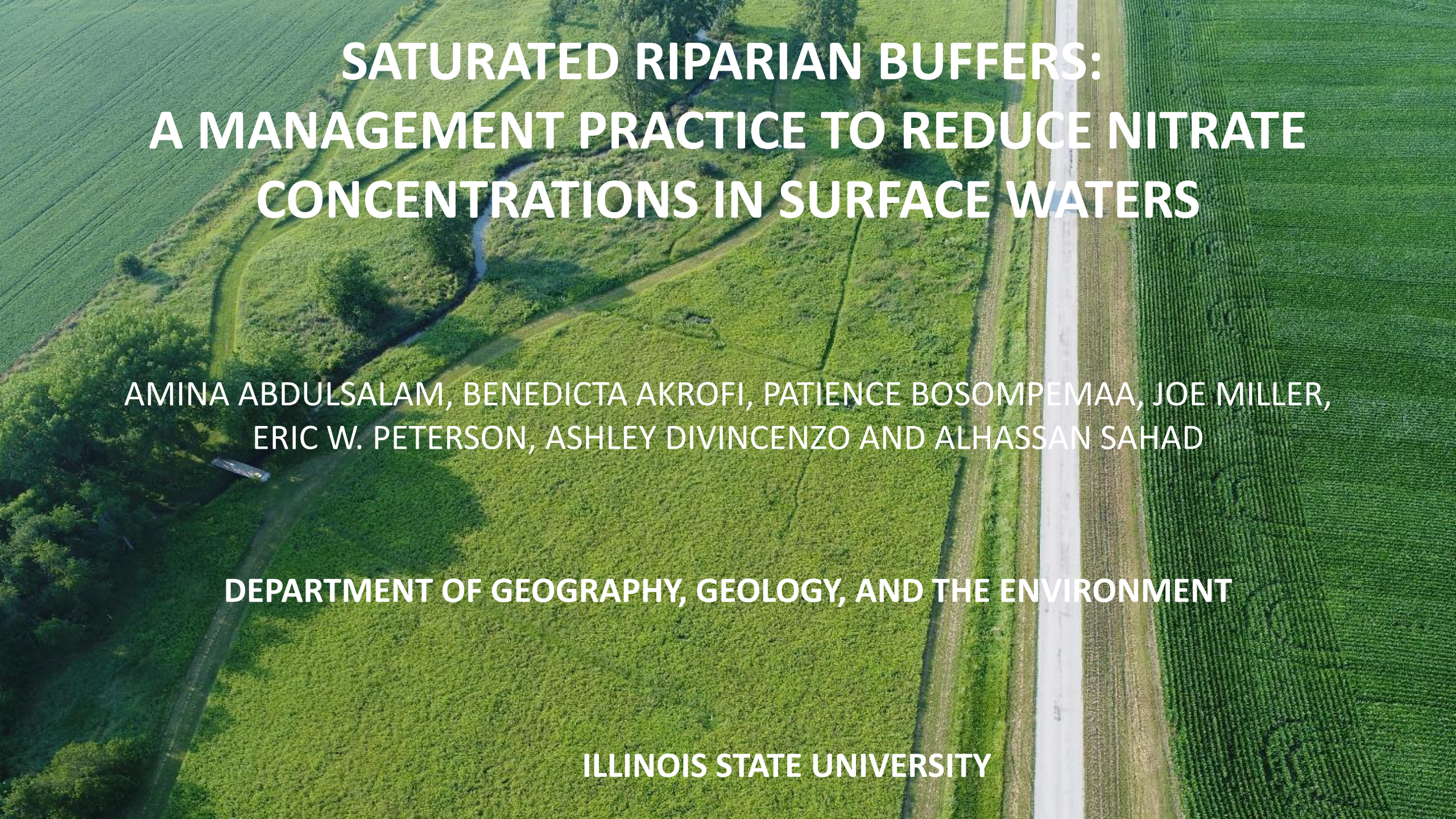

SATURATED RIPARIAN BUFFERS: A MANAGEMENT PRACTICE TO REDUCE NITRATE CONCENTRATIONS IN SURFACE WATERS

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KEY POINTS

- All the incoming tile water is diverted into the system.
- The diverted nitrate-nitrogen (NO_3–N) rich tile water within the SRB has the potential to be treated with a removal rate of 27% - 97%.
- The SRB has a long-term effectiveness in managing NO_3–N concentrations within agricultural settings.

OVERVIEW

1. Introduction

2. Goal And Specific Objectives

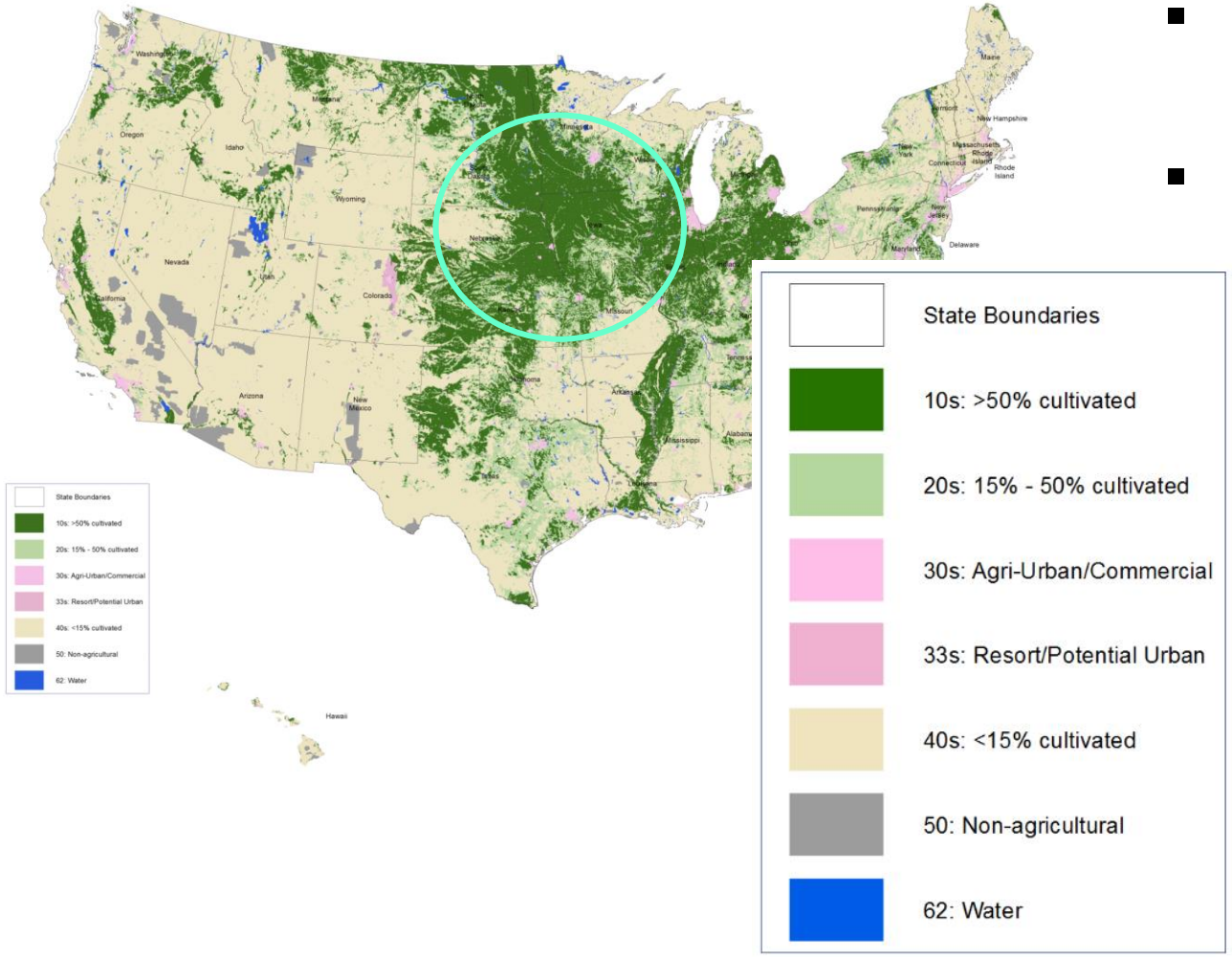
3. Study Site Description

4. Methodology

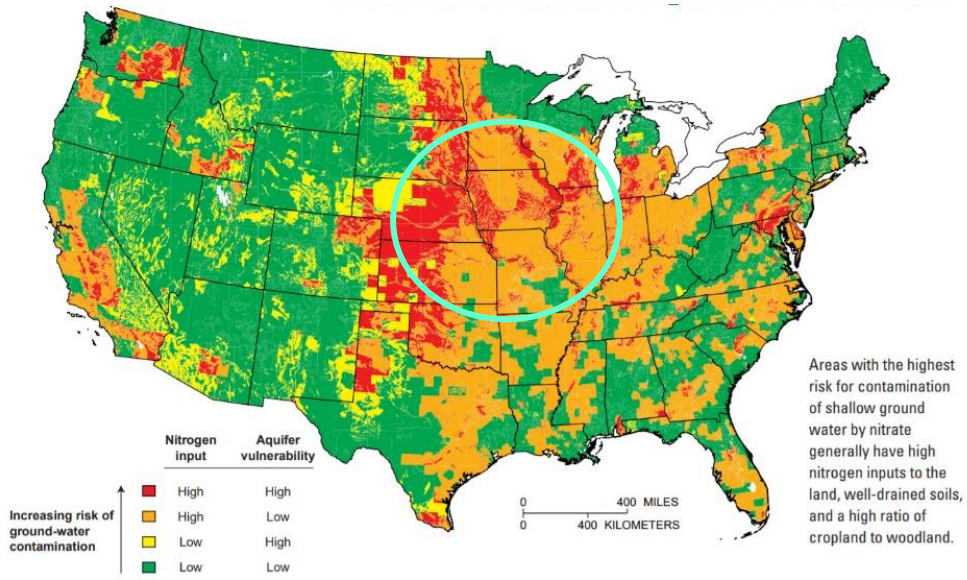
5. Results and Discussion

6. Conclusion

Introduction

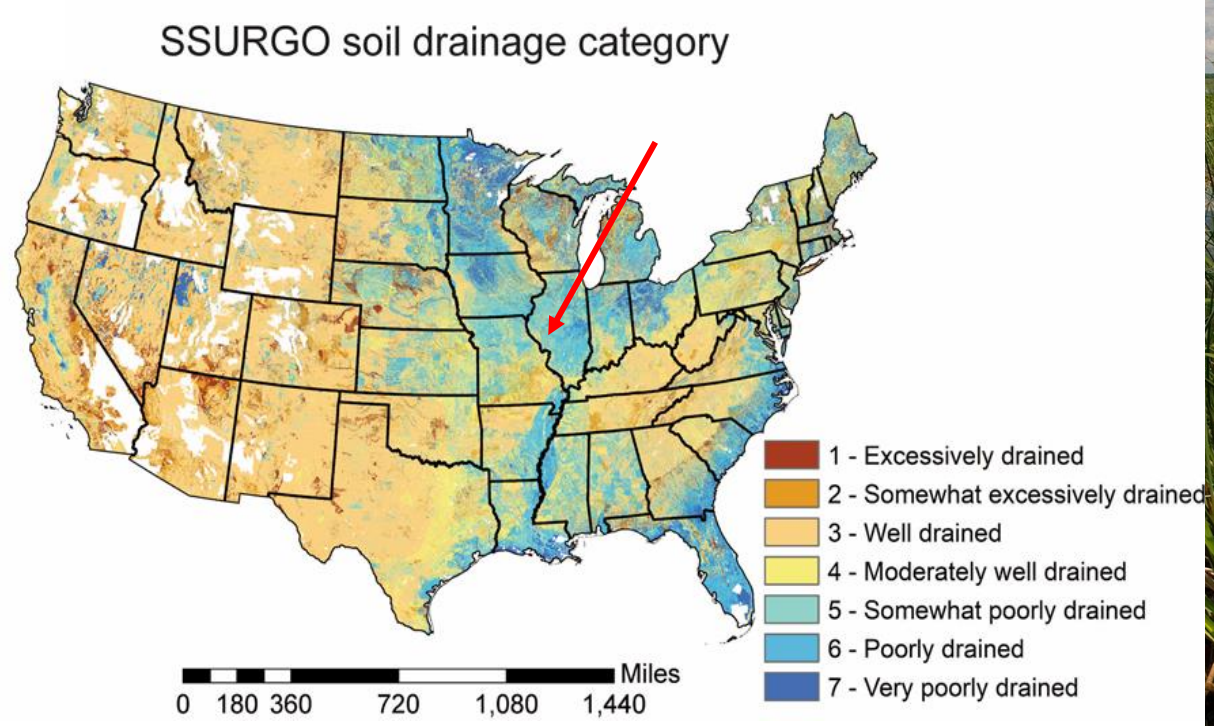


- Nitrogen fertilizers contributes to at least a 50% crop yields.
- Nearly 50% of nitrogen applied not accounted for by crop removal.



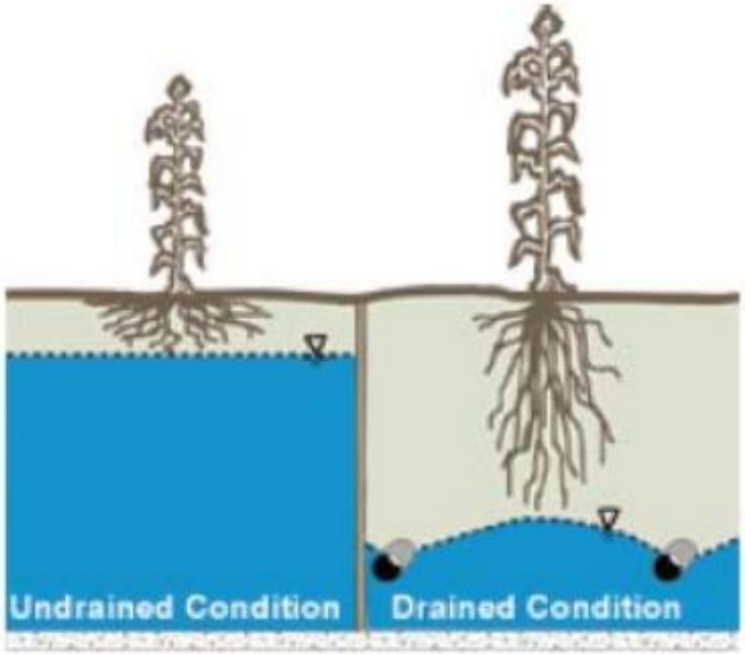
Introduction

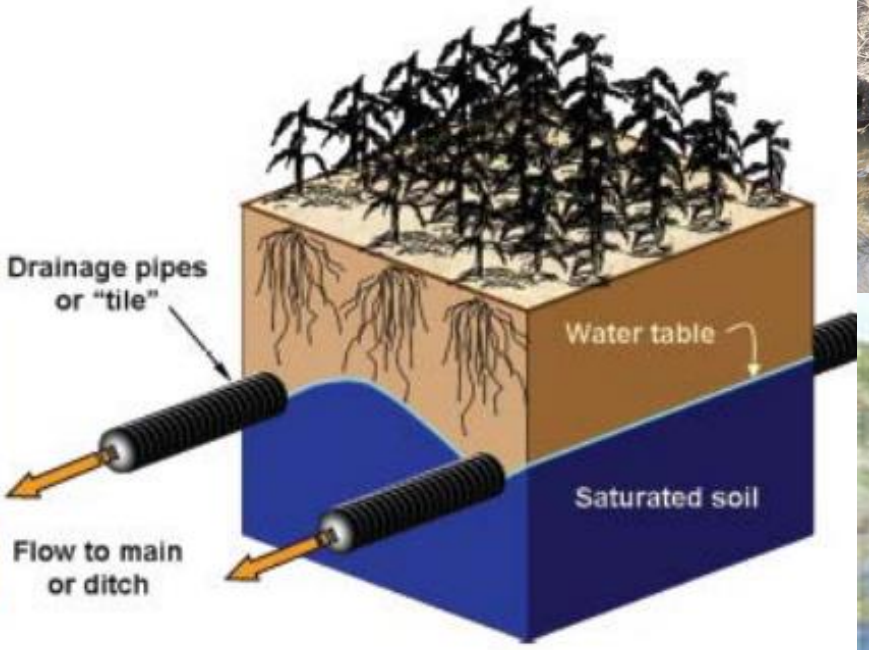
- Midwest Region- Waterlogged Lands
- Unsuitable for Agriculture



Introduction

- Efforts to Drain Wetlands for Agriculture Expansion: Tile Drainage Systems

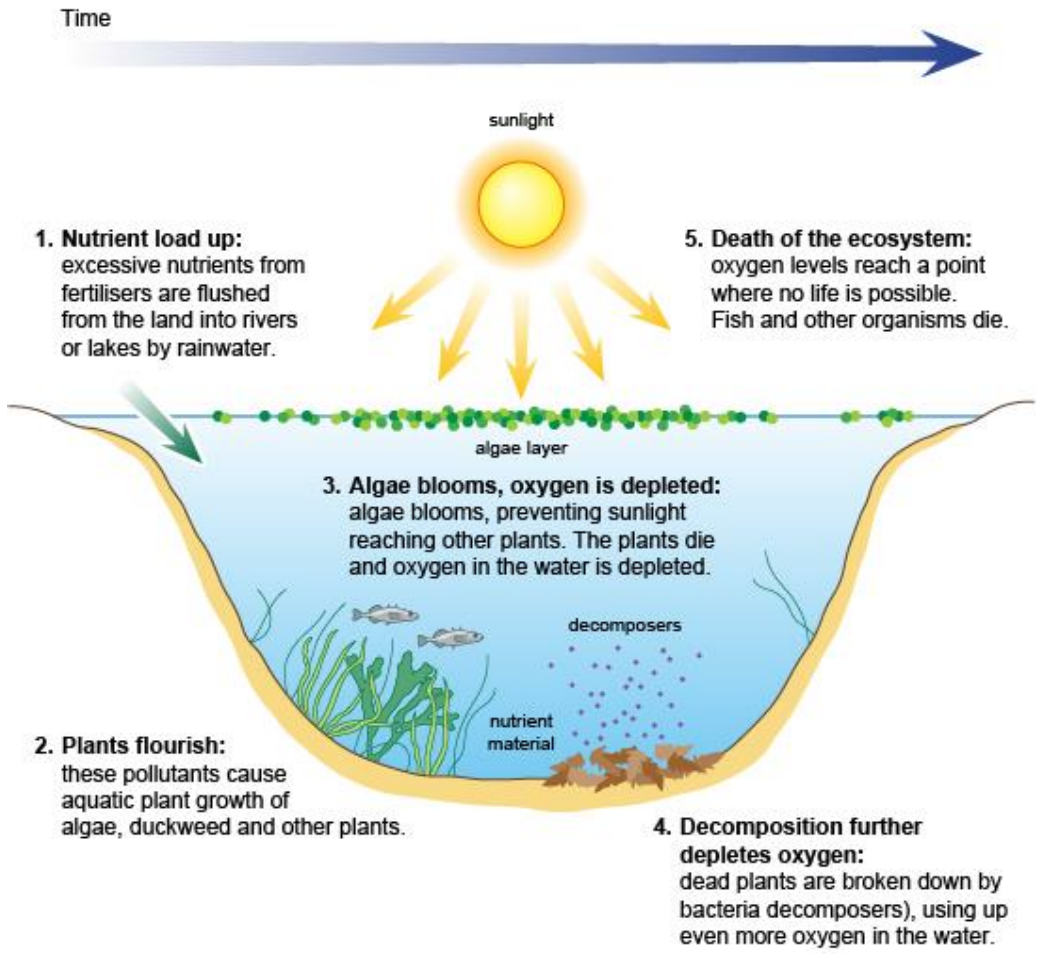


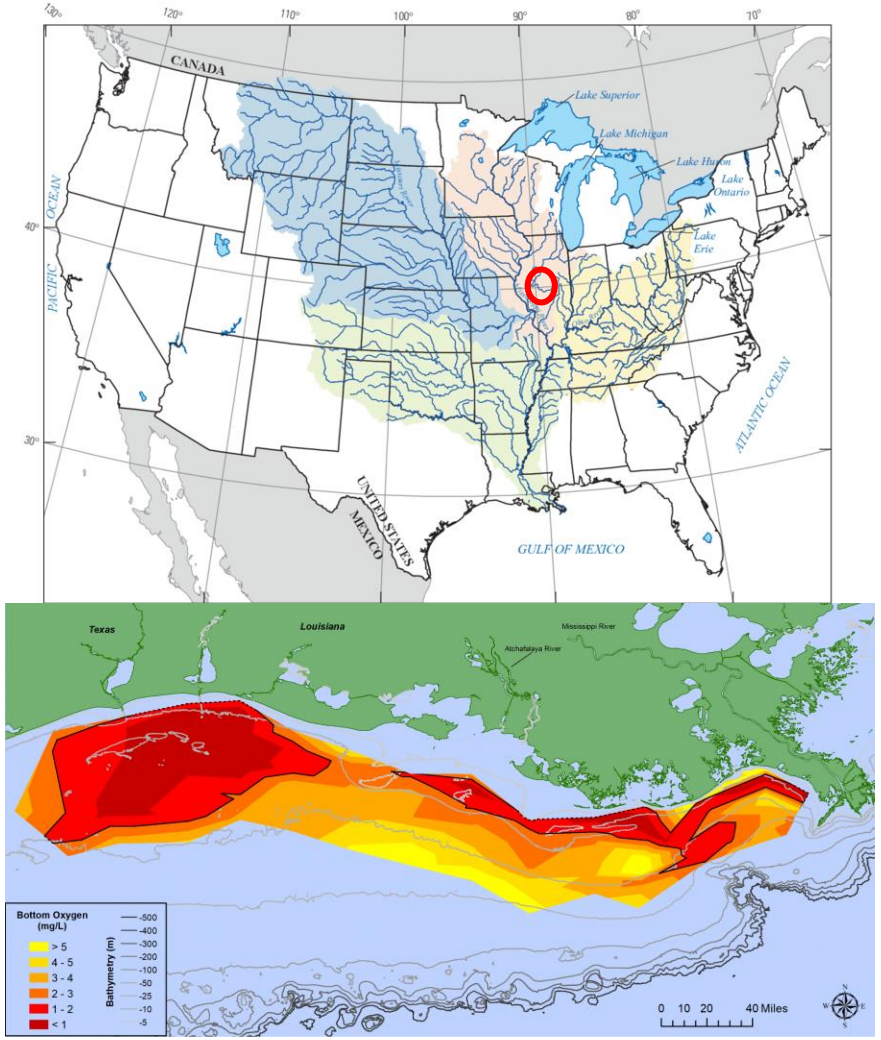


Introduction

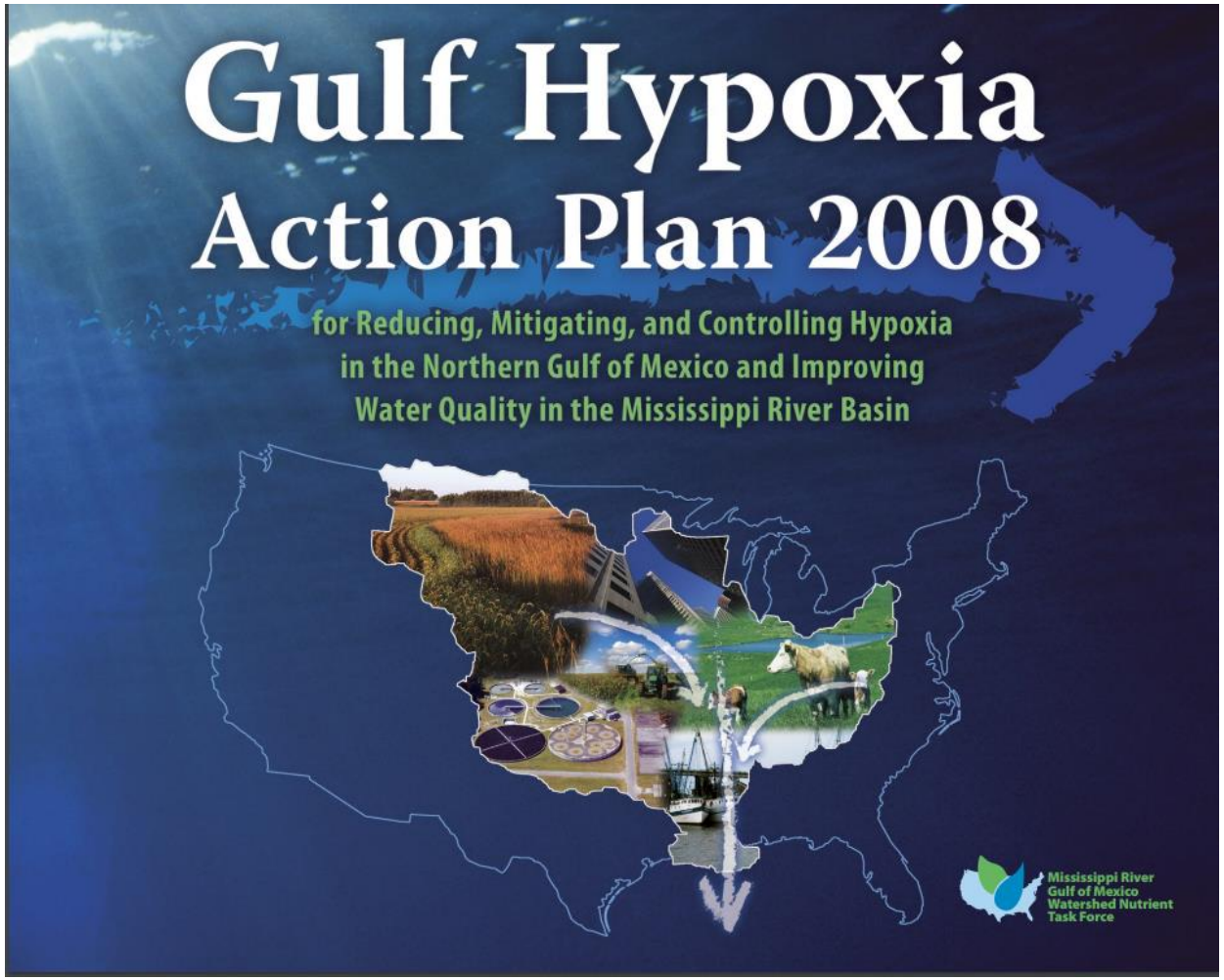
- Outcome of Tile Drained Lands

Rationale: Algae Blooms and Dead Zones





Nutrient Reduction Strategy



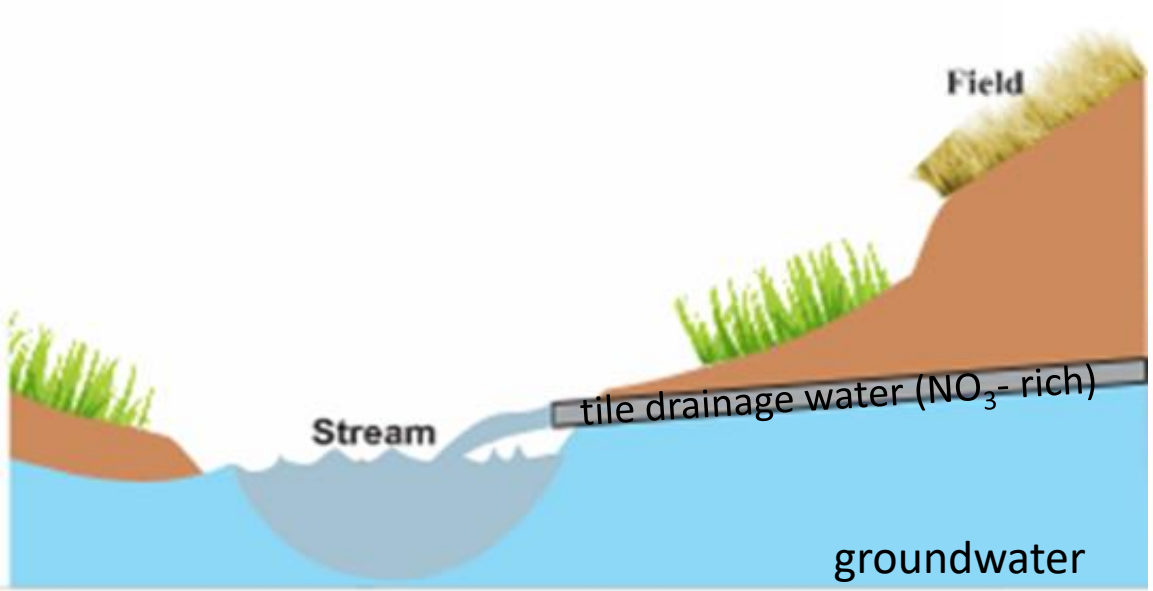
EPA has established a goal of reducing N loads by 45% in the Mississippi River by 2035, with an intermediate goal of 20% reduction by 2025 (United States Environmental Protection Agency, 2017)

- Wetlands
- Cover Crops
- Saturated Riparian Buffers

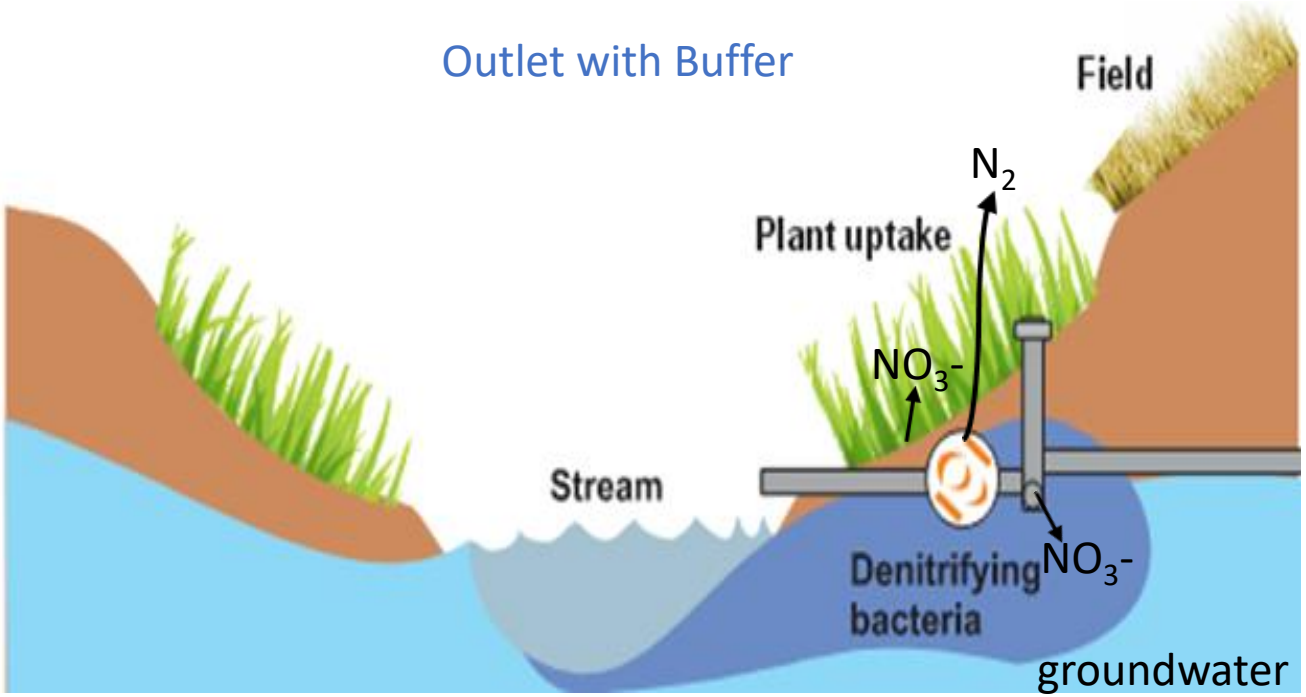
Saturated Riparian Buffer (SRB)

The goal of SRB is to hydrologically reconnect tile water from the agricultural land with a strip-of-filled buffer.

Conventional Outlet



Outlet with Buffer



Research Objectives and Questions

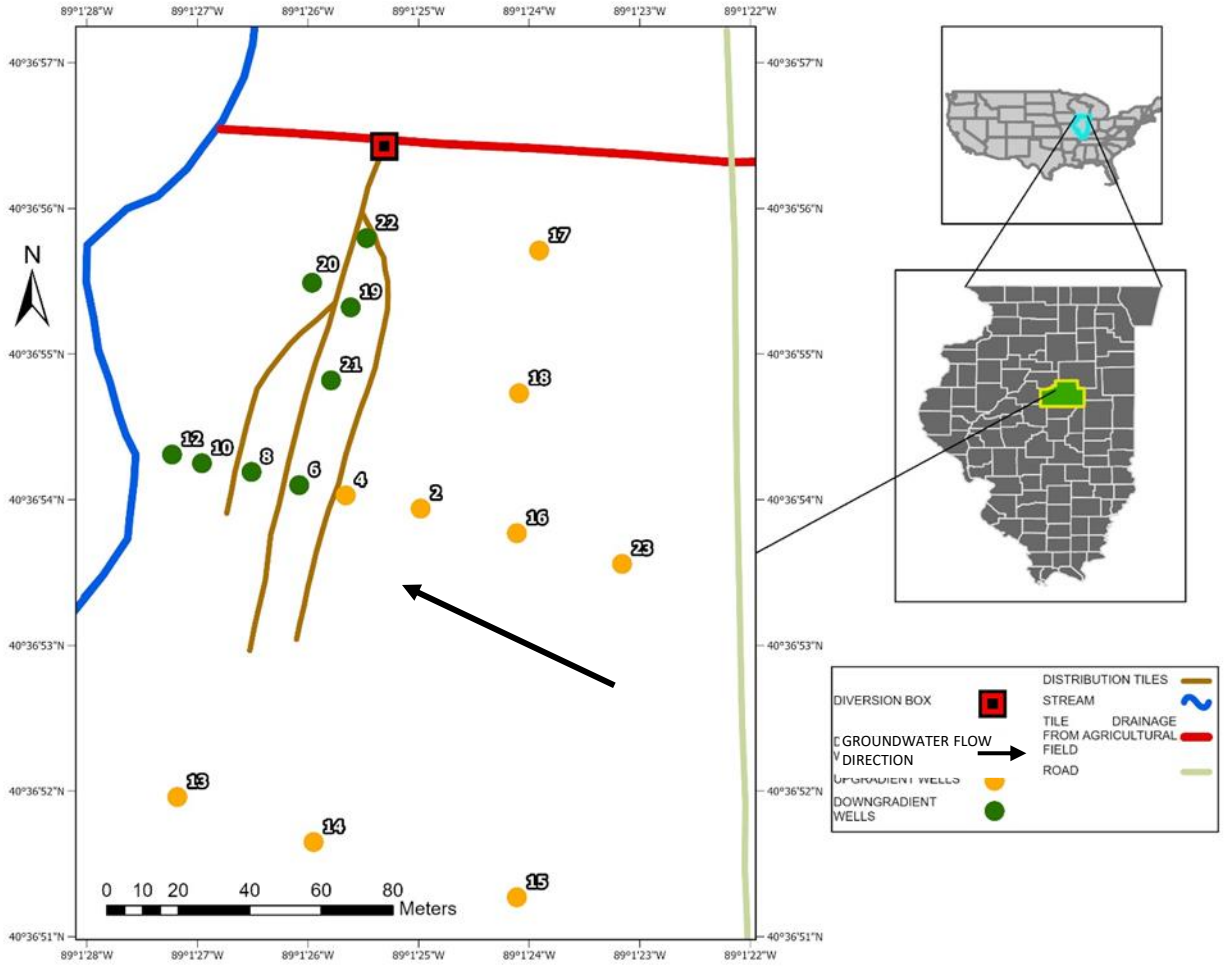
The overall goal aimed to understand the effectiveness of the saturated riparian buffer in managing NO_3-N concentration in agricultural settings.

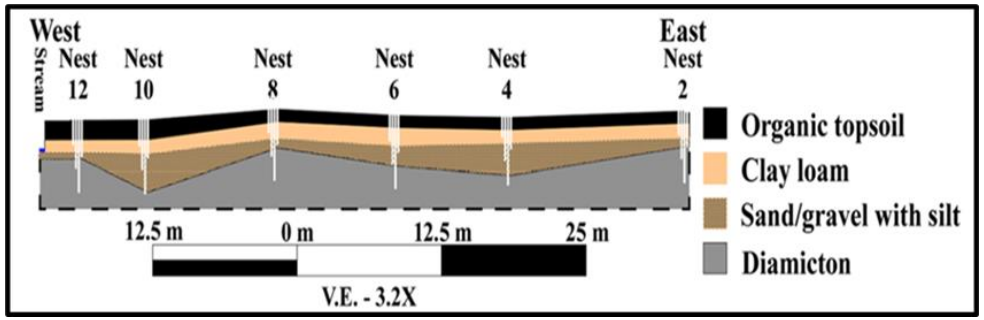
Are SRBs effective in the removal of nitrate?

1. Does tile flow introduce NO_3-N into the SRB?

2. What happens to the added NO_3-N within the system?

Study Area: Unique Buffer Design



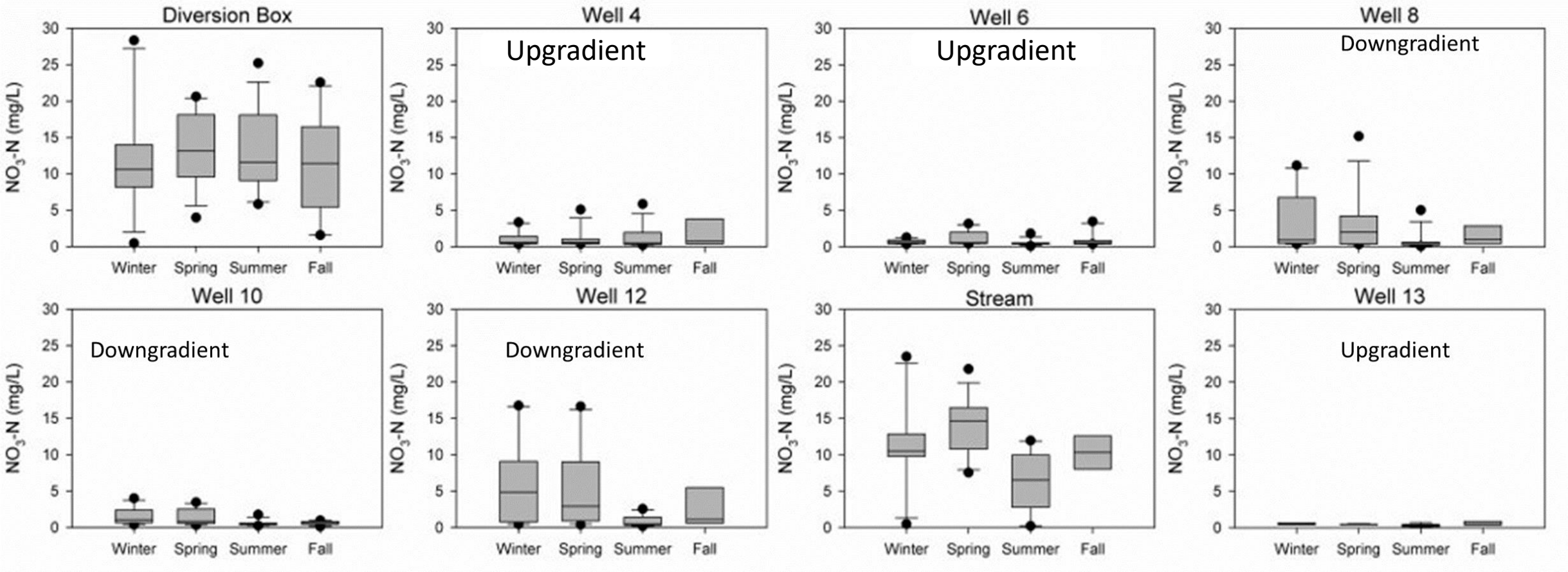


Research Methods

- **Analysis of Tile Flow with NO_3-N concentrations**
- **Temporals of diurnal concentrations**
- **Analysis of presence and absence of plants**
- **Tracer Test and Mixing Model**
- **Analysis of Nitrogen and Oxygen Isotopes**

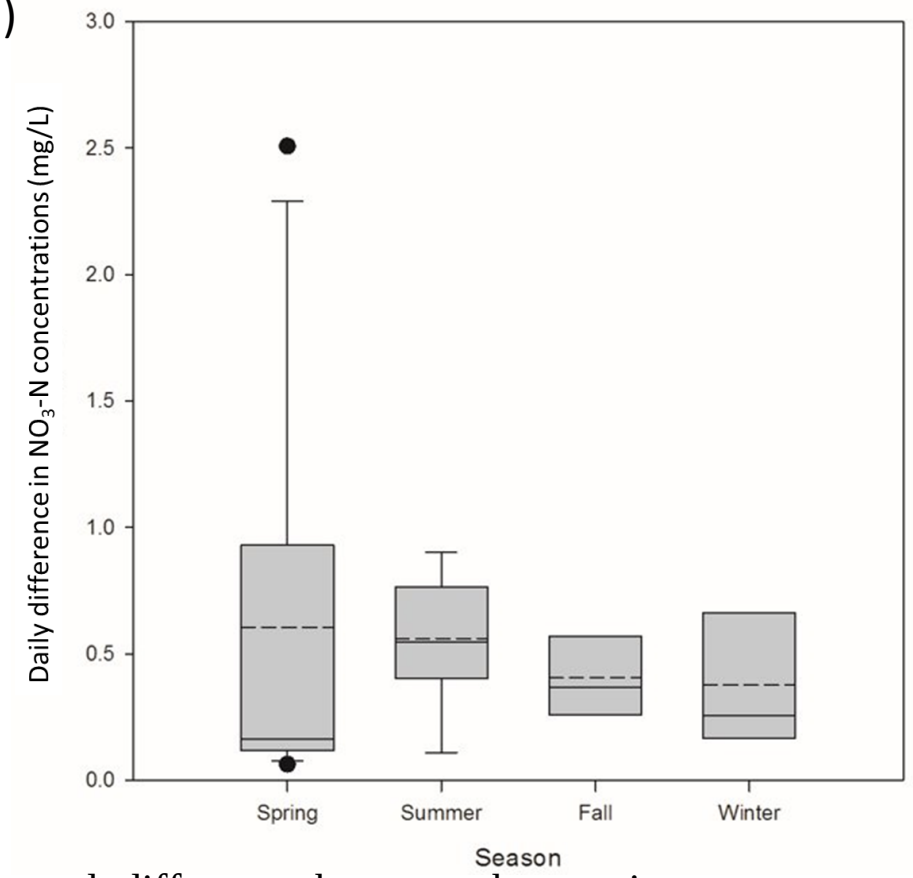
Results and Discussion

Relationship Between Tile Water and Well Groups



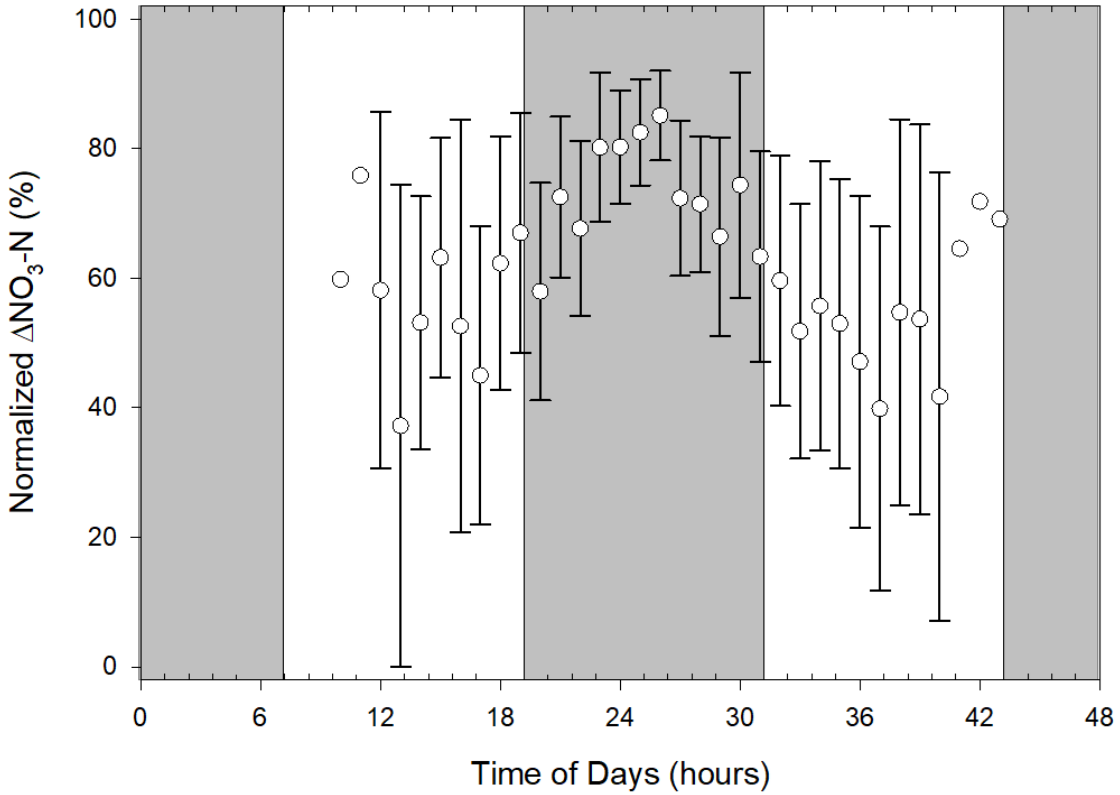
Results and Discussion: Daily NO_3-N Concentrations

(a)



Observed difference between the maximum and minimum daily NO_3-N concentrations across the seasons.

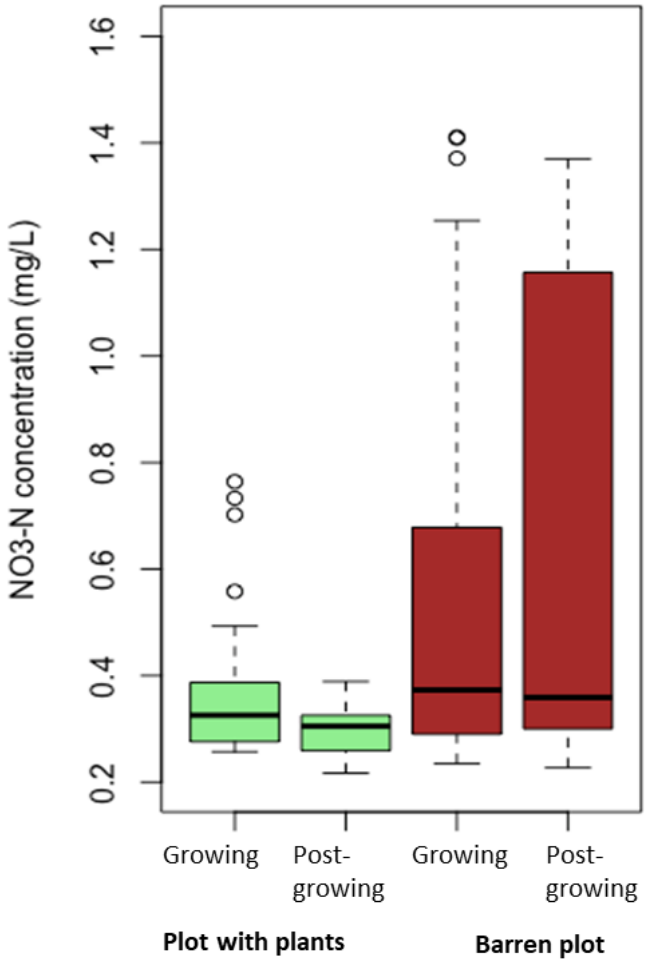
(b)



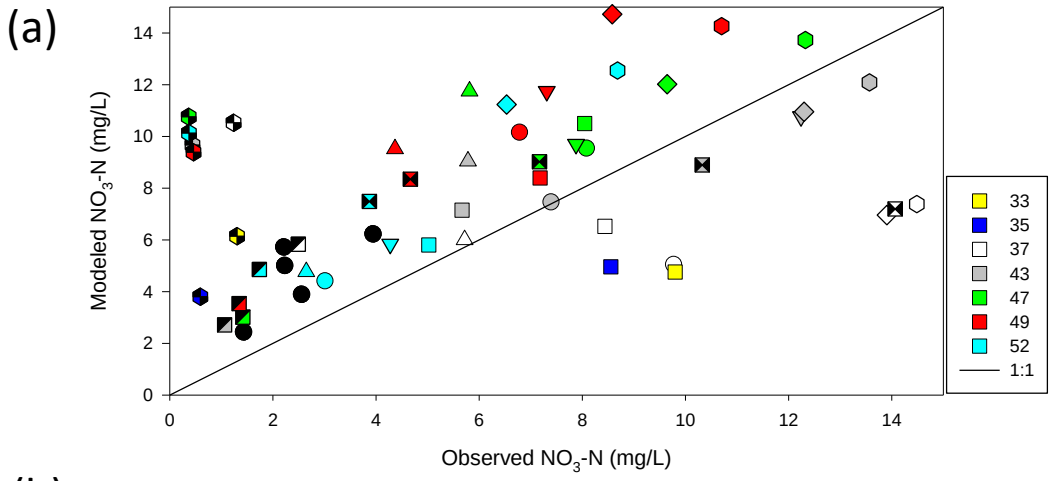
- Nitrate uptake in plants vary with photoperiod.
- NO_3-N concentrations increase when plants are inactive (night).

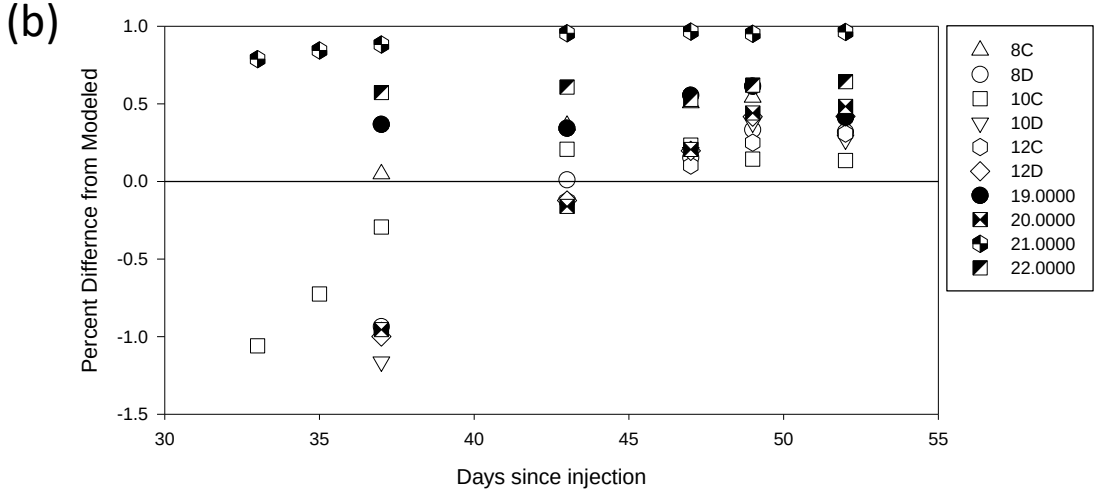
Results and Discussion: Role of Plants

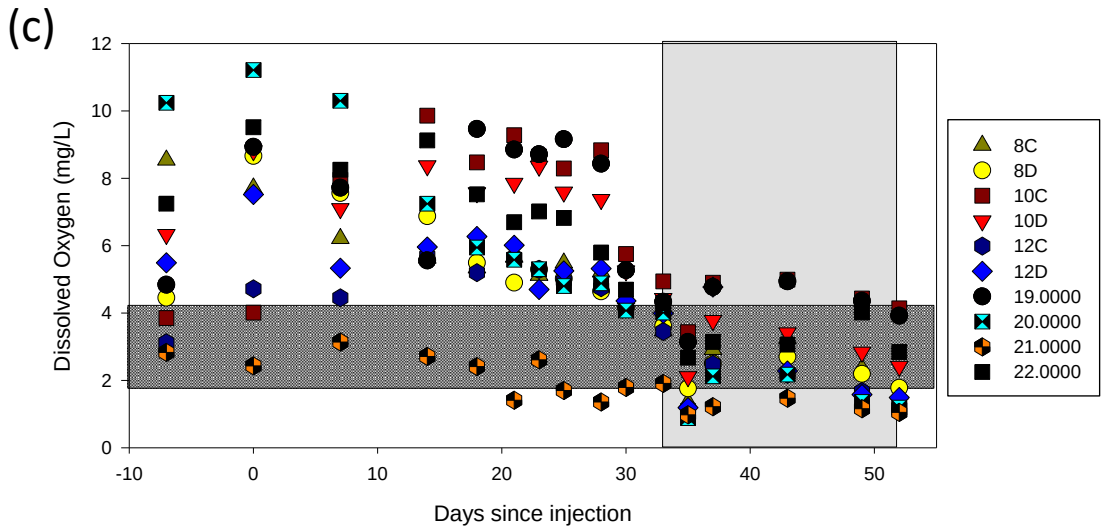
NO_3-N concentration in the vadose waters collected from lysimeters during the growing season and post-growing seasons for plots with plants (green) and barren plots (red). The ends of the boxes represent the 25th and 75th percentiles with the solid line at the median (50th percentiles); the error bars depict the 10th and 90th percentiles; the circles depict the outliers.



Results and Discussion: Travel Time



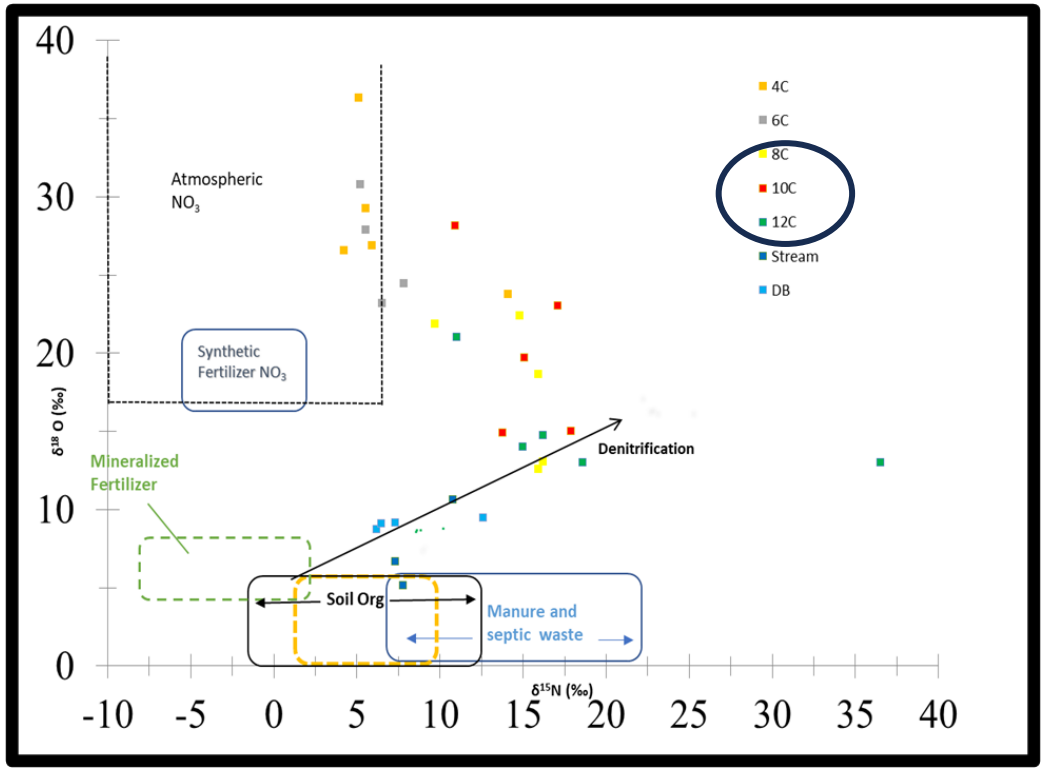


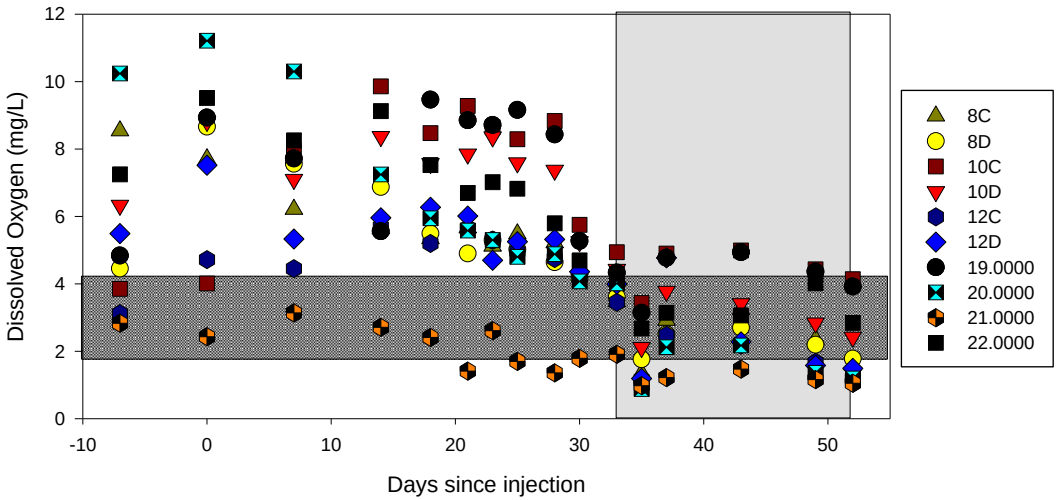


Observed and modeled NO_3-N concentrations for a tracer test completed in March to May 2021. For samples plotting above the 1:1 line, removal of nitrate has occurred. b) Percent (1.0 = 100%) removal of nitrate within the SRB during the tracer test. Negative percents indicate nitrate addition. c) Dissolved oxygen concentrations during the tracer test. DO concentrations below 4.2 are conducive to denitrification (microbial mediated removal).

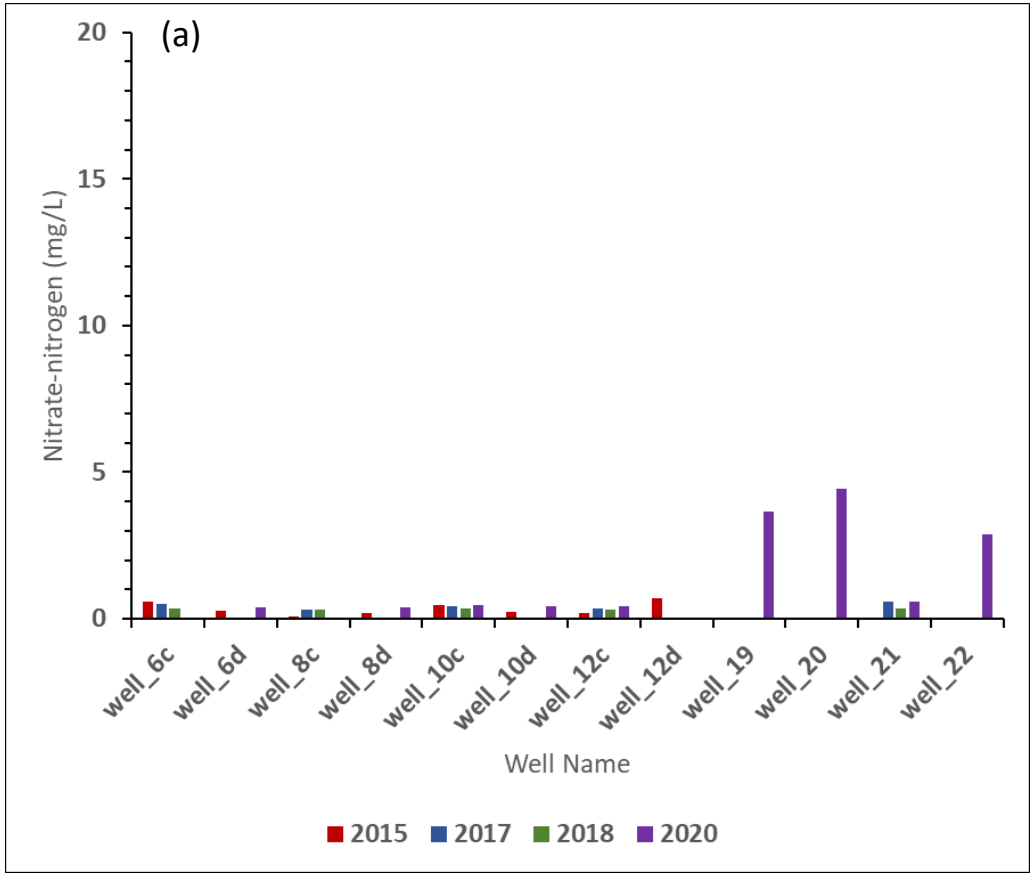
Results and Discussion

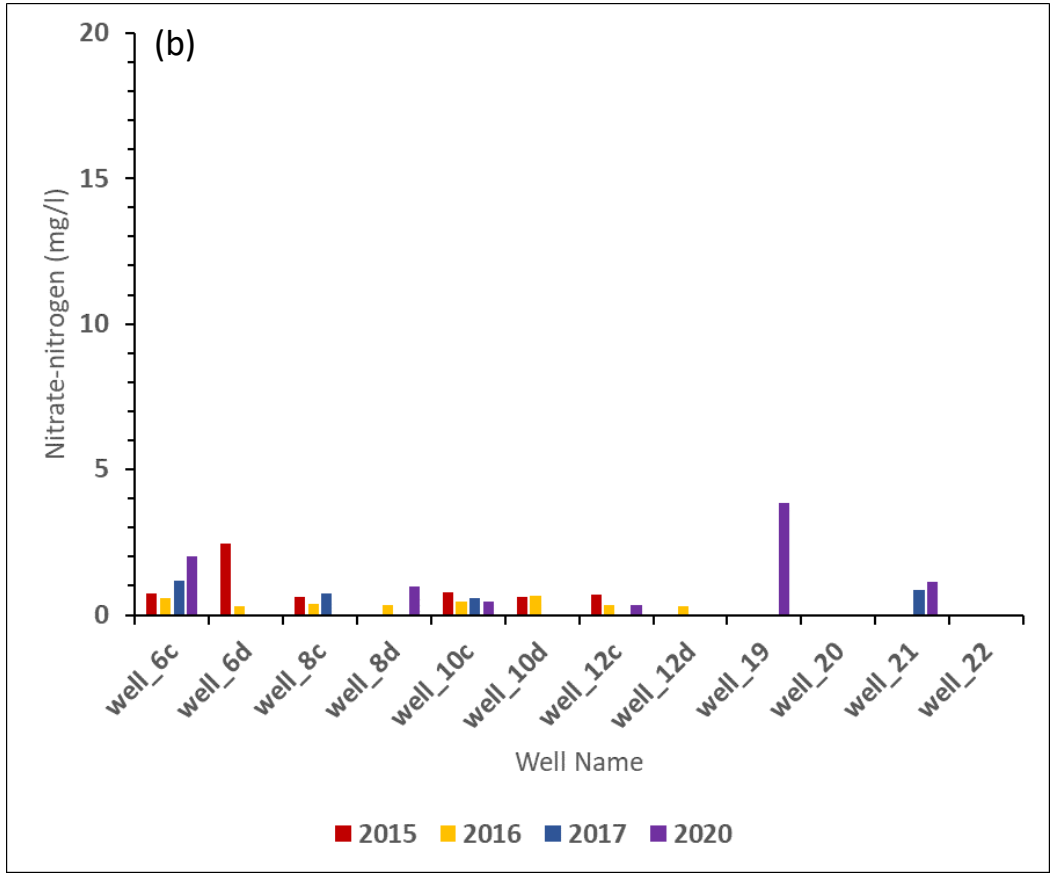
δ 15N and δ18O for select samples from six wells, the stream and the diversion box. The downgradient wells have a denitrification signature, while the upgradient wells exhibit a source signature associated with atmospheric.





Results and Discussion: Annual Temporal Analysis





Concentration of NO_3^- - N in downgradient wells for the month of (a) September and (b) November during no tile flow period.

Conclusion

The SRB removes $\mathbf{NO_3^- - N}$ delivered from agricultural tile waters.

- All the incoming tile water is diverted into the system.
- The diverted nitrate-nitrogen (NO_3-N) rich tile water within the SRB has the potential to be treated with a removal rate of 27% - 97%.
- The SRB has a long-term effectiveness in managing NO_3-N concentrations within agricultural settings.

ACKNOWLEDGMENT

- Dr. Wondeseen Seyoum and Dr. Bill Perry.
- ISOTECH Laboratory

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