Beneath the Surface: Exploring Chlorides in Shallow Groundwater as a Stressor to Aquatic Life in Impaired Urban Streams

COON CREEK WATERSHED DISTRICT

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COON CREEK
WATERSHED DISTRICT

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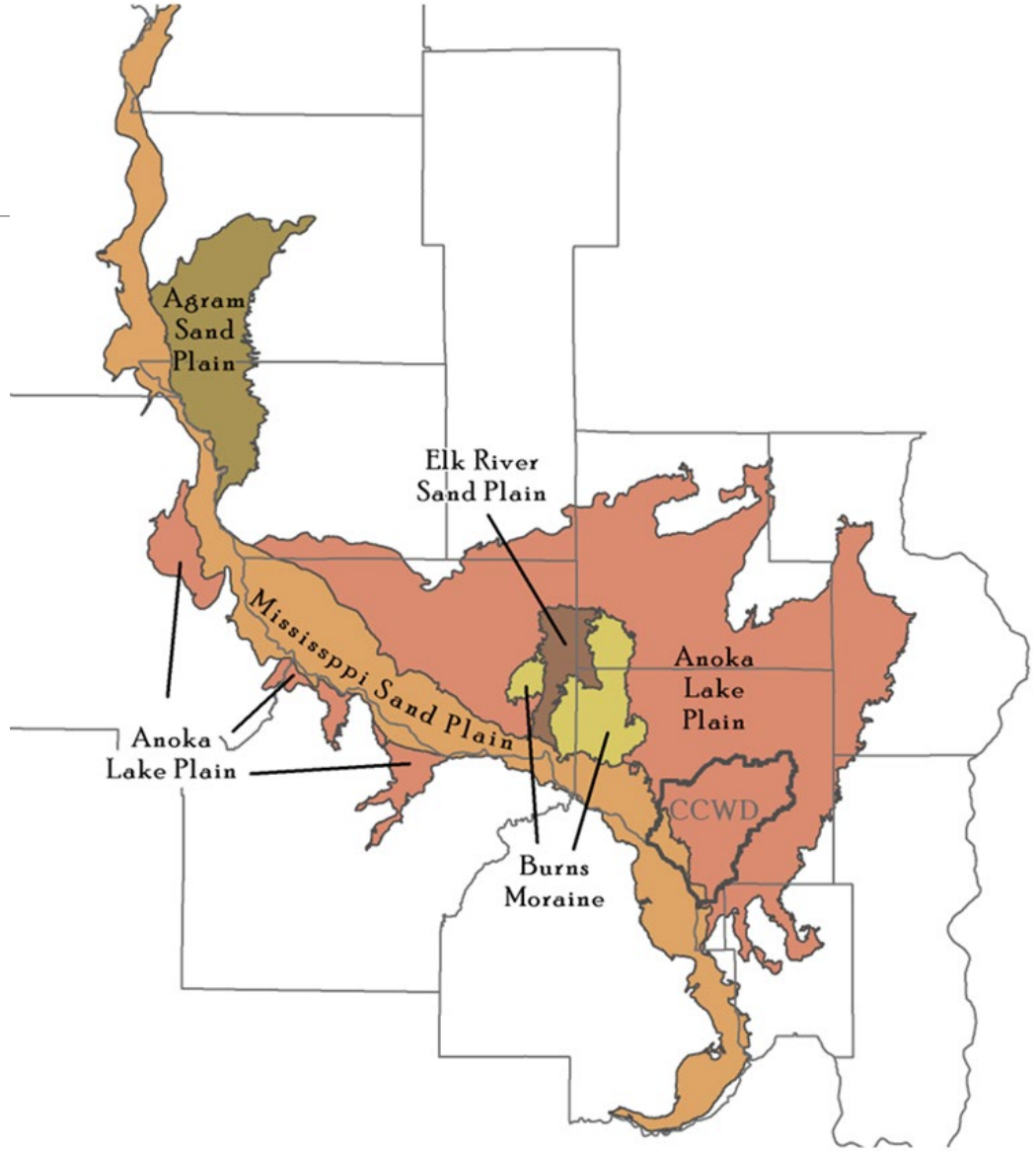
Resource Background

- 4 major impaired streams
- Primary stressors – excess suspended sediments and phosphorus, poor habitat, and altered hydrology (not Cl in 2014 SID)
- In 2024, 2 streams and 1 lake added to 303d list for chloride – pending CL TMDL

With limited resources to address water body impairments – where do we invest our time and money?

How to manage chloride vs. typical pollutants stressors?



Characterizing the problem

- Source ID
- Groundwater-surface water interactions
- Concentrations vs loading

More monitoring and modeling!

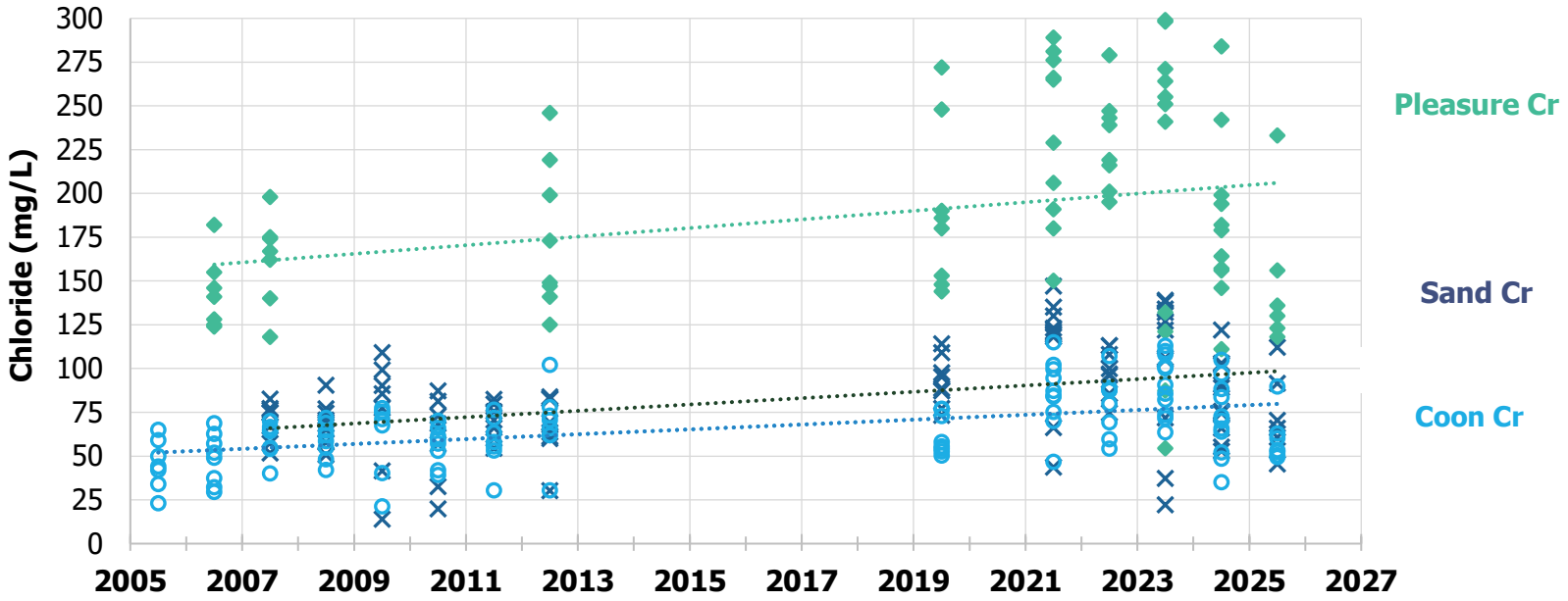
CCWD Cl- Trends over Time

- Stream outlet grab samples, 2005-2025, Apr-Oct, **ALL DATA** (n=288)
- Increasing trends: **+1.4-2.5 mg/L per year (1.75%)**
- High variability: **R^2=0.08-0.25**

Why?

Seasonality?

Dilution?



CCWD Cl- Trends over Time, Baseflow

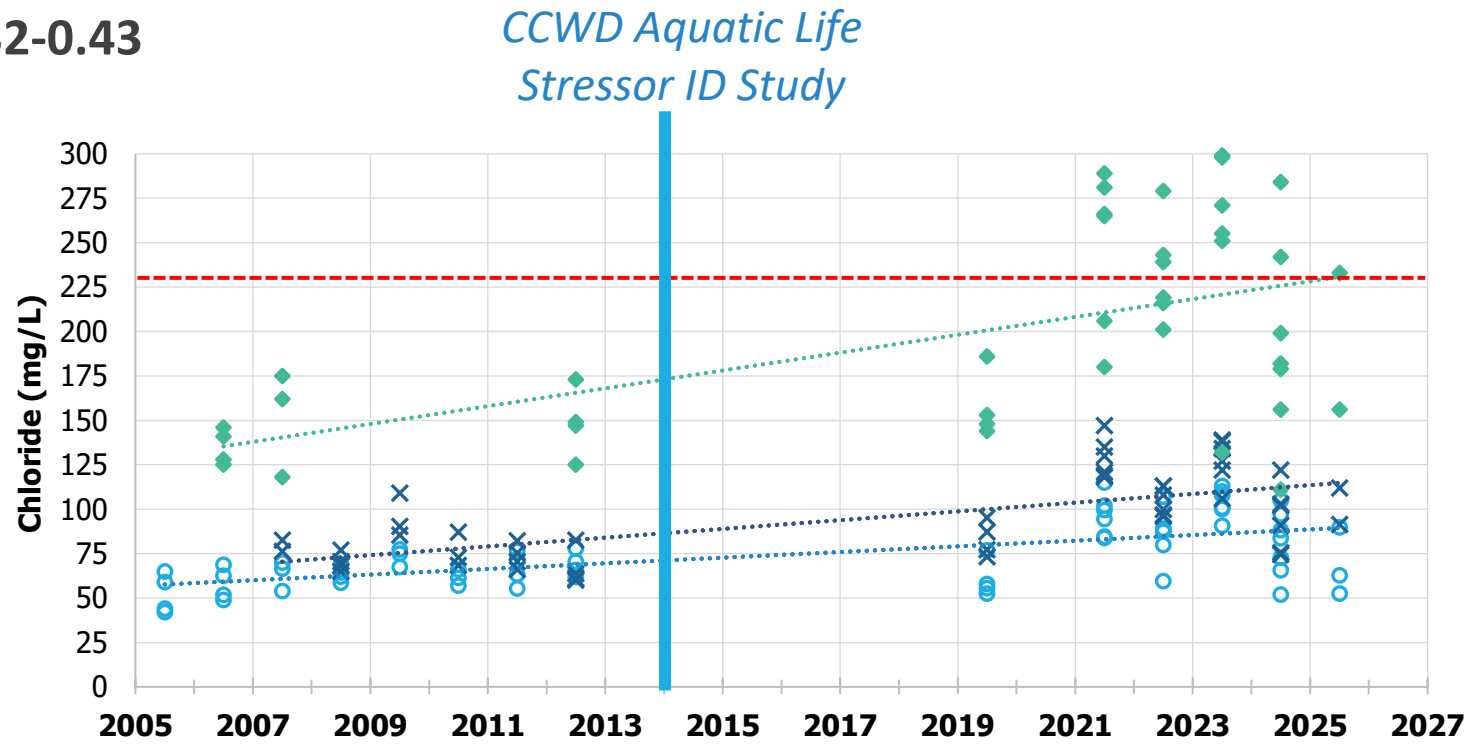
- Stream outlet grab samples, 2005-2025, **May**-Oct, **BASEFLOW ONLY** (n= 153)
- Increasing trends: **+1.6-5.0 mg/L per year (2.75%)**
- Reduced variability: **R^2=0.32-0.43**

>230 mg/L WQS by:

Pleasure Cr: 2024

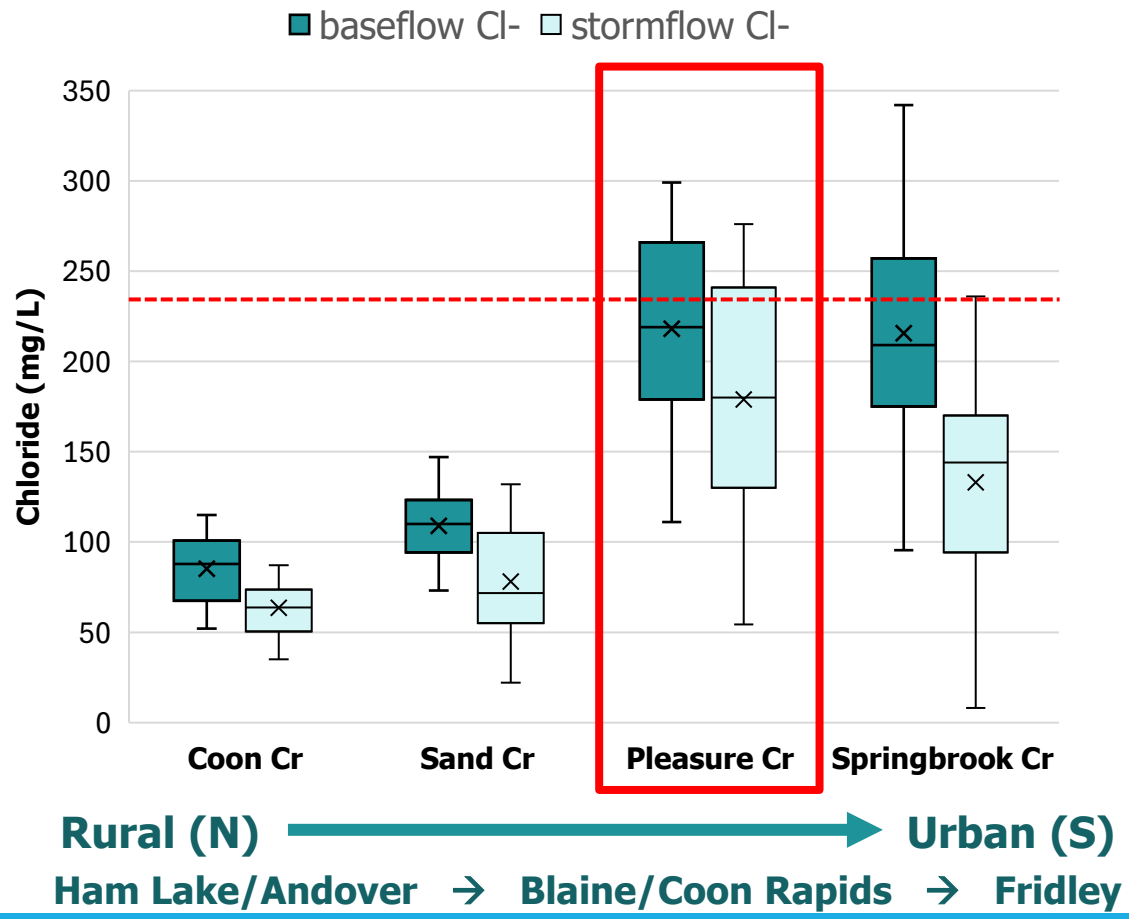
Sand Cr: 2073

Coon Cr: 2112



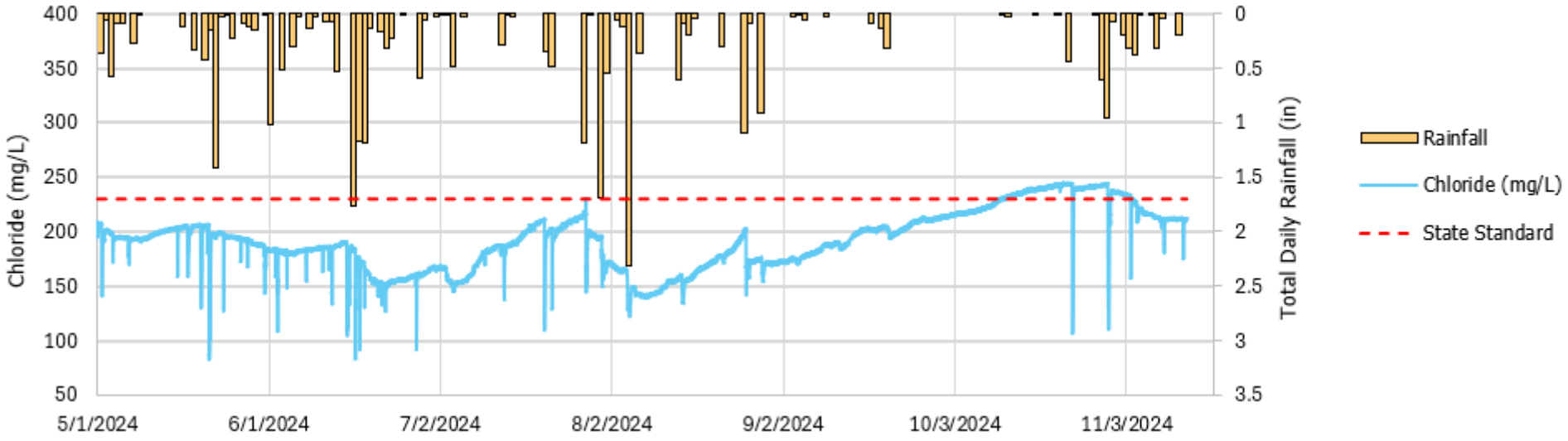
CCWD Cl- Baseflow vs Stormflow

- Baseflow vs Stormflow, May-Oct, 2019-2025
- Exceedances of 230 mg/L chronic WQS during summer baseflow in 2 urban streams
- = contaminated groundwater



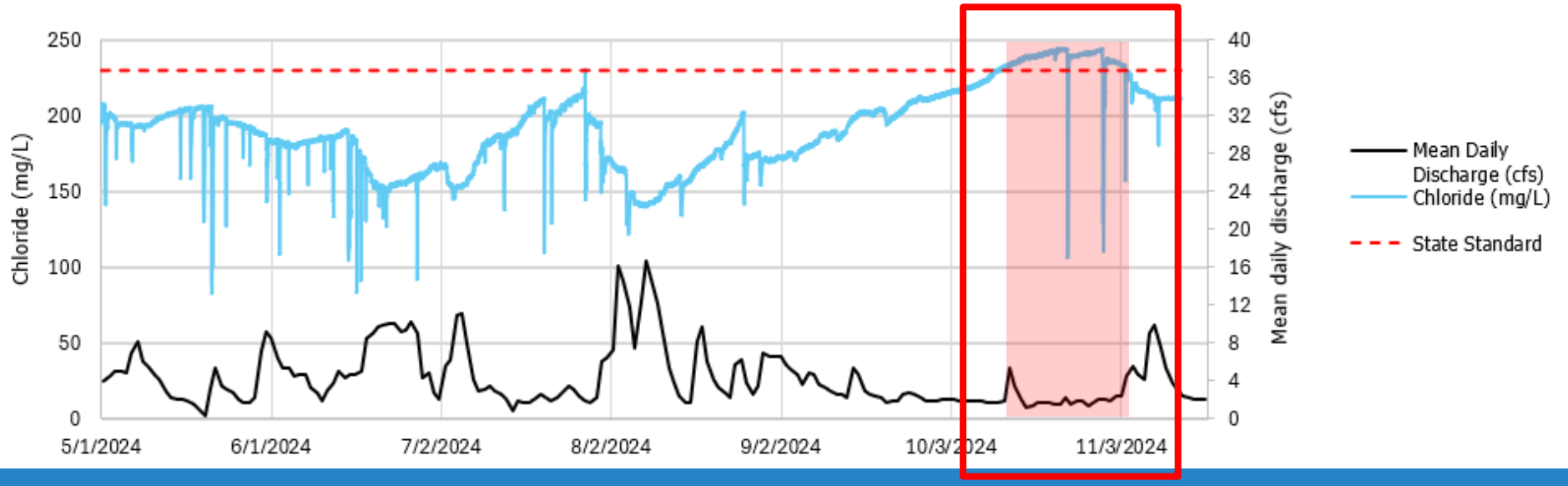
A closer look at in-stream [Cl-]

- Collected continuous level & specific conductivity (15-min) at Pleasure Cr Outlet; May-Mid Nov, 2024
- Estimated [Cl-] from SpCond via linear regression (R^2= 0.84)



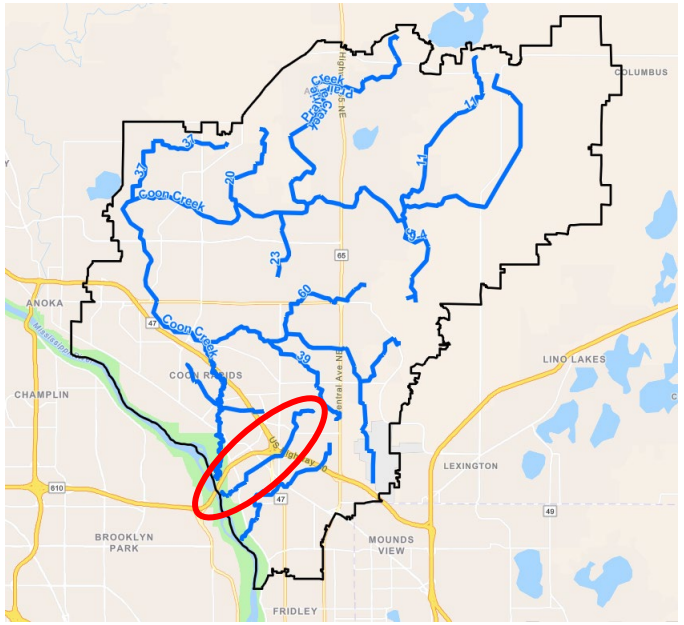
A closer look at in-stream [Cl-]

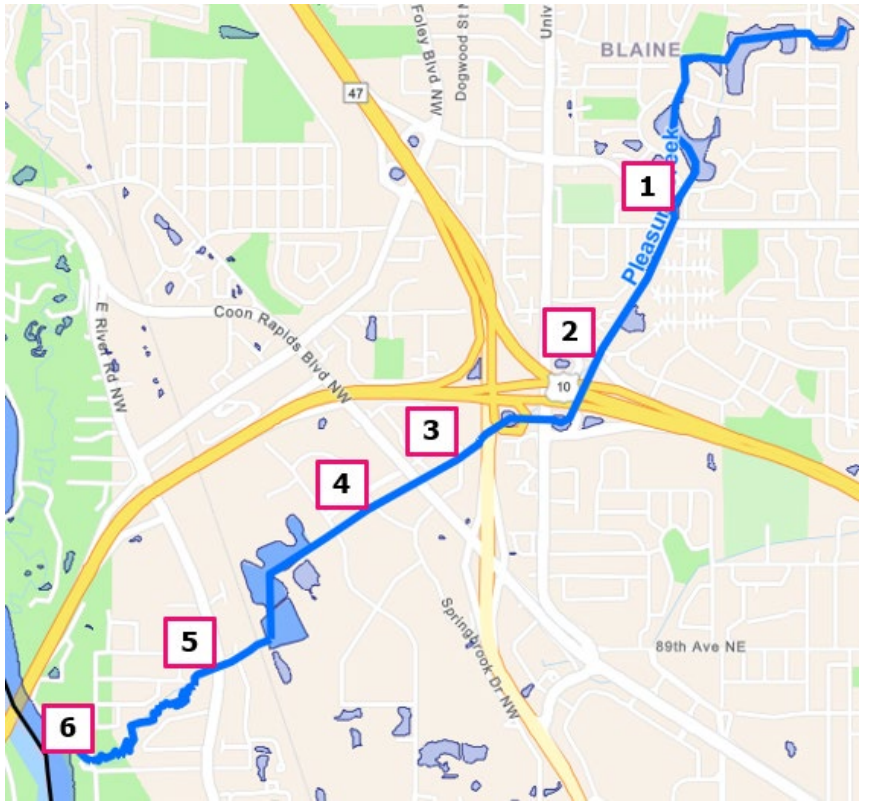
- Collected continuous level & specific conductivity (15-min) at Pleasure Cr Outlet; May-Mid Nov, 2024
- Estimated [Cl-] from SpCond via linear regression (R^2= 0.84)
- Calculated discharge from level data via rating curve
- Exceedances of 230 mg/L chronic WQ only during extended dry periods = 24 days (10/12-11/4/24)



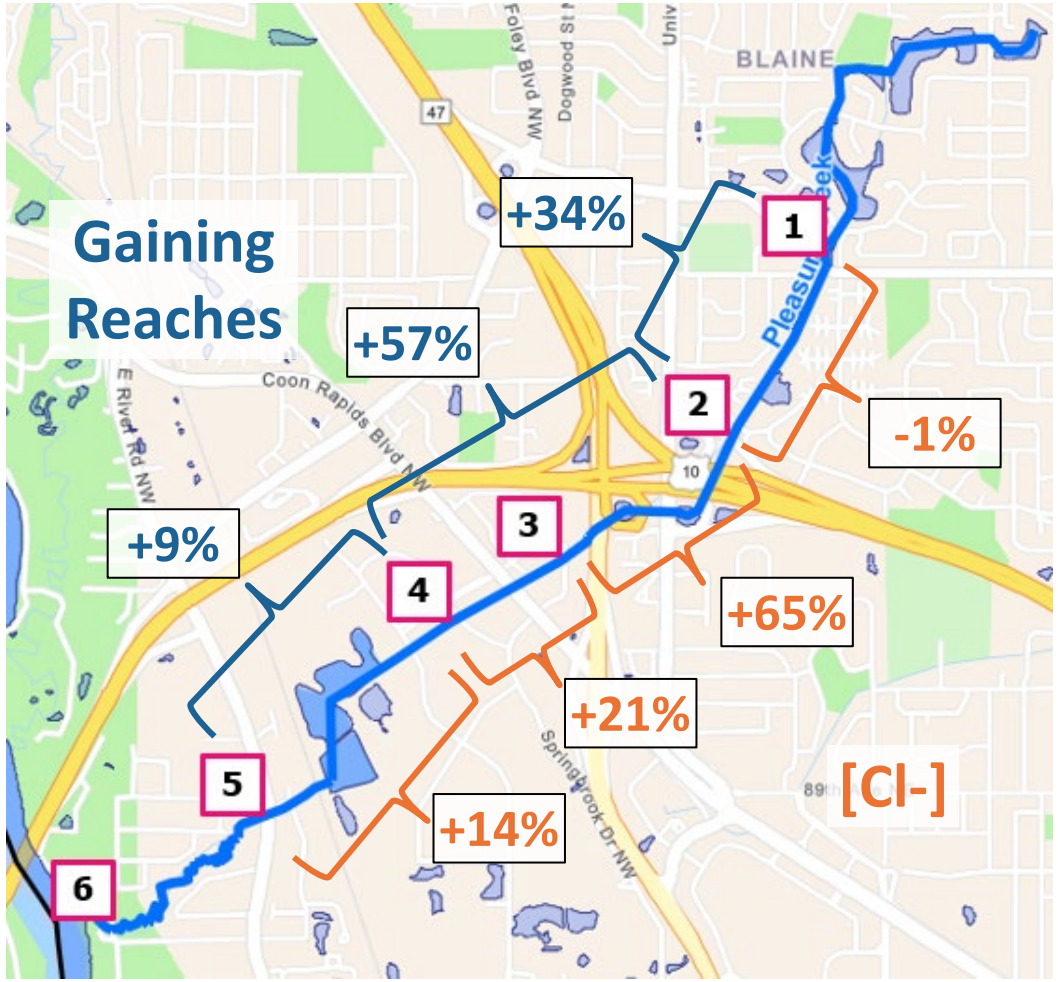
A closer look at in-stream [Cl-]: Sources

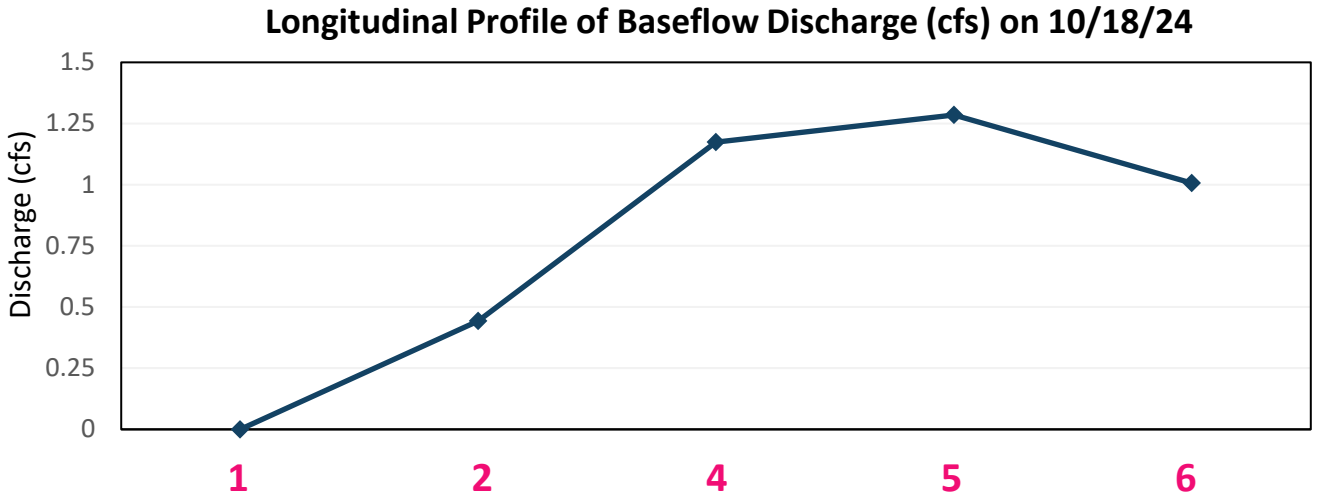
- On 10/18/2024, conducted synoptic sampling at 6 sites along Pleasure Cr
  - Discharge measurement
  - Specific conductivity reading
  - Chloride grab

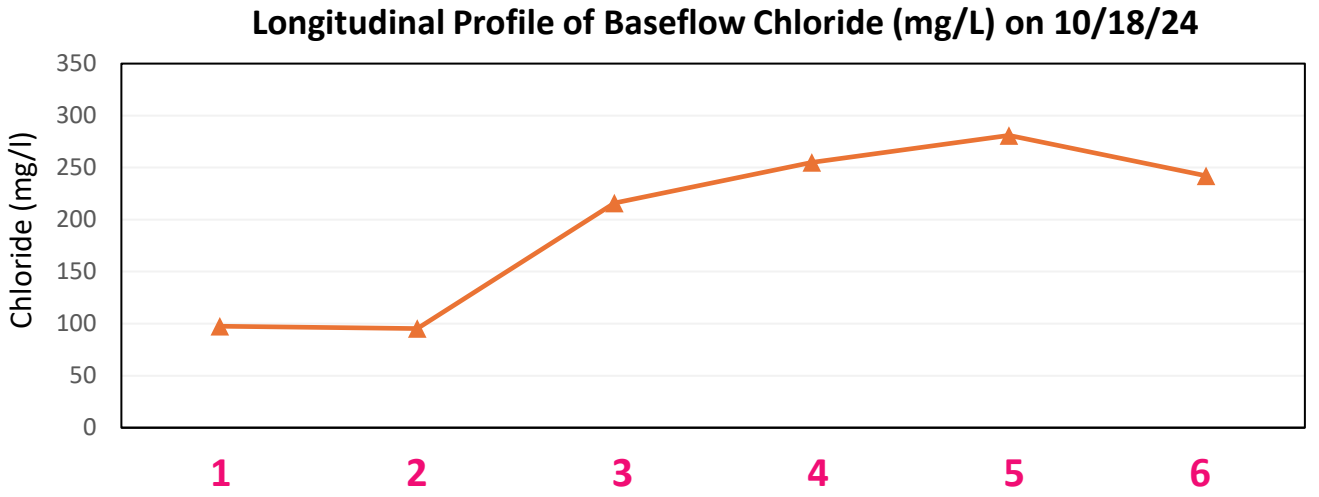




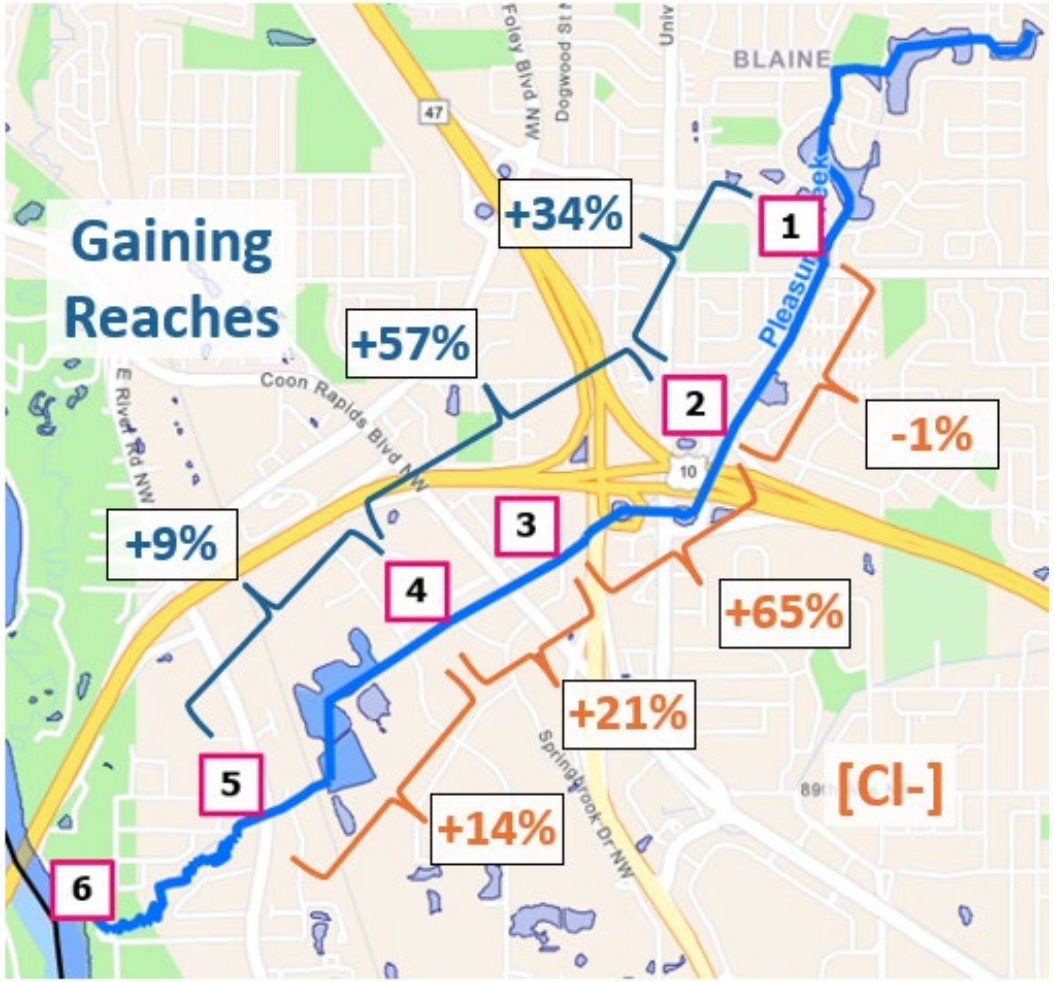
Results

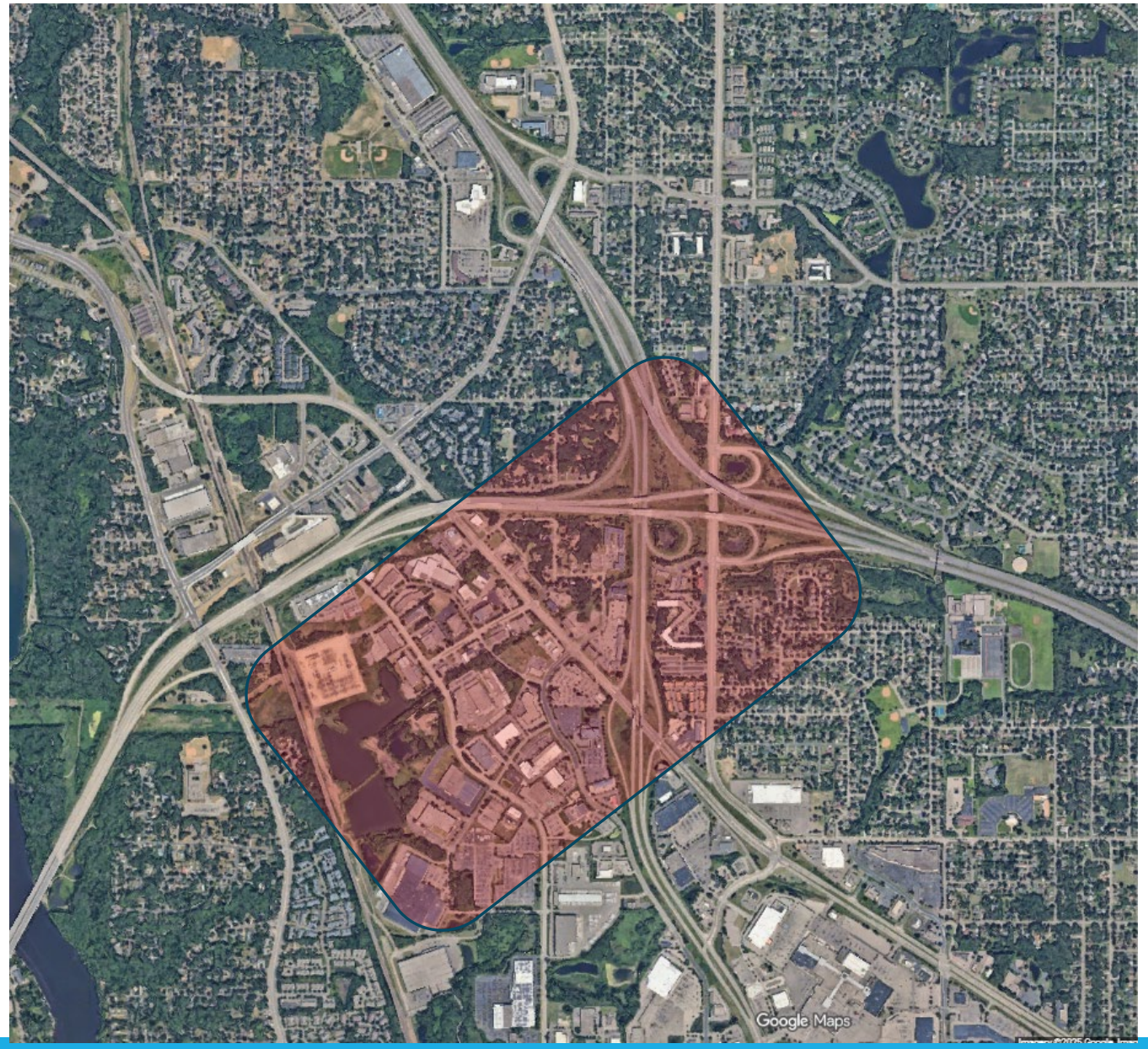

Gaining Reaches
+34%
+57%
+9%
+14%
+21%
+65%
-1%
[Cl-]
1
2
3
4
5
6
BLAINE
Coon Rapids Blvd NW
Foley Blvd NW
E River Rd NW
Springbrook Dr NW
47
10


Longitudinal Profile of Baseflow Discharge (cfs) on 10/18/24
Discharge (cfs)
1.5
1.25
1
0.75
0.5
0.25
0
1
2
4
5
6


Longitudinal Profile of Baseflow Chloride (mg/L) on 10/18/24
Chloride (mg/l)
350
300
250
200
150
100
50
0
1
2
3
4
5
6

Results


Gaining Reaches
+34%
+57%
+9%
+14%
+21%
+65%
-1%
[Cl-]
1
2
3
4
5
6
BLAINE
Foley Blvd NW
Dogwood St
Coon Rapids Blvd NW
E River Rd NW
Springbrook Dr NW
47
10


Google Maps

Summary of CCWD Chloride Situation

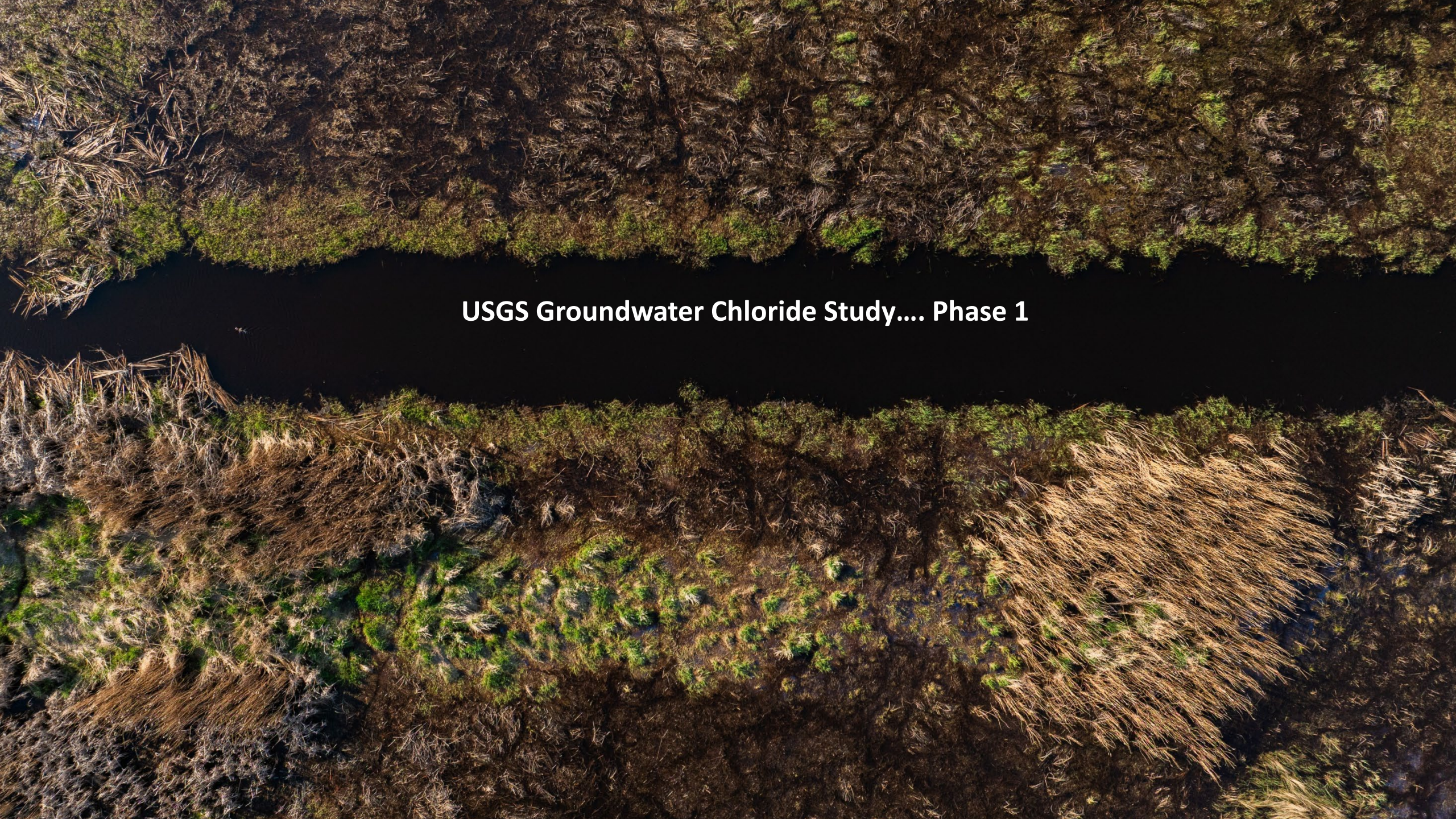
- Problematic, upward trend in baseflow Cl- (2.75% per year)
- Prolonged exceedances of chronic standard during extended low flows
- Localized chloride loading hot spots (flow x concentration)

However…

- In-stream Cl- concentrations highly sensitive to dilution
- Ability to export lots of chloride to Mississippi River:
  410 tons Cl from May-Nov 2024

Management Questions Remaining

- If groundwater is polluted with legacy chloride – how long will source reductions take to improve in-stream chloride levels?
- What is the contributing ground-watershed?
- Where are the loading and transport hot spots in the watershed?



USGS Groundwater Chloride Study…. Phase 1

Project Goals

- **PHASE ONE: January 2025 – June 2025**
  - Compile historical and field data
  - Develop groundwater flow and advective transport model of Coon Creek Watershed District
  - Emphasis on groundwater/surface water interactions, groundwater flow paths and travel times

- **PHASE TWO: Beginning FY26**

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Looking ahead: Phase Two

- Model refinements and improvements:
  - Improve resolution of Quaternary hydrostratigraphy to better simulate predicted flows
  - Incorporate additional data on baseflow discharge, near stream groundwater [Cl-], and historical salt loading
  - Simulate groundwater chloride loading (mass transport) to surface waters and evaluate potential chloride reduction strategies
- Design and install well network for long-term monitoring of groundwater levels and water quality in the surficial aquifer
- Publish a peer-reviewed report and model archive