



Water-Quality Monitoring in Agassiz National Wildlife Refuge (ANWR) 2008-2010

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North Dakota Water Quality
Monitoring Conference

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U.S. Geological Survey

Agassiz National Wildlife Refuge

- Located in northwest Minnesota in the Thief River Watershed
- ANWR is 249 km² and contains 26 impoundments, with the largest impoundment, Agassiz Pool, being about 40 km²
- Managed for the primary purpose of supporting breeding and migratory waterfowl



Problem

- 3 reaches of the Thief River, which flows into and out of ANWR were designated as impaired in 2006



Purpose of Study

- To describe the water-quality characteristics of streams entering and exiting Agassiz NWR through:
 - Continuous monitoring for streamflow, temperature, specific conductance, dissolved oxygen, pH, turbidity
 - Discrete sampling for nutrients and sediment
 - Estimation of loads for nutrients and sediment
- To present a potential water-quality and streamflow monitoring design



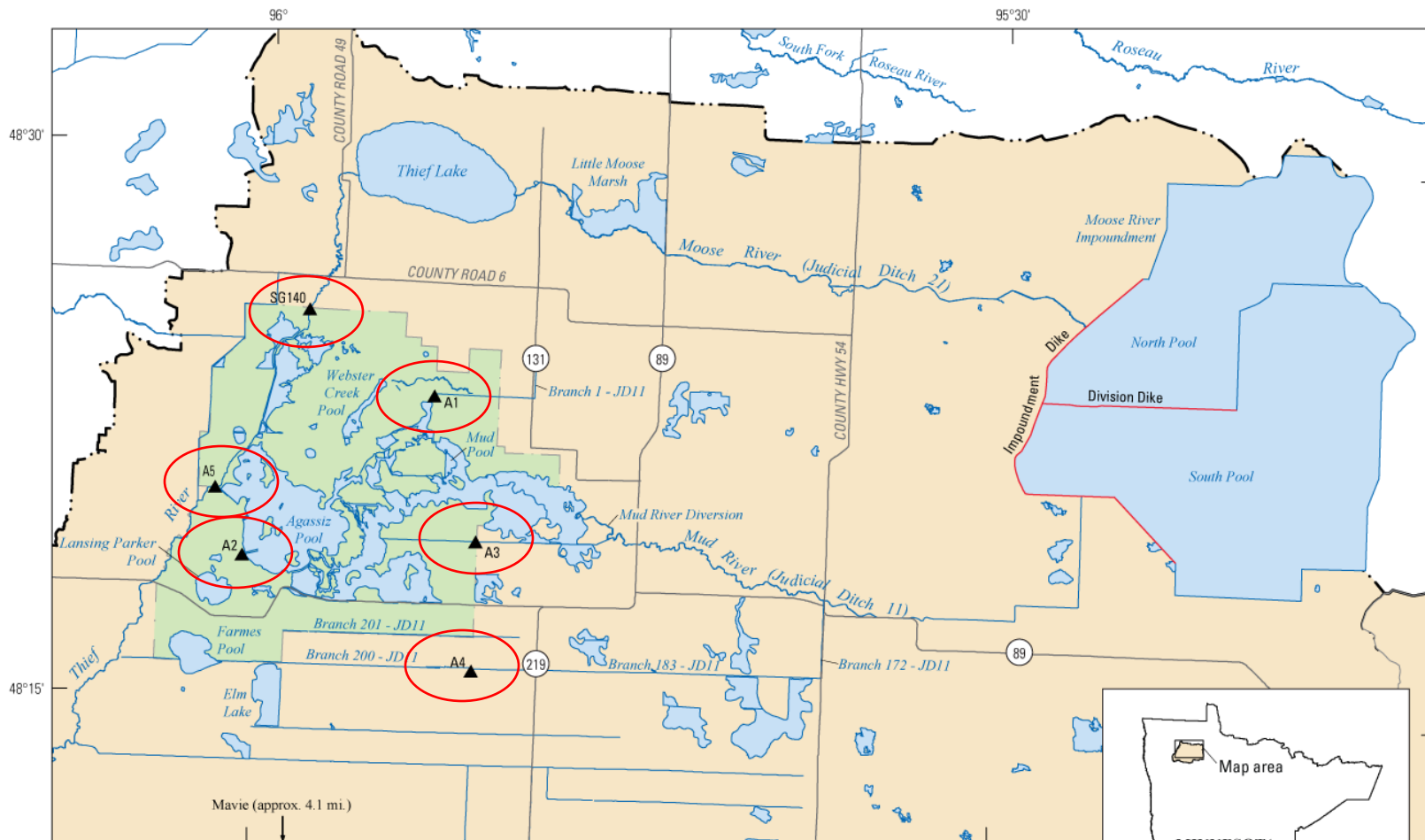
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Site Locations

■ 2 outflow sites

■ 4 inflow sites





Base from U.S. Geological Survey digital data, 1983,
 Universal Transverse Mercator projection
 Zone 15



EXPLANATION

- Agassiz National Wildlife Refuge
- Thief Lake Watershed
- Dike
- ▲ A1 Monitoring sites

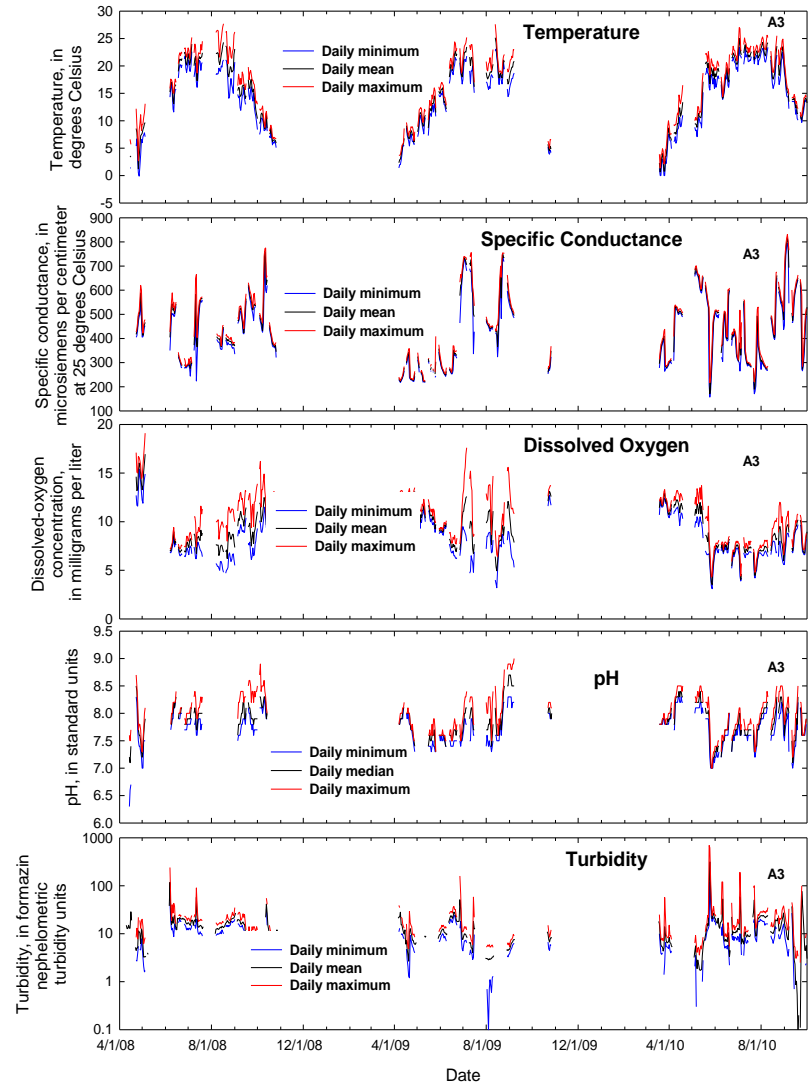
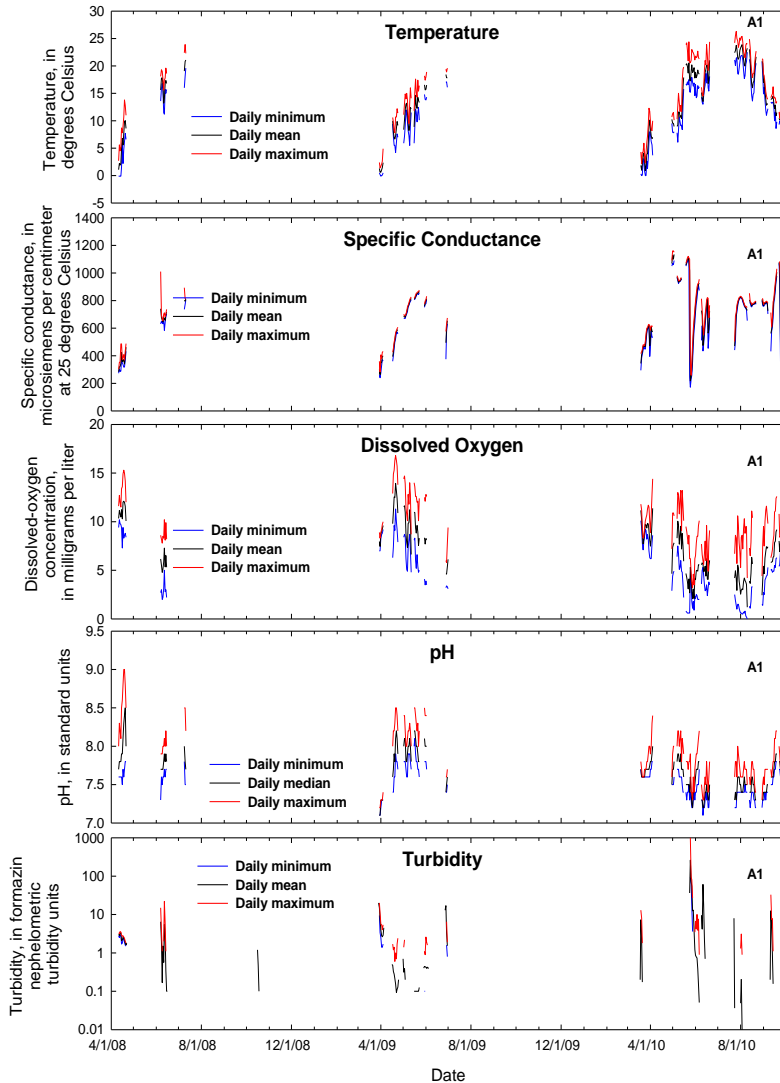


Hydrology



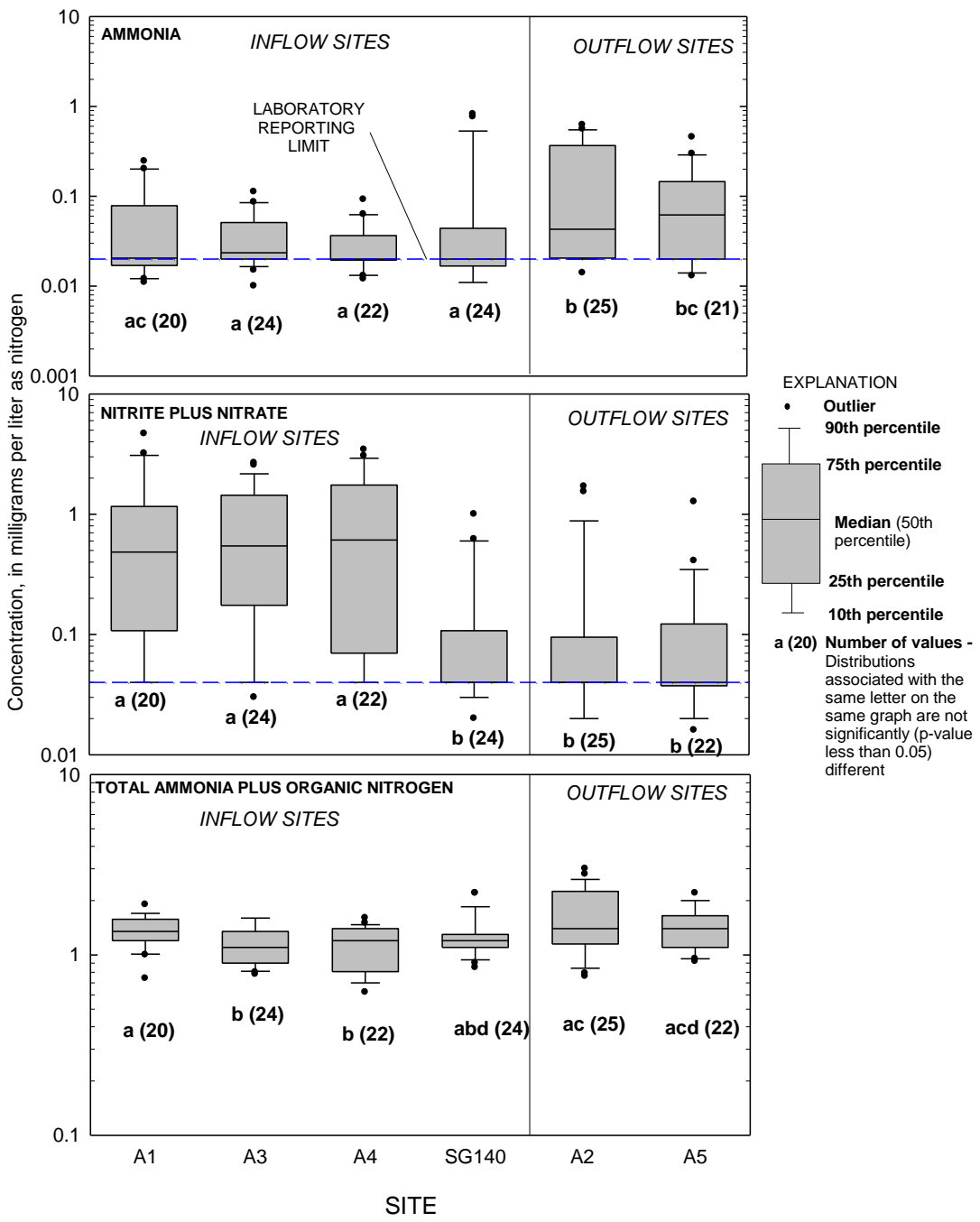
- Of the inflow sites, streamflow was greatest at SG140 and least at A1
- Of all the sites, streamflow was greatest at A2 (the largest outflow site)
- The first year of operation for outflow site A5 was in 2008
- In fall 2009, both WCS were opened at outflow sites for drawdown of Agassiz Pool
- Annual precipitation was greatest in 2010

Continuous Monitoring Data



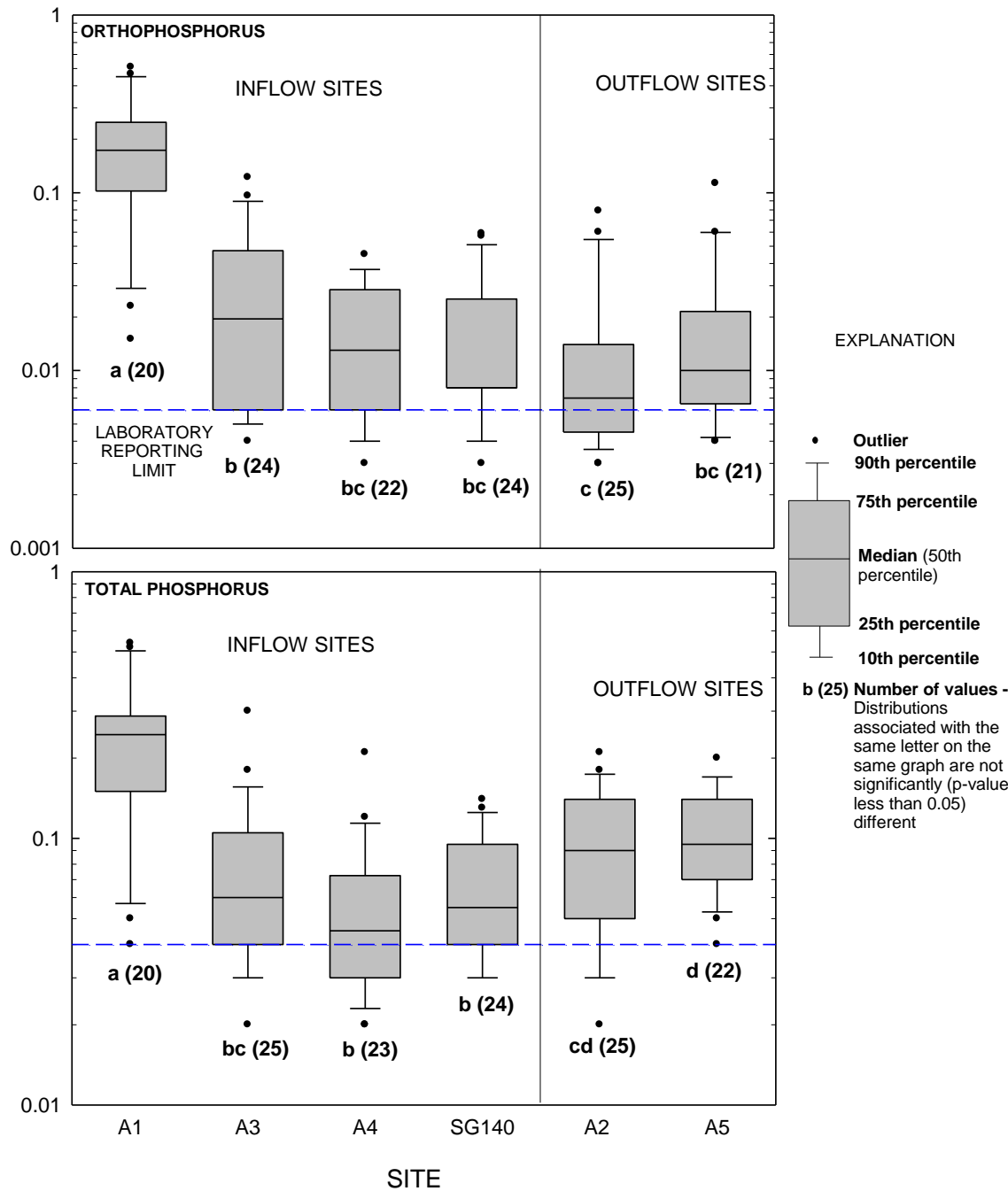
Ammonia higher at outflow sites

Nitrite plus nitrate higher at inflow sites



Phosphorus higher at A1 than any other site

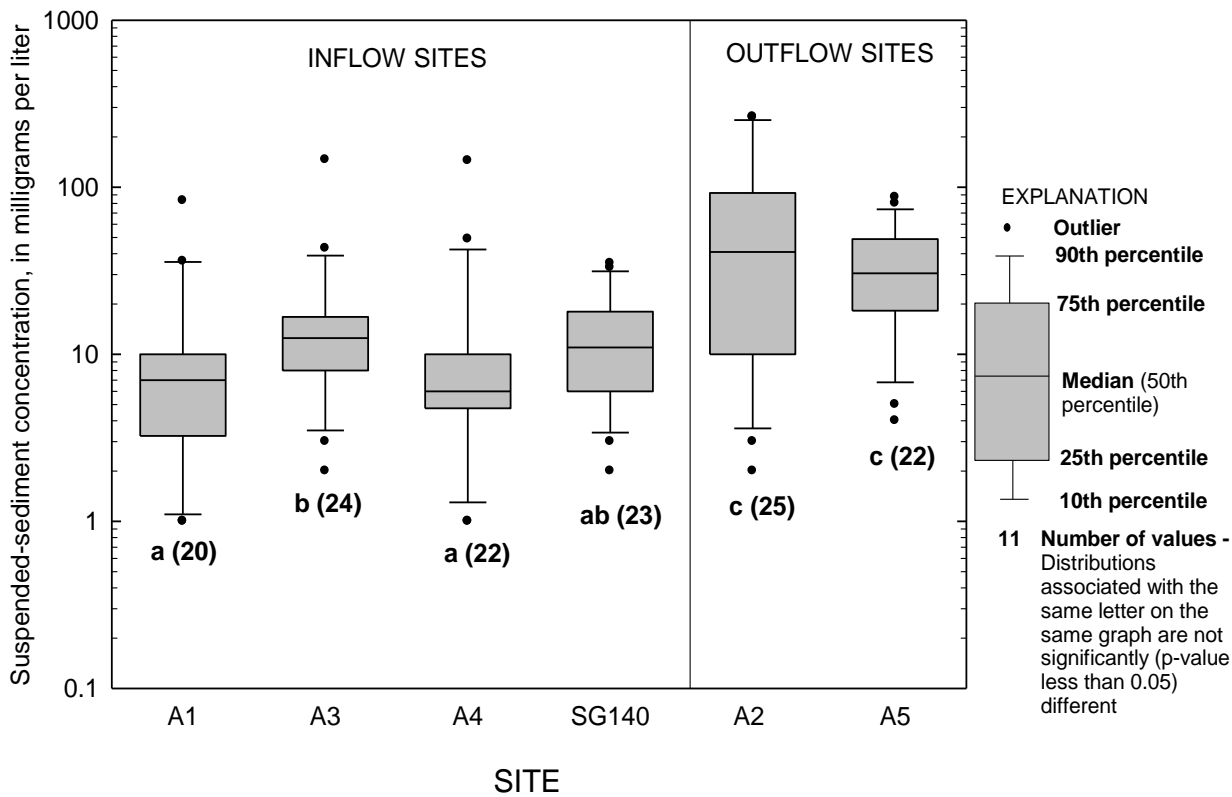
Concentration, in milligrams per liter as phosphorus

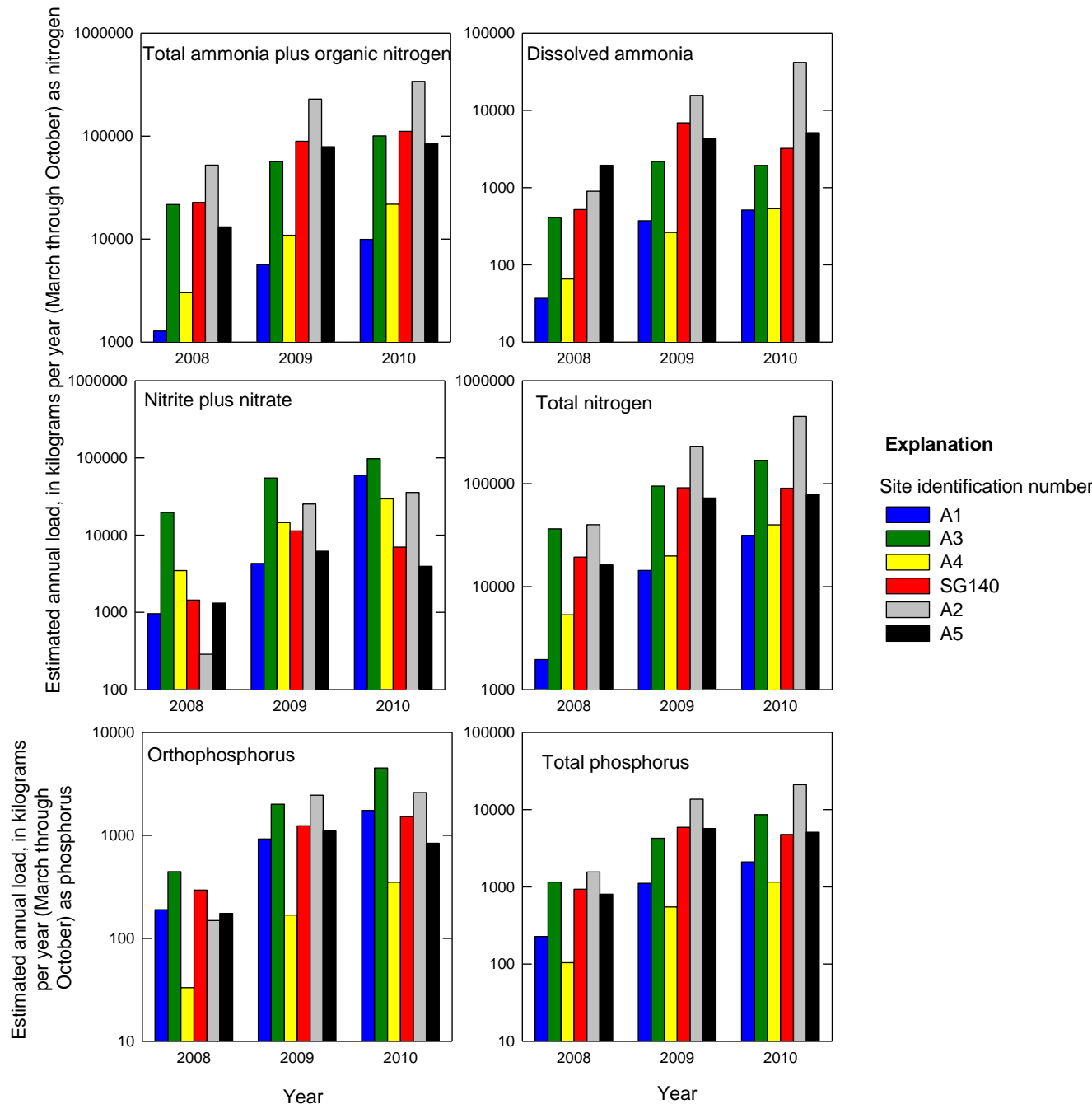


Site A1, inflow site

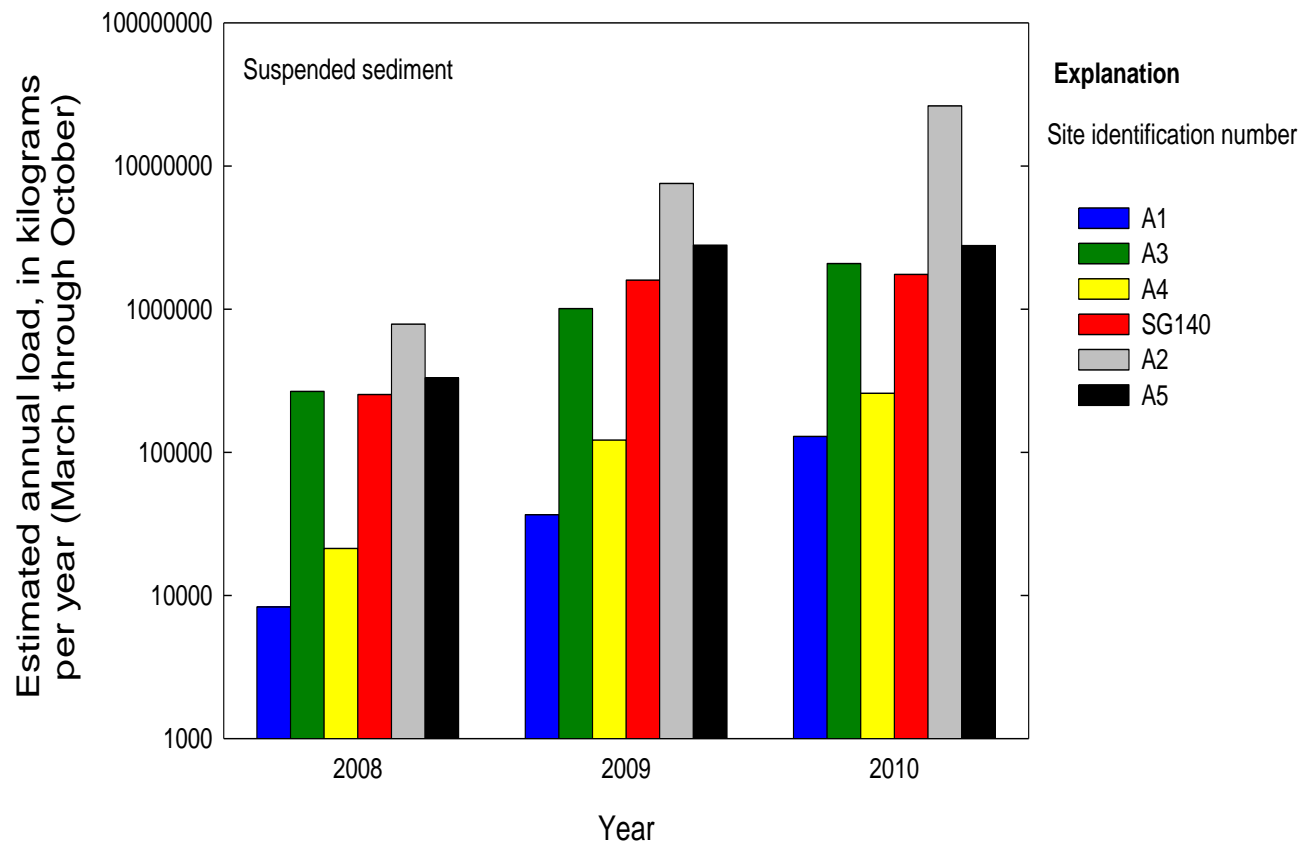


Suspended sediment higher at outflow sites



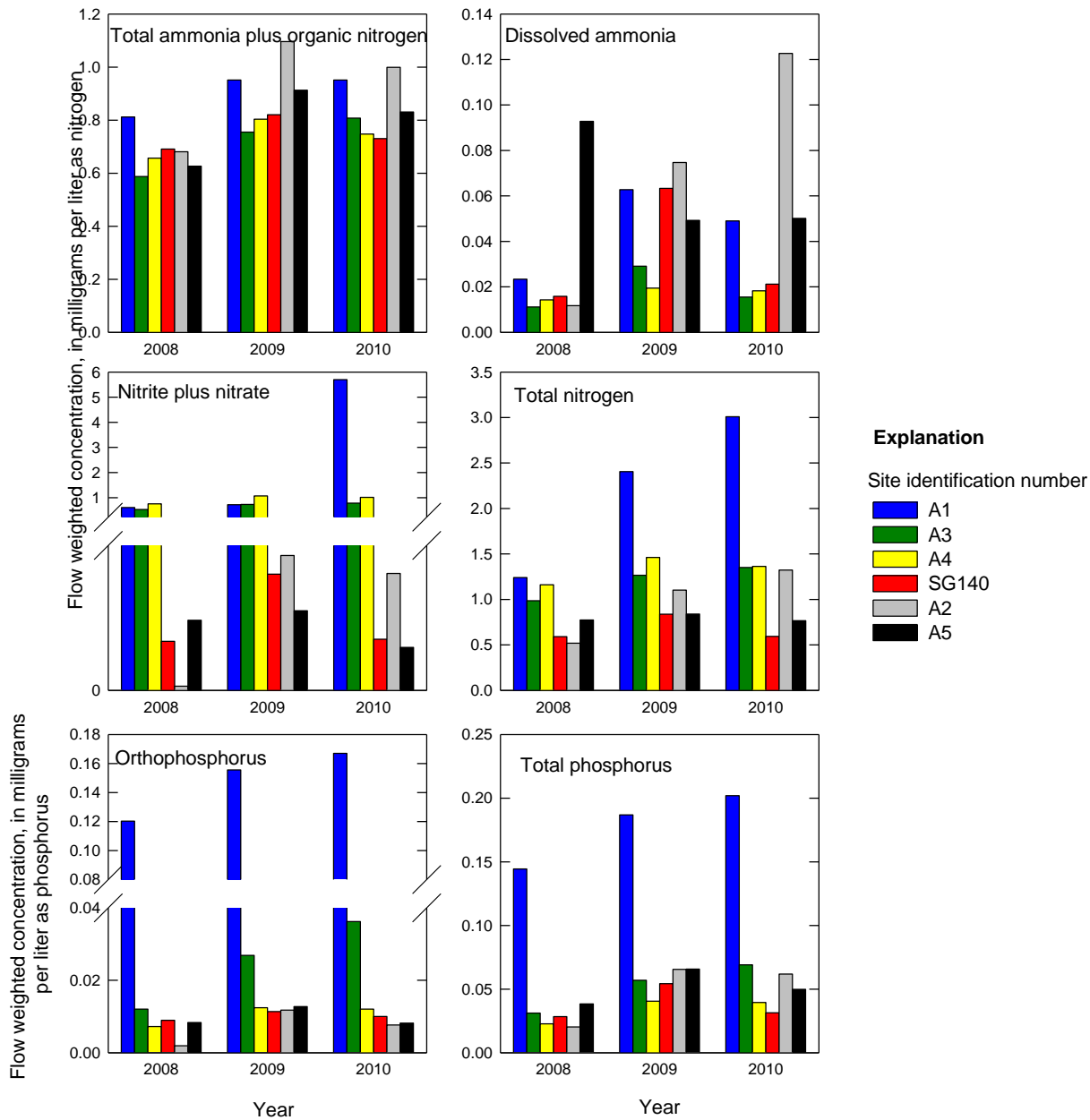


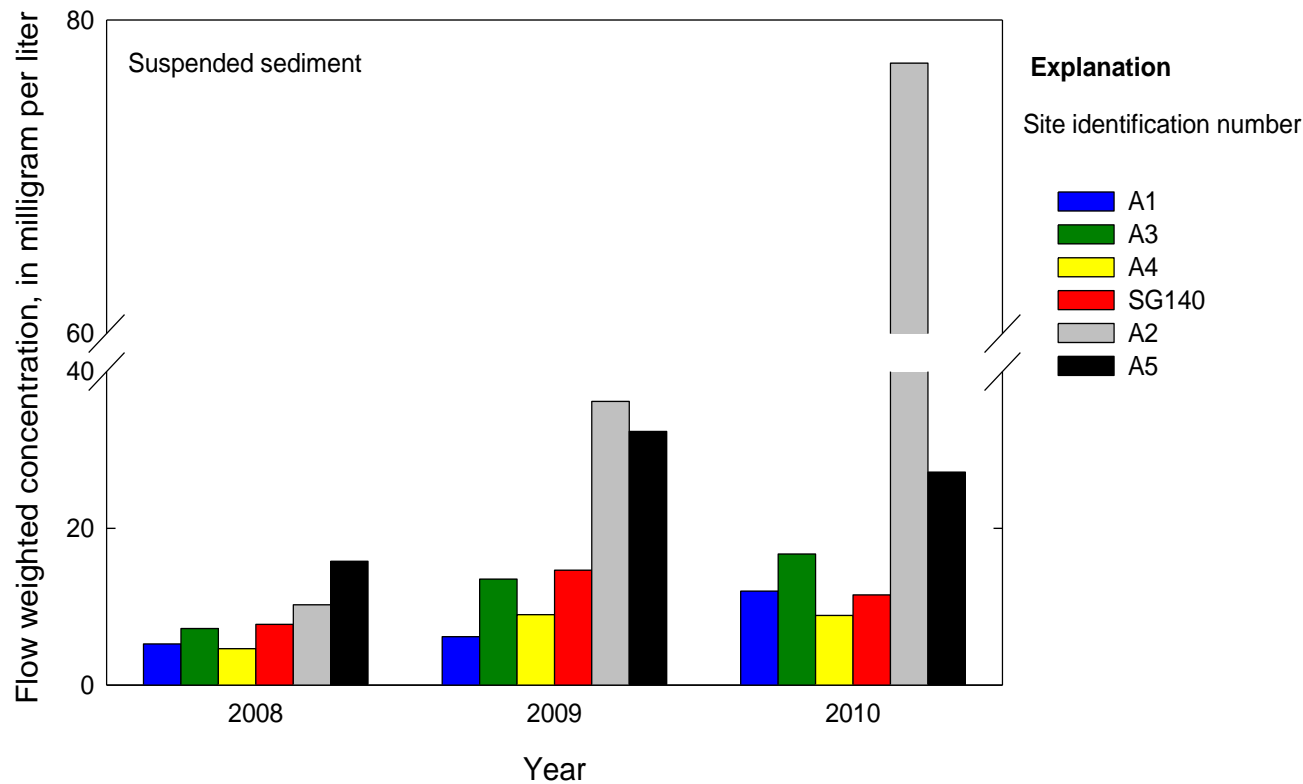
- Nutrient loads generally greatest in 2010
- Nutrient loads greatest at A2
- Substantial phosphorus loads at A1



- Sediment loads generally greatest in 2010
- Greatest loads at A2

Other than A1, flow-weighted concentration for nutrients were greatest in 2009





- Flow-weighted sediment concentrations for SG140 and A5 were greatest in 2009
- For all other sites, flow-weighted concentrations were greatest in 2010

Agassiz Pool Sediment Flux

- A net loss of sediment from Agassiz Pool for all three years
- Appears contrary to results from a sediment study based on radioisotopes ^{137}Cs and ^{210}Pb
- Operating conditions of A2 and A5 appear to have contributed to sediment loss from Agassiz Pool



Future Monitoring Possibilities

- This initial assessment was completed during changes in operating conditions
- Monitoring to detect changes through time (trend analysis) could include a 5 sample design
- Monitoring for load estimation requires sampling over the full range of streamflows

Final thoughts from the residents of Agassiz National Wildlife Refuge...



Thank you!