



# Improving drinking water for Minnesotans through pollution prevention

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Meeting of the Legislative-Citizen Commission on Minnesota Resources  
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# Introduction

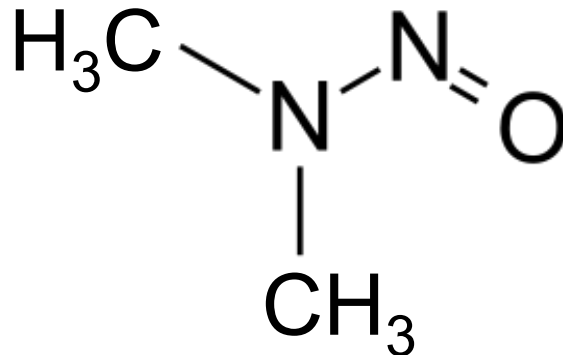
- ① Water is one of our most precious resources
- ② The upper Mississippi River supplies drinking water to ~20% of MN population
- ③ The river is under constant assault from human activities



# NDMA (N-nitrosodimethylamine)

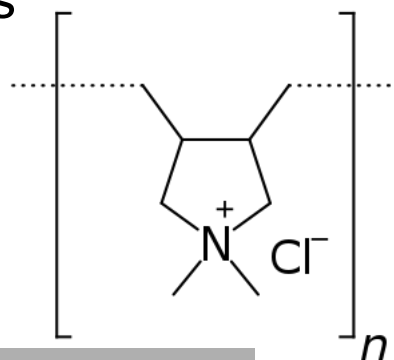
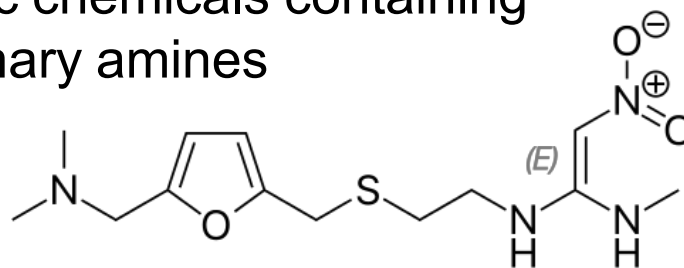
- Highly toxic, human carcinogen
  - Notification Level in CA: 10 ng/L
  - MDH guidance value: 5 ng/L
- Not present in the Mississippi River
- Disinfection by-product (DBP)

**Precursors + Chloramines → NDMA**

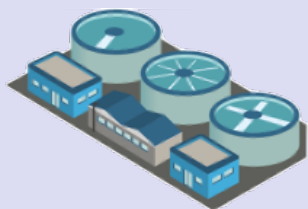


# NDMA Precursors

- Precursors mainly anthropogenic chemicals containing secondary, tertiary, and quaternary amines
- Pharmaceuticals
  - Raniditine
- Water treatment polymers
  - PolyDADMAC
- Agricultural chemicals
  - Antibiotics
  - Pesticides



Industrial  
Production



Wastewater  
treatment



Agriculture



Stormwater

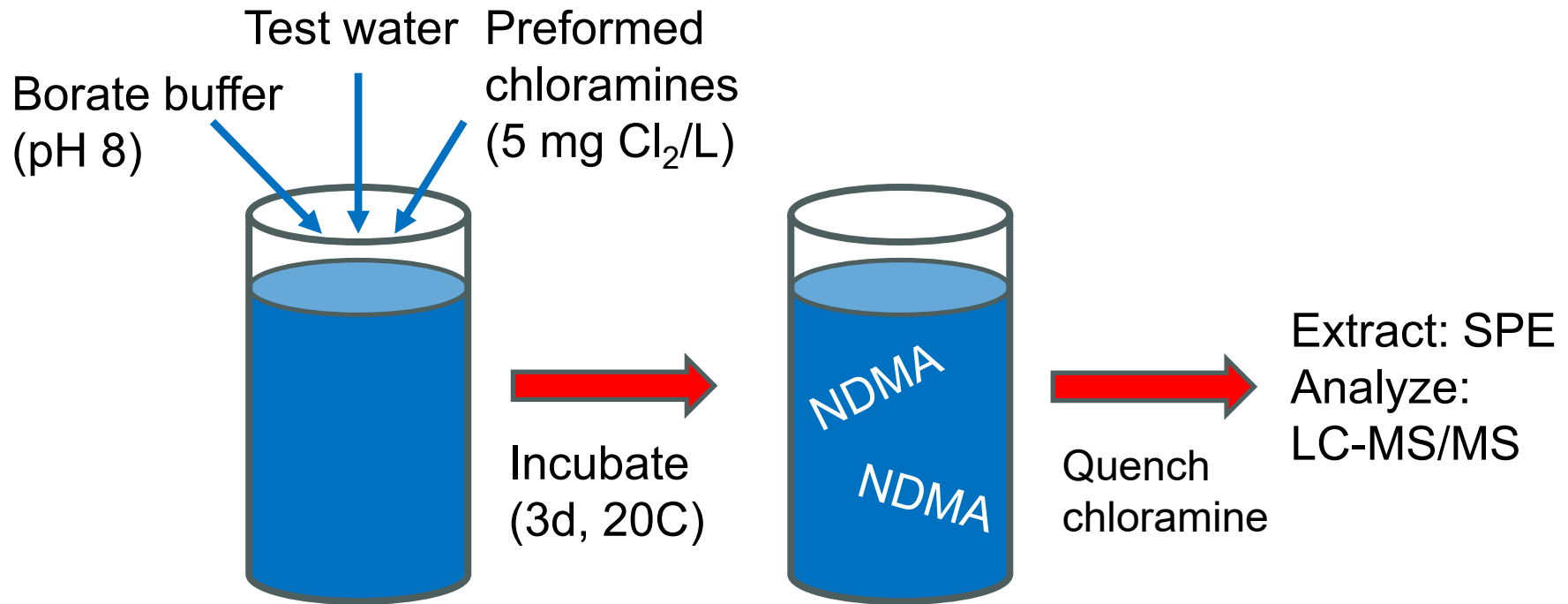


Algal blooms

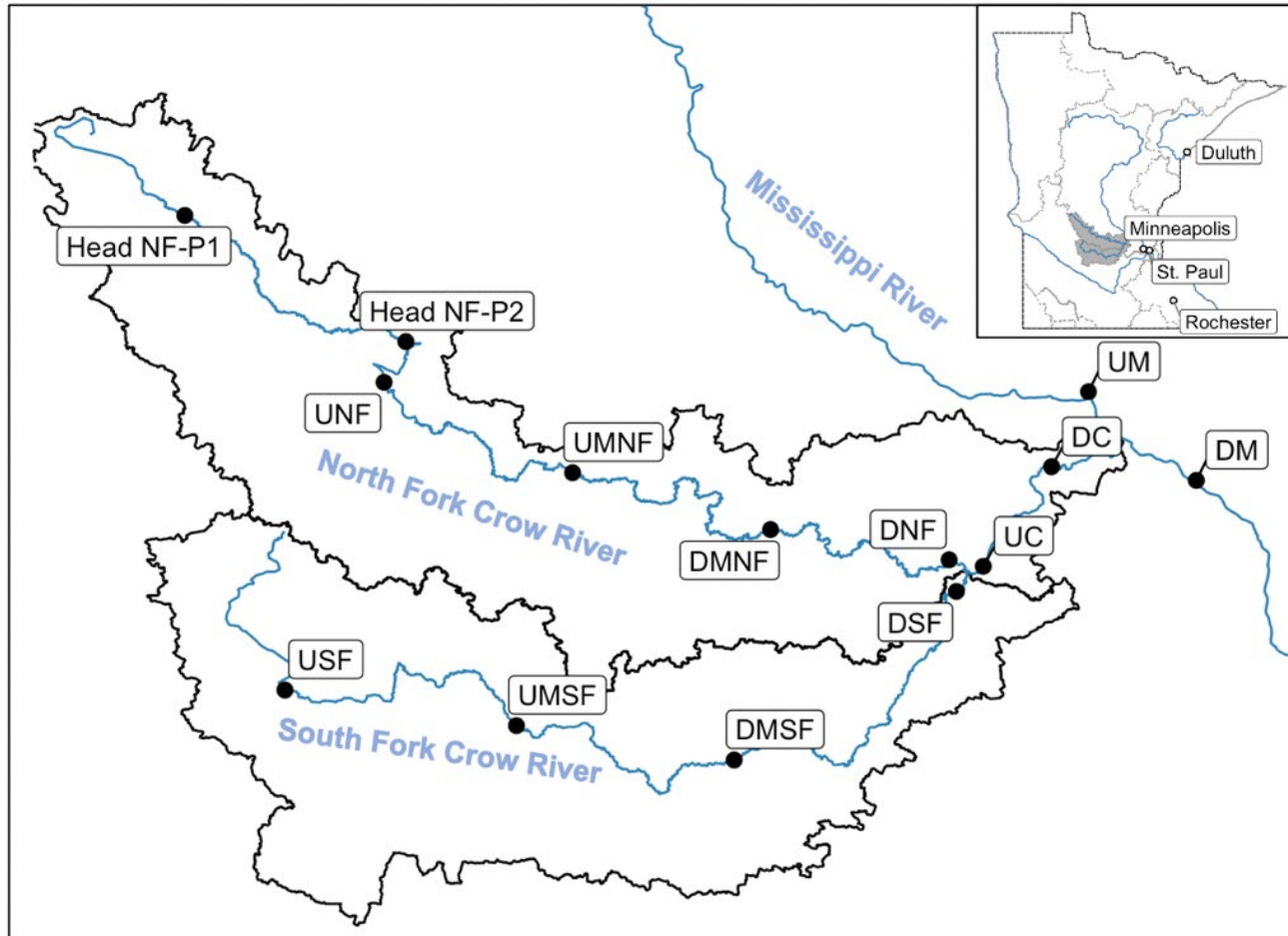


# Research Approach

- Sample river water
- Measure NDMA precursor levels
- Analyze for potential precursor chemicals (non-target analysis)
- Test treatment methods for precursor removal (ozone, free chlorine)



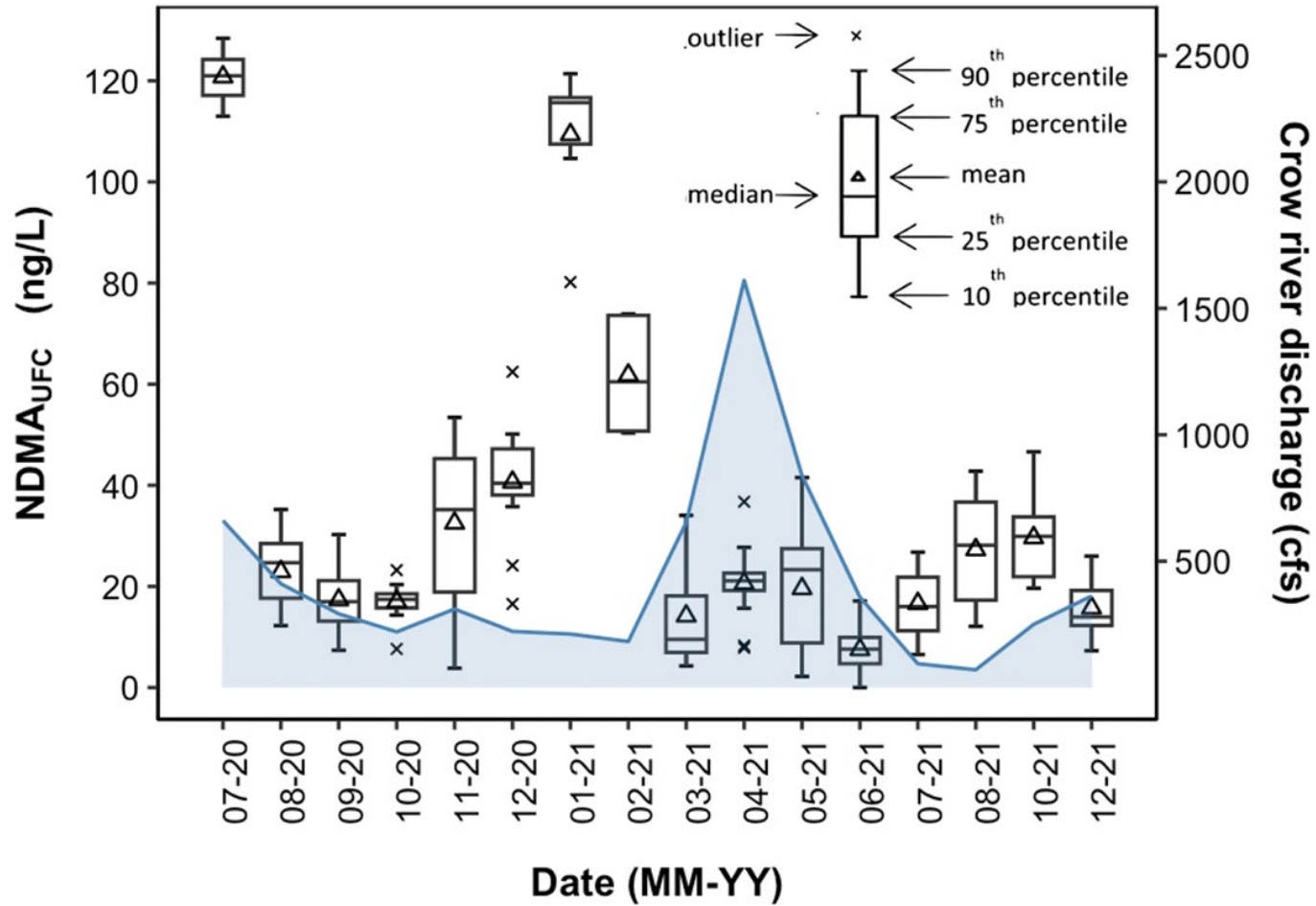
# Sampling locations



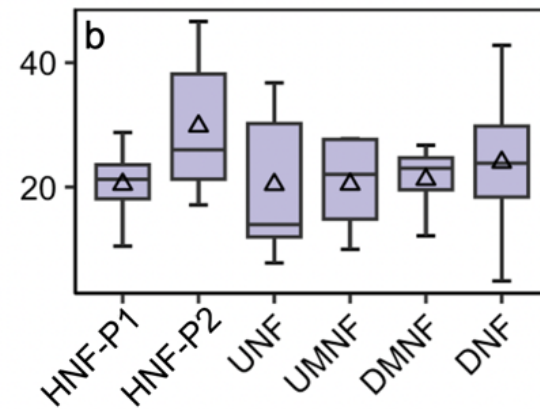
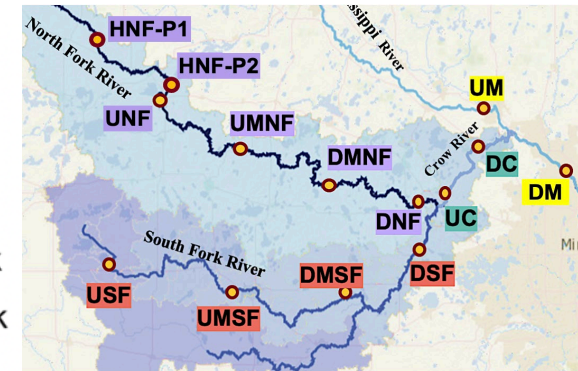
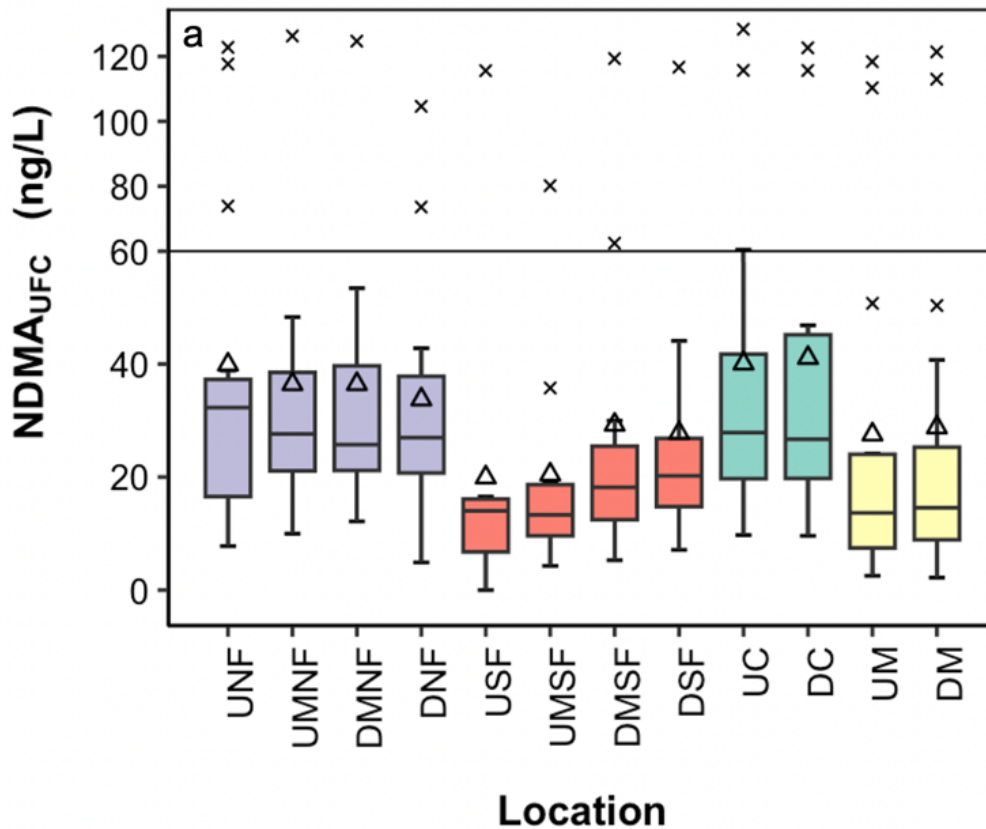
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# Results: Temporal variation

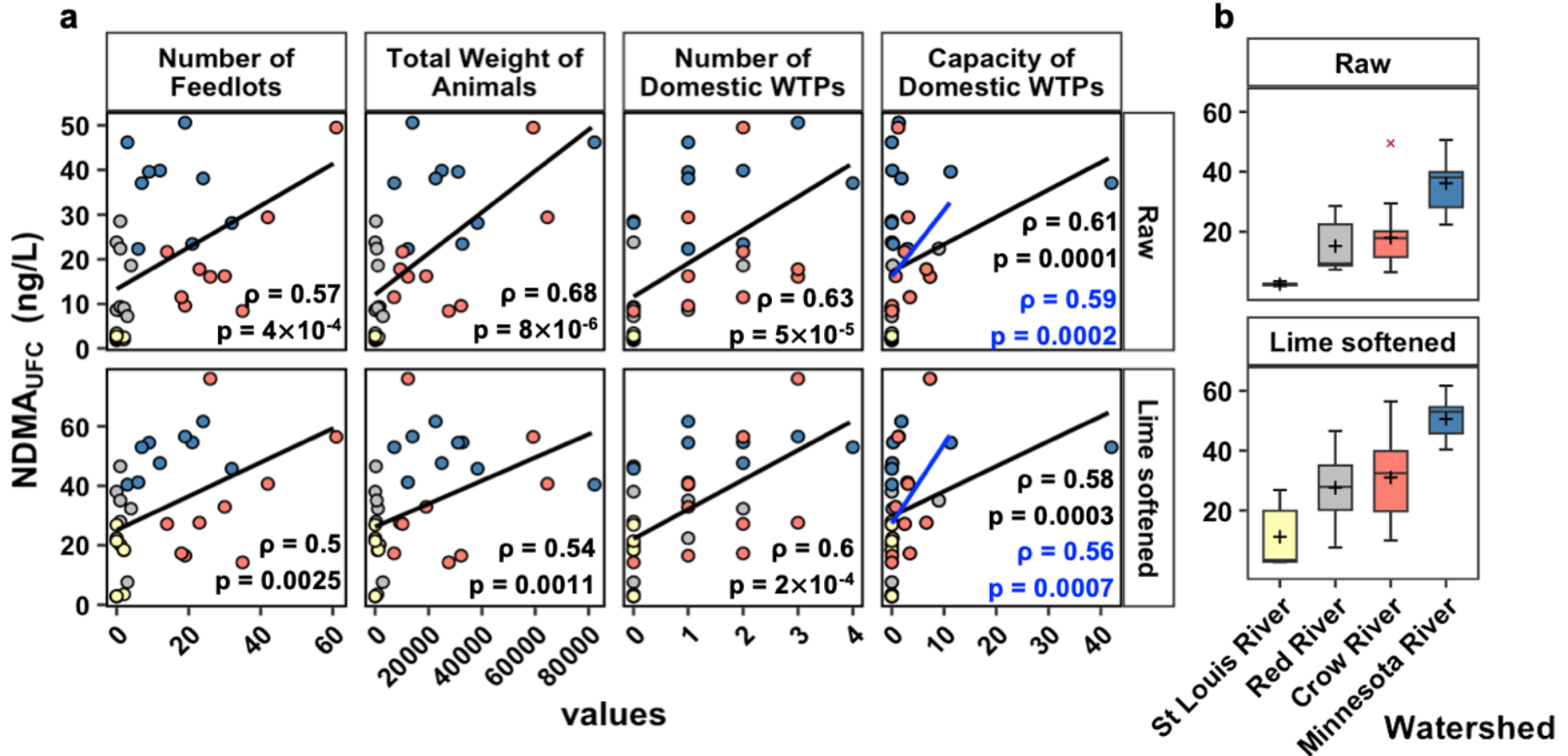


# Results: Spatial Variation



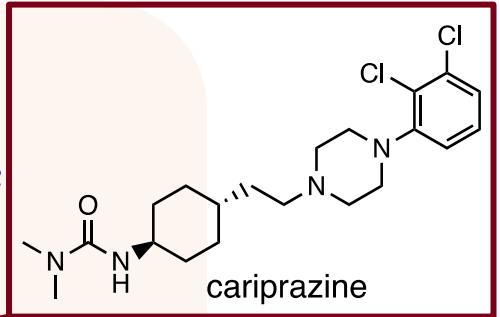
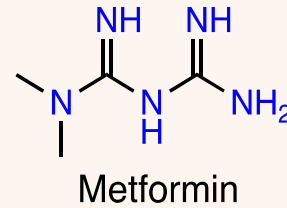
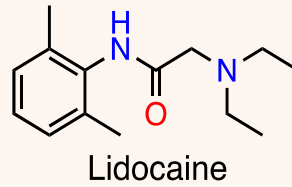
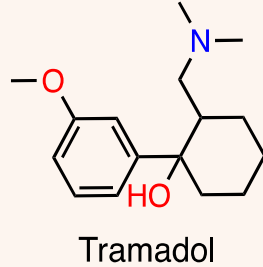
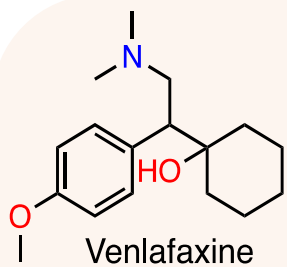


# Compare to other watersheds

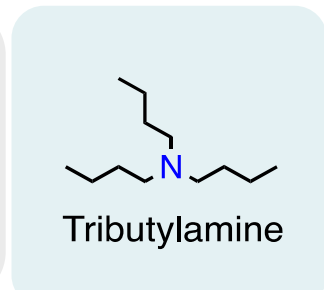
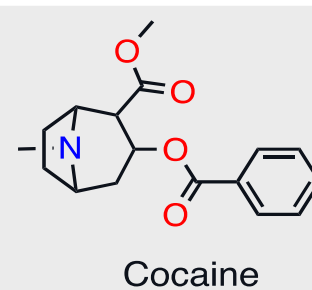
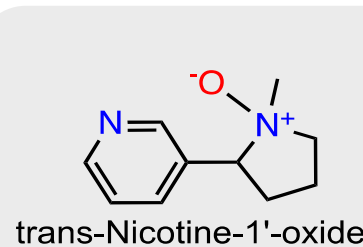
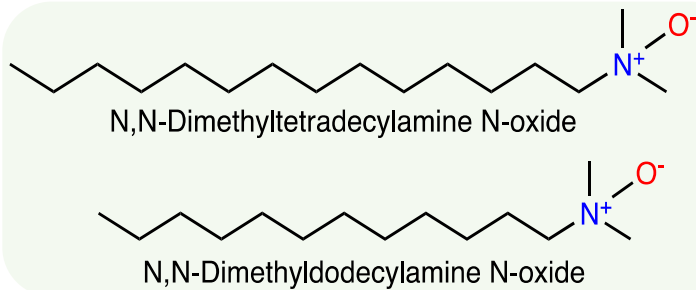
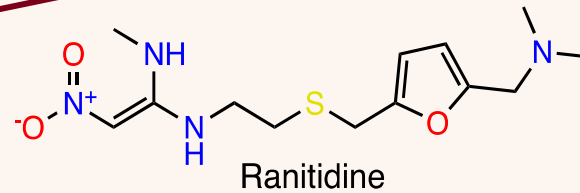
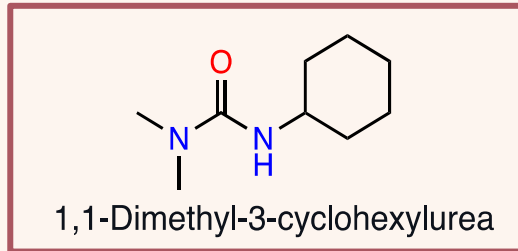
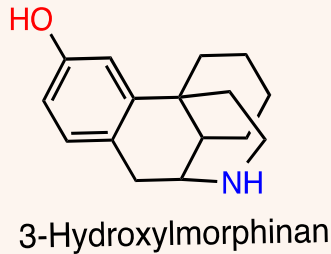


# Non-target analysis

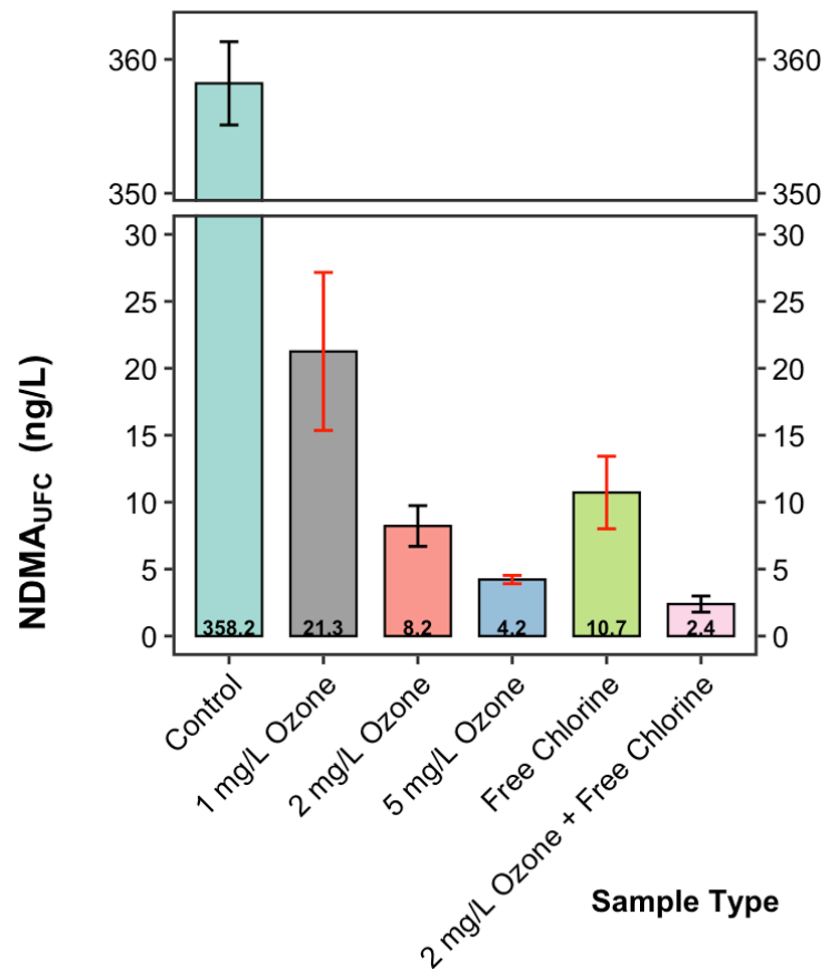
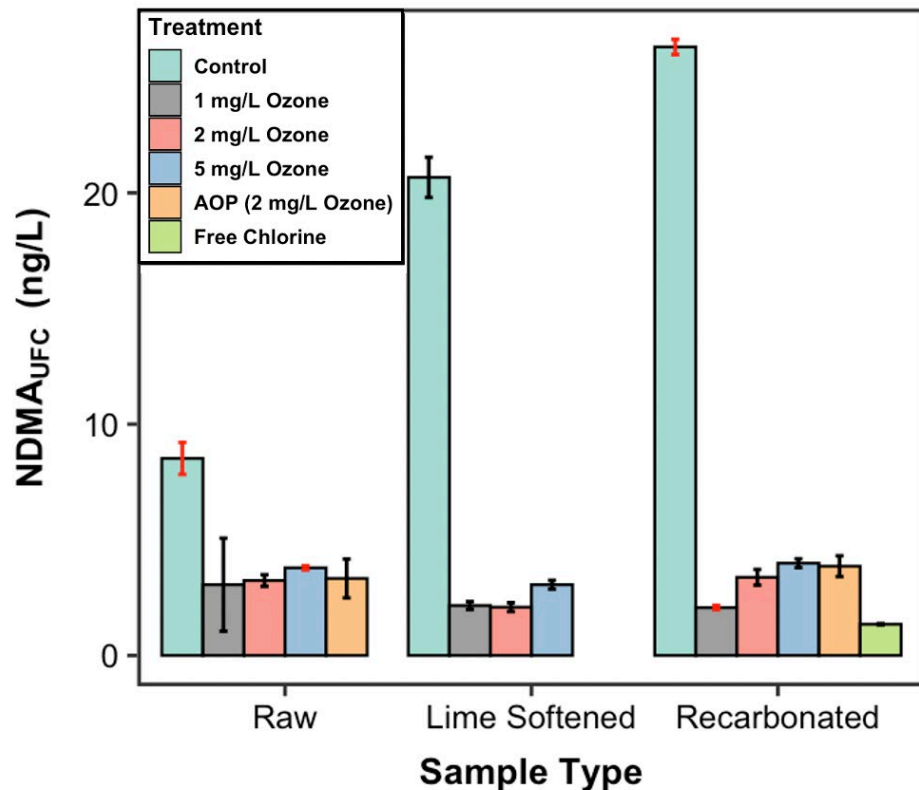
Thirteen nitrosamine precursors were identified



atypical antipsychotic



# Pre-oxidation treatment



# Dissemination

- Shared results with water utilities, MDH, MPCA
- Presented results at MN AWWA conference
- Published 3 scientific journal articles



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