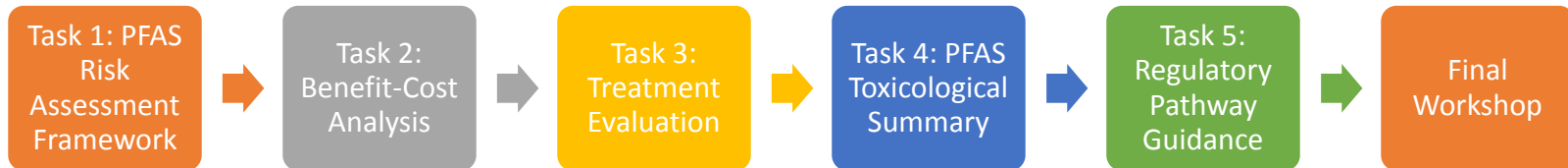
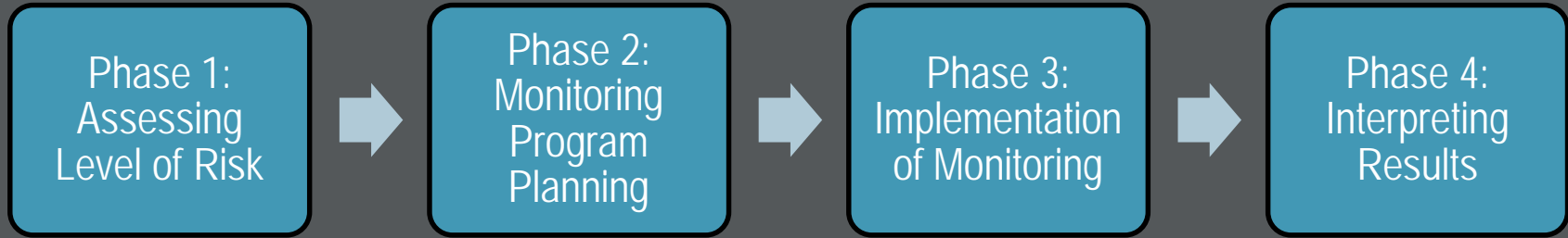




# Project Overview and Goals

- AWWA would like to provide information to help inform federal policy makers and assist utilities and sections with state-level policy discussions.
  - Provide evaluation strategy to assess water system risk
  - Summarize benefit-cost analysis
  - Prepare white paper on drinking water treatment technology
  - Summarize health risk of PFAS
  - Prepare white paper evaluating alternative strategies for regulating PFAS
  - Provide guidance for using strategic communications for PFAS crisis communication





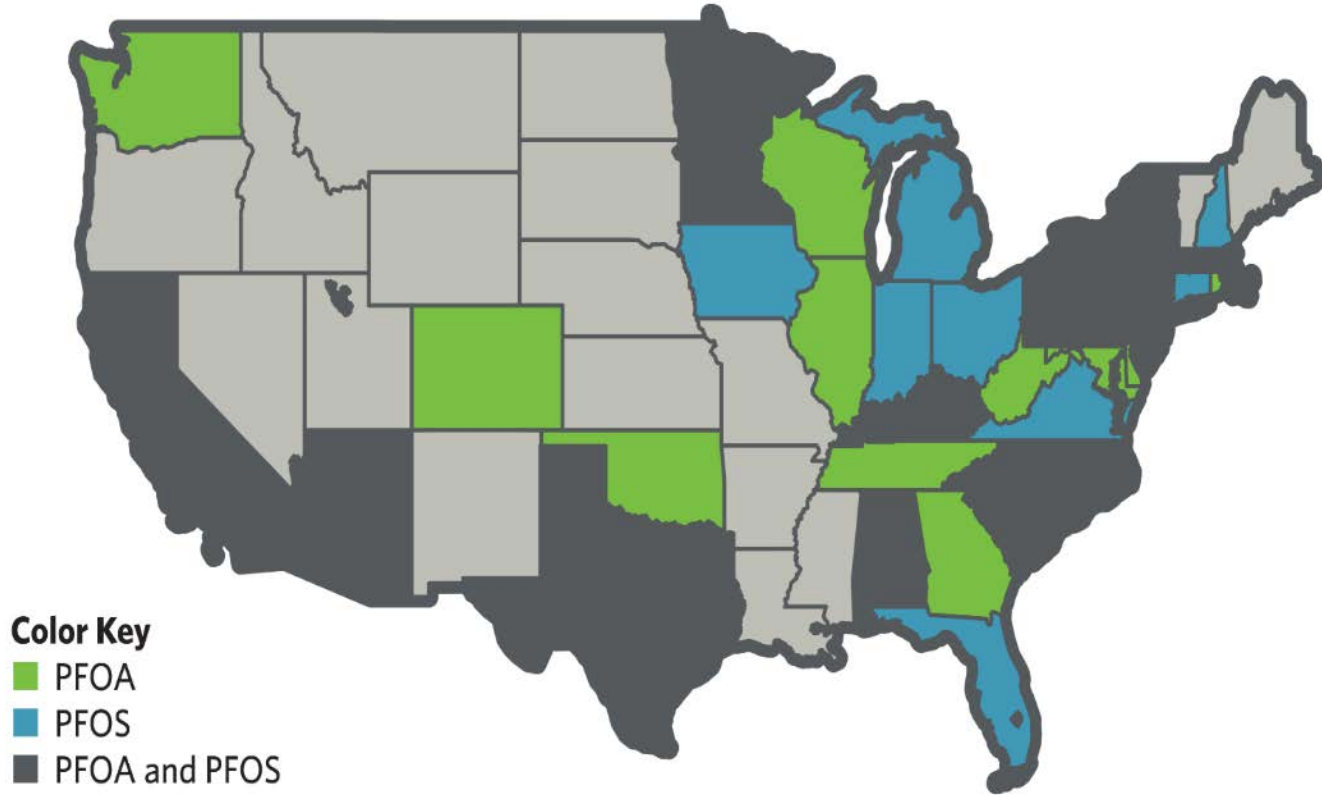
# RISK ASSESSMENT GUIDE

Phases of Assessment

# PHASE 1: ASSESSING THE LEVEL OF RISK

## States with PFOS and PFOA Detections during UCMR3

- Many utilities unexpectedly identified PFAS in their drinking water
- First step in assessing PFAS risk: evaluate the potential for PFAS occurrence in source water
- State sampling campaigns underway (MI, CA, NJ, PA, NC)



# PHASE 1: ASSESSING THE LEVEL OF RISK

State	Waters Sampled	PFAS Measured
Michigan	Surface water, finished water	FtS 4:2*, PFBS, PFBA, PFPeS*, PFPeA*, PFHxA, PFHxS, FtS 6:2, PFHpA, PFHpS*, PFOS, PFOA, PFOSA*, FtS 8:2*, N-EtFOSAA, N-MeFOSAA, PFNS*, PFNA, PFDS*, PFDA, PFUnA, PFDoA, PFTriA, PFTeA
California	Groundwater, surface water, finished water	PFOS, PFOA
New Jersey	Groundwater, surface water, finished water	PFBS, PFBA, PFPeA, PFHxA, PFHxS, PFHpA, PFOS, PFOA, PFNA, PFDA
Pennsylvania	Groundwater, surface water	PFBS, PFHxS, PFHpA, PFOS, PFOA, PFNA
North Carolina	Groundwater, surface water, finished water	HFPO-DA, 4:2 FtS, 6:2 FtS, 8:2 FtS, NetFOSAA, NMeFOSSA, PFBA, PFBS, PFDA, PFDoA, PFDS, PFHpA, PFHpS, PFHxA, PFHxS, PFNA, PFOA, PFOS, PFPeA, PFTreA, PFTriA, PFUnA, FOSA, PFNS, PFPeS, PFTrDA, PFUdA, PFESA BP1, PFESA BP2, PFMOAA, PFO2HxA, PFO3OA, PFMOBA, PFMOPrA, PFO4DA, PFTeDA

# PHASE 2: MONITORING PROGRAM PLANNING

- Risk increase depending on proximity to PFAS source
  - Design sampling plan with consideration of PFAS point source proximity
- Significant detection of PFAS at:
  - Military fire training base
  - Manufacturing sites

## Point Sources



Aqueous Film  
Forming Foam  
(AFFF)



Industrial  
discharge

## Non-Point Sources



Landfills and  
leachates



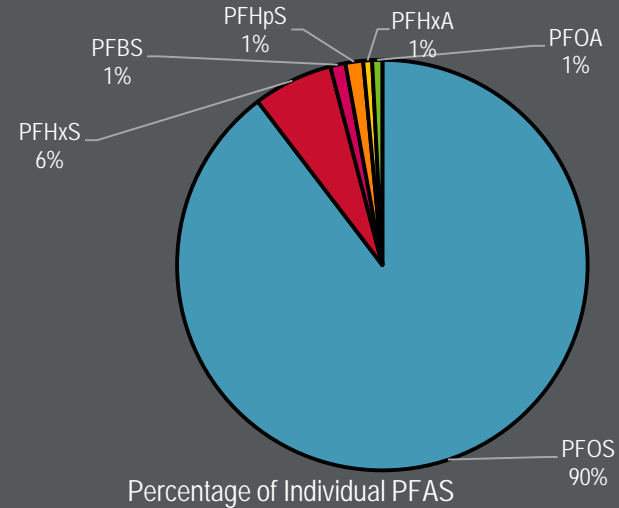
Land application of  
WWTP biosolids

# CONTAMINATION SOURCE: AFFF

- Aqueous Film Forming Foam
  - Used for Class B combustible and flammable liquid fuel fires
  - Assist with extinguishing fires quickly (more effective than water)
- Military fire training areas were correlated well with PFOS, PFOA, PFHxS and PFHpA



Aqueous Film  
Forming Foam  
(AFFF)

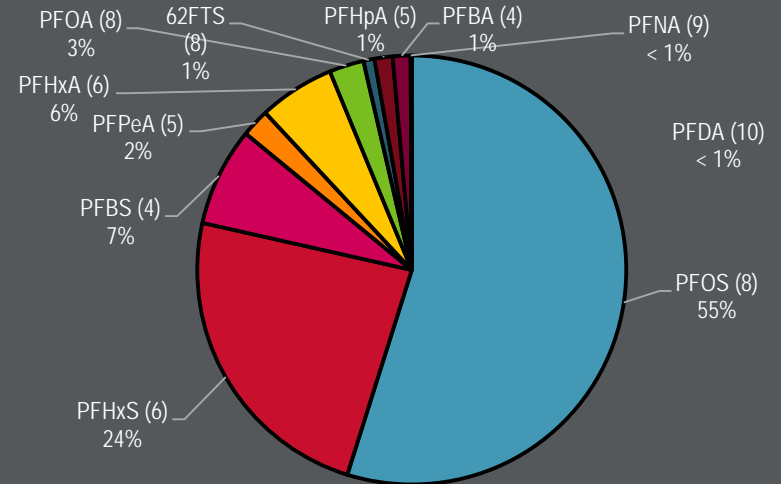


# CONTAMINATION SOURCE: INDUSTRIAL

- Industrial facilities:
  - Teflon® manufacturers,
  - electroplating facilities,
  - cleaning product manufacturers
- Impact both groundwater and surface water sources
- Strongest statistical correlation between a PFAS source and PFAS detection



Industrial discharge



PFAS Speciation in samples near historical industrial site and airport

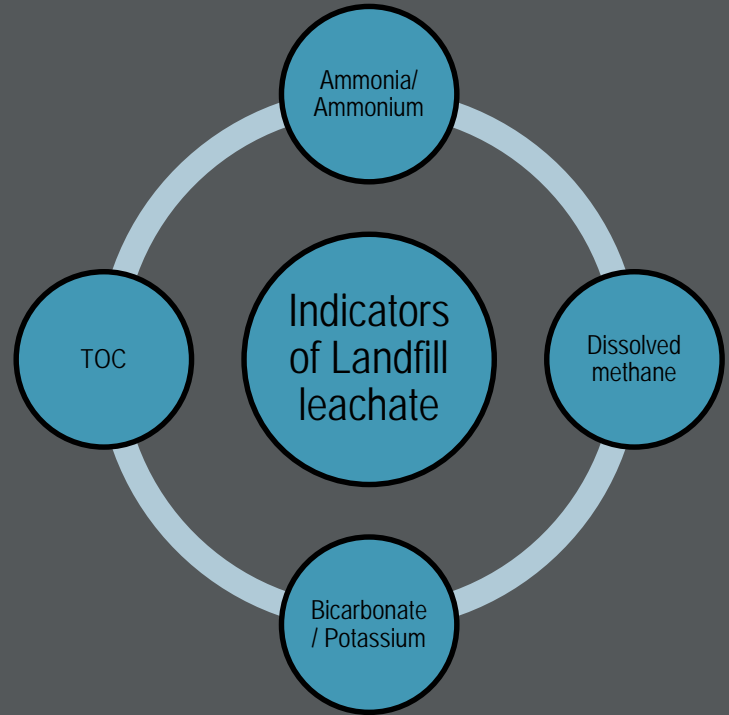


# CONTAMINATION SOURCE: LANDFILL

- Landfills/leachates are not point sources for PFAS
- Consumer products containing PFAS can affect nearby groundwater contamination
- Longer-chain PFAS: less mobility to water from soil
- Shorter-chain PFAS: higher mobility from soil to water



Landfills and  
leachates



# PFAS in Wastewater Systems

## Liquid Stream

- Most common PFAS compounds found in wastewater influent are perfluorooctane sulfonate (PFOS) and perfluorooctanoate (PFOA) with concentration typically between 5-50 ng/L (Margot et al. 2015)
- Total concentrations for common PFAS
  - 30- 150 ng/L (Margot et al. 2015)
- Removal rate of <5% during wastewater treatment and hence detected in WWTP effluent



# PHASE 3: IMPLEMENTATION OF MONITORING

- Utility should develop sampling plan
- EPA method 537.1 outlined sampling protocols:
  - Collect samples using PFAS free or high-density polyethylene containers
- Analyzed samples using certified laboratories
- Sample various locations (point source, up- and downstream)

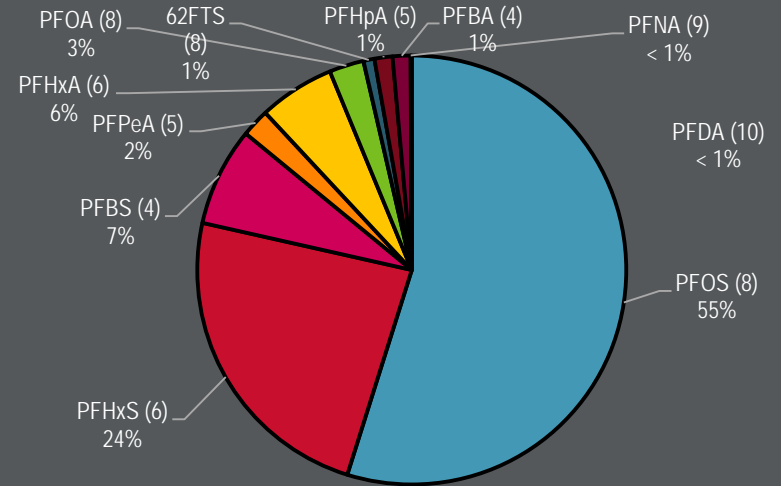


# PHASE 3: IMPLEMENTATION OF MONITORING QUANTIFICATION METHODS

Method	EPA Method 537.1	EPA Method 533	EPA Method 8327	EPA Method 8328	ASTM 7979	ASTM 7968	TOP Assay	TOF Assay	Modified EPA Method 537
Type of Sample	Drinking Water	Drinking Water	Surface Water Groundwater Wastewater	Surface Water Groundwater Wastewater	Surface Water Groundwater Wastewater Sludge (>0.2%)	Soil	Surface Water Groundwater Wastewater Biosolids Soil	Surface Water Groundwater Wastewater Biosolids Soil	Surface Water Groundwater Wastewater
Types of PFAS Observed	Perfluoroalkyl carboxylic acids, sulfonic acids, & sulfonamides and sulfonamido-acetic acids	Exact analytes unknown but focused on short-chain PFASs (4 to 7 carbon chain)	Perfluoroalkyl carboxylic acids, sulfonic acids, & sulfonamides and sulfonamido-acetic acids	Same as all target analytes for modified EPA 537 with GenX	Perfluoroalkyl carboxylic acids, Perfluoroalkyl sulfonic acids, perfluorotelomer acids, perfluoroalkyl sulfonamides	Perfluoroalkyl carboxylic acids, Perfluoroalkyl sulfonic acids, perfluorotelomer acids, perfluoroalkyl sulfonamides	Perfluoroalkyl acids	Organic fluorines	Perfluoroalkyl carboxylic acids, sulfonic acids, & sulfonamides and sulfonamido-acetic acids
Standard Procedure	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Pros and Cons	Limited capture of short-chain PFASs	Effective capture of short-chain PFASs	Procedure already used commercially	Effective capture of long-chain PFASs	Higher minimum reporting limit	Suitable for biosolids and soil	Captures all PFAAs	Surrogate measurement of fluorine compounds	Faster runs but methods are not validated or consistent
Detection Limits (ng/L or ng/kg)***	PFBS: 6.3 PFOA: 0.82 PFOS: 2.7 PFHxS: 2.4 PFHpA: 0.63 PFNA: 0.83	Draft Phase	PFBS: 10 PFOA: 10 PFOS: 10 PFHxS: 40 PFHpA: 40 PFNA: 10	Draft Phase	PFBS: 50 PFOA: 10 PFOS: 10 PFHxS: 10 PFHpA: 10 PFNA: 10	PFBS: 25 PFOA: 25 PFOS: 50 PFHxS: 25 PFHpA: 25 PFNA: 25	2	1	Varies

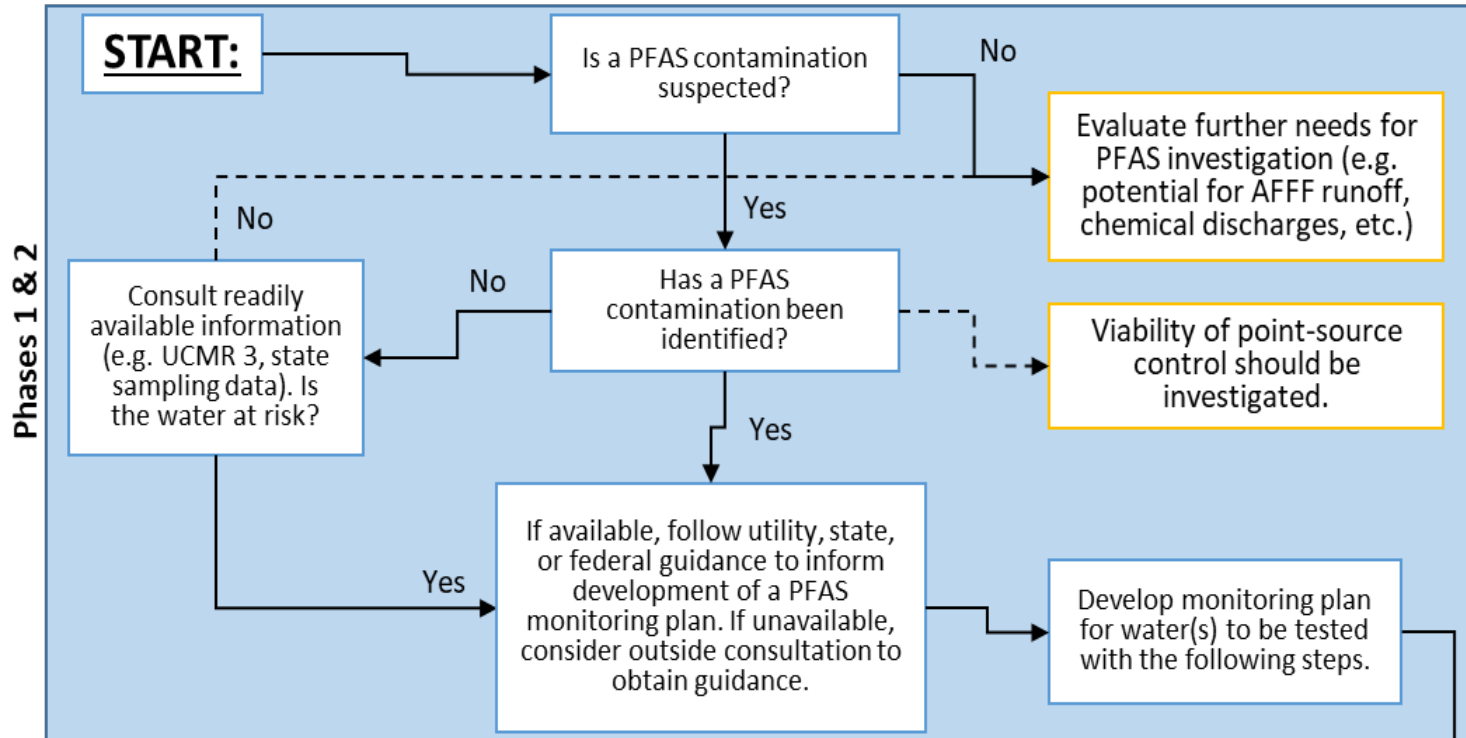
# PHASE 4: INTERPRETING RESULTS

- Fingerprinting can be helpful for determining point-source discharges
  - Measure multiple sites and compare discharge speciation to contaminated water speciation

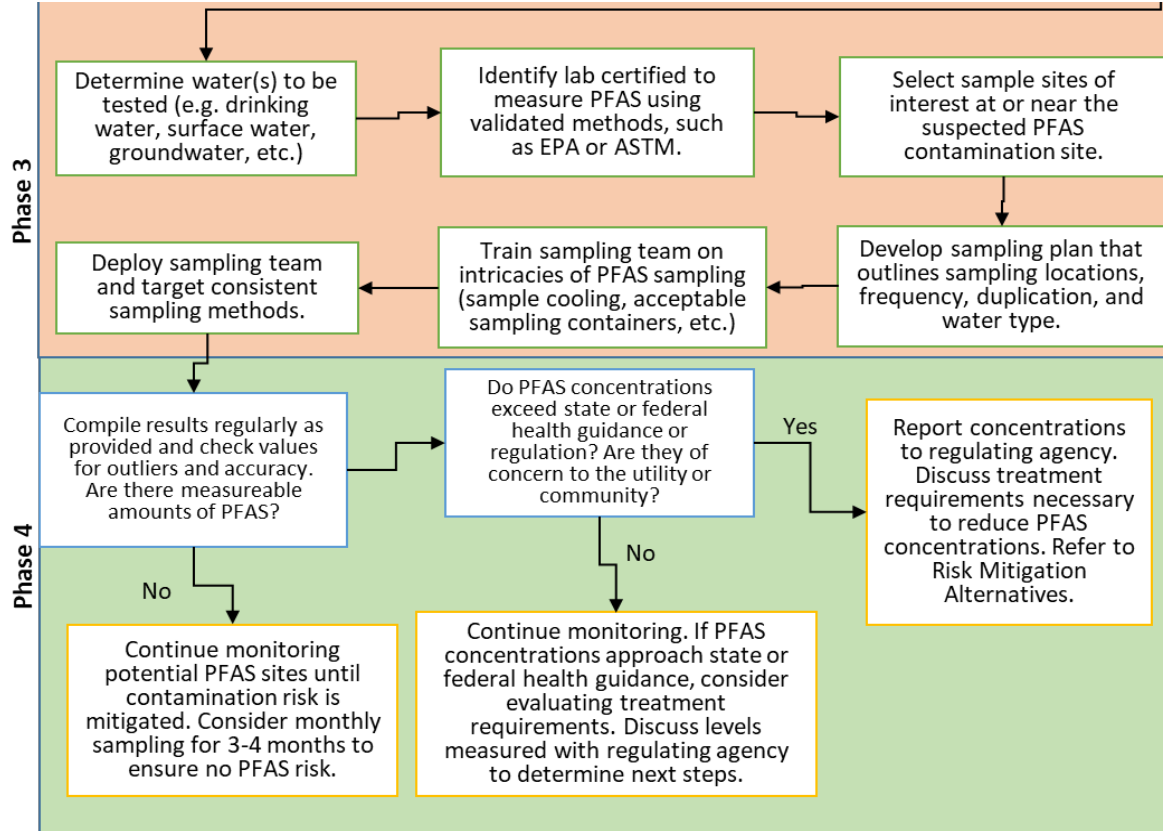


PFAS Speciation in samples near historical industrial site and airport

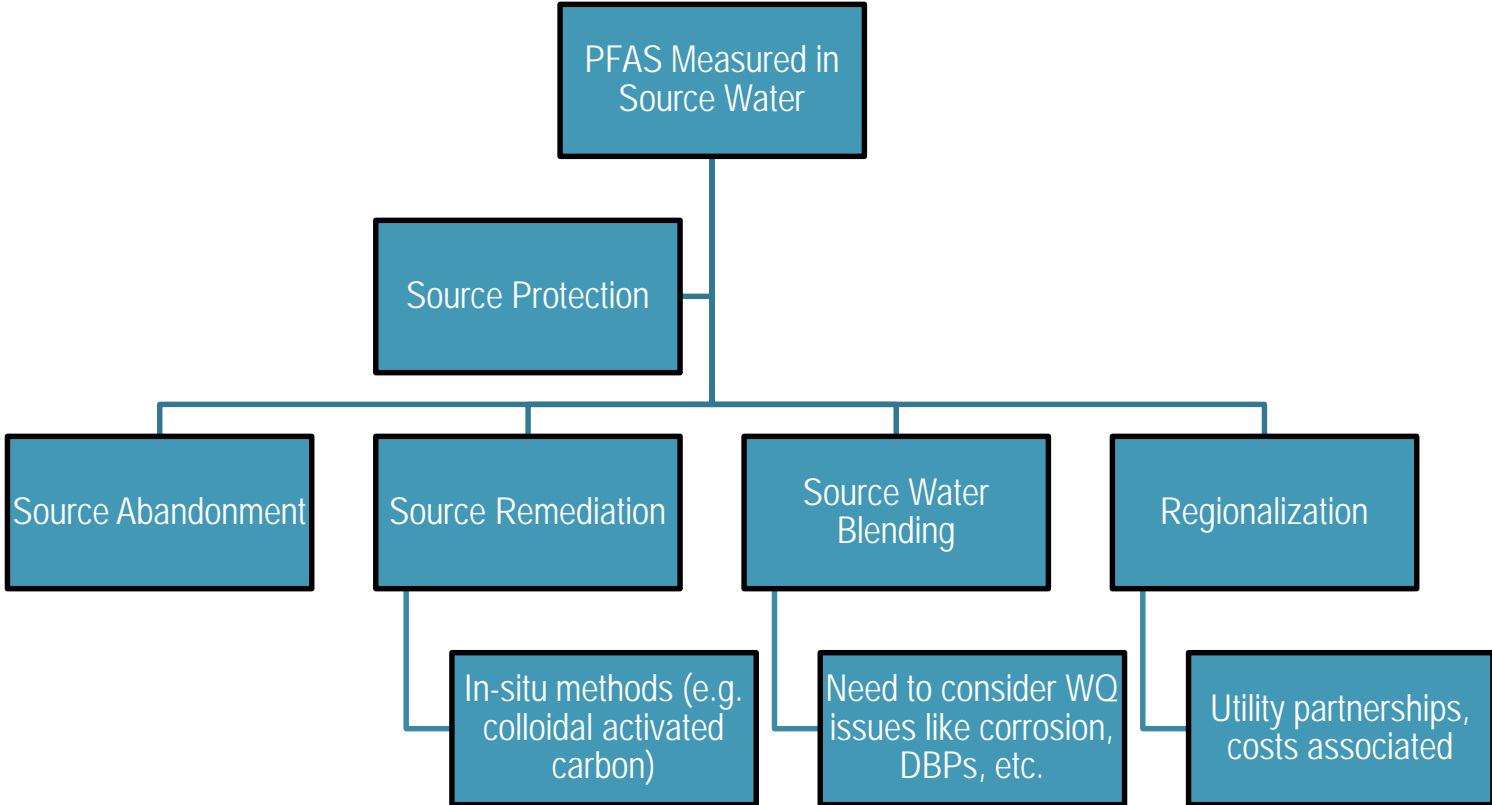
# GUIDANCE FOR MONITORING RISK OF PFAS CONTAMINATION



# GUIDANCE FOR MONITORING RISK OF PFAS CONTAMINATION



# SOURCE WATER MANAGEMENT





# RISK MITIGATION WITH PFAS TREATMENT

- PFAS Treatment
  - Treatment evaluation
  - Consider appropriate treatment technology
- Treatment Validation
  - Bench-, pilot- and full-scale
  - Review utility constraint
  - Water matrix
  - Waste disposal

Treatment Technology	PFAS Removal Effectiveness
Aeration	None
Biofiltration	Low
Chlorine	None
Chlorine Dioxide	None
Conventional Treatment (Rapid mix, flocculation, sedimentation, granular media filtration)	None
Dissolved Air Flotation	Low
Granular Activated Carbon	Moderate to High
High Pressure Membranes	High
Ion Exchange	Moderate to High
Low Pressure Membranes	None
Ozone	None
Ozone/Peroxide	Low to Moderate
Powdered Activated Carbon	Moderate to High
UV	None
UV/Hydrogen Peroxide	None

# STRATEGIC COMMUNICATIONS

