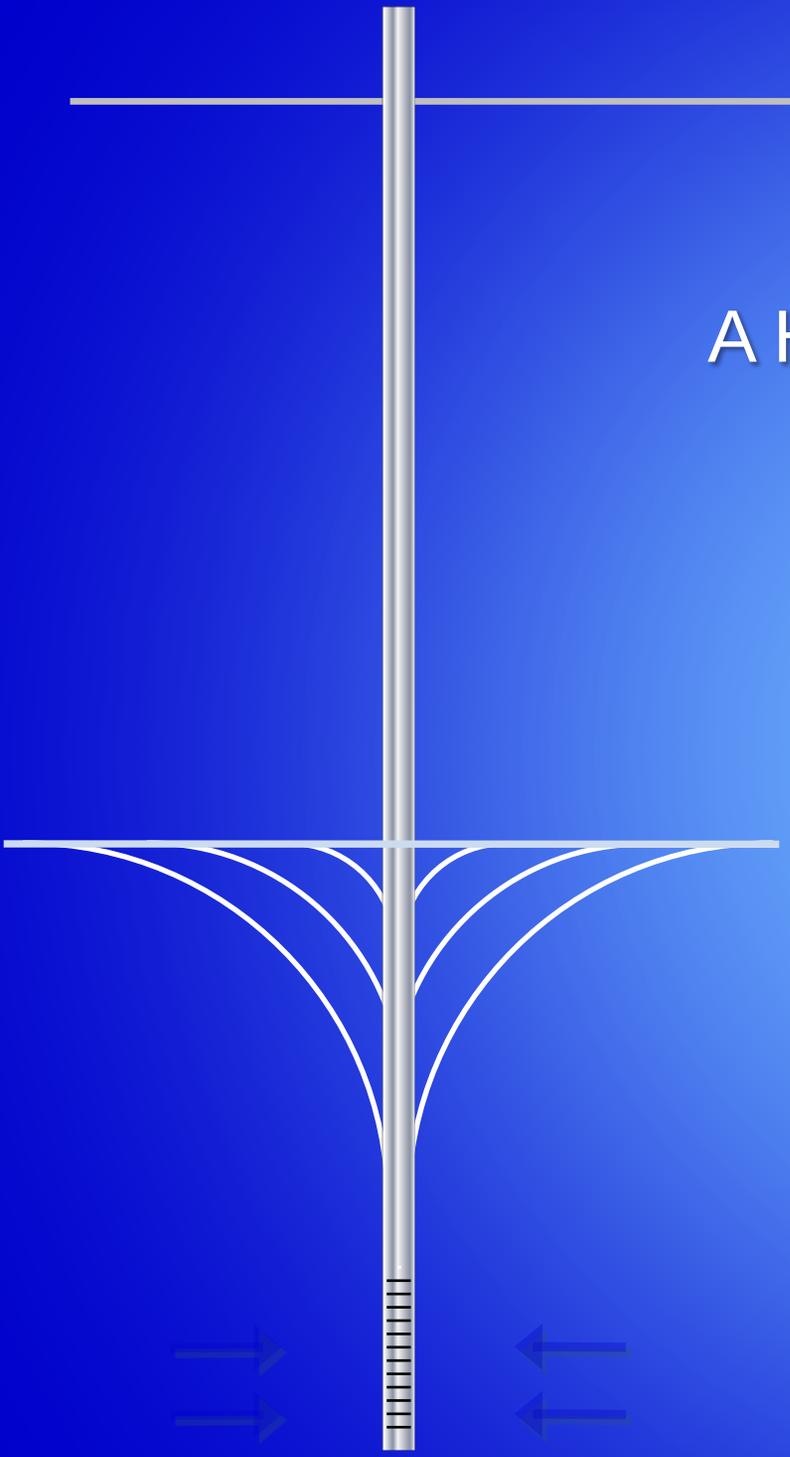
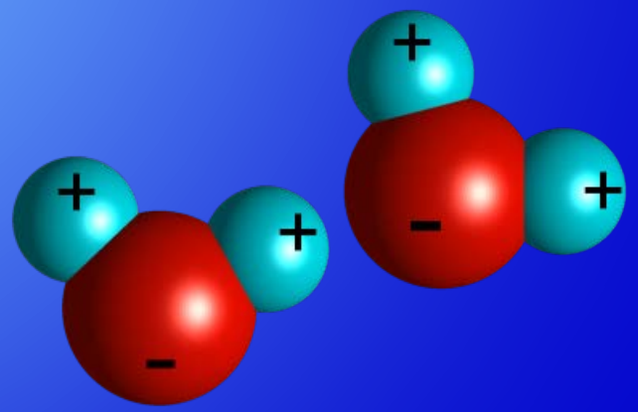


A Hydrogeochemical Investigation of the Rathdrum Prairie Aquifer Kootenai County, Idaho

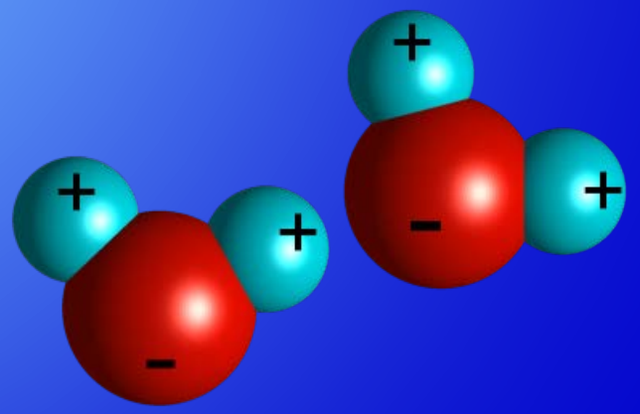
By Gary R. Stevens P.G.
Idaho Department of Environmental Quality

Rathdrum Prairie CAMP
Coeur d'Alene, Idaho
April 22, 2014



Hydrogeochemical Investigation of the Rathdrum Prairie Aquifer

- Purpose
- Sample Locations
- Water Quality Parameters
- Analytical Results



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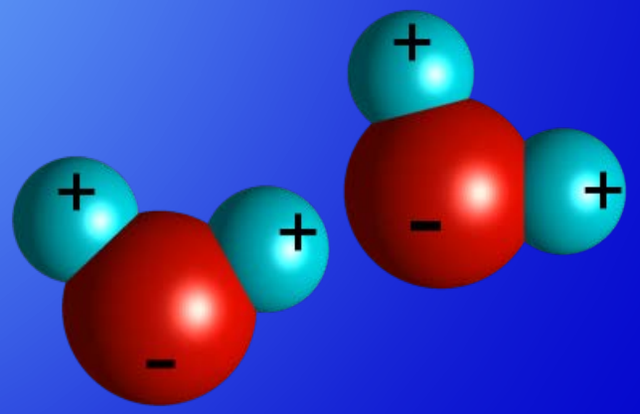

Purpose

- Improve the geographic distribution of wells

- Identify potential water quality impacts from anthropogenic activities and natural occurring constituents

- Determine age/residence times of ground water

- Define recharge sources

Hydrogeochemical Investigation of the Rathdrum Prairie Aquifer

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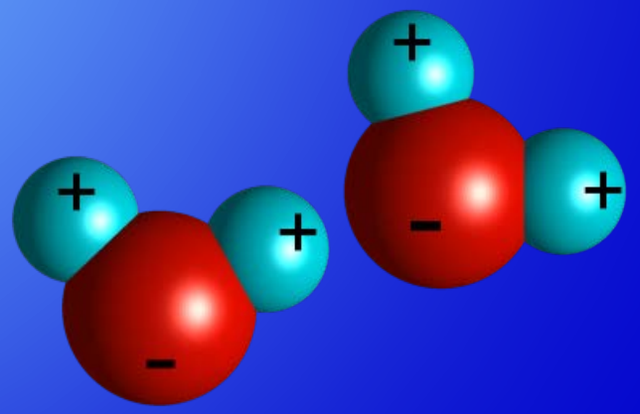
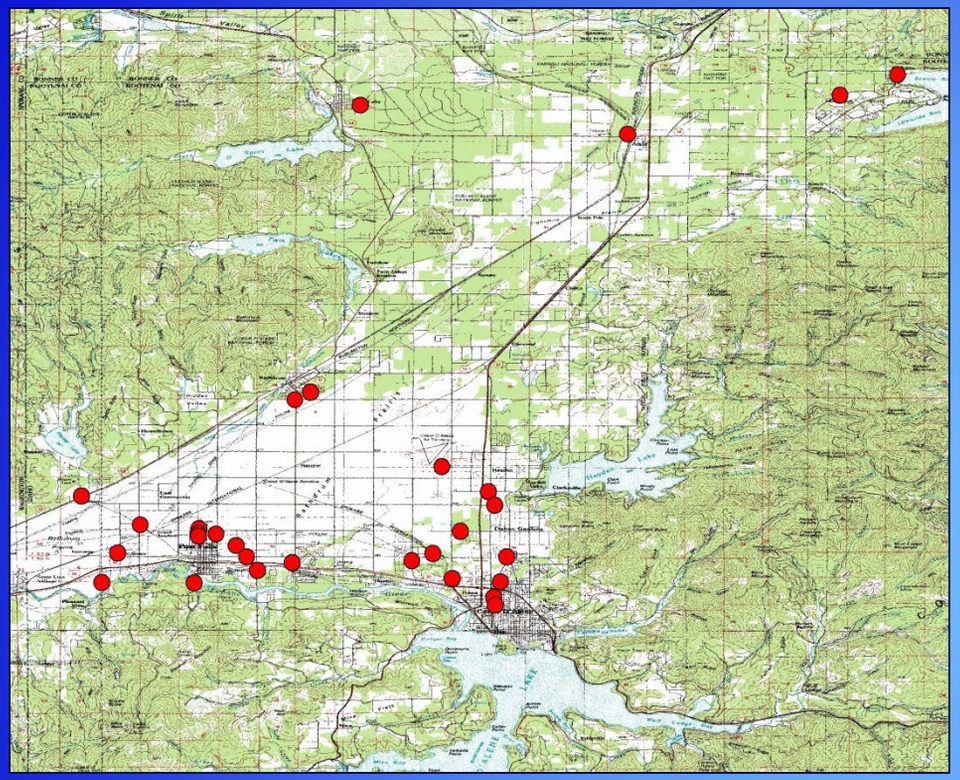
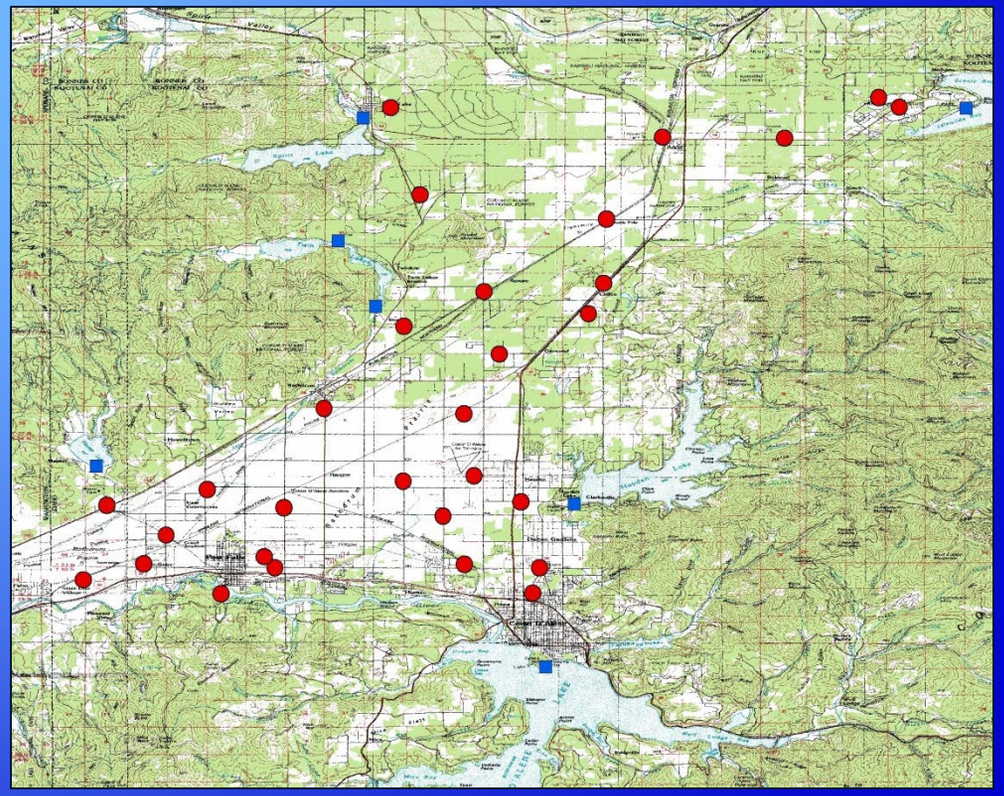


Sample Locations - Geographic Distribution



Panhandle Health District

RPA Hydrogeochemistry Investigation



Sample Locations – Community/Municipal Wells

- Sample Tap
- Proper Construction
- Regularly Pumped/Purged

Con

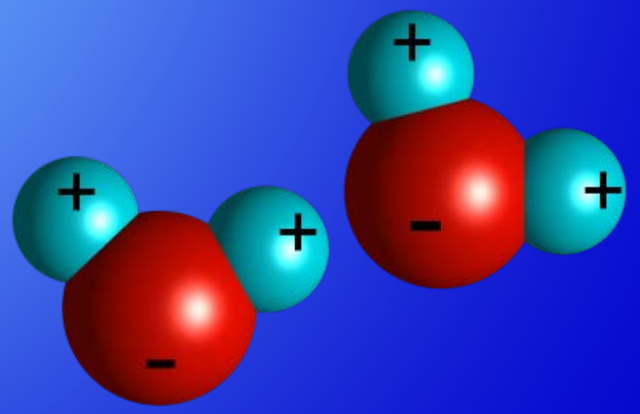
- Sampling for drinking water constituents
- If exceedance then would have to take the appropriate regulatory action

Pro

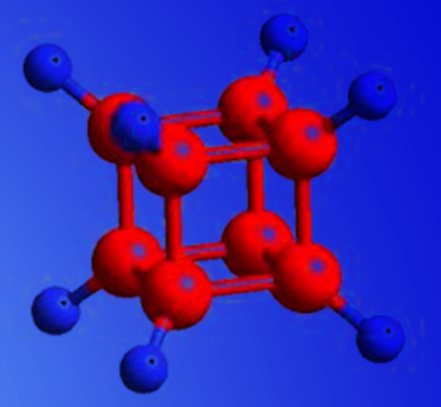
- Sampling for drinking water constituents
- Can use analytical results for required regulatory sampling

Hydrogeochemical Investigation of the Rathdrum Prairie Aquifer

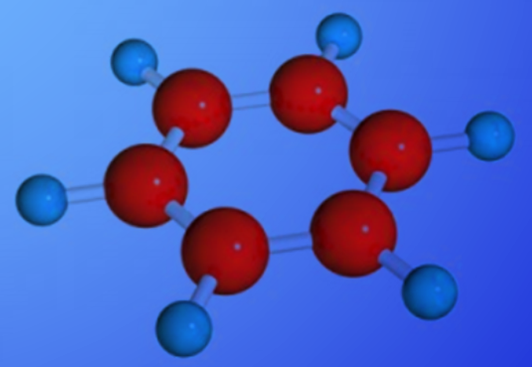
- Purpose
- Sample Locations
- Water Quality Parameters
- Analytical Results



Water Quality Parameters



- Major cations and anions
- Inorganic Constituents
  - Arsenic
  - Bromide
  - Nitrate & Nitrate Isotopes
- VOC's & SOC's
- Radionuclides
  - Uranium
  - Radium 226
  - Radium 228



- CFC's & SF6 – Age Dating
- Deuterium & Oxygen -18
- Temperature, pH, conductivity and DO were measured at each sampling location

Sample Schedule

June, 2012	Ca Na Mg K HCO_3 Cl SO_4	All Wells & Lakes All Three Sampling Events
September 2012	Br TOC As	All Wells All Three Sampling Events
January/February 2013	VOC - WA List SOC - WA List	All Wells June Sampling Event
	Uranium Radium 226 Radium 228	All Wells June Sampling Event
	^{2}H ^{18}O	All Wells & Lakes All Three Sampling Events
	CFC & SF6	Sixteen Wells September Sampling Event
	$^{15}N_{-NO3}$ $^{18}O_{-NO3}$ NO_3	All Wells June Sampling Event

Hydrogeochemical Investigation of the Rathdrum Prairie Aquifer

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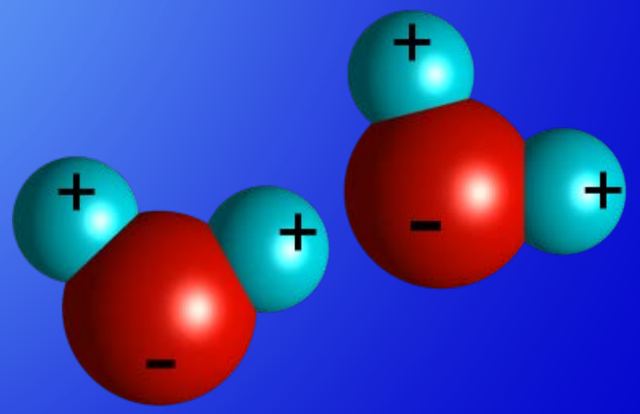
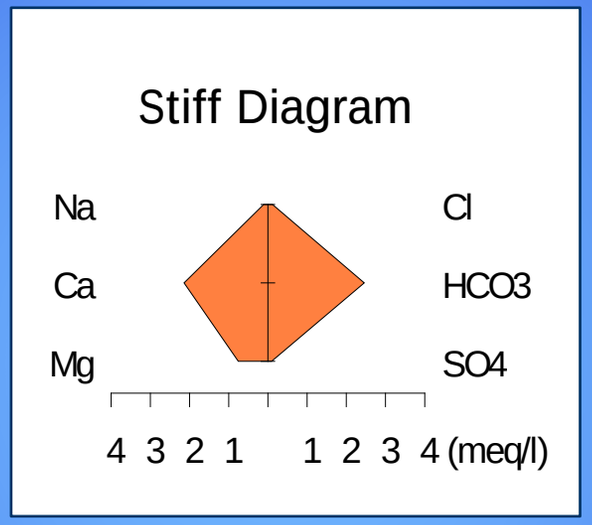


Major Cations & Anions

Cations



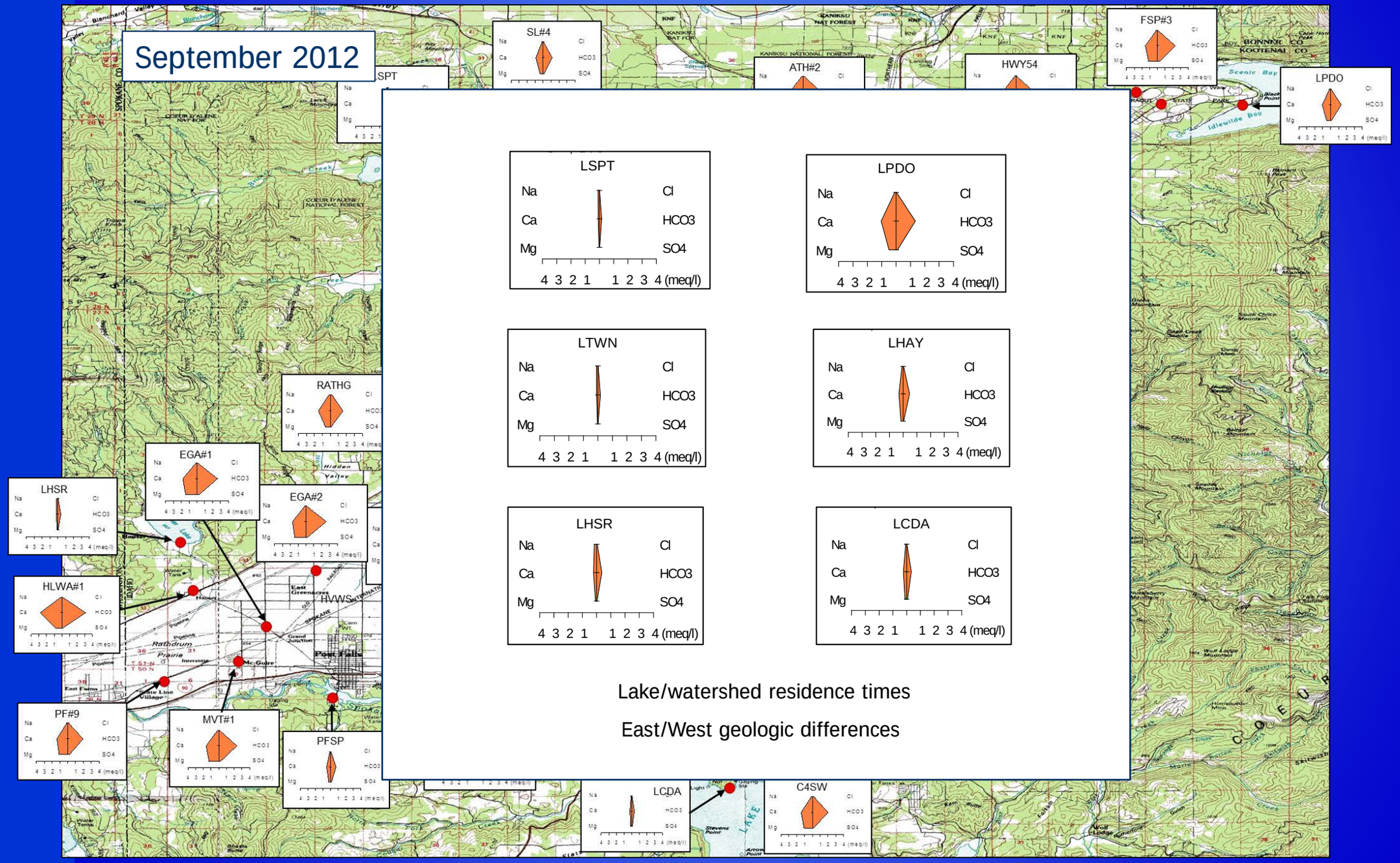
Anions

Greater Amount ← → Greater Amount

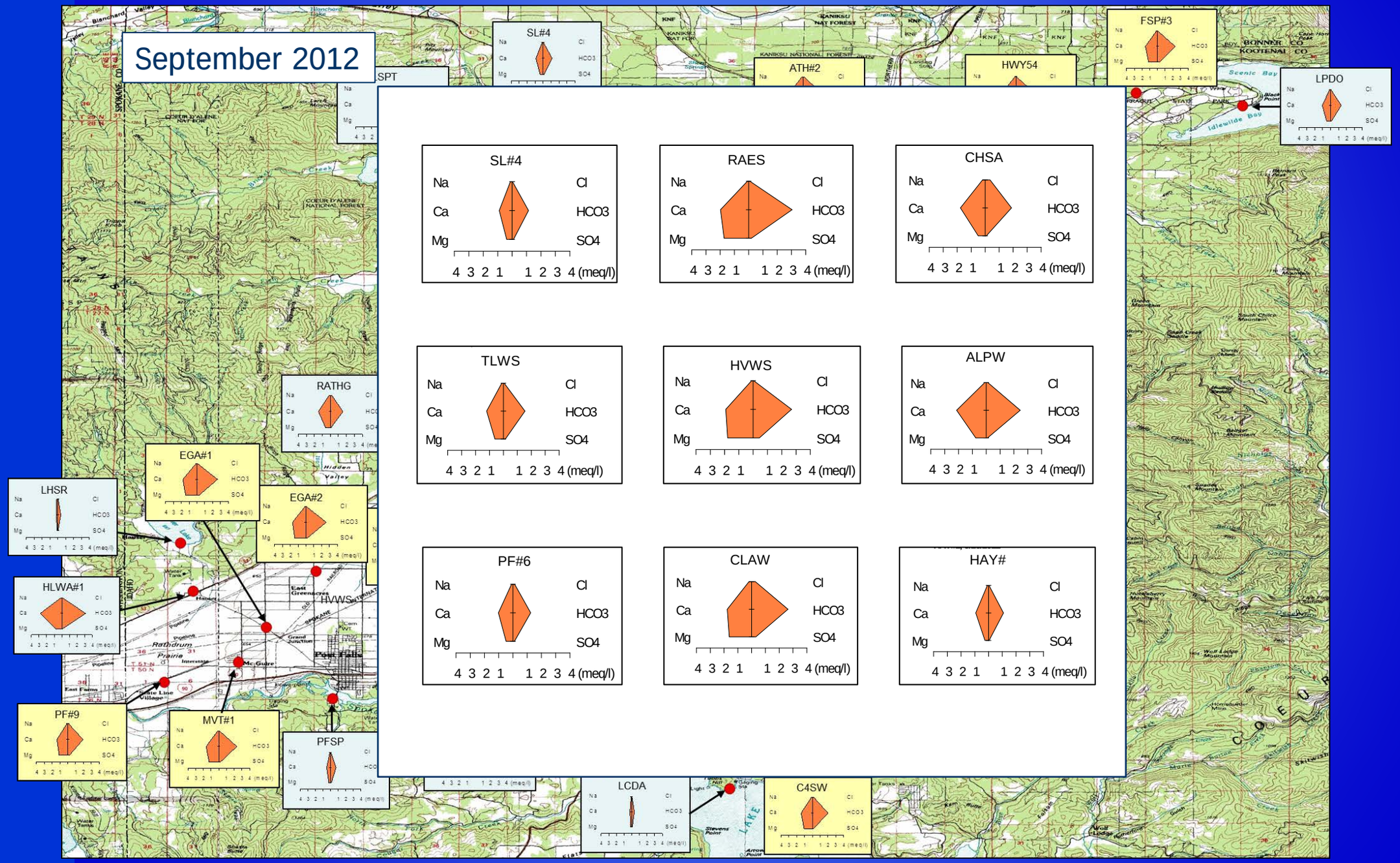
Equivalent = mass of chemical x charge of chemical

Better description of how cations and anions chemically react with each other

Major Cations & Anions

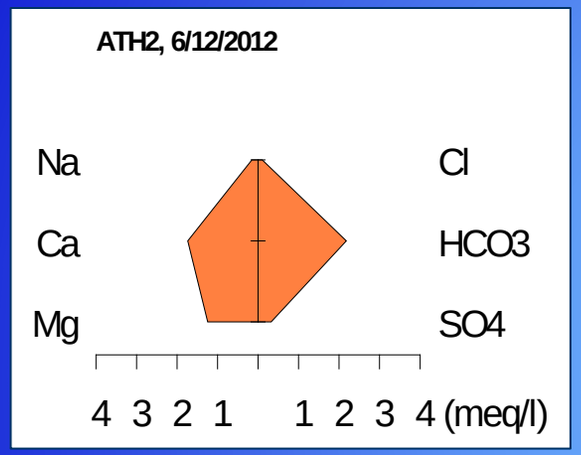


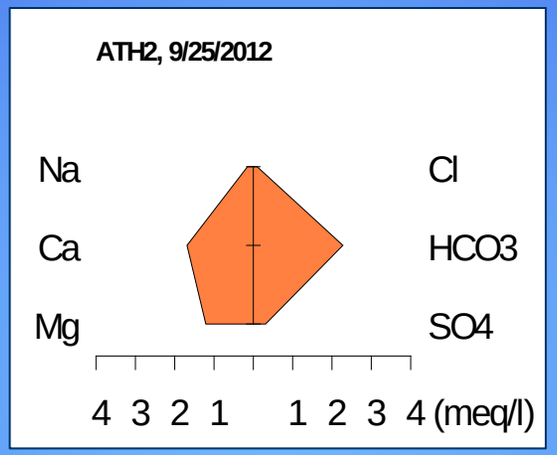
Major Cations & Anions

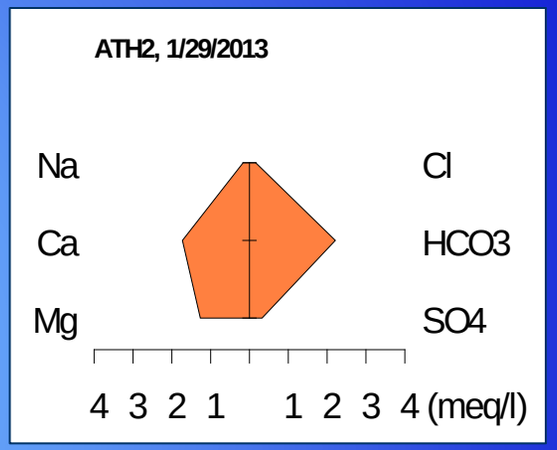


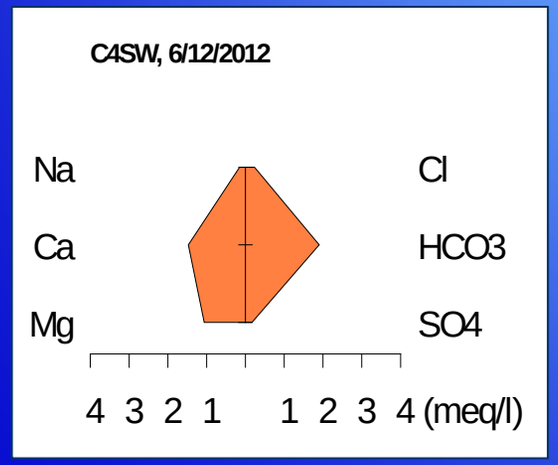
Major Cations & Anions

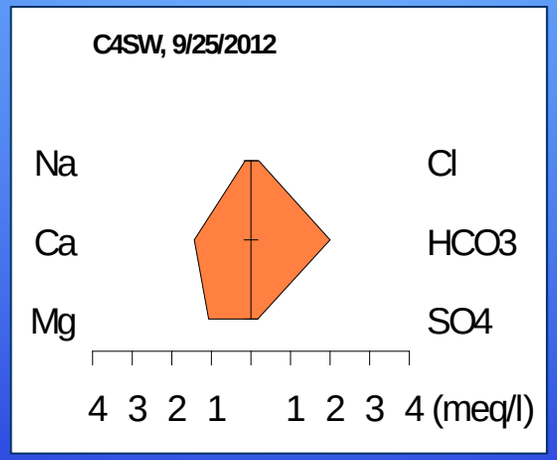
Does not appear to be seasonal variations

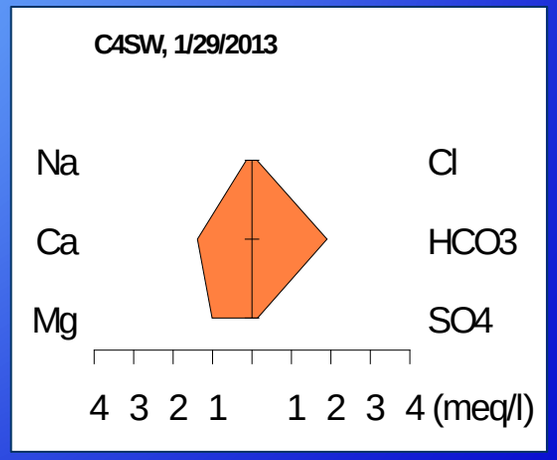




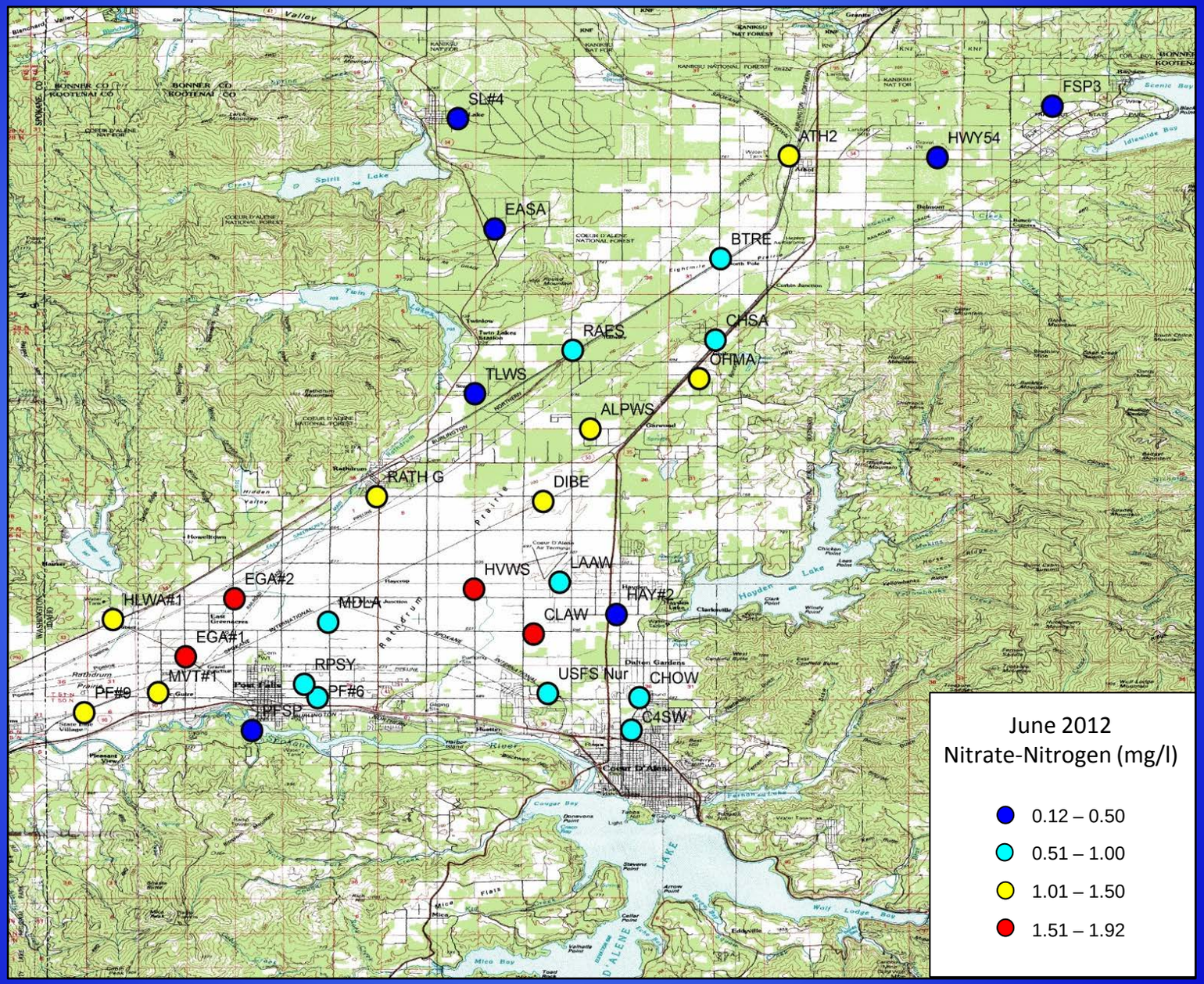




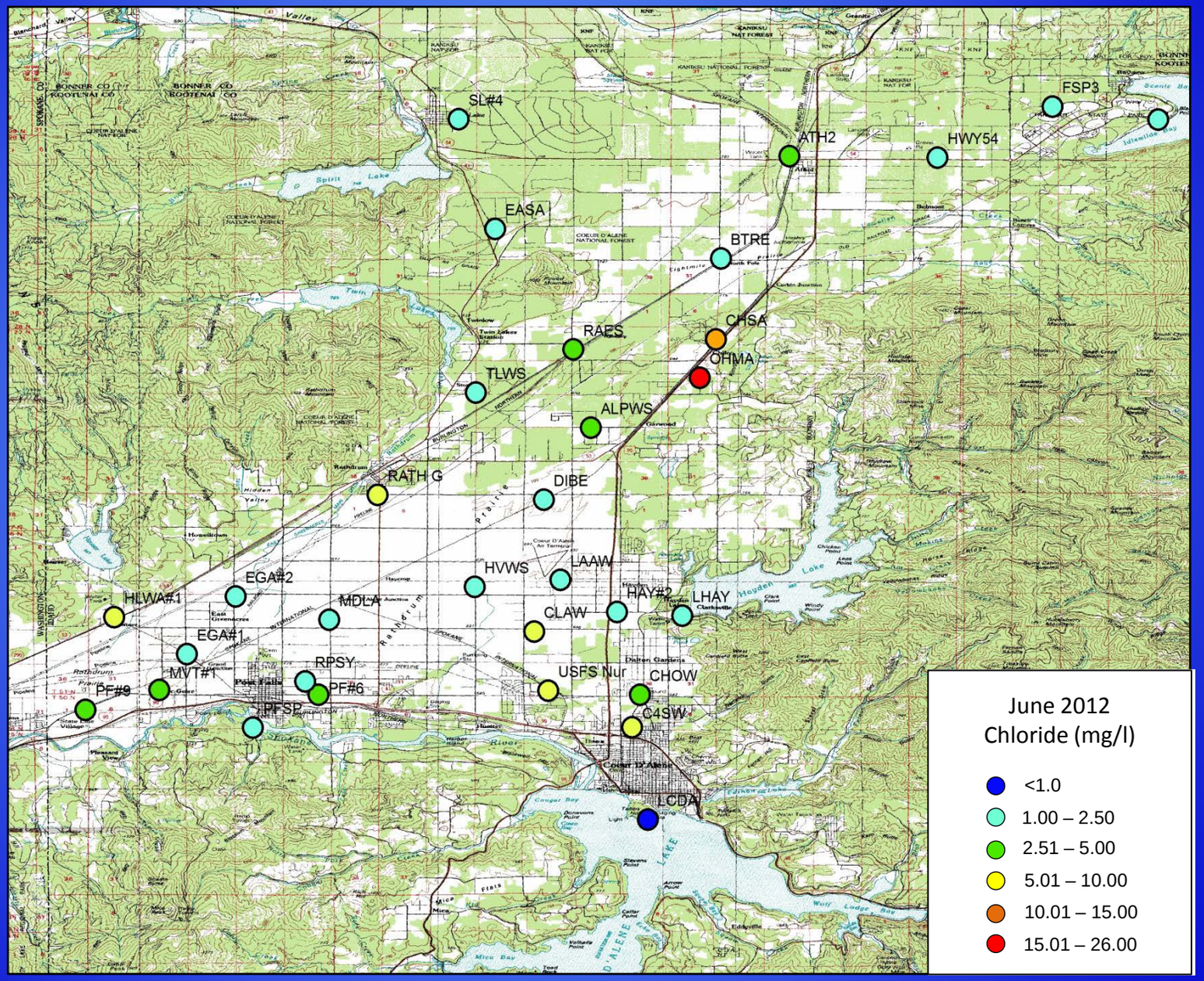




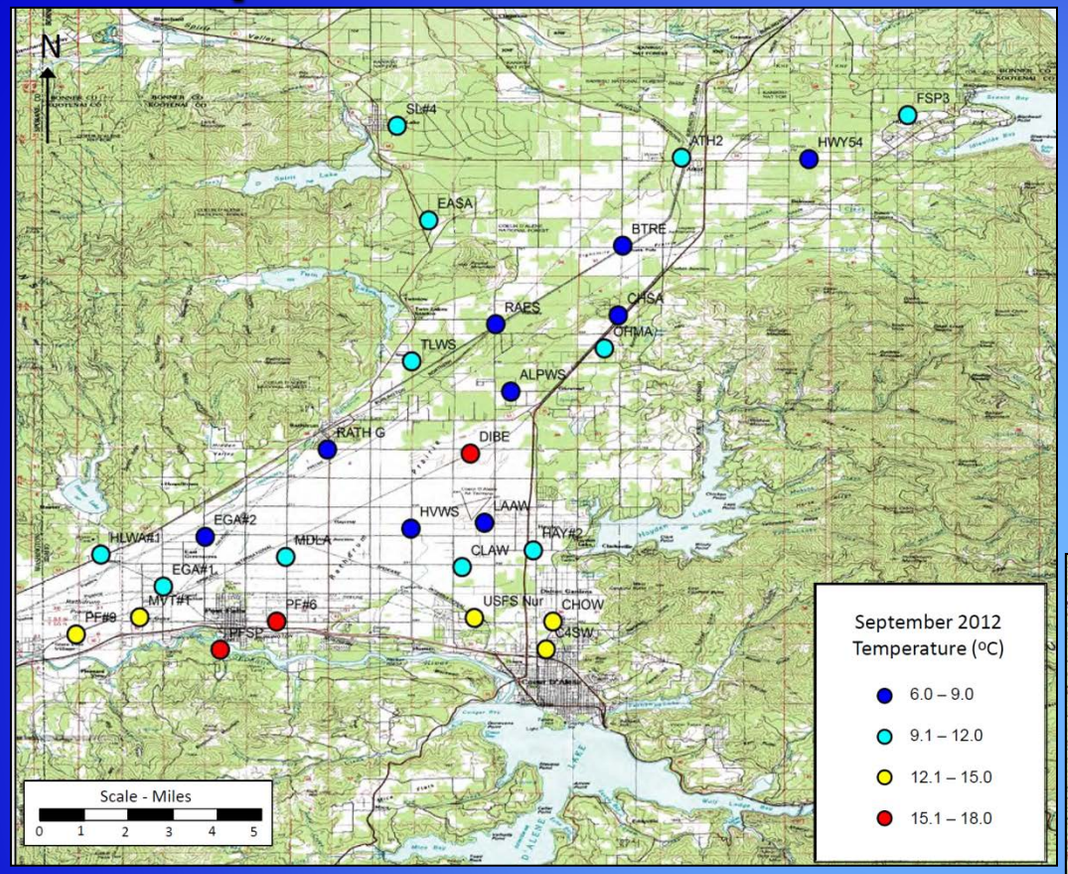
Nitrate-Nitrogen Drinking Water Standard = 10 mg/l

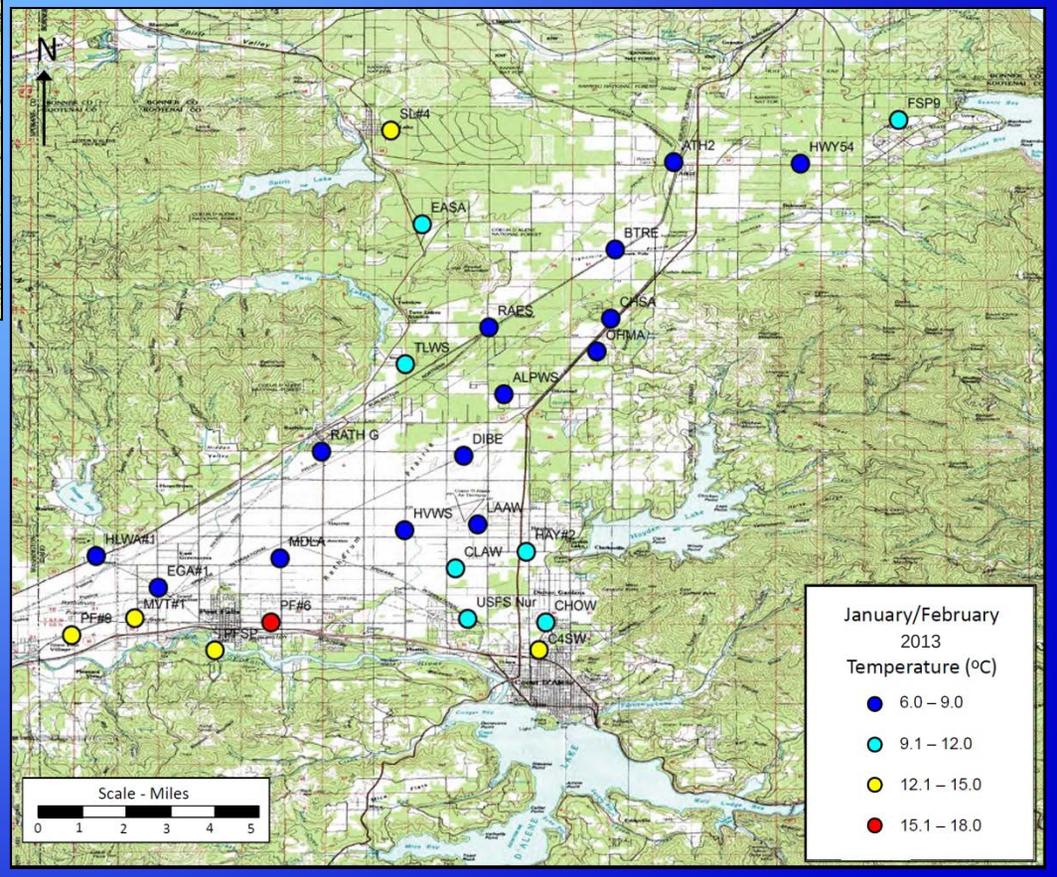


Chloride - Secondary Drinking Water Standard = 250 mg/l

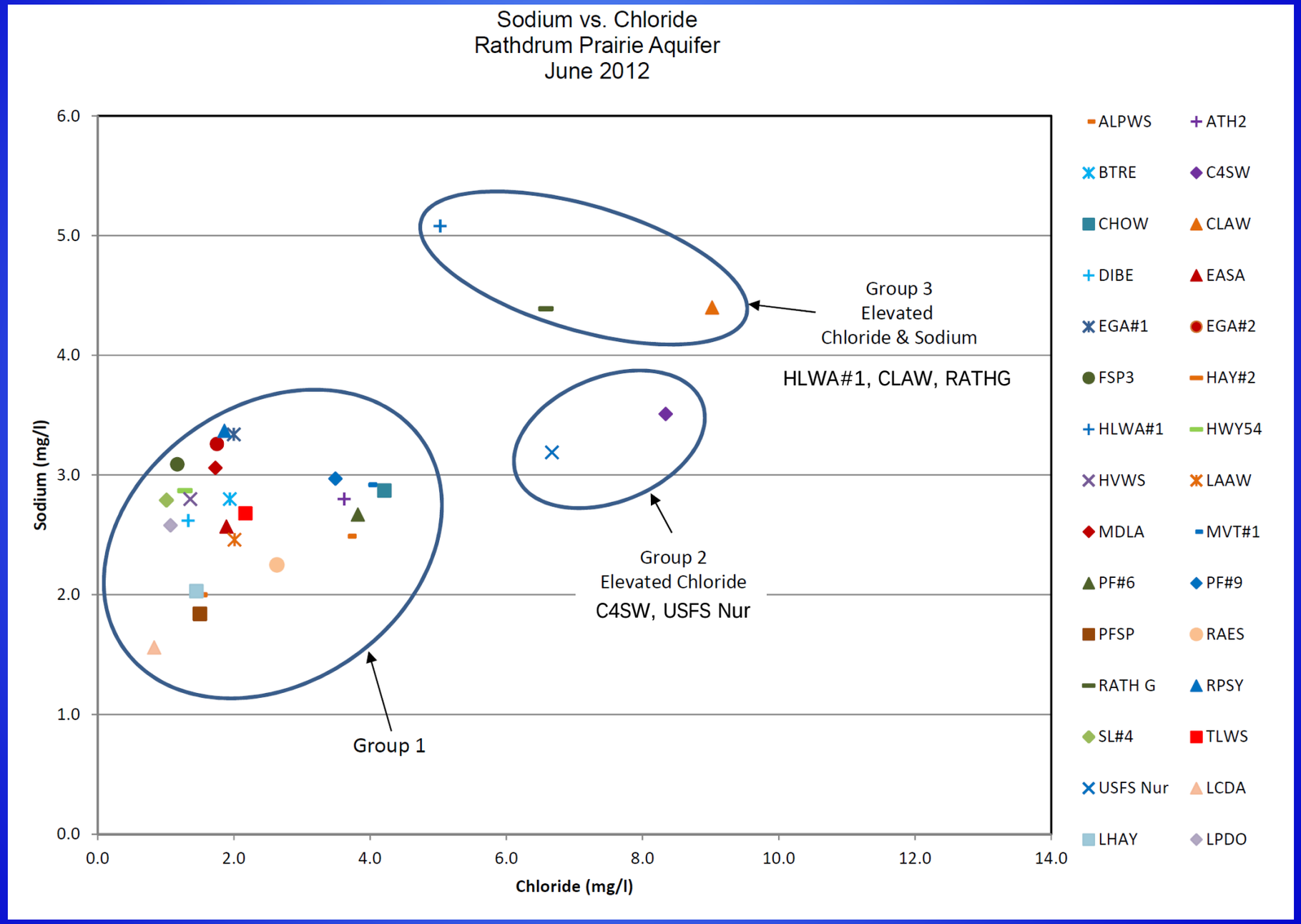


Temperature

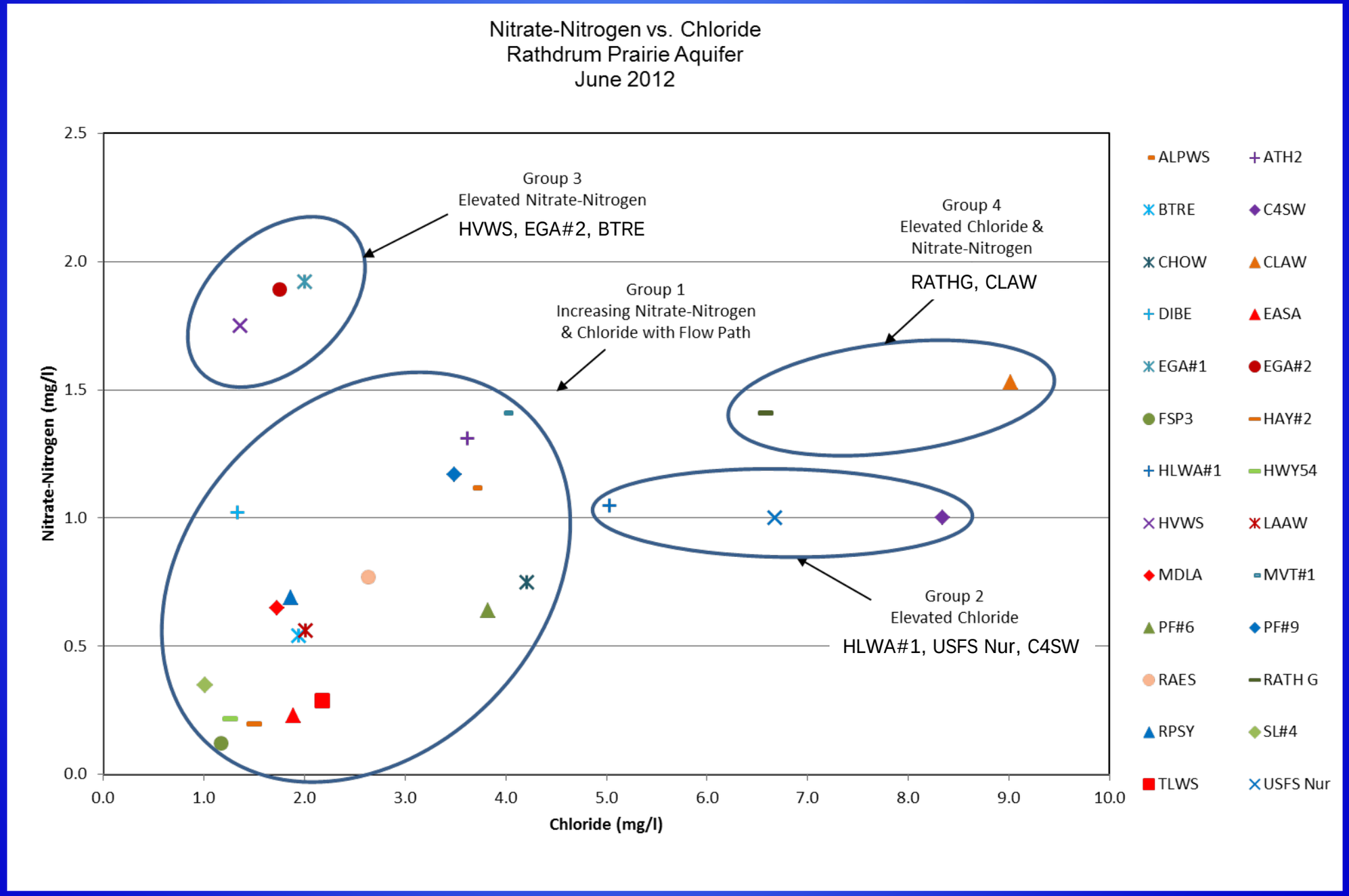




Sodium vs Chloride

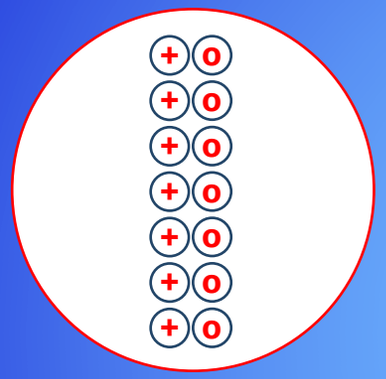


Nitrate vs Chloride

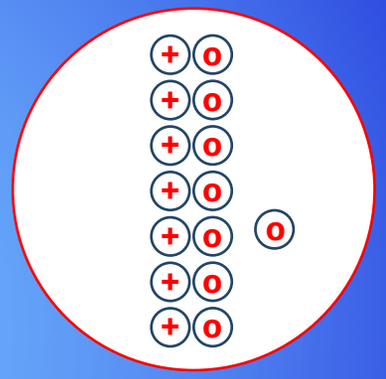


Nitrate - Isotopes

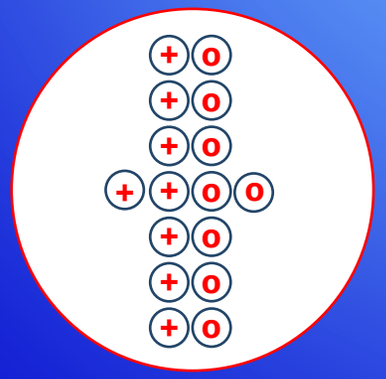
^{14}N
7 Protons
7 Neutrons
Abundance = 99.634%



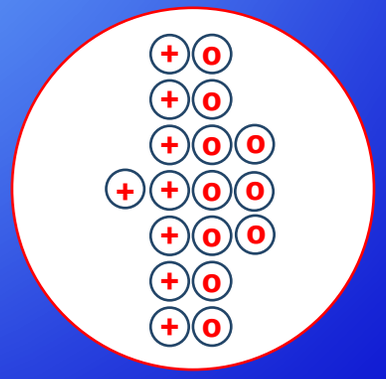
^{15}N – Stable Isotope
7 Protons
8 Neutrons
Abundance = 0.366%



^{16}O
8 Protons
8 Neutrons
Abundance = 99.759%

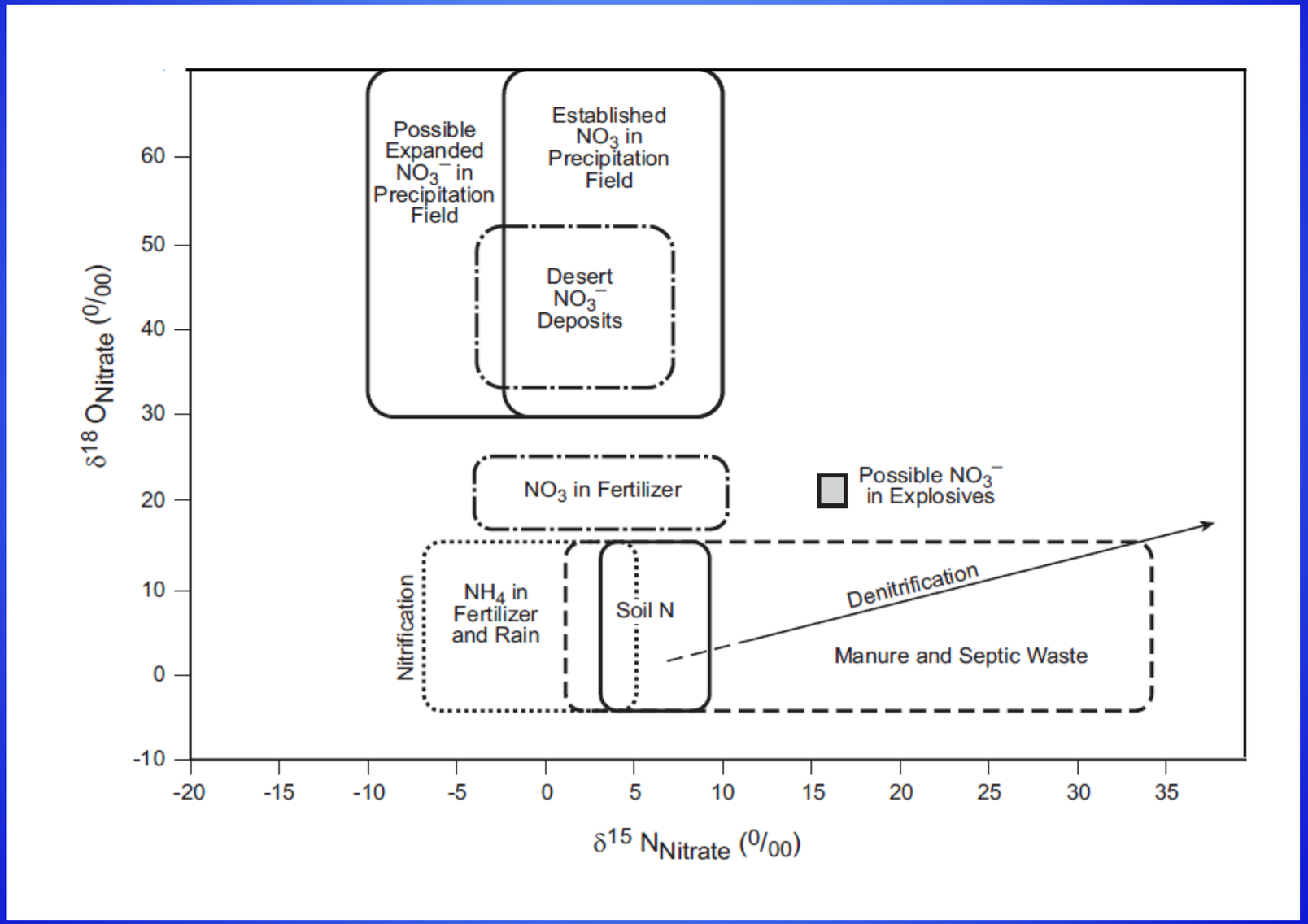


^{18}O – Stable isotope
8 Protons
10 Neutrons
Abundance = 0.204%

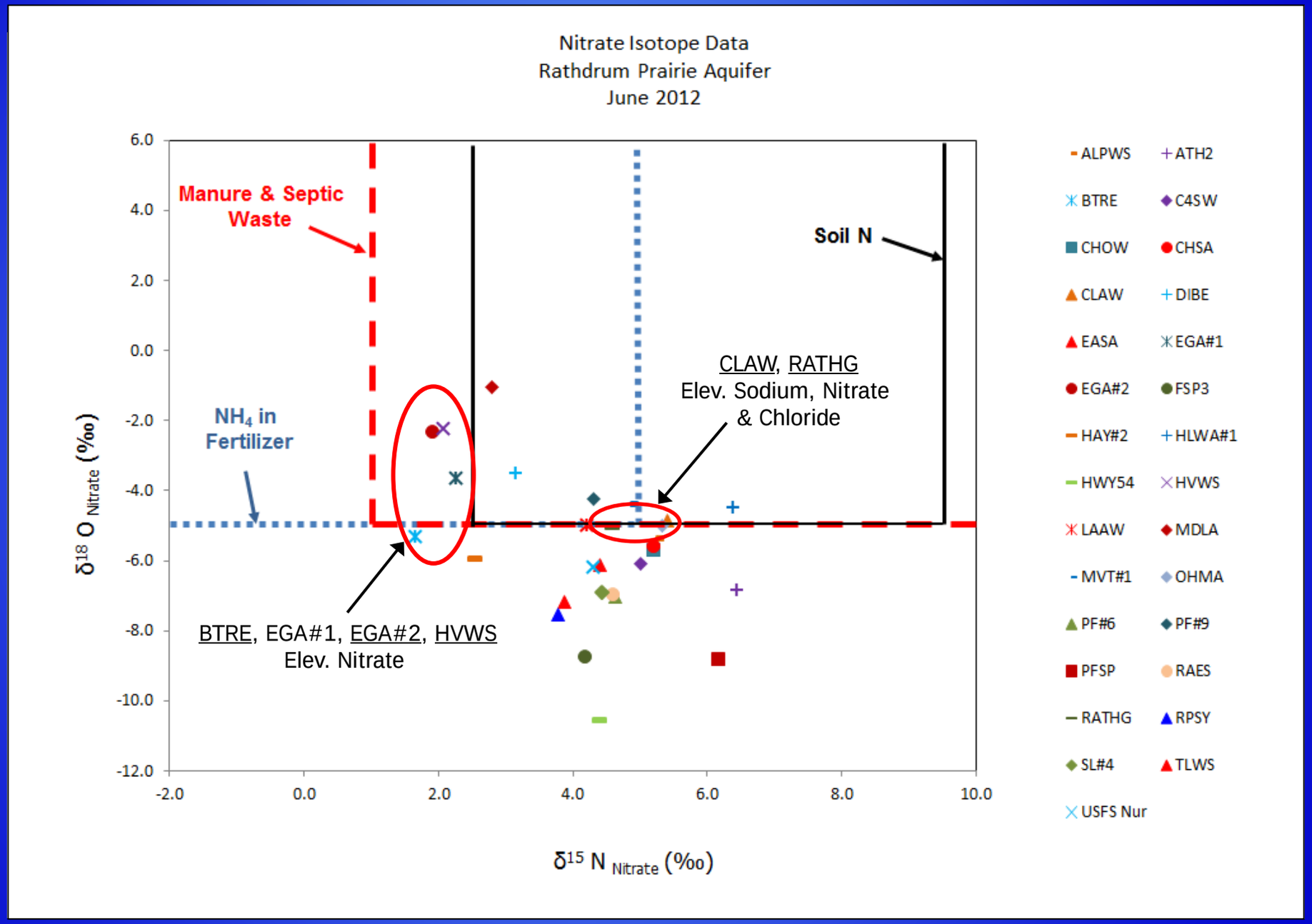


Nitrate Isotopes

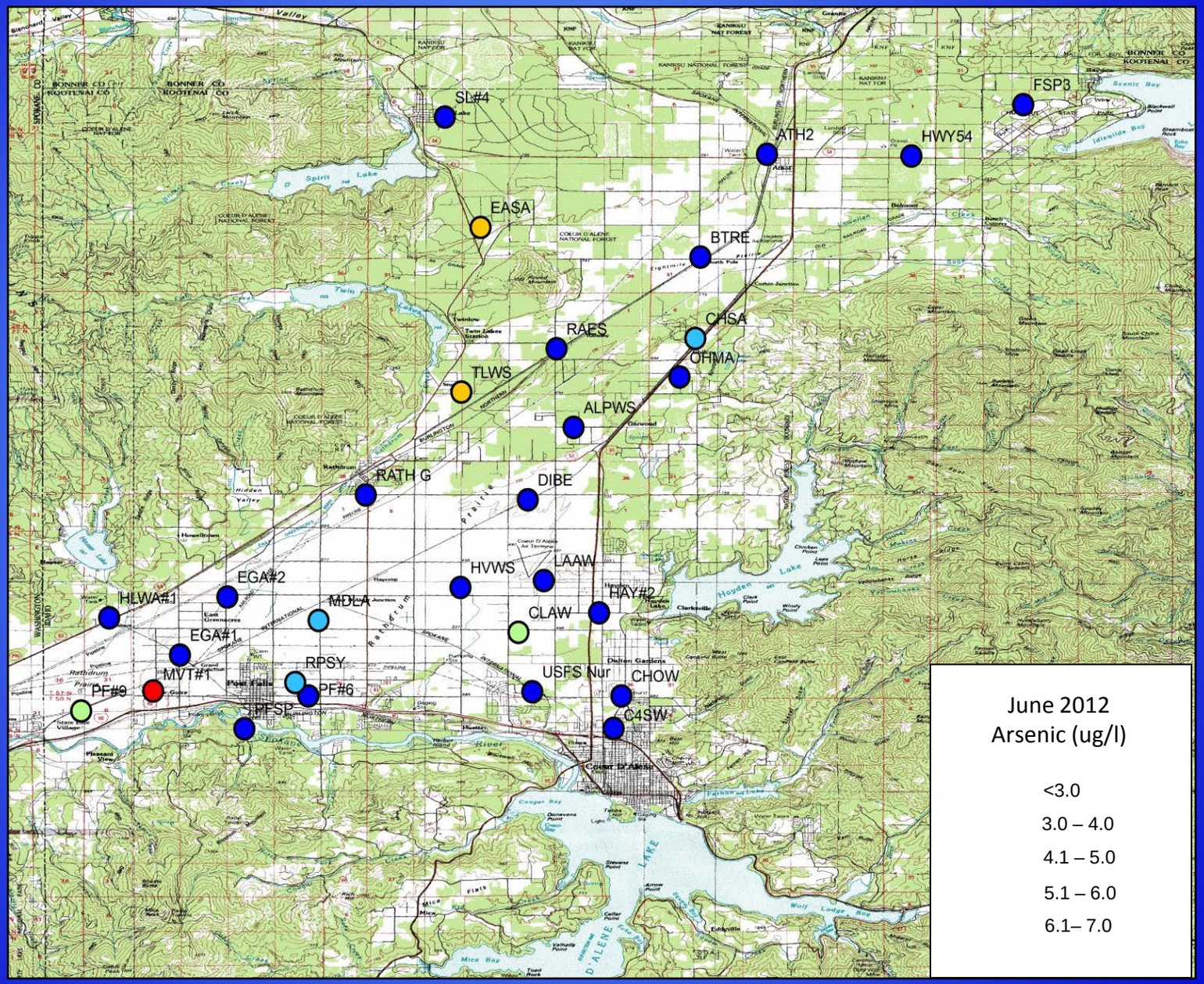
Ranges of N^{15} and O^{18} associated with different sources of Nitrogen-Nitrate



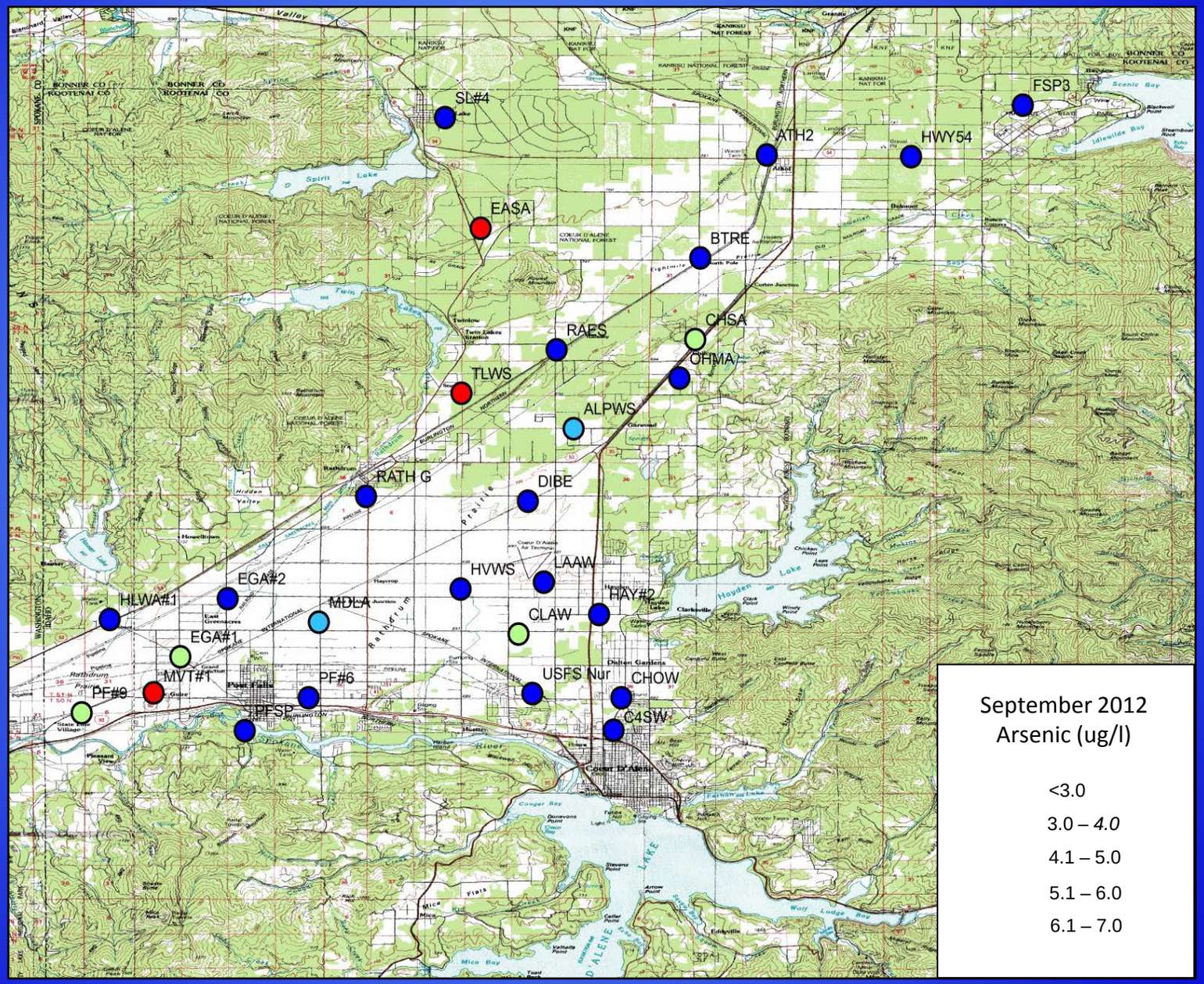
Nitrogen-Nitrate



Arsenic Drinking water Standard = 10 ug/l

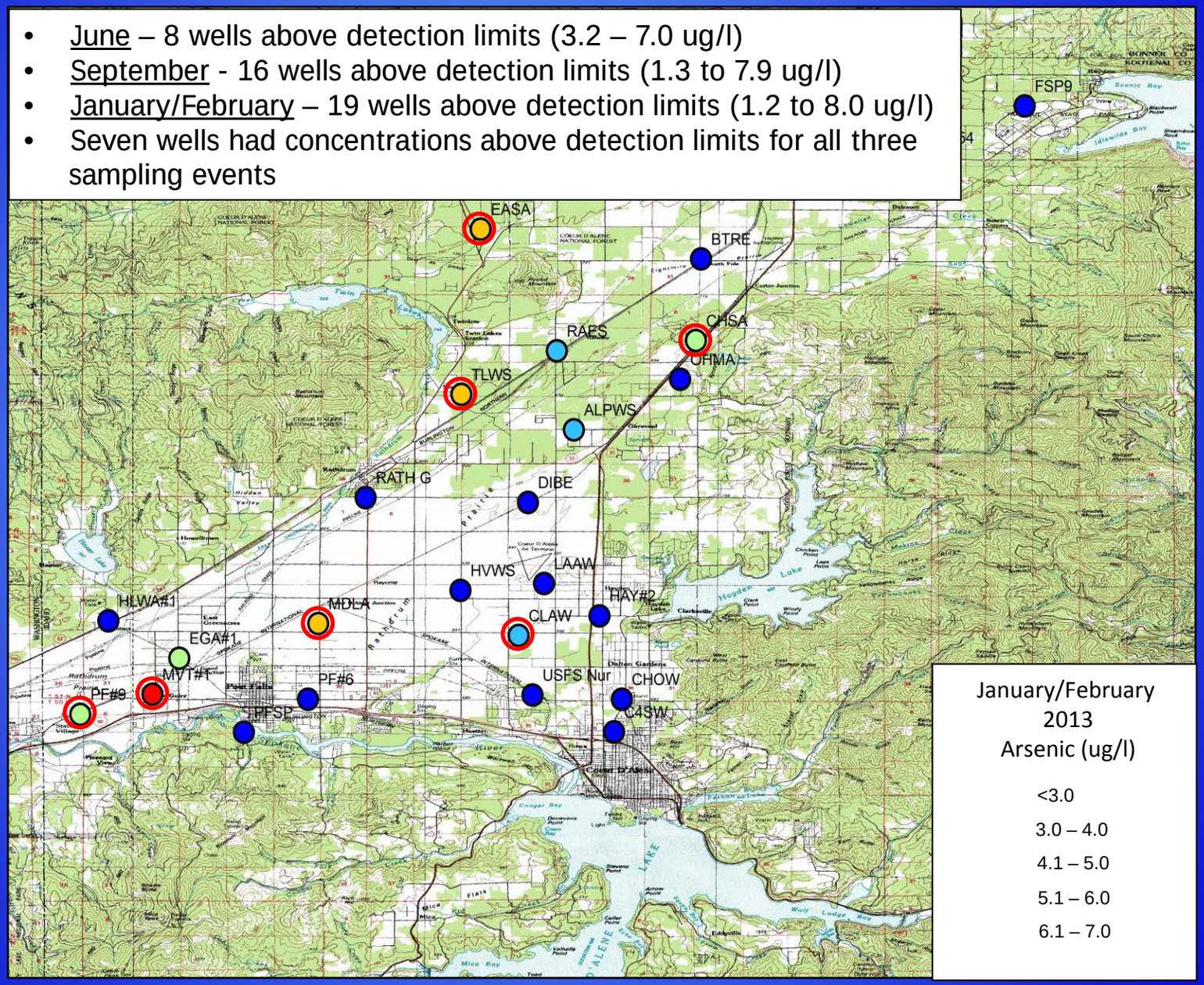


Arsenic Drinking water Standard = 10 ug/l



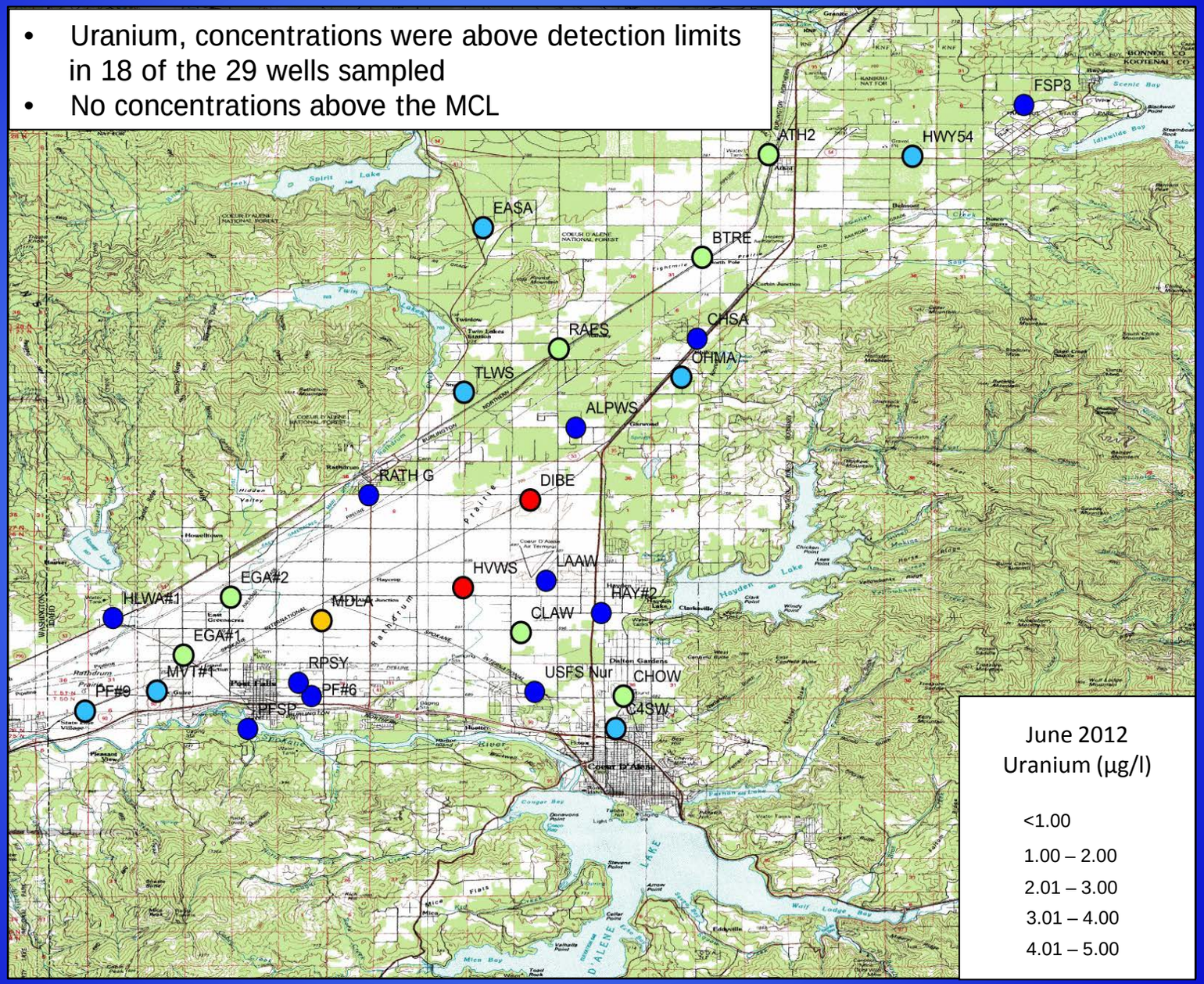
Arsenic Drinking water Standard = 10 ug/l

- June – 8 wells above detection limits (3.2 – 7.0 ug/l)
- September - 16 wells above detection limits (1.3 to 7.9 ug/l)
- January/February – 19 wells above detection limits (1.2 to 8.0 ug/l)
- Seven wells had concentrations above detection limits for all three sampling events



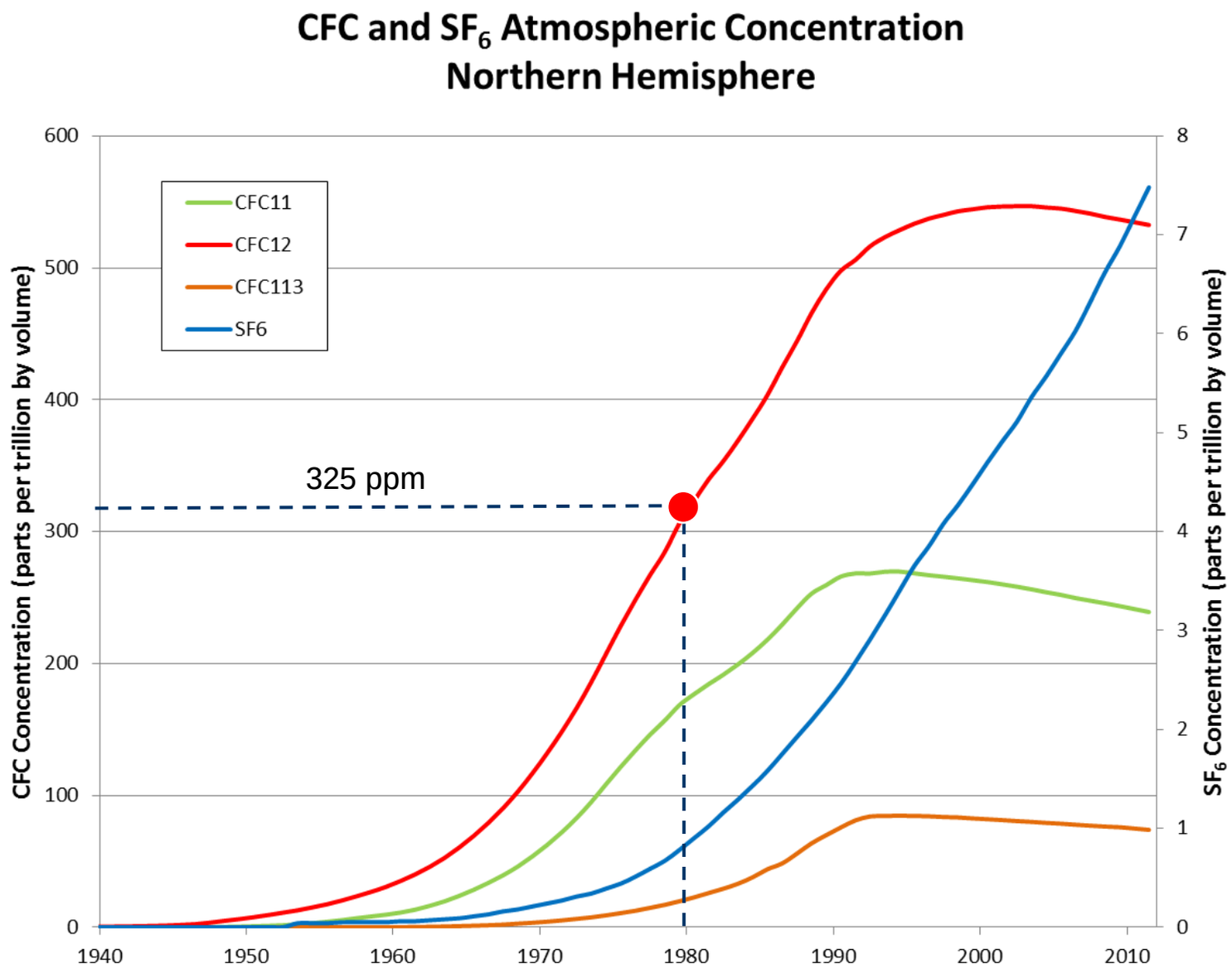
Uranium - Drinking water Standard = 30 ug/l

- Uranium, concentrations were above detection limits in 18 of the 29 wells sampled
- No concentrations above the MCL



Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride

CFC +



nvert
fer CFC
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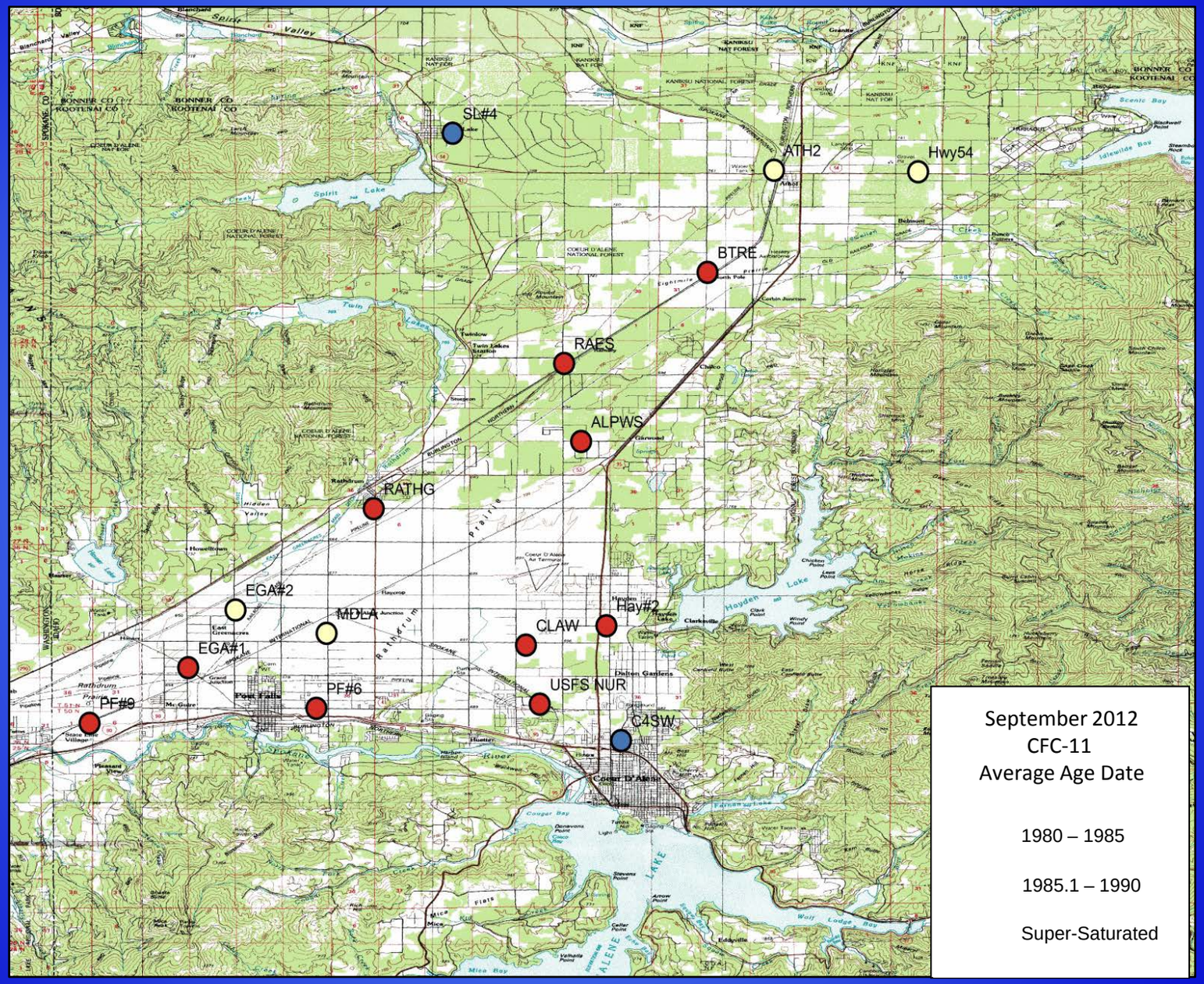
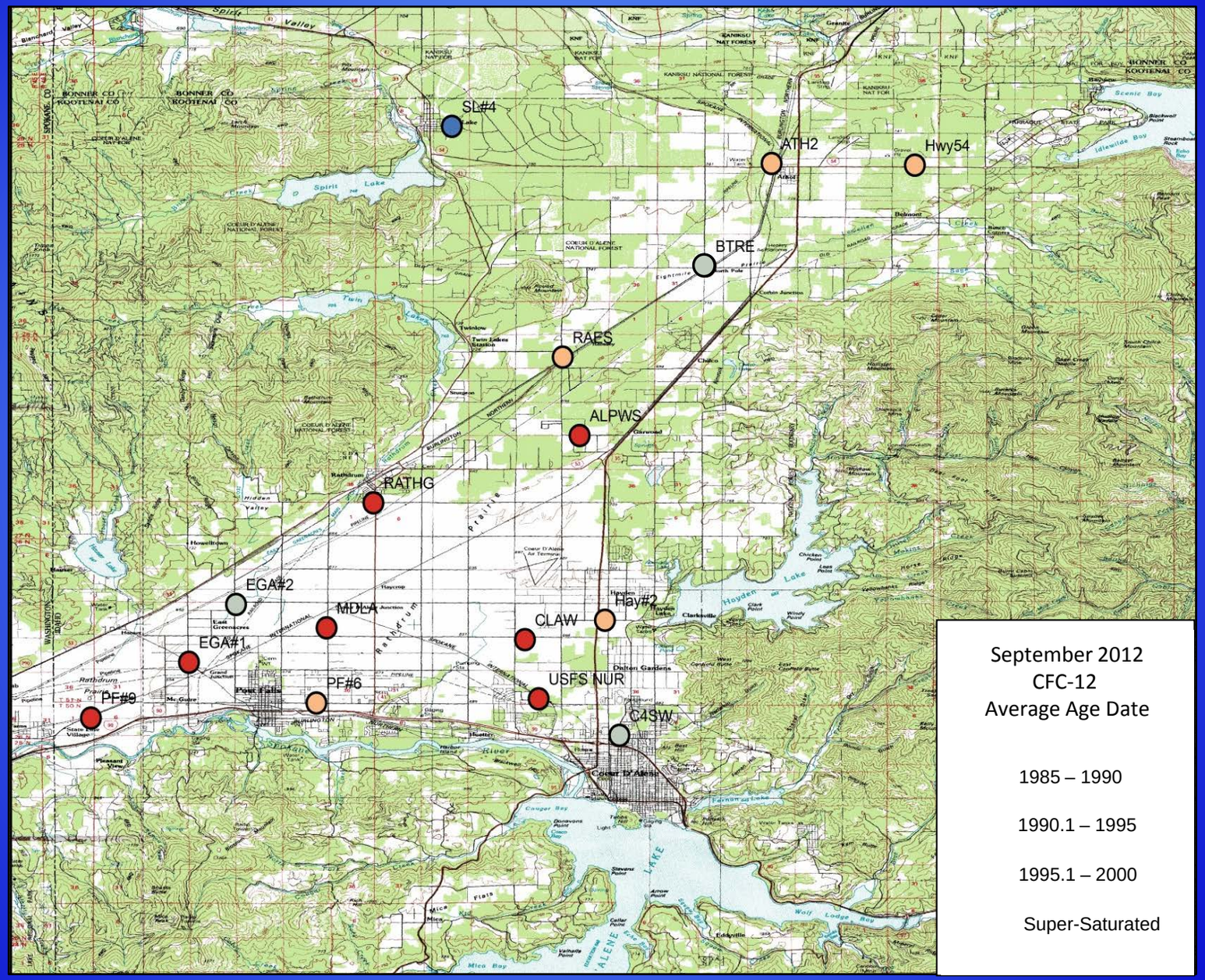
Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride

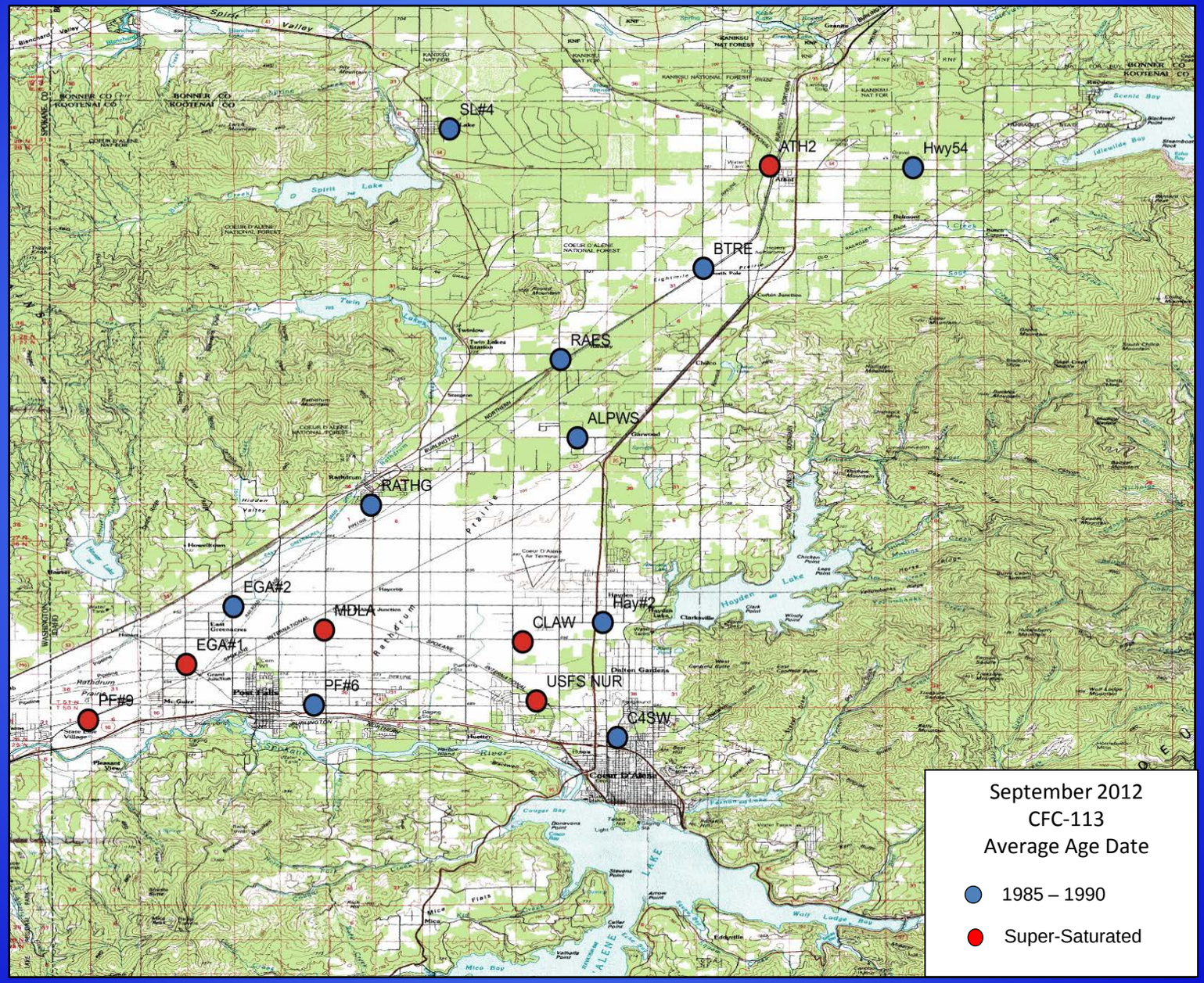
Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride



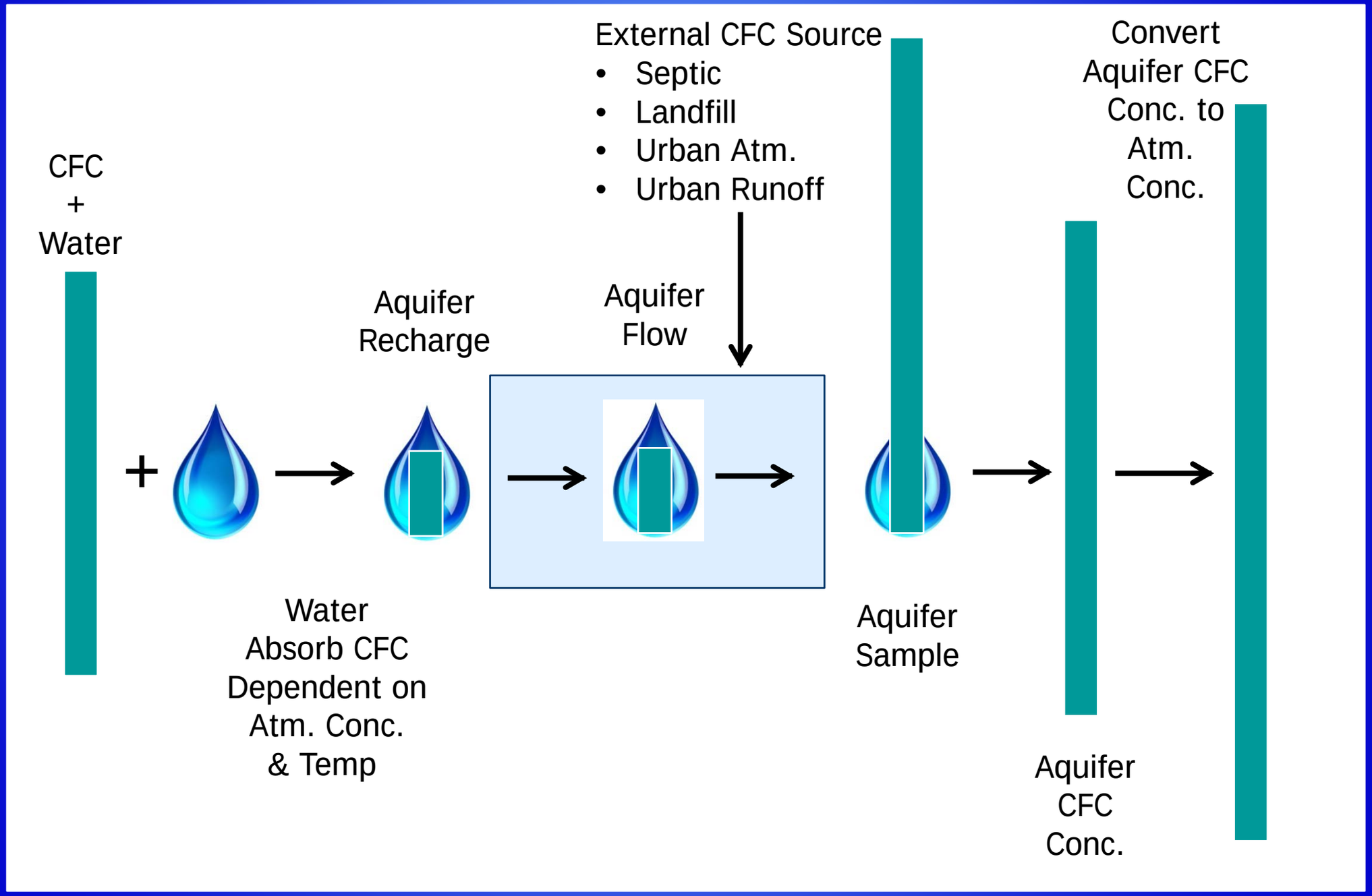
Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride



Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride

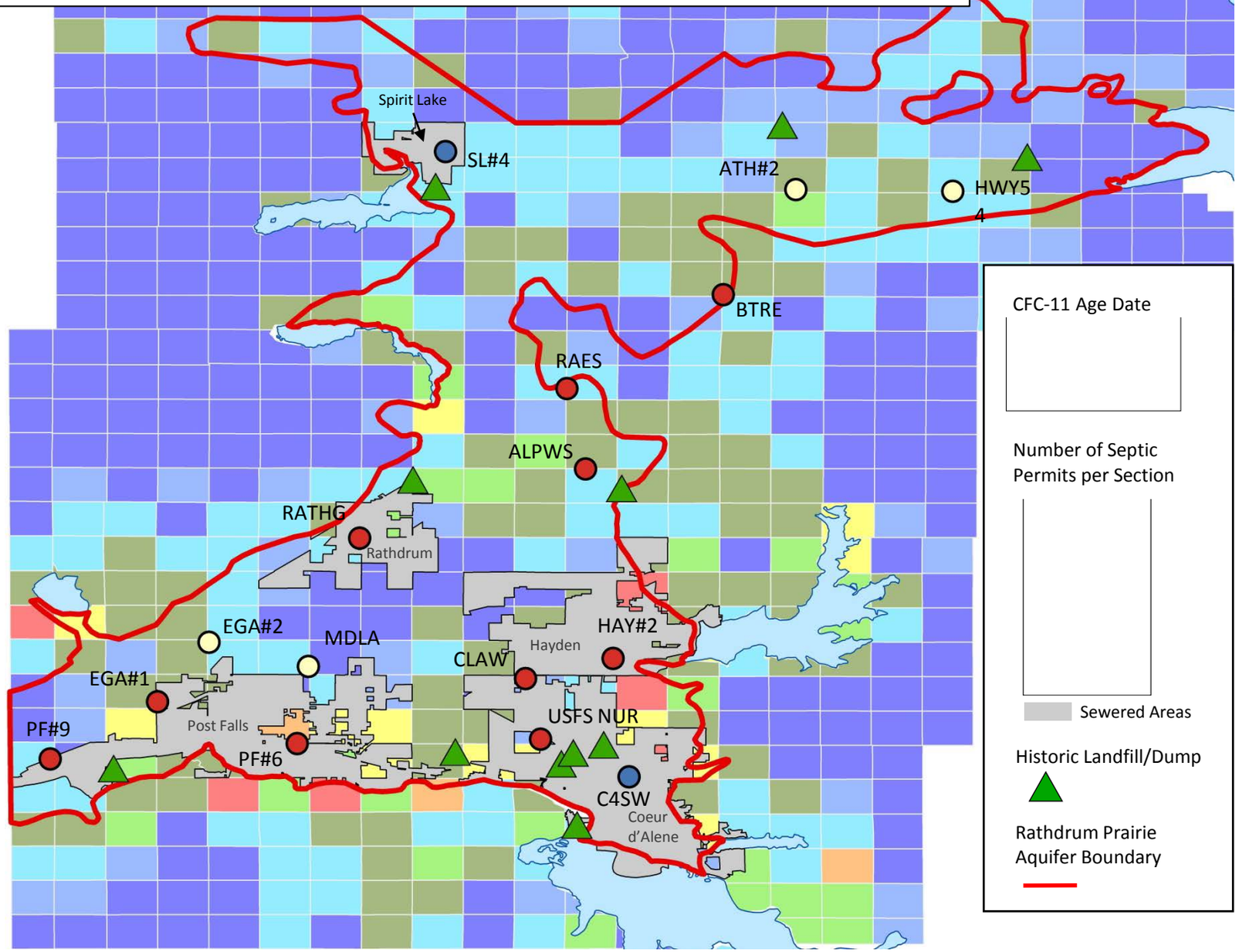


Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride

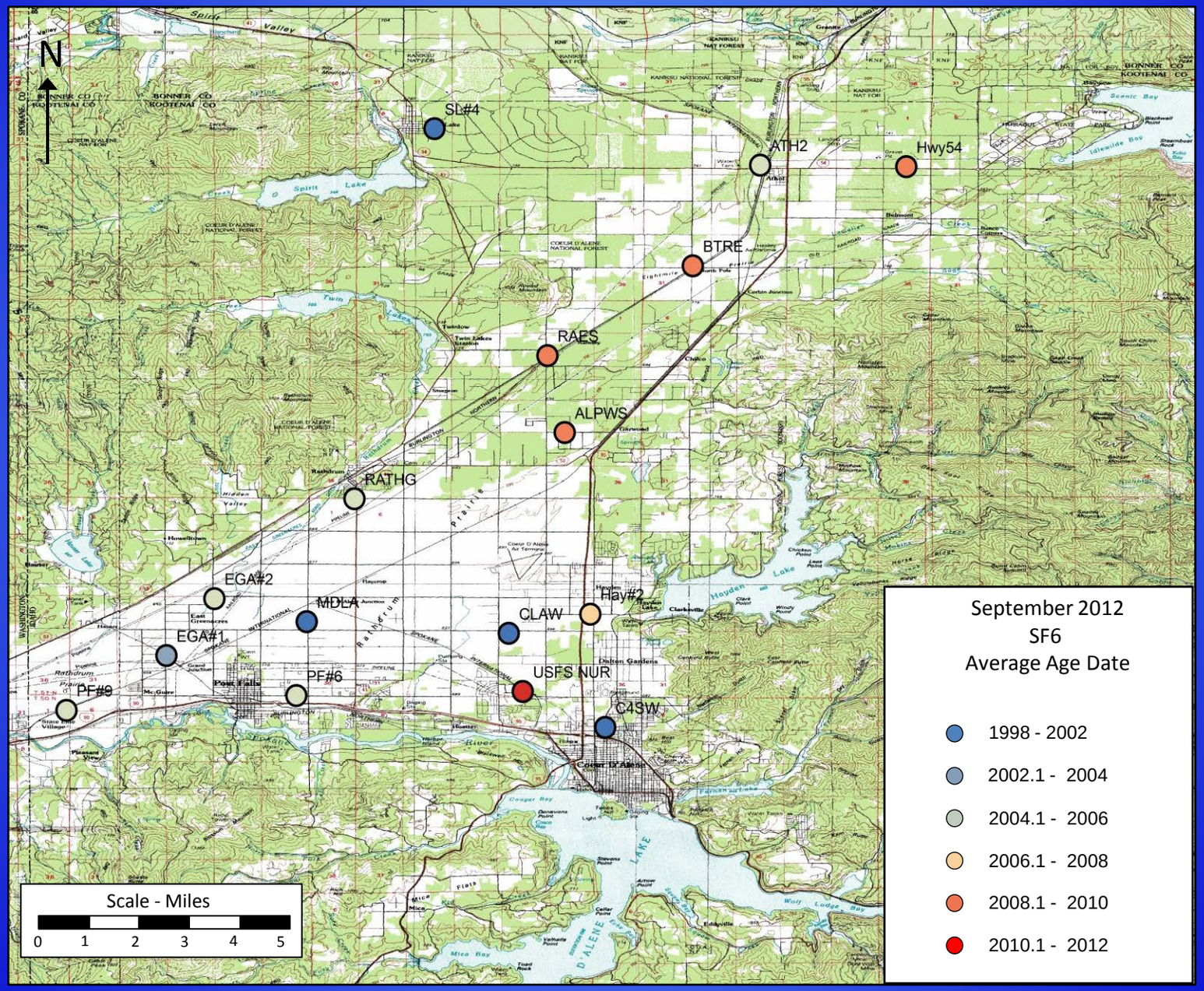


Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride

Samples near lakes may have older age dates
due to anaerobic degradation from lake bottom sediments

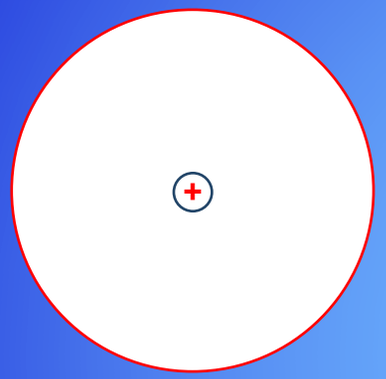


Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride

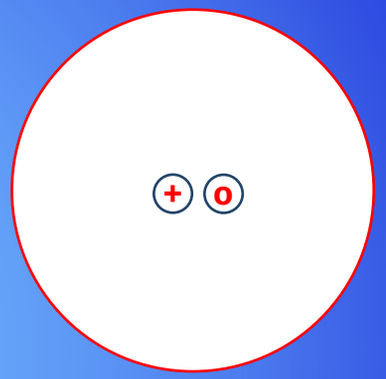


Deuterium & Oxygen 18

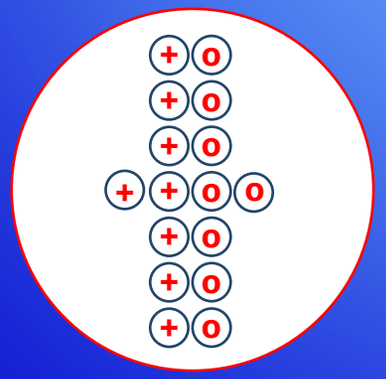
^{1}H
1 Proton
0 Neutron
Abundance = 99.98%



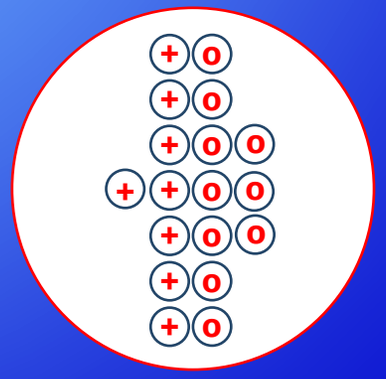
^{2}H – Stable Isotope
1 Proton
1 Neutron
Abundance = 0.013%



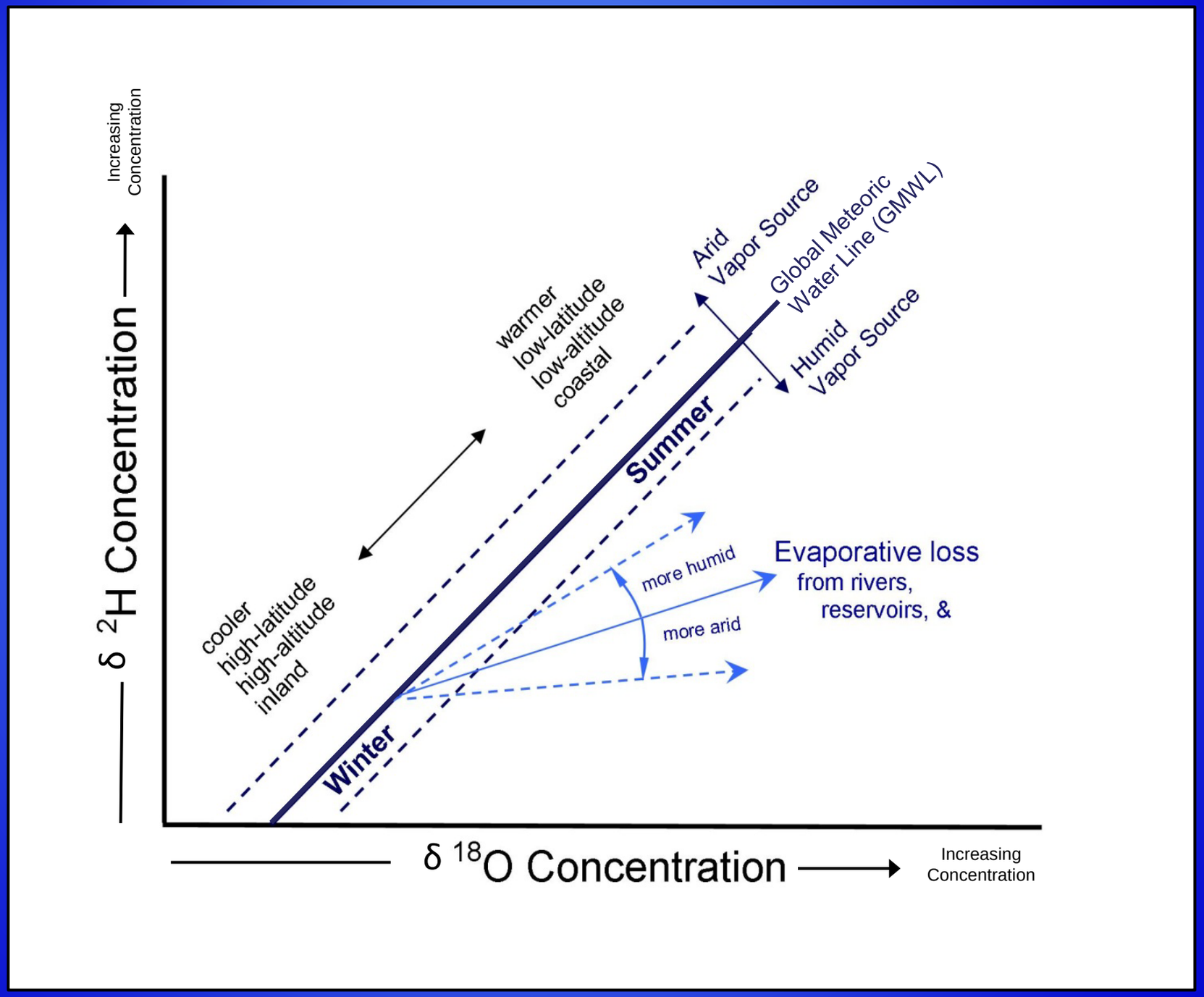
^{16}O
8 Protons
8 Neutrons
Abundance = 99.759%



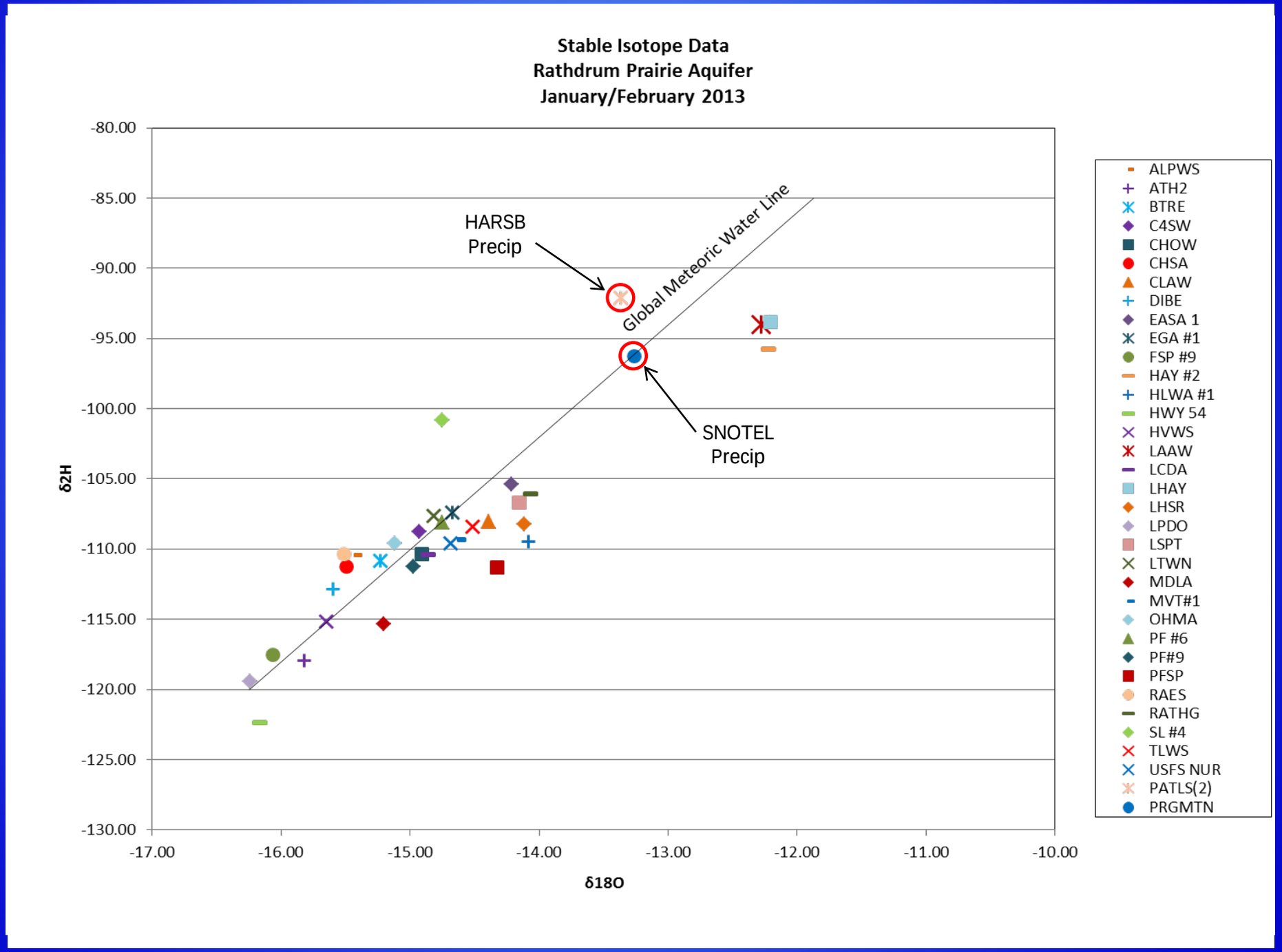
^{18}O – Stable Isotope
8 Protons
10 Neutrons
Abundance = 0.204%



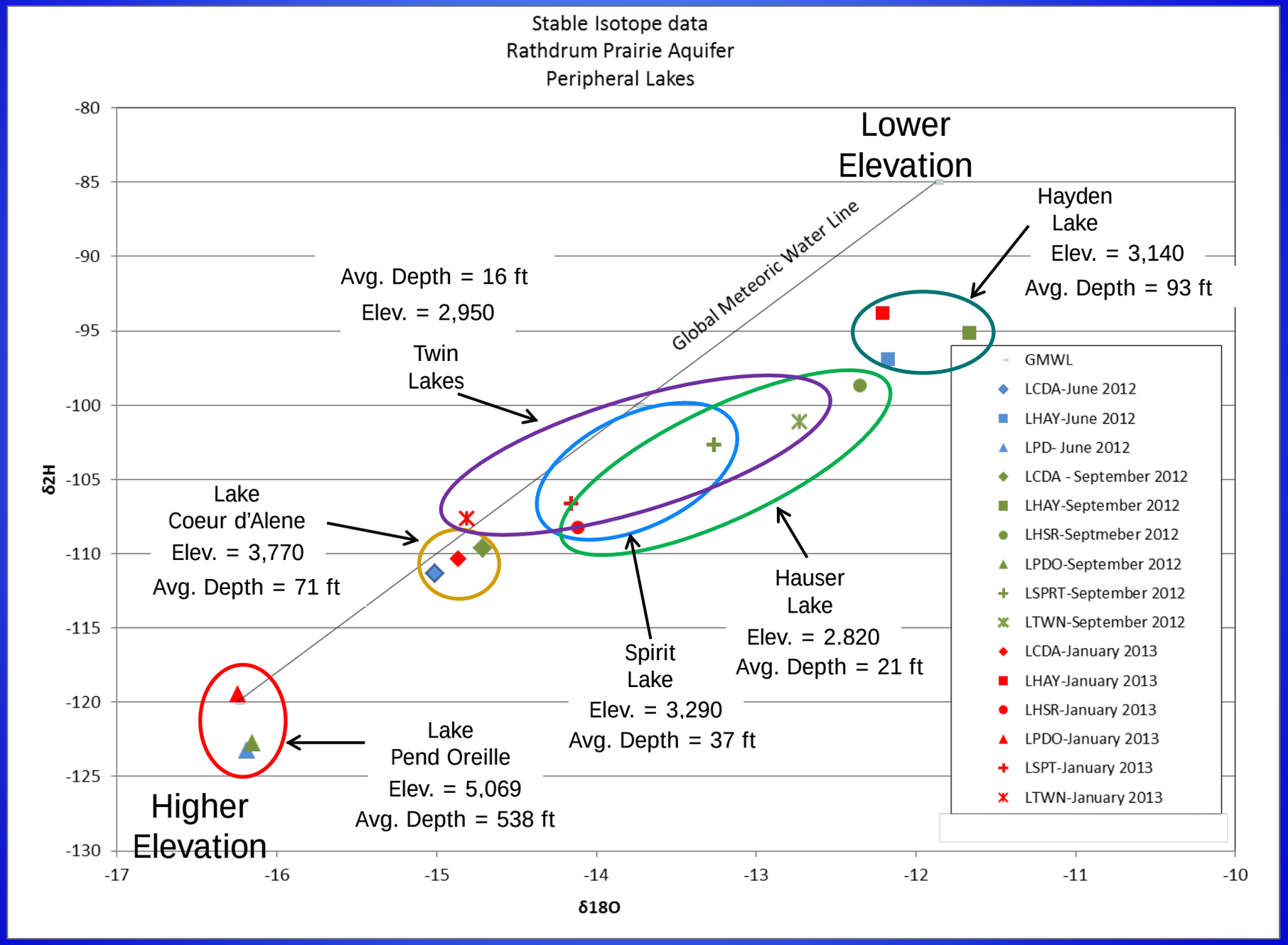
Deuterium & Oxygen 18



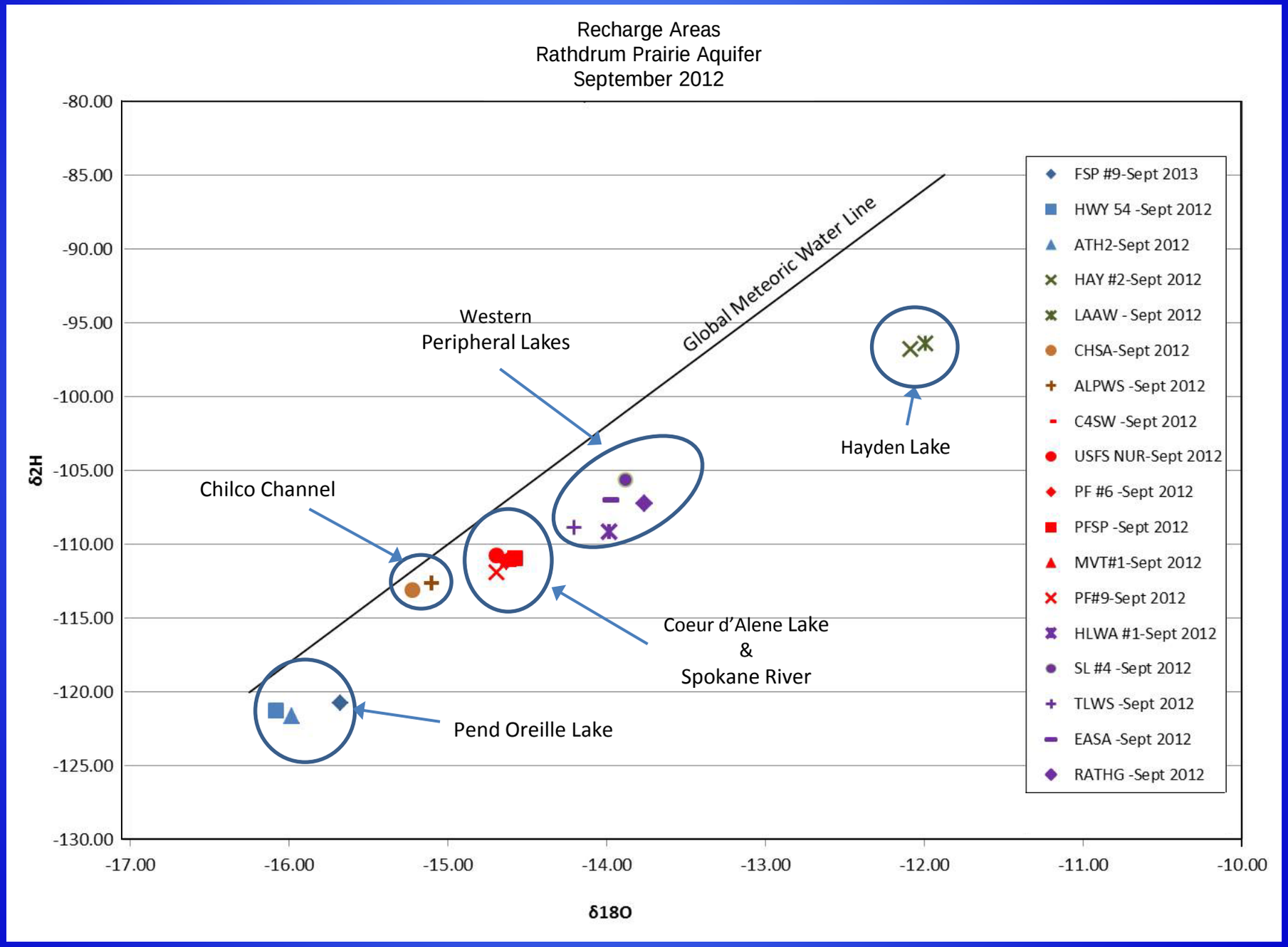
Deuterium & Oxygen 18



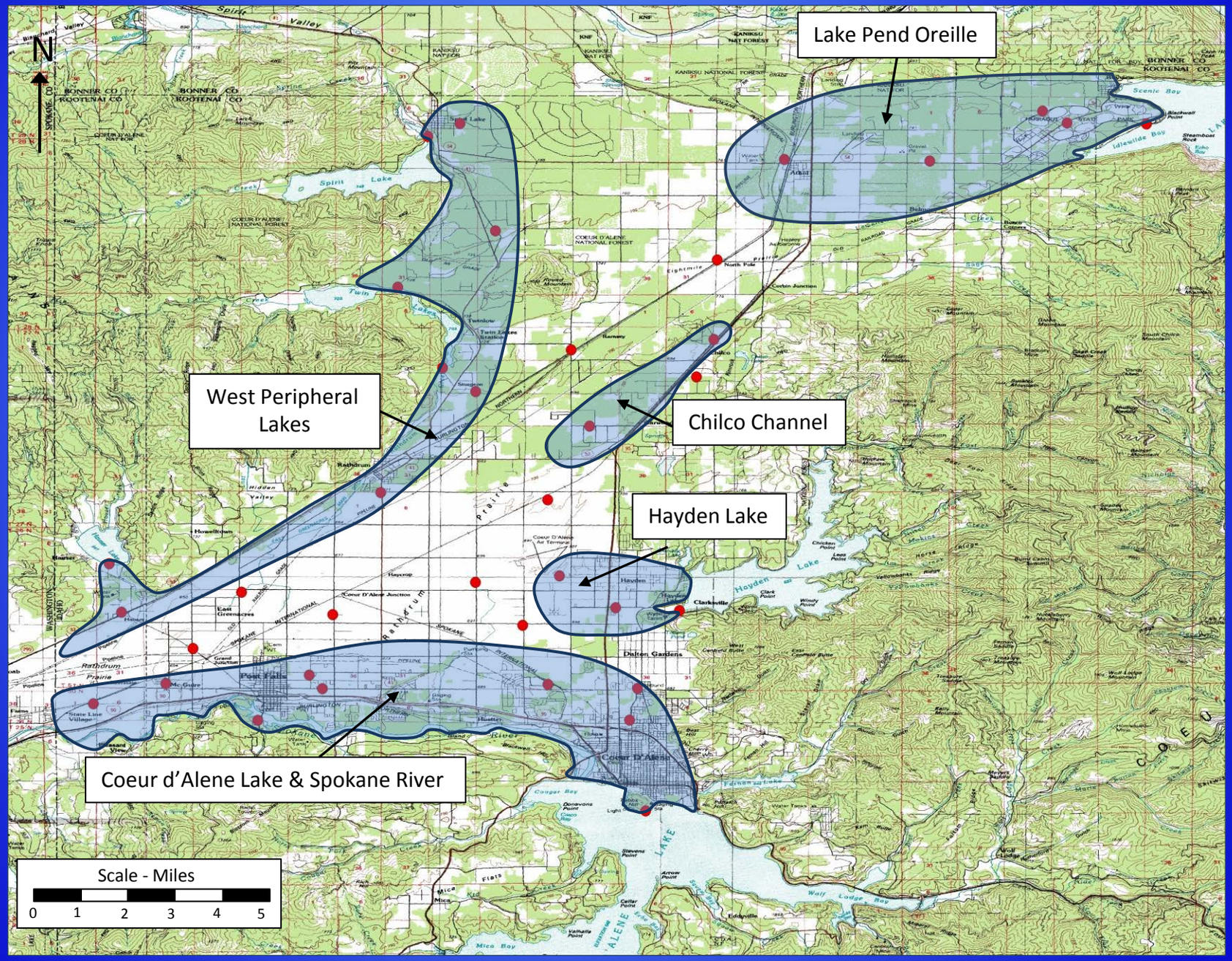
Deuterium & Oxygen 18



Deuterium & Oxygen 18

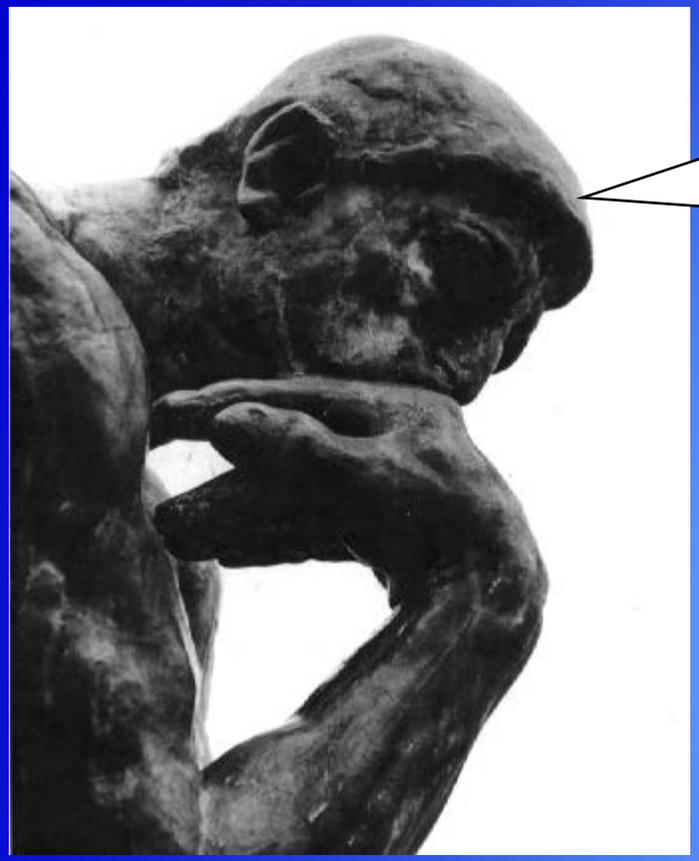


Deuterium & Oxygen 18

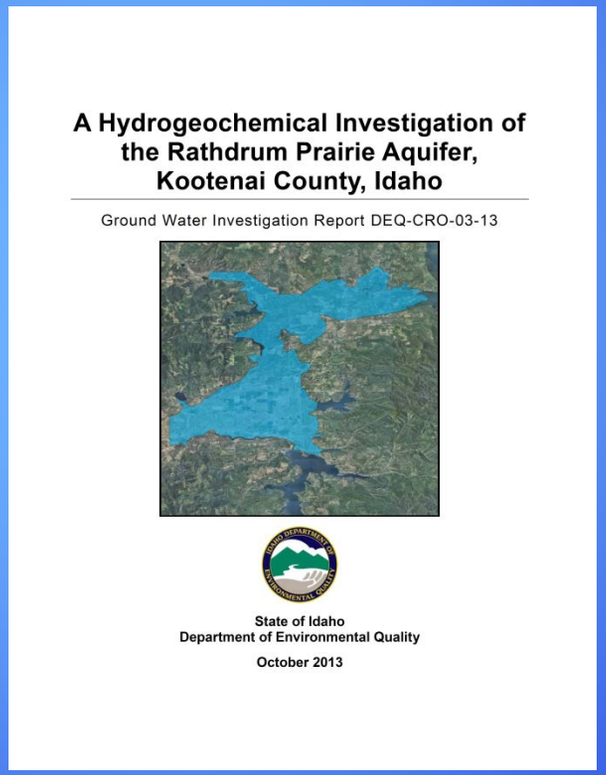


Conclusions

- Drinking water quality is excellent
- All inorganic constituents were below the drinking water standard
- All VOC and SOC concentrations were below detection limits
- Nitrate concentrations were below 2.0 mg/l , with potentially minor contributions from surface activities
- Uranium and radium-226/radium-228 sampling indicate occurrence in some wells but below the drinking water standard
- Arsenic sampling indicate occurrence in some wells but below the drinking water standard. Multiple sampling indicates that arsenic is consistently present in most wells that had arsenic concentrations above the detection limits
- CFC analytical results show the majority of wells with supersaturated concentrations most likely from anthropogenic sources
- SF6 results indicate ground water with ages less than 15 years
- Deuterium/Oxygen-18 analytical results indicate seasonal recharge and significant contributions from the peripheral lakes
- Deuterium/Oxygen-18 results affected by lake/watershed mechanics



Your Question Here ?



A Hydrogeochemical Investigation of the Rathdrum Prairie Aquifer, Kootenai County, Idaho

Ground Water Investigation Report DEQ-CRO-03-13

State of Idaho
Department of Environmental Quality

October 2013

Further Information www.deq.idaho.gov/rpa

Please call Gary Stevens at (208) 666-4627