UCMR3 – Slicing and Dicing The Data

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Presentation Outline

- Why Do Detections Matter?
- Predictions from Pre-UCMR 3 Data Sets
- Overall Results to Date
- Slicing and Dicing the Data
- What Do Utilities Tell Their Customers?
- Conclusions
- Questions

Why Do Detections Matter?

- UCMR1 and UCMR2 had very few detects.
  - How do you evaluate regulatory impact with no detection if you don't have health based standards?

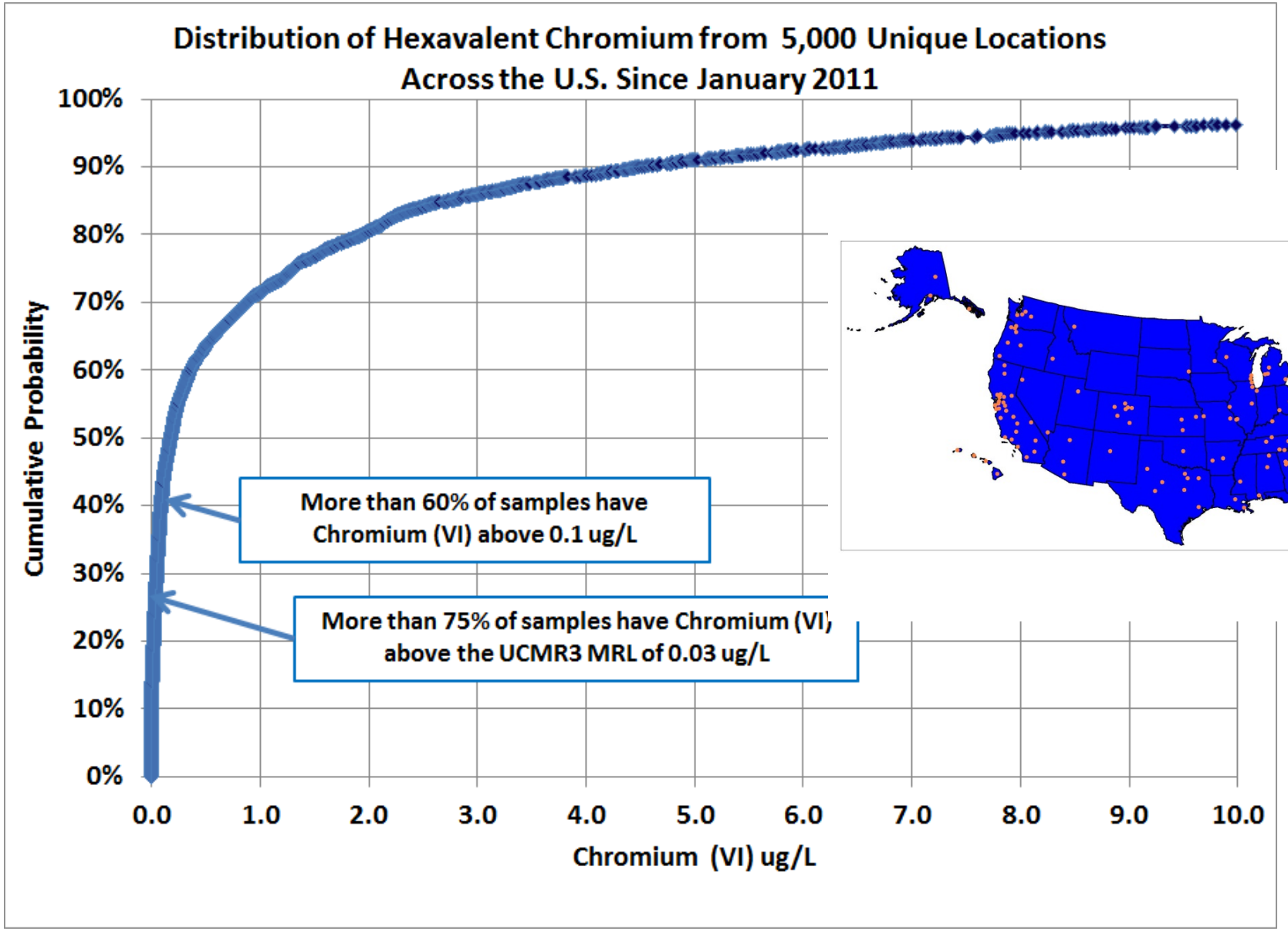
- UCMR Detections must be reported in the CCR.
  - But there is no comparison to health reference levels.

What We Knew Even Before UCMR3 re Detections

- For Inorganics there were multiple reports and sources of data to suggest what we might see.
  - Years of USGS studies
  - Eurofins Eaton Analytical studies
  - NIRS reports
  - Stanford et al data on chlorate

- For organics there was less robust data, but still some hints
  - 1,4 Dioxane studies by Mohr; EPA method development issues
  - PFCs: Most studies related to plumes
  - VOCs: Unregulated data; CA studies
  - Hormones: SNWA and other studies

Cr (VI) Results on >10,000 2011–2012 Drinking Water (DW) Samples



Occurrence Data – Predicted in 2012

Test	Method	Expected Occurrence
Metals (except Co and Mo)	EPA 200.8	>50%
Metals (Co/Mo)	EPA 200.8	<10%
Hexavalent Chromium	EPA 218.7	>75%
Chlorate	EPA 300.1	>50%
1,4-dioxane	EPA 522	2 to 5%
Volatiles	EPA 524.3	0 to 5%
PFCs	EPA 537	<2%
Hormones	EPA 539	<1%

What Are We Actually Seeing?

In October 2013, January 2014, and in April, 2014 EPA released a significant amount of data from the first year of monitoring to the NCOD, now representing ~18,000 samples (11,000 entry points and 7,000 Maximum Residence time points) from multiple labs. Data from our labs accounts for nearly 40% of those results.

The Eurofins Eaton Analytical Labs (EEA) have analyzed ~10,000 UCMR3 samples from across the country. Much of those data are not yet in NCOD.

Expect another data release from EPA sometime soon.

Data in the Current NCOD

- ~1900 unique public water systems (PWS) (~1/3 of total) and ~11,000 List 1 entry point (EP) samples (~6,000 sites)
- ~370 unique List 2 PWS and ~3,500 List 2 EP samples (~1900 sites)
- ~3,700 Maximum residence time sites
- ~2400 completed List 1 ground water (GW) sites (two sample events) ~55% of the ones with any data in NCOD
- ~540 completed List 1 surface water (SW) sites (four sample events) ~ 34% of the ones with any data in NCOD

Bottom Line

- There is already a lot of data available.
- Overall patterns of occurrence have **not changed** that much since the first NCOD data release.

% of PWS with Detects			
Contaminant	**10-13 release**	**1-14 release**	**4-14 release**
1,4-dioxane	19%	19%	20%
PFOS	1.5%	1.6%	1.8%
Vanadium	75%	77%	74%
Hex Chrome	89%	90%	90%
Testosterone	4%	5%	4.6%

Lets Start Looking at the Data

- How Can We Sort Through It?

- Overall frequency by count/by PWS
- Comparison to Health Reference Levels (HRLs)
- GW sources vs SW sources
- Entry Points (EP) vs Max Residence Time (MR)
- By Disinfectant Type
- Geographic Patterns
- Hex Chrome vs Total Chrome

But Not All Those Sorts Are Relevant

Category	Metals	ClO3	Cr6+	VOCs	PFCs	Dioxane	Hormones
Overall by count	✓	✓	✓	✓	✓	✓	✓
Overall by PWS	✓	✓	✓	✓	✓	✓	✓
Compared to HRL	✓	✓	✓	✓	✓	✓	✓
EP vs MR	✓	✓	✓				
GW vs SW	✓		✓			✓	✓
Disinfectant Type		✓	✓				
Geography	✓			✓	✓		✓
Cr6+ vs Tot Chrome			✓				

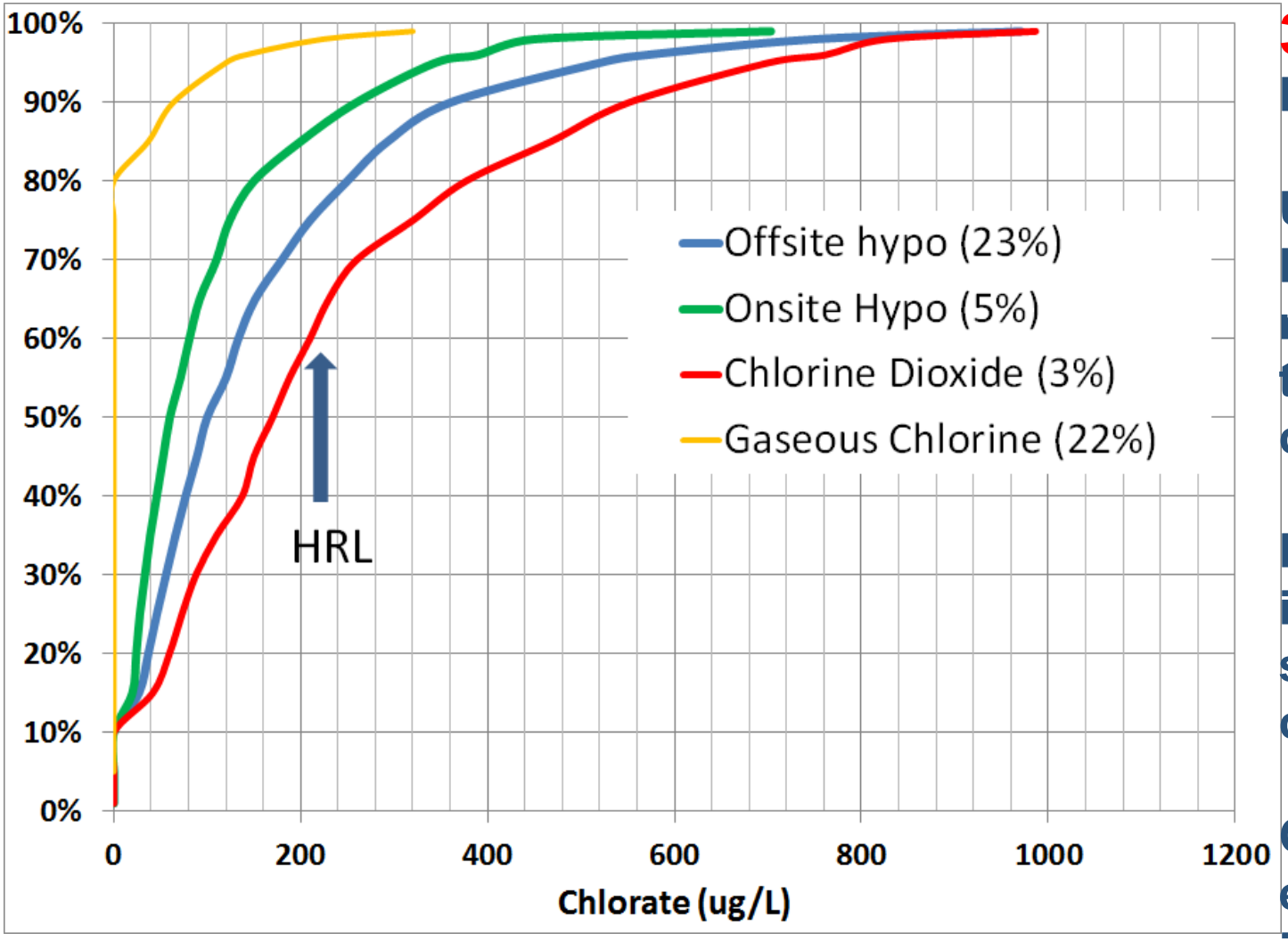
What's Frequent Overall?

Contaminant	% of results ≥MRL	% of total results >Reference Concentrati	% of PWSs with results ≥MRL	% of PWSs with results >Reference Concentration
1,2,3-trichloropropane	0.9%	0.9% / 0.7%₂	1.7%	1.7% / 1.4%₂
1,3-butadiene	0.0%	0.009% / 0%₂	0.1%	0.05% / 0%₂
Chloromethane	0.7%	0.07% / 0%₂	2.2%	0.3% / 0%₂
1,1-dichloroethane	3.0%	0% / 0%₂	4.7%	0% / 0%₂
Bromomethane	0.3%	0%	1.1%	0%
HCFC-22	2.2%	- -	5.1%	- -
Halon 1011	2.0%	0%	5.6%	0%
1,4-dioxane	11.7%	3.5% / 0%₂	20.2%	6.8% / 0%₂
Vanadium	62.8%	2.9%	74.2%	3.4%
Molybdenum	43.2%	0.24%	51.7%	0.7%
Cobalt	1.3%	0.02%	4.6%	0.2%
Strontium	99.3%	0.4%	100.0%	1.0%
Chromium	48.7%	0%	70.3%	0%
Chromium-6	76.2%	- -	90.0%	- -
Chlorate	57.0%	15.8%	69.4%	35%
PFOS	0.8%	0.07%	1.8%	0.3%
PFOA	0.9%	0%	1.9%	0%
PFNA	0.1%	- -	0.2%	- -
PFHxS	0.6%	- -	1.1%	- -
PFHpA	0.6%	- -	1.5%	- -
PFBS	0.0%	- -	0.1%	- -
17β-estradiol	0.0%	0% / 0%₂	0.0%	0% / 0%₂
17α-ethynylestradiol	0.0%	0%	0.3%	0%
Estriol	0.0%	0%	0.3%	0%
Equilin	0.0%	0%	0.0%	0%
Estrone	0.0%	0%	0.0%	0%
Testosterone	0.5%	- -	4.6%	- -
4-androstene-3,17-dione	0.5%	- -	3.2%	- -

Analytes in yellow – frequently occurring, but natural or not at significant levels.

Analytes in red – frequently occurring and/or significant number of samples/ PWS over the HRL.

ClO3 is Present at Significant Levels (above HRL) in > 15% of Samples Nationwide



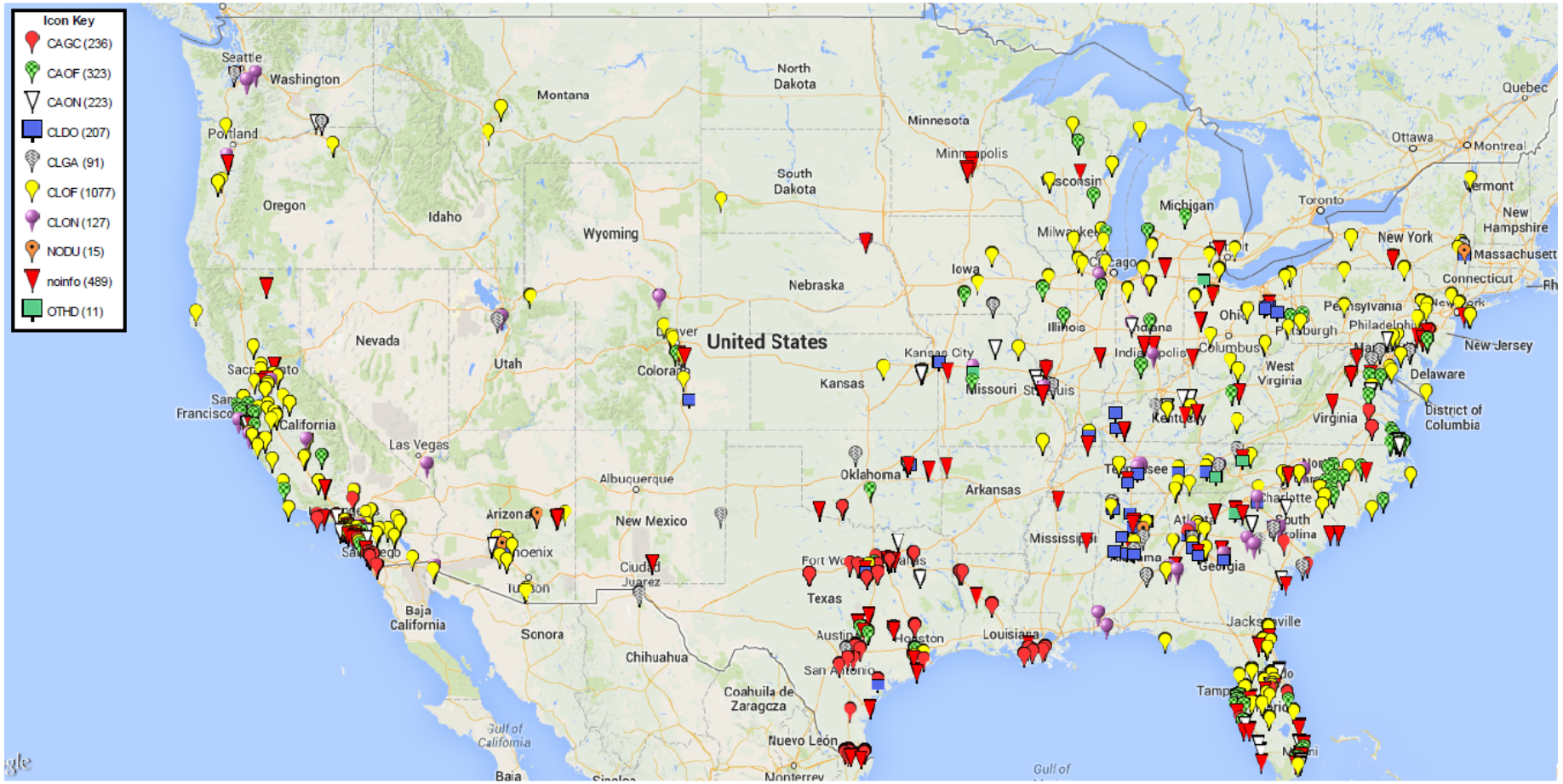
35% of PWS EXCEED the HRL.

Utilities are using hypochlorite more frequently than gaseous chlorine.

Bulk hypochlorite is a significant source of chlorate.

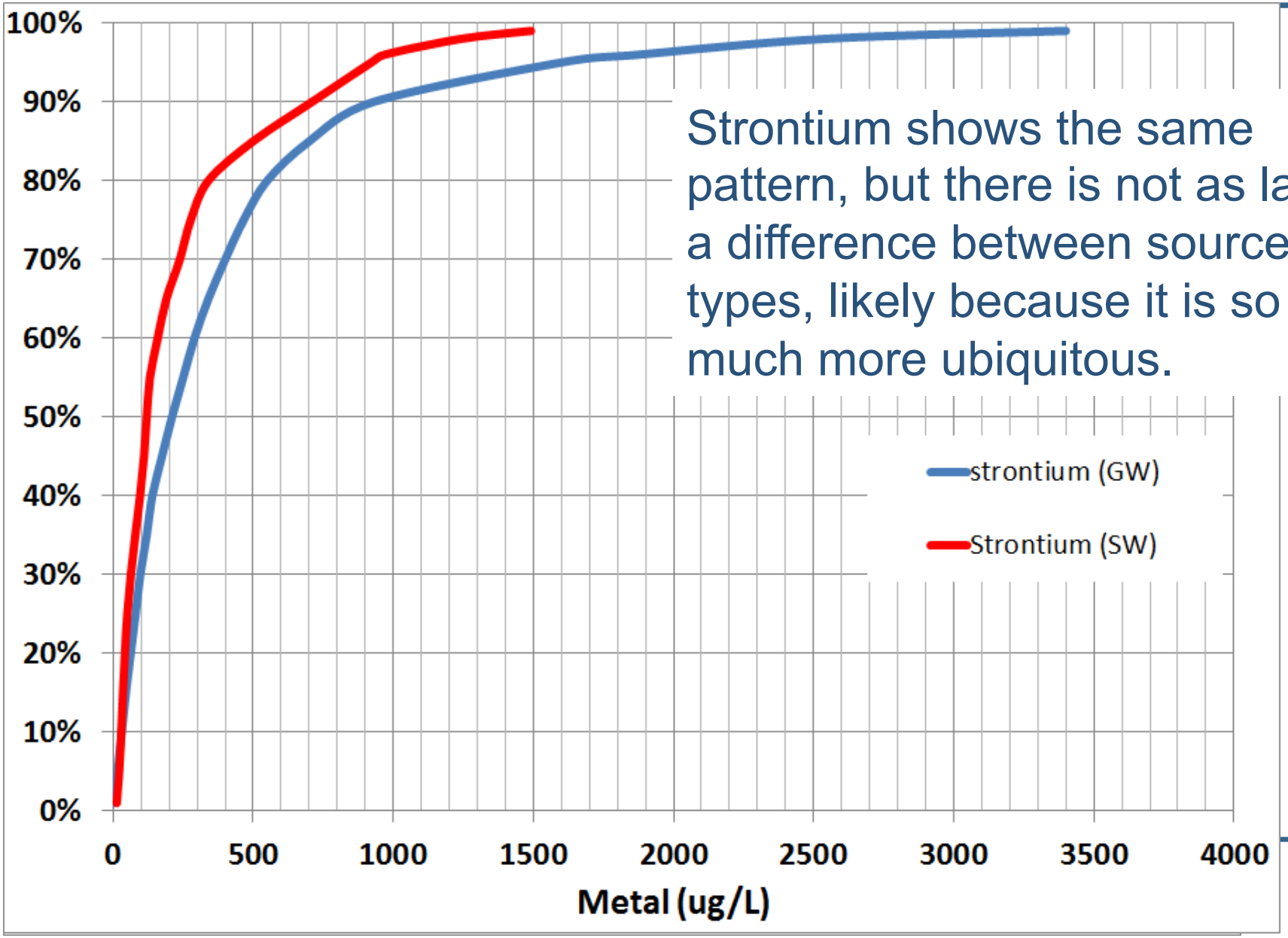
Chlorate can be easily controlled in bulk hypo.

High Chlorate Values Are Not Restricted to Warm Climate Areas



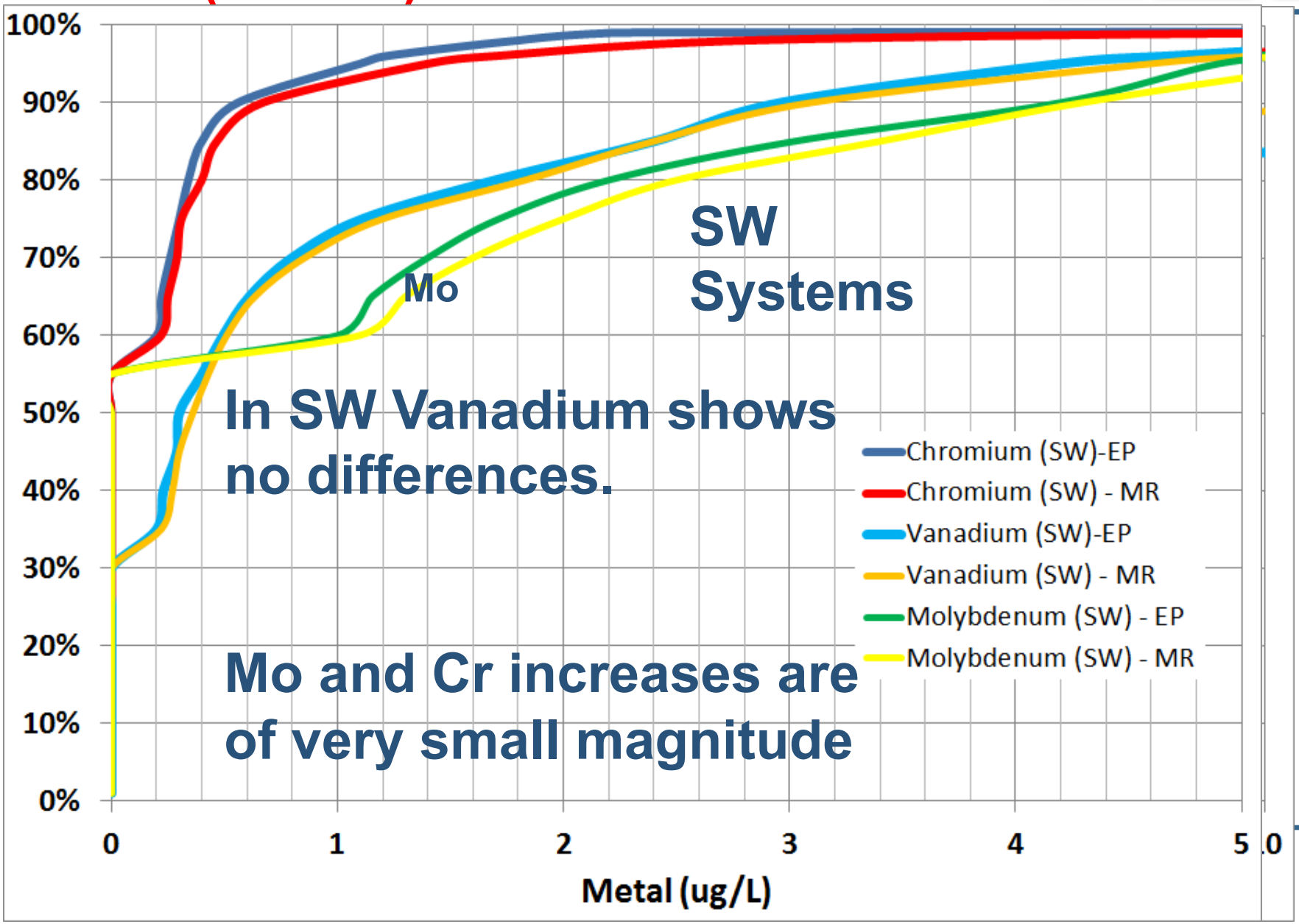
As an aside, there are a lot of data points in the database that have “no information” on disinfectant type.

Metals are Much More of a Groundwater Issue Than a Surface Water Issue

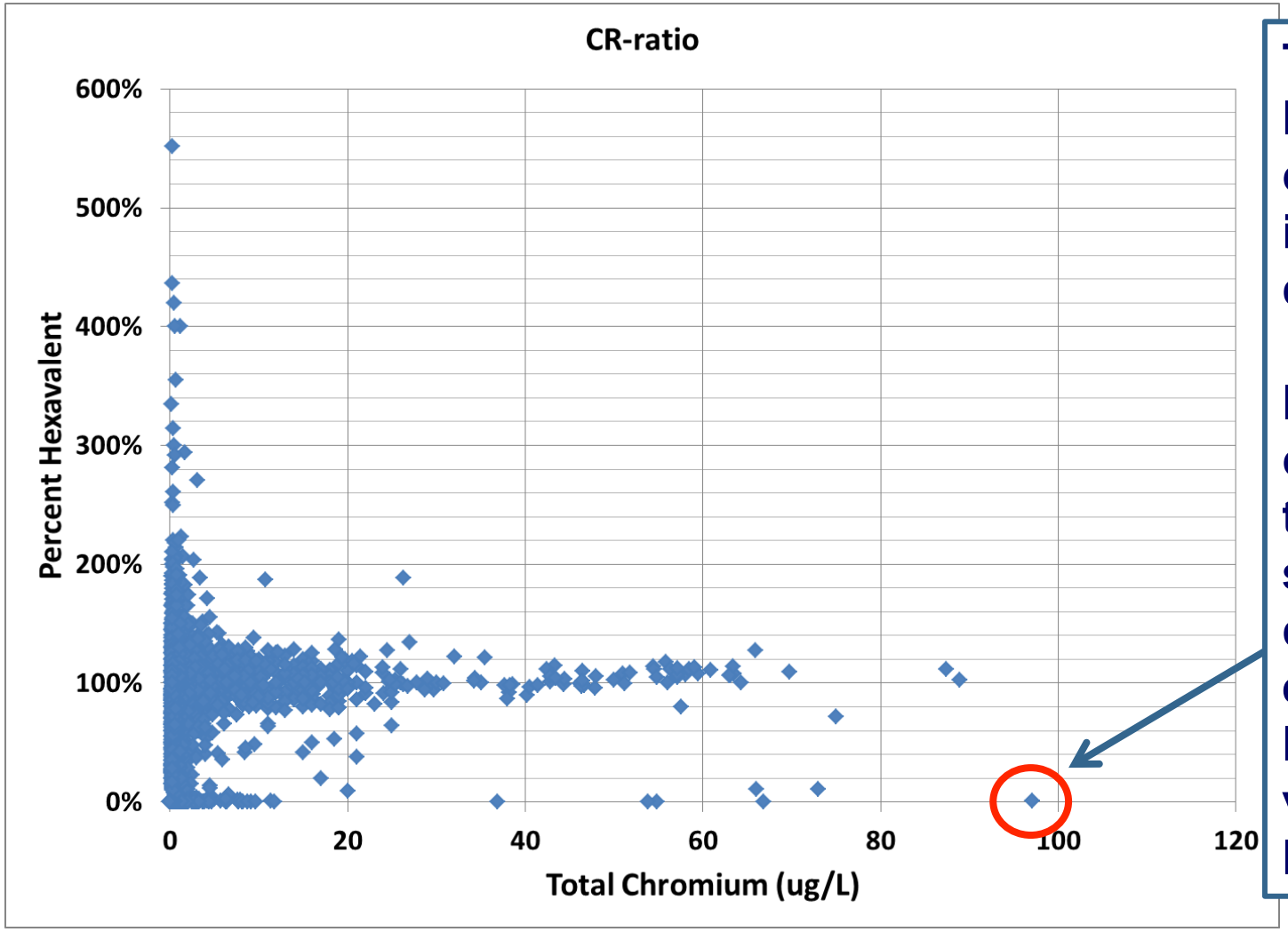


Strontium shows the same pattern, but there is not as large a difference between source types, likely because it is so much more ubiquitous.

Metals Changes from EP to MR are Subtle (at Best)



Other Than at Very Low Levels, Chromium is Predominantly Cr (VI)



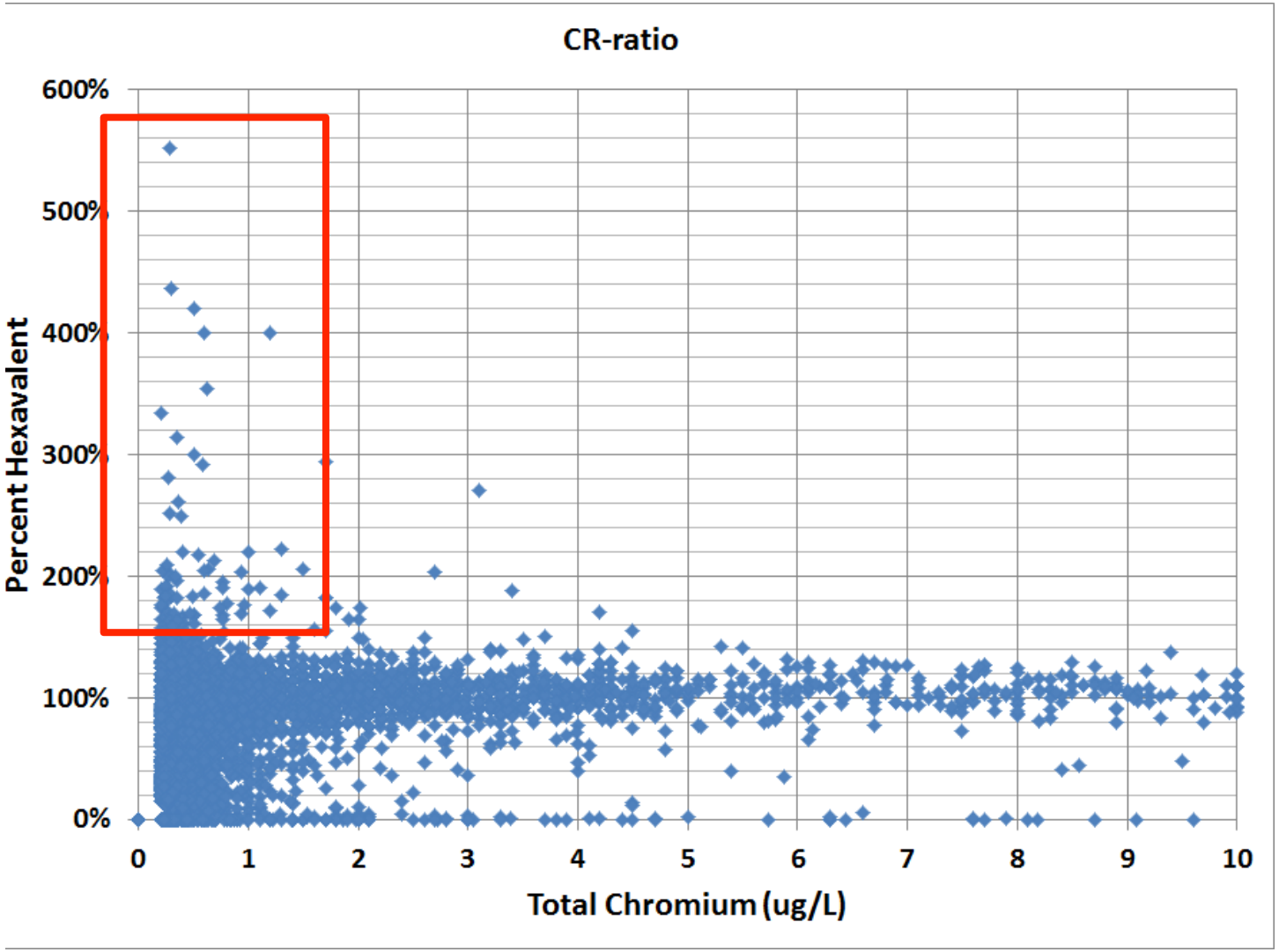
There are, however, cases that indicate poor data review.

In those cases, close review of the data suggests a data entry error by the lab and the value is more likely 0.97 ppb.

At Low Cr-T Concentrations There Are Some Analytical Issues

The hexavalent chromium method (218.7) is much more rugged at low levels than the total chromium method.

This suggests that even with sample digestion there may be biases associated with total chromium measurements at sub ppb levels.



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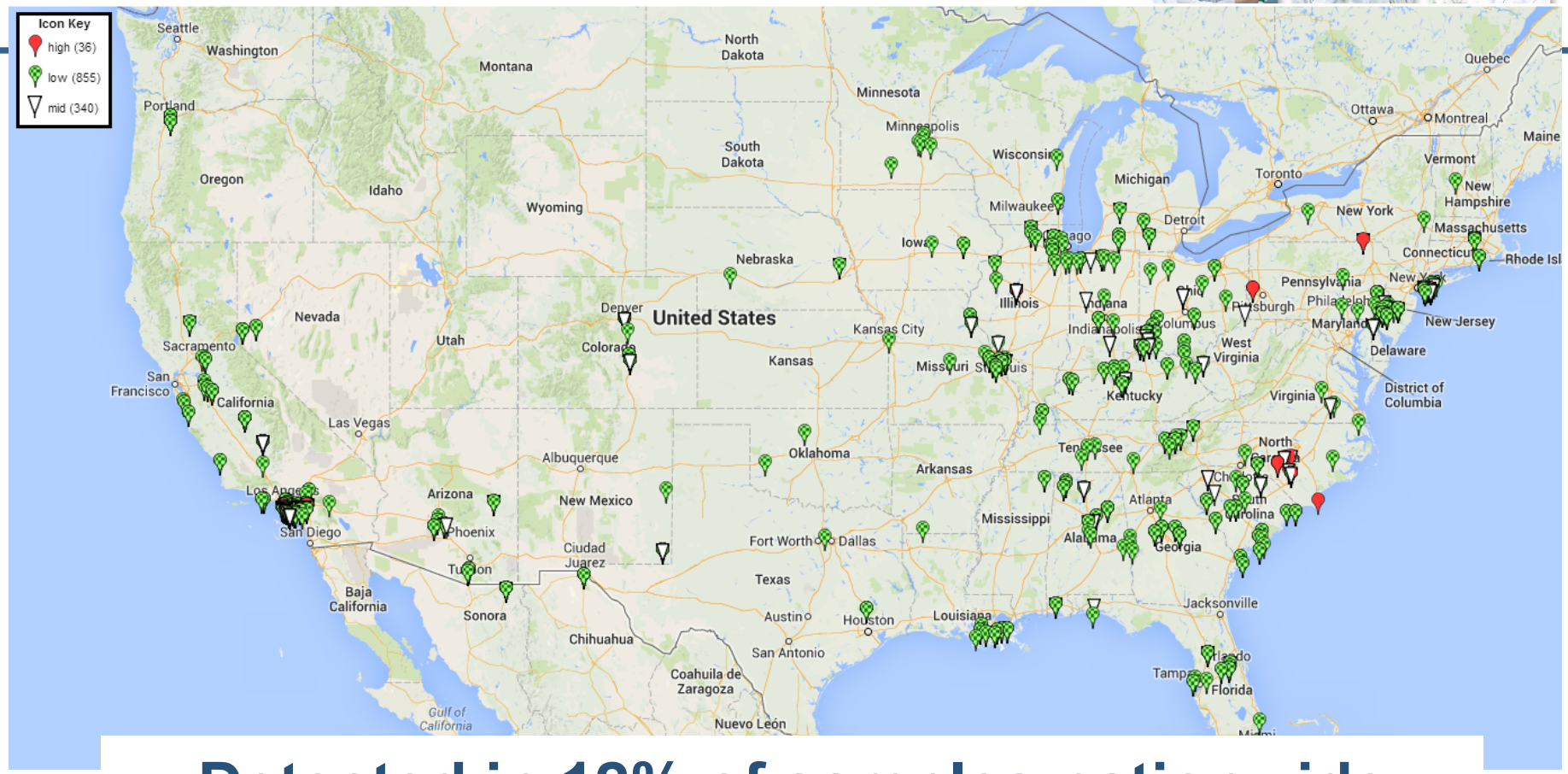
1,4-Dioxane is Widespread

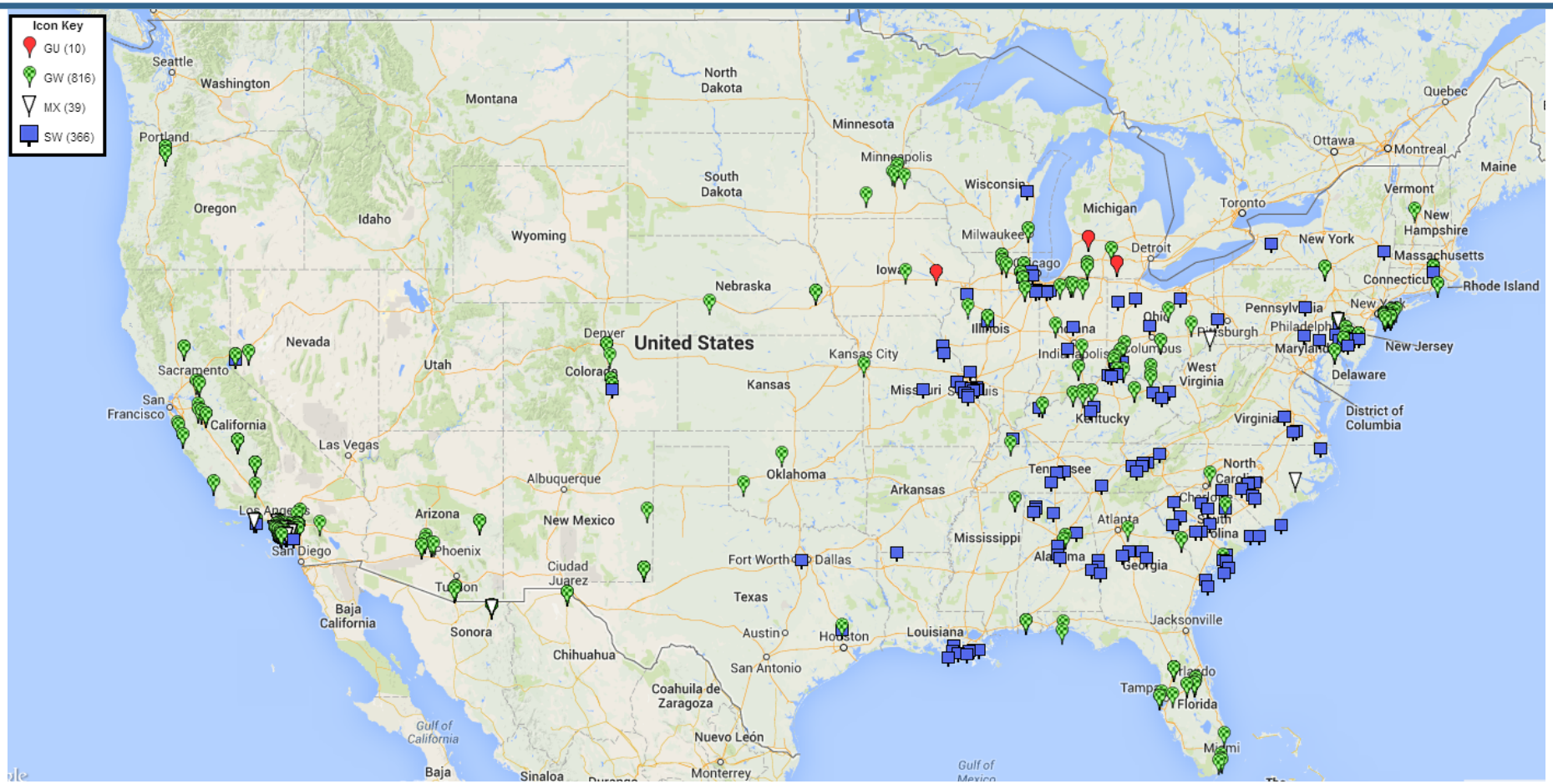


Detected in 12% of samples nationwide

~3% exceed the 0.35 ug/L HRL

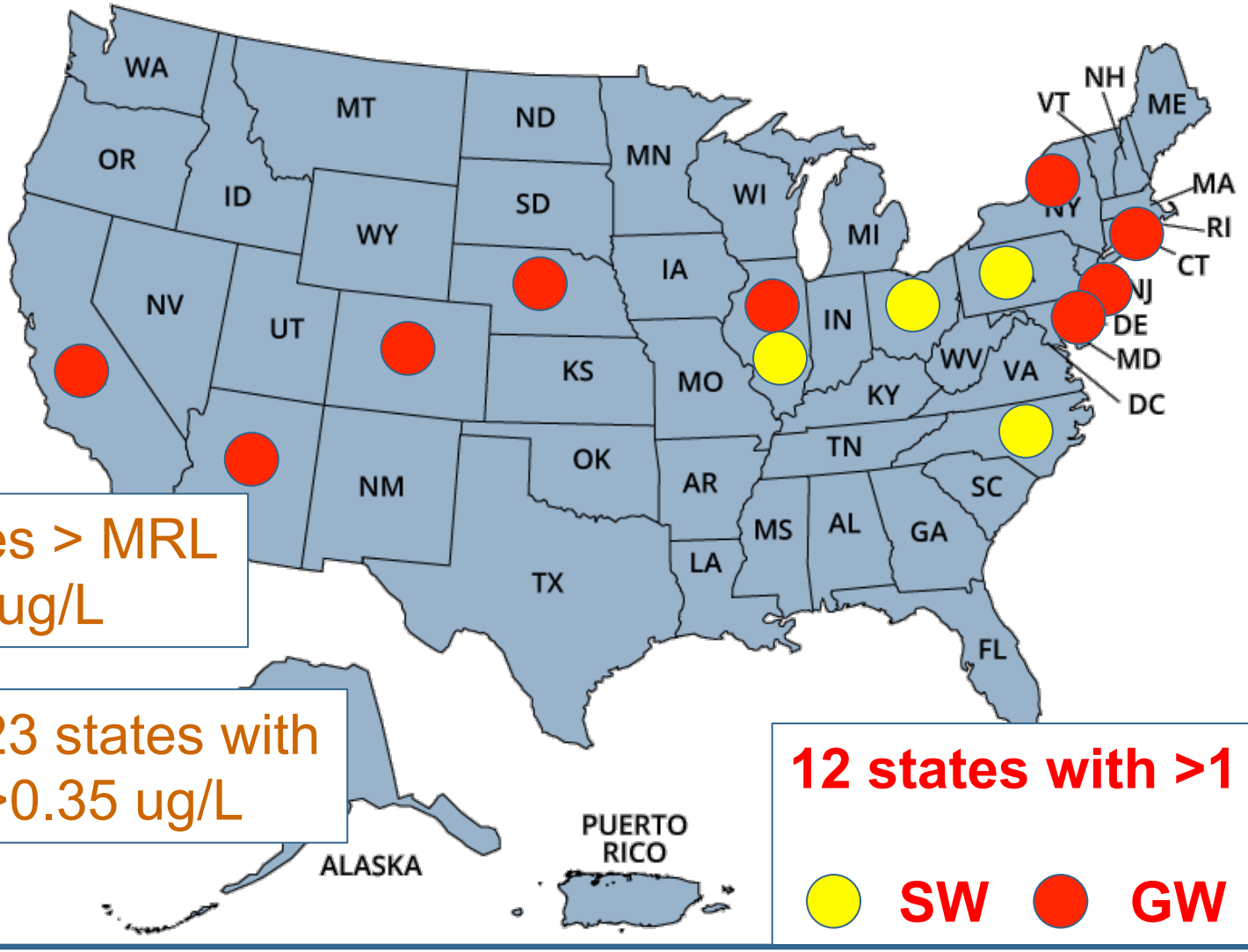
~1% exceed a 10^{-5} risk level of 3.5 ug/L

1,4-Dioxane is Both a GW and SW Issue



Most of the surface water hits are in the Southeast (textile mills?)

Where Are We Finding High Levels of 1,4-Dioxane?



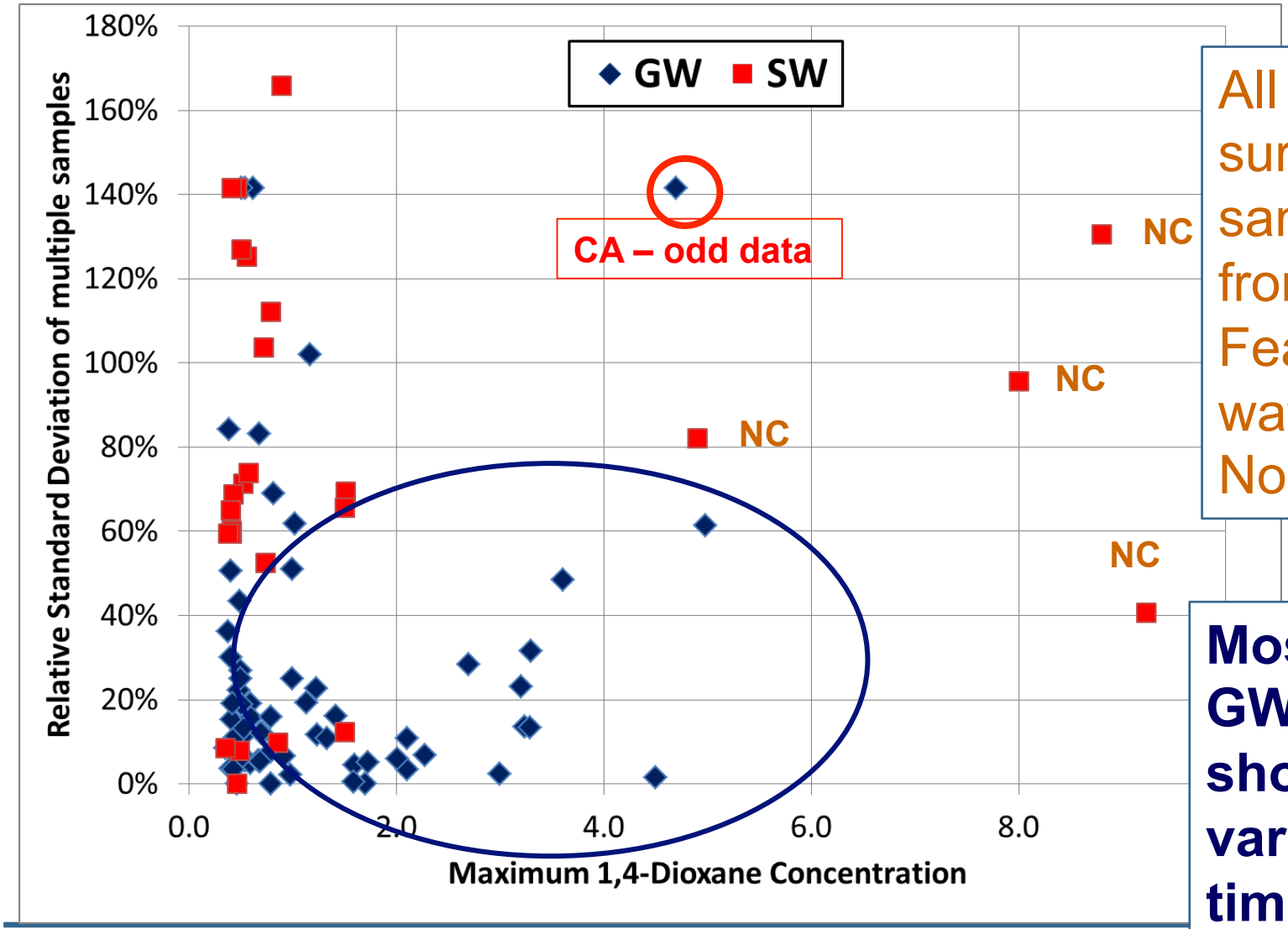
35 states > MRL of 0.07 ug/L

23 states with >0.35 ug/L

12 states with >1 ug/L

SW **GW**

Variability of 1,4-Dioxane Over Time – Results of Multiple Sample Events



All of the high surface water samples are from the Cape Fear River watershed in North Carolina.

Most of the GW sources show minimal variation over time, as would be expected.

Volatile Organic Compound Occurrence

- Overall, about 5% of samples have 1 or more VOC detections **(minimal co-occurrence)**
- As expected, almost all the hits are GW samples.
- Most common detections:
  - 1,1-DCA (3%)
  - **Chlorodifluoromethane** aka **HCFC-22 (2.2%)**
  - **Bromochloromethane** aka **Halon 11 (2.0%)**

What About 1,3-Butadiene and 1,2,3-TCP?

- 1,3-Butadiene is a potent carcinogen.
  - One (1) hit out of ~11,000 samples
- 1,2,3-TCP is a potential driver for the Carcinogenic Votatile Organic Compound (CVOC) Rule.
  - Only 100 hits (96 GW) (1.3% of sites)
  - Only 7 states with detections (AL, HI, NY, NJ, CA, CT, PA)
    - HI and NY have a high percentage of sites with hits (>10%).
    - CA, where TCP is "on the radar" only has ~4% of sites with hits.
    - TCP concentrations are relatively stable over multiple events.
  - But note that any hits are automatically over the HRL.

Perfluorinated Compounds(PFCs) Detections are Infrequent (N ~11,000)

Compound	Frequency of Detection as % of samples		% PWS w Hits	99th % conc	Max conc (ug/L)	HRL
PFOS	0.8%		1.8%	ND	0.93	0.4
PFHxS	0.6%		1.1%	ND	0.44	--
PFHpA	0.6%		1.5%	ND	0.07	--
PFOA	0.9%		1.9%	ND	0.29	0.2

Detections in ~ 20 states; not necessarily consistent hits over time.

Many of the hits are non-CCL3 PFCs (only PFOA and PFOS are on the CCL3 list).

~9600 unique sample points

~ 1900 PWS

Perfluorinated Compounds Are Localized

PFOS is Most Common (and has an HRL)

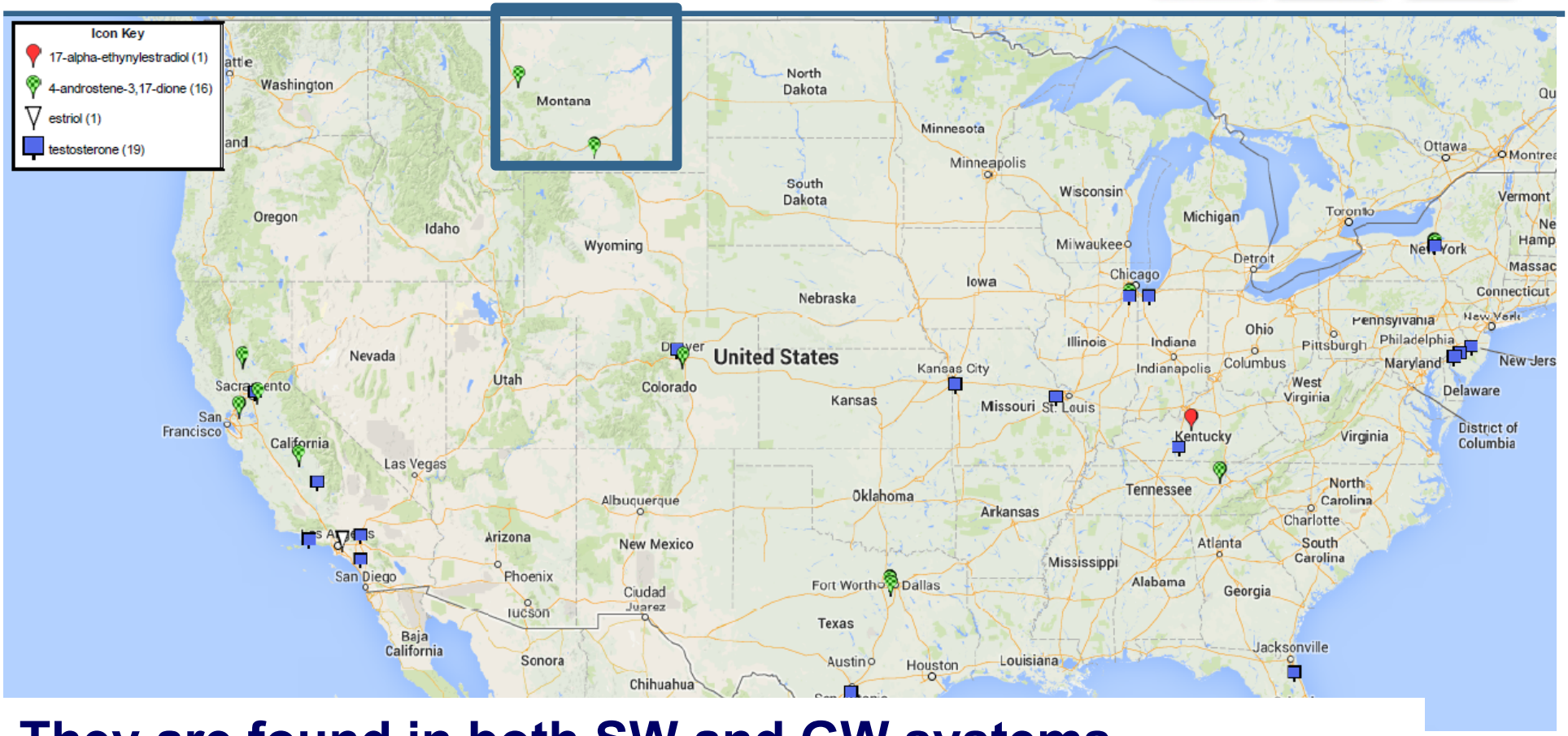
75% of the PFC hits are from ground water sources, so there are still a fair number of SW detections.

What About the Hormones?

- ~3,500 samples (but only 370 PWS, 1900 sites)
  - 37 hits—maximum values from 1 to 5 part per trillion
    - 4-androstene-3,17-dione (16 hits) max 0.00189 µg/L
    - Testosterone (19 hits) max 0.0053 µg/L
    - 17-alpha-ethynylestradiol (2 hits) max 0.0015 µg/L
    - estriol (1 hit) max 0.0011 µg/L

Neither of the most frequently detected analytes are on the CCL 3 List.

Hormones Are Very Infrequent (Only 11 States), But Some Unexpected Areas



They are found in both SW and GW systems.

Geographically there is no pattern.

Most of the hormone data seem to be one time hits (e.g. very problematic)

How Should Utilities Communicate All These Results?

- UCMR 3 requires that results be included in the annual CCR.
  - But no provision for comparison to HRLs
- EPA has very minimal communication material.
  - Focus on “reference levels” in data releases
- How should utilities keep customers informed?
  - Go beyond the minimum. Knowledge minimizes concern and questions.

There Are Already a Few Examples of Strategies

- Fairfax County Water Authority
  - Maximize availability of data
- Fayetteville, NC
  - Make the data easily available but no frame of reference for customers
- Spartanburg SC
  - Share and put in context

Fairfax County Tries to Put it All Out There

Water Quality - Fairfax Water Service Area

- Annual Report on Water Quality
- Water Quality Analytical Reports
- Facts About Lead
- Fluoride
- Chromium
- Emerging Water Quality Issues
- Emerging Compound Test Results Tables - 2008, 2009, 2010
- Emerging Compound Test Results Tables - 2011
- Emerging Compound Test Results Tables - 2012
- Emerging Compound Test Results Tables - 2013
- Student Projects
- FAQs
- The Occoquan Reservoir Shoreline Easement Policy
- Source Water Assessment Program (SWAP)
- Grants
- Conservation
- Water Wise Landscaping & Watering Guide
- How We Treat Water
- Uranium Mining

Fairfax Emerging Contaminants Information Is Easily Searchable

What is found in your water?

Listed below are some common compounds that may be found in the source and drinking water. While some contaminants were found in the source water, only a few were found in the treated drinking water. In these cases, the levels detected were well below acceptable levels.

How to interpret the symbols for each compound...

- Not Detected in Source or Drinking Water
- Exceeds Acceptable Limit
- Detected in Source Water
- Detected in Drinking Water
- Detected in Source and Drinking Water

Compound *What is it?*	2010 Q1	2010 Q2	2010 Q3	2010 Q4	2011 Q1	2011 Q2	2011 Q3	2011 Q4	2012 Q1	2012 Q2	2012 Q3	2012 Q4	2013 Q1	2013 Q2	2013 Q3	2013 Q4	For Drinking Water: Maximum Detected (µg/L)	For Drinking Water: Acceptable Daily Intake Concentration (µg/L)	Some Perspective...
17b-estradiol *Natural human hormone*	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	Not Detected	1.8	-
2,4-D *Herbicide*					◐	◐	◐	◐	◐	◑	◐	◐	◐	◐	◐	◐	0.095	70	Over 6,200 Glasses
Atrazine *Commonly used herbicide for maize crops*	○	◐	◑	○	○	◐	○	○	○	◑	◑	○	○	◑	◑	○	0.3	3	Over 84 Glasses
Bisphenol A *Intermediate in manufacture of plastics and resins*	○	◐	○	○	○	○	○	○	○	○	○	○	○	○	○	○	0.025	1,800	Over 600,000 Glasses

Shares all the data on the FCWA website AND puts it in context for customers

Fairfax County – UCMR3 Data Are NOT as Useful (Yet)

Data On the Website, but no discussion of meaning of HRL

Components Detected in 2013 UCMR3 Monitoring

Components (ppb)	Average	Minimum	Maximum	Use or Environmental Source*
Molybdenum	0.20	ND	1.7	Naturally occurring element found in ores and present in plants, animals, and bacteria; commonly used form molybdenum trioxide used as a chemical reagent.
Strontium	123	42	180	Naturally occurring element; historically, commercial use of strontium has been in the faceplate glass of cathode-ray tube televisions to block x-ray emissions.
Vanadium	0.61	0.36	0.76	Naturally occurring elemental metal; used as vanadium pentoxide, which is a chemical intermediate and a catalyst.
Hexavalent Chromium or Chromium-6	0.11	0.09	0.18	Naturally occurring element; used in making steel and other alloys; chromium-3 or -6 forms are used for chrome plating, dyes and pigments, leather tanning, and
Chlorate	237	180	400	and used in production of chlorine dioxide

No discussion of this compared to HRL (but not allowed in CCR)

* "Use or Environmental Source" and "Health Effects" further documented in UCMR3 Contaminants Information Compendium, EPA 815-B-11-001, Jan. 2012

Fayetteville NC – Dioxane Hot Spot

The detailed data are there for all to see, but again, because it is the CCR, they can't put it in context.

Contaminant	Units	Sample Date	Sample Location	Result
1, 4-dioxane	ug/L	1/17/13 4/25/13 7/17/13 10/28/13	P.O. Hoffer P.O. Hoffer P.O. Hoffer P.O. Hoffer	7.961 8 1.39 0.155
Vanadium	ug/L	1/17/13 4/25/13	P.O. Hoffer P.O. Hoffer	- 0.74
Strontium	ug/L	1/17/13 4/25/13 7/17/13 10/28/13	P.O. Hoffer P.O. Hoffer P.O. Hoffer P.O. Hoffer	48 62 50 26
Chromium[1]	ug/L	7/17/13	P.O. Hoffer	0.3
Chromium-6[2]	ug/L	7/17/13 4/25/13 7/17/13 10/28/13	P.O. Hoffer P.O. Hoffer P.O. Hoffer P.O. Hoffer	0.035 0.038 0.089 0.033
Chlorate	ug/L	1/17/13 4/25/13 7/17/13 10/28/13	P.O. Hoffer P.O. Hoffer P.O. Hoffer P.O. Hoffer	110 94 190 230
Perfluoroheptanoic (PFHpA)	ug/L	1/17/13	P.O. Hoffer	0.01

Spartanburg, SC

How to frame the debate- On Their Website.

- From the EPA's total number of 30 contaminants listed on the UCMR3, only four were detected during Spartanburg Water's testing.
- Three of those elements—Vanadium, Strontium and Hexavalent Chromium—are naturally occurring in the environment. The fourth substance, Chlorate, is a by-product of an EPA-approved water treatment process that protects customers from bacterial and microbial contaminants.

Concentrations and Concepts.

- Vanadium levels were less than one part per billion.
- Strontium levels were at 40 parts per billion.
- Hexavalent chromium levels were at 0.5 parts per billion.
- An easier way to understand the concept of a "part per billion" is to consider it in the context of a few examples. A part per billion is also:
    - 1 penny in 10 million dollars
    - 1 second in 32 years

Spartanburg SC - Continued

More examples putting data in context.

Water systems around the country also reported results for these constituents.

- 1,430 out of 1,432 water systems who tested for Strontium reported a result.
- 1,100 out of 1,432 water systems who tested for Vanadium reported a result.
- 1,319 out of 1,462 water systems who tested for Hexavalent Chromium reported a result.
- 989 out of 1,449 water systems who tested for Chlorate reported a result.

No comments on the fact that chlorate exceeds HRL.

Parameter	Location	Units	Average	Range
Unregulated Contaminants (UCRM3) (2013)		*Only a single round of sampling completed in 2013.		
Strontium	R.B. Simms Plant Distribution System	ppb	29 32	NA*
Vanadium	R.B. Simms Plant Distribution System	ppb	0.29 0.26	NA*
Hexavalent Chromium	R.B. Simms Plant Distribution System	ppb	0.14 0.19	NA*
Chlorate	R.B. Simms Plant Distribution System	ppb	400 450	NA*

Conclusions

UCMR3 patterns of occurrence have not changed much as more data have been released.

We are seeing a lot more hits than we did in prior UCMRs.

There are a few “challenging” compounds.

1,4-dioxane and chlorate in particular

With the prevalence of hits utilities need be proactively communicating to their customers.

Any Questions?

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