



Investigating the storage and transport of roadway salt to surface waters in a second order suburban watershed, Owings Mills, Maryland

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Road Salt

- Road salt is used as de-icer during winter
- Baltimore County uses primarily NaCl
- Private companies or homeowners often use MgCl or other de-icers
- Road Salt Use has continued to rise since the 1940s



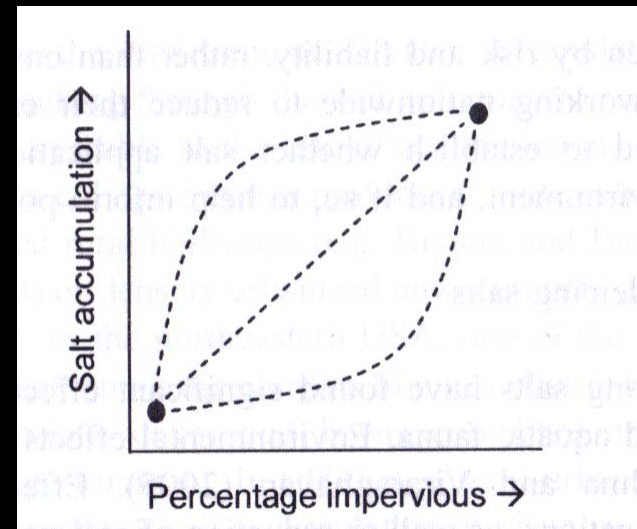
<http://www.post-gazette.com>



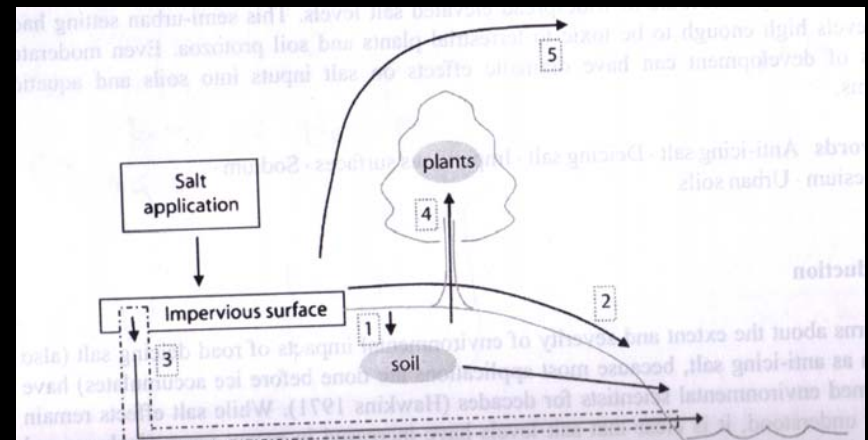
<http://www.sciencedaily.com>

Road Salt cont.

- 8-12 million tons applied in the U.S.
- Maryland general application policy: 300-500 lb/lane mile
- EPA does not consider road salt a contaminant; not regulated

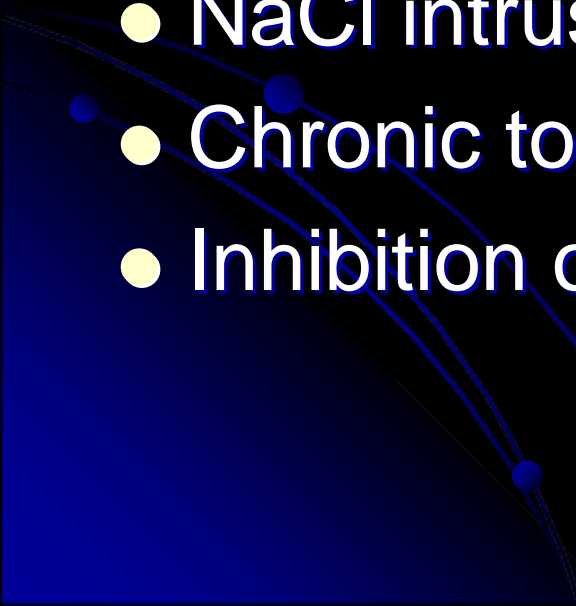


Cunningham *et al.*, 2007



Cunningham *et al.*, 2007

Potential Effects of Road Salt

- Increased mobility of metals and displacement of ions
 - Reduced acid neutralizing capacity from ion exchange
 - NaCl intrusion into drinking aquifers
 - Chronic toxicity of stream organisms
 - Inhibition of plant vigor and reproduction
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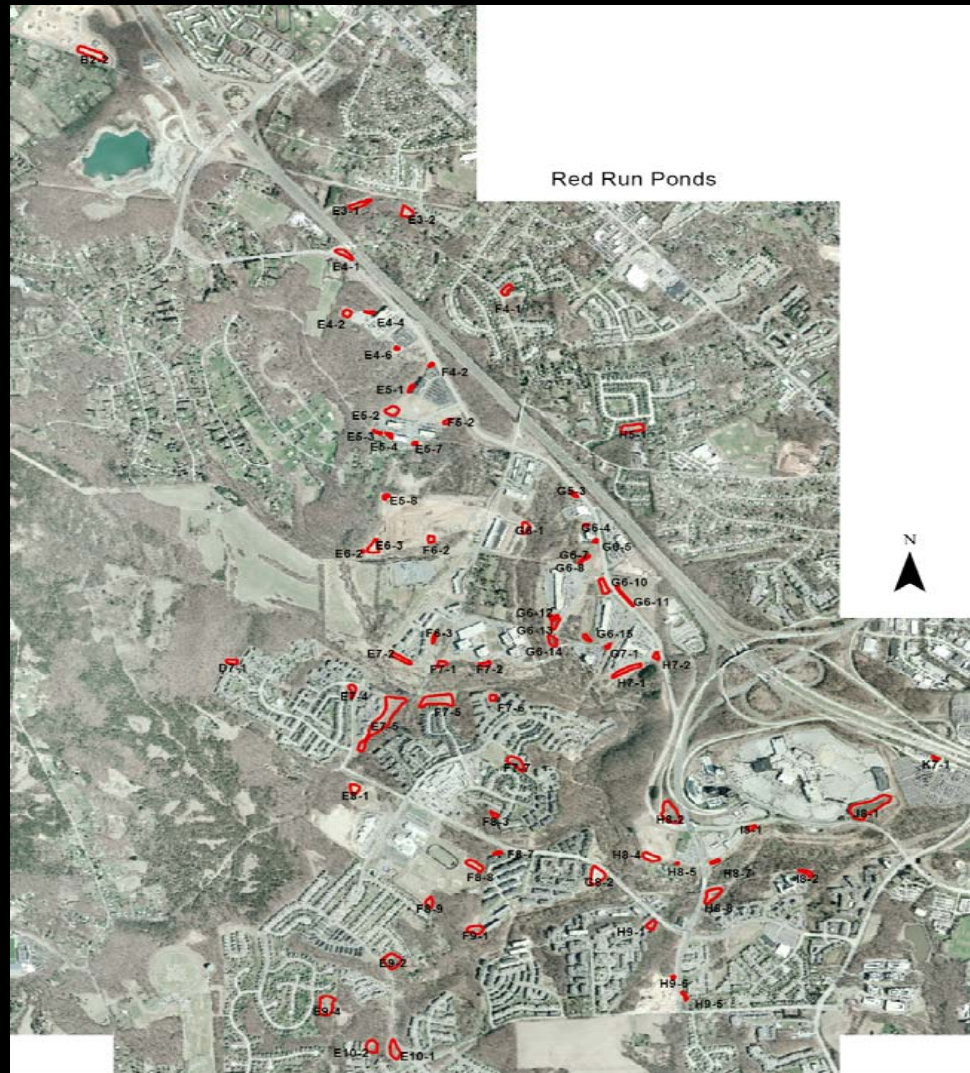
Stormwater Retention Ponds

- Current BMP for Baltimore County
- Stormwater Residence Time of typically < 3 days
- Allows pollutants to settle out or be neutralized
- Reduces discharge into streams closer to natural, “pre-impervious surface” levels

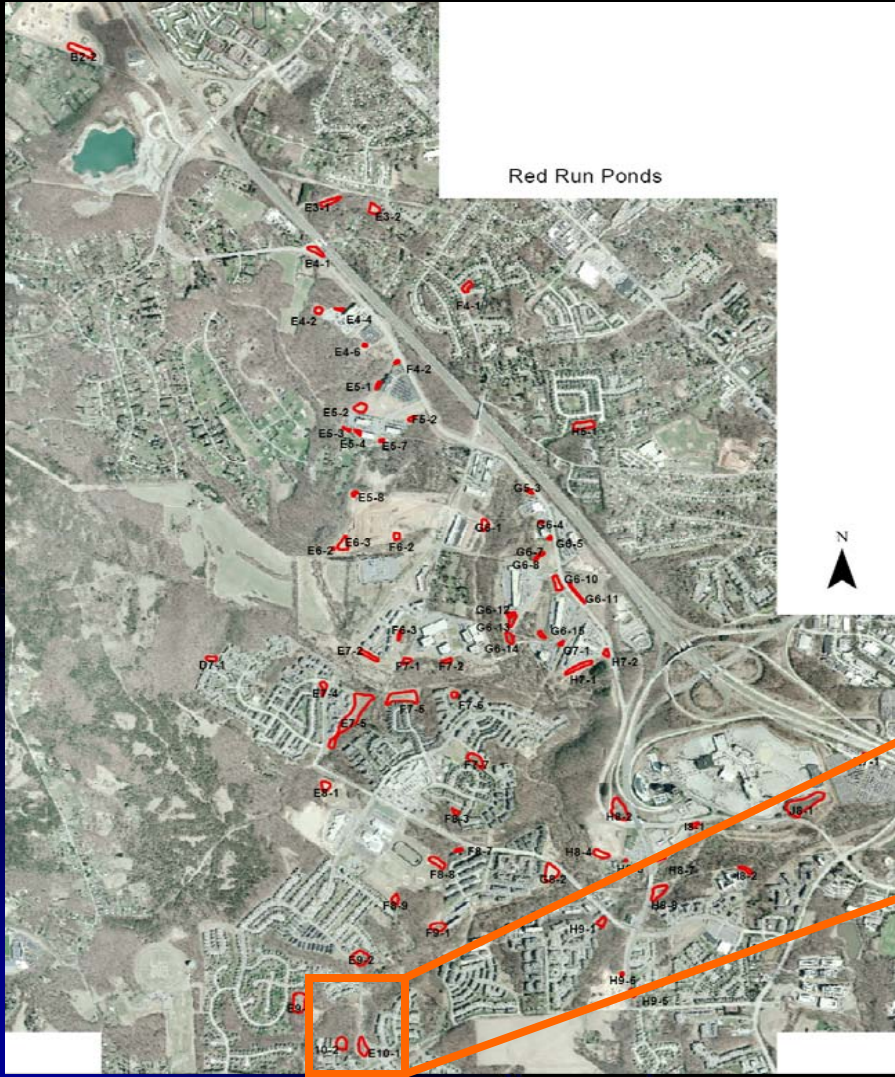


Photo by Rob Flora

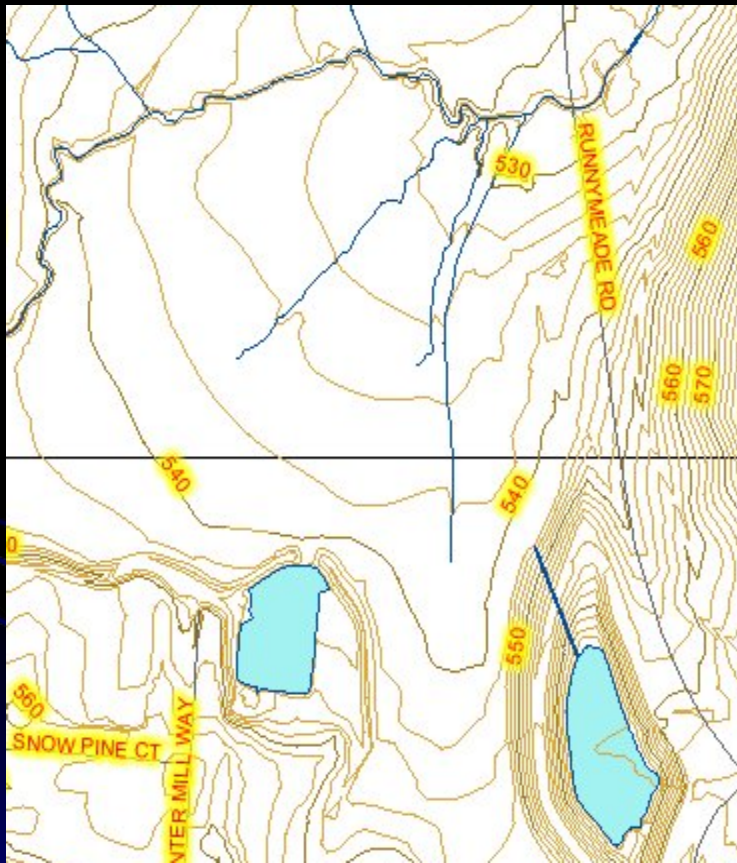
Red Run Watershed



Red Run Watershed cont.



Field Site



Ba.Co. Planimetric

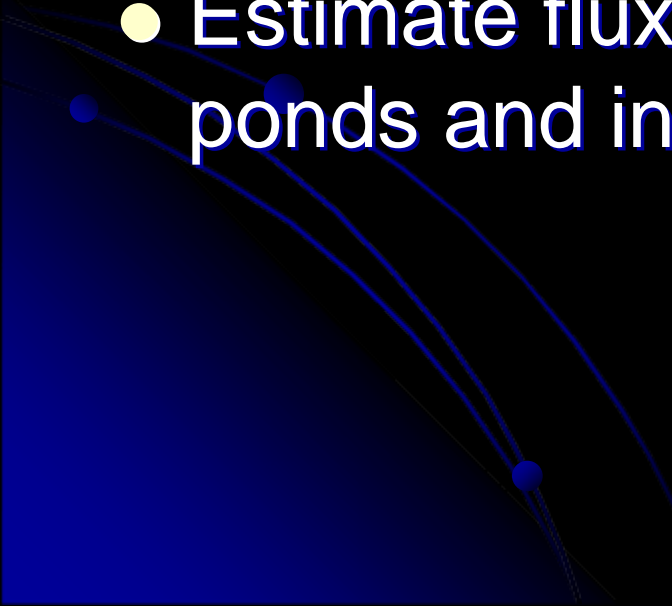
- 3 acres
- ~14 ft elevation drop
- Receives effluent from two retention ponds
- 3 1st order tributaries empty into 2nd order stream
- Aerial salt dispersion is minimal



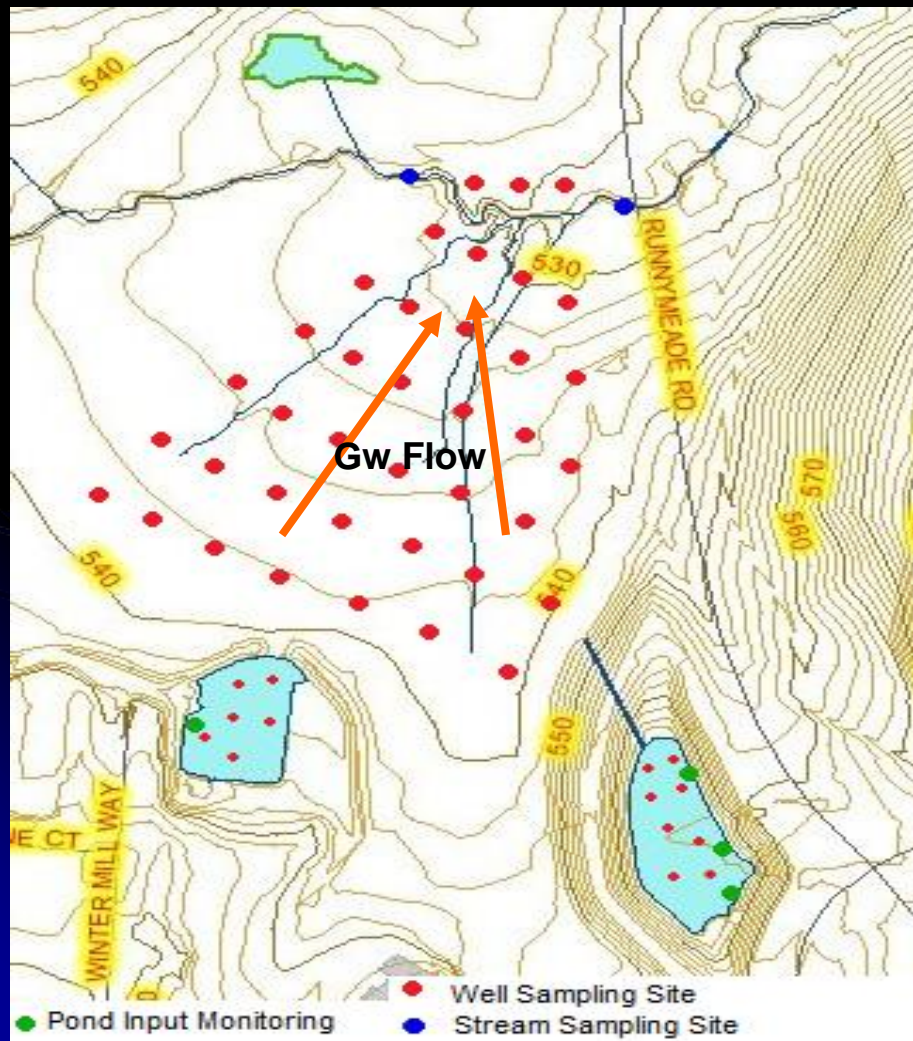
Ba.Co. Planimetric

Photos by Rob Flora

Objectives

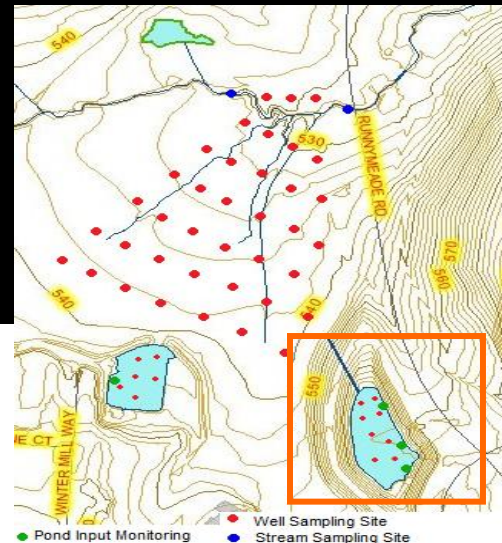
- Identify chloride plume in groundwater as a result of a continuing pond source
 - Analyze phreatic groundwater for trends in aqueous chemistry from road salt use
 - Estimate flux of chloride from two retention ponds and in the flood plain
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Field Sampling

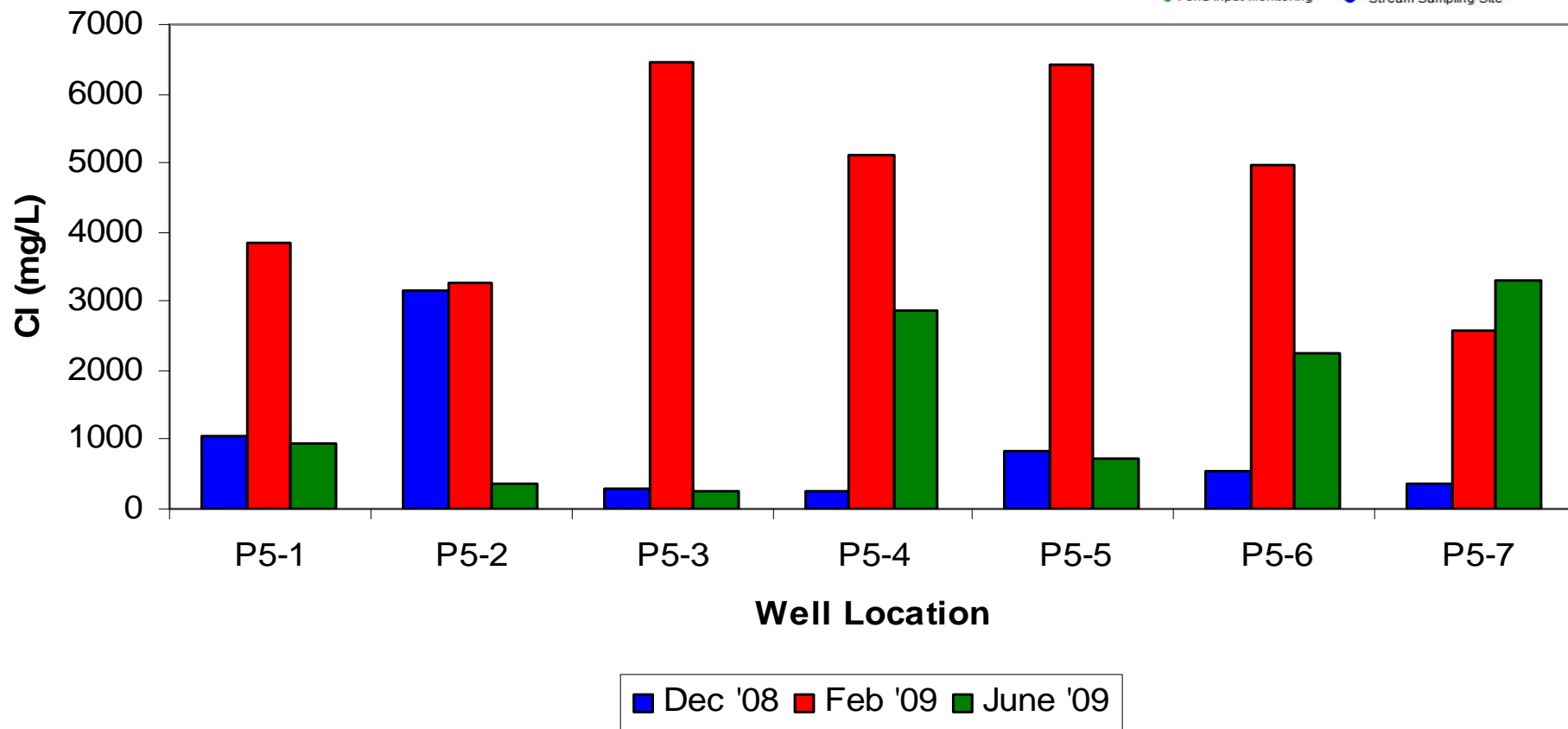


- 9 flood plain transects
- 13 wells in ponds
- Pond Input monitoring
- Stream Cl monitoring
- Sample ground and surface water every 2-3 months
- Sampled only well recharge

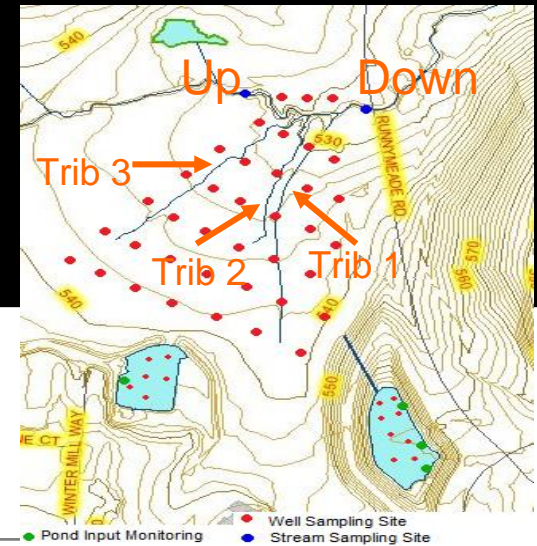
Retention Pond



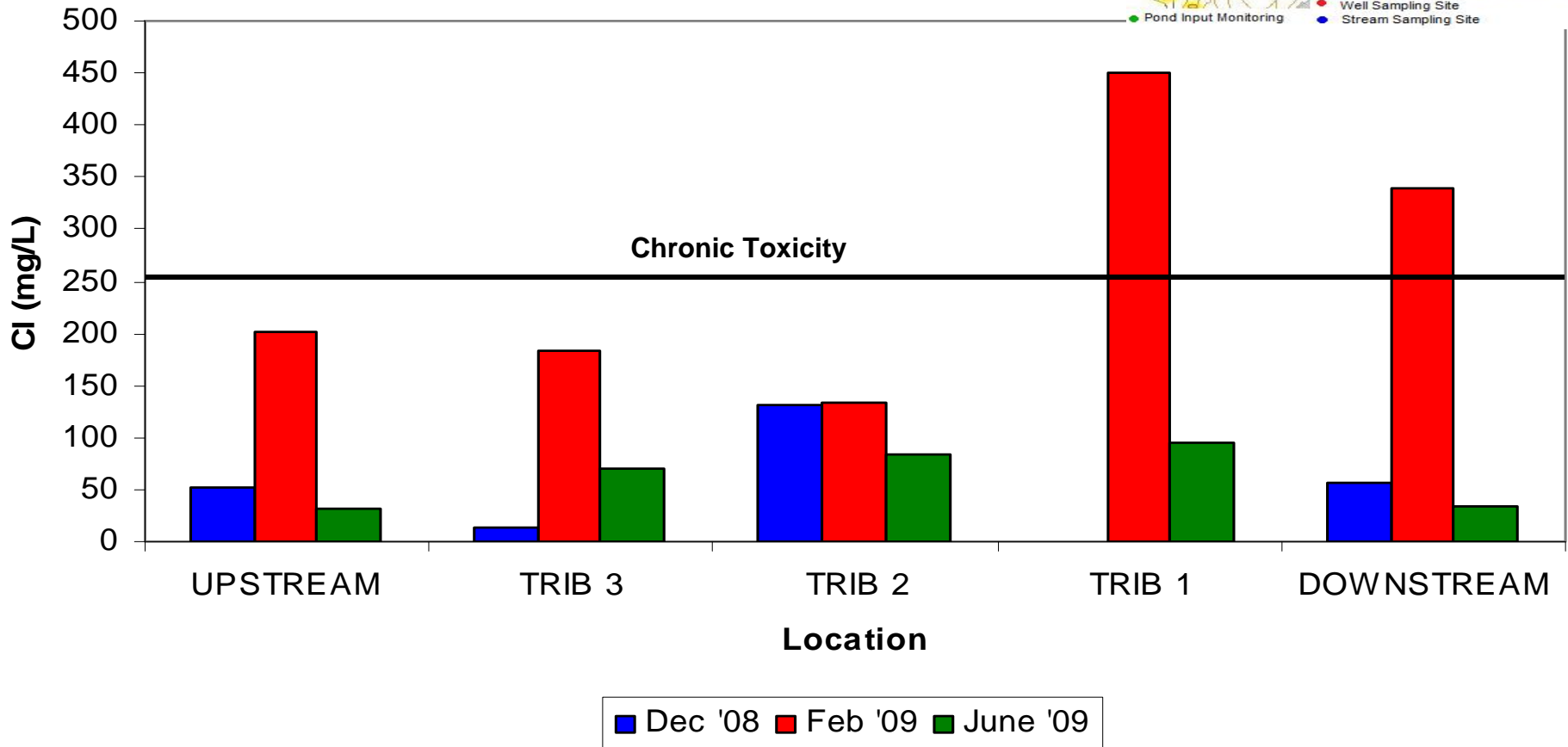
Large Pond Groundwater Chloride December '08 to June '09



Surface Water

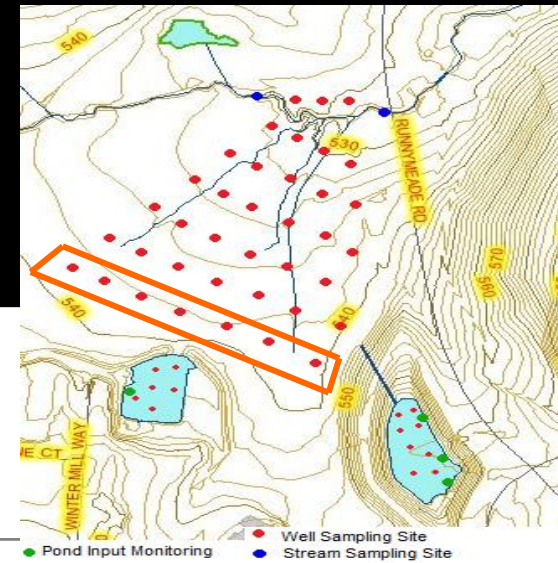
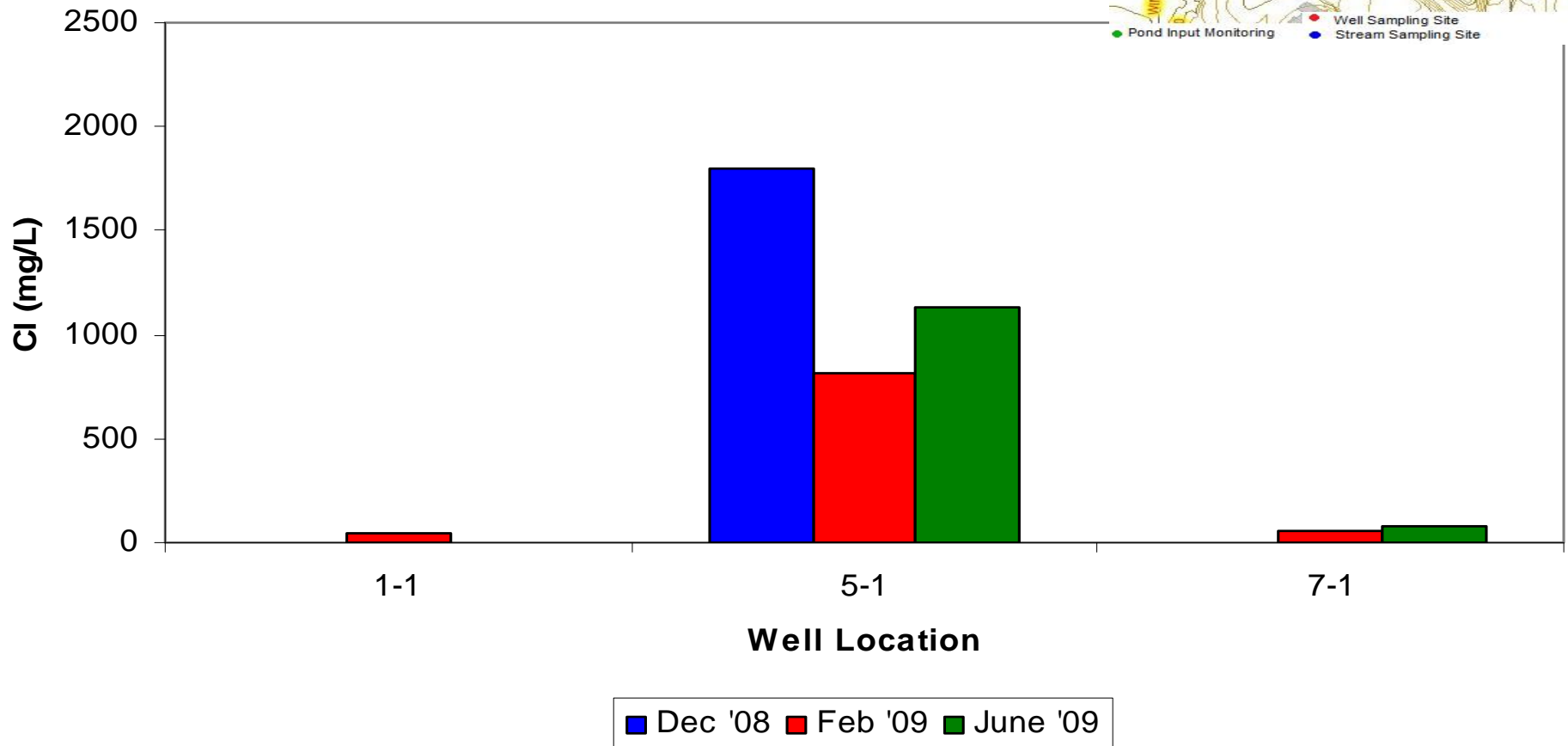


Surface Water Chloride: December '08
to June '09



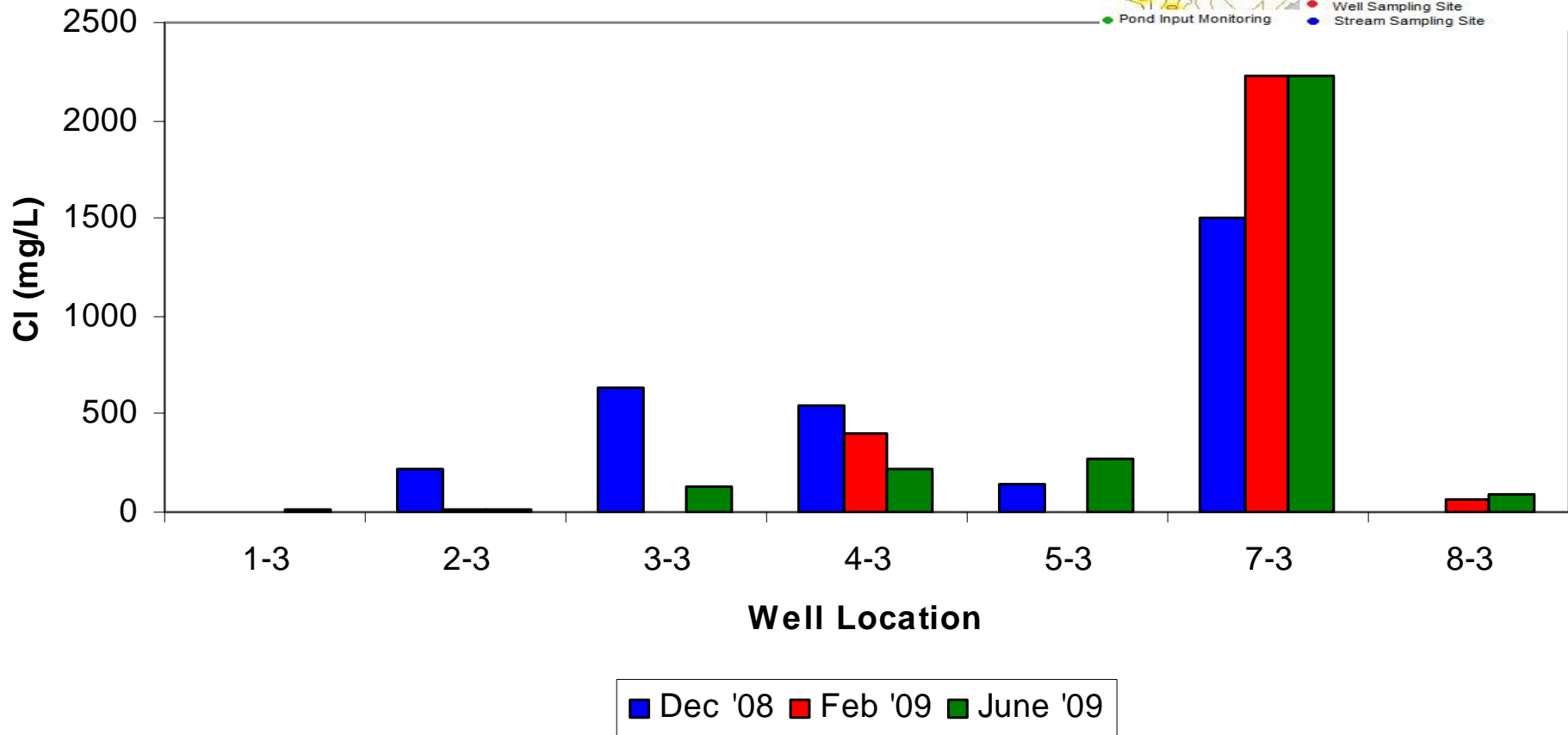
Groundwater

Chloride Groundwater Concentrations Across Flood Plain: December 2008 to June 2009



Groundwater

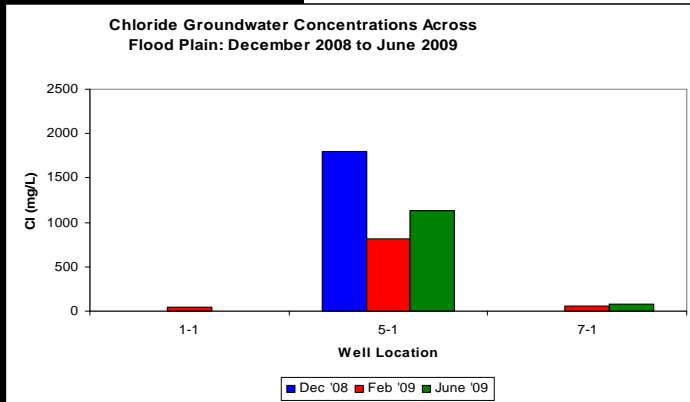
Chloride Groundwater Concentrations Across Flood Plain: December '08 to June '09



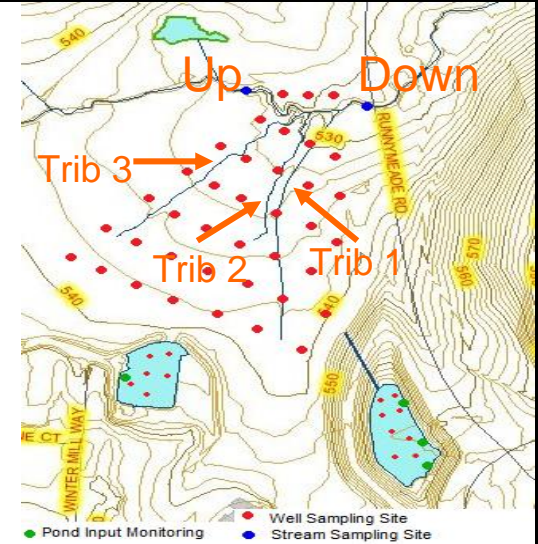
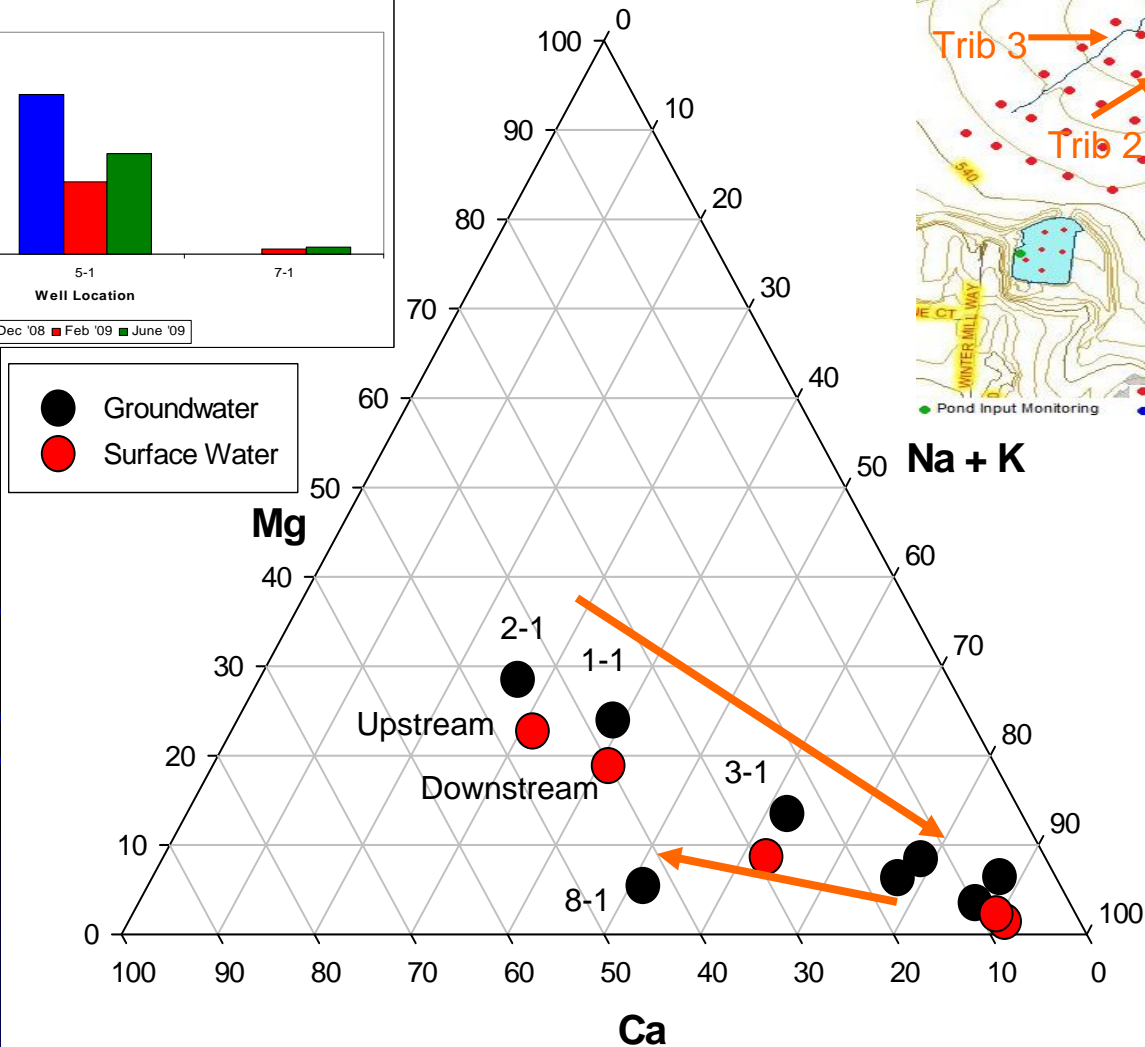
Groundwater Chloride

- The retention ponds are a continued source of Cl throughout the year
- Surface water concentrations of Cl are above chronic toxicity levels of 250mg/L during winter and during periods of groundwater discharge
- A groundwater Cl plume has been identified between transects 1 and 8

Groundwater Cation Trend

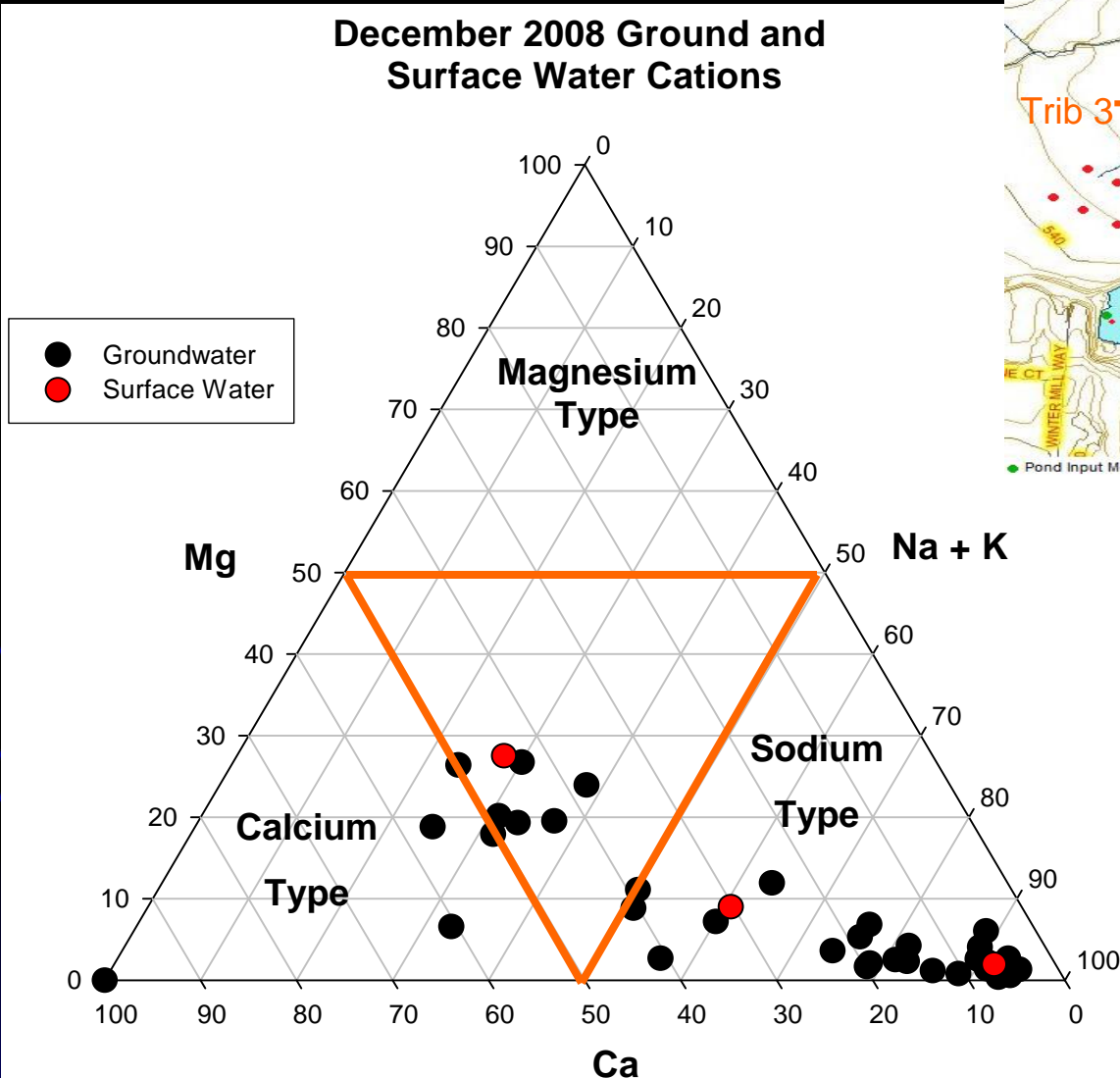


**Groundwater Cations June 2009
Transect 1**



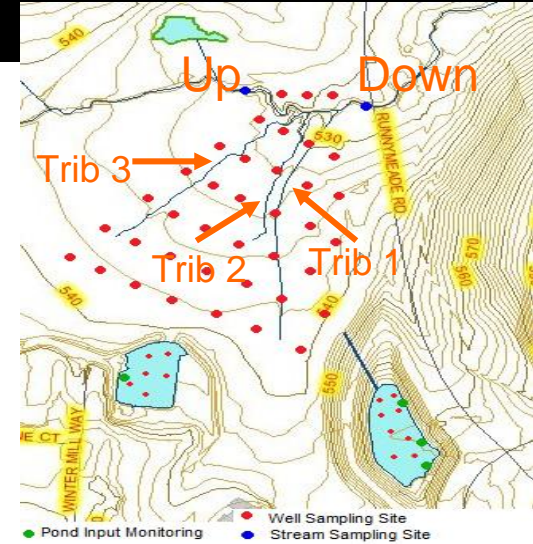
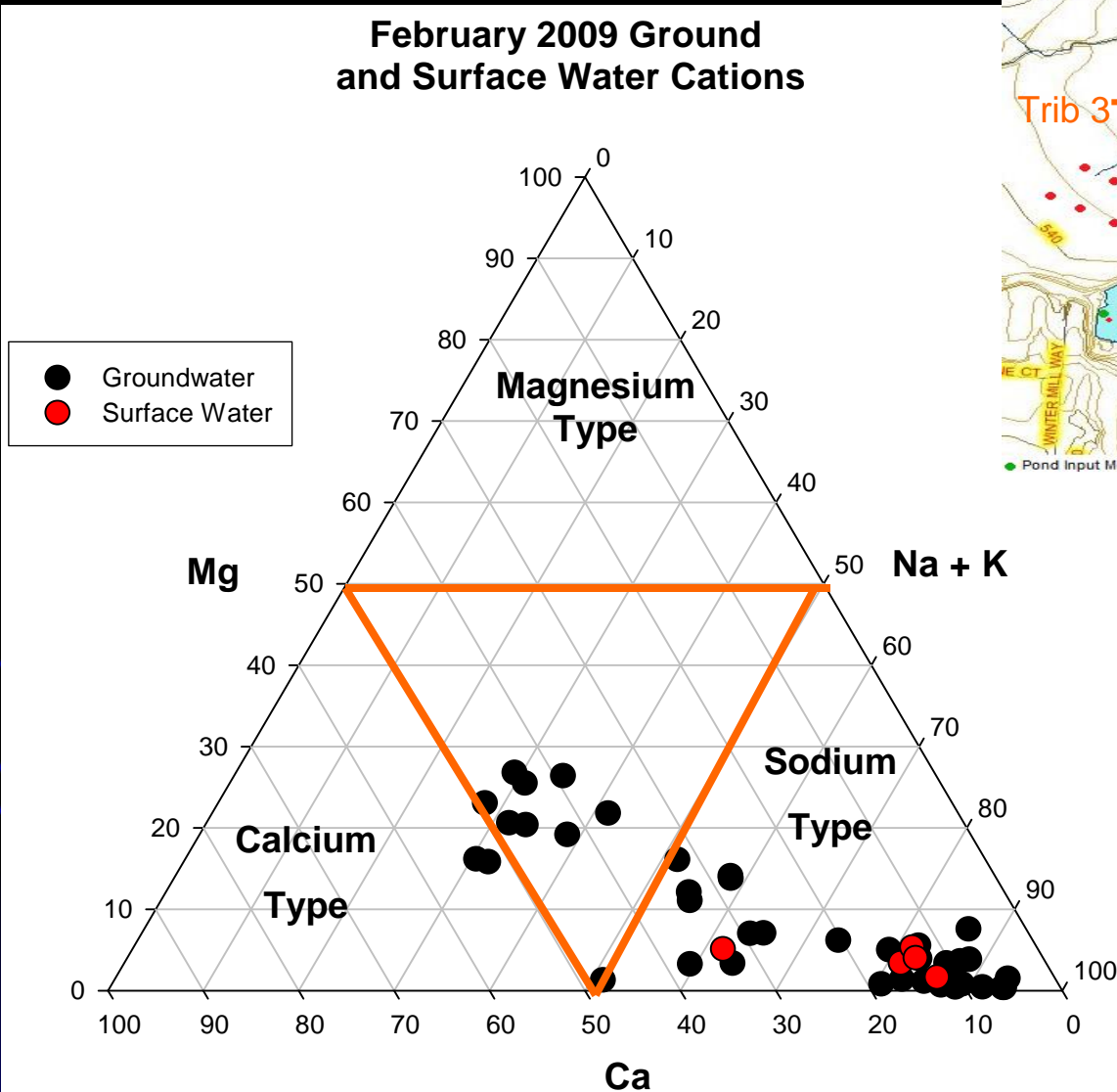
December 2008 Groundwater Cations

December 2008 Ground and Surface Water Cations



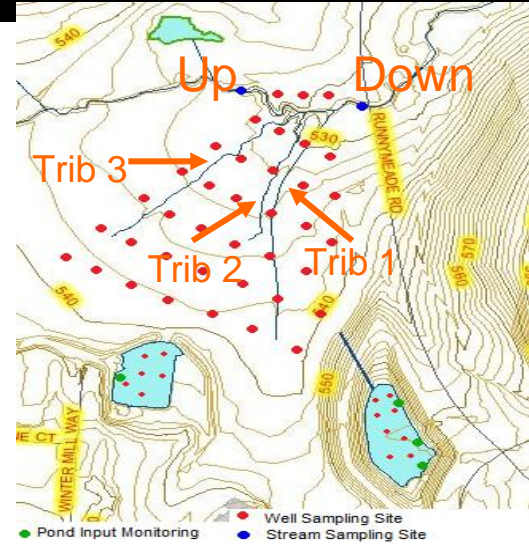
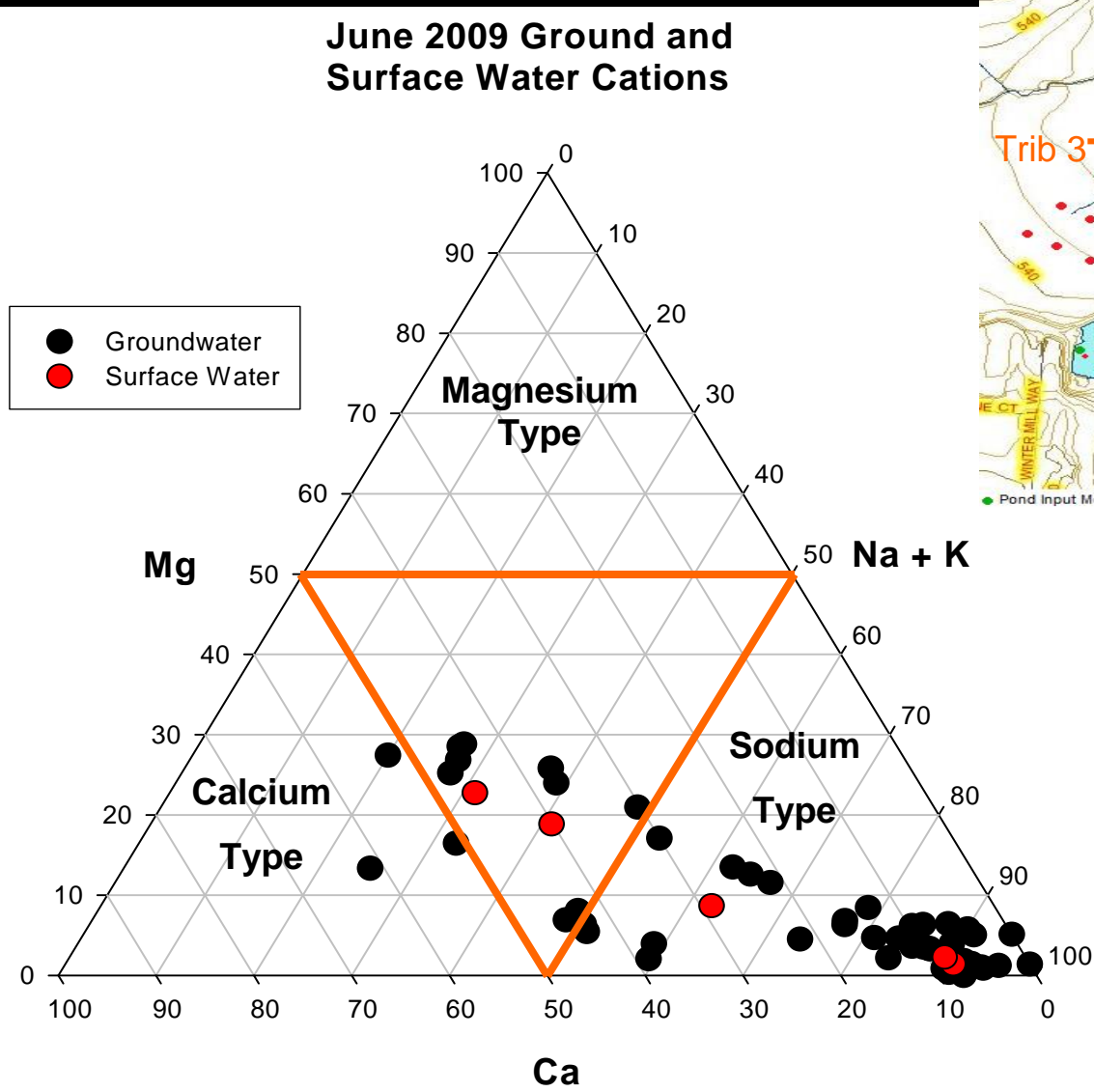
February 2009 Groundwater Cations

February 2009 Ground and Surface Water Cations



June 2009 Groundwater Cations

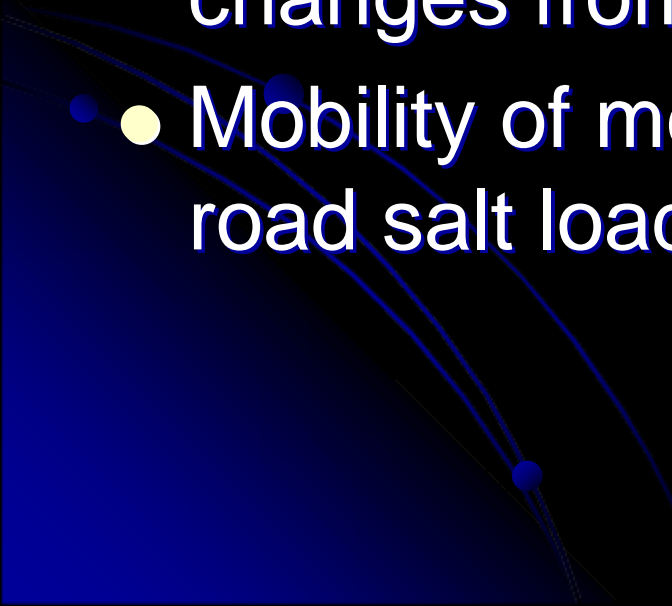
June 2009 Ground and Surface Water Cations



Summary and Conclusions

- A Cl plume is evident year round with retention ponds as a continued source
- The presence of road salt results in sodium dominated groundwater
- Surface water during winter and periods of groundwater discharge may exceed chronic toxicity levels of 250mg/L Cl
- Groundwater Na exceeds 20mg/L; recommended limit for hypertension

Future Research

- The effects of road salt on soil chemistry in the ponds and flood plain over an extended time period
 - Storage of Cl in the system and temporal changes from year to year
 - Mobility of metals as a result of different road salt loadings
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Acknowledgements

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 - We would like to thank Mark Monk and everyone else who has helped us sample or analyze samples
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