Arsenic Water Pollution Sensor Priorities

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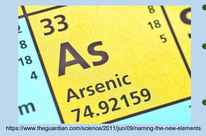
What is it Arsenic?



https://www.theguardian.com/science/2011/jun/09/naming-the-new-elements

- Naturally-occurring semi-metal
- Results from natural deposits, agricultural & industrial activity
- Drinking water wells mobilize groundwater arsenic

Why is it important?

- Tasteless, odorless human toxin & carcinogen
- Chemical form is important
  - Inorganic arsenic highly toxic
  - Organic arsenic much less toxic
  - Total arsenic measurement doesn't distinguish forms
- Regulated by EPA at 10 ppb (drinking water)
- Dietary sources (rice, apple juice)

http://blogs.discovermagazine.com/crux/files/2013/08/bowl-of-rice1.jpg

Current Approach – Arsenic Monitoring

- Laboratory Methods
  - Colorimetry ✓
  - Hydride Generation Atomic Absorption Spectrometry ✓
  - Electrothermal Atomic Absorption Spectrometry ✓
  - Inductively Coupled Plasma-Atomic Emission Spectrometry ✓
  - Inductively Coupled Plasma-Mass Spectrometry ✓
- Field and on-line methods
  - On-line voltammetry instruments ✗
  - Field test strips ✗

✓ EPA-Approved
✗ Not EPA-Approved

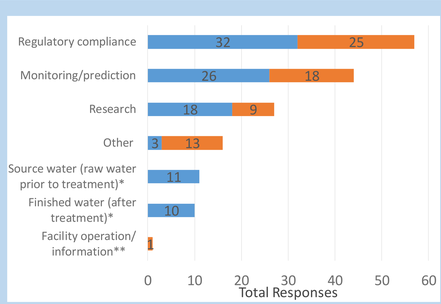
Drawbacks to Current Approaches

- Lab-based methods:
  - Time lag from sample collection to data
  - Difficult to make real-time decisions (e.g. process control)
- High per-sample collection & analysis cost
- Limited data (due to cost)
- Lab instruments require trained analysts

Key for All Figures

Feedback received from federal employees & partner orgs
Feedback received during arsenic sensor needs webinar
**Combined responses from federal employees & partners*
***Option only available to webinar attendees*
Note: there may be overlap between the feds & partners and webinar groups

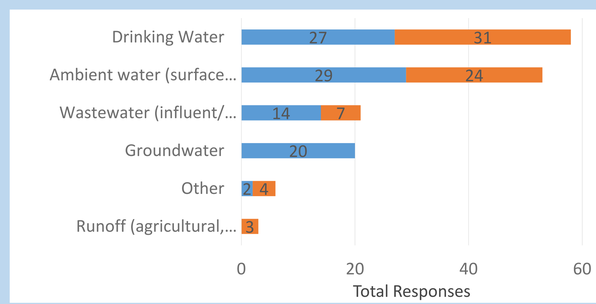
Reasons for Monitoring Arsenic

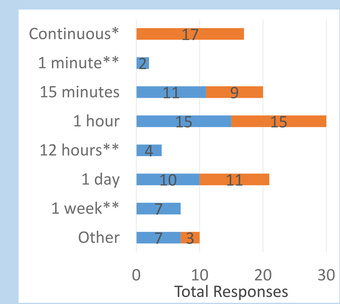


Summary of Arsenic Feedback

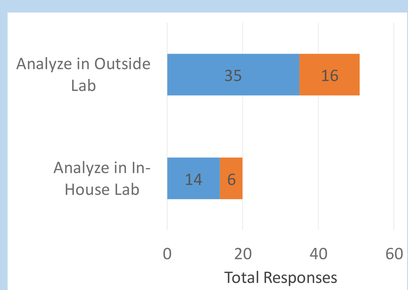
Characteristic	Need
Limit of Detection	Lower: 1 µg/L, Upper: 100 µg/L
Response Time	Real-time
Sampling Frequency	1 hour
Deployment Length	1 month
Data Logging	Integrates with external data logger
Data Transmission	Cellular/Satellite
Price	$2,500 - $5,000

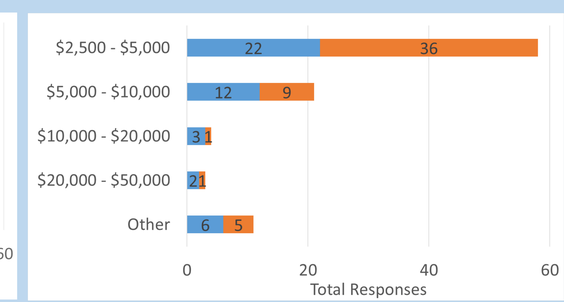
Sampling Environment, Sampling Frequency



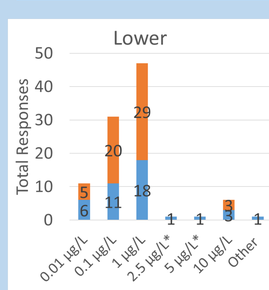


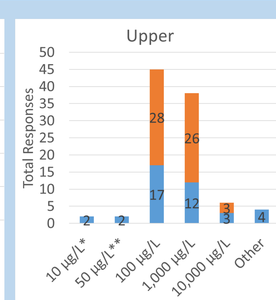
Current Monitoring Practices, Desired Price

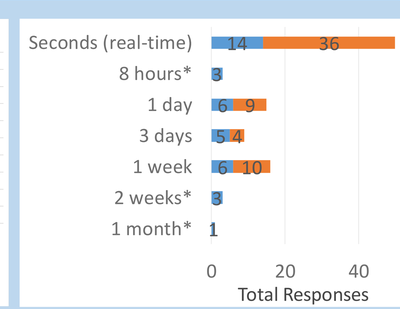




Limits of Detection, Response Time







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Association of State Drinking Water Administrators
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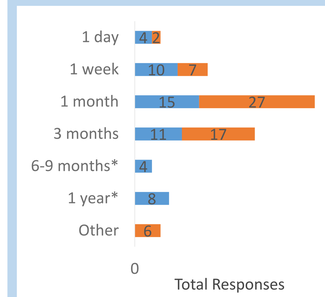
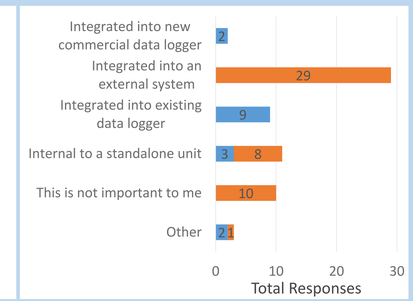
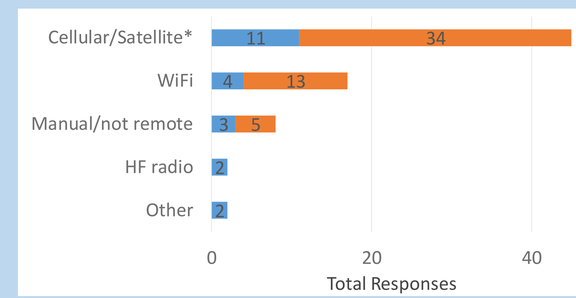
U.S. Bureau of Reclamation
U.S. Department of Agriculture
U.S. Environmental Protection Agency
U.S. Geological Survey
U.S. Park Service
Water Environment Federation

Deployment Length & Data Integration

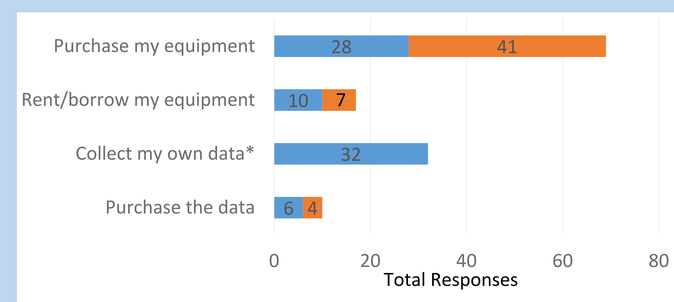




Data Transmission



Ownership



Potential Benefits of Advanced Arsenic Sensors

Benefits

- "Real-time" data
- Easy to operate
- Continuous monitoring
- Field-deployable
- Portable
- Affordable

Applications

- Drinking water:
  - Source monitoring
  - Point of use monitoring
  - Treatment optimization
- Wastewater treatment
- Contaminated site monitoring

Next Steps

Arsenic Sensor Challenge

- Phase 1: Ideation
- Phase 2: Prototype development
- Fall, 2016 launch date
- Winners may receive cash prizes, commercial partnerships, assistance from government scientists

DISCLAIMER

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