



# Minnesota's Experience with PFAS

James Kelly, M.S.

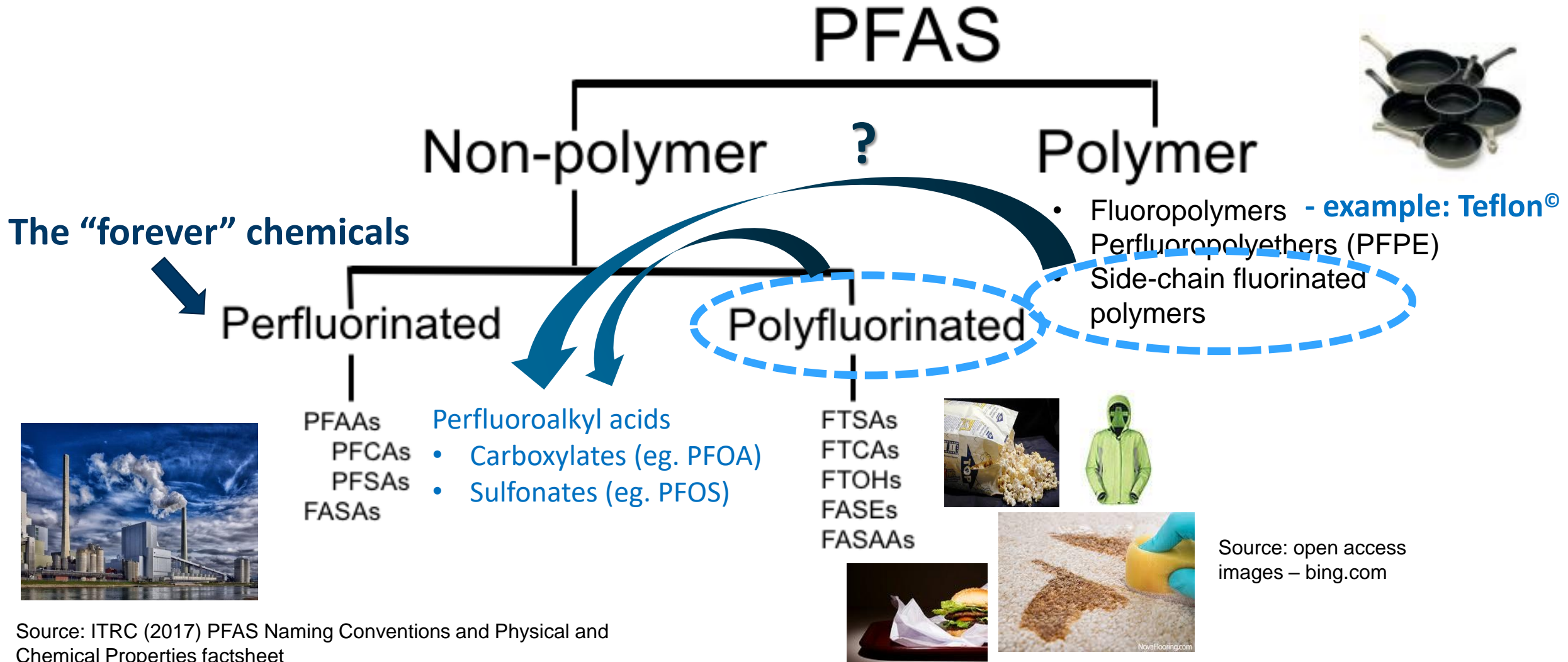
Manager, Environmental Surveillance & Assessment

# What are Per- and Polyfluoroalkyl Substances (PFAS)?

- Large class of surfactants (>4000)
- Unique chemical & physical properties (oil-repelling, water-repelling) making them very useful but also extremely persistent and mobile
- Manufactured and widely used in consumer and industrial applications since 1940/50's
- Found globally in both remote and urban settings



# The PFAS “Family Tree”



Source: ITRC (2017) PFAS Naming Conventions and Physical and Chemical Properties factsheet

Source: open access images – bing.com

# PFAAs in the Environment

- Chain length and functional group help predict where PFAAs are most likely to be found

## Little/no bioaccumulation

## Bioaccumulate

Short-chain PFCAs				Long-chain PFCAs				
PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnA	PFDoA
PFBS	PFPeS	PFHxS	PFHpS	PFOS	PFNS	PFDS	PFUnS	PFDoS
Short-chain PFSA				Long-chain PFSA				

Source: ITRC (2017)  
PFAS Naming  
Conventions and  
Physical and Chemical  
Properties factsheet

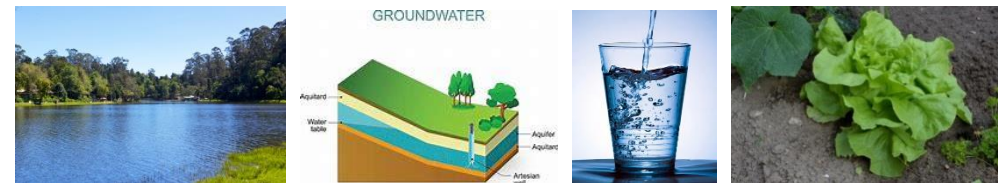
- Longer chain and/or sulfonate: relatively less water soluble & more bioaccumulative

- Soils & sediments
- Animals & humans



- Shorter chain and/or carboxylate: relatively more water soluble & less bioaccumulative

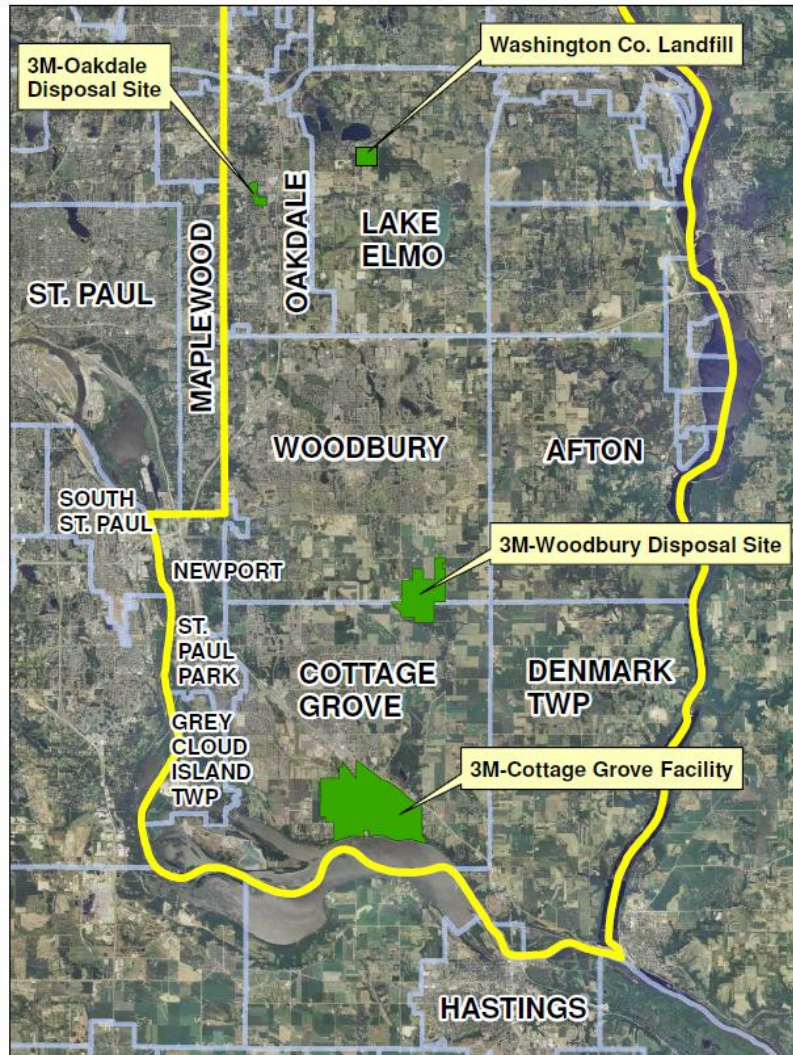
- Surface water, groundwater, drinking water
- Plants



- BUT: once in water all PFAAs are mobile to some extent



# Why Minnesota?



## Location of Legacy PFAS Sites in Washington Co., Minnesota



- 2002 – MPCA request for PFOS & PFOA guidance
- 2003 - extensive testing of public and private water supplies in Washington County
- 2004 - PFOA and PFOS detected in Oakdale municipal wells

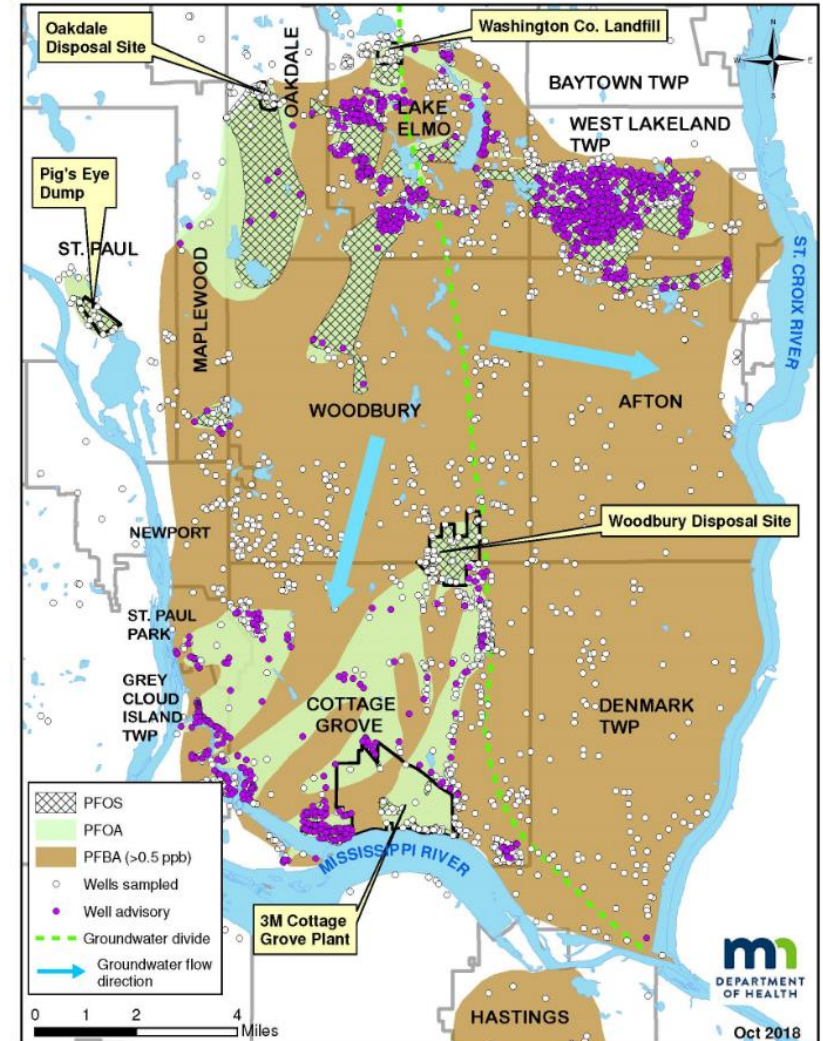
# Initial Response Activities

- Focused on the extent and magnitude and addressing community concerns – PFOA and PFOS
- Source investigations and plume delineation (by sampling many public and private wells)
- Water guidance development
- Water filtration study (funded by legislature)
- Garden produce study in East Metro
- Biomonitoring study (funded by legislature)
- Health outcome reports (e.g. cancer incidence, birth outcomes)

# East Metro PFAS Issue Expands

## 2006 – a perfect storm

- Expanded laboratory list (PFBA, PFPeA, PFHxA, PFBS, & PFHxS)
- Lower detection limits
- Lowering guidance values
- Area of impact greatly expanded (mainly due to **PFBA**)
- Area of impact was >> models predicted



# Health Concerns of PFOA and/or PFOS

## ➤ Animal (lab studies)

- ❑ Developmental effects
- ❑ Endocrine effects (thyroid)
- ❑ Immunological effects
- ❑ Liver effects
- ❑ Kidney
- ❑ Hematological (blood) effects
- ❑ Neurobehavioral effects
- ❑ Tumors (liver, testicular\*, pancreatic\*)

## ➤ Human (possible links)

- ❑ Liver effects (serum enzymes/bilirubin, cholesterol)
- ❑ Immunological effects (decreased vaccination response, asthma)
- ❑ Developmental effects (birth weight)
- ❑ Endocrine effects (thyroid disease)
- ❑ Reproductive effects (decreased fertility)
- ❑ Cardiovascular effects (pregnancy induced hypertension)
- ❑ Cancer\* (testicular, kidney)

\* PFOA Only



# Setting MDH Health-Based Values for Water

**Most Sensitive (subtle) Health Effects in Animals**

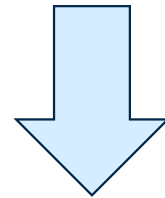
**Identify Exposure Level  $\neq$  Health Effects**

**Add Margins of Safety (100 to 300-fold)**



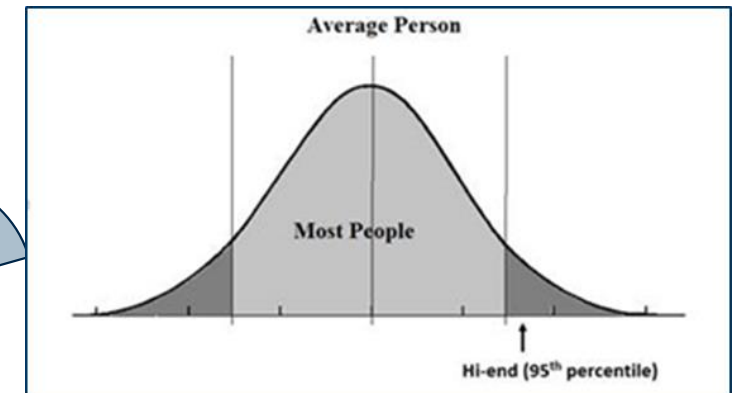
**Reference Exposure Level**

**% allowed to come from  
drinking water**



***Health-Based Value for Lifetime Exposure***

**High-End Water Intake Rate**



# Minnesota Water Guidance



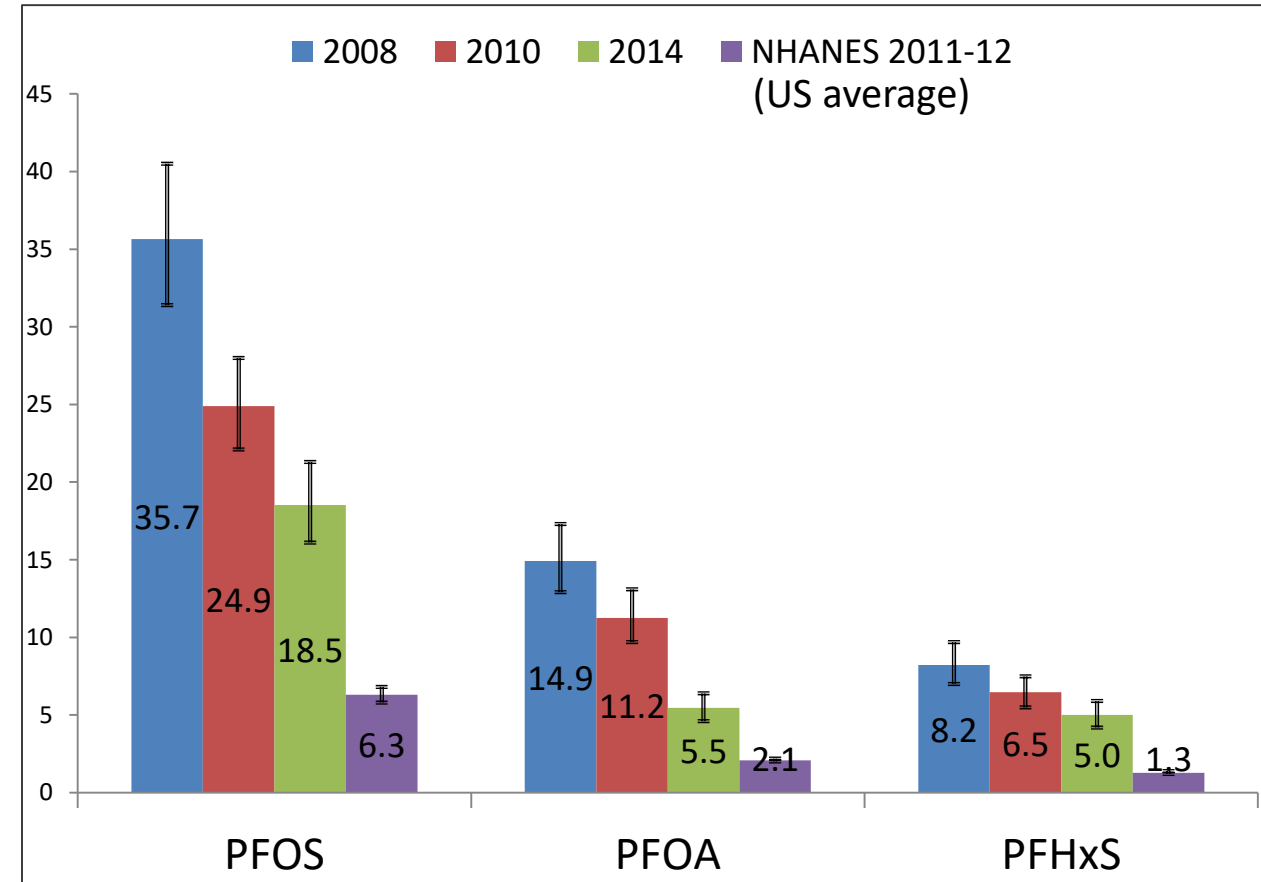
- MDH health-based guidance values evolve as new research becomes available
- Protects the most vulnerable - developing fetuses & breast-fed infants born to mothers exposed 10+ yrs.
  - Provides even greater protection for the general population
  - More than protective for cancer and other less sensitive endpoints
- MDH also evaluates the additive effect of mixtures of similar chemicals (like PFAAs)
- EPA: PFOA + PFOS < 0.07 ppb
- EPA & states looking at PFAS “group” values

	Long-chain			Short-chain	
	PFOA	PFOS	PFHxS	PFBA	PFBS
2002	7	1			
2006	1	0.6		1	
2007	0.5	0.3		7	
2009	0.3	0.3		7	7
2013	0.3	0.3	0.3	7	7
2016	0.07	0.07	0.07	7	7
2017	0.035	0.027	0.027	7	2
2019	0.035	0.015	0.047	7	2

Values in ppb      Blue = HRL; Red = HBV; Green = Surrogate

# Biomonitoring

- Exposed adults in affected East Metro communities:
  - 3 rounds: 2008, 2010, 2014
  - 196 initial participants (164 completed all 3 rounds)
- PFOS, PFOA, and PFHxS detected in 100%
- PFAS serum levels decreased for residents drinking treated water, but...
- Average concentrations > national average
- Conclusion: removing drinking water pathway key to reducing exposure



# PFAS - A Communication Challenge

## **Widely present in the environment**

Detected in air, water and wildlife

## **Evolving understanding of fate & transport**

New pathways and affected areas create sense the problem is “getting worse”

## **Evolving analytical capabilities**

Expanding analyte lists and lower detection limits = “more detections” and sense the problem is “getting worse”

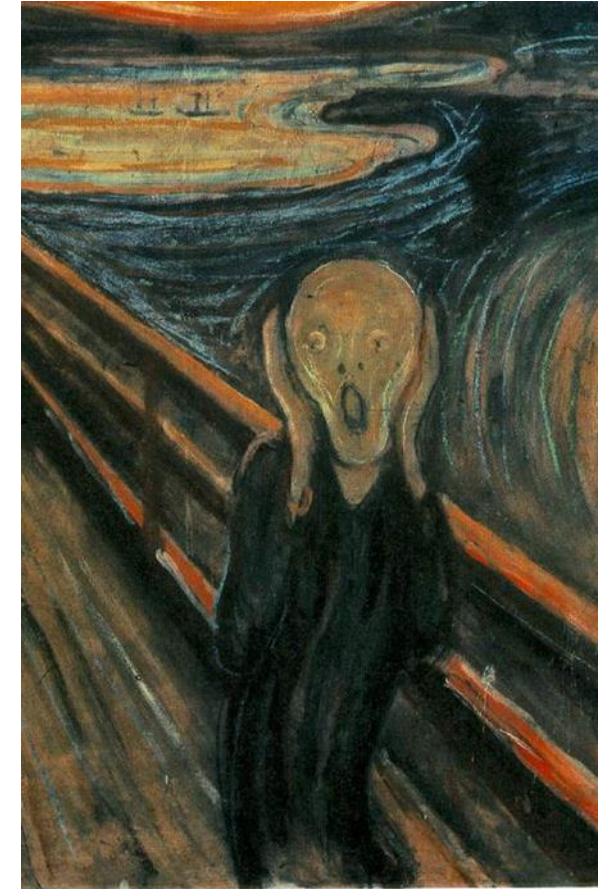
## **Evolving understanding of sources**

Primary production, industrial & consumer usage, waste disposal, etc.

## **Evolving risk assessment**

Changing/differing guidance values = public confusion and sense the problem is “getting worse”

## **Risk Communication**





# Ongoing MDH Activities

## East Metro

- Monitoring and mitigation of public systems and private wells; support settlement efforts; outreach and education
- Health Risk Advisories issued for 7 communities
  - Oakdale, Woodbury, Lake Elmo, Cottage Grove, St. Paul Park, Fridley,

## Statewide

- Tracking the science (health, analytical, fate and transport, etc.)
- Drinking Water System Sampling – Bemidji has been a focus

# PFAS Sampling – Community Water Systems

143 Community Public Water Systems (CPWSs) sampled for PFAS

- UCMR3 (2013-2015) – 84 CPWSs sampled
- UCMP (2019) – 46 CPWSs sampled

13 CPWSs have ongoing sampling for PFAS

- Started in 2006
- Sampling frequencies range from quarterly to biennial
- About 250 samples per year

## UCMR5 – PFAS expected to be included

- Will use new EPA Method 533 – published at end of 2019
  - 25 PFAS compounds
  - Lower reporting limits
- AWIA requires testing of all 3,300 – 10,000 population systems, **IF** sufficient appropriations and lab capacity are available
  - Would add 90 CPWSs to this sampling list – total of ~ 180 systems

## EPA Grant/CWF CEC Funds– Additional PFAS sampling starting in 2020

- Plan includes 125 CPWSs
- Most sites not sampled previously

# Thank you.

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651-201-4910

Slide acknowledgements: Helen Goeden, Ginny Yingling

<https://www.health.state.mn.us/communities/environment/hazardous/topics/pfcs.html>

<https://www.pca.state.mn.us/waste/perfluorochemicals-pfcs>





# PFAS in Minnesota Environmental and Source Investigation



# Environmental Monitoring

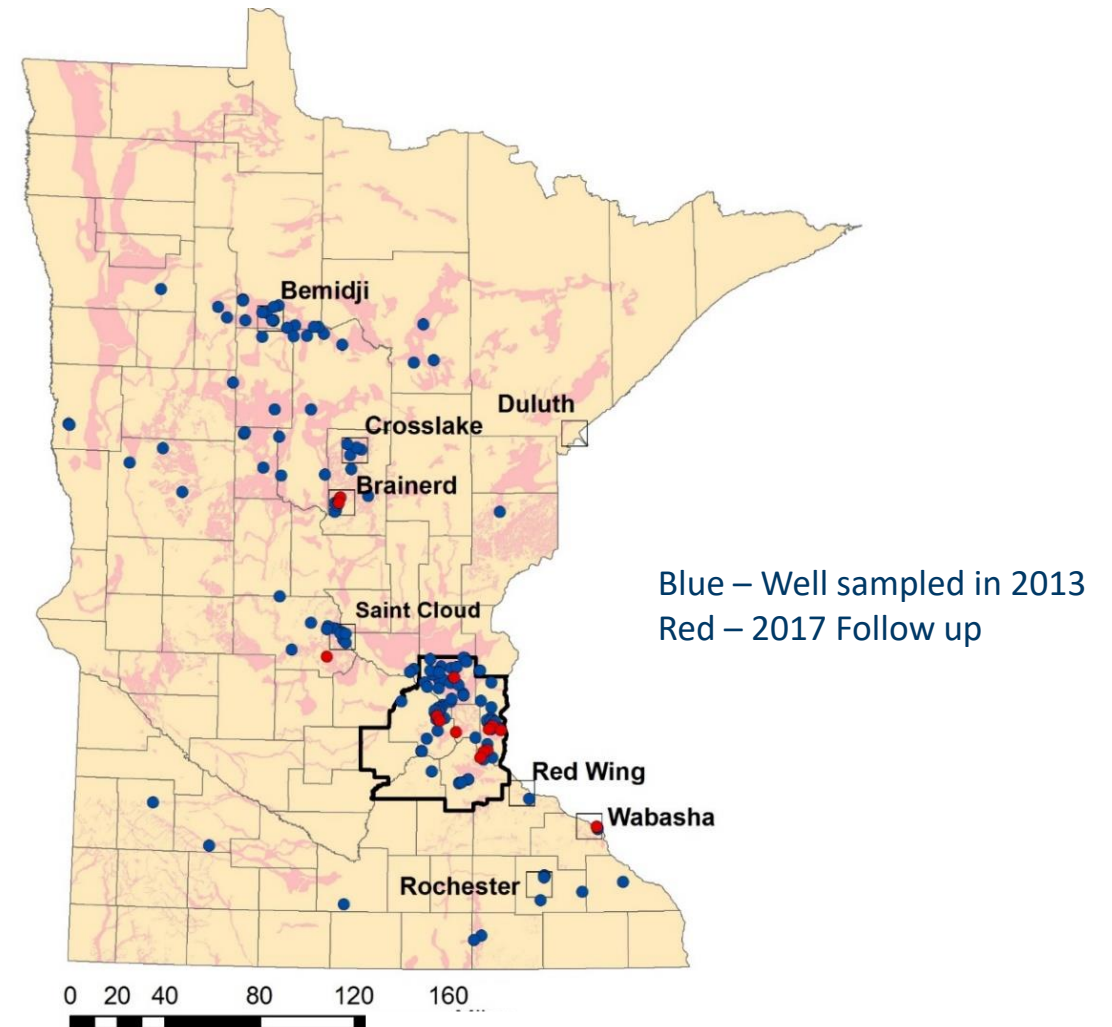
Catherine Neuschler – Manager, Water Assessment Section

- The East Metro area was our introduction to PFAS
- PFAS is becoming (and will remain) a statewide issue
- We know much more about PFAS than we did even a few years ago and are continuing to improve our understanding



# Ambient Groundwater

- Ambient groundwater network was sampled for PFAS compounds in 2013
  - Limited follow-up in 2017
  - Entire network re-sampled in 2019
- 70% of tested wells contained PFAS
- PFOA concentrations in eight wells exceeded MDH's 2017 HBV
- PFOS concentrations in ten wells exceeded MDH's 2019 HBV
- PFAS concentrations declined between 2013 and 2017 in the wells that were re-sampled
- 2019 results are pending



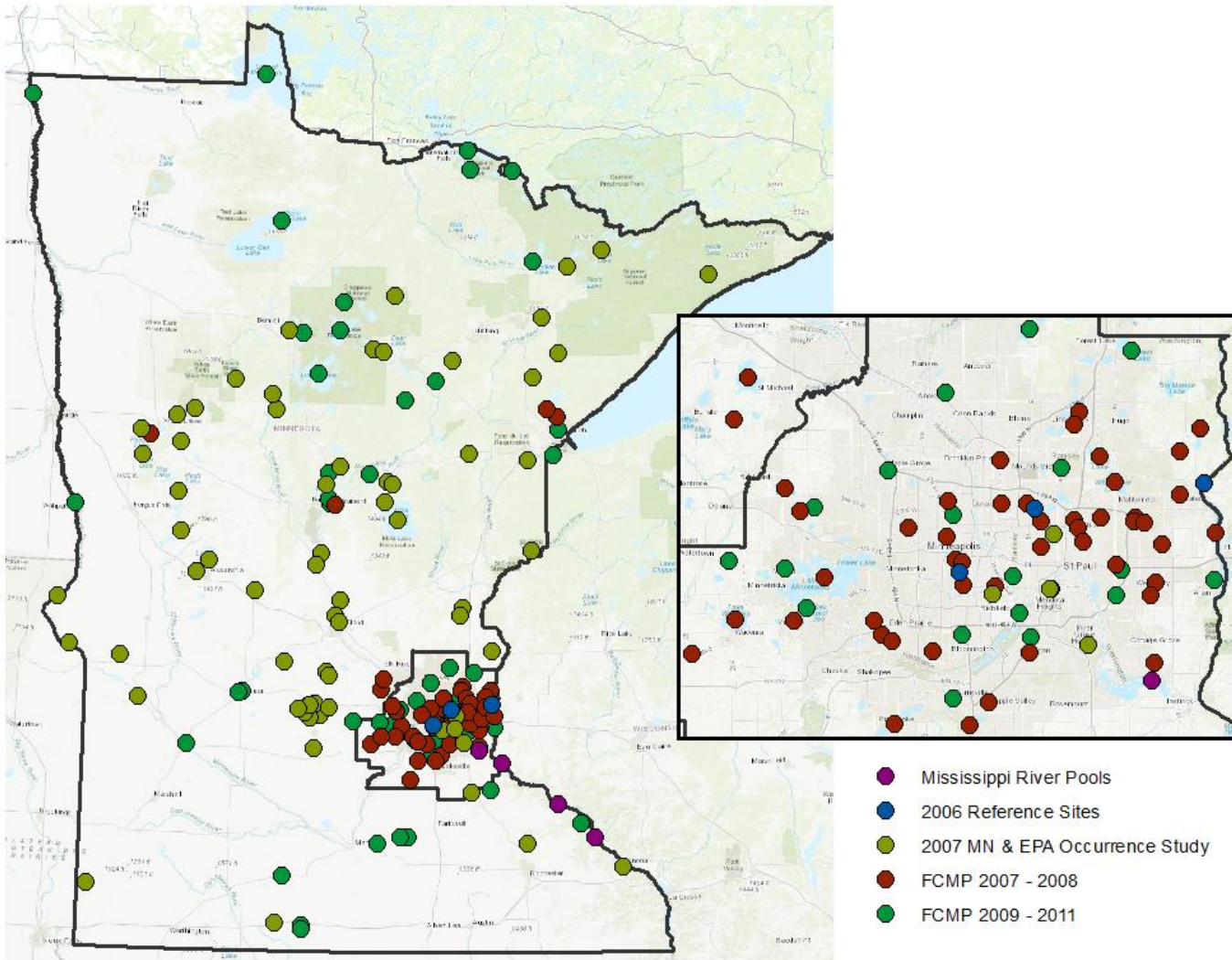


# Surface Water and Fish Tissue

Surface waters in Minnesota are protected for multiple uses – recreation, aquatic consumption, aquatic life

- Main concern to date has been PFAS accumulation in fish and impacts to human health
  - MPCA has listed 10 waterbodies as impaired for aquatic consumption
  - MPCA is revising and developing site-specific criteria for PFOS in fish tissue
- Information on other impacts is less developed

# Gathering Fish Tissue Data: 2004 - 2012

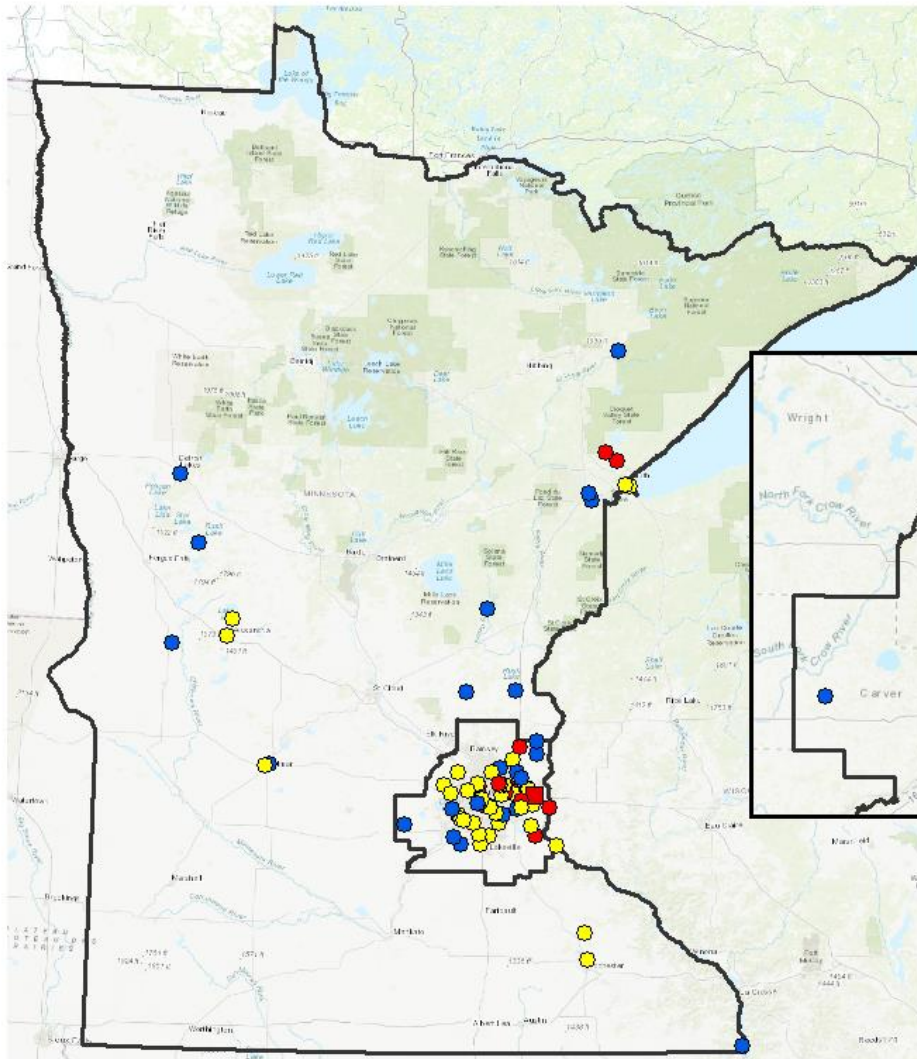


- Earliest collections where 3M Cottage Grove Plant discharges wastewater
- Some targeted sampling sites (AFFF, WWTP effluent, plating)
- By 2012, data from 155 lakes + 8 rivers

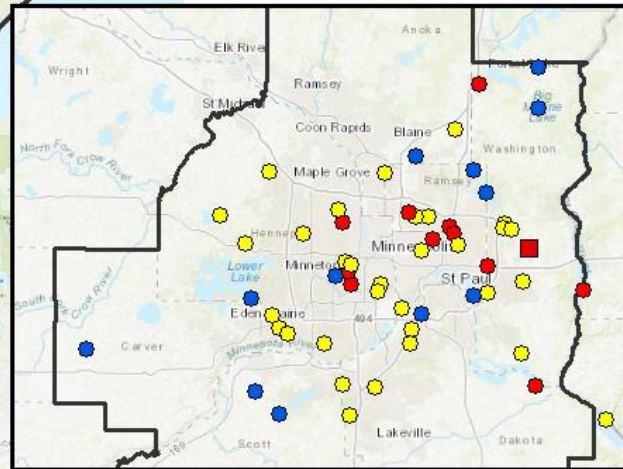
# Science, Regulatory and Programmatic Changes

- Improved understanding of PFAS clarified that PFAS chemicals were harmful to human health at levels lower than previously thought
  - 2016 - EPA issued health advisories for PFOS and PFOA
  - MDH changes to drinking water values and fish consumption advice thresholds
- MPCA/MDH had mostly “aging” fish data (5+ years old)

# Gathering Data: 2018 Survey of PFAS in Fish and Water



Dots show maximum mean concentrations for any species from the waterbody  
Blue dots = no restrictions under MDH FCA



PFOS site max-mean (ng/g)

- < 10
- 10 - < 50
- 50 - < 200
- > 200

- 95% of waterways tested had at least one fish with detectable PFOS
- 26% of the water samples (19 of 70) had detectable PFOS
- At least one PFAS chemical detected in every water sample

# Next Steps and Needs

- Identify protective fish tissue concentration and translate to water concentrations
  - Site-specific: First for East Metro, then consider other needs
- Continue to monitor fish tissue and water concentrations, and add sediment testing
  - 2020 Plan: 15 previously sampled waters, 5 new waters
  - 2021 Plan: 30 – 40 sites (funding dependent)
- Improve understanding of bioaccumulation
- Determine need for statewide water quality standard for PFOS in fish tissue



# Other Surface Water Needs

- Consider how to incorporate MDH health values into statewide water quality standards for drinking waters (surface and groundwater)
- Evaluate the potential for risk to humans recreating in waters with higher levels of PFAS
  - Probably safe at higher levels of PFAS than needed to keep fish tissue safe for human consumption
  - MPCA/MDH developing charter to kick off this work
- Evaluate PFAS risks to aquatic life and wildlife that drink from surface waters
  - Could result in a statewide water quality standard
  - Likely farther out in the future



# Sources and Conduits of PFAS

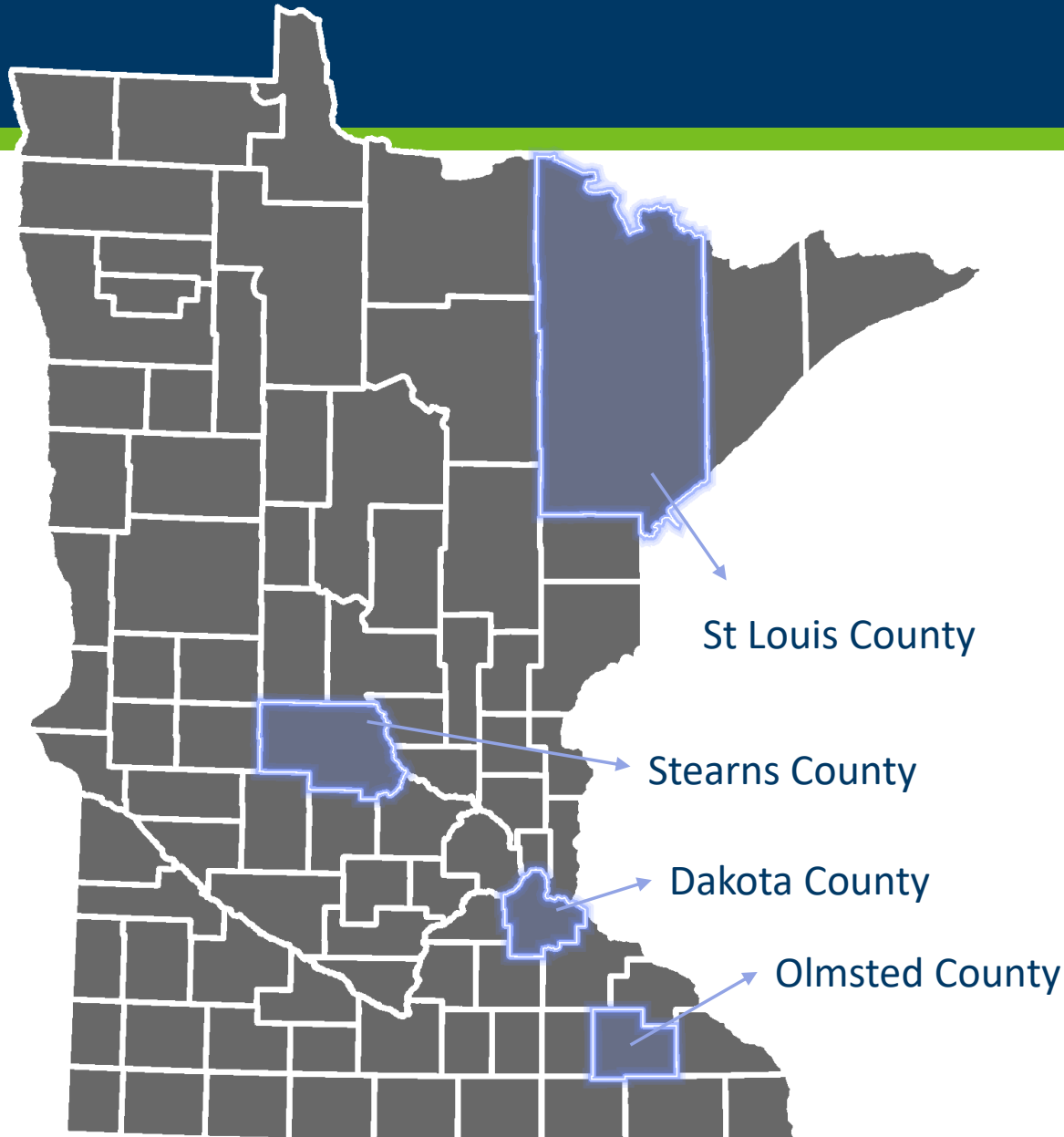
Jamie Wallerstedt – Manager, Site Remediation and Redevelopment

# How does PFAS enter the environment?

- Sources
  - Direct generation and use of PFAS
- Conduits
  - May be the point where PFAS enters the environment but do not generate PFAS
  - Pass through PFAS that comes from everyday residential use, commercial use, and from industrial sources

# PFAS Source Inventory – Pilot Project

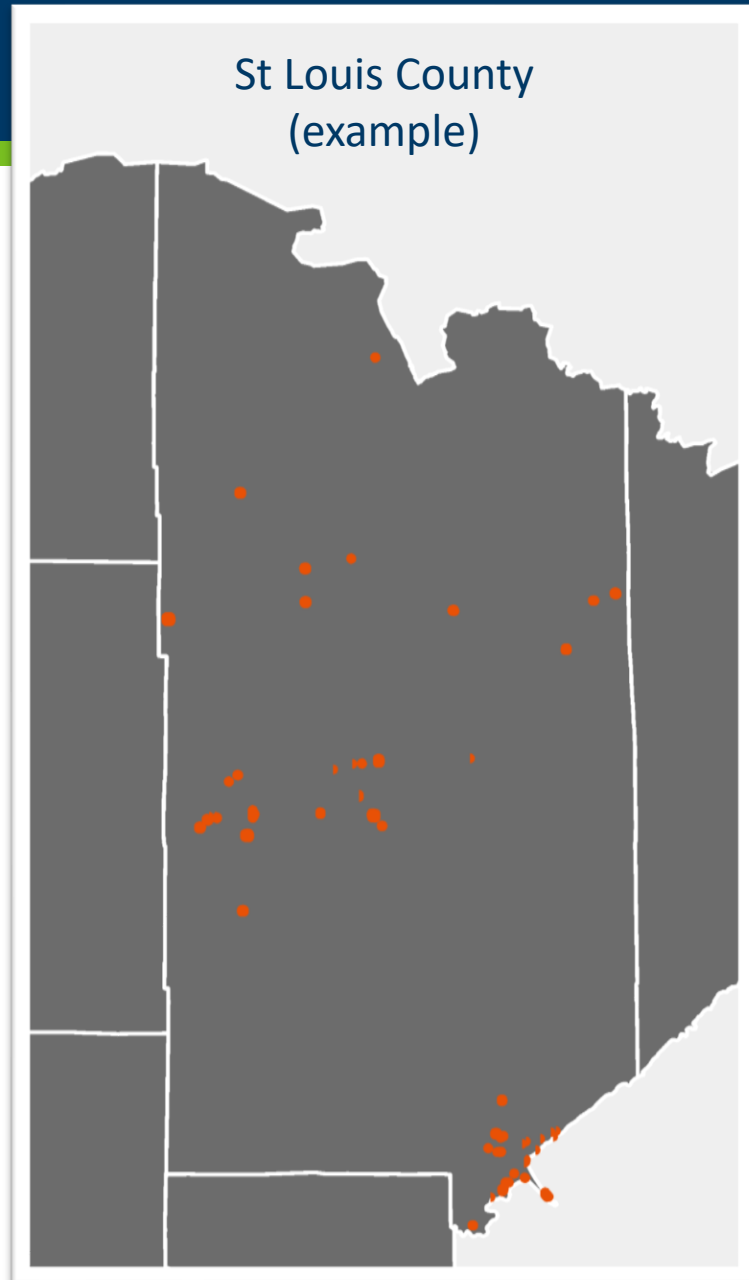
## Overview



- MPCA developed a protocol to evaluate and prioritize PFAS source investigations
- 4 counties are part this pilot study:
  - St. Louis
  - Stearns
  - Dakota
  - Olmsted

# PFAS Source Inventory – Pilot Project

## Types of Industries



- Industrial types were chosen based on national research
- Industries identified COULD have used PFAS in their industrial processes, but each industry MAY not have used PFAS
- Protocol is a tool to prioritize if sampling may be warranted near sources of drinking water or surface water
- Industry types:
  - Airports – fire fighting foam usage
  - Plating facilities
  - Waterproofing industries
  - Refineries – fire fighting foam usage
  - Commercial printing and paper mills
  - Landfills/disposal facilities



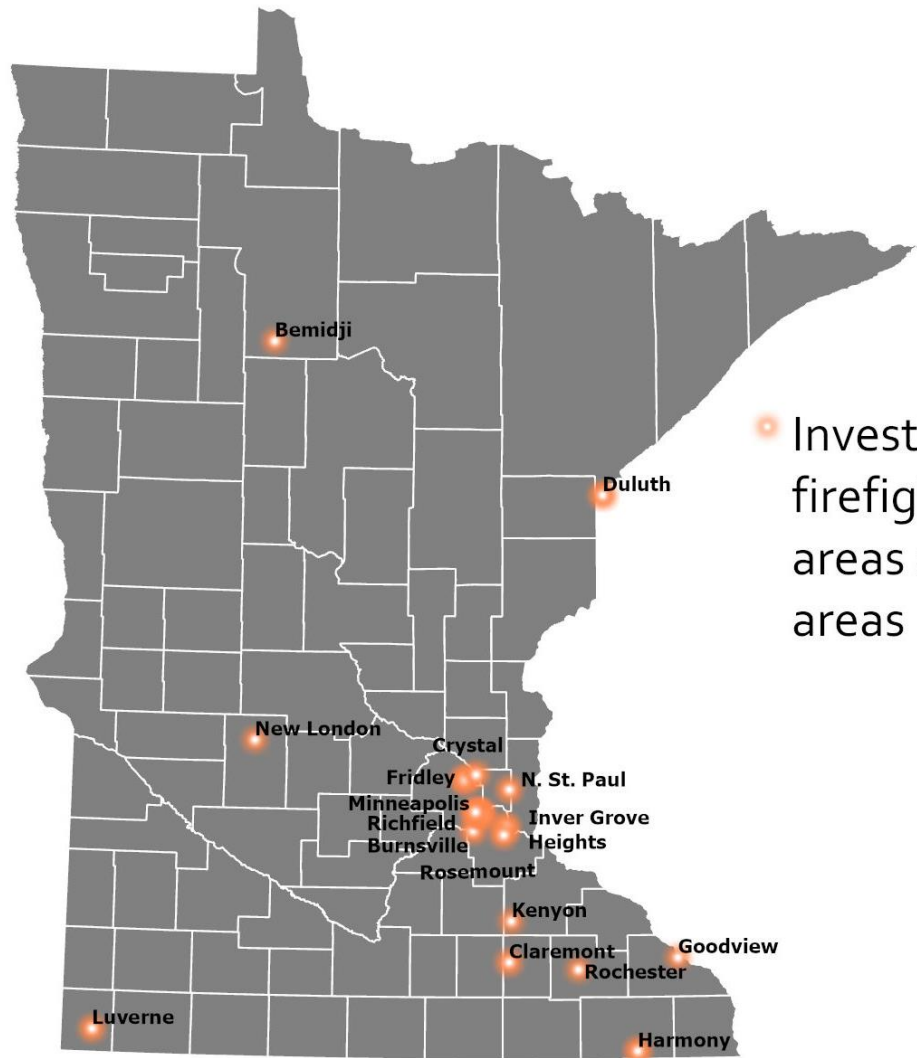
# PFAS Source Inventory – Pilot Project

## Next Steps



- Validate the protocol with known historical release sites
- Sample 10 sites near industries identified to test protocol
- Utilize protocol as a tool as sites enter into the remediation programs at the MPCA

# Airports and Fire Training Sites

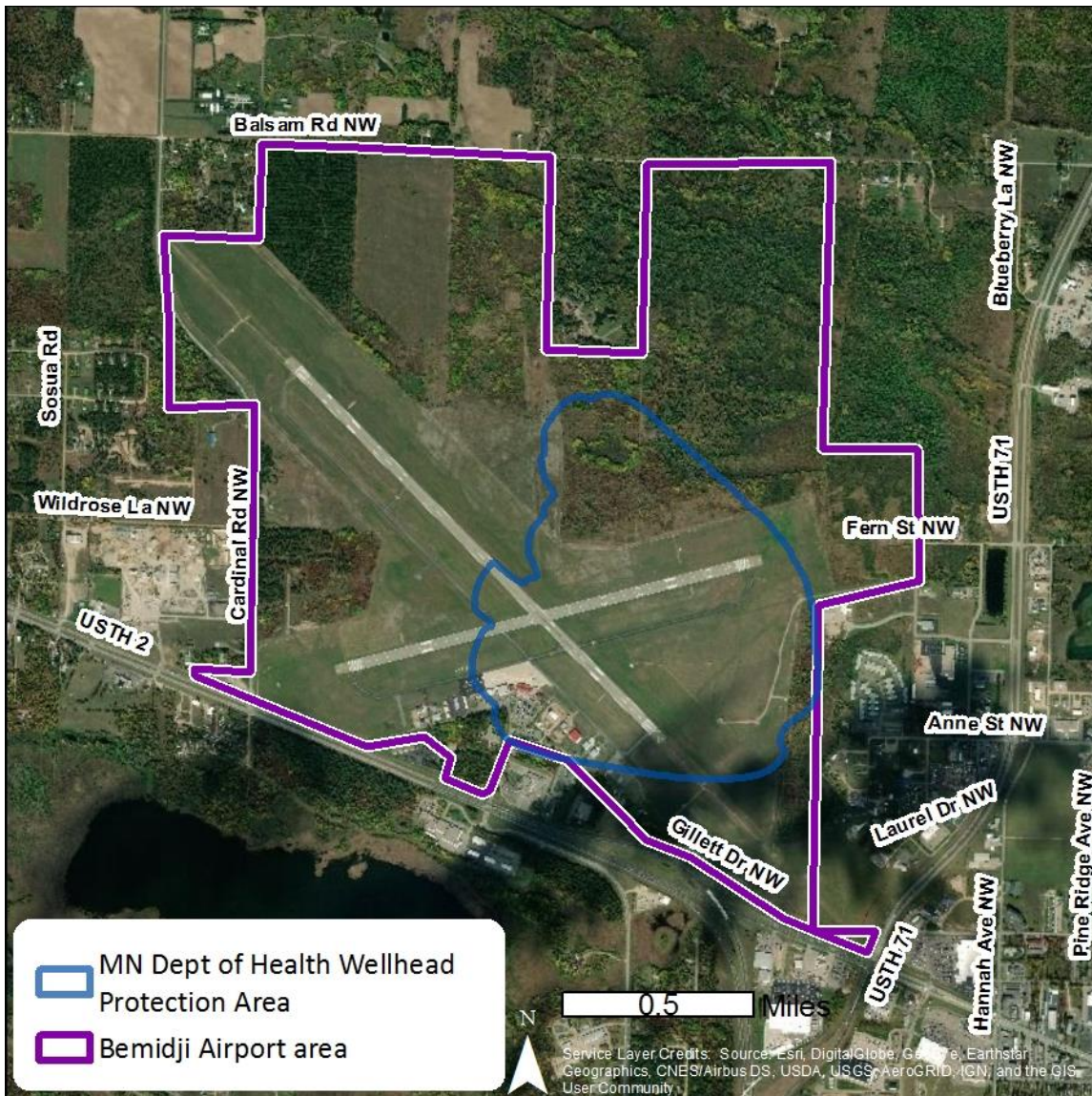


- 2009 – MPCA study to evaluate airports and fire training sites
- Identified sites potentially using PFAS-containing fire fighting foam
- Evaluated sites for PFAS detections and nearby drinking water sources
- Since the study, health risk limits have been lowered and in depth investigations at some sites have occurred



# Airports

## Bemidji



**Discovery:** PFAS was detected in Bemidji's municipal drinking water supply in 2014.

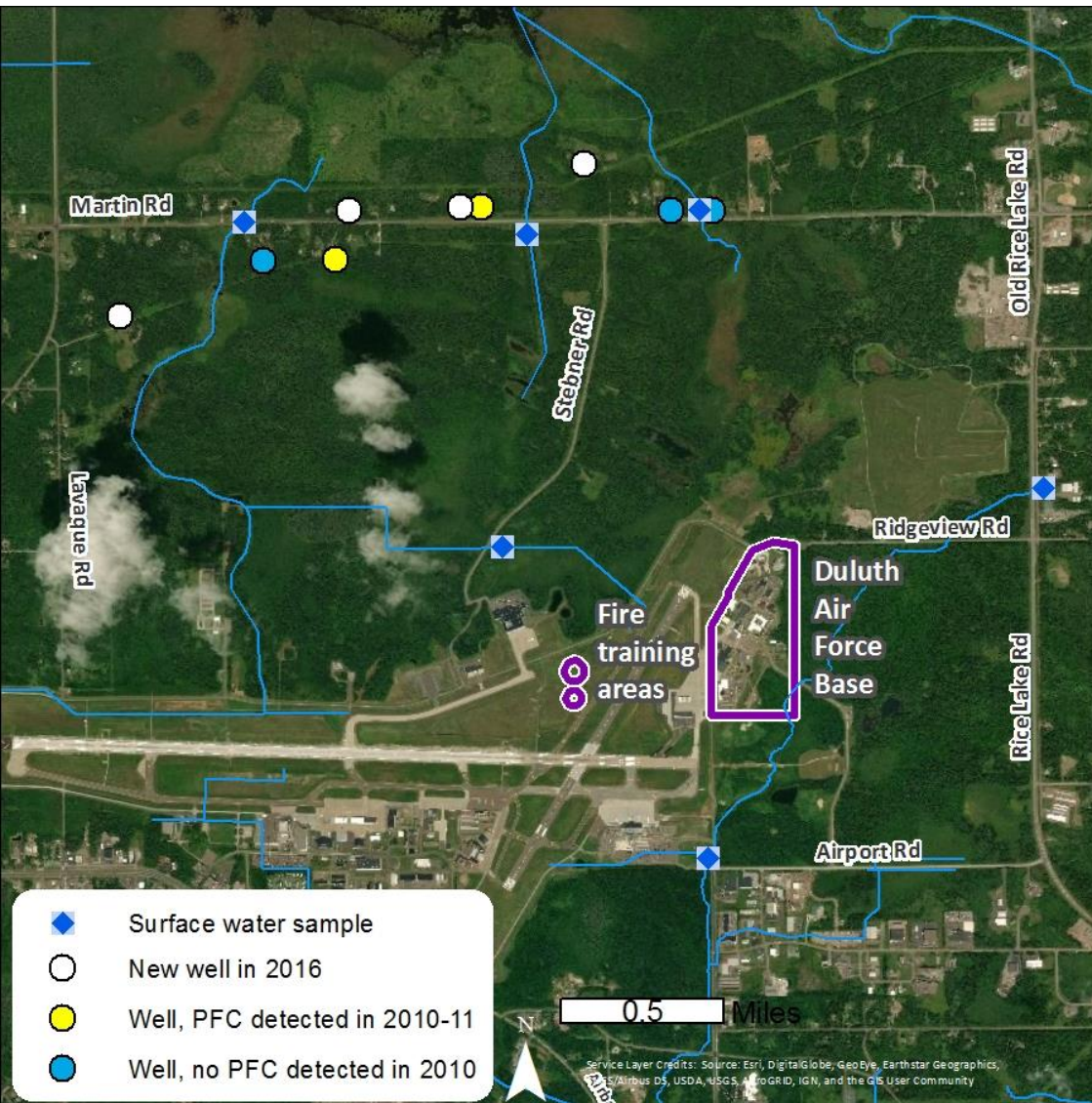
**PFAS Source:** Firefighting foam use during training and fire response activities.

**Next Steps:** City is planning a water treatment plant to be installed on the municipal water supply. Additional PFAS investigations and groundwater modeling will be completed.



# Department of Defense Sites

## Duluth Air Force Base



**Discovery:** PFAS detected in groundwater and surface water in 2008; detected in private water wells and fish tissue in 2010.

**PFAS Source:** Firefighting foam use during training and fire response by National Guard, Air Force and civilian industries.

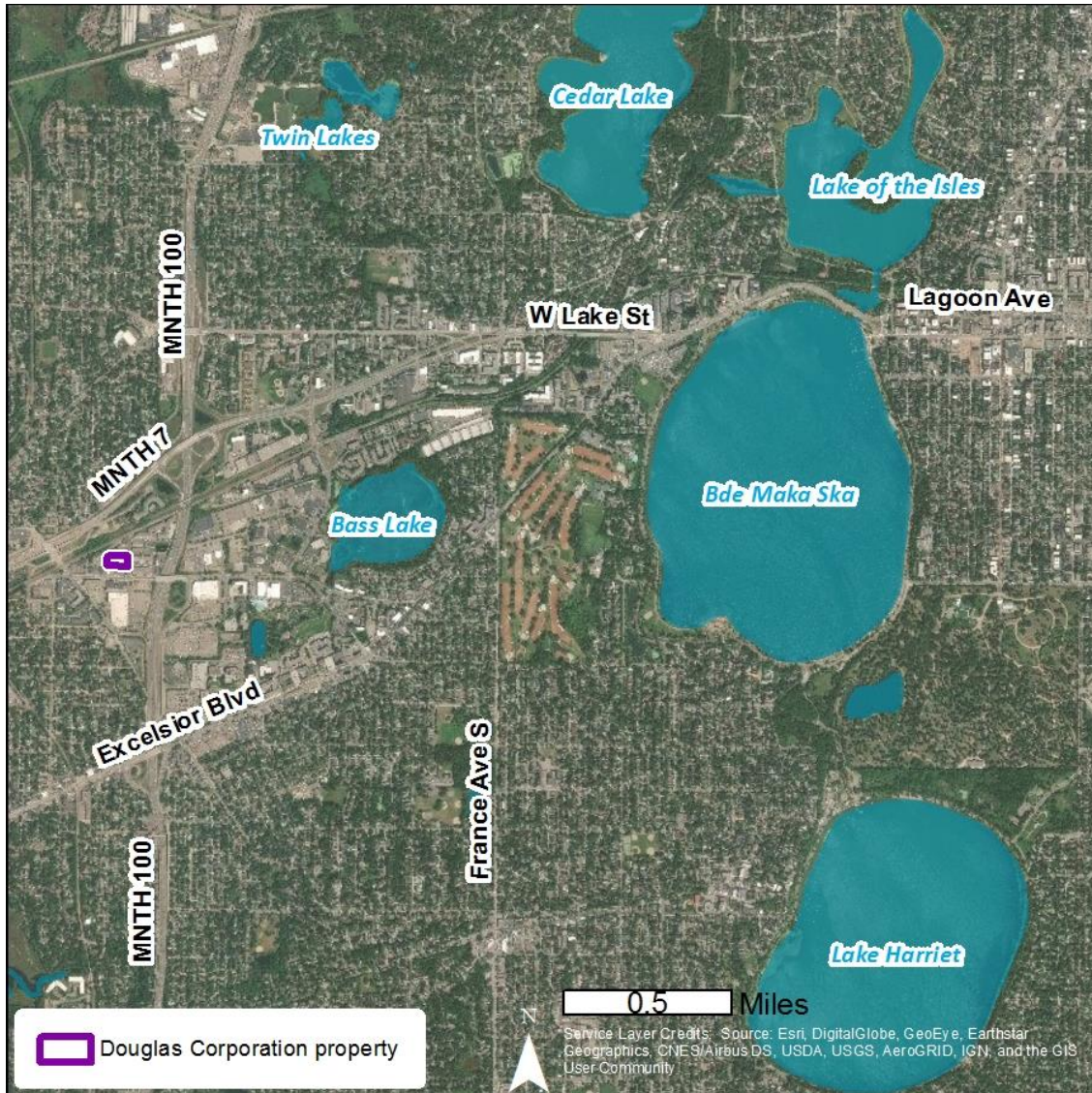
**Next Steps:** Air National Guard is conducting investigations to identify potential cleanup actions. Treatment to be installed on individual wells.

Army National Guard is beginning investigations at the St. Cloud, St. Paul, and Camp Ripley Army National Guard sites.



# Manufacturing Sites

## Douglas Corporation



**Discovery:** PFAS was detected in Bde Maka Ska in 2004; MPCA traces PFAS back through the stormwater system to a chrome plating facility in St. Louis Park.

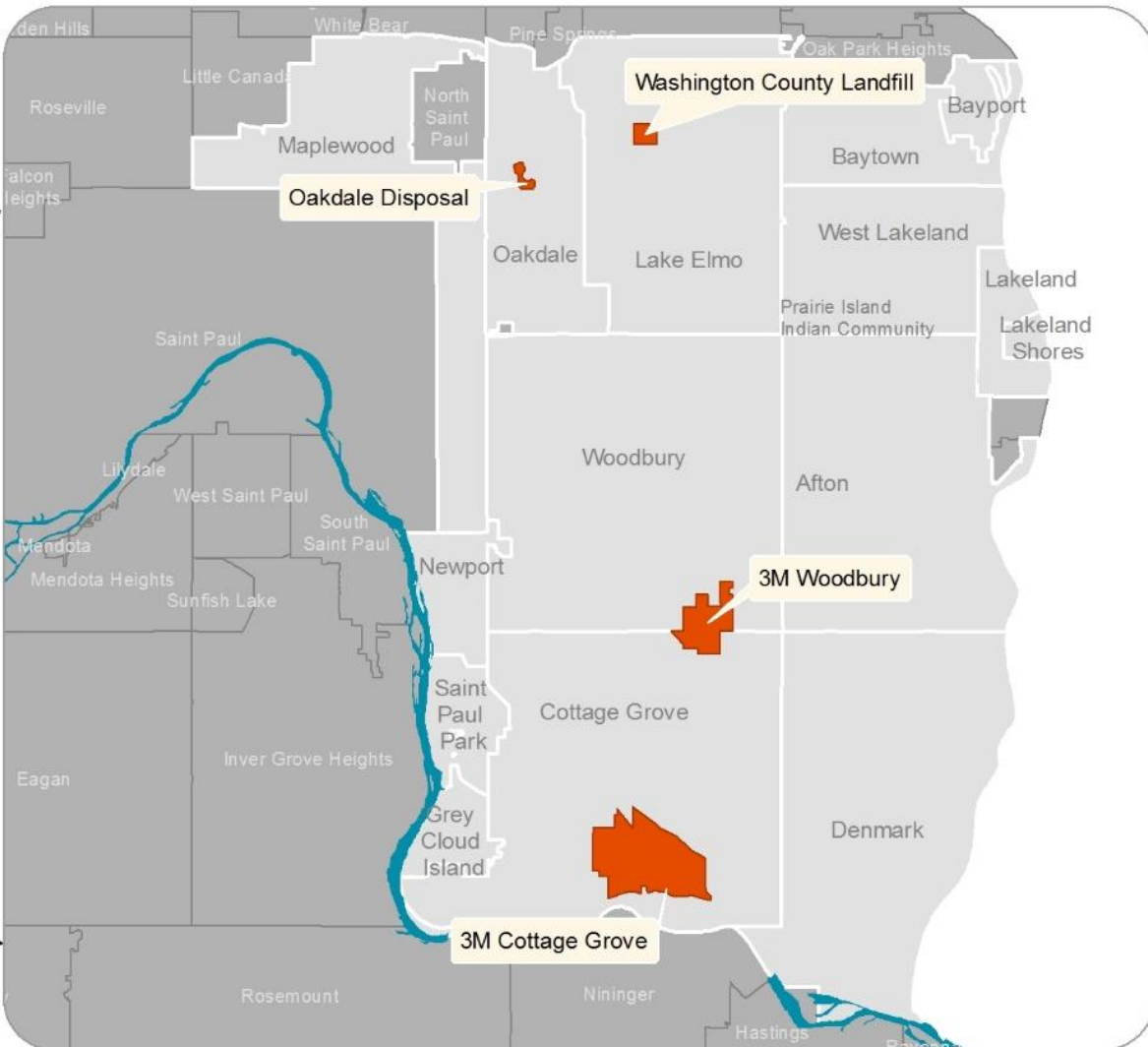
**PFAS Source:** Mist suppressant used during industrial operations.

**Next Steps:** Douglas Corporation worked to stop releases of PFAS to the stormwater systems. The company is also required to investigate whether PFAS has entered the groundwater and how far it has traveled in the environment.



# Disposal Sites

## 3M/East Metro



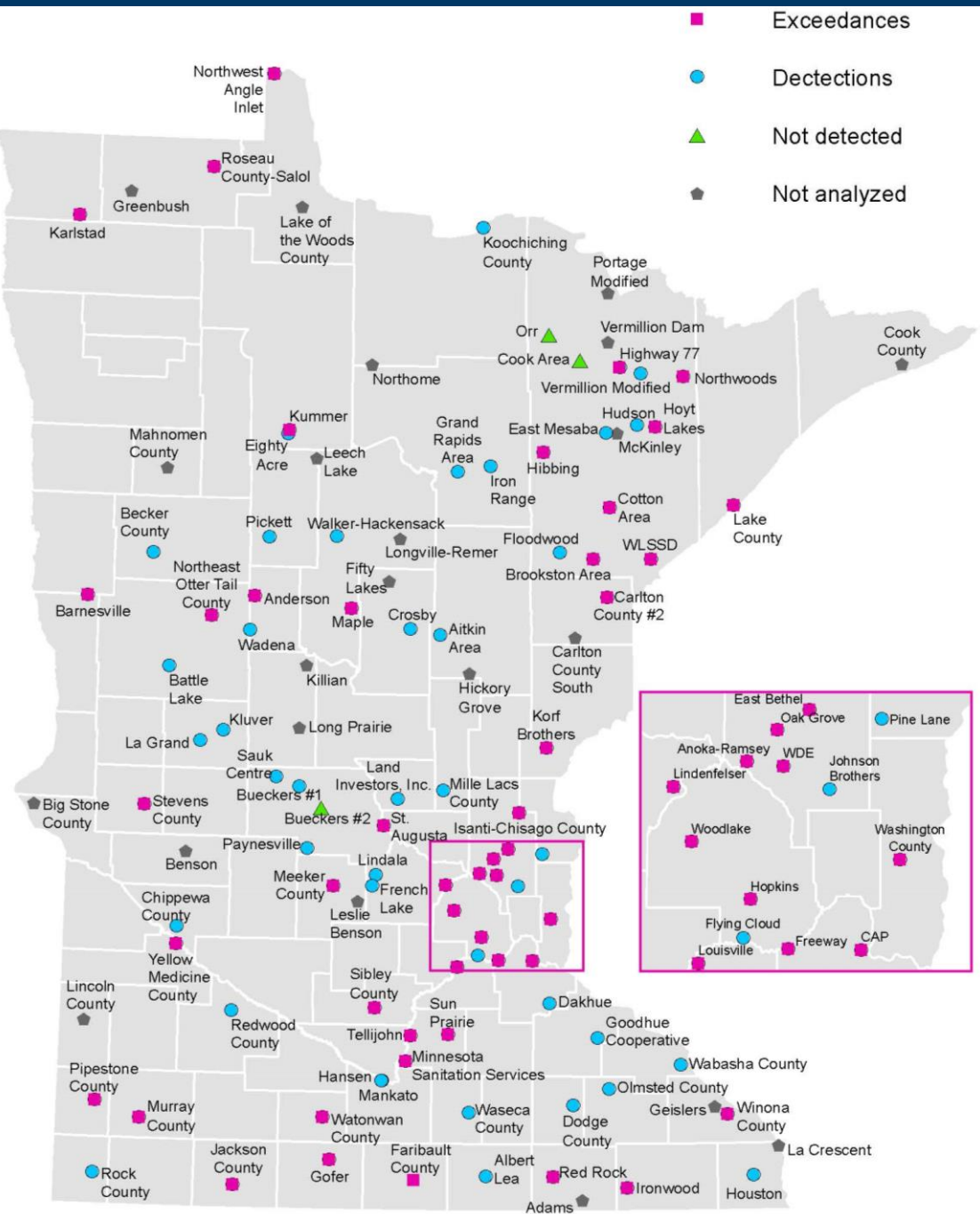
**Discovery:** 2005, PFAS detected in Washington County Closed Landfill after 3M reported the use of the chemicals. PFAS then found in:

- Oakdale and Woodbury 3M disposal sites
- Groundwater
- Municipal drinking water systems
- Private drinking water wells
- Surface water

**PFAS Source:** Disposal of industrial wastes in landfills (high concentrations)

**Next Steps:** Implement the 2018 3M Settlement to ensure safe drinking water and enhance natural resources. Settlement preserves 3M's Superfund obligations under a previous 2007 Consent Order.

# Disposal Sites Closed Landfill Program



**Discovery:** PFAS was detected in various Closed Landfills beginning in 2012.

Private wells have been impacted near 4 closed landfills with low levels of PFAS. Wells now have treatment or well replacement.

90 landfills have been sampled – 97% of them have had detections.

**PFAS Source:** Disposal of mixed municipal solid wastes in landfills (relatively low concentrations present – except Washington County due to 3M disposal)

**Next Steps:** Continue PFAS sampling. Implement treatment, if needed.

# PFAS in surface water foam

- January 2020 - MPCA announced that PFAS was found in foam in surface water for the first time in Minnesota
- Foam was found along two creeks in east metro
- Raleigh Creek – Oakdale and Lake Elmo
- Battle Creek – St. Paul and Maplewood
- Further testing is needed at Battle Creek site
- Two other states have found PFAS in surface water foam: Michigan and Wisconsin

# Solid Waste – Landfill Leachate



**Discovery:** Landfill leachate is taken to WWTPs or land applied. 8 of 21 Municipal Solid Waste (MSW) landfills in MN land apply

All landfills that monitor leachate for PFAS have concentrations that have exceeded the MDH standard. All landfills that land apply leachate monitor groundwater for PFAS - 4 have exceeded the MDH standard

**PFAS Source:** Likely conduit of PFAS consumer products, needs more investigation.

**Next Steps:** MPCA is working with landfills on alternative solutions to manage the leachate. 4 landfills are researching pretreatment of the leachate to remove PFAS



# Solid Waste – Compost Sites



**Discovery:** Compost sites manage contact water several different ways – send to a WWTP or through land application (not currently).

2019 study of contact water to check for the presence of PFAS – 7 facilities. At least one sampling event at all facilities showed an exceedance of an MDH health value for PFAS.

**PFAS Source:** Likely conduit of PFAS consumer products, such as food package and service ware, needs more investigation.

**Next Steps:** Better understand sources, amounts and impacts of PFAS at compost sites, as well as potential treatment options



# Wastewater Treatment Plants



**Discovery:** 2007 and 2008 survey of municipal and industrial treatment plant effluent. Work in other states. Mostly low concentrations, but some higher.

**PFAS Source:** Municipal largely conduit of PFAS from upstream sources. Needs additional investigation.

**Next Steps:** Further investigation into influent, effluent, and sources. LCCMR proposal for biosolids.

- Improved methodology for testing water from specific sources
  - Landfills and compost
- Improve knowledge of upstream sources in wastewater, landfills, and compost facilities
- Increase the understanding of PFAS sources, air transport, and the risks associated with PFAS in the air
  - In process with EPA grant

# MPCA LCCMR Grant



- \$1.4 million to assist municipal wastewater plants, landfills, and compost facilities
- Identify PFAS management solutions including prevention and viable treatment options
- Analyze PFAS in biosolids, leechate, compost, soil, groundwater, crops
- Characterize risk of land application





## National PFAS Work

- Federal
  - No enforceable federal drinking water standard
    - Lifetime health advisory (LHA) for PFOS and PFOA
    - New requirements to monitor for PFAS in drinking water systems
  - EPA to impose reporting requirements under toxics release inventory
  - EPA to write new rules under Toxic Substance Control Act (TSCA)
  - USGS required to do national monitoring of lakes, streams, etc.
  - DOD to phase out use of aqueous fire-fighting foams that contain PFAS



# Interstate PFAS Coordination

- Minnesota is tracking and engaged in interstate, regional and nation efforts
  - Environmental monitoring
    - Drinking water systems, wastewater, biosolids, fish
  - Developing standards
    - Some states are limited because they cannot be more stringent than the federal government
    - Others are developing and proposing drinking water and water quality standards
  - Pollution prevention
    - Bans on use of PFAS-containing fire-fighting foam in some instances

# Additional PFAS Collaboration

- Environmental Council of the States (ECOS)
  - ECOS PFAS Standards White Paper
- Great Lakes Region 5 States PFAS Task Force
  - Three topical focus groups: Air, Fish and Wildlife, Biosolids and Land Application
- Informal groups
  - e.g. surface water foam containing PFAS (WI, MI & MN)
- Association of Clean Water Administrators (ACWA)
- Interstate Technology and Regulatory Council (ITRC)

# MN Participation in ITRC PFAS Team

## RISK MANAGEMENT GUIDANCE



MANAGE PFAS WHERE IT EXISTS



KNOW WHERE TO LOOK FOR SOURCES



UNDERSTAND INNOVATIVE TECHNOLOGIES

## PFAS FUNDAMENTALS

- HISTORY AND USE
- ENVIRONMENTAL BEHAVIOR
- RISKS TO HUMAN HEALTH AND THE ENVIRONMENT

## INFORMATION TRANSFER AND EXCHANGE

- INVESTIGATION AND SAMPLING PROTOCOLS
- RISK COMMUNICATION TOOLS
- STATE, FEDERAL, ACADEMIC & PRIVATE SECTOR COLLABORATION
- MN CO-TEAM LEADER & 14 TEAM MEMBERS

# Minnesota PFAS Lateral Team

- MPCA has re-formed a cross-divisional and cross-agency PFAS team, including MDH & DNR, in order to better collaborate and share information
- Three initial areas of focus with work groups
  - Communications: Inform public about PFAS and share agencies activities
  - Presence in environment, products and processes: Assess current activities, identify strengths and gaps, propose next steps
  - Risk based values for PFAS: Assess current activities, identify strengths and gaps, propose next steps
- Adding a PFAS Coordinator to lead this effort

# Minnesota PFAS Lateral Team

- Work groups to develop work plans, share learnings and identify gaps and opportunities for future work including data needs
- Outcome will inform allocation of existing resources and future budgetary and policy asks
- Communicate risks and needs related to project work and program implications
- The management team will also consider future focus areas for similar conversations, and the lateral team may recommend focus areas.



*Thank You*

Questions?