UCMR3 – Results and Implications for UCMR4

Purpose of UCMR3

“To collect occurrence data for contaminants suspected to be present in drinking water but don’t have health-based standards set under the Safe Drinking Water Act (SDWA).”*

*EPA Fact Sheet EPA 815-F-12-003

UCMR3 – A LOT of Data

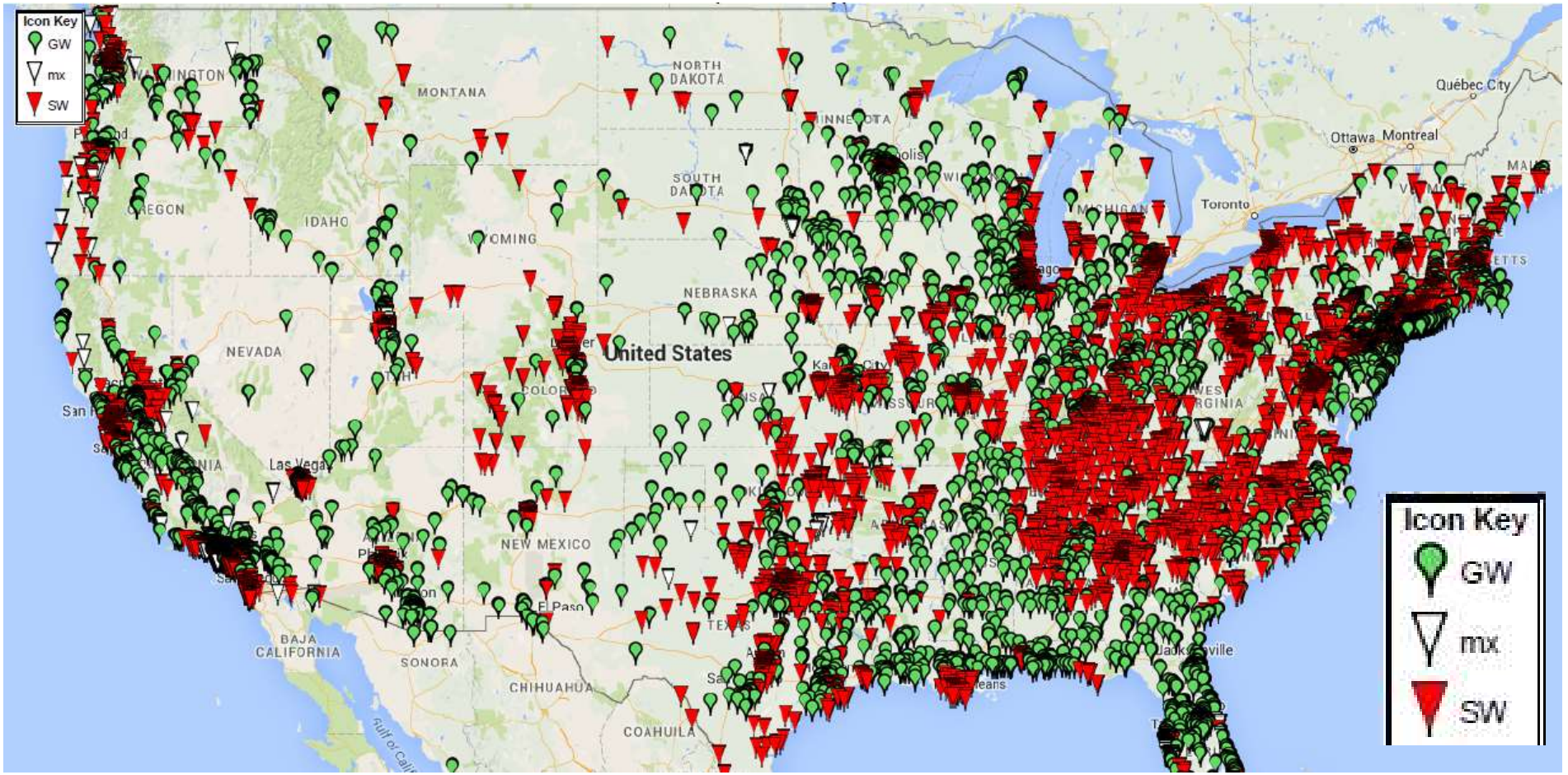
EPA is releasing data periodically: 10/13, 01/14, 4/14, 7/14, 10/14, 1/15, 6/15, 10/15, 1/16, 4/16 (~ Quarterly)

The NCOD, now represents ~60,000 samples (~35,000 entry point samples and 25,000 Maximum Residence time samples) from multiple labs. It is about 1,000,000 points. Data from our labs accounts for up to 40% of those results.

Represents about 4800 PWS for List 1 and about 1150 PWS for List 2.

So > 90% of the PWS that need to sample.

Data Represents a Good Mix of GW (3600) and SW (5000) PWS



Occurrence Frequency is Not Changing as More Data Are Published.

- **Overall patterns of occurrence have not changed that much since the first NCOD data release.**

% of PWS with Detects									
Contaminant	**10-13**	**1-14**	**4-14**	**7-14**	**10-14**	**1-15**	**6-15**	**1-16**	**4-16**
1,4-dioxane	19%	19%	20%	20%	20%	20%	21.5%	21.8%	21.9%
PFOS	1.5%	1.6%	1.8%	1.6%	1.8%	1.9%	2.0%	1.9%	1.9%
Vanadium	75%	77%	74%	70%	72%	73%	72%	74%	74%
Hex Chrome	89%	90%	90%	87%	88%	88%	88%	89%	89%
Testosterone	4.0%	5.0%	4.6%	4.7%	5.0%	5.6%	4.7%	4.5%	4.9%

For assessing overall frequency of occurrence we don't need as many samples as we have.

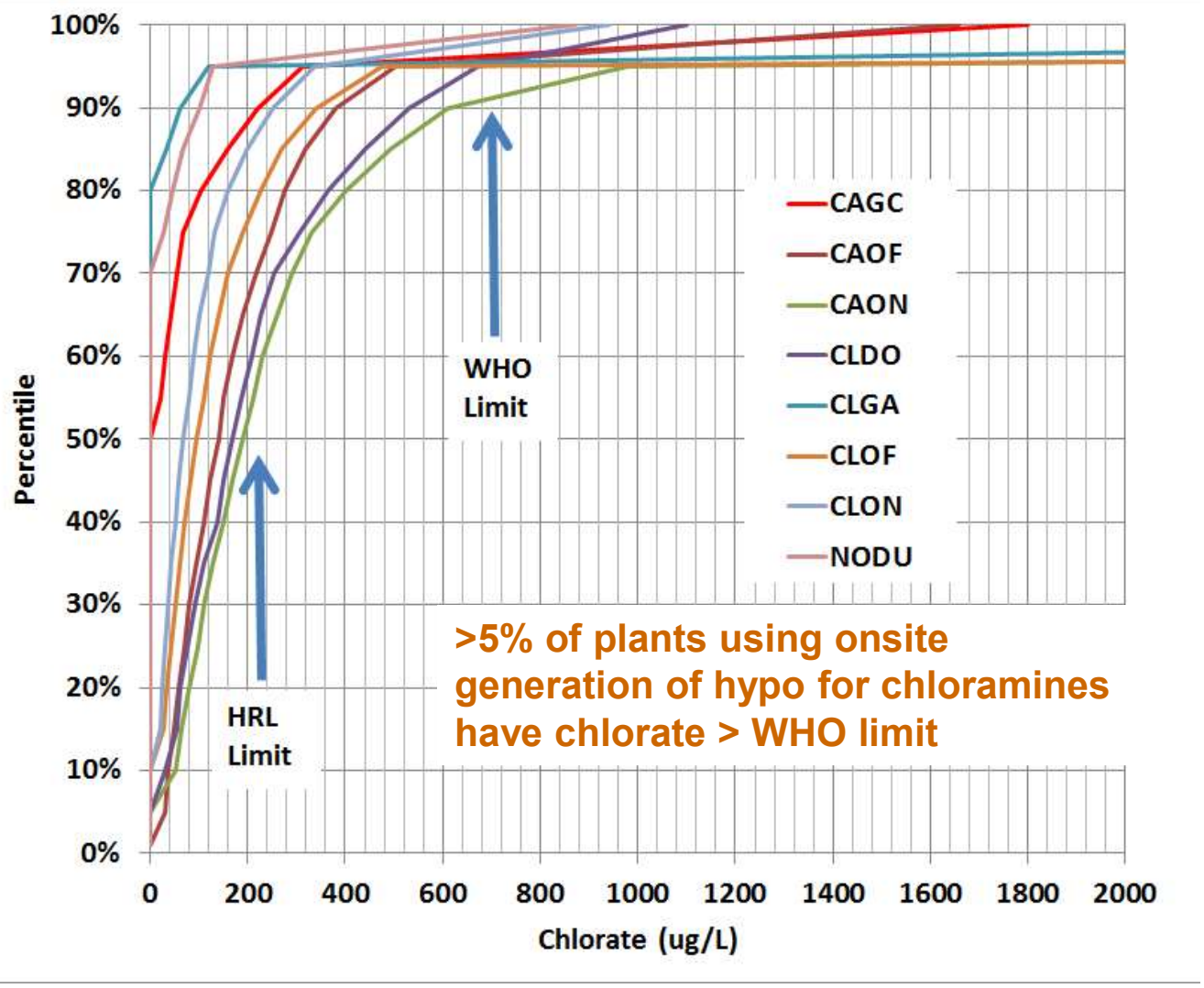
Out of 28 Chemical Contaminants, There are Only A Few With Significant Occurrence

Contaminant	% greater than MRL	% of total results >Reference Concentration	% PWS greater than MRL	% of PWSs with results >Reference Concentration
1,2,3-trichloropropane	0.7%	0.7% / 0.5%[1]	1.3%	1.3% / 1.1%[1]
1,1-dichloroethane	2.3%	0.003% / 0%[1]	5.0%	0.02% / 0%[1]
HCFC-22	2.3%	- -	5.8%	- -
Halon 1011	1.8%	0%	6.2%	0%
1,4-dioxane	11.6%	3% / 0%[1]	21.8%	7% / 0%[1]
Vanadium	60.0%	2.8%	73.6%	3.3%
Molybdenum	40.8%	0.2%	51.5%	0.7%
Strontium	99.7%	2.8%	100.0%	5.7%
Chromium	50.7%	0.002%	74.3%	0.02%
Chromium-6	75.5%	- -	89.3%	- -
Chlorate	55.2%	15.6%	68.7%	37.8%
Testosterone	0.5%	- -	4.5%	- -
4-androstene-3,17-dione	0.8%	- -	6.0%	- -

Infrequent occurrence does not however automatically mean that other compounds should be ignored. **Consider PFAS compounds.**

Yellow – frequently occurring, but natural or not at significant levels.
Red – frequently occurring and/or significant # of samples/PWS >HRL.

ClO3 is Present at Significant Levels in over 15% of Samples Nationwide



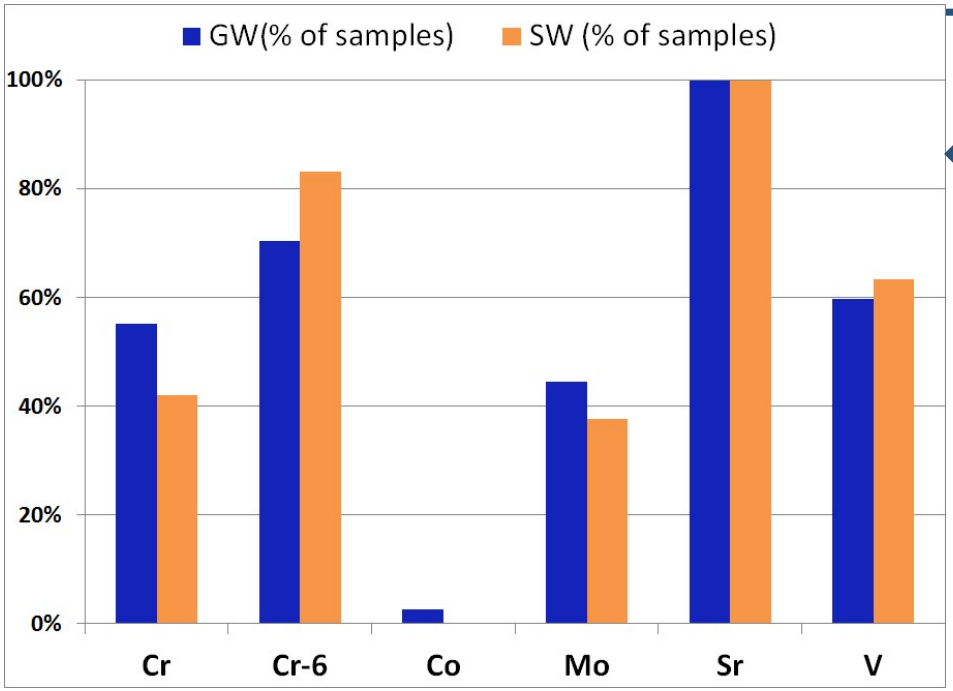
37% of PWS EXCEED the HRL (210 ug/L).

PWS are using hypochlorite more than gaseous chlorine post 9/11.

Bulk hypochlorite is a significant source of chlorate; but so is onsite generation.

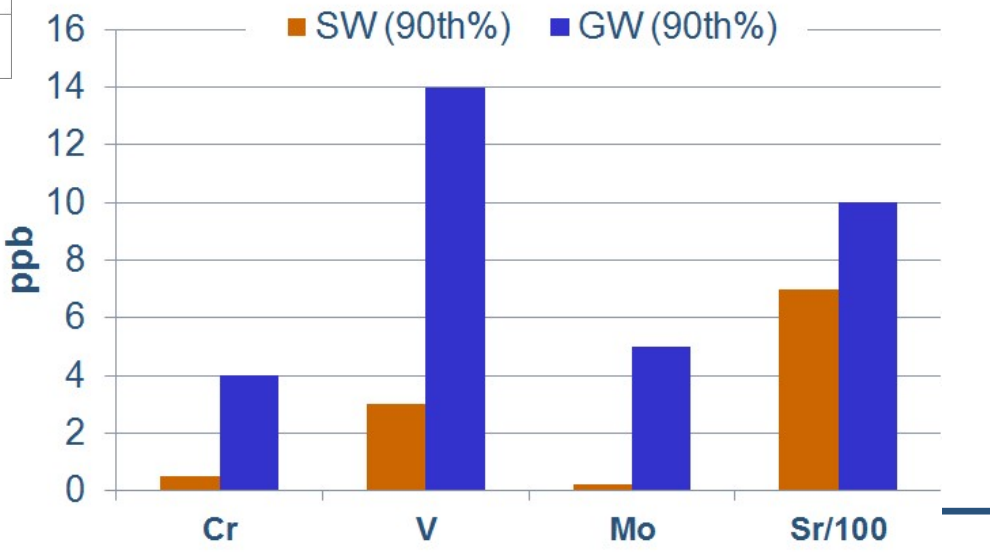
Chlorate can be easily controlled in bulk hypo.

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

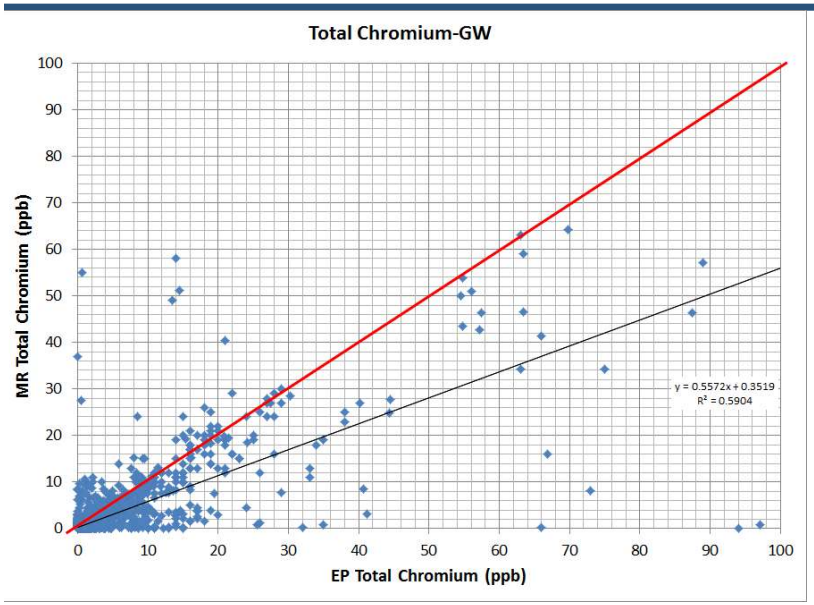


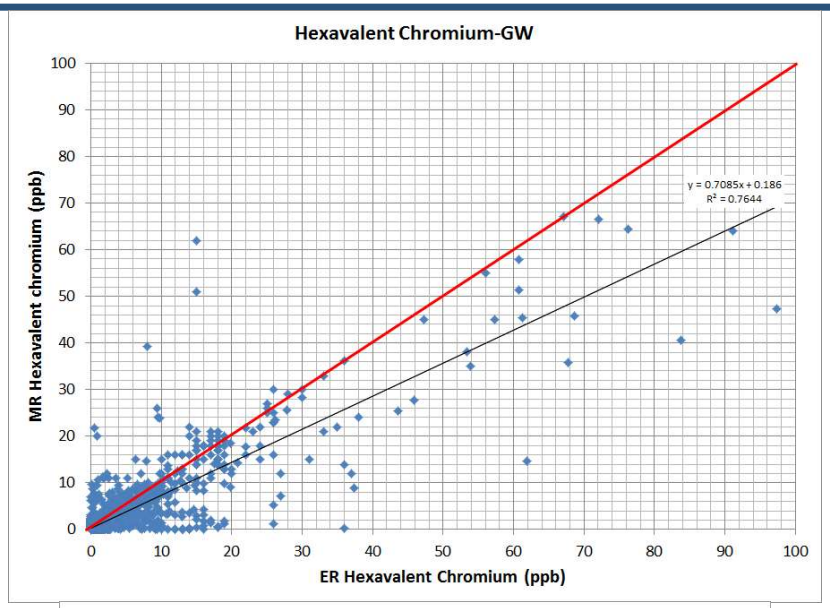
Although metals are detected almost as frequently in systems with surface water sources as in groundwater systems…

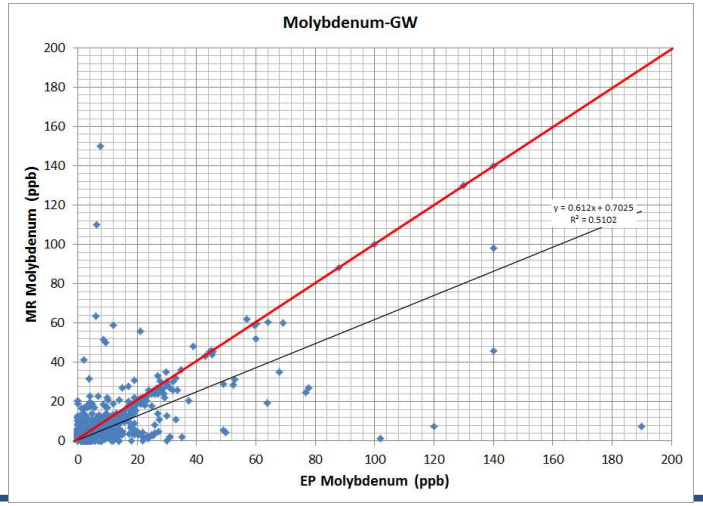
Concentrations tend to be significantly higher in systems with groundwater sources.

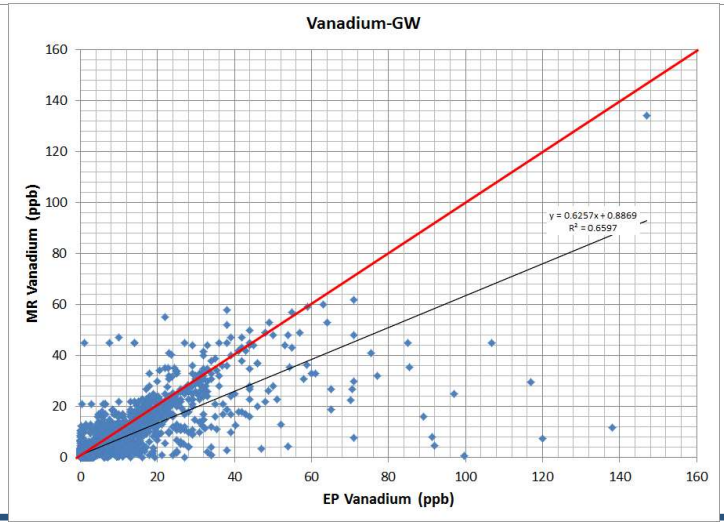


For GW Systems There is No Overall Systematic Change Between EP & MR

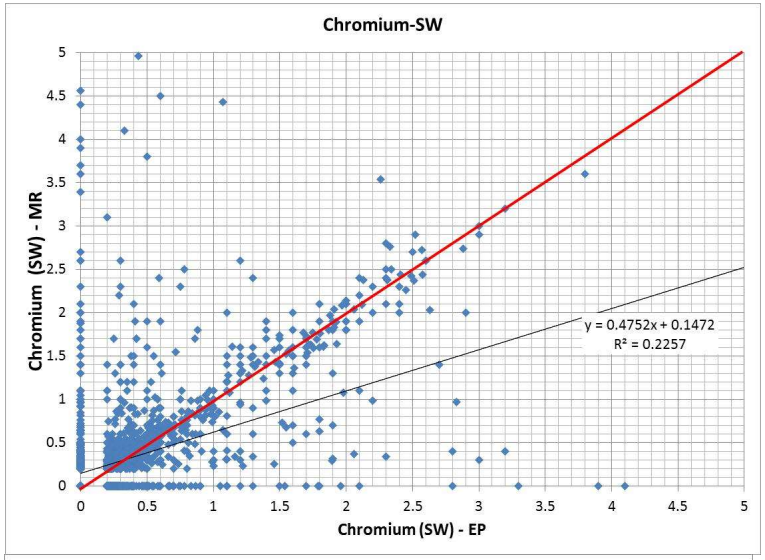


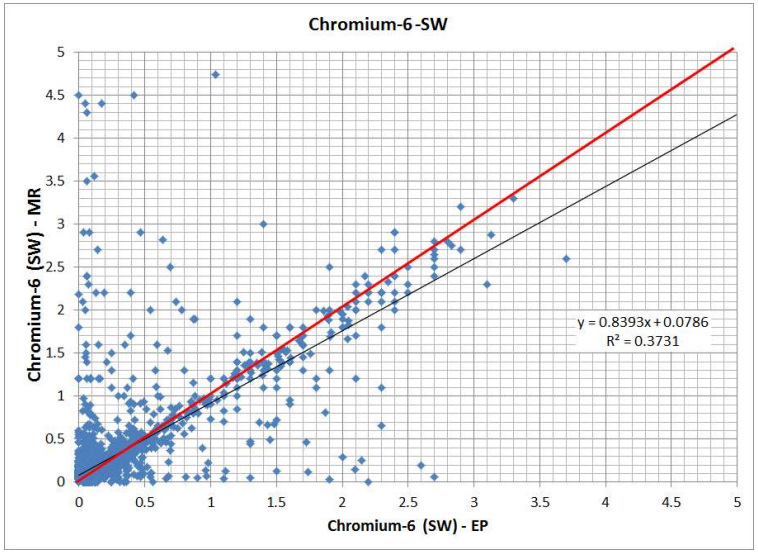


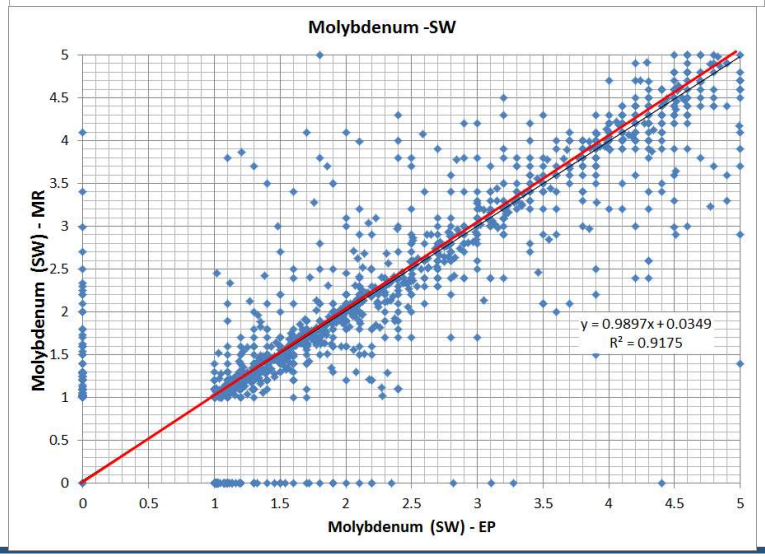


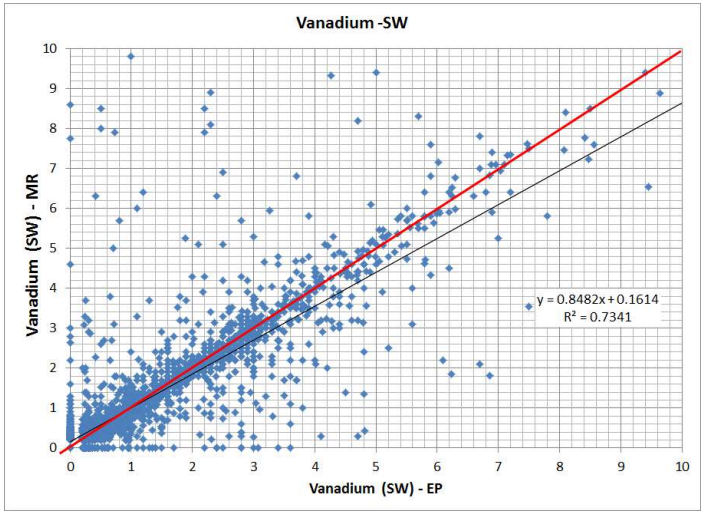


For SW Systems, with Lower Concentrations, There is Also no Overall Pattern of Changes

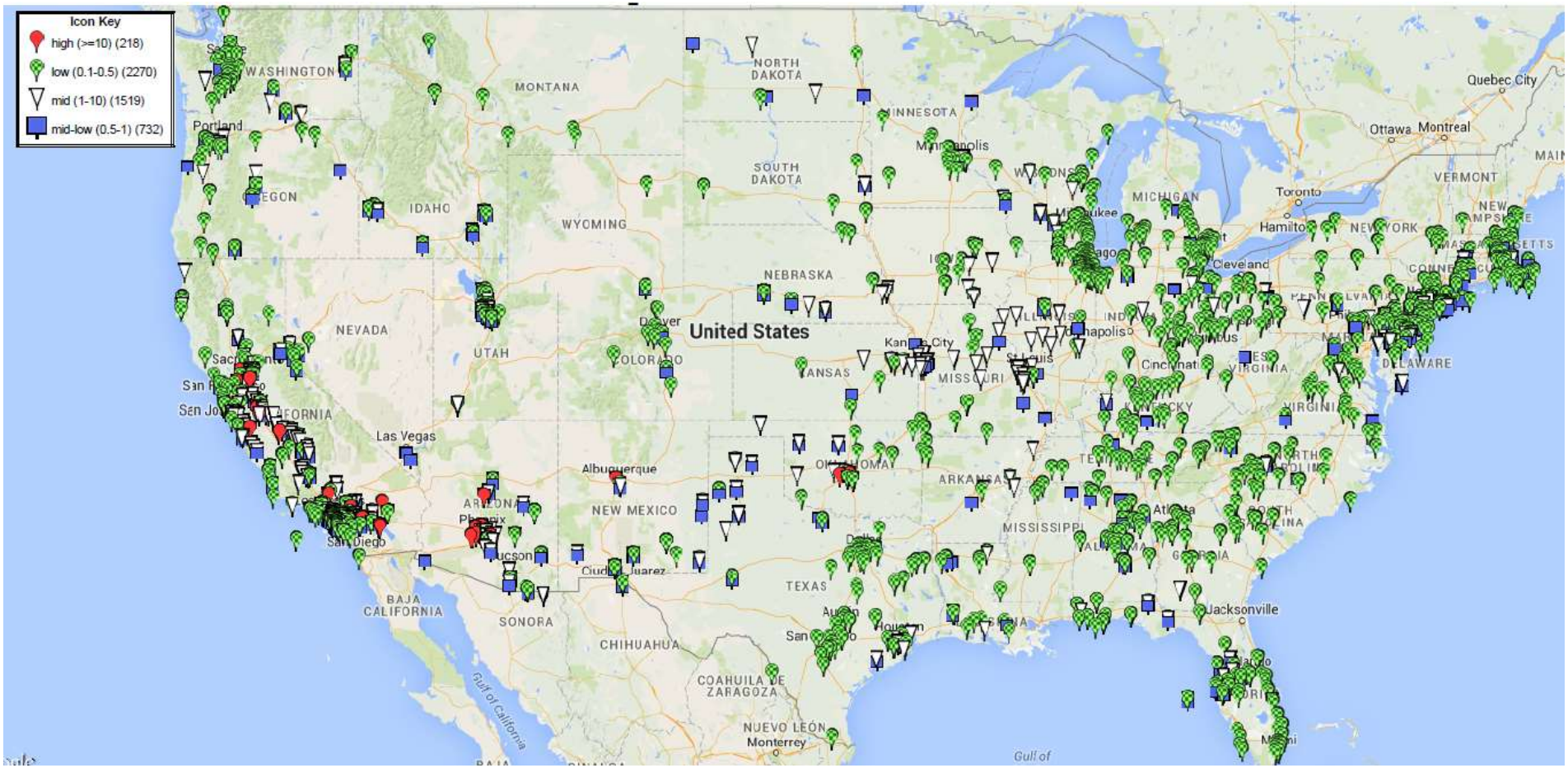








Hexavalent Chromium is Widespread, But High Values Are Isolated



Strontium Is “Regionally” High Compared to the HRL (1500 ug/L)

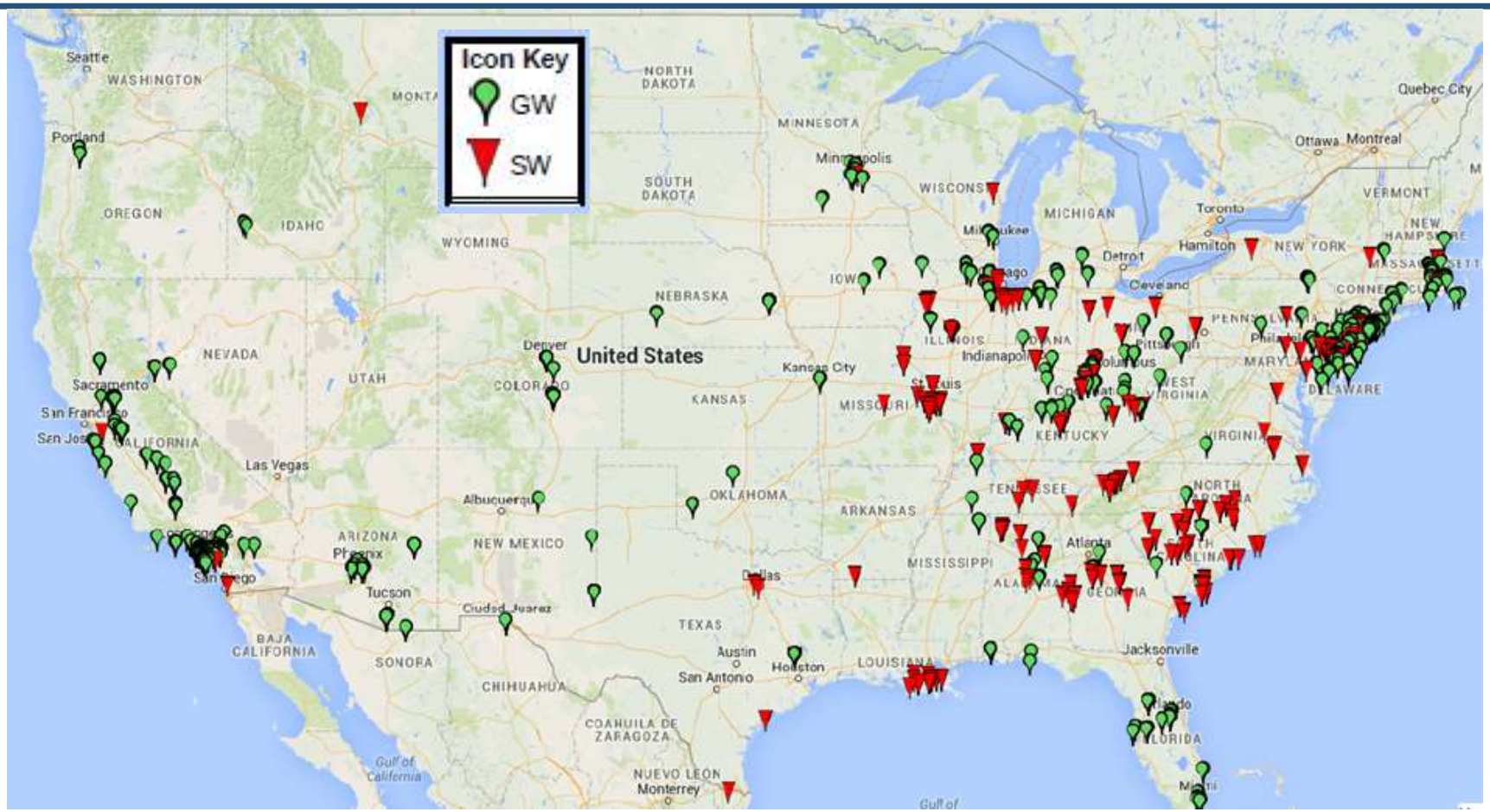
The lowest measured concentration is 10X the MRL.

1,4-Dioxane is Widespread, But High Values Are Clustered

Detected in 12% of samples nationwide

~3% exceed the 0.35 ug/L HRL

1,4-Dioxane Detections are Both a GW and SW Issue



Many of the surface water hits are in the Southeast and likely represent point sources

Sidebar – 1,4-Dioxane Concerns

- EPA listed as a probable carcinogen (B2)
- Highly miscible and mobile in groundwater (think MTBE)
- Not biodegradable
- Does not readily evaporate from surface waters
- Seems likely to be regulated at some point but at what level? (0.3 to 5 ug/L action levels already in place in some states)
- Will EPA prepare a health advisory for 1,4-dioxane????

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%)
  - 1,2,3-TCP (1.3%) – ALL hits are over HRL

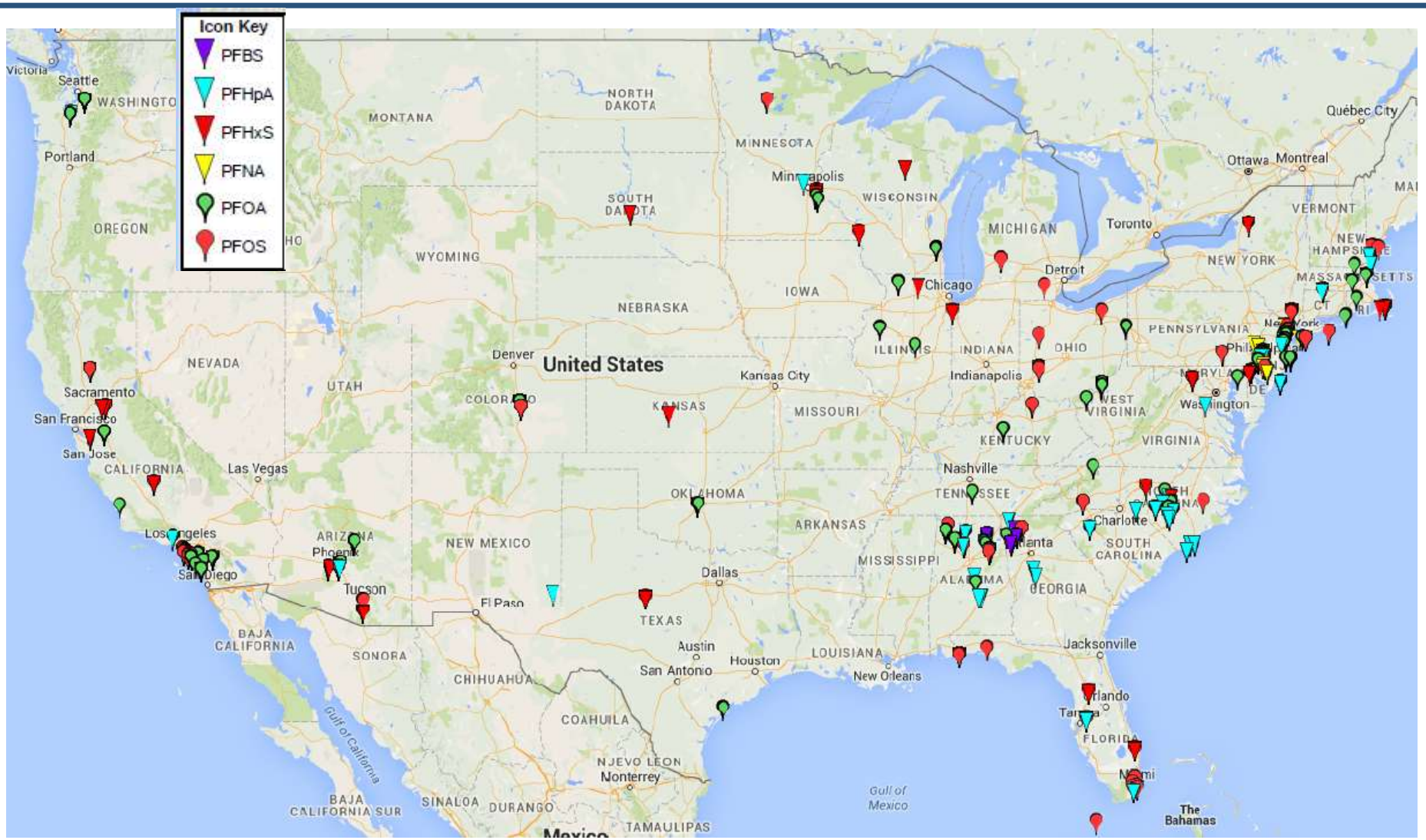
VOC Occurrence is Very Regional and Very Low Overall

Perfluorinated Compounds(PFCs) Detections are Infrequent (N ~36,000)

Compound	Detection as % of samples		% PWS w Hits	% above HA (0.07)	99th % conc	Max conc (ug/L)	HRL
PFOS	0.8%		1.9%	0.9%	ND	1.8	0.07
PFHxS	0.6%		1.1%		ND	0.68	--
PFHpA	0.6%		1.7%		ND	0.07	--
PFOA	1.0%		2.2%	0.3%	ND	0.35	0.07

- Detections in ~ 20 states; not necessarily consistent hits over time.
- GW system frequency and levels are higher than SW
- Many of the hits are non-CCL3 PFCs (only PFOA and PFOS are on the CCL3 list).
- BUT KEY TAKEAWAY – UCMR 3 significantly underestimates PFCs due to high MRLs (0.01 to 0.09 ppb)

All UCMR 3 PFC Hits



Hormones Present a Conundrum- Non CCL Dominate

- ~11,000 samples (but only ~1150 PWS, 3600 sites)
  - 155 hits—maximum values from 1 to 5 part per trillion
  - 4-androstene-3,17-dione (89 hits 78 < 1 ppt) max 1.9 ppt
  - Testosterone (58 hits – 56 < 1 ppt) max 5.3 ppt
  - 17-alpha-ethynylestradiol (3 hits) max 1.6 ppt
  - estriol (1 hit) max 1.1 ppt
  - 17b-estradiol (3 hits) max < 1 ppt

Neither of the most frequently detected analytes are on the CCL 3 List. (95% of hits)

Hormones Are Infrequent (25 States), But Some In Unexpected Areas

Most of the hormone data are one time hits

(e.g. very problematic to explain)

Implications of UCMR3 for UCMR4

- How low should we go? (are we chasing 0)
- What frequency of detection is meaningful?
- What ancillary data (metadata) are useful?
- When does the distribution system matter?
- How do we balance CCL compounds vs analytical method target lists?
- How frequently do we sample?
- When do we sample?

Reporting Limits Should Be Reviewed Critically and Not Just be Formulaic

- Have we engaged in overkill by relying on the Lowest Conc Min Reporting Level (analytical methods capability) to set reporting limits?
  - Example: Sr (lowest detected value > 10X MRL)
  - Example: Cr-T is often < Cr-6 due to problems with the Cr-T method at low levels, which are not addressed in the LCMRL protocol
- PFCs provides a perfect example of the other extreme. MRLs actually ended up being 5-10X higher than they could/should have been.
  - Due to a quirk in the way MRLs are established.

While Regulatory Determinations are NOT the Same as UCMR, They ARE Inter-related.

- **What's the threshold occurrence for potential regulation (or Health Advisories)?**
  - **% of detections?**
  - **% exceeding current HRL?**

Examples:

- **1,4-dioxane is detected in 22% of PWS with 7% of PWS exceeding 10^{-6} HRL**
- **Strontium exceeds HRL in 5% of PWS**
- **PFCs – exceed HAs in <2% of systems**

Are We Really Looking for the Right Compounds?

- **Are we chasing zero?**
  - **Other than 1,4-dioxane, most of the organics are still mostly ND, even at ultra low MRLs..**
  - **Except for PFCs, where method could go lower and still be meaningful levels.**

- **Is the existing CCL really the best source for determining what to monitor?**
  - **"Frequently" detected hormones not on CCL**
  - **Same issue for PFCs**
  - **And you won't find what you don't look for…**

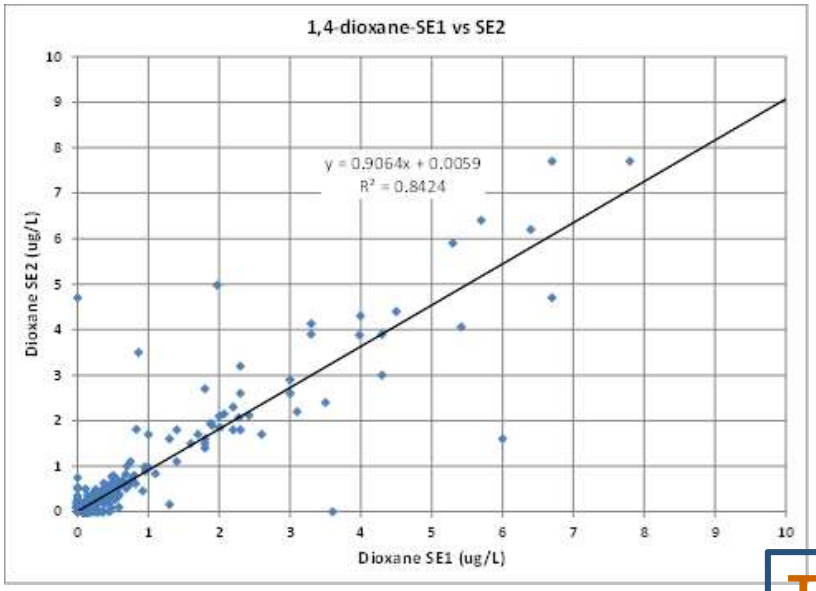
The Current UCMR Framework is Overly Rigid

- We are still chasing ultra-low numbers because we can.
  - LCMRL determinations for potential UCMR4 methods for EPA come up with VERY low numbers
- Cyanotoxins really don't fit well into the UCMR framework.
  - Sporadic in occurrence
  - Triggered monitoring is not ideal
  - UCMR approach would estimate low
  - Triggered approach (proposed) could estimate high

Metadata Can Help Utilities With Interpretation

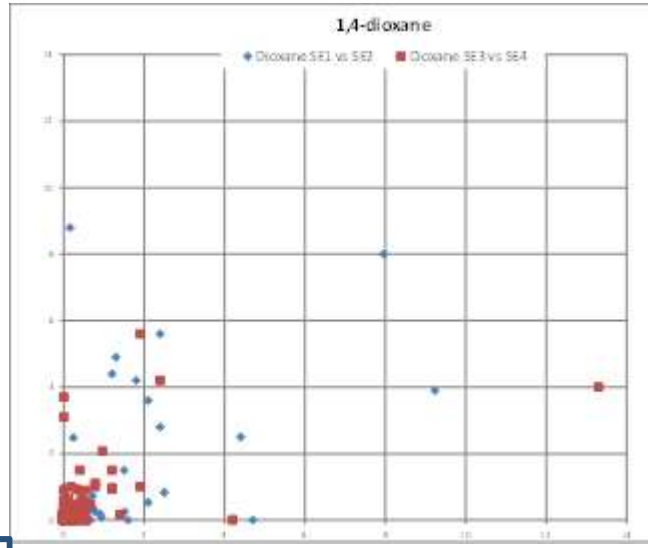
- Disinfection information must be "detailed" to be truly useful.
  - Requires further detailed studies
- Source water data can be critical when analytes may be formed/removed in the treatment process, but does it fit in UCMR?
  - Cyanotoxin strategies depend on source info.
  - EPA's draft UCMR 4 includes source water for MCs.
  - But the UCMR is really all about finished water.

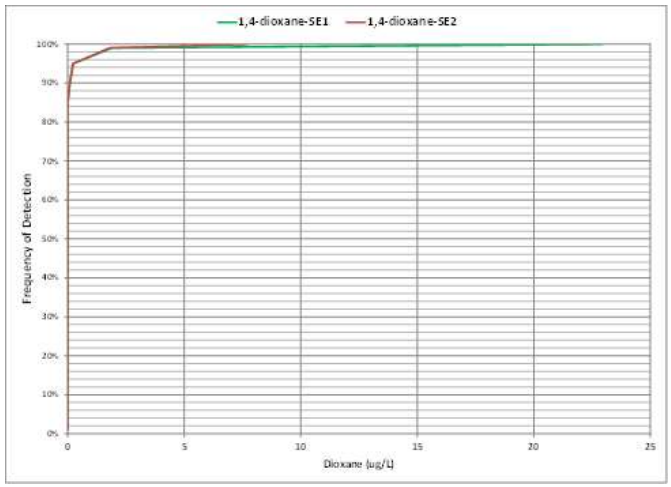
Do We Really Need This Many Samples? (Dioxane Example)



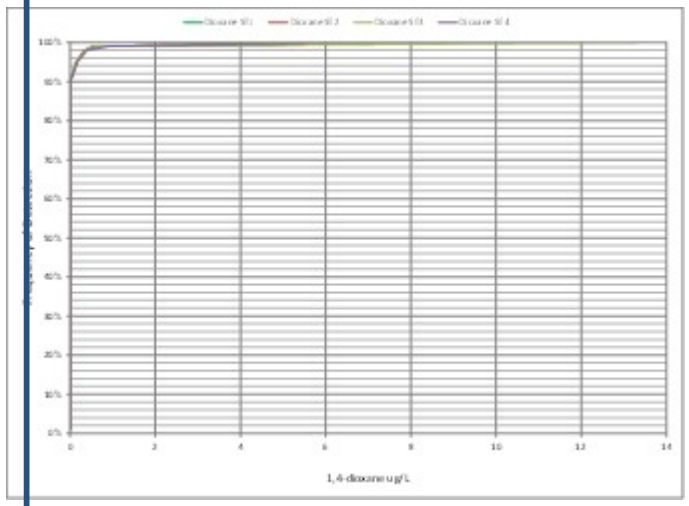
GWs

SWs

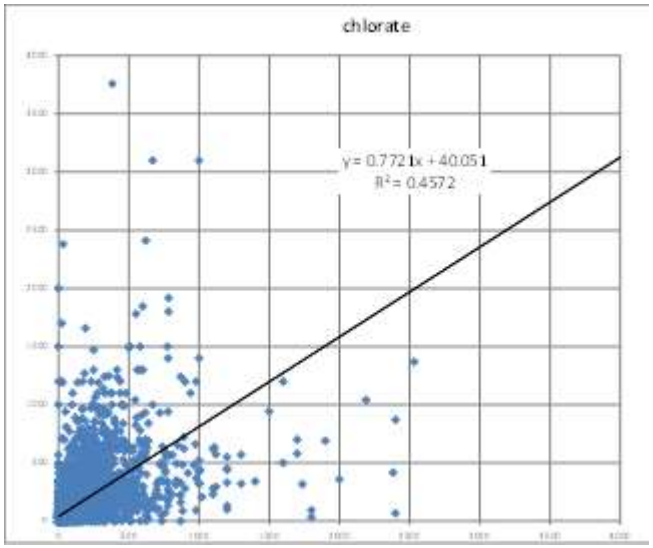




There is in general excellent correlation among sample events, and probability plots overlap.

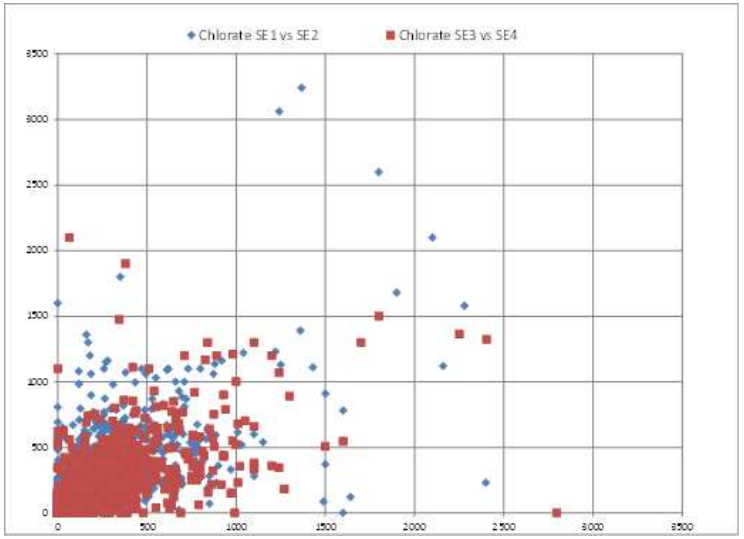


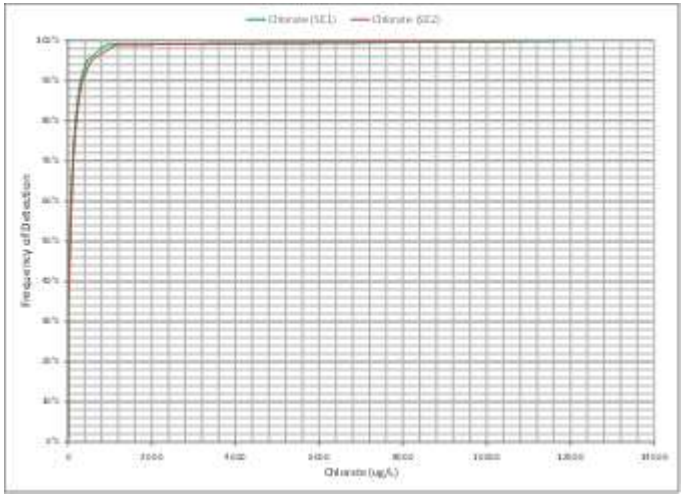
Do We Really Need This Many Samples? (Chlorate Example)



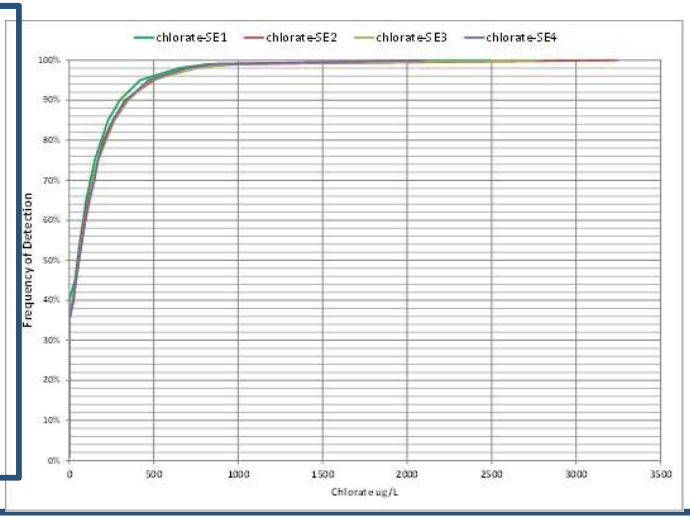
GWs

SWs

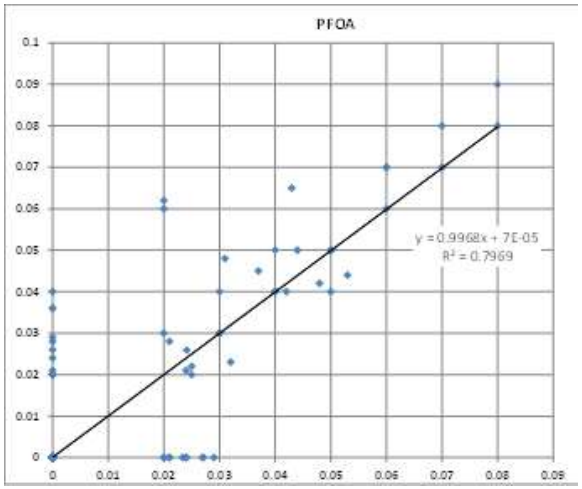




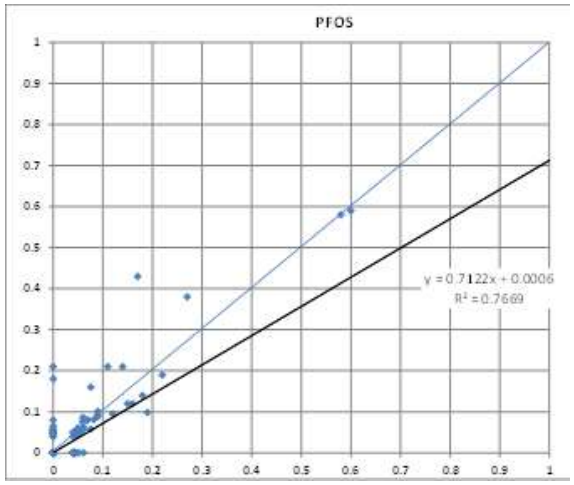
Even though there is minimal correlation among multiple sample events, probability plots are very similar



Do We Really Need This Many Samples? (PFC Example)

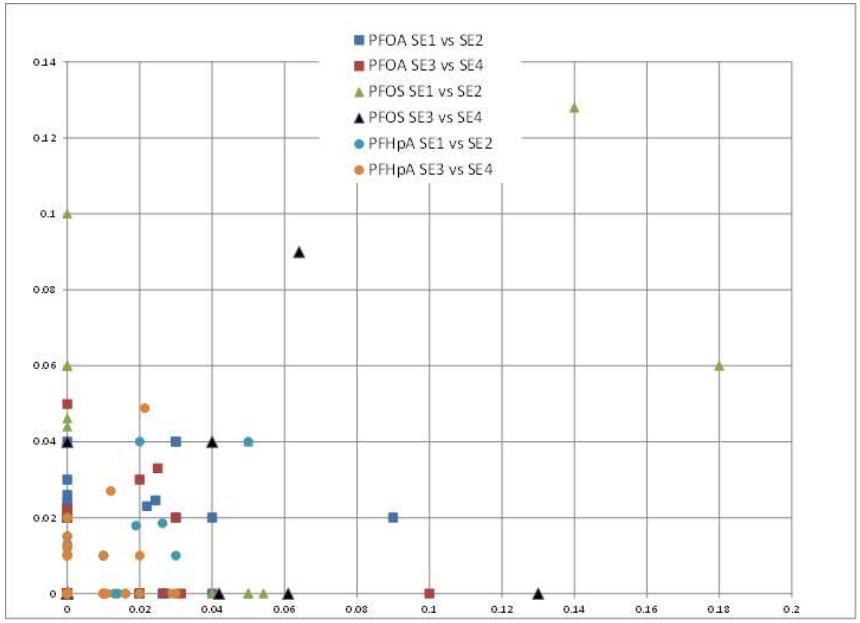


GWs



For groundwater systems there is little variability between two sample events. For surface water systems, there is more variation but overall frequency of occurrence and range is very similar.

SWs



Overall Comparison Among Sample Events.

- For ALL cases, except chlorate (as expected) there is generally good correlation between SE1 and SE2 for groundwater systems.
- There are **almost NO statistical differences** between probability distributions for **both groundwater and surface water systems.** The only differences that may occur are in the extremes (min and max).
- This is true whether there are frequent hits or very infrequent ones.
- There is also no real difference if we exclude Dec-Feb sample events.

Conclusions- UCMR3 Results Implications for UCMR4

- As long as we look for ultra-low concentrations, we are going to get hits and create communications challenges for utilities.
- The UCMR framework is not a good way to get useful information for individual plants, and may be overkill for national occurrence assessments.
- Choosing analytes and MRLs for UCMR monitoring is not as straightforward as it appears.
- We can get useful national information with a LOT less sampling.

Any Questions?

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