Water Quality and Security

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Opening Statement

- Security = Robustness, which can be built from an understanding of the characteristics, fate and transport of chemicals in a *specific natural system*
- Vigilance = Monitoring, which requires understanding *beyond standards* – don't abdicate knowledge of your system to Official Standards
- So today let's make a place in your thinking for the required understanding
- I'll give my assessments of security along the way

Overview

- Major Ions
- Minor Ions
- Nuclear Chemistry
- Organic Compounds
- Suspended Particles
- Summary

Major Ions and the Total

- A few "major" ions dominate the total dissolved load of natural waters
- Many don't sample for them (except NO_3) <u>because they don't generally represent a health risk</u>
- They are:
  - Ca . Mg . Na . K
  - Cl . HCO_3/CO_3 . SO_4 . NO_3
- Digress: the power of hydrogen (pH), acid rain, mine drainage
- *Security – context and total "salt" load*

Minor Ions

- Mostly classic trace metals – Al, As, Hg, Sb, Cr, Pb, Cu …
- Others – B, F, Si, PO_4…
- Health-based standards
- Natural (dissolved and suspended) vs. pollution
- The natural levels of some pose an unacceptable health risk
- Tracers, Redox Pairs – context
- *Security – context and health*

Nuclear Chemistry

- The nucleus of an atom for a given element can have differing numbers of neutrons and still be the same element – some stable, some radioactive
- We look at the various isotopes for two reasons:
  - Tracers (labels) – context
  - Radioactivity – health-based standards
- *Security – context and health*

Organic Chemistry

- Vast array of compounds always built from C and H, sometimes O, and from there S, N, and the other attachments.
- Natural, human-synthesized, human-relocated
- Major categories to track:
  - Solvents
  - Fuels
  - Pesticides/Herbicides
  - Medications
  - Other, “Emerging” contaminants
- Security – *Health, depending on MNA, and what we haven’t analyzed for yet*

Suspended Particles

- Not dissolved – "bumping along for the ride"
- An expanding list:
  - Sediment
  - Microorganisms
  - Nanoparticles
- Security – *total load, health, and what we haven't analyzed for yet*

Summary

- **We are generally secure**, but understanding of a specific water system typically vanishes in **only meeting health-based standards**
- Don't depend on the determining factors for input, fate and transport being **constant/static**
- Build a foundational **understanding** of your water system – hydraulics and water chemistry relevant to natural systems
- Be **vigilant** with the best tools available: Think about the context for chemistry in your system, investigate as necessary, monitor continuously and interpret the results on a regular basis.