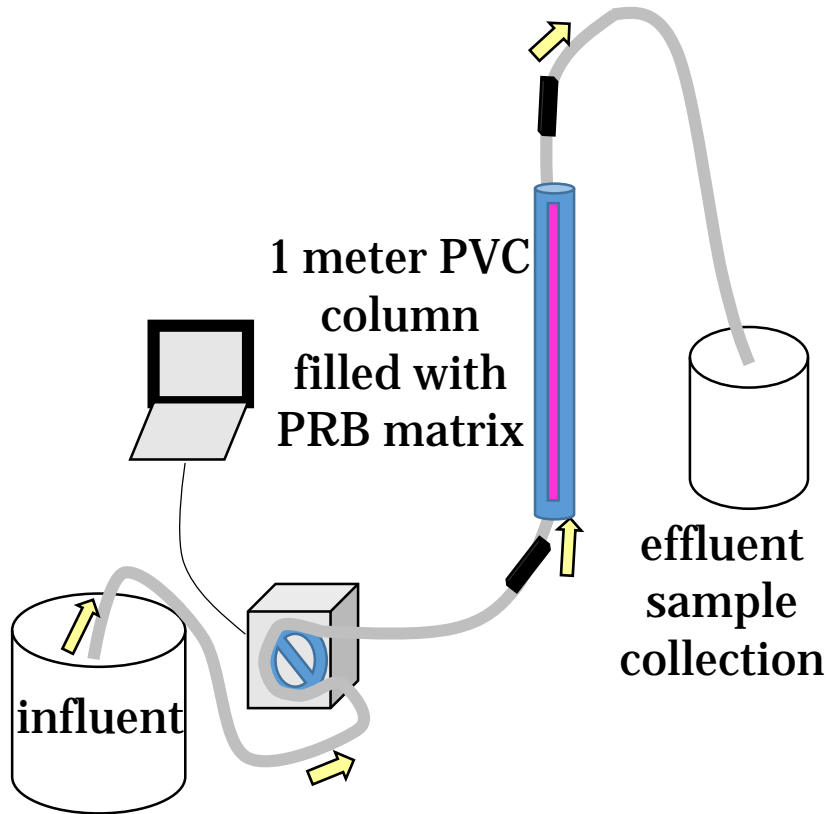


PRB Design Considerations

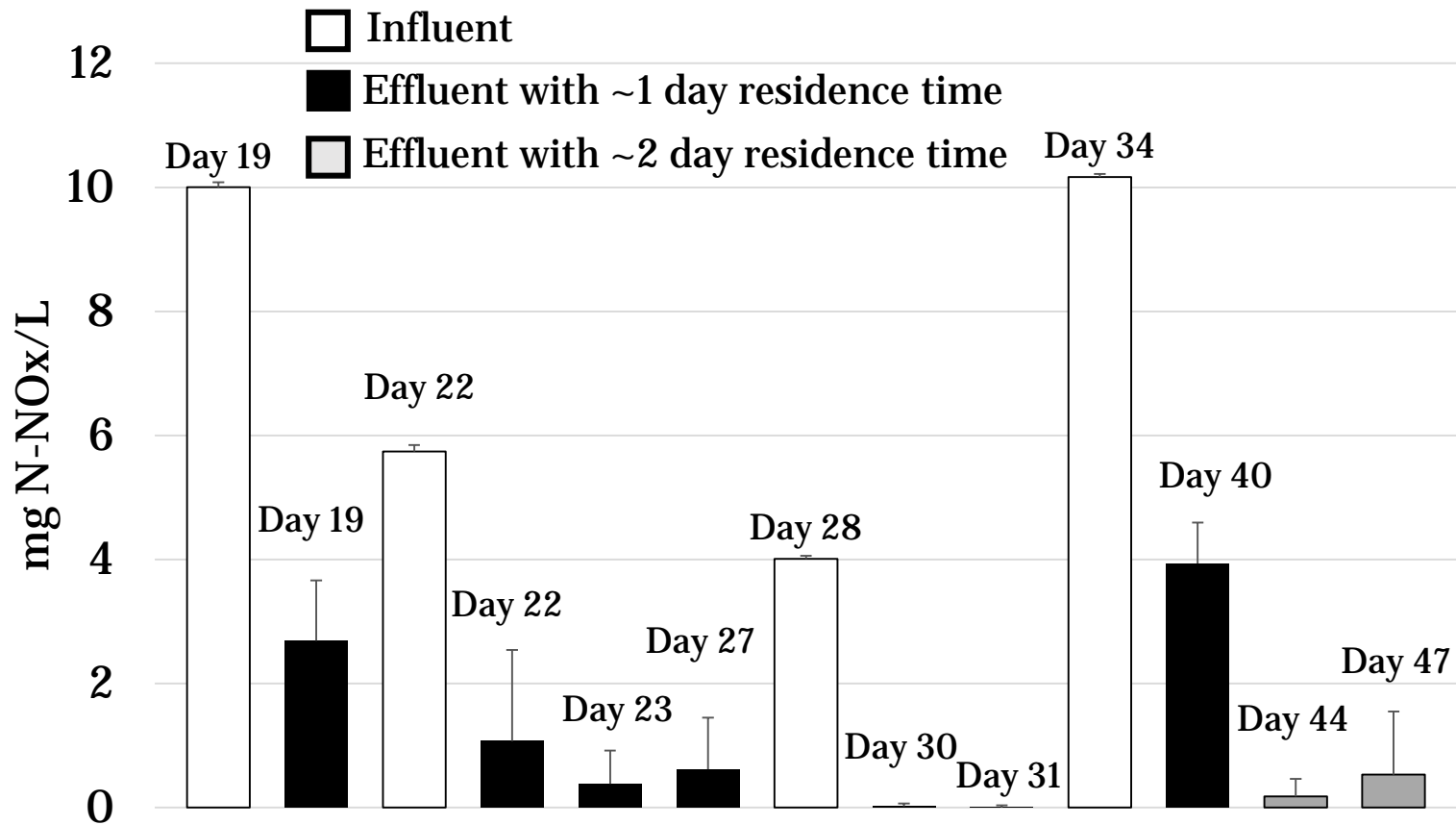
- Oscillating conditions may lead to faster carbon use
- Seawater has high ionic strength
- Microbes can use sulfate for their metabolism and produce a gas called H_2S
- H_2S may be toxic to denitrifying microbes and lead to release of N_2O , a potent greenhouse gas



Experiment with Aged PRB Matrix

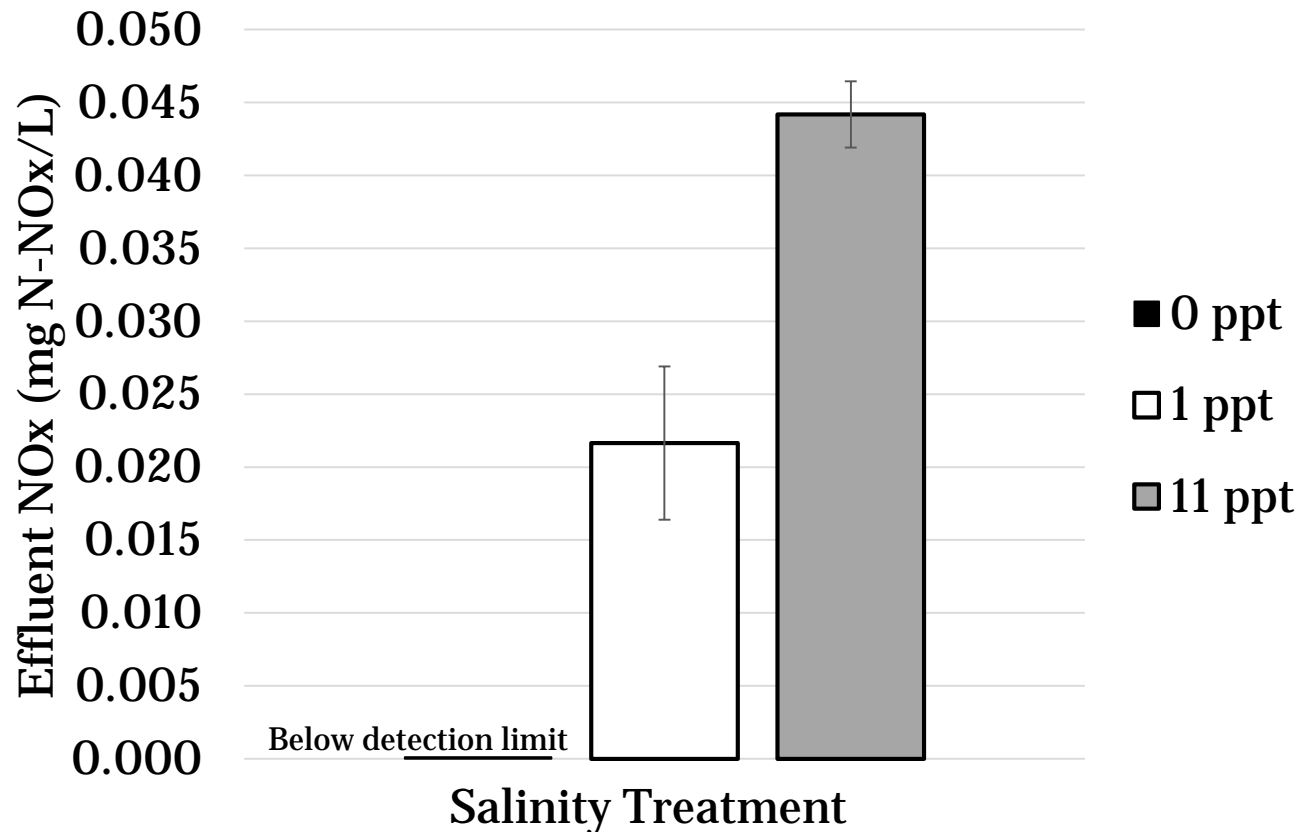


Nitrate Removal Depends on Influent Concentration and Residence Time



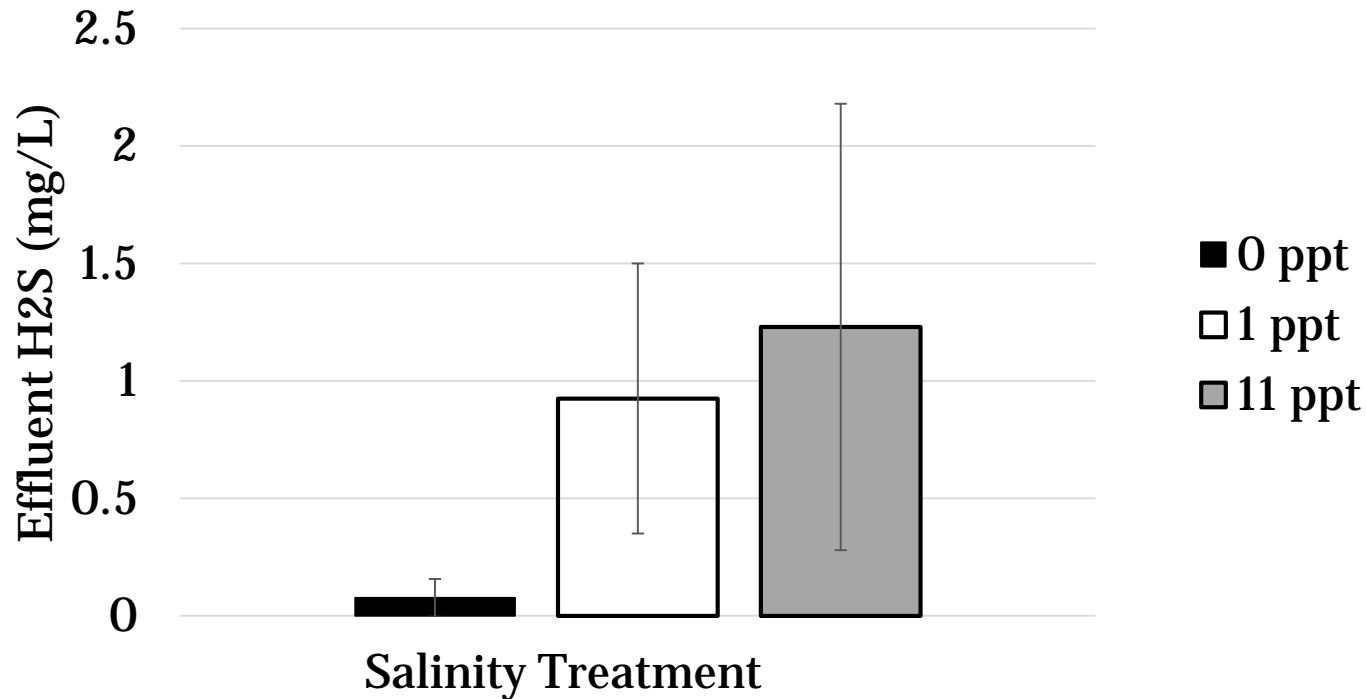
Does Salinity Impact Nitrate Removal in a PRB?

- All treatments remove >99% nitrate
- Statistically significant ($p \leq .05$) salinity effect



Low H₂S Concentration in Effluent

- H₂S is present in the PRB test cell and experimental columns
- These low concentrations do not impact nitrate removal



PRB Summary

- Strategic placement could help mitigate surface water nitrogen pollution
- Bulkhead PRBs may be one innovative solution
- The test cell consistently removes 80-100% nitrate
- Field and laboratory data suggest complete nitrate removal at high salinity
- Field and laboratory data suggest low H₂S concentrations do not negatively impact nitrate removal

Future Work

- Lab experiment with oscillating conditions which directly mimic field conditions
- Monitor greenhouse gas concentration at PRB and in lab experiments
- Continue collaborative work with Cornell Cooperative Extension

QUESTIONS?