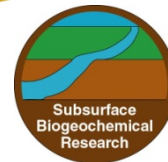


Aquifer Response to River Stage Fluctuations and the Resultant Uranium Contribution From the IFRC Smear Zone

Jim McKinley, Micah Miller, Tom Resch, Rachael Kaluzny, Vince Vermeul,
John Zachara, and Don Girvin, PNNL

IFRC Project Meeting
Pacific Northwest National Laboratory
Richland, WA

January 19, 2011

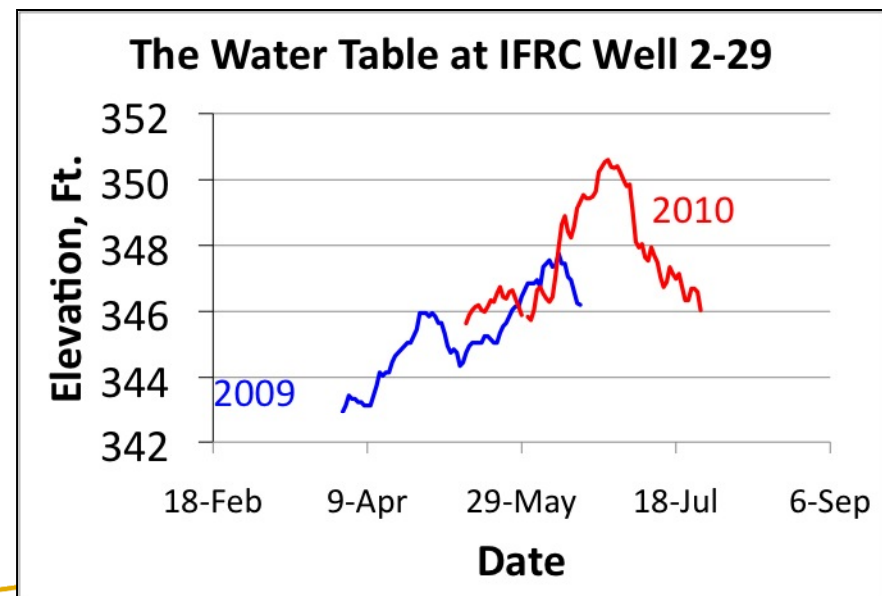


Proudly Operated by Battelle Since 1965

Experimental Design

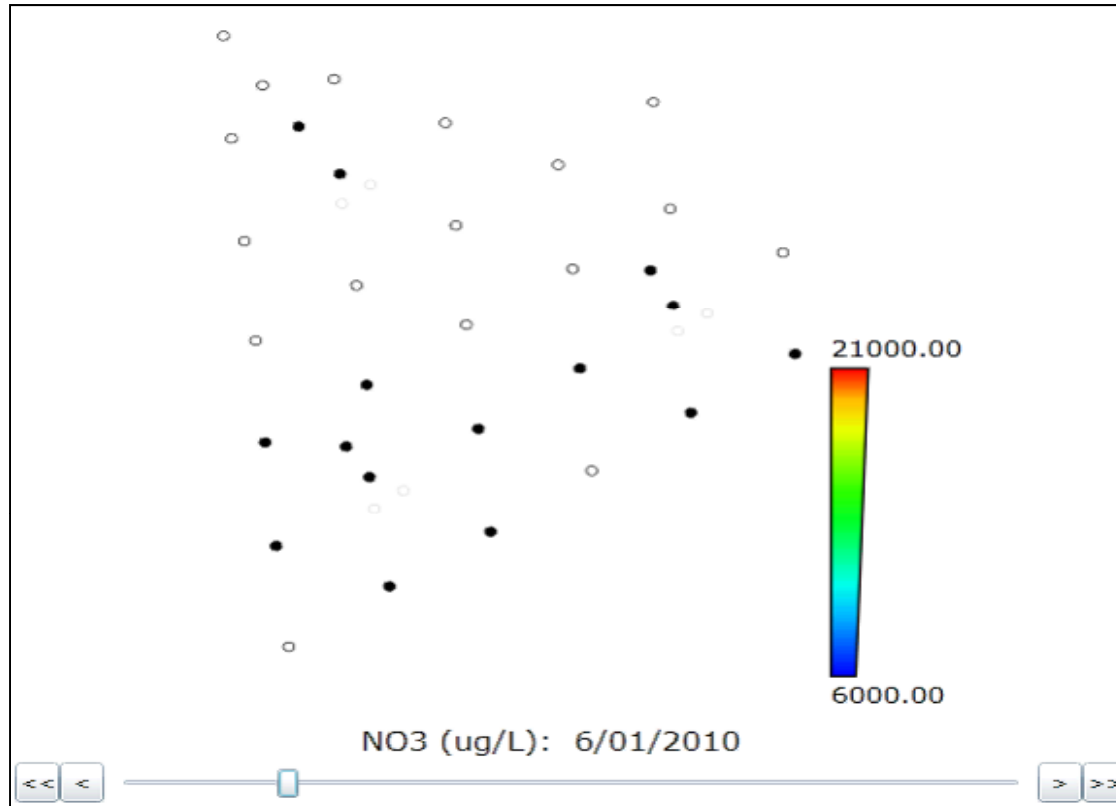
- ▶ Hypothesis: U contributed to aquifer as Columbia River and WT rise during Spring melt of snowpack
- ▶ Water bailed and pumped from aquifer to test whether pump averaging masked the smear zone contribution

- Bail: upper 15 cm
- Pump: center of screened interval
- Depth recorded for each bailed sample
- PT-2: small volume tracer tests at June 3 (ca. 20,000 gal. into Shallow cluster wells)
- 2010 was a higher-stage year than 2009



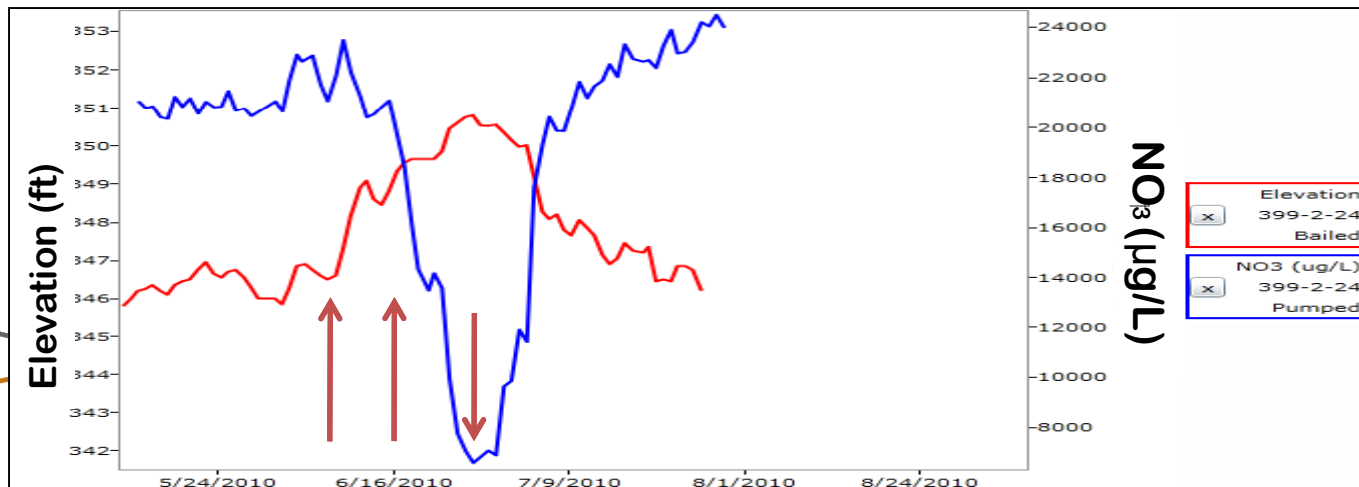
River Water Influx

NO₃⁻ Conc.



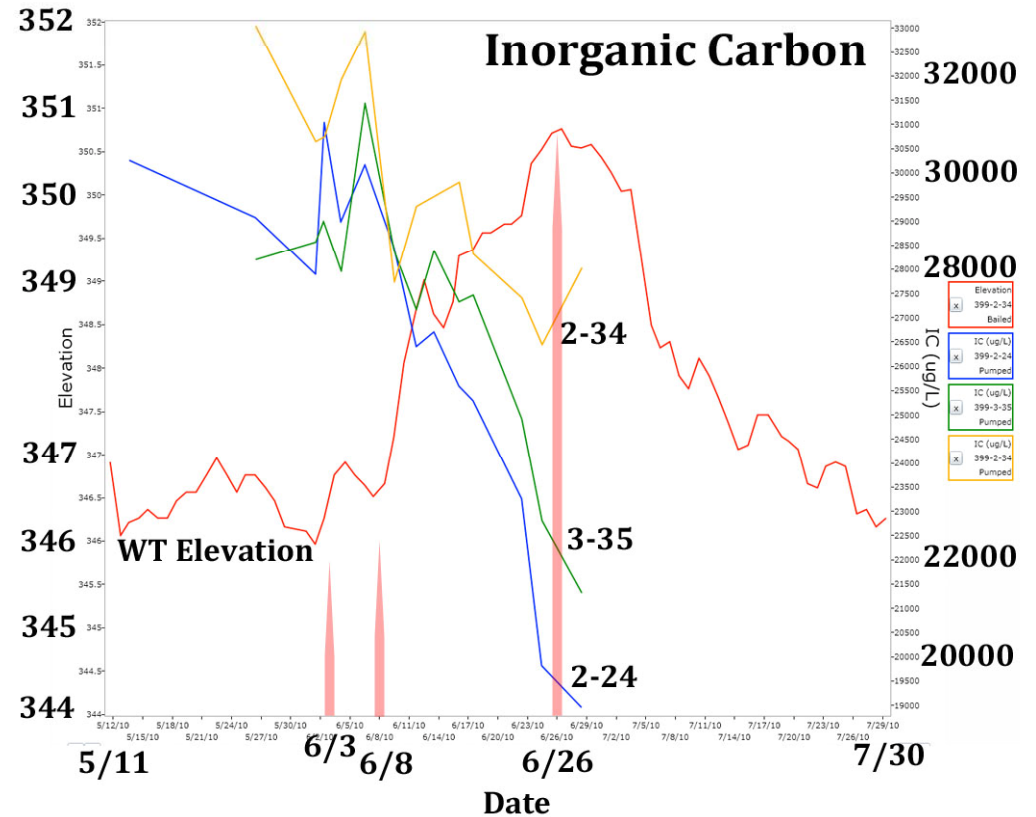
- ▶ GW = 21000
- ▶ RW = 0.42
- ▶ WT Rise at June 8
- ▶ RW Arrival at June 15
- ▶ RW and WT Min/Max at June 26
- ▶ Min = 6500
- ▶ Max RW = 70%

Well 2-24



River Water Effect on Dissolved Inorganic Carbon

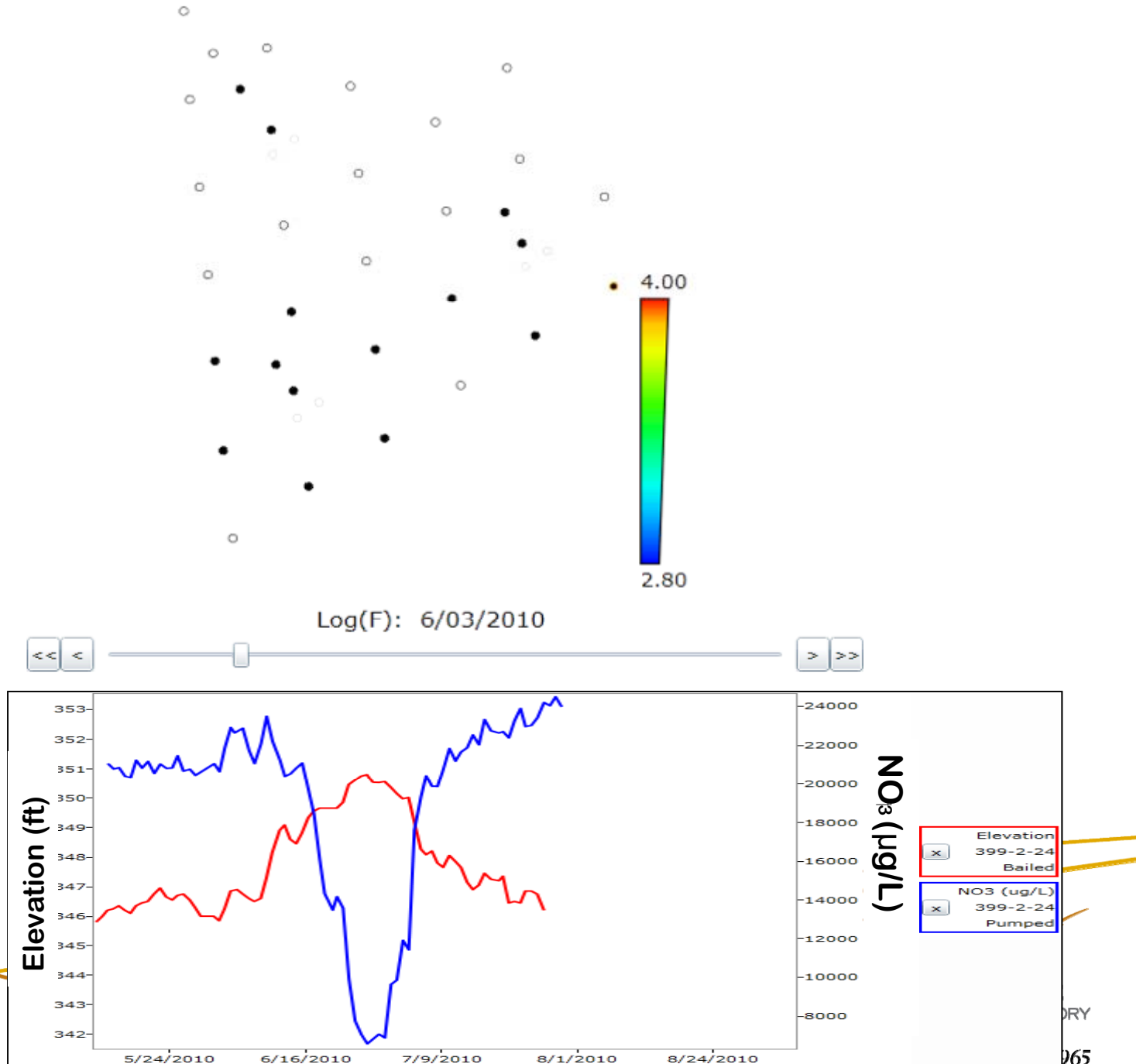
- Data incomplete
- Background concentrations higher to the North
- (GW = 99-198 mg/L at Hanford)
- GW est. 145 mg/L HCO_3^-
- RW est. 56 mg/L
- GW Min. = 19 mg/L
- Est. Max. RW = 57%
- Compare est. 70% by NO_3^-
- (2009 est. max of 10% RW)



TRACERS

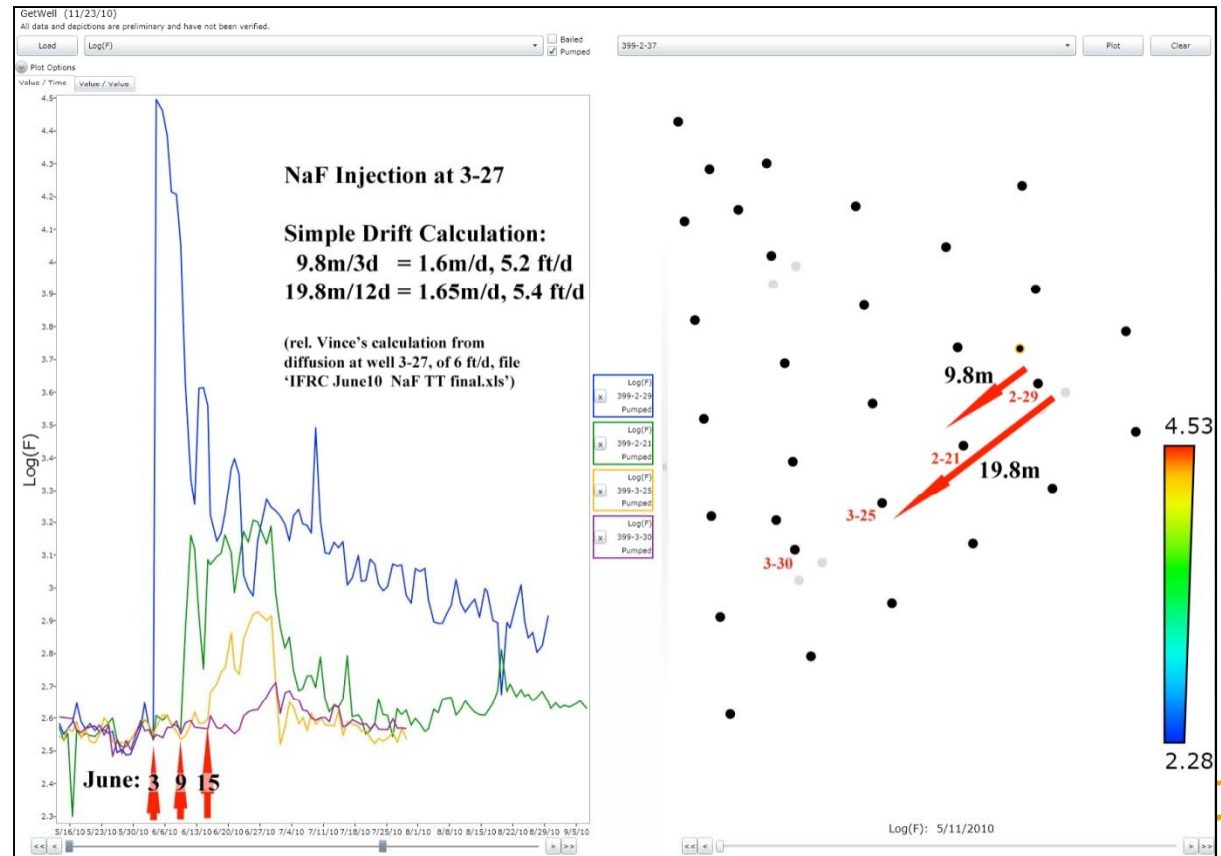
F⁻ Injected June 3

- Ca. 26,000 gal.
- As NaF
- 40 ppm
- Log Scale
- 2.8 = 0.63 ppm
- 4.0 = 10 ppm
- Movement South and West



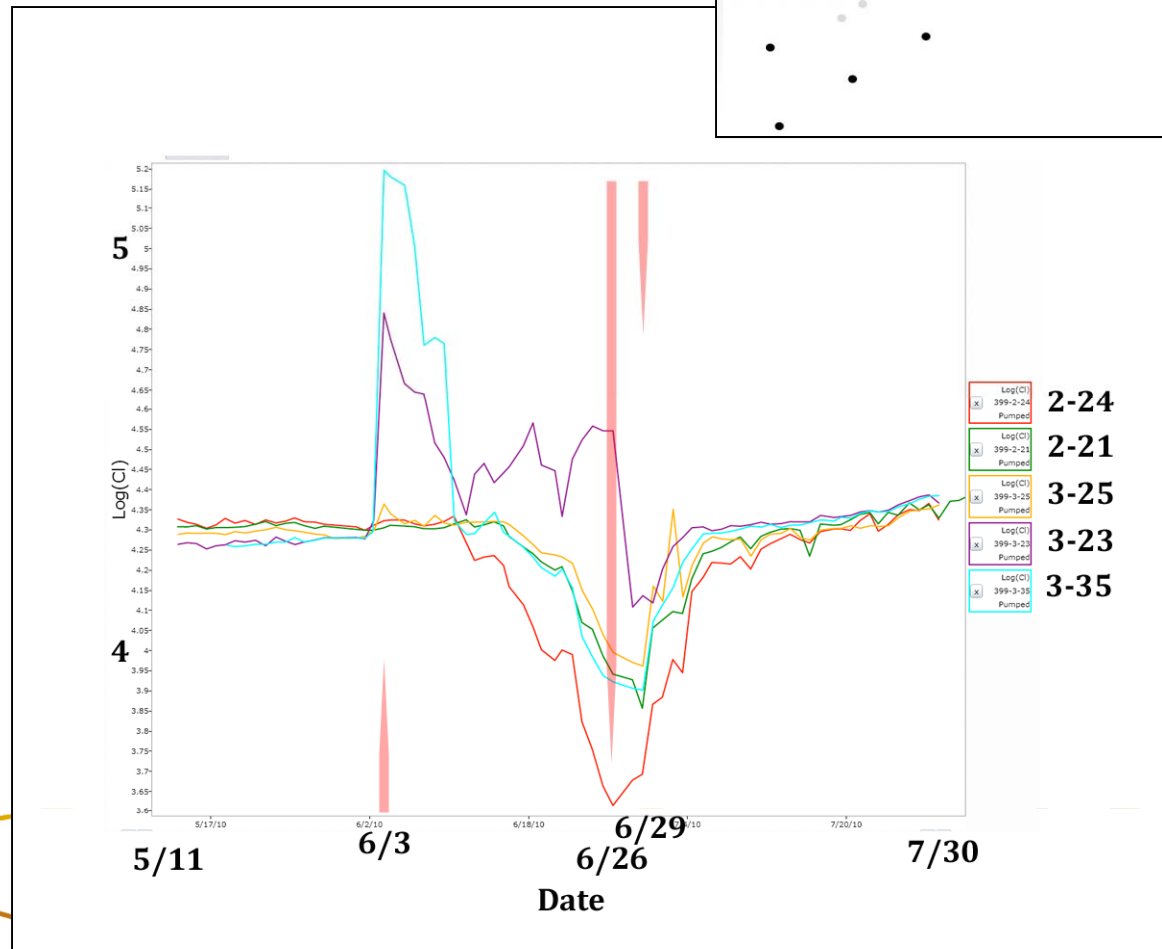
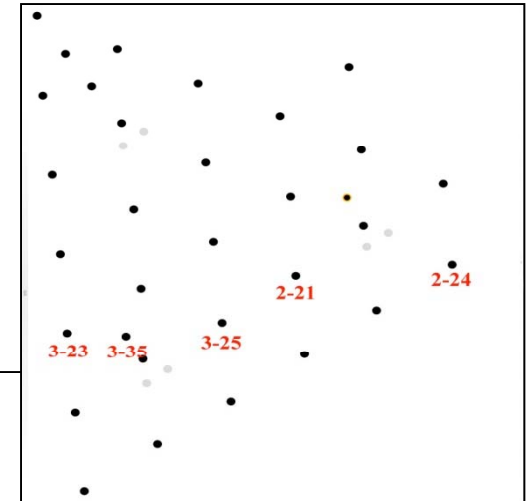
Tracer Velocity Calculated from Arrivals

- ▶ Plot used to estimate background F^-
- ▶ $\text{Log } F^- > 2.6$ (400 ppb) assumed to represent tracer
- ▶ Inflection dates and distance
- ▶ Velocity est'd at 5.2 – 5.4 ft. per day



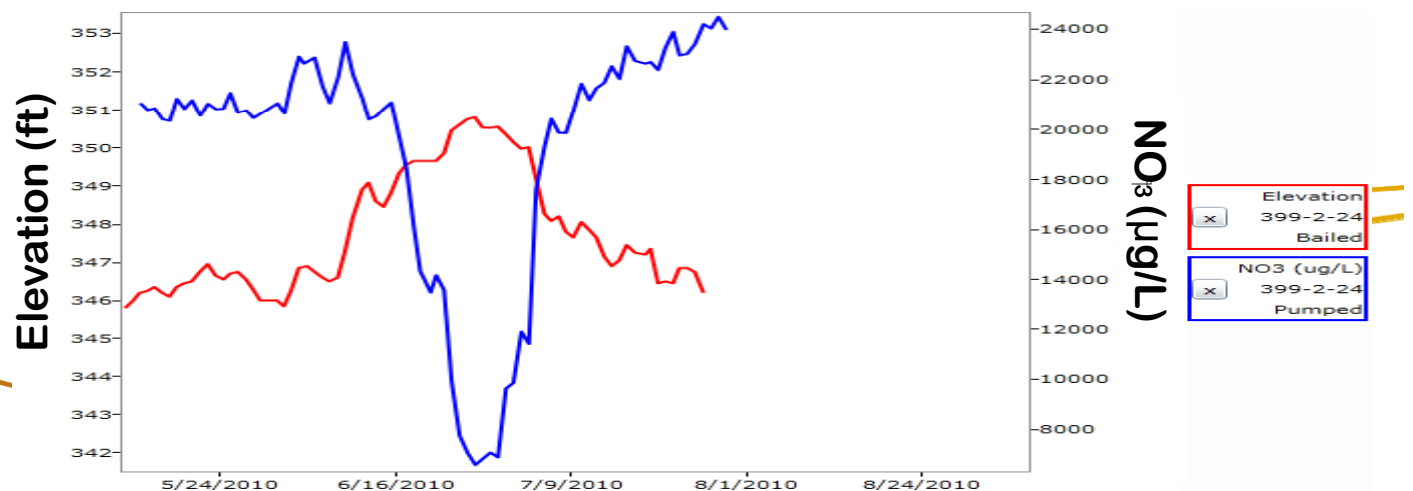
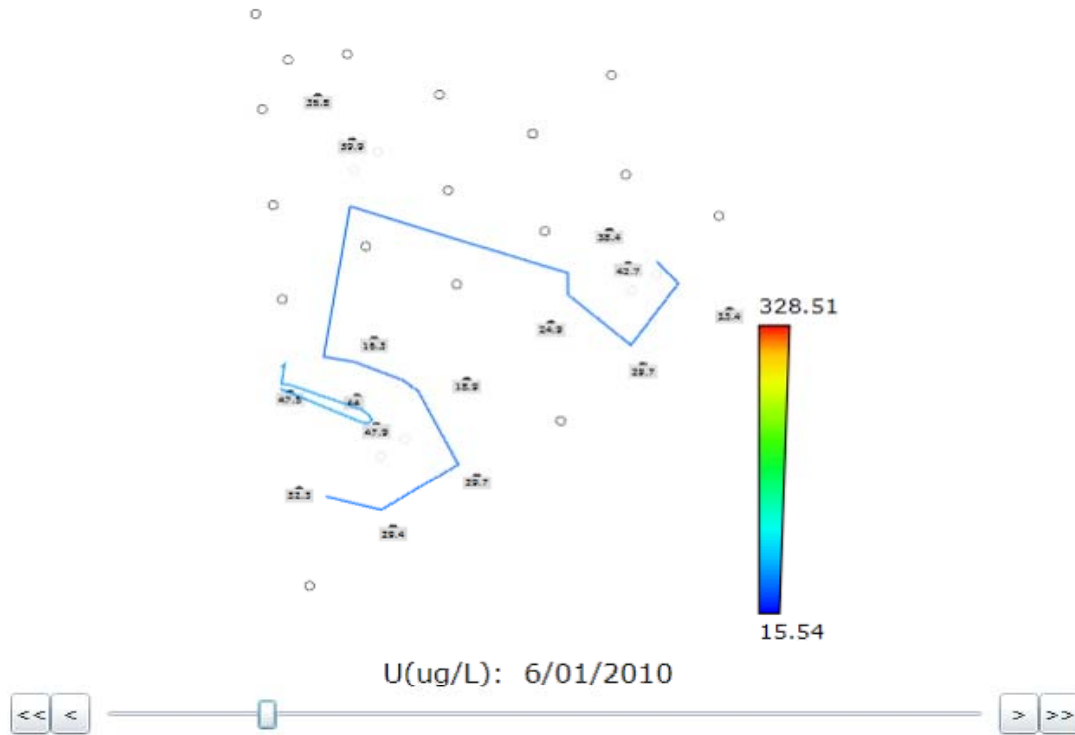
Chloride: Tracer and RW Effects

- ▶ Effect of RW intrusion diminishes E – W
- ▶ Arrival of RW trough delayed
- ▶ Cl conc. oscillations adjacent to injection site.



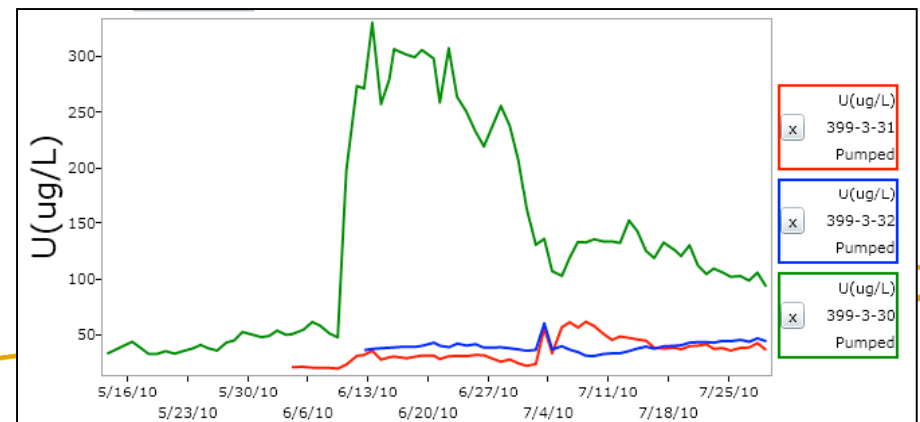
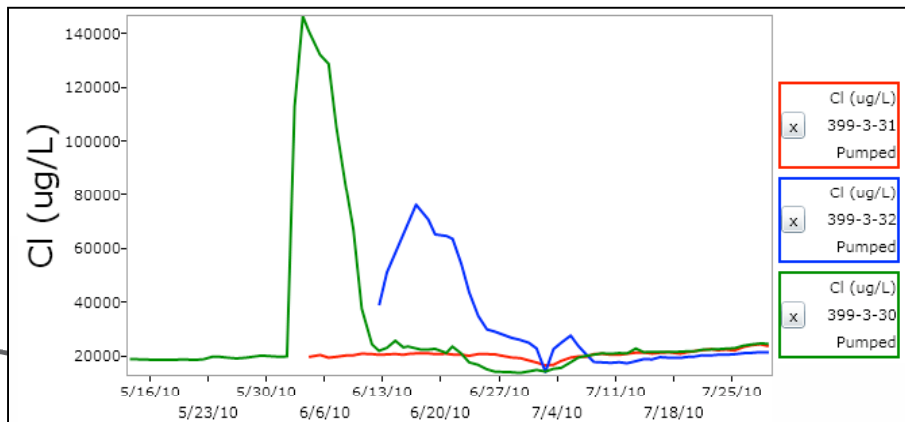
Uranium Contribution From Smear Zone

- Bckd = 30 ppb
- Contribution from Smear Zone during WT rise
- Maximum Well 3-30 = 320 ppb
- Later Pulse Well 3-13 = 270 ppb (RW retreat)
- U dispersed, yielding doubled concentration in western IFRC



Summary

- ▶ River water intrudes to become majority component in high-stage years
- ▶ Low-carbonate concentrations may affect complexation
- ▶ Smear zone contributes significant U to the aquifer during WT rise
- ▶ Uranium is contributed to GW of RW composition at top of aquifer
- ▶ Tracer and U data indicate rapid dilution and dissemination of water across the site
- ▶ Deeper aquifer zones have muted response to RW intrusion and U capture at the WT
- ▶ FY11: long-term sampling of upper most aquifer



Pacific Northwest
NATIONAL LABORATORY

Proudly Operated by Battelle Since 1965