

# Landfill Leachate PFAS Management Options

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January 27, 2020

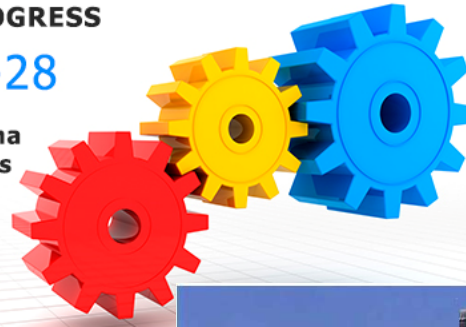
2020 Joint Summit

PARTNERS IN PROGRESS

January 26-28

Wyndham Lake Buena  
Vista Disney Springs  
Resort Area

Lake Buena Vista, FL



# Outline

- PFAS Sources
- Chemistry
- PFAS in FL
- PFAS Regulations
- Treatment Options
- Summary

# PFAS Related Health Effects

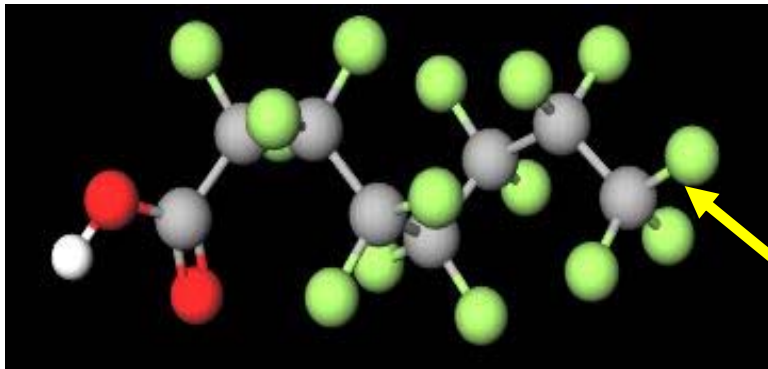
Studies have shown:

- Increased Cancer risk:
  - Colon
  - Kidney
  - Pancreatic
- Affect the immune system
- Increase cholesterol

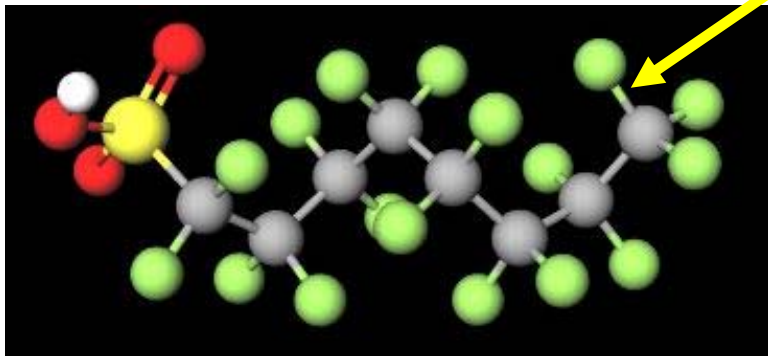


# PFAS Structure

## PFOA Perfluorooctanoic acid



## PFOS Perfluorooctanesulfonic acid



Strong  
C-F bonds

	kJ/mol of bonds
<b>C-F</b>	<b>485</b>
C-H	436
C-C	346
C-Cl	339
C-N	305
C-Br	285
C-S	272

Sometimes you may hear **C8** Chemicals-  
That's PFAS.



# PFAS is Everywhere



# PFAS Contamination- New Mexico Dairy



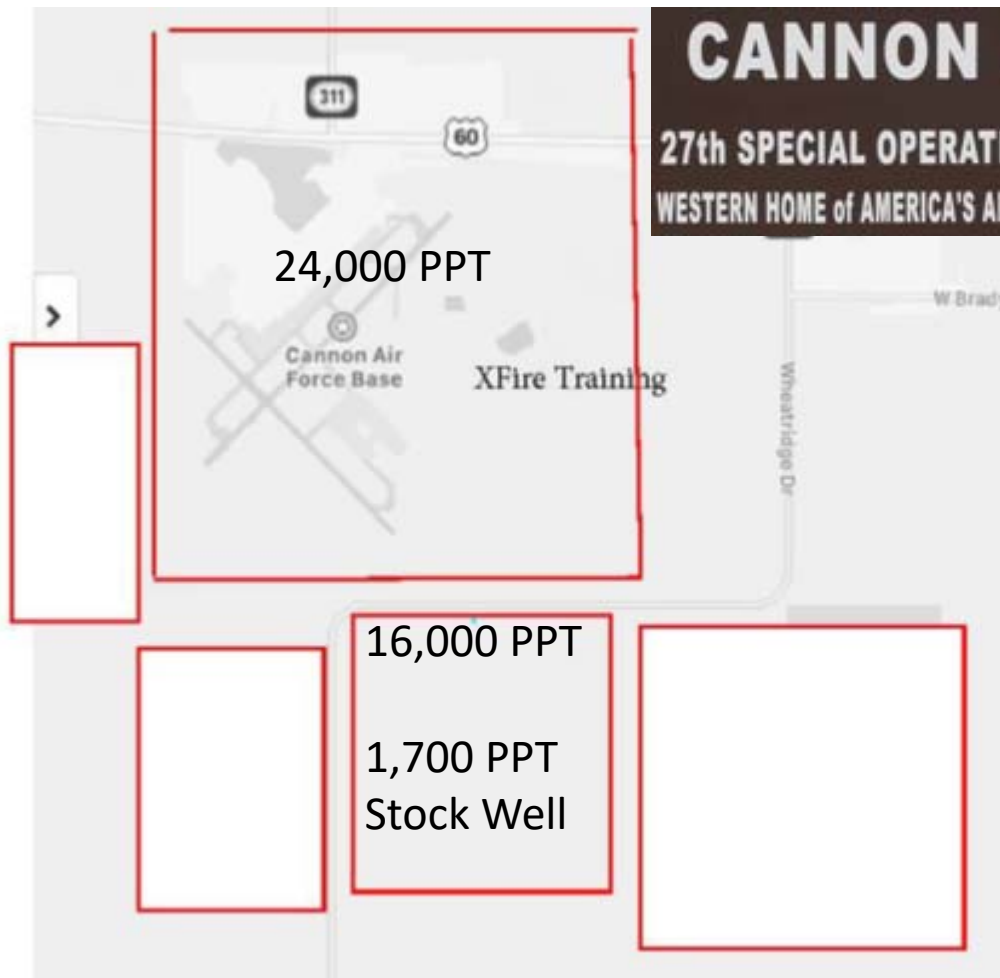
Cows were supplied with Water with 1,700 PPT PFAS.

The Milk had 700 PPT PFAS

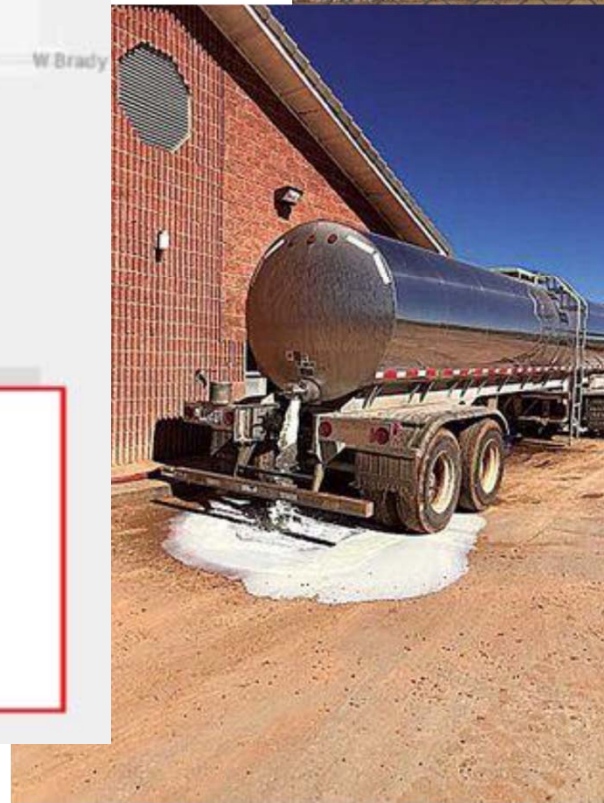




# NM Dairy next to Cannon AF Base 8K-12K gpd milk Poured to Ground



**CANNON AFB**  
27th SPECIAL OPERATIONS WING  
WESTERN HOME of AMERICA'S AIR COMMANDOS



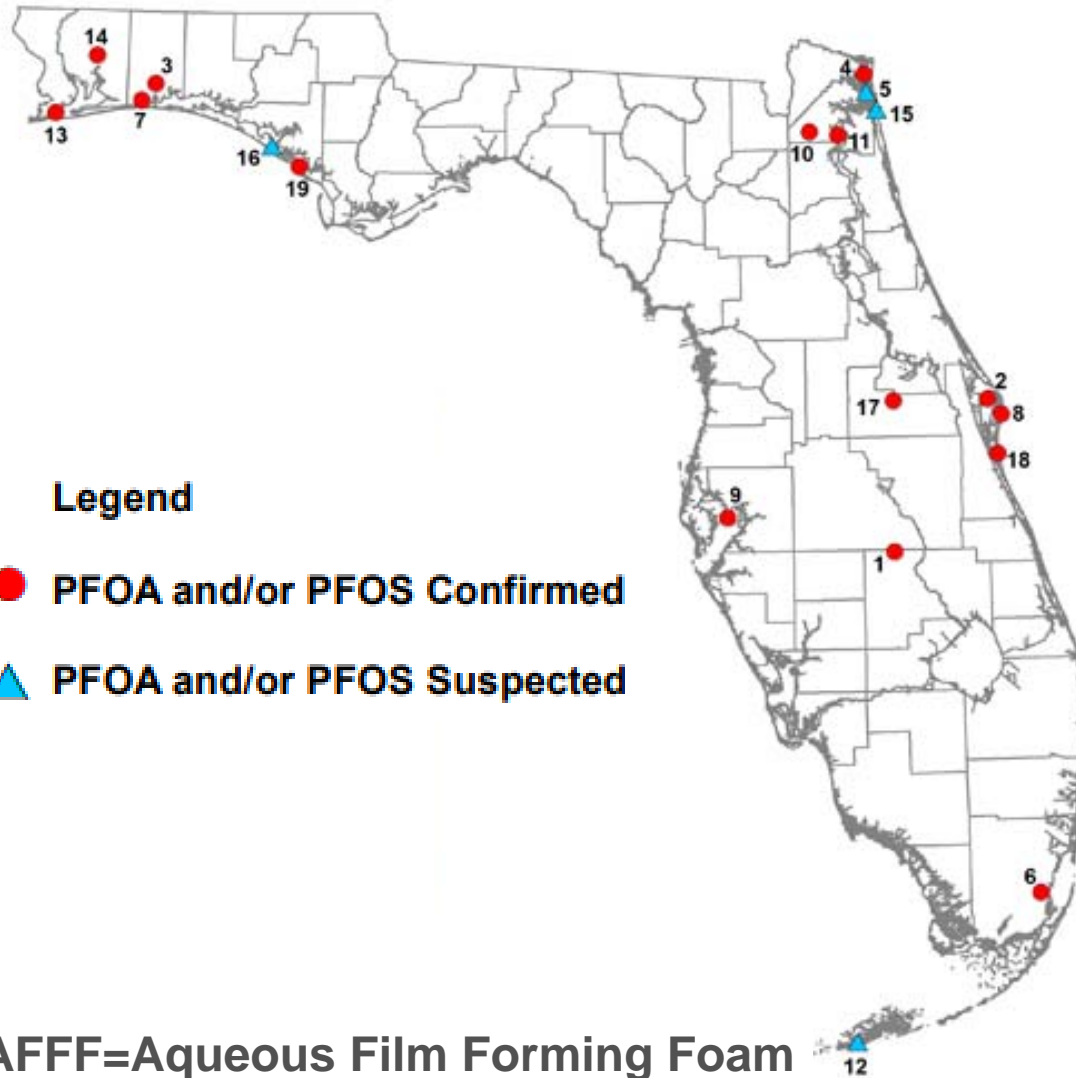
# PFAS in FL Drinking Water (Max. PPTs)

1. Miami Dade Water and Sewer Authority (65 PPT)
2. City of Miami Beach (82 PPT)
3. MIA (47 PPT)
4. City of North Miami (50 PPT)
5. City of Stuart (286 PPT)
6. City of Zephyrhills (337 PPT)
7. Florida State Fire College, Ocala (270,000 PPT)
8. Eglin Air Force Base
9. (280,000 PPT)
10. Naval Air Station Pensacola (126,300 PPT)
11. Emerald Coast Utilities Authority (694 PPT)





# PFAS in Federal Facilities using AFFF

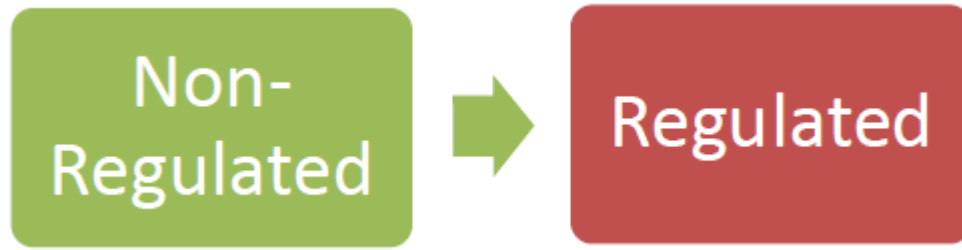


ID	Federal Facility
1	Avon Park AFR
2	Cape Canaveral AFS
3	Eglin AFB
4	FANG 125th Fighter Wing
5	Fleet Logistics Center/Jacksonville
6	Homestead ARB (Active and Former)
7	Hurlburt Field
8	Kennedy Space Center
9	MacDill AFB
10	Former NAS Cecil Field
11	NAS Jacksonville
12	NAS Key West (Active and Former)
13	NAS Pensacola Complex: NAS Pensacola, Corry Station, OLF Bronson Field, Saufley Field
14	NAS Whiting Field
15	Naval Station Mayport
16	NSA Panama City
17	Former NTC Orlando
18	Patrick AFB
19	Tyndall AFB

Source: floridadep.gov

# PFAS Regulations

- 2016 EPA issued Health Advisory for PFOA and PFOS limit of 70 ppt
- 2019 EPA has developed PFAS Action Plan to begin developing a Drinking Water Standard for PFAS
- Several States have established PFAS drinking water limits / advisories



## EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan



U.S. Environmental Protection Agency

# PFAS Regulations

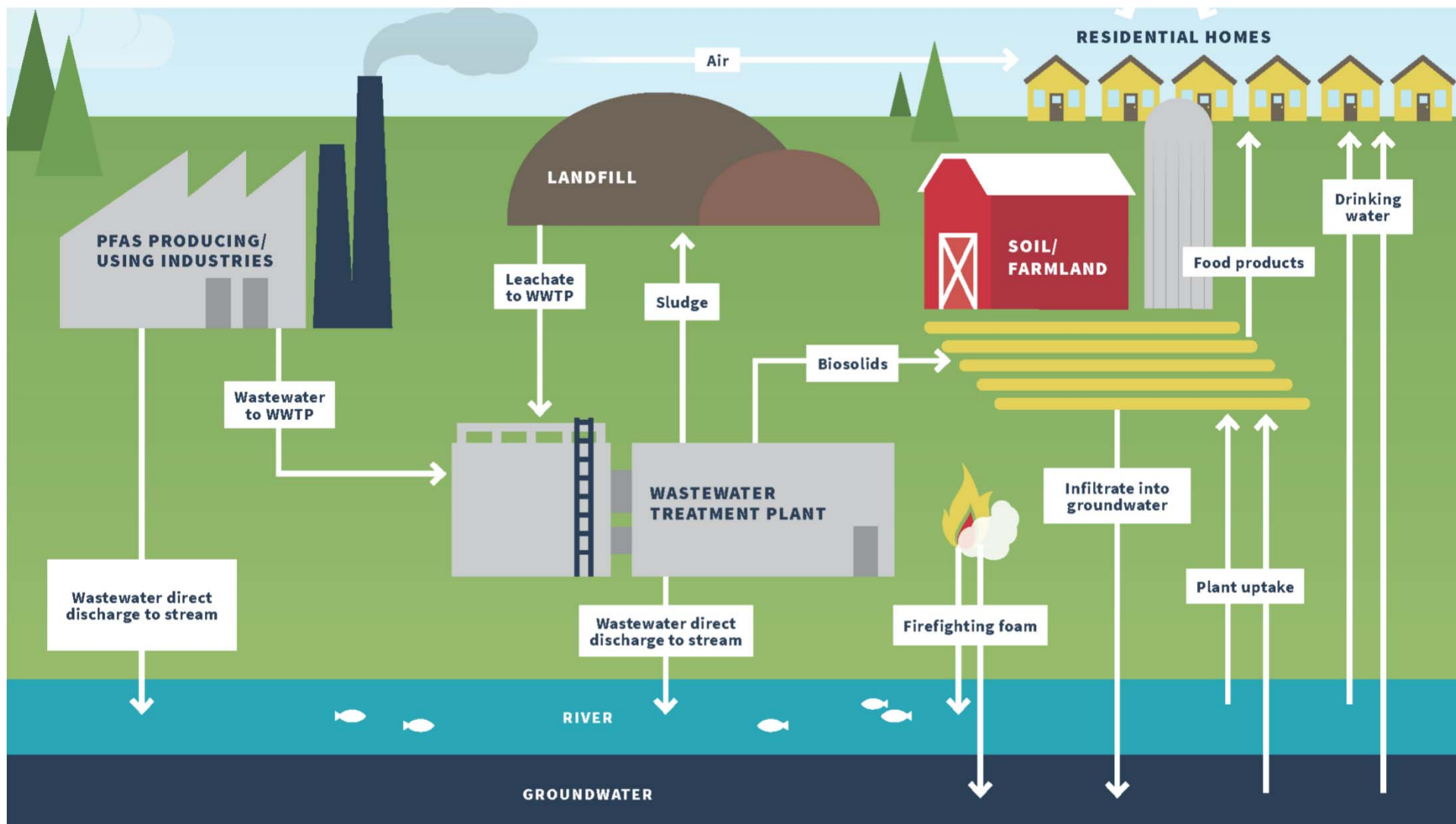


State	PFOA	PFOS
Alaska	70	70
California	<b>5.1</b>	<b>6.5</b>
Colorado	70	70
Delaware	70	70
Florida	70	70
Iowa	70	70
Maine	400	400
Massachusetts	70	70
Michigan	<b>9</b>	<b>8</b>
Minnesota	<b>35</b>	<b>15</b>
Montana	70	70
Nevada	667	667
New Hampshire	<b>12</b>	<b>15</b>
New Jersey	<b>14</b>	<b>13</b>
North Carolina	2,000	TBD
Oregon	24,000	300,000
Pennsylvania	70	70
Rhode Island	70	70
Texas	290	560
Vermont	<b>20</b>	<b>20</b>

Concentrations in ng/L (PPT)

ITRC, 2019

# PFAS Transport Pathways to Water

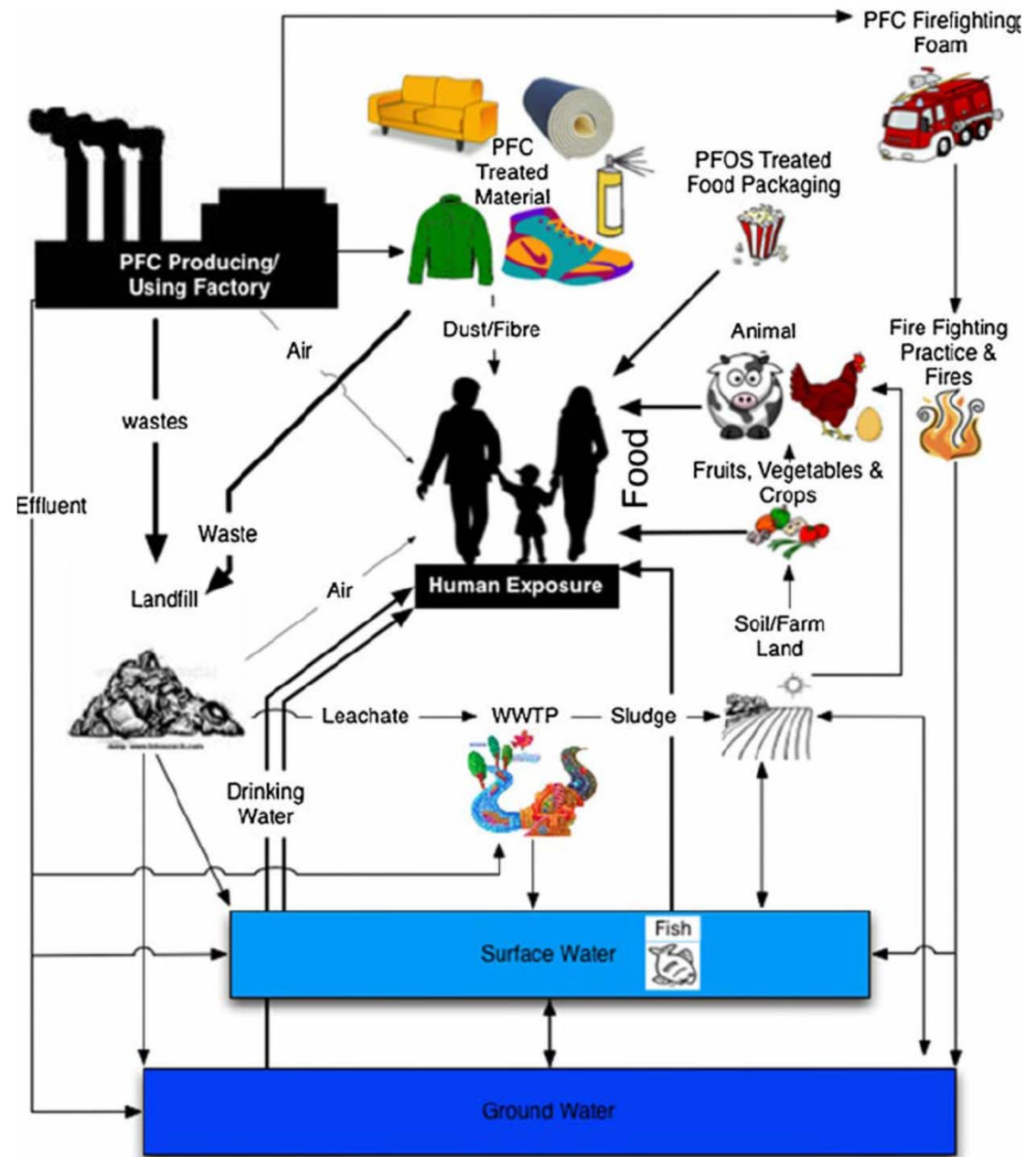


Source: MI DEQ (2019)



# PFAS Exposure Pathways:

- Bioaccumulation
  - food chain
- Inhalation
  - Indoor Dust
  - Airborne particulates
- Oral
  - Food
  - Drinking water



# Limited Analytical Methods

## EPA 537.1

- SPE LC-MS/MS
- 18-33 Compounds
- For drinking water
- Holding time: 14 days for extraction
- Typical RL: 5 - 25 ppt
- ~ \$250-400/sample
- Approximate 40 laboratories

## Sample collection:

- Cross contamination



# PFAS Sources: Landfills

- Consumer products
- Industrial waste
- Construction debris
- Biosolids from WWTPs
- Landfill leachate
  - a source of PFAS for WWTP
- Landfill gas condensate
- Ambient air around landfills



# PFAS Levels (PPT) from Landfill Leachates

PFAS Compounds	Minimum	Maximum
<b>Michigan Landfills (32)</b>		
PFOA	16	3,200
PFOS	9	960
<b>USA</b>		
PFOA	30	5,000
PFOS	3	800
<b>Europe</b>		
PFOA	ND	1,000
PFOS	ND	1,500
<b>Australia</b>		
PFOA	17	7,500
PFOS	13	2,700
<b>China</b>		
PFOA	281	214,000
PFOS	1,150	6,020



MWRA Report,  
March, 2019



# PFAS Cycle between Landfills and WWTPs

Biomass  
containing  
PFAS



Leachate  
containing  
PFAS

# PFAS Treatment

- GAC (Granular Activated Carbon)
- IX (Ion Exchange)
- RO (Reverse Osmosis)

# Typical GAC Process

- Influent/Second GAC vessels

- "Lead" & "Lag"

- Monitoring

- Influent
  - Mid-point
  - Effluent

- Carbon Change Out

- Lead to reactivation
  - Lag to lead
  - New to lag

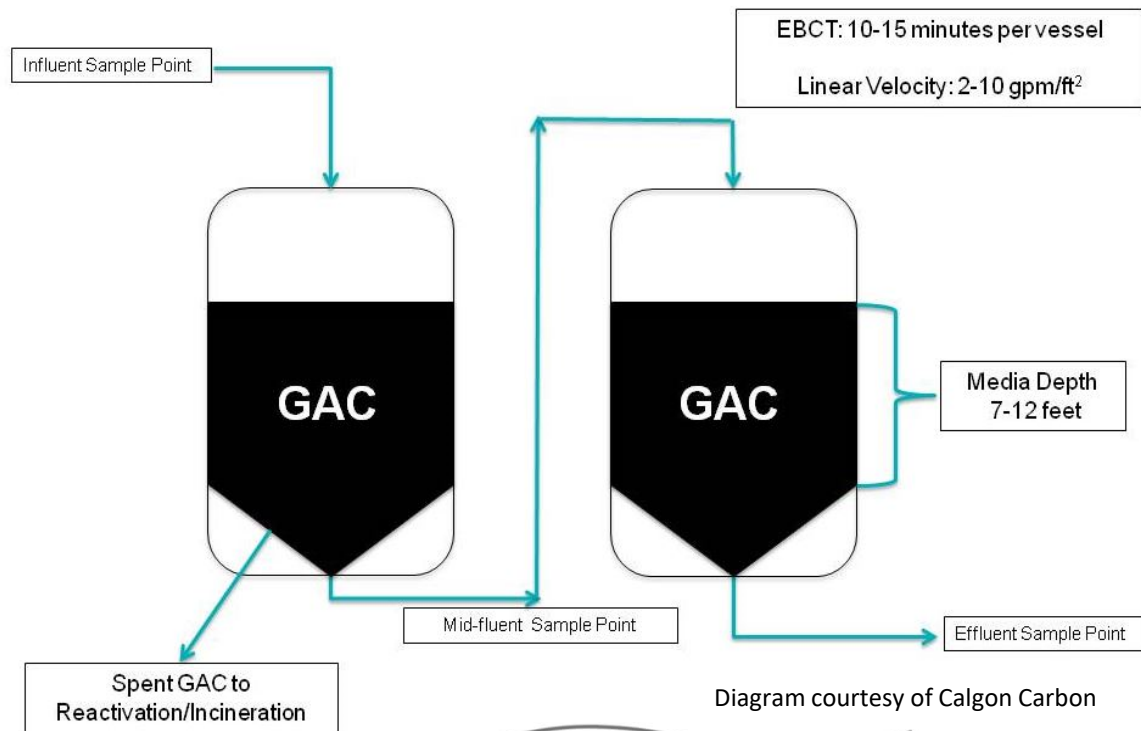
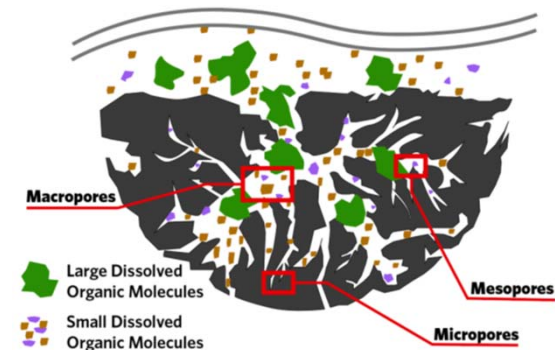


Diagram courtesy of Calgon Carbon



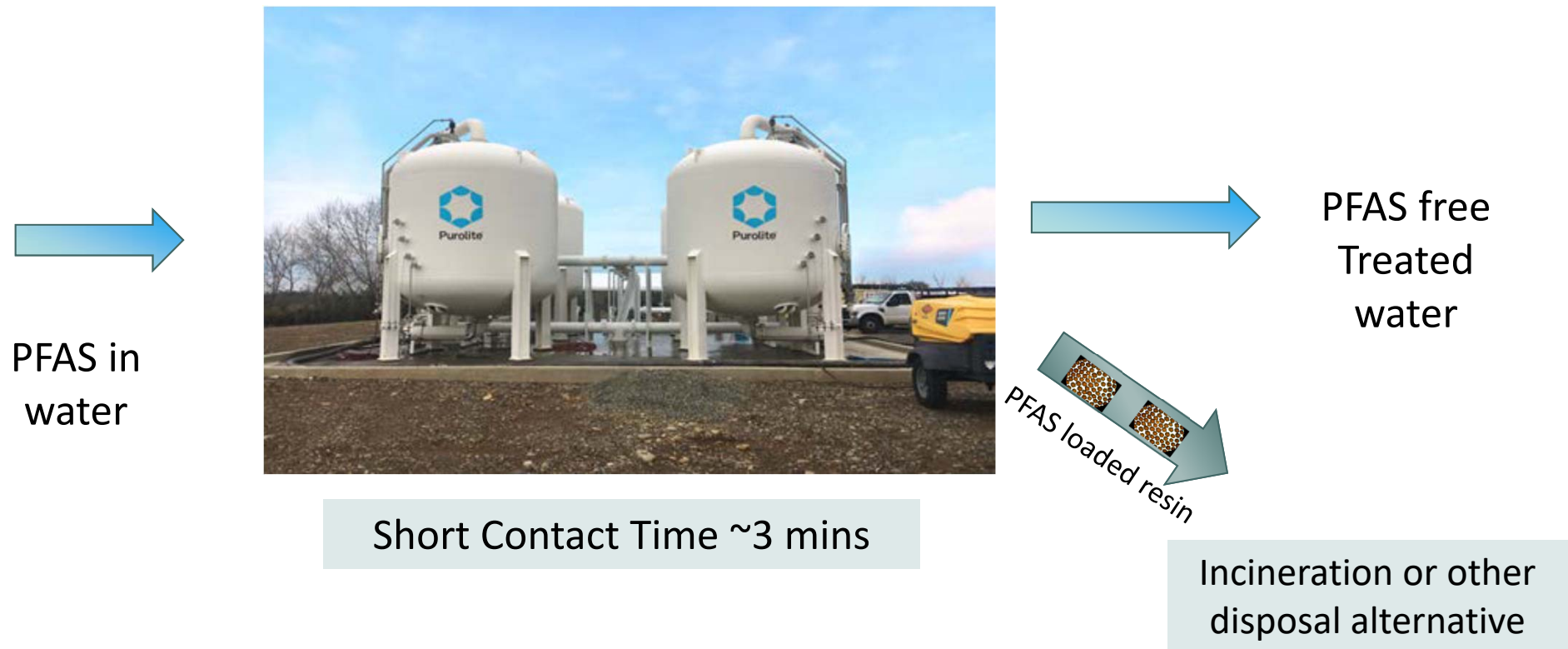
# PFAS Treatment: GAC

- May require pretreatment
- Effectiveness depends on:
  - pH
  - Temperature
  - contact time
  - NOM
  - Chlorine
- Better for long-chain PFAS
- No brine and chemicals
- GAC may be cost-effective





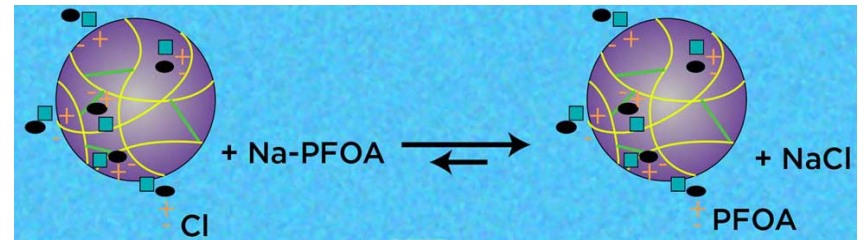
# PFAS Treatment: Ion Exchange (IX)



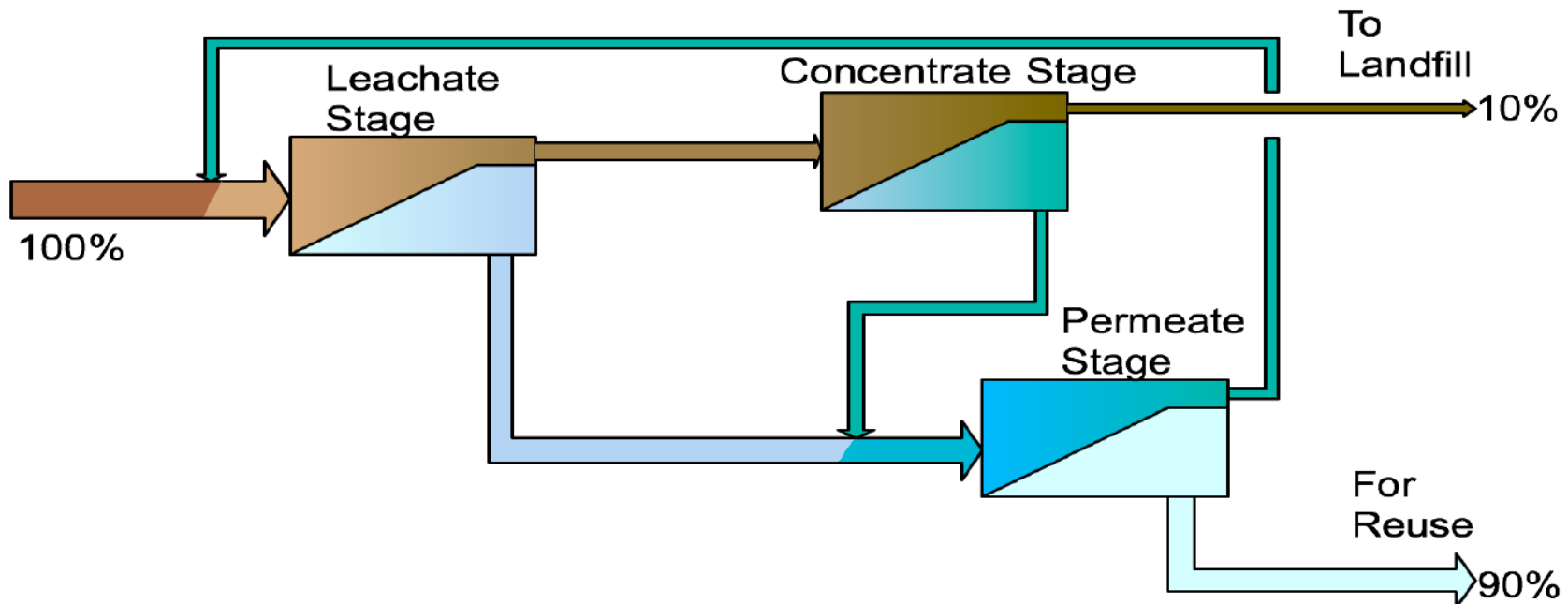
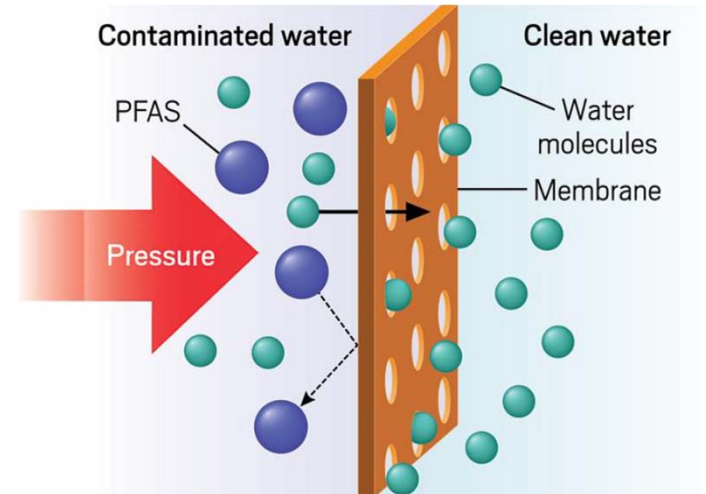
Illustrations courtesy of Puro-lite, Inc.

# PFAS Treatment: Ion Exchange (IX)

- PFAS are anions - IX can remove
- Longer PFAS chains preferred over shorter chains
- Resins disposed offsite (incineration)



# PFAS Treatment: Reverse Osmosis (RO)





# PFAS Treatment Using RO (SCS Design)



New Hanover County, NC (2017)



Starting New RO Study/Design-  
Escambia County, FL (2020)



# PFAS Treatment Efficiencies

Treatment Method	PFOA	PFOS	Considerations
Granular Activated Carbon	48-90%	89-98%	Requires regeneration or replacement and disposal. May release PFAS into the atmosphere
Ion Exchange	51-90%	90-99%	Resins need to be regenerated or replaced
Reverse Osmosis	90%	93-99%	Waste stream contains salts, and filtrate require disposal.

# Deep Well Injection

- Inject far below drinking water sources
- Construction is Costly ~\$4-6 M/Well
- Clogging well during injection may be an issue
- 3rd Party accepting 0.18-0.25/Cents Gallon

# SUMMARY - PFAS Treatment

- PFAS removal may be Influenced by:
  - pH, water temperature, contact time, Organics and Chlorine compounds
- Treatment is site specific (pilot testing)
- Polishing Step may be required
- Disposal of PFAS waste generated during PFAS treatment is important



# QUESTIONS?

## Landfill Leachate PFAS Management Options

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SCS ENGINEERS

Plan to attend SCS  
Chaired PFAS  
Sessions:

1. SWANAPalooza 2020  
(Atlanta)
2. WasteExpo 2020 (New  
Orleans)

