

THE RESULTS ARE IN: THE IMPLICATIONS OF THE UCMR3 TESTING FOR NORTH CAROLINA UTILITIES

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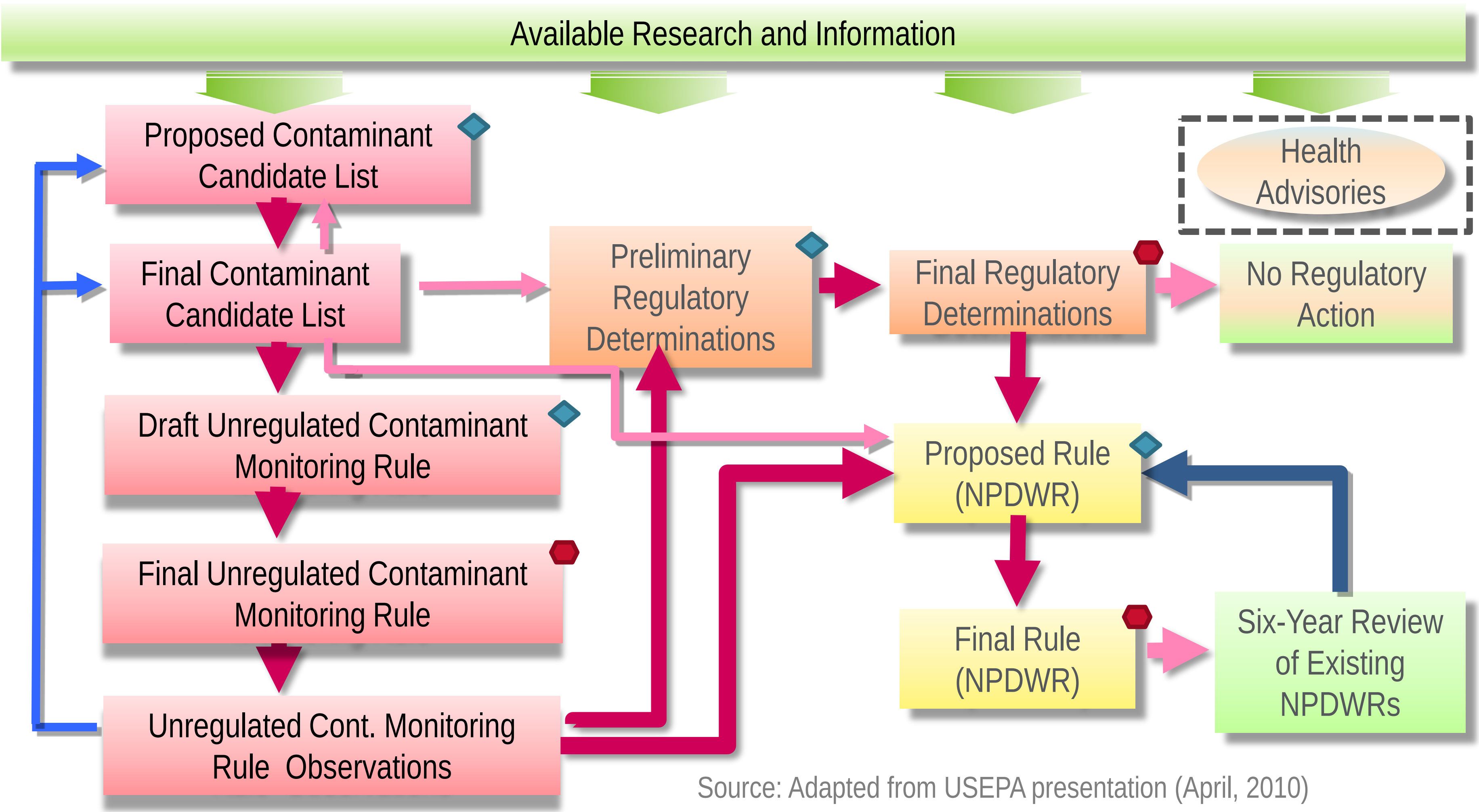
01 Regulatory Development and Making it to the Top of the Pile

Unregulated Contaminant Monitoring Rule (UCMR)

- Once every 5 years, EPA needs to issue a list of no more than 30 unregulated contaminants to be monitored by public water supply systems
- UCMR provides scientifically valid occurrence data used to
  - Assess exposure
  - Develop regulatory decisions
- Samples are collected at the point-of-entry to the distribution system and maximum residence time

Standard Setting Processes



Source: Adapted from USEPA presentation (April, 2010)

Drivers to the Top of the Regulatory Pile

- Public health disaster (Milwaukee, Flint)
- Political pressure (major driver for perchlorate, Senator Barbara Boxer (D-CA))
- The plodding, long EPA processes involving the CCL, UCMR, etc.
- Congressional action mandating that a rule on a specific contaminant be written with an actual deadline in the legislation – DBP rules were in this category
- Backpressure from states (CrVI pressure from CA)

02 UCMR3

UCMR 3

- Monitoring occurred from 2013-2015
- 21 List 1 Contaminants
  - All PWSs serving >10,000 people
  - 800 representative PWSs serving <10,000 people
  - 12-month period
- 7 List 2 Contaminants
  - All PWSs serving >100,000 people
  - 320 representative PWSs serving 10,001 – 100,000 people and 480 serving < 10,000 people
  - 12-month period
- 2 List 3 Constituents (viruses)
  - 800 undisinfected ground water PWSs serving 1000 or fewer people (karst and fractured bedrock sites)

UCMR 3 List 1

Contaminant	Minimum Reporting Level	Sampling Points
1,2,3-trichloropropane	0.03 µg/L	EPTDS
1,3-butadiene	0.1 µg/L	EPTDS
chloromethane (methyl chloride)	0.2 µg/L	EPTDS
1,1-dichloroethane	0.03 µg/L	EPTDS
bromomethane (methyl bromide)	0.2 µg/L	EPTDS
chlorodifluoromethane (HCFC-22)	0.08 µg/L	EPTDS
bromochloromethane (halon 1011)	0.06 µg/L	EPTDS
1,4-dioxane	0.07 µg/L	EPTDS

UCMR 3 List 1

Contaminant	Minimum Reporting Level	Sampling Points
vanadium	0.2 µg/L	EPTDS & DSMRT
molybdenum	1 µg/L	EPTDS & DSMRT
cobalt	1µg/L	EPTDS & DSMRT
strontium	0.3 µg/L	EPTDS & DSMRT
chromium[3]	0.2 µg/L	EPTDS & DSMRT
chromium-6	0.03 µg/L	EPTDS & DSMRT
chlorate	20 µg/L	EPTDS & DSMRT

UCMR 3 List 1

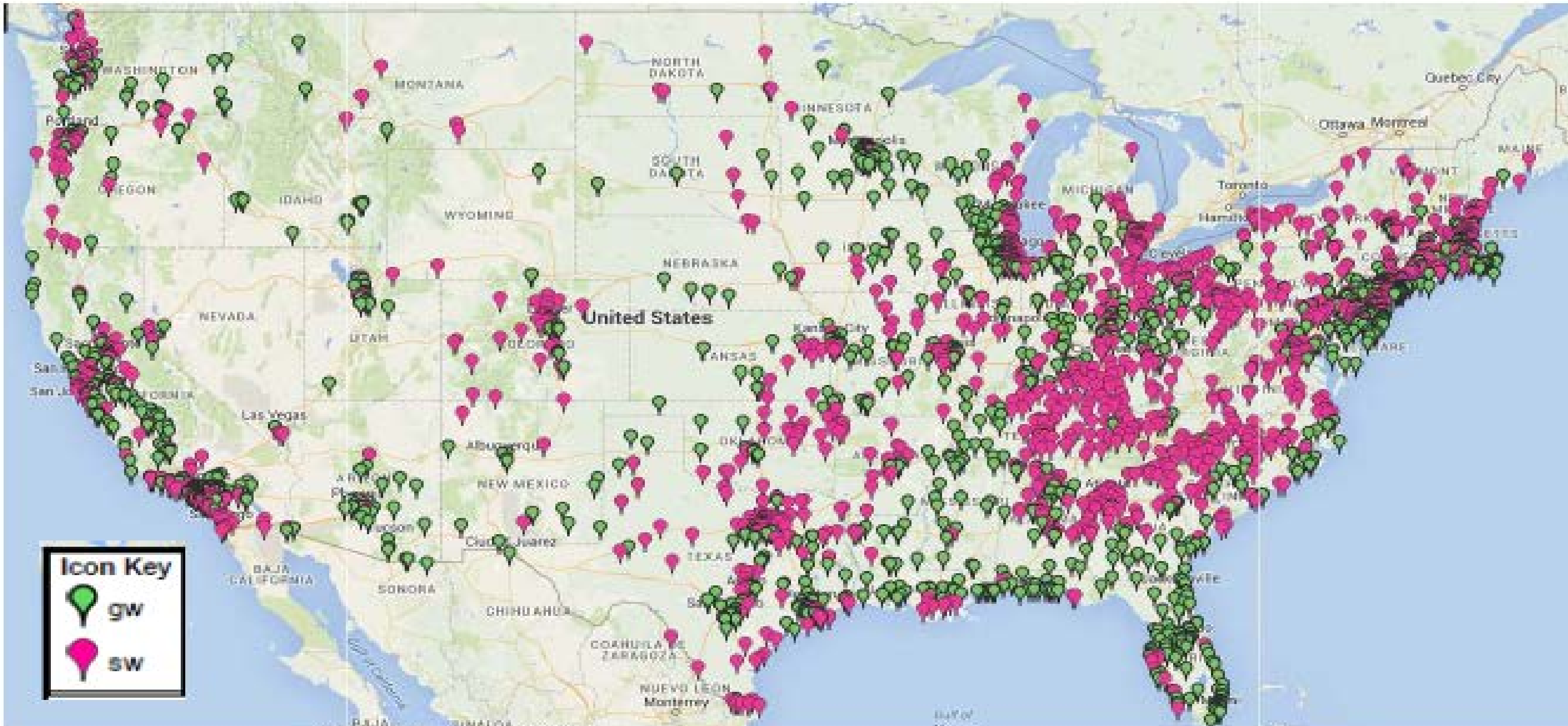
Contaminant	Minimum Reporting Level	Sampling Points[2]
perfluorooctanesulfonic acid (PFOS)	0.04 µg/L	EPTDS
perfluorooctanoic acid (PFOA)	0.02 µg/L	EPTDS
perfluorononanoic acid (PFNA)	0.02 µg/L	EPTDS
perfluorohexanesulfonic acid (PFHxS)	0.03 µg/L	EPTDS
perfluoroheptanoic acid (PFHpA)	0.01 µg/L	EPTDS
perfluorobutanesulfonic acid (PFBS)	0.09 µg/L	EPTDS

UCMR 3 List 2 and List 3

Contaminant	Minimum Reporting Level	Sampling Points
17-β-estradiol	0.0004 µg/L	EPTDS
17-α-ethynylestradiol (ethinyl estradiol)	0.0009 µg/L	EPTDS
16-α-hydroxyestradiol (estriol)	0.0008 µg/L	EPTDS
equilin	0.004 µg/L	EPTDS
estrone	0.002 µg/L	EPTDS
testosterone	0.0001 µg/L	EPTDS
4-androstene-3,17-dione	0.0003 µg/L	EPTDS

Contaminant	Minimum Reporting Level	Sampling Points
enteroviruses	Not Applicable.	EPTDS
Noroviruses	Not Applicable.	EPTDS

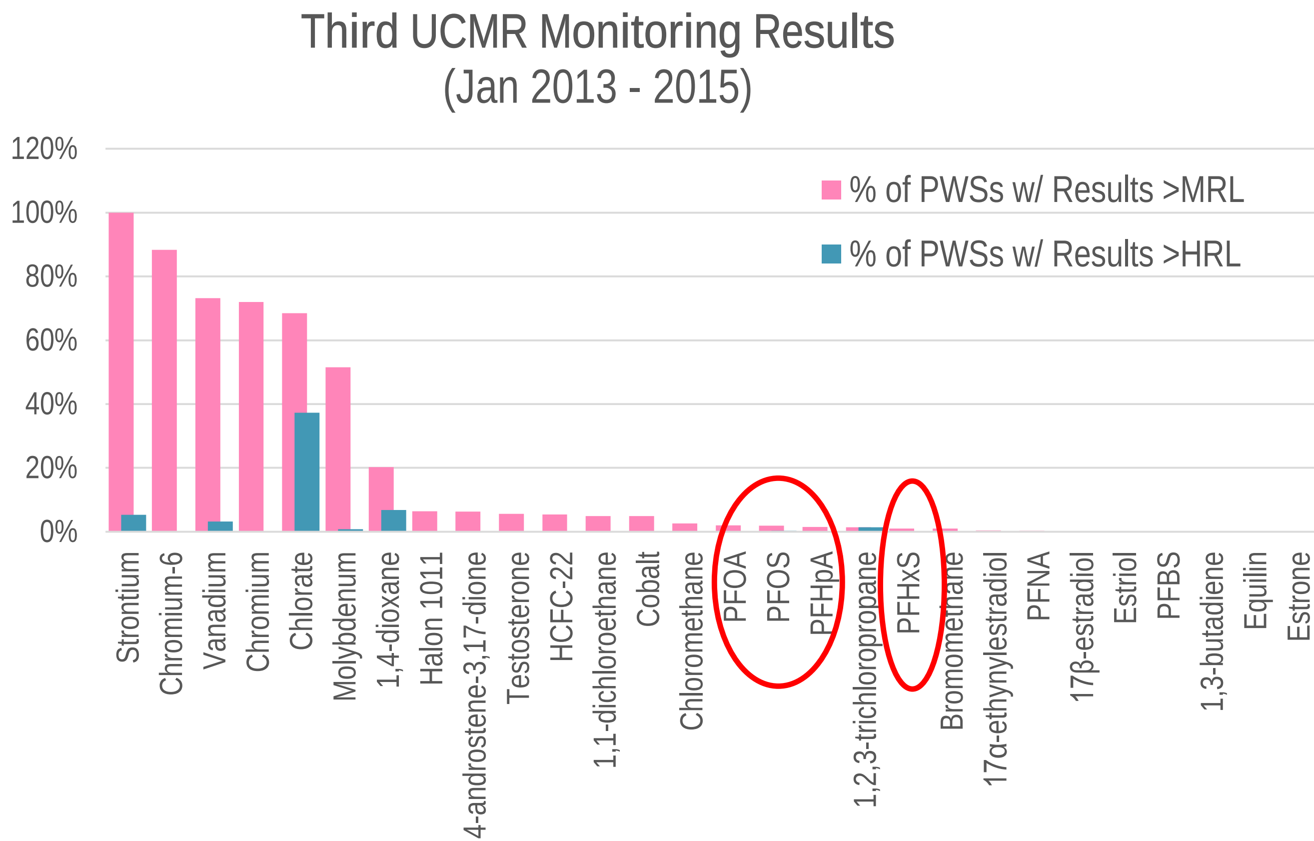
GW (2200) and SW (7200) Sites



Graphic from eurofins | Eaton Analytical

Unregulated Contaminant Monitoring

- Lots of low level detections for metals
- Few analytes appear at levels above health reference level



Miscellaneous Metals

Compound	MRL, µg/L	Health Risk Level (HRL), MCL, Other µg/L	NC Detects
Vanadium	0.2	21	114 (max. 13 µg/L)
Molybdenum	1	40/80	161 (max 45 µg/L)
Cobalt	1	40	68 (max 9.4 µg/L)
Strontium	0.3	4,200	1,535 (max. 2,700 µg/L)
Chromium	0.2	100	>1,000 (max 9.9 µg/L)
Chromium VI	0.02	10/0.02	>1,000 (max 9.1 µg/L)
Chlorate	20	210	>1,000 (max 22,000 µg/L)

03 Review of Selected Contaminants

1,4-Dioxane

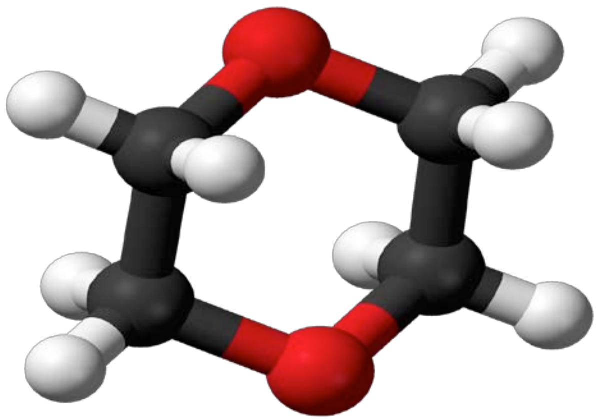
- Primarily used as solvent stabilizer and industrial solvent
- Probable human carcinogen. One in a million cancer risk associated with a 1,4-dioxane concentration of 0.35 mg/L (EPA IRIS database)
- Very stable (soluble and non-volatile)
- Difficult to treat

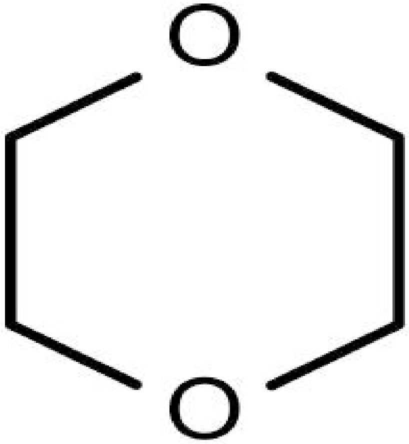
1,4-Dioxane (Graphic from eurofins | Eaton Analytical)

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

- 148 detects in NC samples > MRL
- 13.3 μg/L highest NC concentration
- NC had 4 highest concentrations in national UCMR3
- Significant hits in Cape Fear and Haw Rivers





1, 4- Dioxane

Treatment Method	Effective	Not Effective
Conventional		x
PAC, GAC	x	
RO	x	
Permanganate		x
O3/H2O2	xxx	
UV/H2O2	xxx	

Chlorate

- HRL - 210 ug/L
- Health Effects
  - High levels of chlorate impair the blood's ability to carry oxygen
  - Toxic effects – rupture red blood cell membranes
  - Impair thyroid function

Chlorate

- 37% of utilities Exceeded HRL of 210 μg/L
- 470 samples in NC > 210 μg/L
- Predominant sources include:
  - Bulk hypochlorite storage
  - On-site hypochlorite generation
  - Chlorine dioxide
  - Weed killers
  - Pharmaceuticals

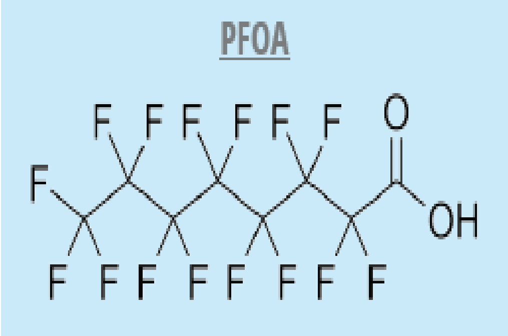
Graphic from eurofins Eaton Analytical

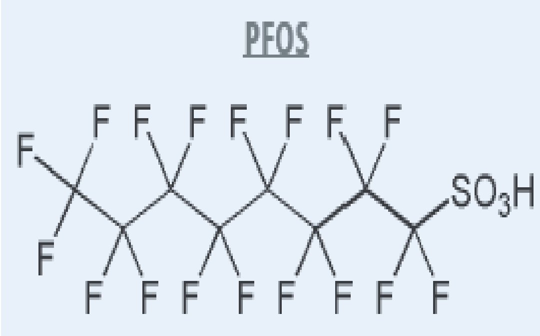
Chlorate Treatment and Control

- Hypochlorite management (dilution, use quickly)
- Lower storage temperatures
- Avoid direct sunlight on storage
- Treatment with granular activated carbon/biofiltration, anion exchange, ozone, and sulfur dioxide

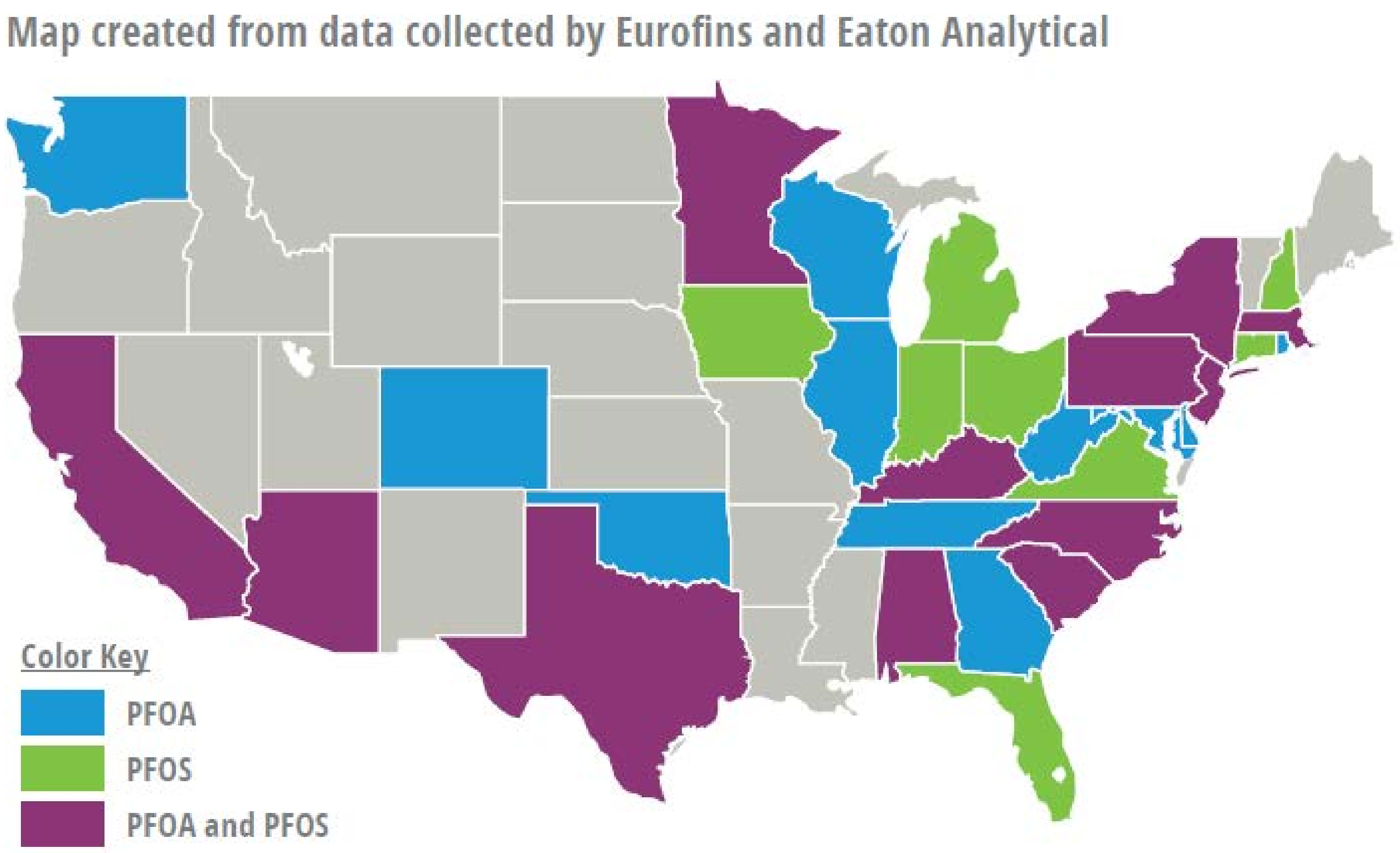
Perfluorinated Compounds

- Stable, Synthetic Chemicals – 50-60 Year Legacy
- Hydrophobic – Ideal Surfactants
- Most common are:
  - o Pefluorooctane Sulfonate (PFOS)
  - o Perfluoroctanoic Acid (PFOA)
    - 70 ng/L Lifetime Health Advisory
- Linked to Reproductive and Developmental Impacts, Cancer, Thyroid Function, Liver Damage





UCMR 3 Results



NC UCMR 3 Results

- 700 Samples from 106 PWSs
- 28 PFAS Detects from 15 PWSs
- 75% of Detects from Surface Water

UCMR3 Data for North Carolina – Perfluoroalkyl substances

Compound	MRL, ng/L	NC Detects
Perfluoroheptanoic acid (PFHpA, C7)	10	18 (max. 50 ng/L)
Perfluorooctanoic acid (PFOA, C8)	20	6 (max. 30 ng/L)
Perfluorononanoic acid (PFNA, C9)	20	0
Perfluorobutanesulfonic acid (PFBS)	90	0
Perfluorohexanesulfonic acid (PFHxS)	30	2 (max. 42 ng/L)
Perfluorooctanesulfonic acid (PFOS)	40	6 (max. 76 ng/L)

Treatment Method	Treatment Process	Documented PFC Removal %	Application	Comment
Activated Carbon	GAC or PAC	PFOA > 90 PFOS > 90 PFNA > 90	Surface Water Groundwater Point of Use	Competitive Adsorption Kinetics
Anion Exchange	Special Resins	PFOA - 10 to 90 PFOS > 90 PFNA - 67	Surface Water Groundwater	Brine Disposal Less effective on short chain PFCs Kinetics
Membrane Filtration	RO, NF	PFOA > 90 PFOS > 90 PFNA > 90	Surface Water Groundwater Point of Use	Fouling Pretreatment High Energy
Advanced Oxidation	UV/H2O2 UV/Persulfate	PFOA < 10 PFOS 10 to 50 PFNA < 10	Surface Water Groundwater	High Energy
DAF		Some PFOA removal		More Evaluation Needed

Chromium

- Natural weathering of chromite containing minerals
- Industrial sources
  - Chrome plating, dyes and pigments, leather and wood preservation, steel and pulp mills, coal ash, others
- 1997 estimated release of chromium was 111,384 pounds to water from 3,391 large processing facilities (about 0.3% of total environmental releases)
- Chromium compounds very persistent in water

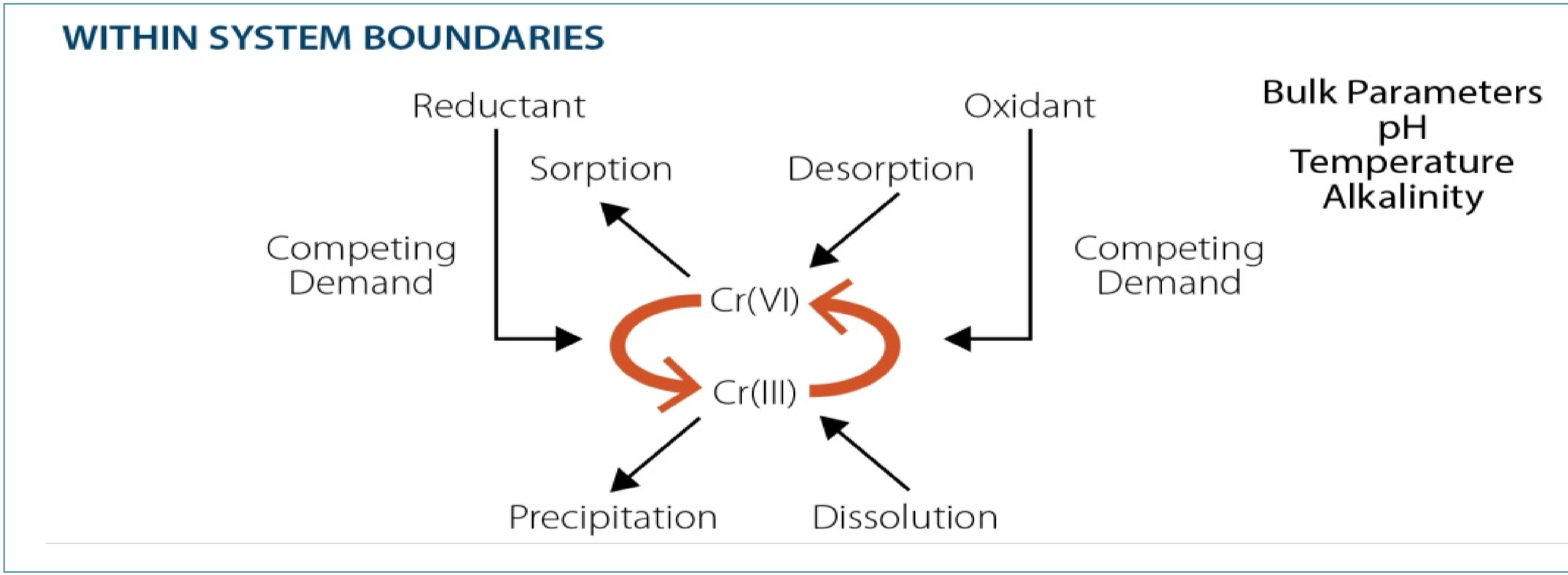
Why Cr(VI)?

- 2008 National Toxicology Program (NIH)
  - Oral injection of Cr(VI) resulted in increased cancer risk for laboratory animals (oral cavity and small intestine)
- 2010 USEPA IRIS Toxicological Review of Cr(VI)
  - Probable human carcinogen by oral ingestion
- UCMR 3 requires monitoring of Cr(VI) during 2013-2015 period
- Significant industrial releases of chromium in NC based on Toxic Release Inventory

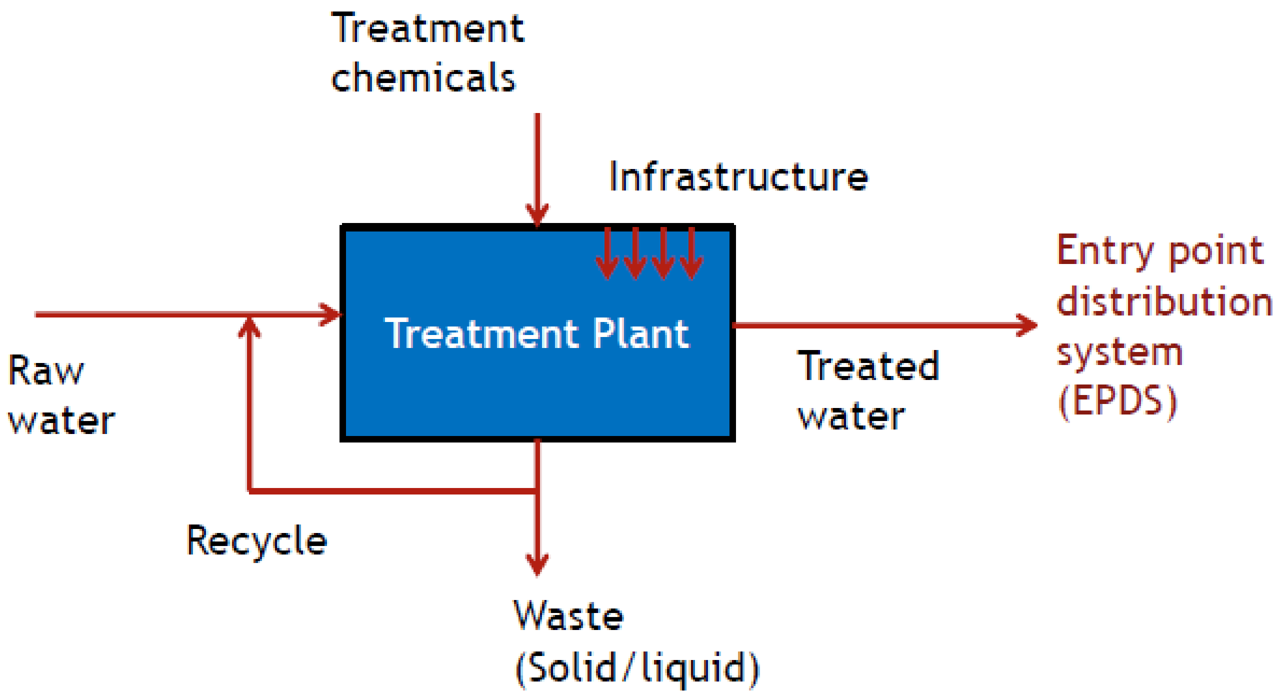
Current Regulatory Status

- National standards are for total chromium (Cr(III) + Cr(VI))
  - USEPA MCL = 100 μg/L
  - USEPA MCLG = 100 μg/L
- No national standard for Cr(VI)
- California unique Cr standards
  - Total Cr = 50 μg/L
  - Cr(VI) = 10 μg/L
- California Cr(VI) public health goal (PHG) = 0.02 μg/L

Factors Influencing Speciation in System



Fate of Chromium in Water Treatment Plants



Minutes to hours
Many chemicals and processes
Large changes to equilibrium

Does Cr increase or decrease?
Does Cr(III) convert to Cr(VI)?

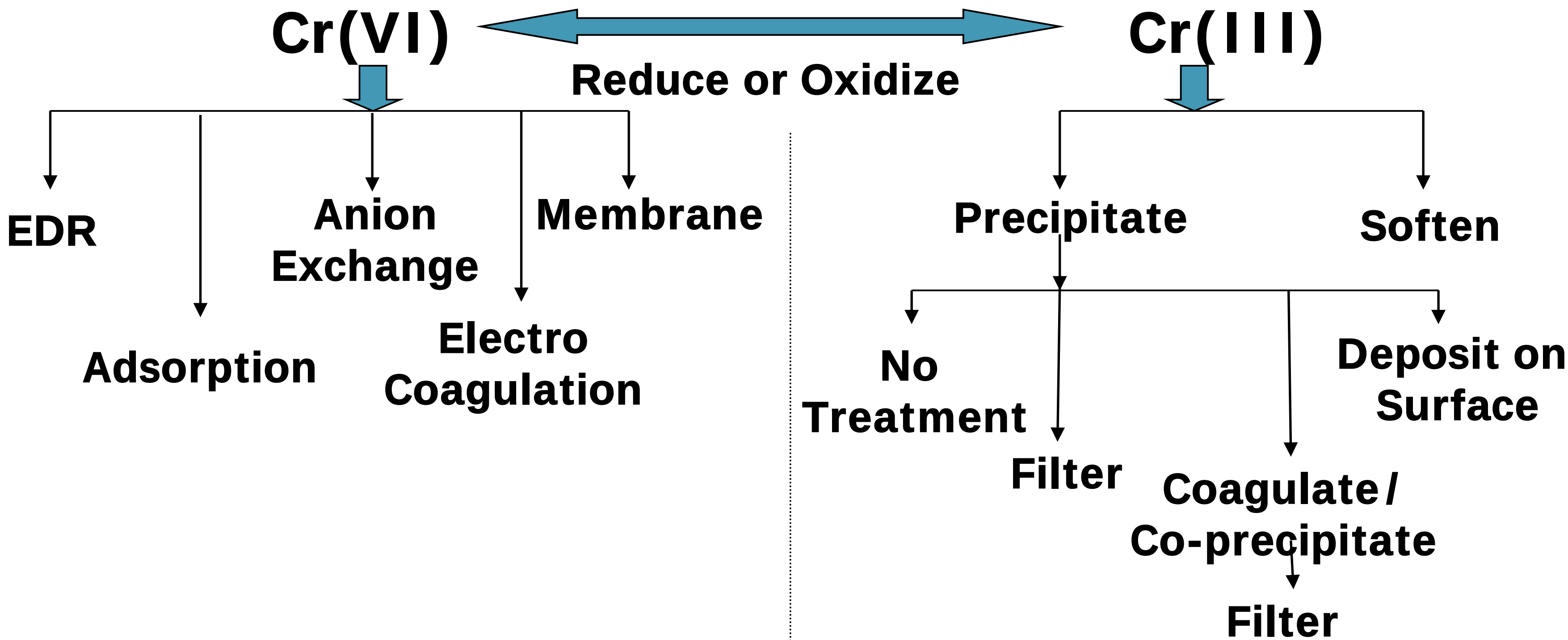
Summing Up Current Research (WRF 4497)

- Practical Observations
  - Tendency for Cr(VI) concentrations to stay same or slightly increase in water treatment plants
    - Treatment chemicals
    - Oxidation of Cr(III)
  - Cr(III) tends to be well removed by conventional treatment processes
  - Large changes in Cr(VI) concentrations do not appear to be common in distribution systems

04 Summary and Conclusions

Questions?

Potential Treatment Technologies



Delivered water Cr(VI) only

Delivered water Cr(III) only
Potential oxidation to Cr(VI) in distribution system