



Naturally Occurring Arsenic in Groundwater on Vashon-Maury Island in King County, Washington

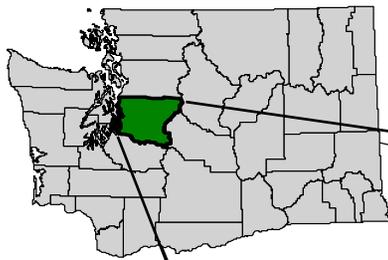
NGWA Ground Water Summit
April 2, 2008



King County

Eric Ferguson, LHG

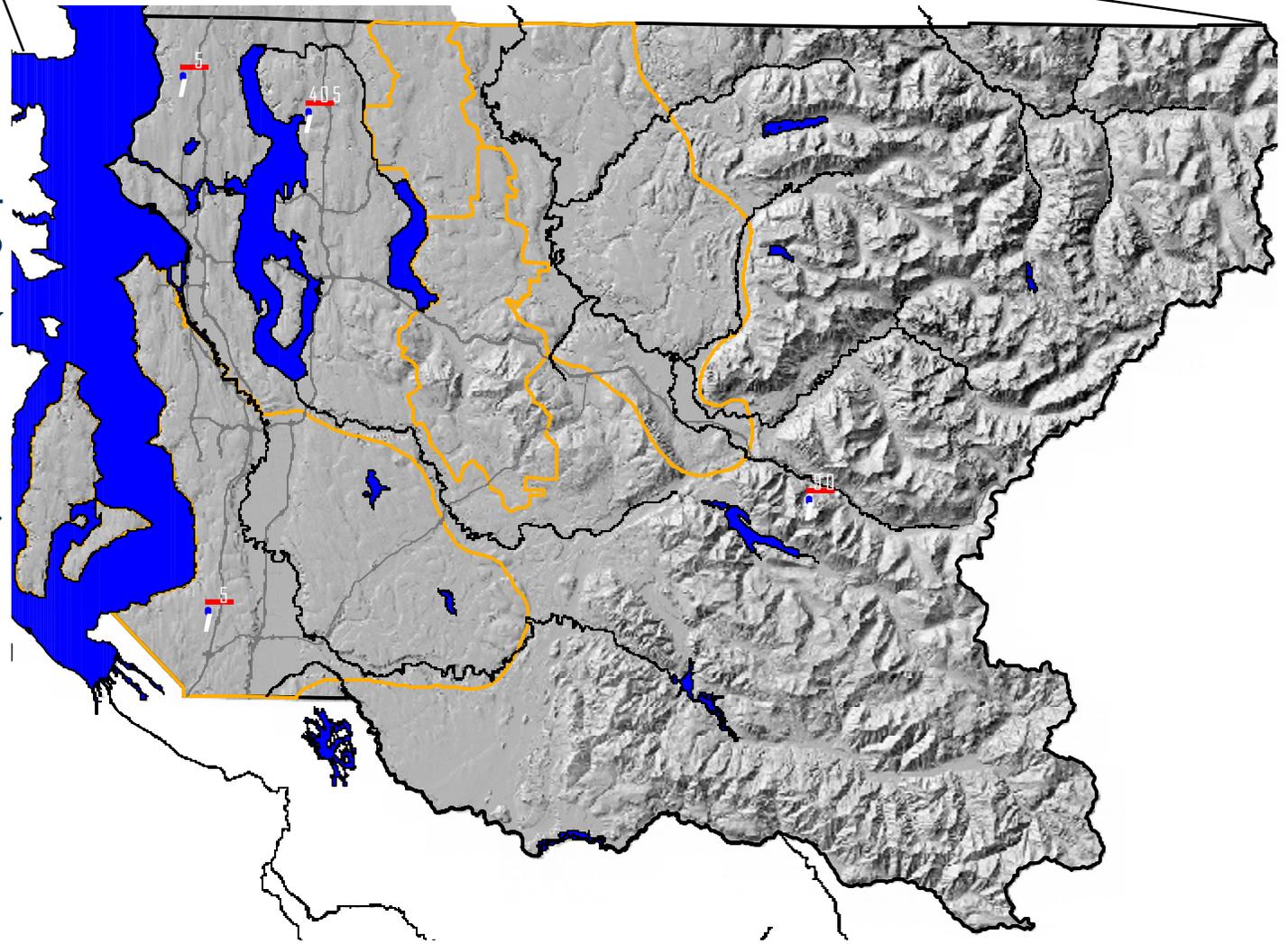
Department of Natural Resources and Parks



Washington State

King County

VMI →



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Vashon-Maury Island

- Rural King County
- 37 sq mi
- 10K population
- Island Aquifer System
- EPA Sole Source
 - All water used on island comes from ppt.

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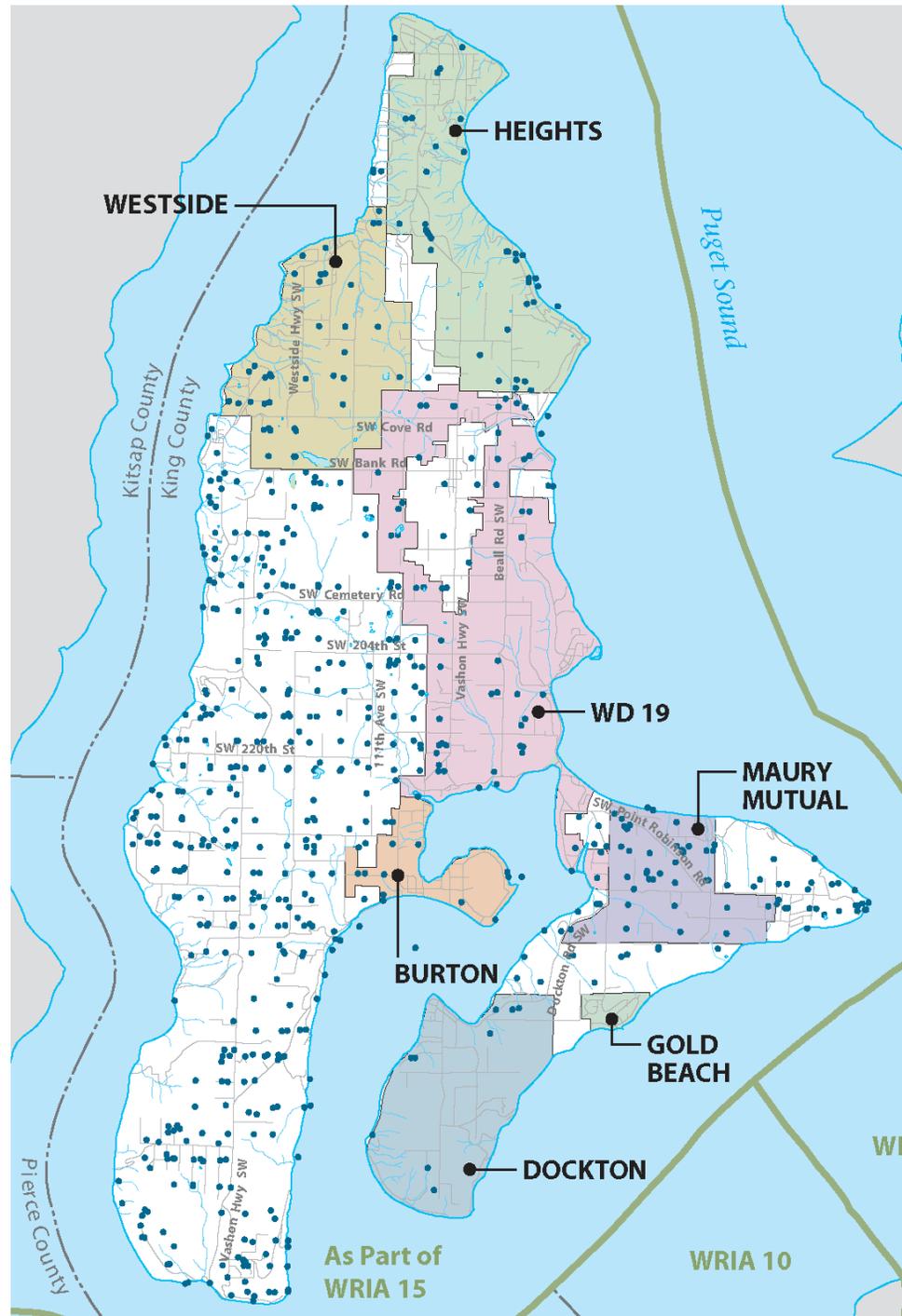
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VMI con't

- PWS supply majority of population
- Over 1000 wells
- 20 long-term sites
- 10 monitoring wells

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Wells on VMI

Group A Sources = Red Squares

(53)

Group B PWS = Pink Squares

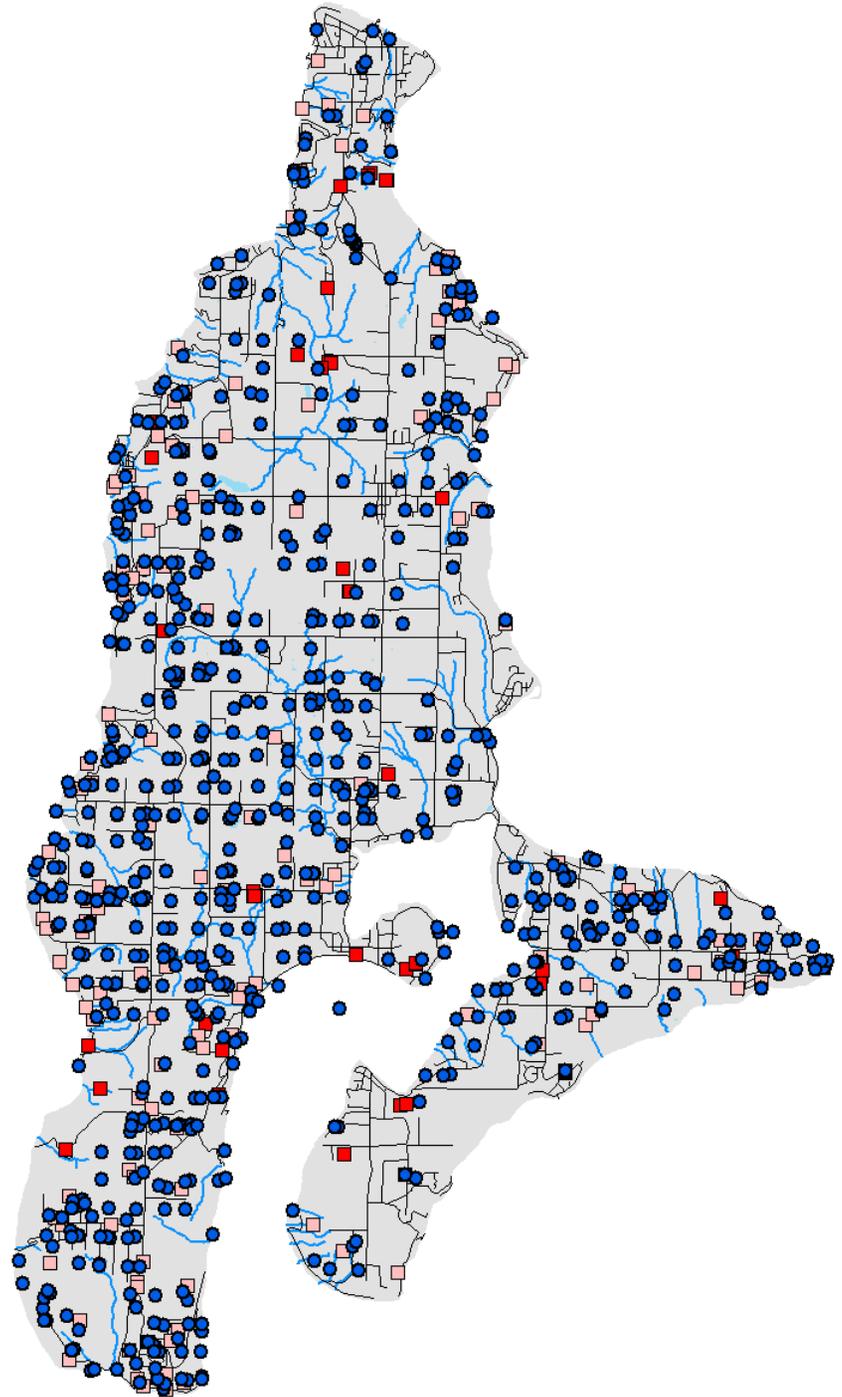
(137)

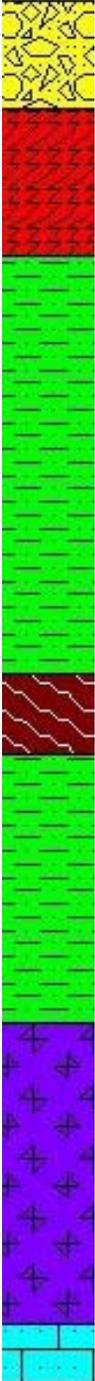
Exempt wells = Blue Circles

(884)

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WQ Monitoring Program

- Data collected 2001-2007
 - Follow up of previous work (1989-91)
 - 20 long term sites
- Sampled for Metals, Nutrients & Conventional
- Arsenic was detected in 18 of 20 VMI sites
 - MDL for As is 0.0005 mg/L
 - Speciation data collected in 2006 & 2007
- Special Studies
 - 11 sites
- Monitoring wells
 - As data from 3 wells

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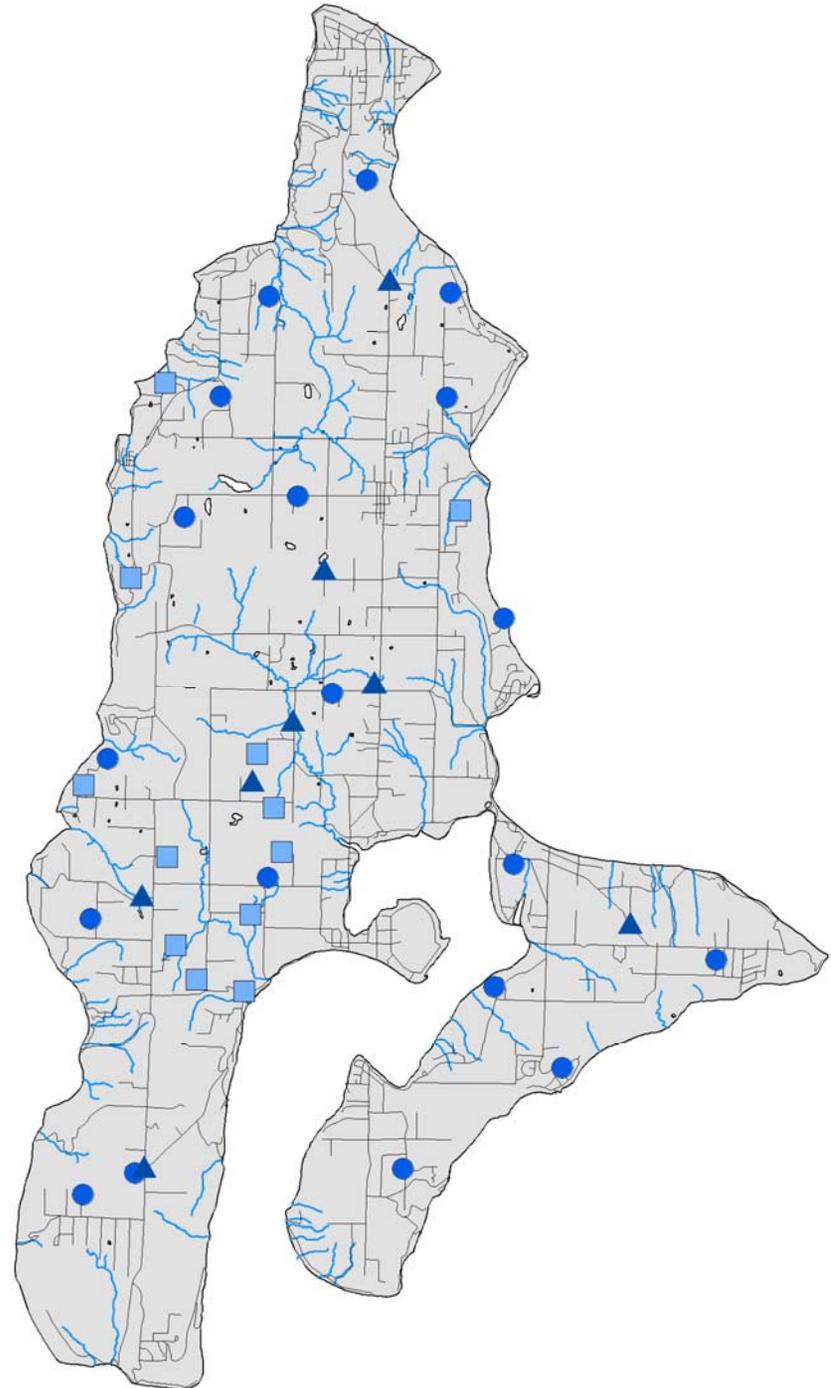
GW Water Quality Sites

20 Long-term sites
(circles)

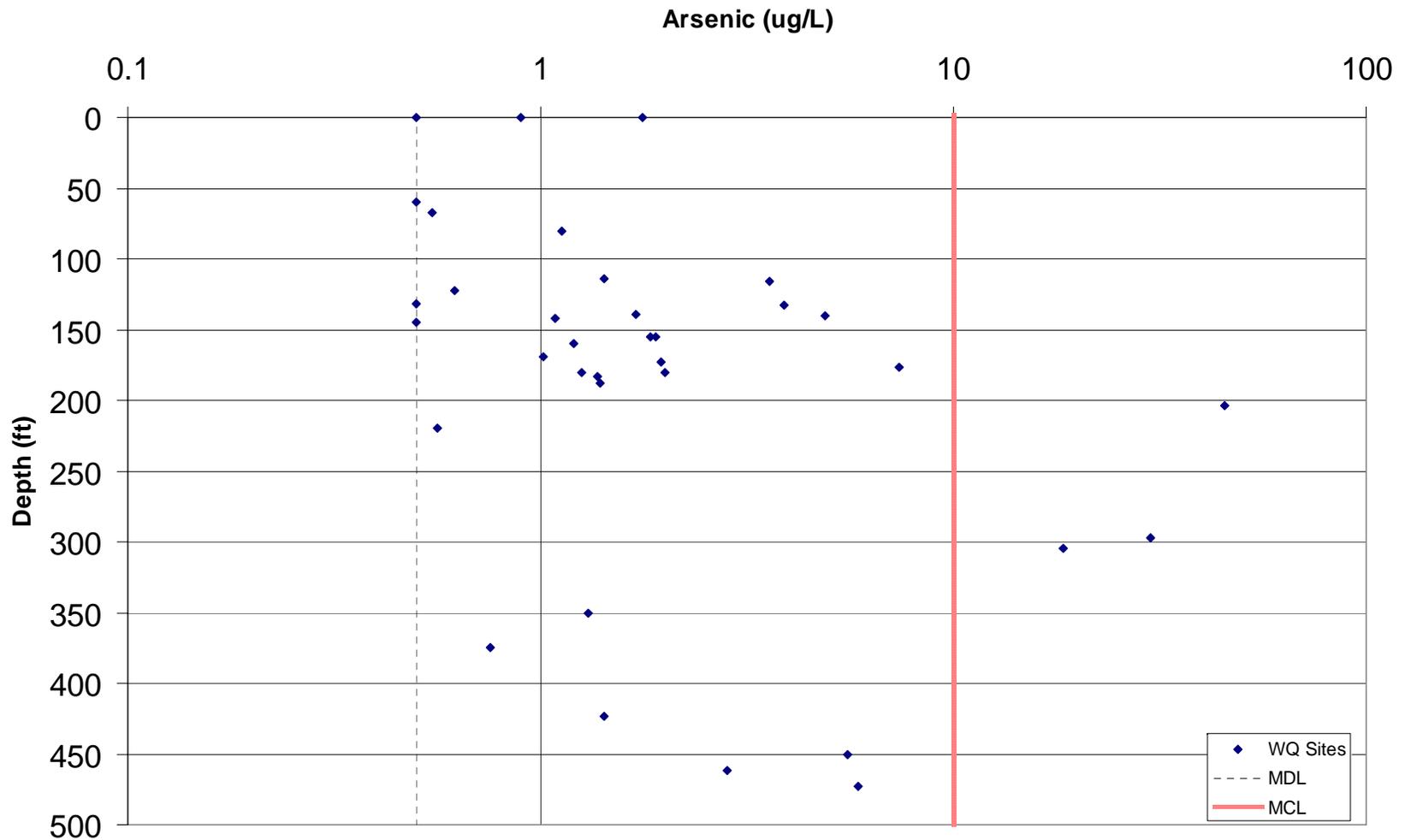
10 Monitoring Wells
(triangles)

11 Special WQ sites
(squares)

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Arsenic concentrations vs. depth



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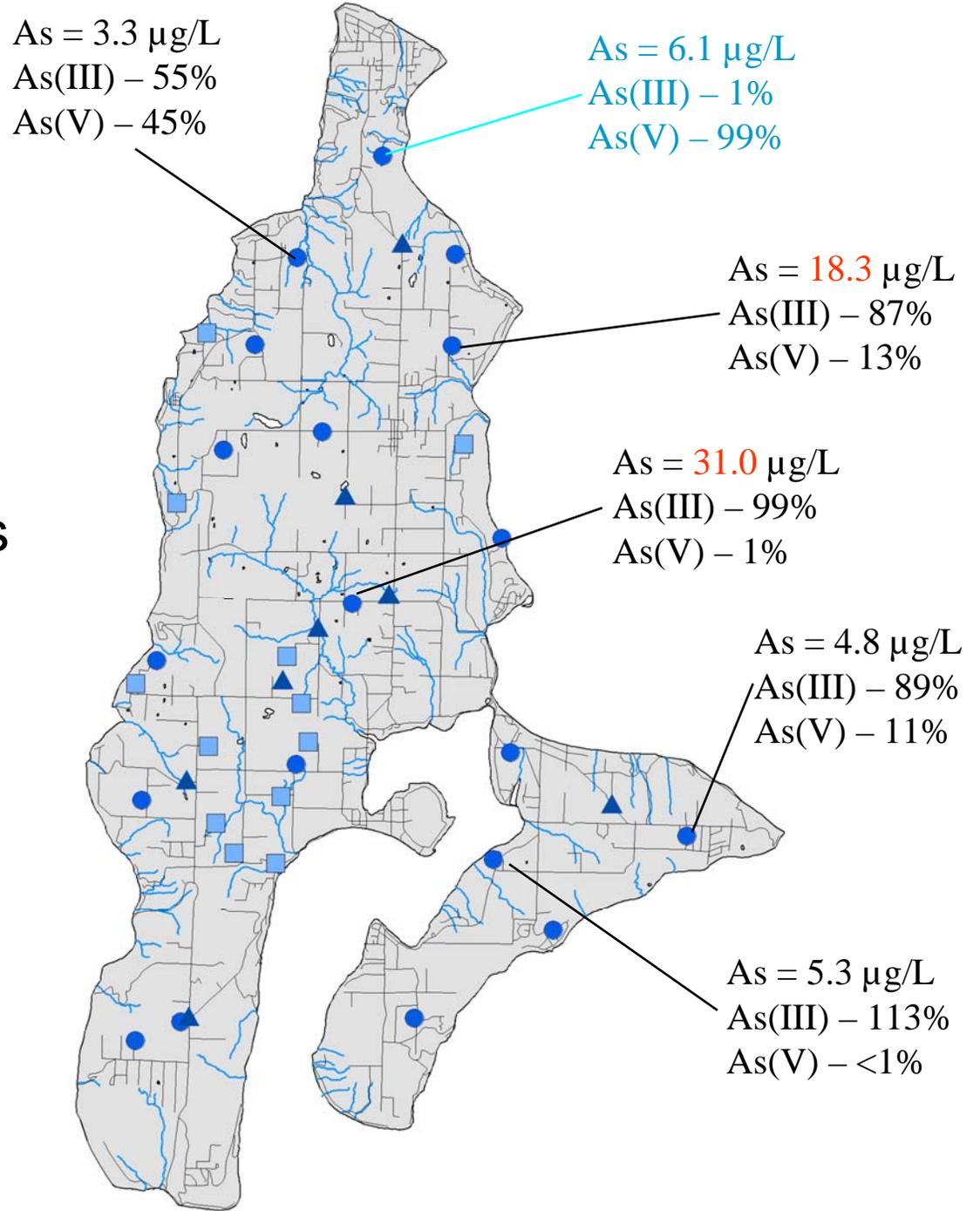


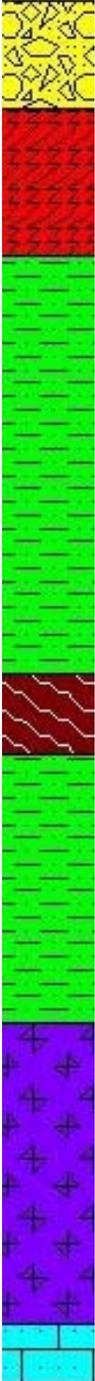


2006 Arsenic Speciation Sites

- 6 sites
– long term sites
- Highest As concentrations
- As(III) — 4
- As(V) — 1
- As(mix) — 1

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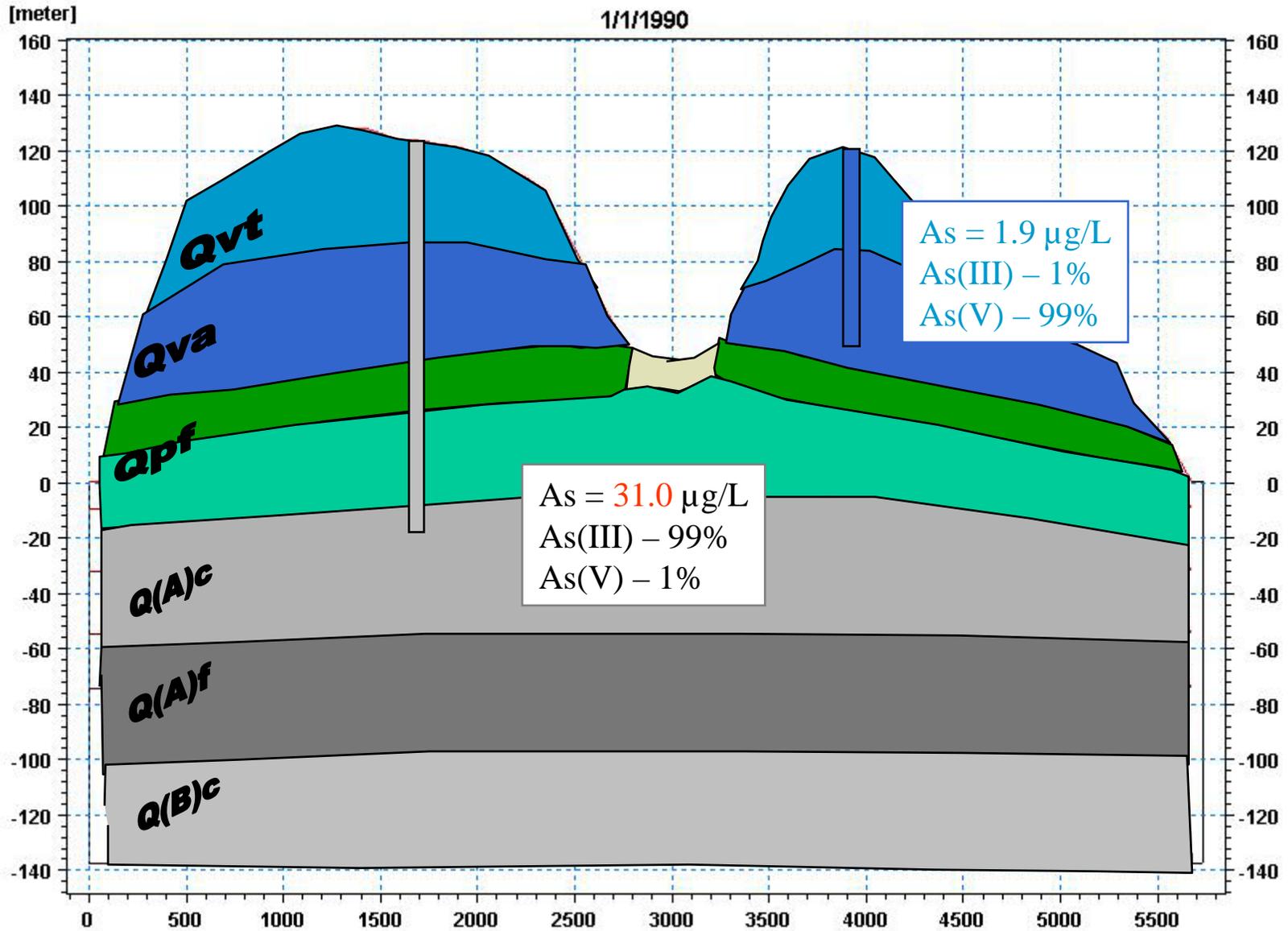




Interpretation

- As predominantly in older units
- As(III) was the major species present
- Initial interpretation: derived from natural leaching of arsenic from locally-derived rocks and soil minerals
- Results similar to other reports:
 - USGS Water Supply Papers 94-4082 & 92-4098
 - Public Health - Seattle-King County (PHSKC) 2000

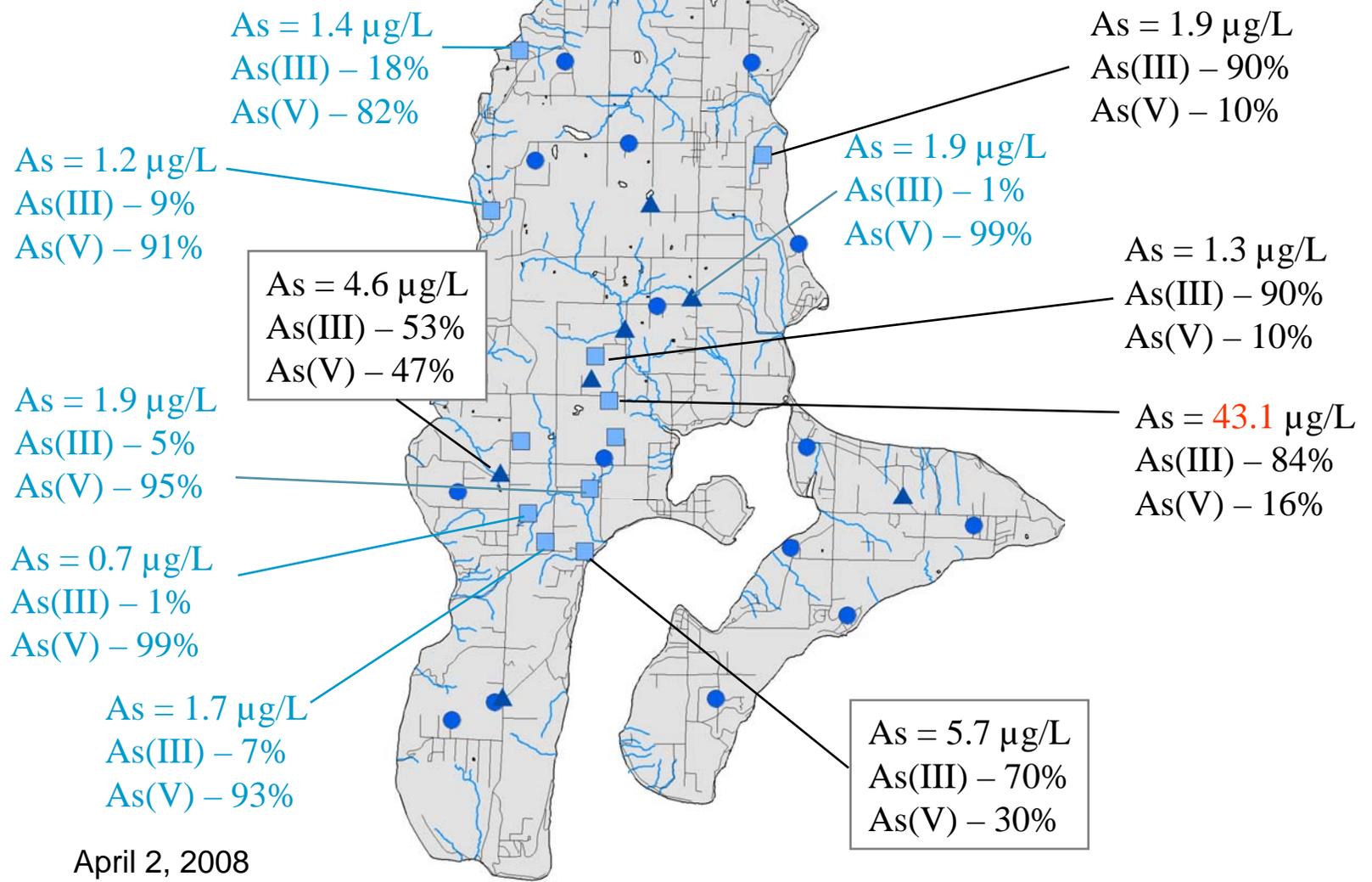
VMI Geology – cross-section



2007 Arsenic Sampling Sites



- As(III) — 3
- As(V) — 6
- As(mix) — 2



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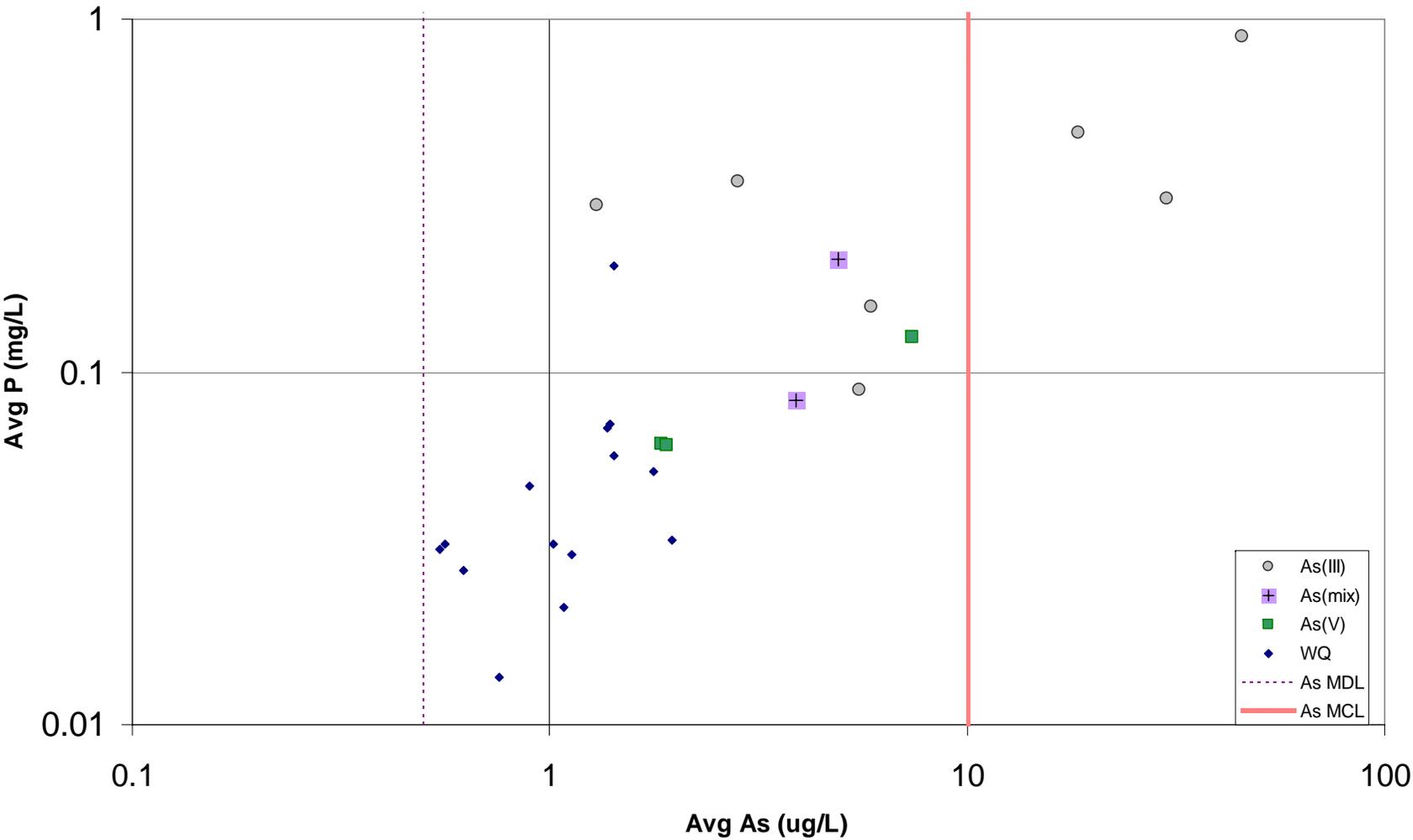
Phosphorus

- Initially not part of the Ambient Monitoring program
- KC Lakes Programs monitors P
 - wanted to obtain the GW component
- Total Phosphorus added
- Noted a correlation between As and P

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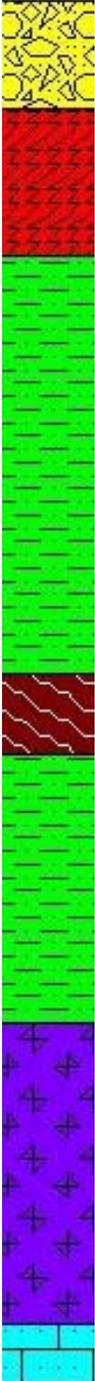
Phosphorus vs. Arsenic



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Peat-derived hypothesis

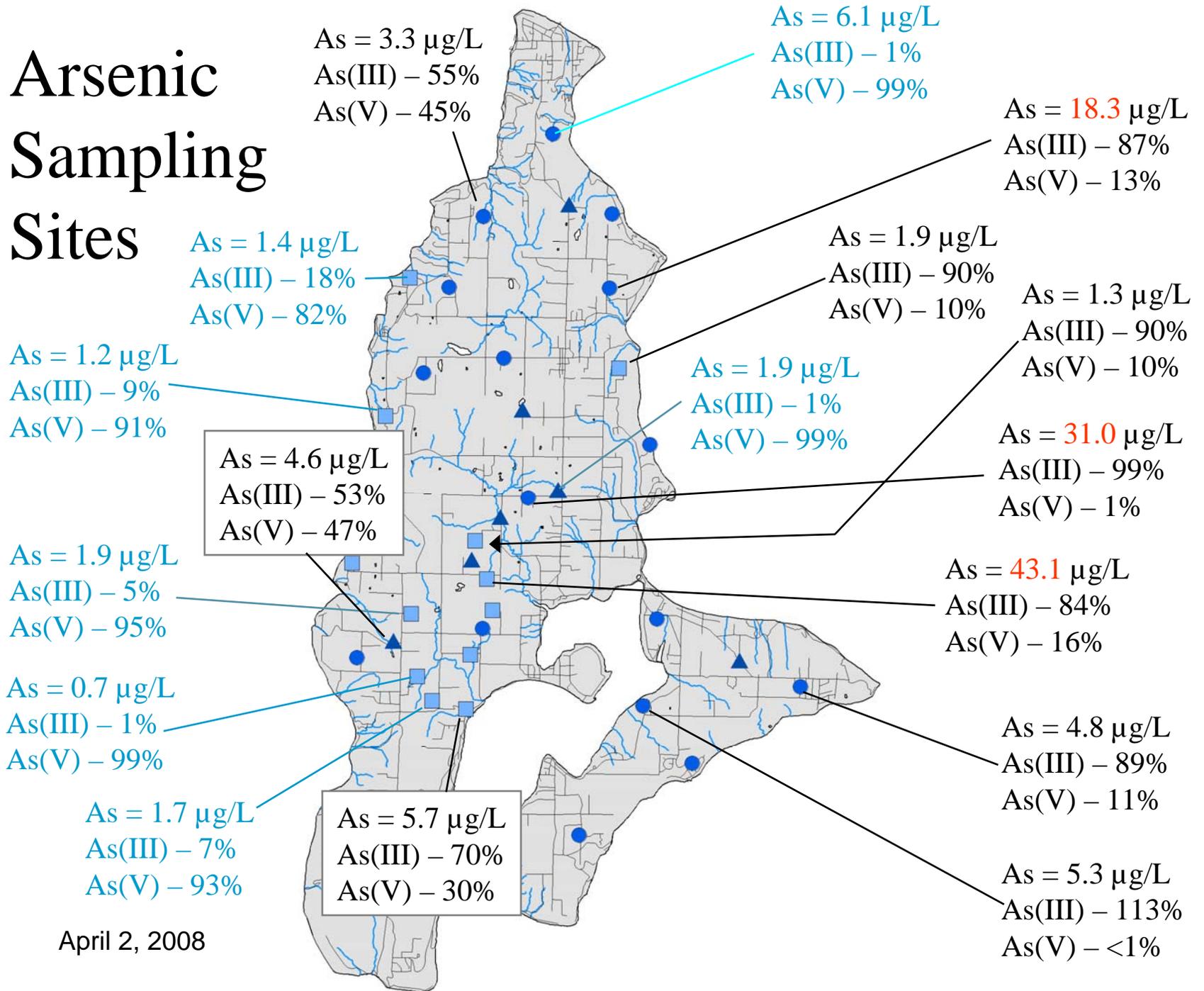
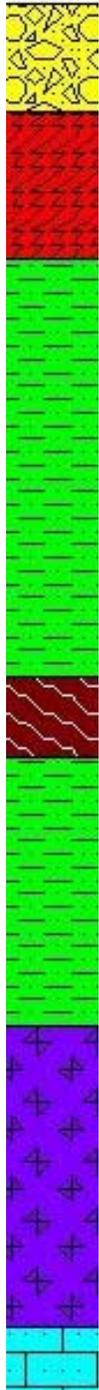
- P vs. As correlation
- Reduction of FeOOH
 - Ravencroft et al., 2001 – Bangladesh area
 - Anoxic conditions (<2.5 mg/L DO) in most wells
- High Arsenic concentrations in Peat Deposits in KC
- Recent “uncovering” of peat deposits in SRV



Conclusions

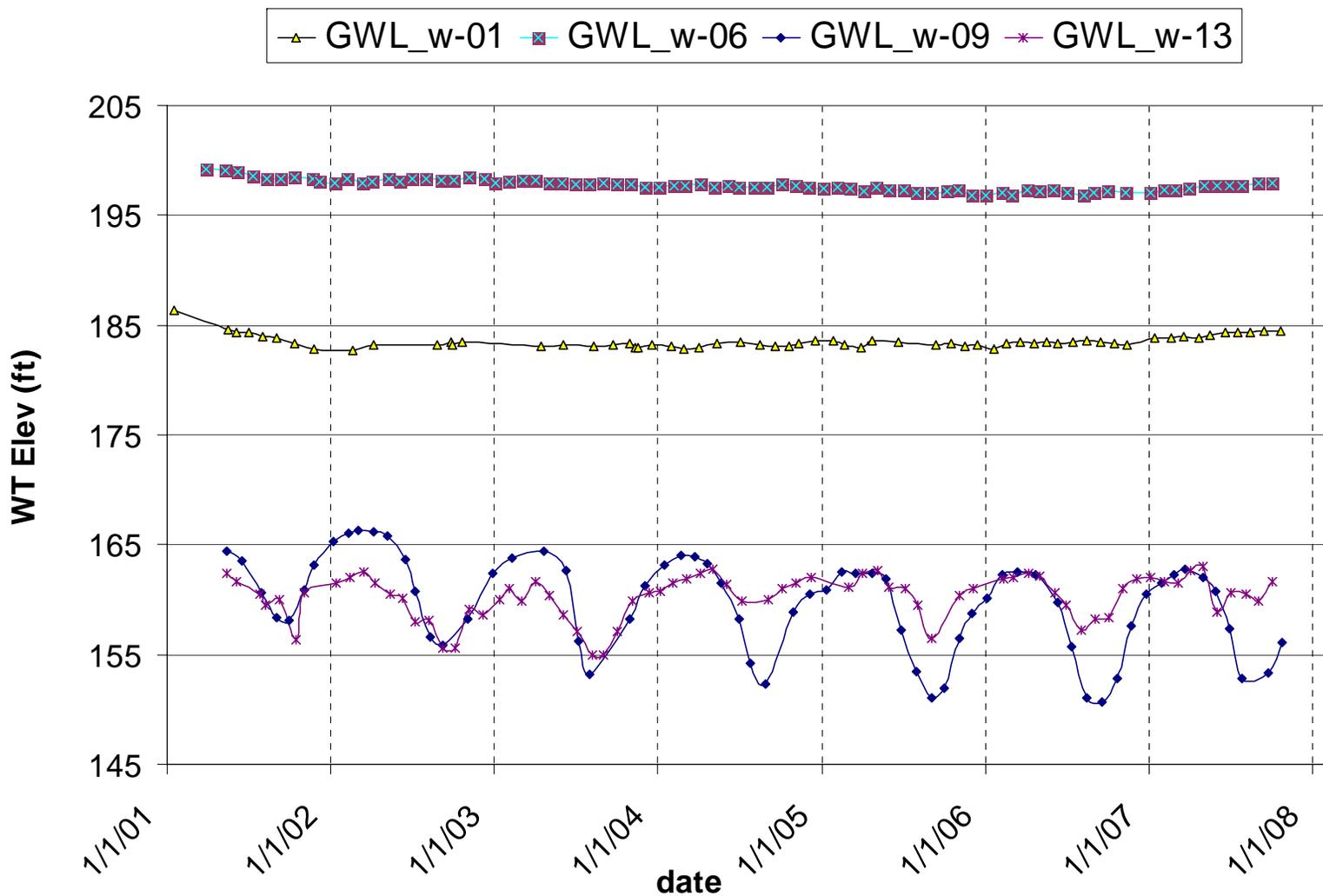
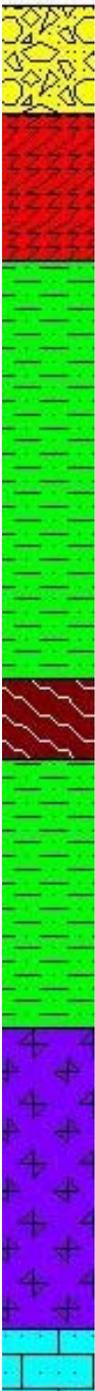
- Two types of Arsenic derived sources appear to be present in King County
 - Peat derived...for a few locations
 - Local rocks and soil minerals derived...predominant source
- Future Work
 - Additional speciation sites
 - Identify geochemical signatures

Arsenic Sampling Sites



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Volunteer water level sites



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Other Arsenic findings in KC

- Samples from a peat bog in western King County (Des Moines Creek) were found to have arsenic as high as 432 mg/kg,
 - samples in surface water systems downstream from the peat bog
 - water samples: 0.003 mg/L
 - sediment samples: 47.6 mg/kg
- buried peat bog located further inland (~30 km east) has arsenic: 3.49 mg/kg