

# PFAS in Drinking Water

Water Utility Board Update

2-5-2019

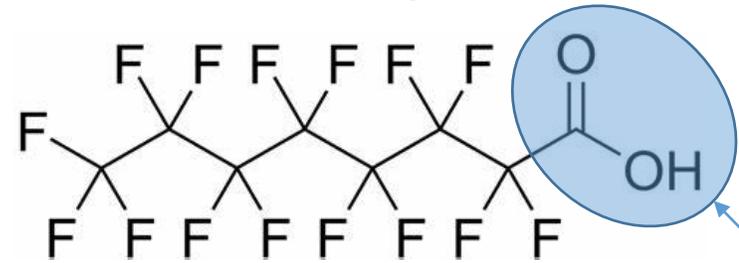
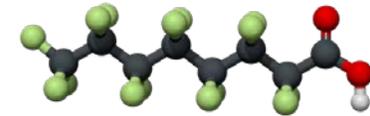
# Objectives

- Provide a general description of PFAS chemistry and its application
- Describe the current regulations relating to PFAS in drinking water
- Summarize our PFAS monitoring to date and future plans
- Provide a brief overview of the known contamination at Truax
- Introduce a potential framework for developing a PFAS action level

# Per- and polyfluoroalkyl Substances (PFAS)

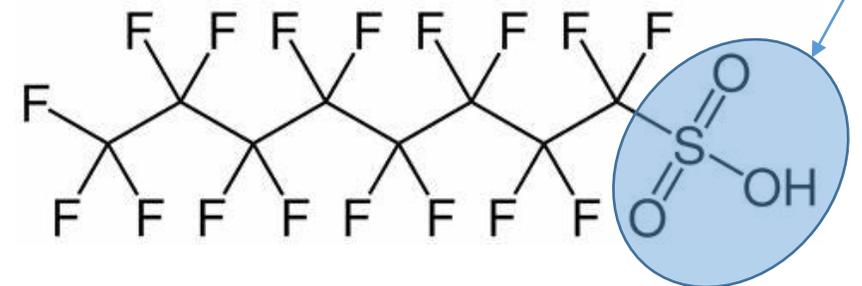
Family of 3000+ related chemicals

- Fluorinated organic compounds
- Important commercial applications
- High environmental risk
  - ✓ Soluble in water
  - ✓ Do not readily degrade
  - ✓ Mobile
- Human health risk
  - ✓ Toxic at low levels
  - ✓ Bio accumulative
  - ✓ Long half-life in humans

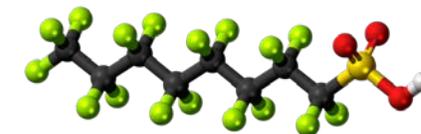


**PFOA** – perfluorooctanoic acid

Head



**PFOS** – perfluorooctanesulfonic acid



# Important Commercial Application

## Desirable Properties:

- Oil, stain, grease, and water repellent
- Heat resistant

## Variety of Applications:

- Non-stick cookware
- Coatings on clothing, fabrics, food packaging
- Fire-fighting foam



# Current State of PFAS Regulation

No federal or state drinking water standard	US EPA Health Advisory (2016) – PFOA & PFOS Some states have set guidelines or standards
No current federal testing requirements	UCMR3 testing (2013-2015) – six PFAS chemicals Some states now require monitoring
No standard test method	US EPA Method 537 (14 PFAS) – UCMR3 Some labs have modified Method 537 <ul style="list-style-type: none"><li>• Expanded list of PFAS measured, lower reporting levels</li><li>• Little consistency between private contract labs</li></ul>
No standard list of PFAS chemicals	UCMR3 included six PFAS contaminants <ul style="list-style-type: none"><li>• EPA Method 537 quantifies 14 PFAS</li><li>• Some labs can now measure 40+ PFAS</li></ul>

# *Madison Water Utility PFAS Testing, 2012-2018*

	2012		2015		2017		2018	
	Tested	Results	Tested	Results	Tested	Results	Tested	Results
Well 06	X	ND	2X	ND				
Well 07			2X	ND	X	ND		
Well 08			2X	ND				
Well 09			2X	ND				
Well 11	X	ND	2X	ND				
Well 12			2X	ND				
Well 13			2X	ND				
Well 14	X	ND	2X	ND				
Well 15			2X	ND	2X	31-35 ppt	2X	37-42 ppt
Well 16	X	ND	2X	ND	2X	2.4-2.6 ppt	X	2.4 ppt
Well 17			2X	ND				
Well 18			2X	ND	X	ND		
Well 19			2X	ND				
Well 20			2X	ND				
Well 23			2X	ND				
Well 24			2X	ND				
Well 25			2X	ND				
Well 26			2X	ND				
Well 27			2X	ND				
Well 28			2X	ND				
Well 29			2X	ND	X	ND		
Well 30			2X	ND				
Well 31								
PFAS Tested	6		6		6		12/18	
Test Method	EPA 537	RL: 10-90 ppt	EPA 537	RL: 10-90 ppt	Mod EPA 537	RL: 2 ppt	Mod EPA 537	RL: 2 ppt

ND = not detected at reporting limit (RL)

# PFAS Testing at Well 15

Results in parts per trillion or ng/L

3/10/2015    9/15/2015    8/1/2017    12/4/2017    3/19/2018    10/16/2018

## Perfluorosulfonic Acids (PFSAs)

Abbreviation

	Abbreviation	3/10/2015	9/15/2015	8/1/2017	12/4/2017	3/19/2018	10/16/2018
perfluorobutanesulfonic acid	PFBS	<90	<90	<b>2.4</b>	<b>2.1-2.3</b>	<b>2.4</b>	<b>2.6</b>
perfluorohexanesulfonic acid	PFHxS	<30	<30	<b>19</b>	<b>19-20</b>	<b>20</b>	<b>21</b>
perfluorooctanesulfonic acid	PFOS	<40	<40	<b>5.4</b>	<b>4.8-5.0</b>	<b>4.4</b>	<b>5.1</b>

## Perfluorocarboxylic Acids (PFCAs)

Abbreviation

	Abbreviation	3/10/2015	9/15/2015	8/1/2017	12/4/2017	3/19/2018	10/16/2018
perfluorohexanoic acid	PFHxA	not tested	not tested	not tested	not tested	<b>5.2</b>	<b>5.3</b>
perfluoroheptanoic acid	PFHpA	<10	<10	<b>2.2*</b>	<2.0	<2.0	<b>2.2</b>
perfluorooctanoic acid	PFOA	<20	<20	<b>4.9</b>	<b>4.9-5.0</b>	<b>4.7</b>	<b>5.4</b>

**Combined PFOA + PFOS\*\***

ND    ND    10    9.7-10    9.1    11

**Total PFAS Concentration**

ND    ND    34    31-32    37    42

## PFAS Tested but Not Detected

perfluorononanoic acid  
 perfluorodecanoic acid  
 perfluoroundecanoic acid  
 perfluorododecanoic acid  
 perfluorotridecanoic acid  
 perfluorotetradecanoic acid  
 N-Ethyl perfluorooctane sulfonamidoacetic acid  
 N-Methyl perfluorooctane sulfonamidoacetic acid  
 GenX  
 ADONA  
 F-53B Major  
 F-53B Minor

Notes: ND - not detected

\* Found only in raw water; not in distribution system

\*\* EPA Health Advisory Level for PFOA & PFOS: 70 ppt

# On-going Monitoring: Well 15

- Monthly testing in 2019
- Modified EPA Method 537
- 24-30 PFAS chemicals
- Low detection limits

## Lab A (24 PFAS)

Perfluorobutanoic acid  
Perfluorobutane sulfonic acid  
Perfluoropentanoic acid  
Perfluoropentane sulfonic acid  
Perfluorohexanoic acid  
Perfluorohexane sulfonic acid  
Perfluoroheptanoic acid  
Perfluoroheptane sulfonic acid  
Perfluorooctanoic acid  
Perfluorooctane sulfonic acid  
Perfluorooctanesulfonamide  
Perfluorononanoic acid  
Perfluorononane sulfonic acid  
Perfluorodecanoic acid  
Perfluorodecane sulfonic acid  
Perfluoroundecanoic acid  
Perfluorododecanoic acid  
Perfluorotridecanoic acid  
Perfluorotetradecanoic acid  
N-Methyl perfluorooctane sulfonamidoacetic acid  
N-Ethyl perfluorooctane sulfonamidoacetic acid  
4:2 Fluorotelomer sulfonic acid  
6:2 Fluorotelomer sulfonic acid  
8:2 Fluorotelomer sulfonic acid

## Lab B (30 PFAS)

Perfluorobutanoic acid  
Perfluorobutane sulfonic acid  
Perfluoropentanoic acid  
Perfluoropentane sulfonic acid  
Perfluorohexanoic acid  
Perfluorohexane sulfonic acid  
Perfluoroheptanoic acid  
Perfluoroheptane sulfonic acid  
Perfluorooctanoic acid  
Perfluorooctane sulfonic acid  
Perfluorooctanesulfonamide  
Perfluorononanoic acid  
Perfluorononane sulfonic acid  
Perfluorodecanoic acid  
Perfluorodecane sulfonic acid  
Perfluoroundecanoic acid  
Perfluorododecanoic acid  
Perfluorotridecanoic acid  
Perfluorotetradecanoic acid  
N-Methyl perfluorooctane sulfonamidoacetic acid  
N-Ethyl perfluorooctane sulfonamidoacetic acid  
4:2 Fluorotelomer sulfonic acid  
6:2 Fluorotelomer sulfonic acid  
8:2 Fluorotelomer sulfonic acid  
10:2 Fluorotelomer sulfonic acid  
HFPA-DA / GenX  
N-Methyl perfluorooctane sulfonamide  
N-Ethyl perfluorooctane sulfonamide  
N-Methyl perfluorooctane sulfonamidoethanol  
N-Ethyl perfluorooctane sulfonamidoethanol

# Uncertain Health Risks

- US Environmental Protection Agency (EPA)
  - 2016 Health Advisory – 70 parts per trillion (ppt), sum of PFOA & PFOS
  - Provisional Health Advisory (2009): PFOA – 400 ppt; PFOS – 200 ppt
- DRAFT Agency for Toxic Substances and Disease Registry (ATSDR)
  - In 2018, reviewed potential human health effects of 14 PFAS chemicals
  - Most comprehensive review of human and animal studies to date
  - Proposed minimal risk levels for four (4) PFAS



PFAS	Minimal Risk Level (mg/kg/day)	Drinking Water Equivalent – Adult	Drinking Water Equivalent – Infant	Well 15 (max)
PFOA	$3 \times 10^{-6}$	78 ppt	21 ppt	5.4
PFOS	$2 \times 10^{-6}$	52	14	5.4
PFHxS	$2 \times 10^{-5}$	517	140	21
PFNA	$3 \times 10^{-6}$	78	21	<2

ppt = part per trillion

Source: [www.atsdr.cdc.gov/pfas/docs/PFAS\\_MRL\\_HA-H.pdf](http://www.atsdr.cdc.gov/pfas/docs/PFAS_MRL_HA-H.pdf)

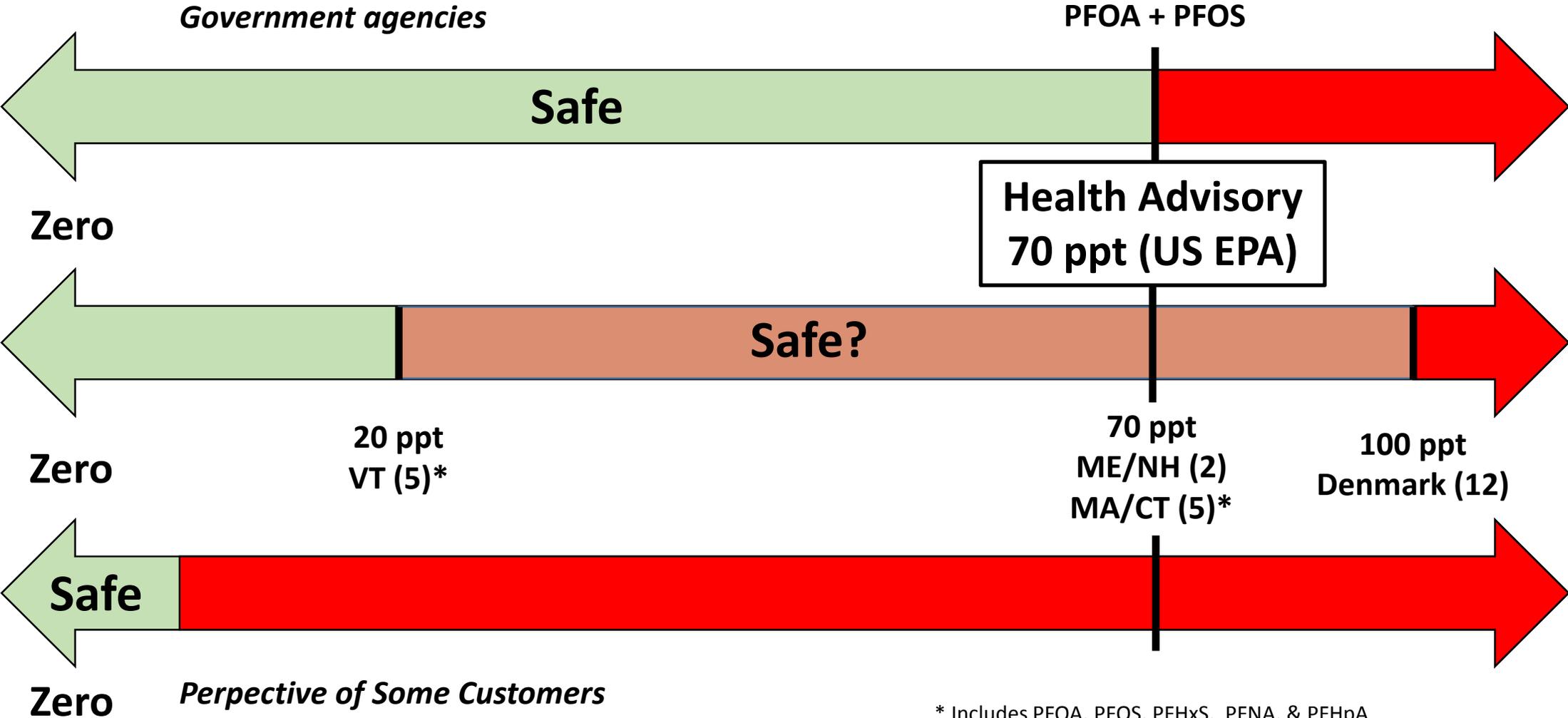
Accessed 1/25/19

# Regulatory and Guidance Levels Vary by State

State	Drinking Water Action	Compound	Level (ppt)
California	<a href="#">Interim Response Levels</a>	Sum of PFOA and PFOS	70
Connecticut	<a href="#">Action Level</a>	Sum of PFOA, PFOS, PFNA, PFHxS, PFHpA	70
Maine	<a href="#">Maximum Exposure Guidelines</a>	Sum of PFOA and PFOS	70
Massachusetts	<a href="#">Office of Research &amp; Standards Guideline</a>	Sum of PFOA, PFOS, PFNA, PFHxS, PFHpA	70
Minnesota	<a href="#">Health Based Guidance for Water</a> Surrogate of PFOS HBV	PFOA	35
		PFOS	27
		PFHxS	27
New Hampshire	<a href="#">Rulemaking Initiated 12/31/18</a>	PFOA	70
		PFOS	38
		Sum of PFOA and PFOS	70
		PFHxS	85
		PFNA	23
New Jersey	<a href="#">Adopted Regulation</a> Regulation in Development Guidance Value	PFNA	13
		PFOA	14
		PFOS	13
North Carolina	<a href="#">Health Advisory</a>	GenX	140
Vermont	<a href="#">Groundwater Quality Enforcement Standards</a>	Sum of PFOA, PFOS, PFNA, PFHxS, PFHpA	20

Source: [www.asdwa.org/pfas/](http://www.asdwa.org/pfas/) Accessed 1/18/19

# Different Perspectives on What is "Safe"



\* Includes PFOA, PFOS, PFHxS, PFNA, & PFHpA

Potential Sources of PFAS to UW 15

# Key: PFOS+PFOA / Total PFAS

## BASE BOUNDARY ANALYTICAL RESULTS

Truax Field Air National Guard Base  
Madison, Wisconsin

### Legend

-  Temporary Monitoring Well
-  Installation Area (approximate)
-  Potential AFFF PFOS/PFOA PRL (approximate)
-  Assumed Groundwater Flow

### Notes & Sources

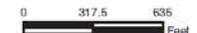
**Notes:**  
 AFFF = aqueous film forming foam  
 PRL = potential release location  
 PFC = perfluorinated compounds  
 PFOS = Perfluorooctanesulfonic acid  
 PFOA = Perfluorooctanoic acid  
 PFBS = Perfluorobutanesulfonic acid  
 PFHpA = Perfluorheptanoic acid  
 PFHxS = Perfluorohexanesulfonic acid  
 PFNA = Perfluorononanoic acid

**BOLD** text indicates a detection

**YELLOW** highlighted cells indicate 0.07 µg/L Health Advisory Exceedance.

\* Field duplicate value exceeded primary sample

Sources: Potential AFFF PFC PRLs and Installation Area datalayers obtained from Figure 2 of the Final Perfluorinated Compounds Preliminary Assessment Site Visit Report prepared by BB&E and dated February 2016.

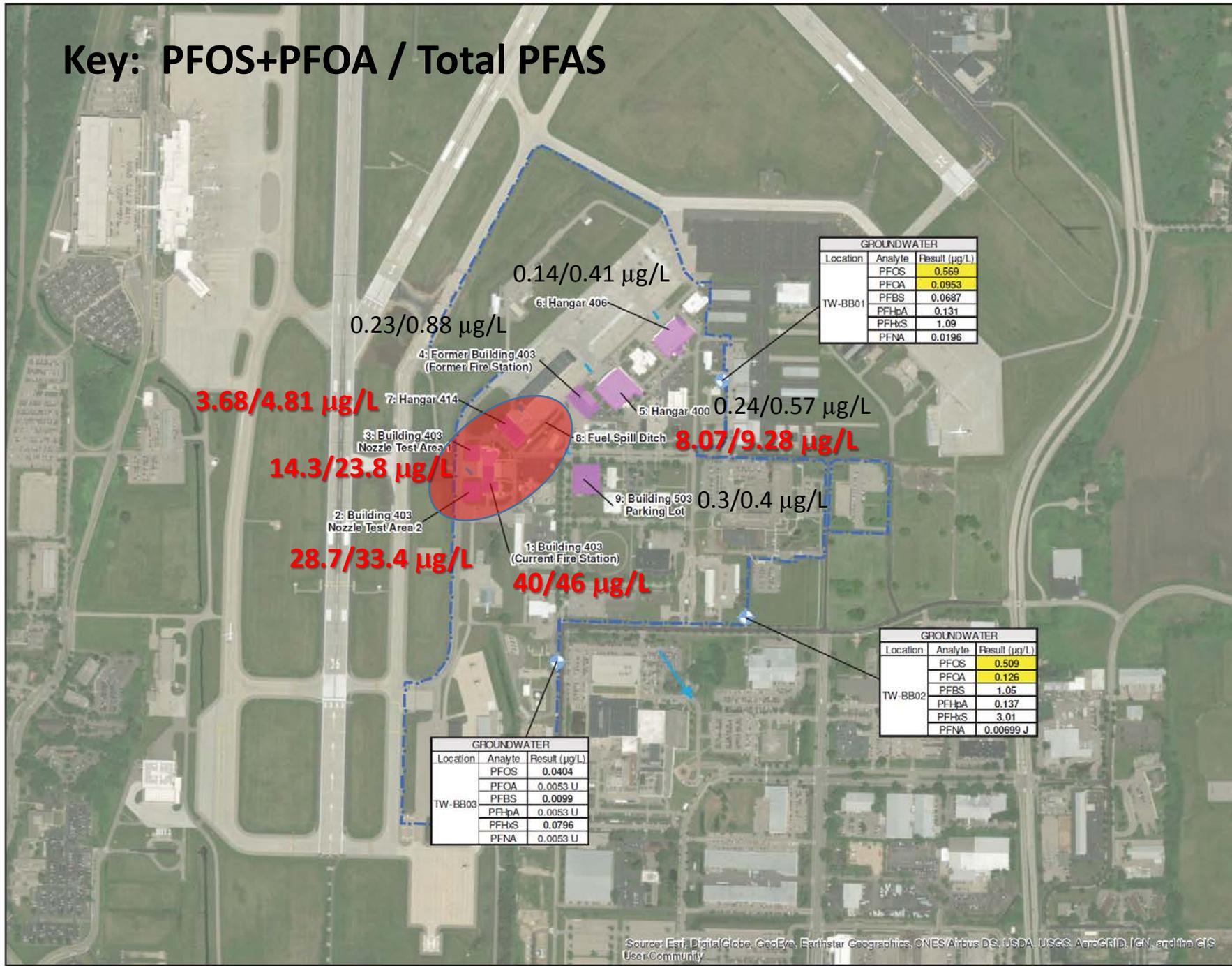


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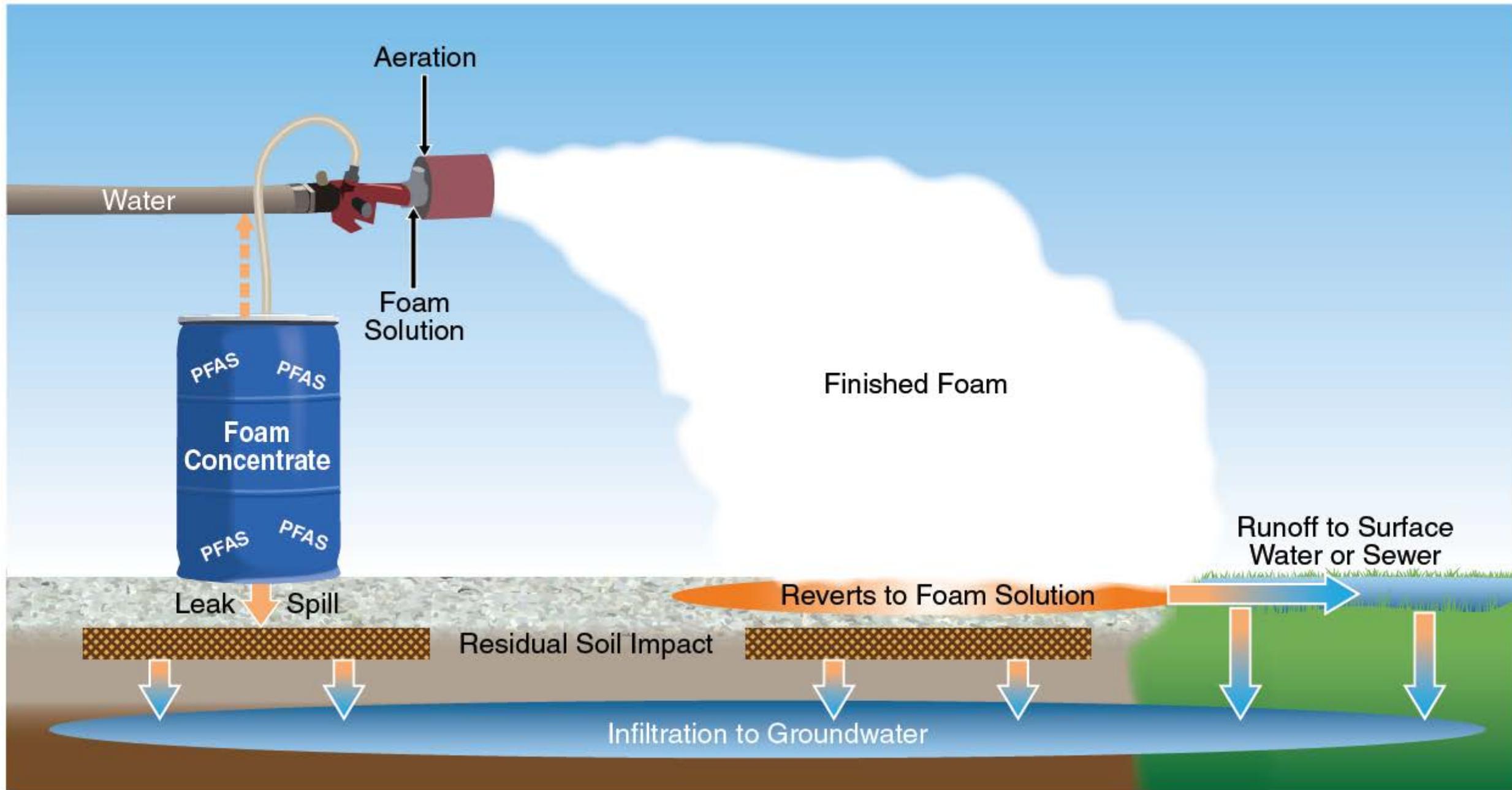


FIGURE

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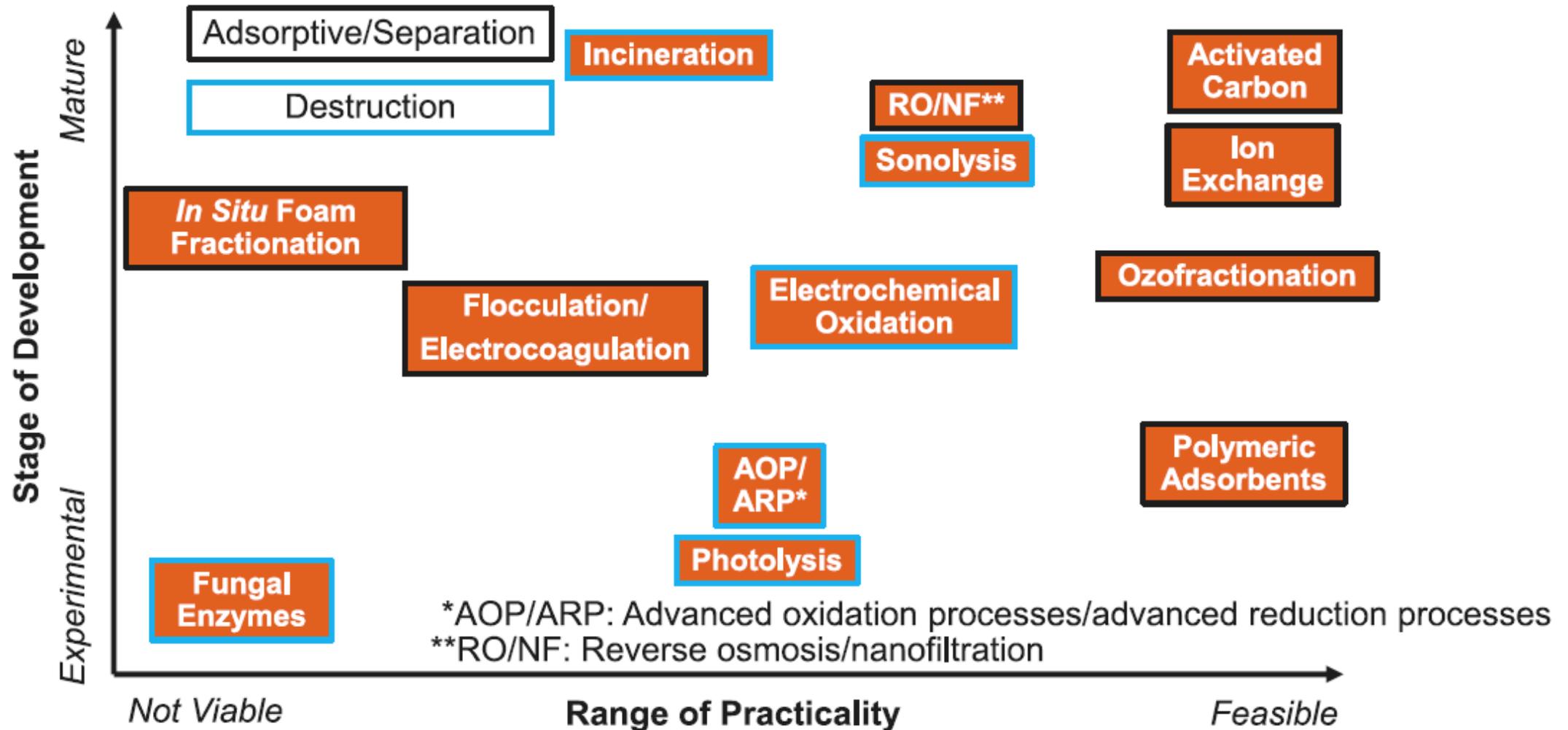


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



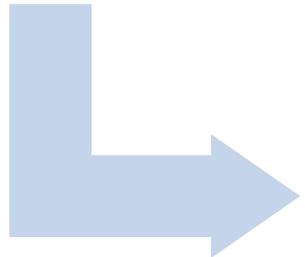
From *History and Use of Per- and Polyfluoroalkyl Substances (PFAS)*; ITRC Factsheet, November 2017

# PFAS Treatment Technologies for Water



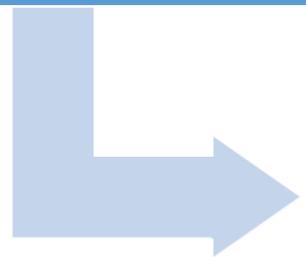
## Problem Scope

- Individual or “Total” PFAS
- PFOA & PFOS as surrogates
- Standard or “emerging” test method
- Applicable detection/reporting limits



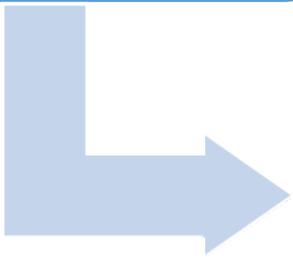
## Health Risk Assessment

- Health benchmark: lifetime HA or MCL
- Individual PFAS or additive approach; PFOA & PFOS
- Significant health risk reduction achievable



## Treatment Alternatives

- Best Available Technologies (BATs)
- Complementary to organics removal
- Removal effectiveness
- Required pre- or post-treatment
- Handling of waste stream



## Economic Impact

- Capital costs (debt)
- Annual operating costs
- Cost-benefit analysis
- Affordability

**Typical standard (MCL) setting process accounts for occurrence, risk reduction, feasibility of treatment, and economic impact to community**

# Final Thoughts on PFAS

- Madison's current monitoring goes above and beyond SDWA requirements
- No test requirements; no standard method; no standard list of PFAS
- No regulatory or public health agency (US EPA, PHMDC, WI DHS, WDNR) that oversees our work has warned that Well 15 water is not safe for human use or recommended that we take Well 15 out of service
- MWU believes in transparency – doing the tests, communicating the results, and helping our customers understand the significance of these results
- Although the issue is complex and uncertain, MWU is responsive to new science and the evolving regulatory environment
- Finally, MWU is committed to delivering water that is safe for all customers including the most vulnerable in our community