



W1-1

MAWWG Meeting 9-24-2025

**Is climate change and
road salt salinization
undermining nitrogen
removal by
freshwater
urban/suburban
wetlands?**

Md. Moklesur Rahman & Shreeram Inamdar



Wetlands – important nutrient filters

- **Wetlands are kidneys of the urban landscape**
- **Help remove excess nutrients and pollutants from runoff**
- **Example - remove nitrate nitrogen via denitrification**
- **Ecosystem services - important in managed landscapes – urban, suburban, and agricultural**

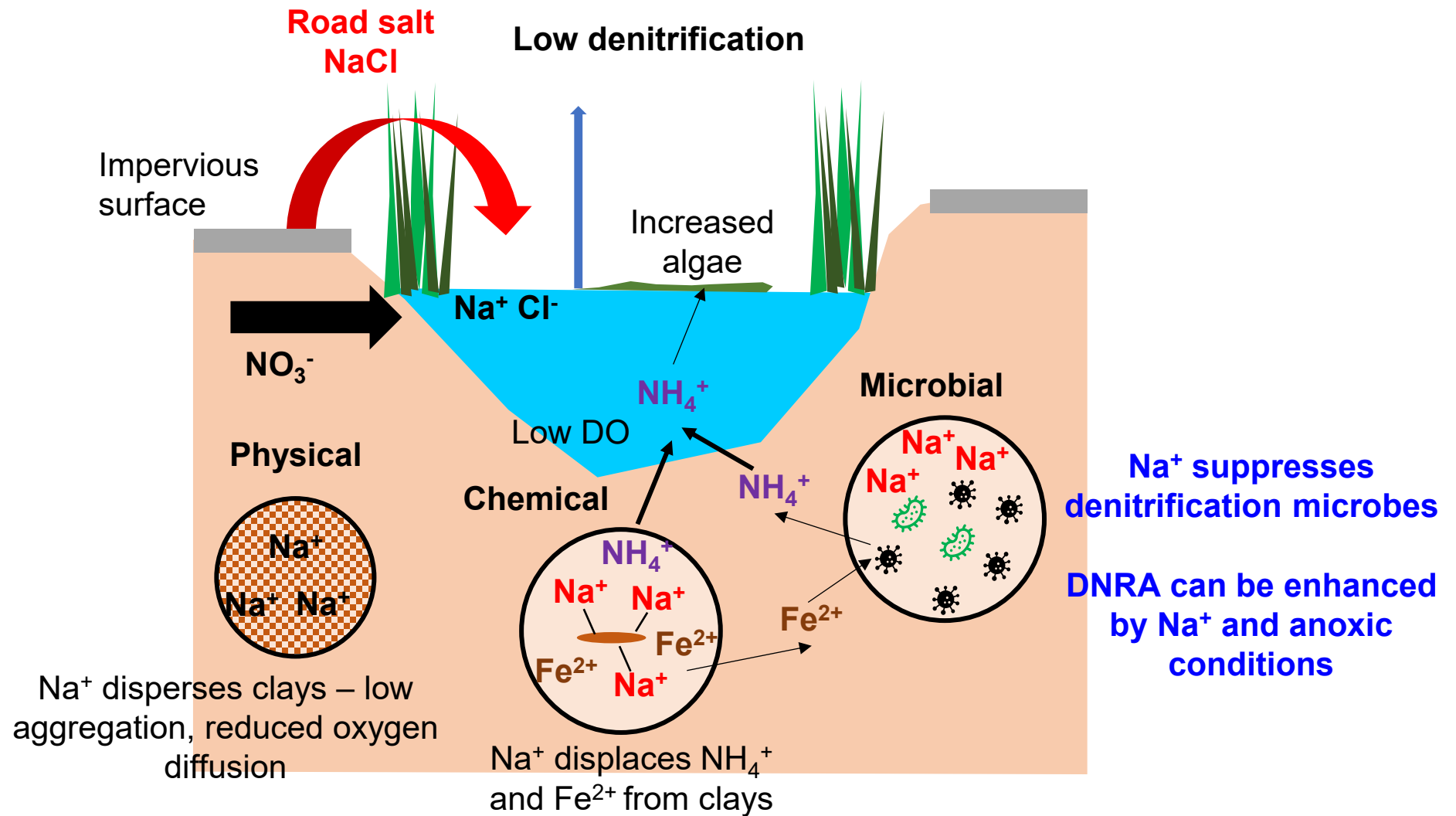


Road salt impact on wetlands

- Road salt application is the key management practice in urban and suburban landscapes to address winter ice & road safety
- But road salt can degrade wetland nitrogen filtering services



Urban/suburban wetland N regime impacted by road salt



Road salt effects that undermine nitrogen removal processes in wetlands

Key Questions

- How do Na^+ concentrations alter the balance of **sorbed NH_4^+ concentrations in wetland sediments**?
- How do road salt NaCl concentrations and soil temperatures affect the **rates of denitrification and DNRA** in freshwater wetland sediments?
- Are **microbial populations** lower in wetlands affected by road salt and higher soil temperatures?

Key Tasks

- **T1: Field sampling and characterization of road salt impacted urban/suburban and reference wetland soils**
- **T2: Controlled laboratory experiment to assess salt levels and temperatures**
- **T3: Existing data synthesis to assess salt trends and nitrogen concentration impacts**

Task 1: Wetland Sampling & Characterization

Hypotheses:

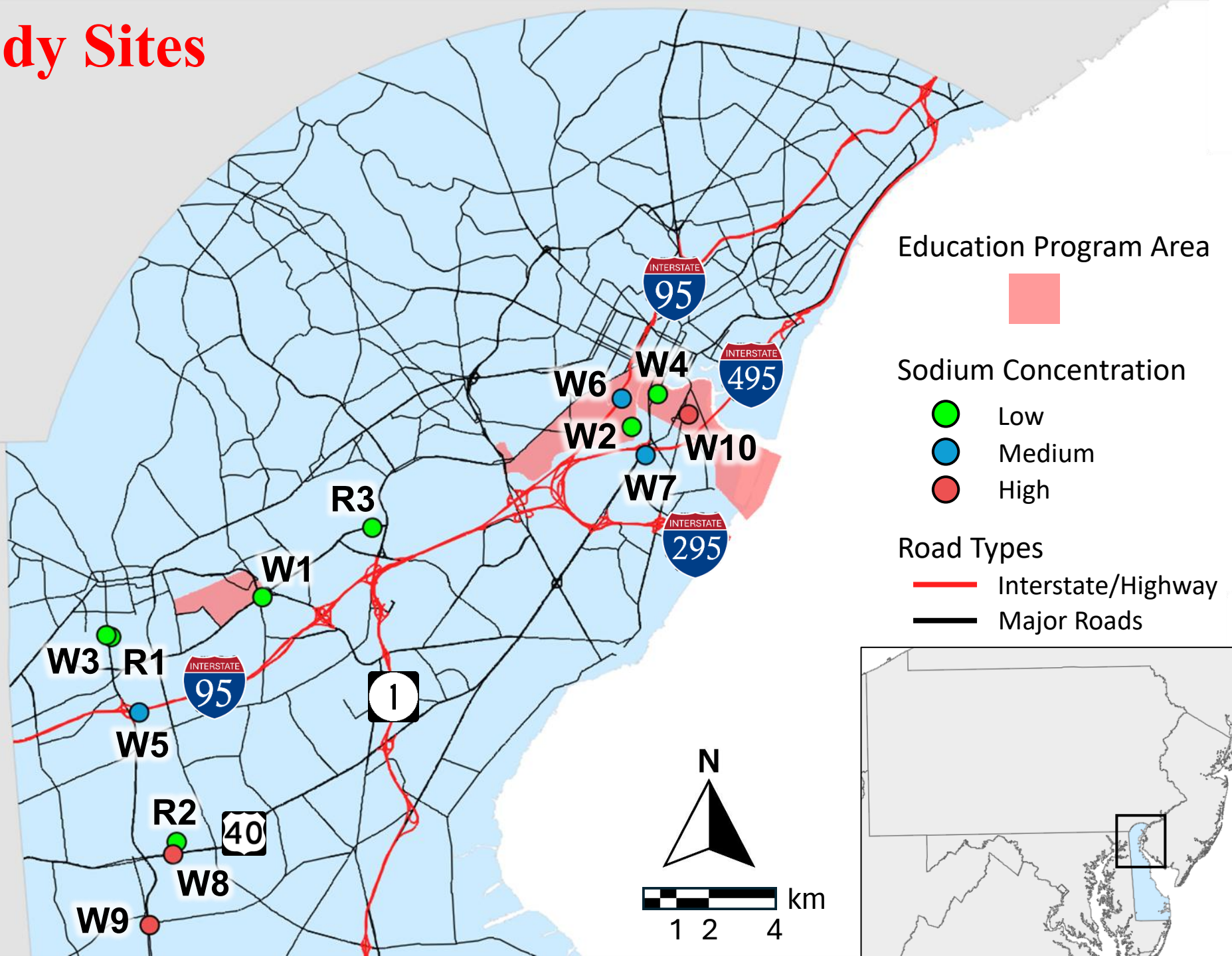
H1: Road salt affected wetlands sediments will have **poor soil aggregation**.

H2: Higher concentrations of Na^+ in soil due to road salt will result in **release of soil/sediment bound NH_4^+** .

H3: Elevated Na^+ concentrations will **decrease denitrification rates but increase DNRA rates**.

H4: Road salt will **decrease denitrification functional genes (nosZ), but increase DNRA genes (nrfA)**

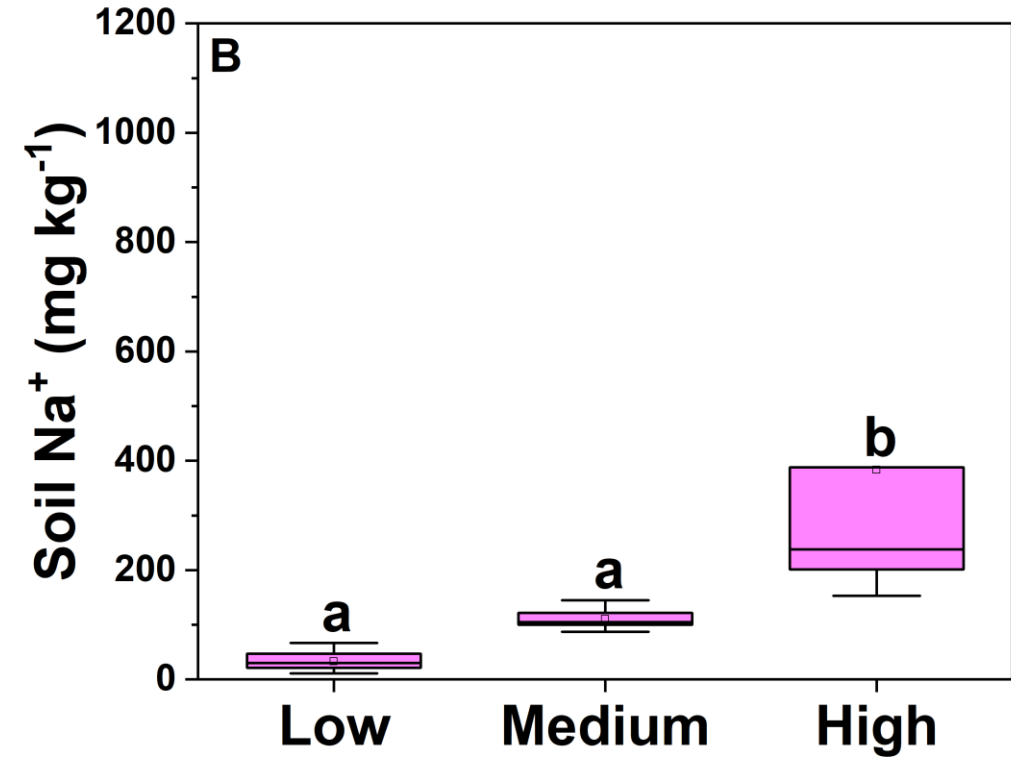
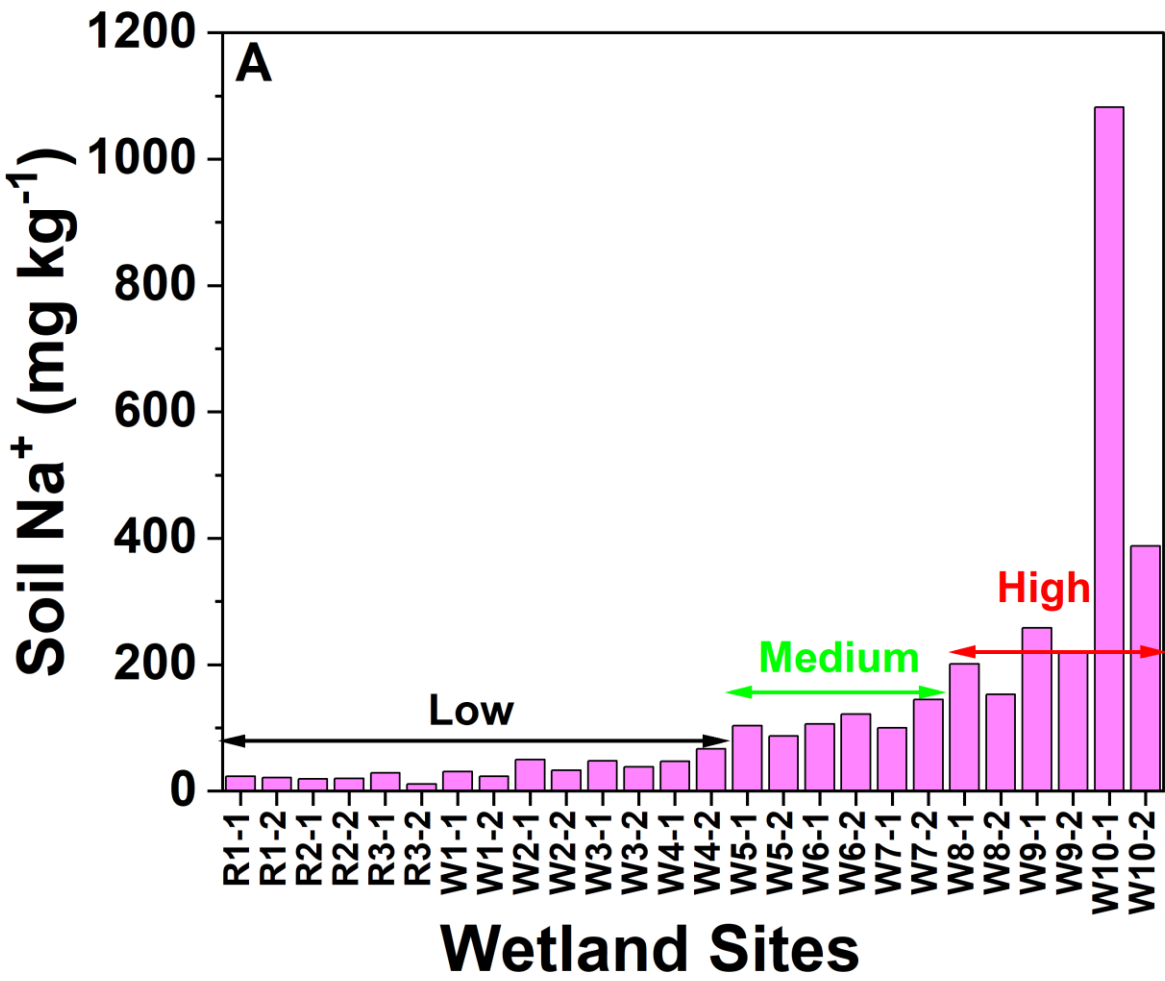
Study Sites



Collecting Soil and Water Samples

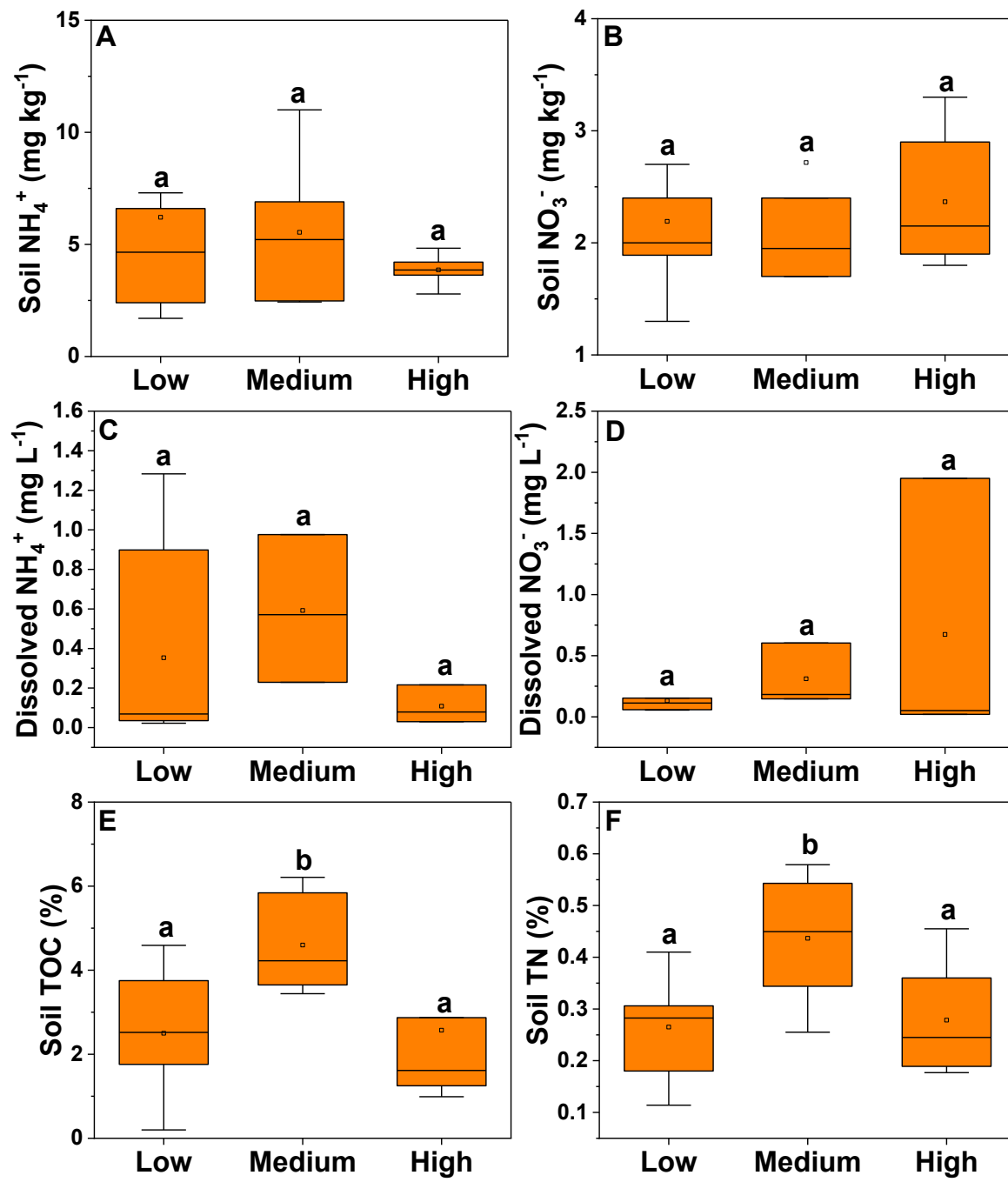


Na⁺ concentrations across sampling sites and categories

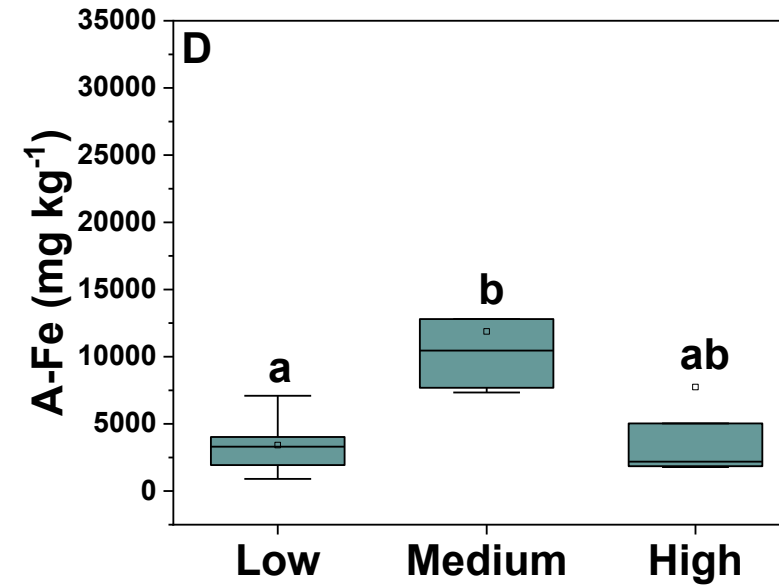
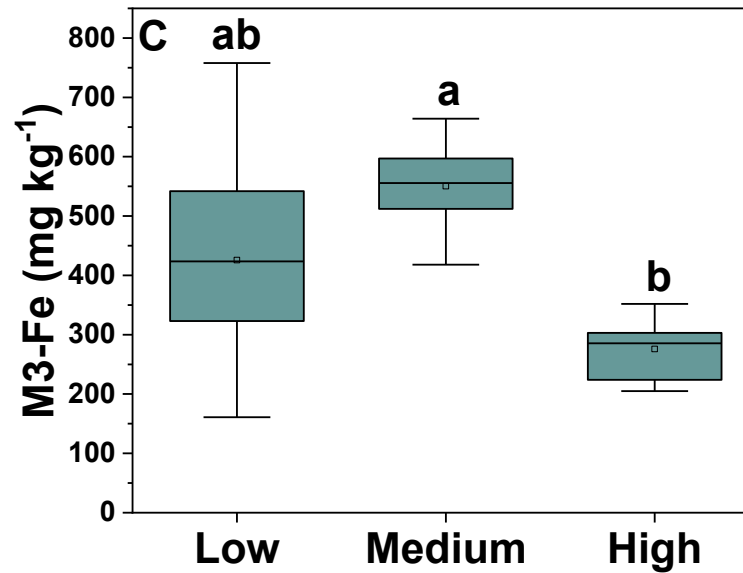
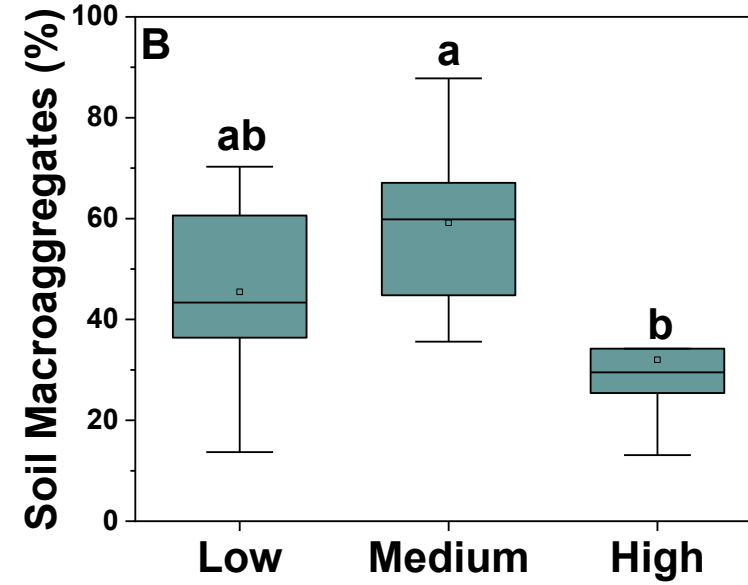
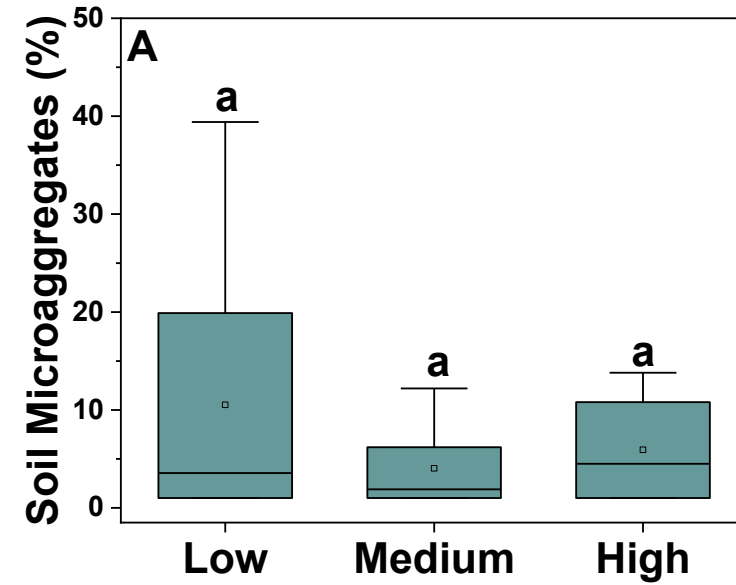


Sites divided into 3 categories

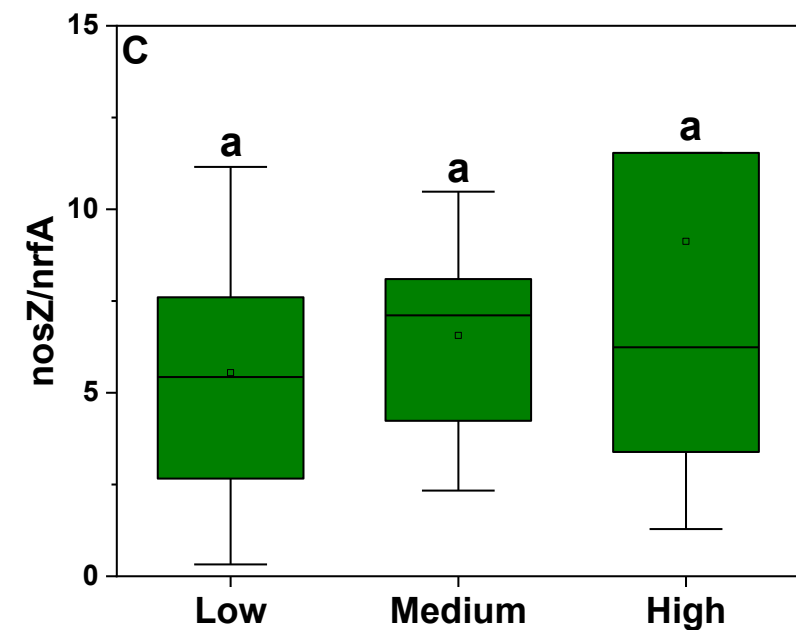
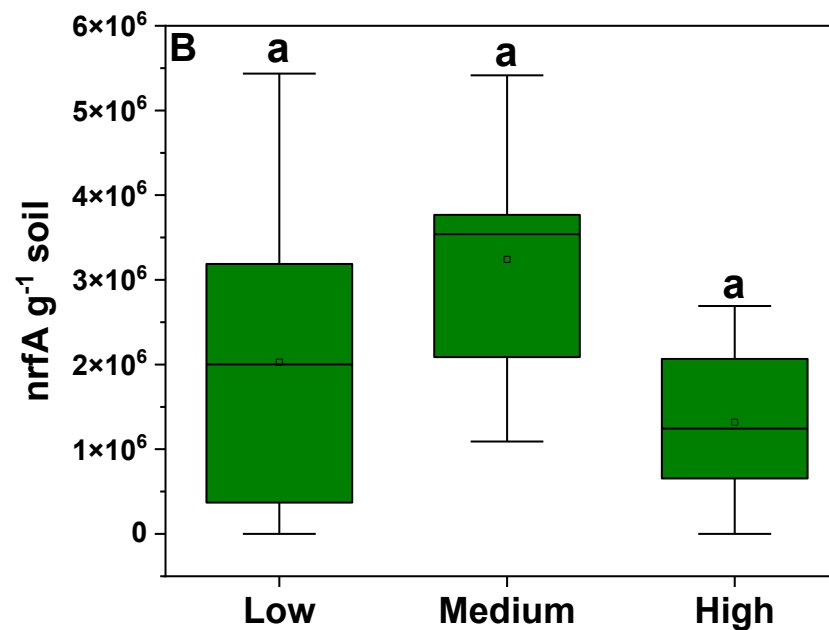
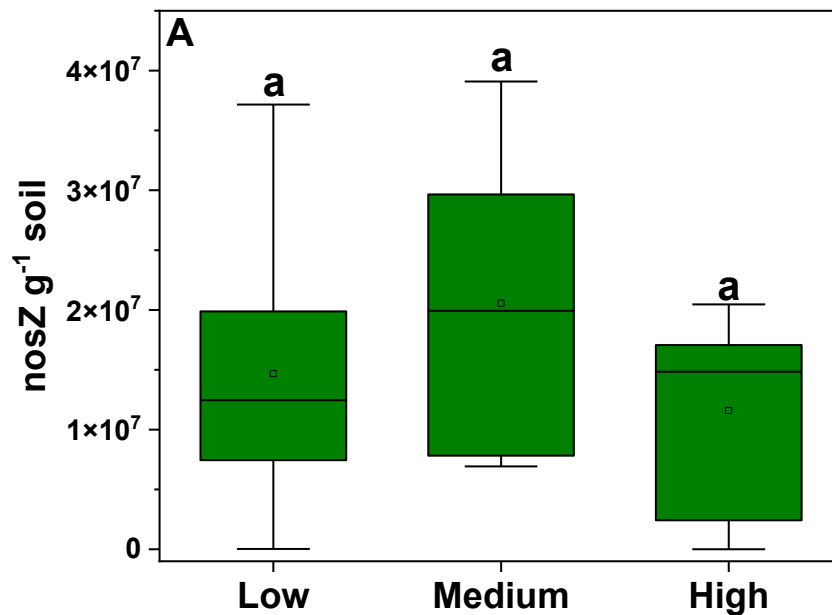
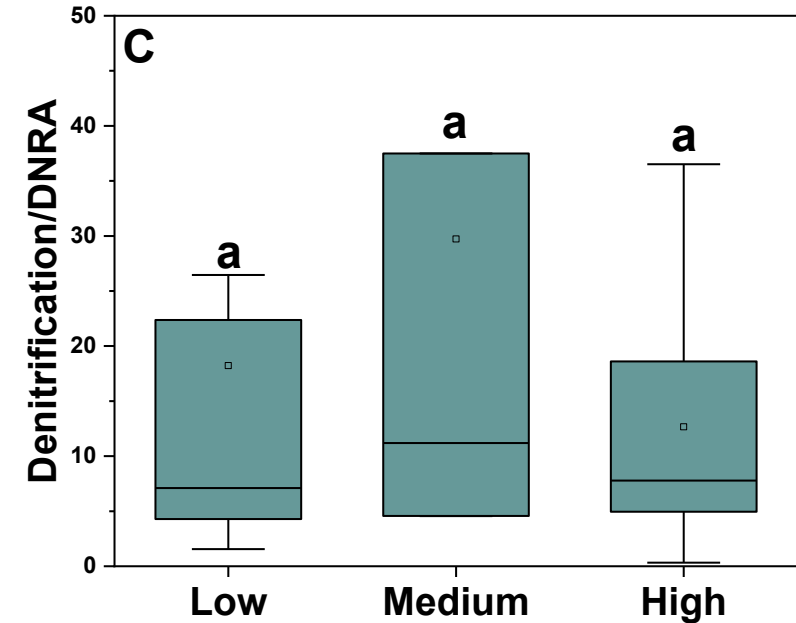
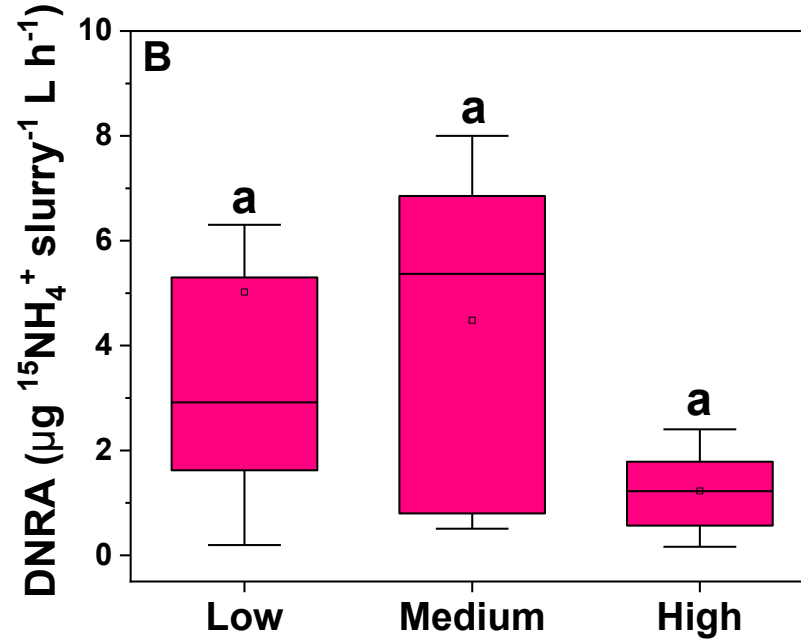
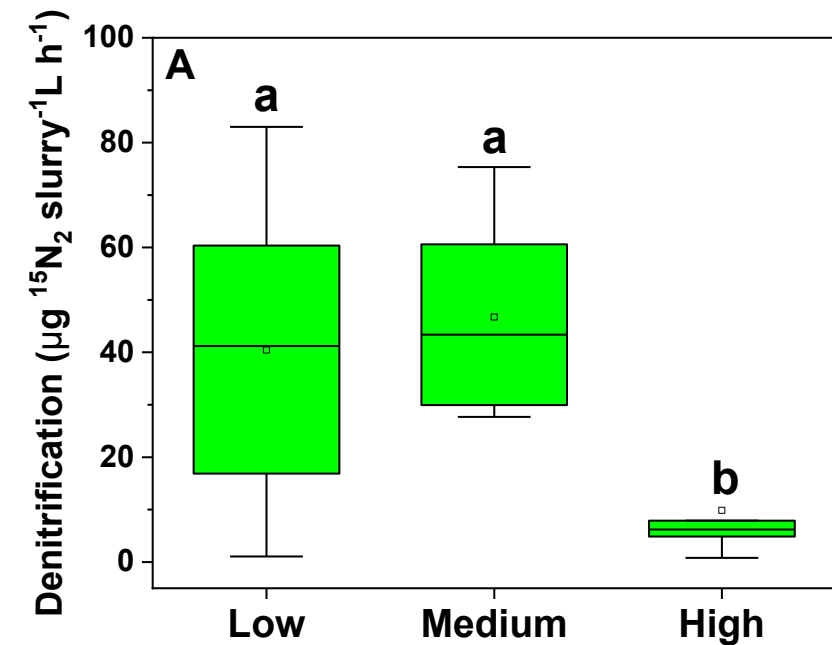
Impact on N Species, OC & TN



Soil aggregation and Fe release



Effects on process rates and microbial functional genes



Key Takeaways

- Denitrification was impacted more significantly by road salt than DNRA
- Release of solid phase and accumulation of dissolved phase NH_4^+ was not enhanced by road salt
- Soil macro-aggregation decreased significantly in the high compared to the medium salt category wetlands
- There was no significant impact of road salt on overall microbial abundance and functional genes

Manuscript In Review with Wetland Journal

Wetlands

Effects of road salt on nitrogen removal by freshwater urban wetlands

--Manuscript Draft--

Manuscript Number:		
Full Title:	Effects of road salt on nitrogen removal by freshwater urban wetlands	
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Abstract:	Freshwater urban wetlands are important ecosystems that can naturally filter and remove excess nitrogen (N) through the process of denitrification (DNF). However, anthropogenic inputs such as road salt application may affect the N removal capacity of urban wetlands by affecting the relative rates of DNF and another competing reductive process that retains N – dissimilatory nitrate reduction to ammonium (DNRA). Here, we assessed 13 roadside wetlands in urban/suburban areas of Delaware, USA to determine the effects of road salt sodium (NaCl) on soil physical, chemical, and	

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Mohamed Abdou Bahman, a postdoctoral researcher, sampling water in a Southwold, Del., wetland. PHOTO BY MURTA SANTAR

University of Delaware gets EPA grant to study effects of road salt on freshwater wetlands

By Meg McGuire | August 21, 2024

Road salt, while good when roads are icy, can be bad for water systems and the critters that inhabit them.

The U.S. Environmental Protection Agency has given \$319,382 to the University of Delaware to investigate how the coupled effects of extreme climate events and road salt could undermine the ability of freshwater wetlands to filter and remove nitrogen from runoff.

A little nitrogen is great for growing crops but it is "mobile," said Shrivaram Inamdar, professor of watershed hydrology and biogeochemistry at the university's Plant and Soil Sciences Department.

And that mobility means it doesn't stay on the soil but rather runs off with rains into nearby streams and other water bodies – especially wetlands.

Here's how Inamdar explains the problem:

Wetlands are considered the "kidneys" of the land because of their unique ability to filter nutrients like nitrogen from runoff. Nitrogen is a fertilizer, and while it is good for growing crops, excess nitrogen in our waterways causes water pollution. Nitrogen can stimulate algal growth that sucks out dissolved oxygen from water when it decomposes. Low oxygen affects fish and other aquatic species. Thus, wetlands provide a valuable ecosystem service by removing nitrogen.

(Readers might remember the problem of dissolved oxygen – or the lack of it – for the Atlantic sturgeon.)

This removal of nitrogen is a natural process that healthy wetlands provide "for free," Inamdar noted.

Algae can upset the natural systems


The water running in a nearby stream is an ever-changing mix of sediment, nutrients, dissolved gases, like oxygen and nitrogen, and visible as well as invisible critters – all in a balance that yields us a healthy stream or wetland.

When we use fertilizers – usually a combination of nitrate and ammonia – the nitrate moves on with stormwater but the ammonia is "sticky," according to Inamdar.


That "free" nitrate will also do its fertilizing magic on the plant life in a pond or wetland and stimulate the growth of algae. We tend to separate good and bad forms of algae.


Blue-green algae, for example, is toxic and dangerous on contact for animals and humans, but even the less dangerous algae end up being problematic. As it dies and sinks to the bottom of a water body, decomposing, it sucks out oxygen and upsets the natural systems that keep the waters clear.

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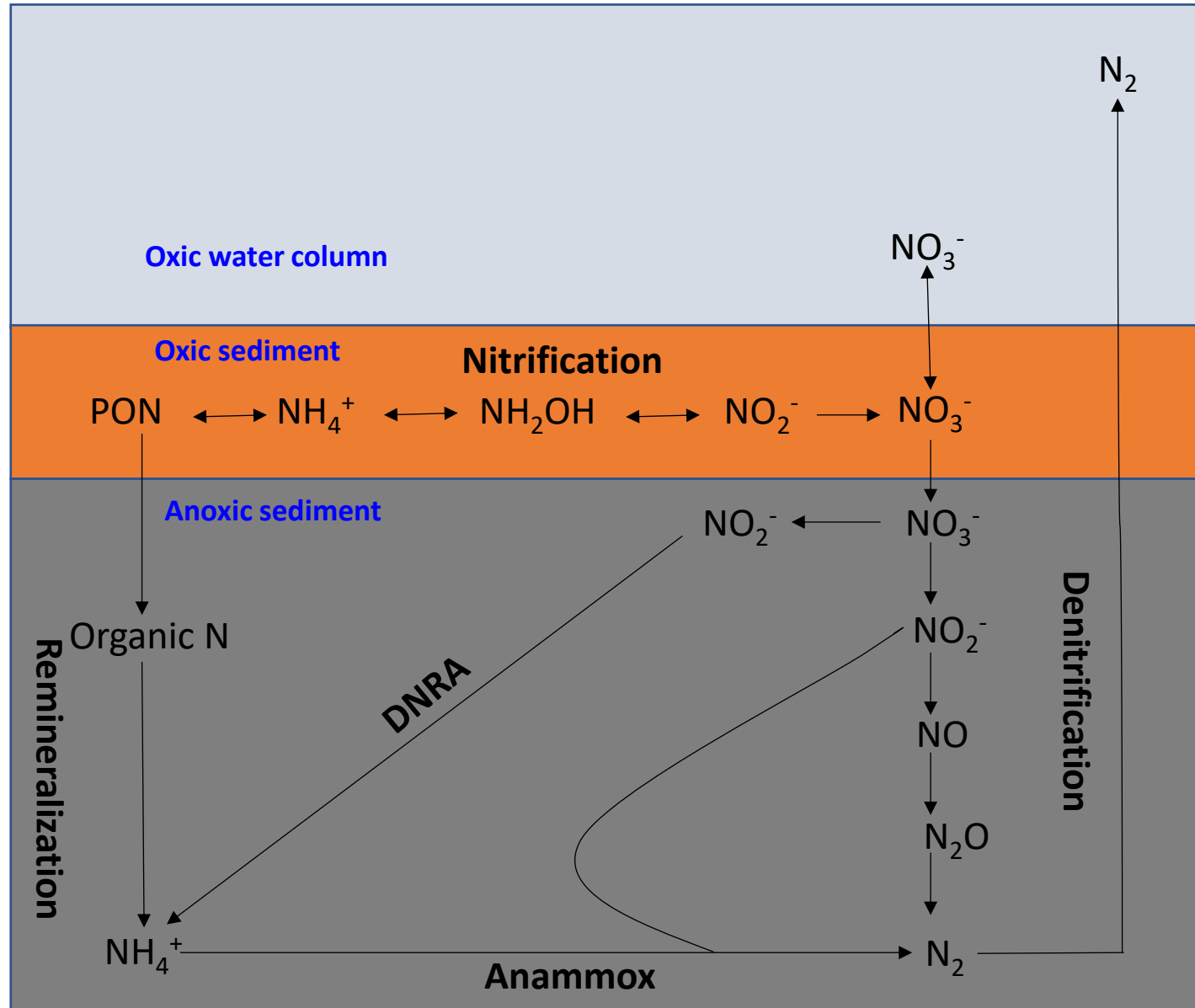
Thank you all

Any questions or comments???



Email: mmrahman@udel.edu

Nitrogen Cycling Processes



Microbial N transformations above, below and across a suboxic/anoxic sediment interface (modified from *Francis et al., 2007*).