



Evidence for Rapid Transport of Recharge from Onsite Sewage Treatment and Disposal Systems to Groundwater at Manatee Springs State Park.

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OSTDS Karst Study

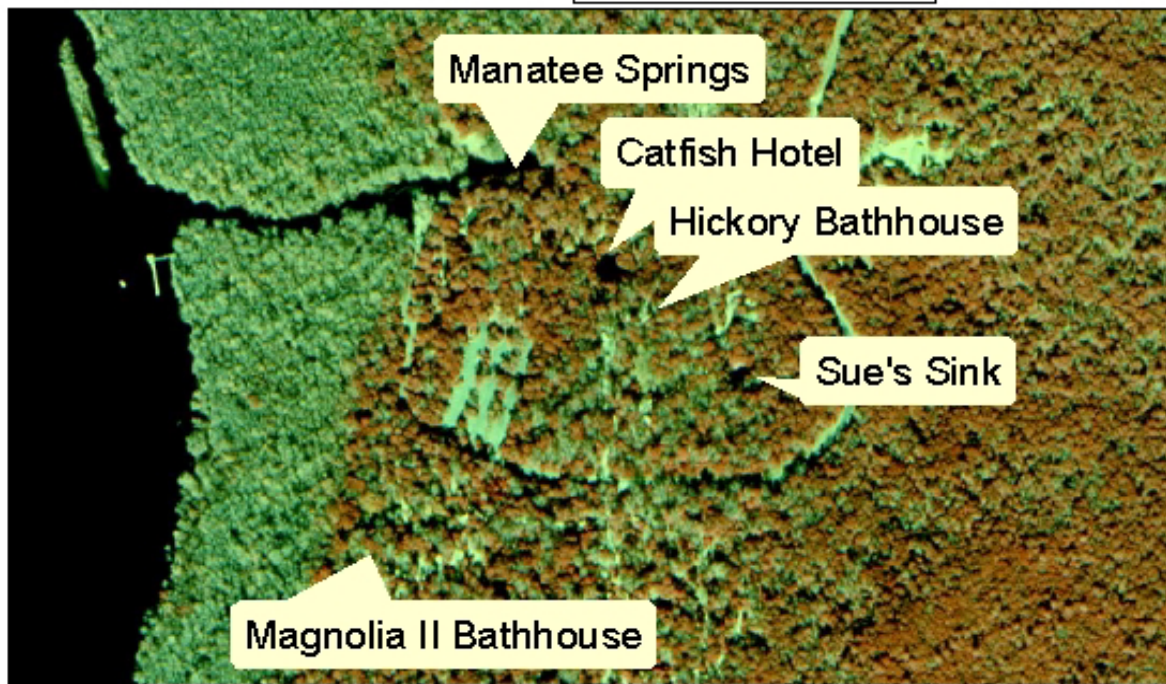
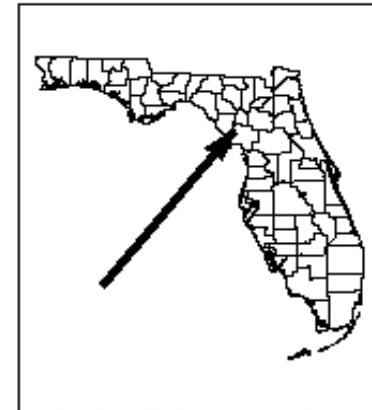
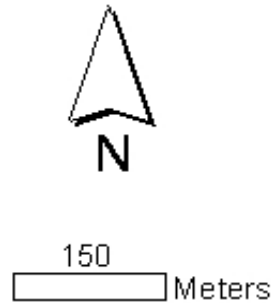
- Hypotheses: Rapid flow of recharge into and through the groundwater and limited attenuation of any components of the recharge
- Test with wastewater effluent from two Onsite Sewage Treatment and Disposal Systems (OSTDS) as recharge
- Tracer Test (inject 50 gal in ~45 min into drainfield)
 - Fluorescein (soluble)
 - Sulfur Hexafluoride (SF_6) (volatile)
- Groundwater quality monitoring
 - Nitrate (soluble, product of functioning drainfields)
 - Total Phosphorus
 - Fecal Coliform





Manatee Springs State Park

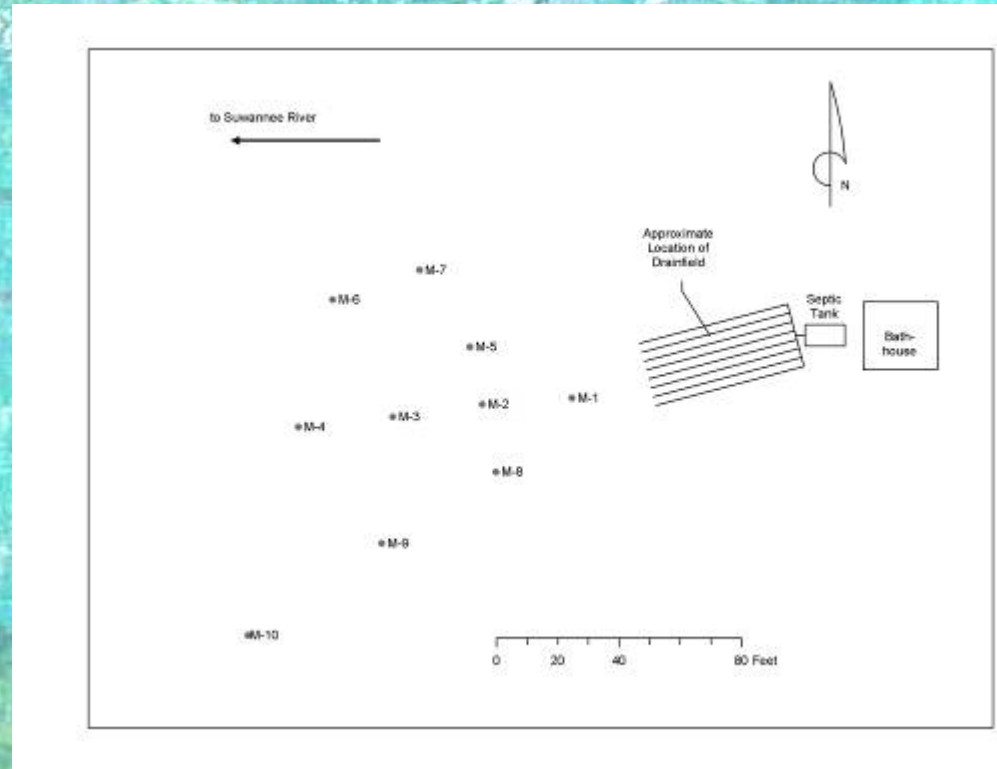
- Manatee Springs is remote, so OSTDS can be studied in relative isolation from other sources of nutrients
- Two OSTDS (septic tank and drainfield)
 - River front/shallow water table and
 - Upland/deep water table





Magnolia II: River Front Site

- Shallower water table (4-9 feet)
- Built into mound for flood protection

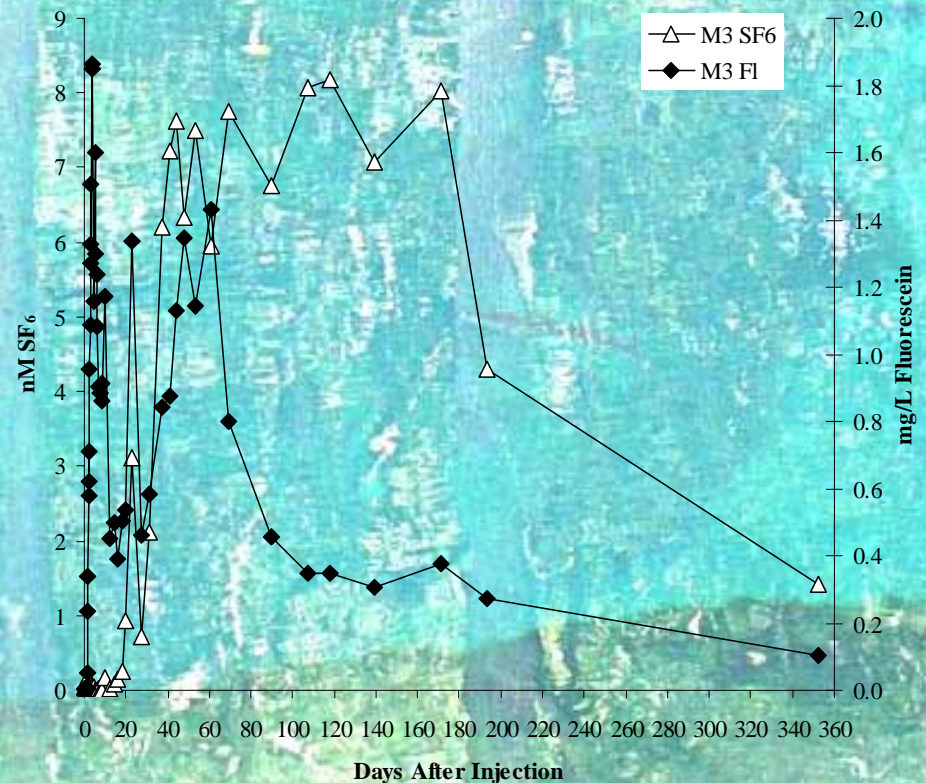
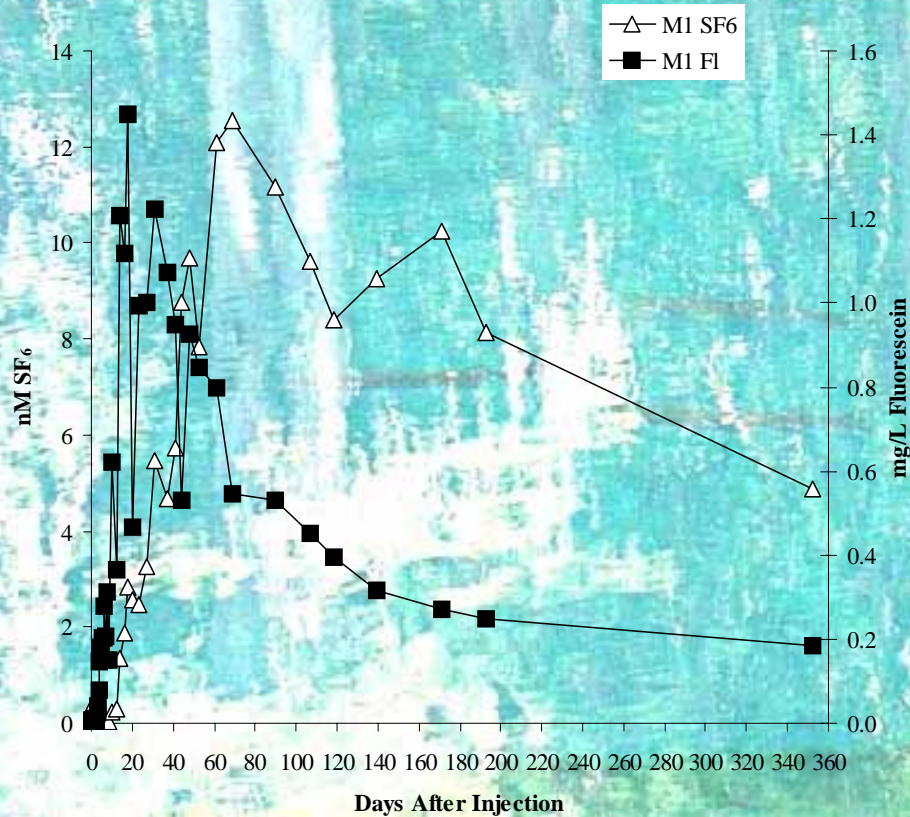




Tracers at Magnolia II

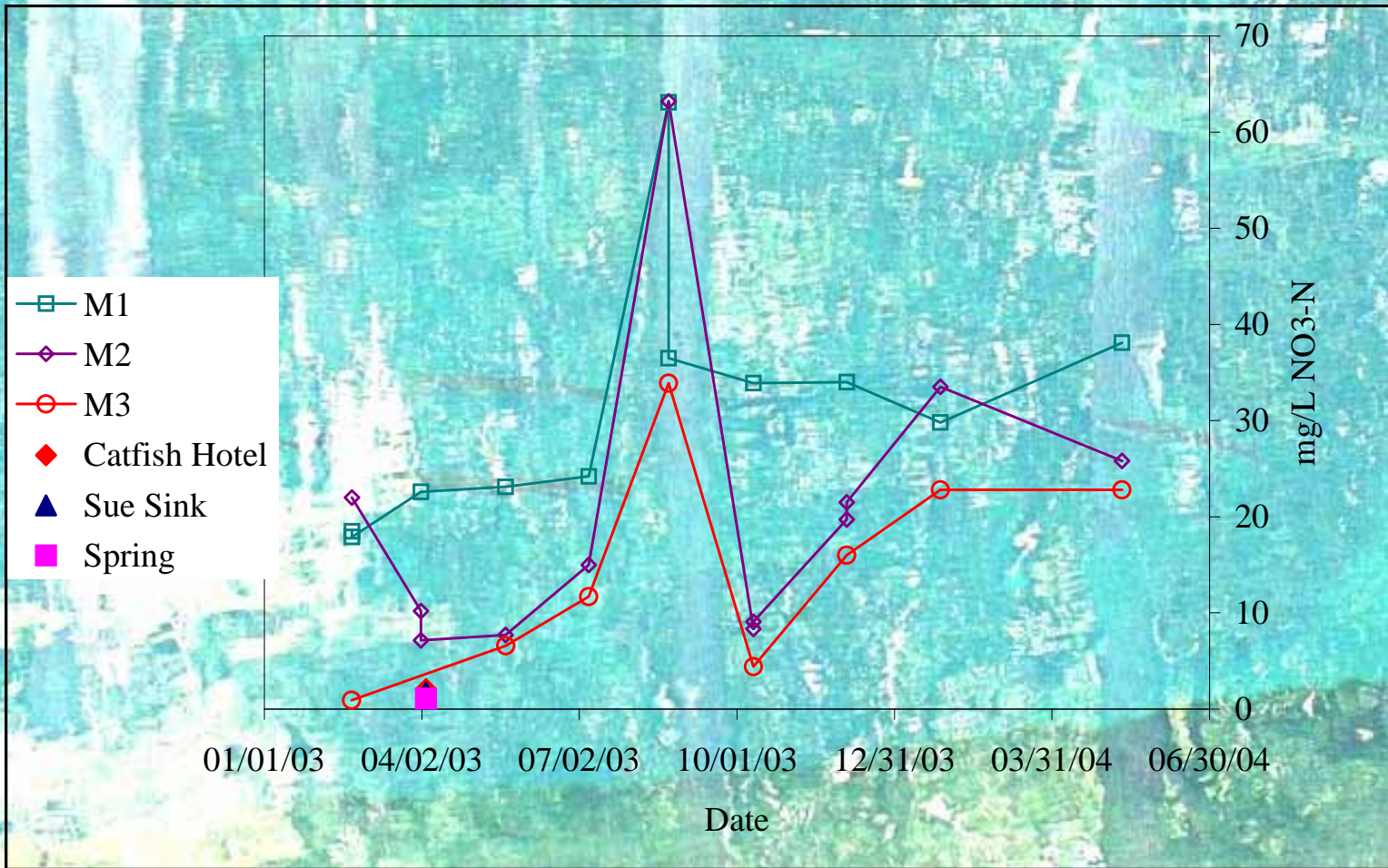
M-1: 75 feet from injection point
Fl arrival in 2.5 days

M-3: 135 feet from injection point
Fl arrival in 1.4 days





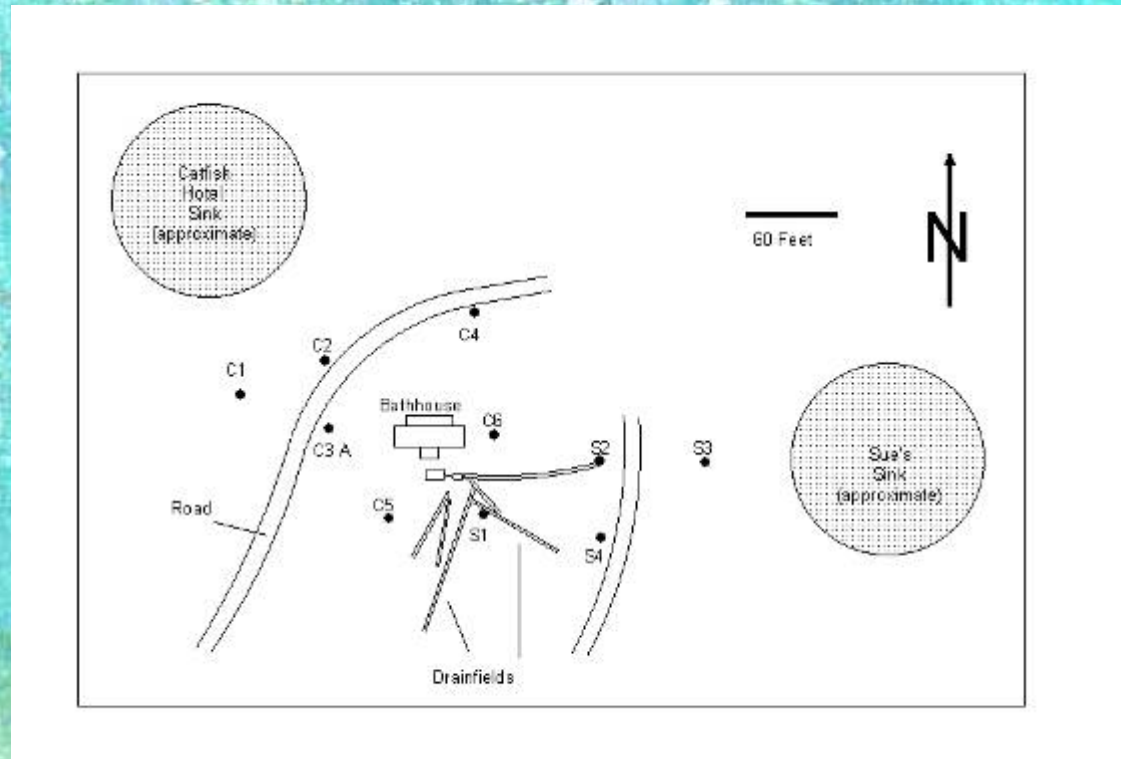
Nitrates at Magnolia II





Hickory: Upland Site

- Deeper water table (12-15 ft)
- On top of Manatee Springs cave system

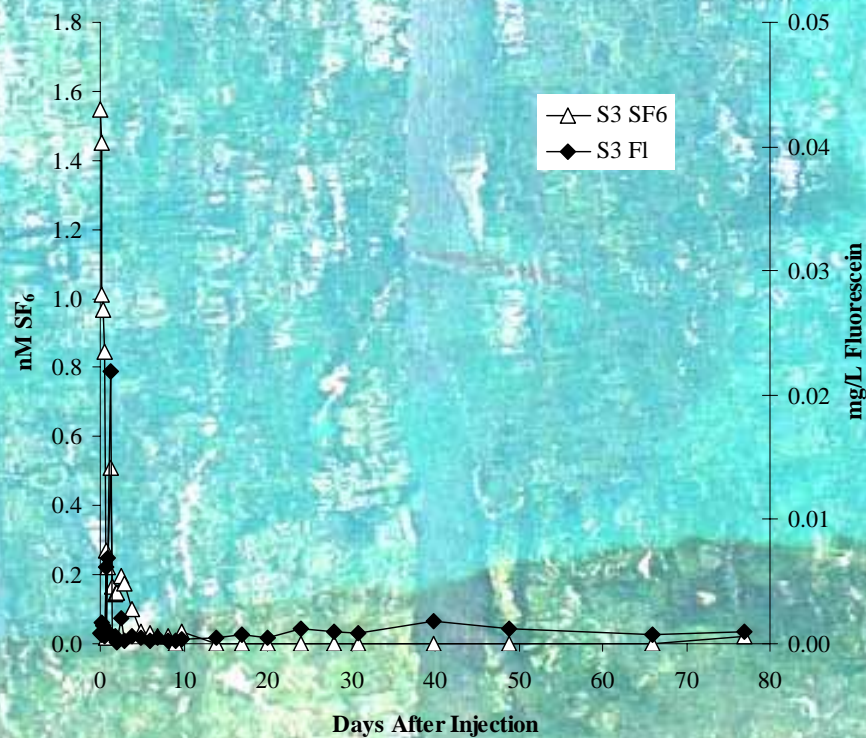
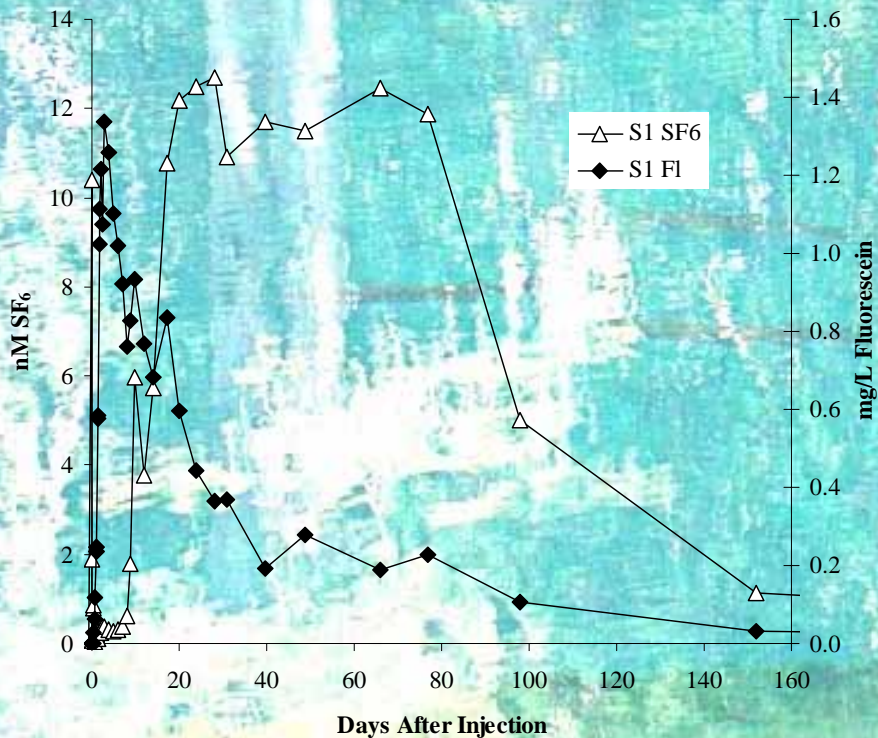




Tracers at Hickory

S-1: 35 feet from injection point
SF₆ arrival within one hour

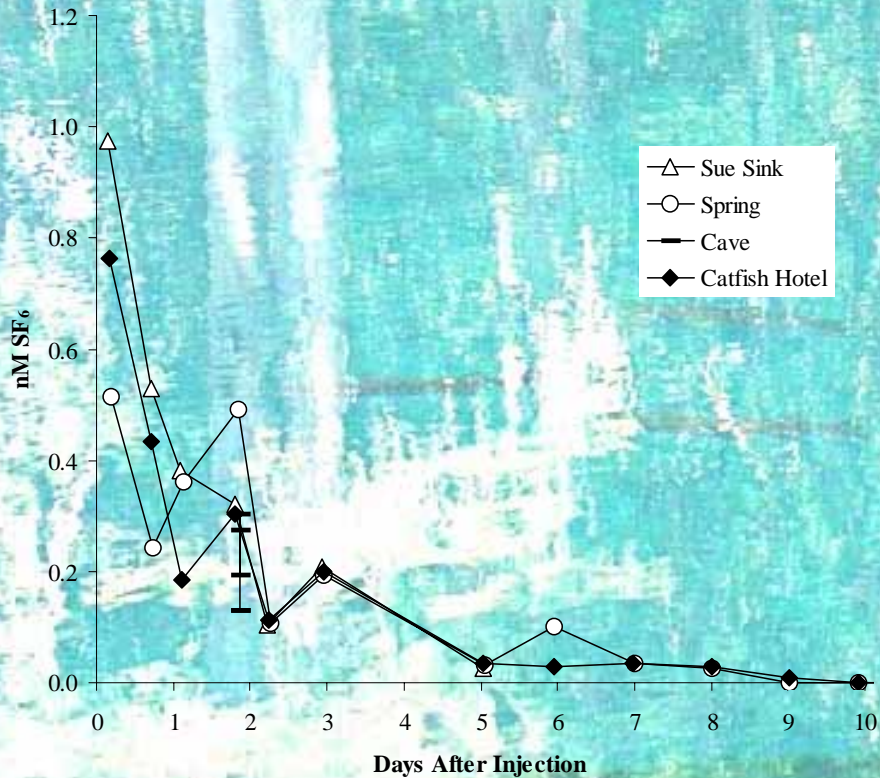
S-3: 165 feet from injection point
SF₆ arrival within one hour



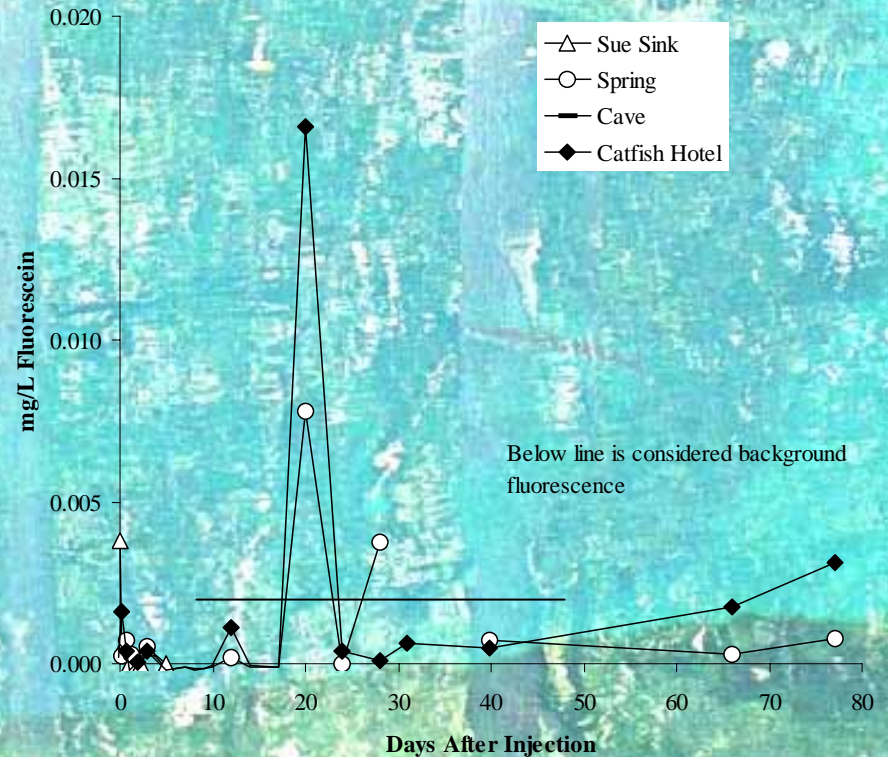


Hickory: Tracers in Surface Water

SF6 in surface water

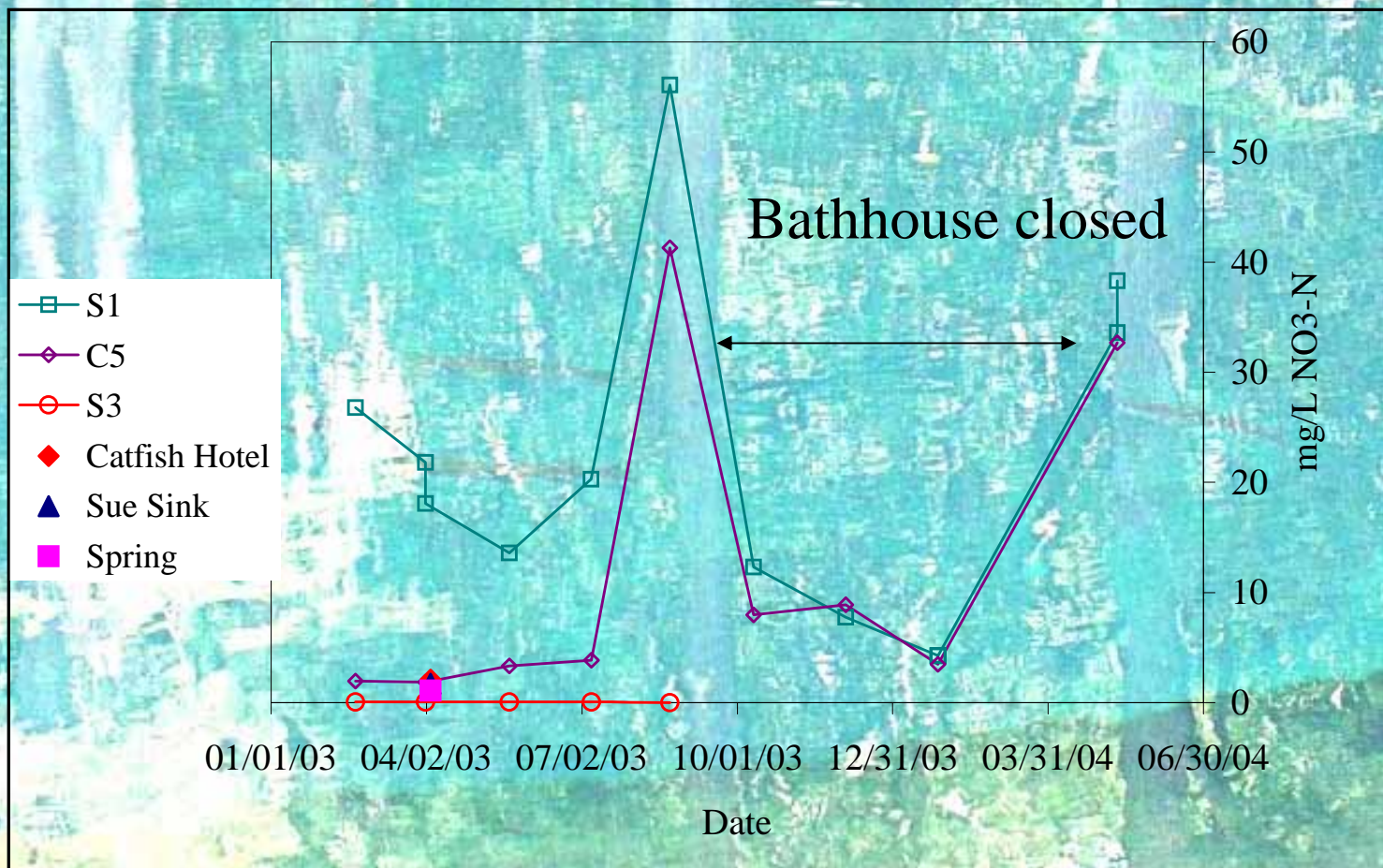


Fluorescein in surface water





Nitrates at Hickory





Results

- Transport velocities (based on tracer arrival times):
 - Magnolia II, from 5 to 100 feet per day
 - Hickory, from 1 to 280 ft/day
- More than one peak in many monitoring well concentration time series and persistently high tracer concentrations up to a year after begin of the tracer test indicate multiple porosities
- Elevated nutrients in wells surrounding the septic systems with nitrate concentrations as great as 20 to 60 mg/L
- High tracer concentrations correspond to high nutrient concentrations, wastewater is source of nutrients





Acknowledgements

- EPA-Gulf of Mexico Program and DOH-Bureau of Onsite Sewage Programs: funding
- FSU-Dept. of Oceanography:
PI Dr. Jeff Chanton and Harmon Harden
- Manatee Springs State Park:
Park Manager Sally Lieb
- Suwannee River Water Management District

