

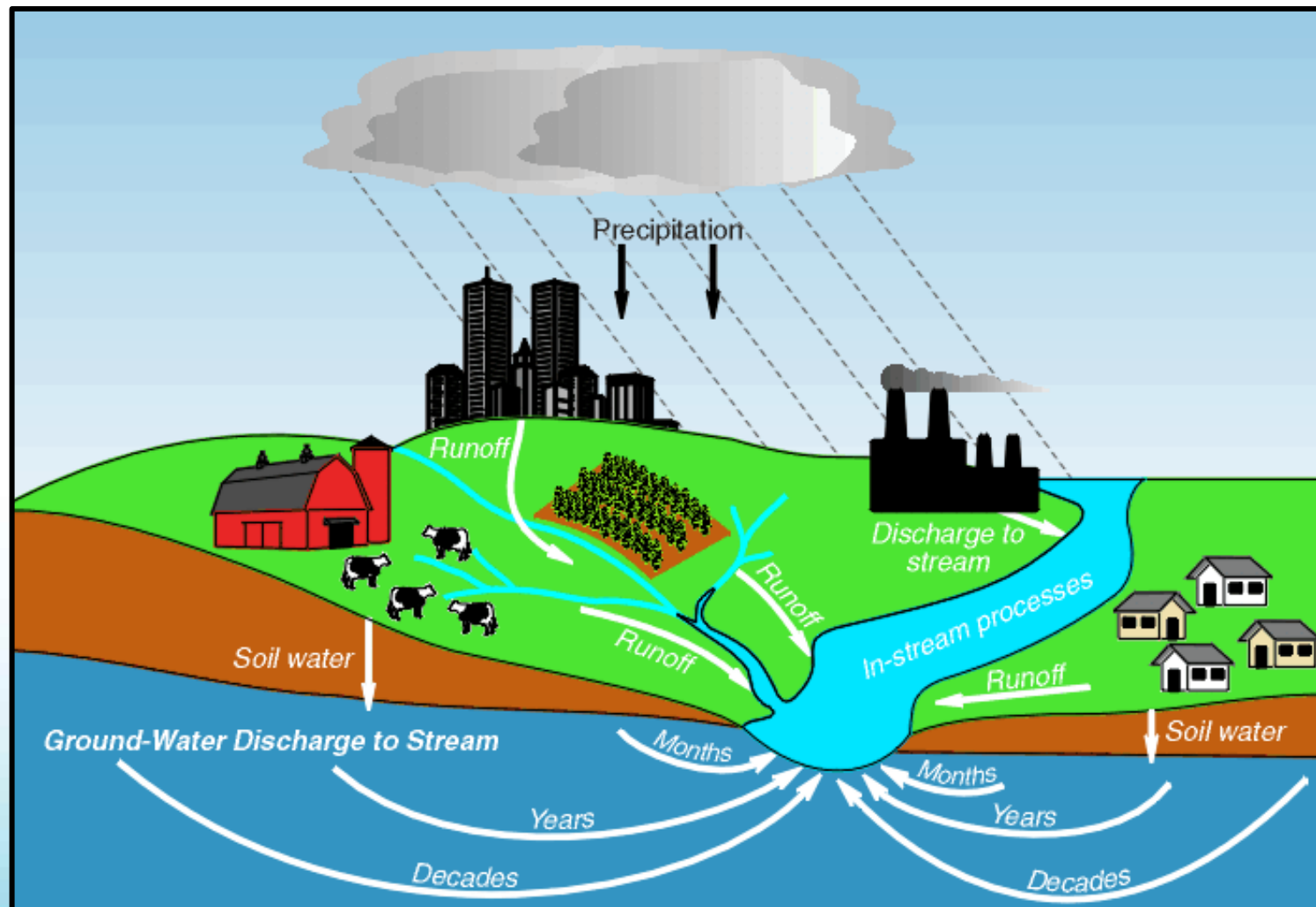
# Using Molecular Biological Tools to Address Nitrogen Transformation in Groundwater

Molecular Tools to Navigate Your Diagnostic Exploration

**mi**  
microbialinsights



# NITRATE IMPACTS



Discharge, Nitrate Load, and Residence Time of Ground Water in the Chesapeake Bay Watershed, USGS Fact Sheet FS-150-99



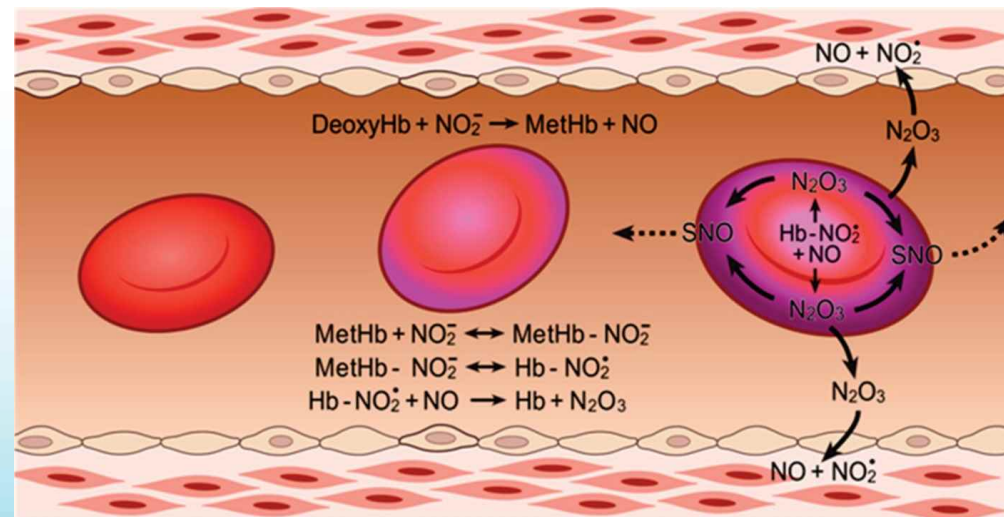
# NITRATE IMPACTS



worldatlas.com



sierraclub.org



<https://pubs.acs.org/doi/10.1021/ar800089j>



# NITRATE IMPACTS

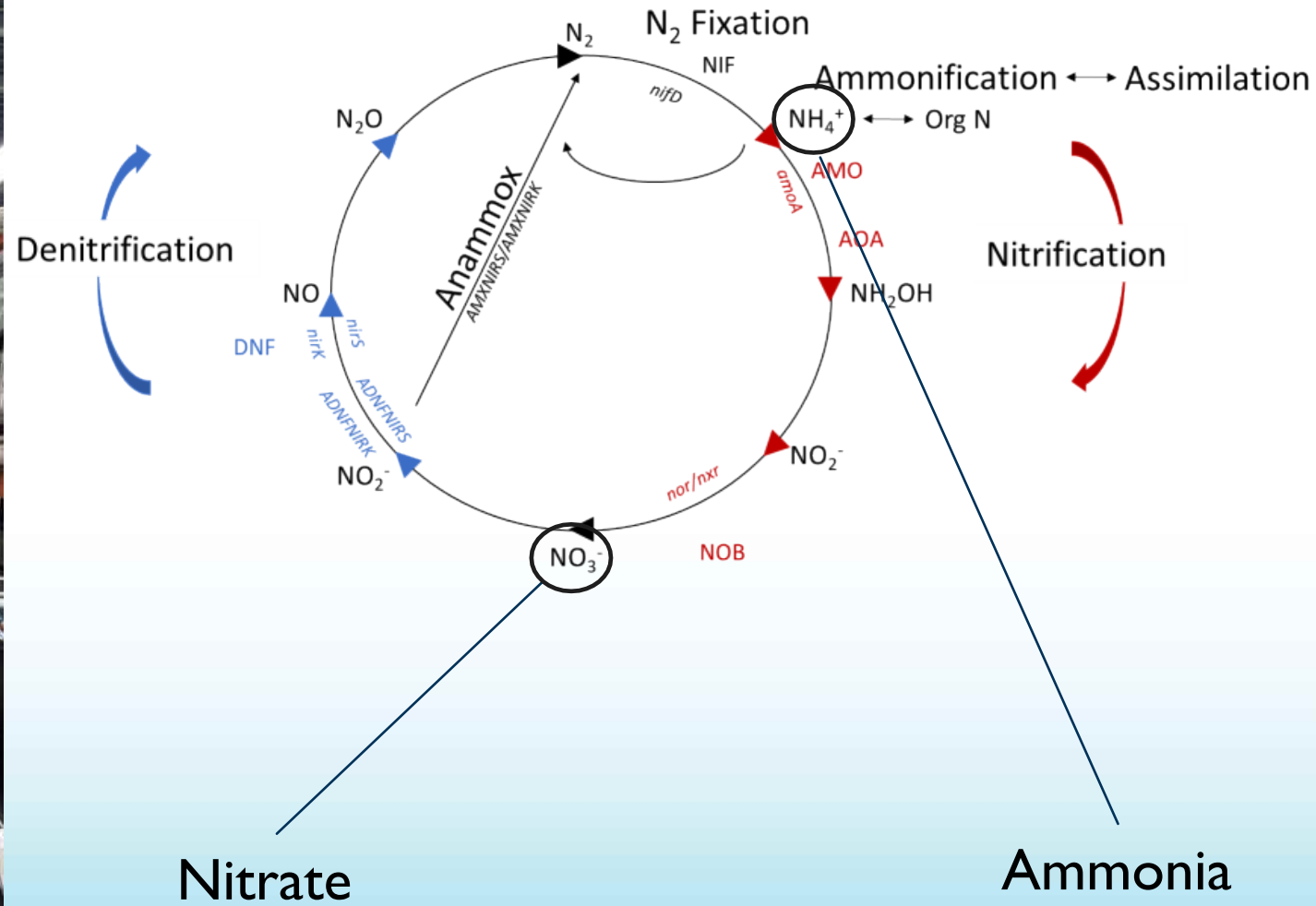


Bluemask Darter

*Conservation Fisheries, Inc.*



# NITRATE IMPACTS





# AEROBIC OR ANAEROBIC





Nitrogen Cycle

Iron and Manganese Reduction

Sulfur Reduction

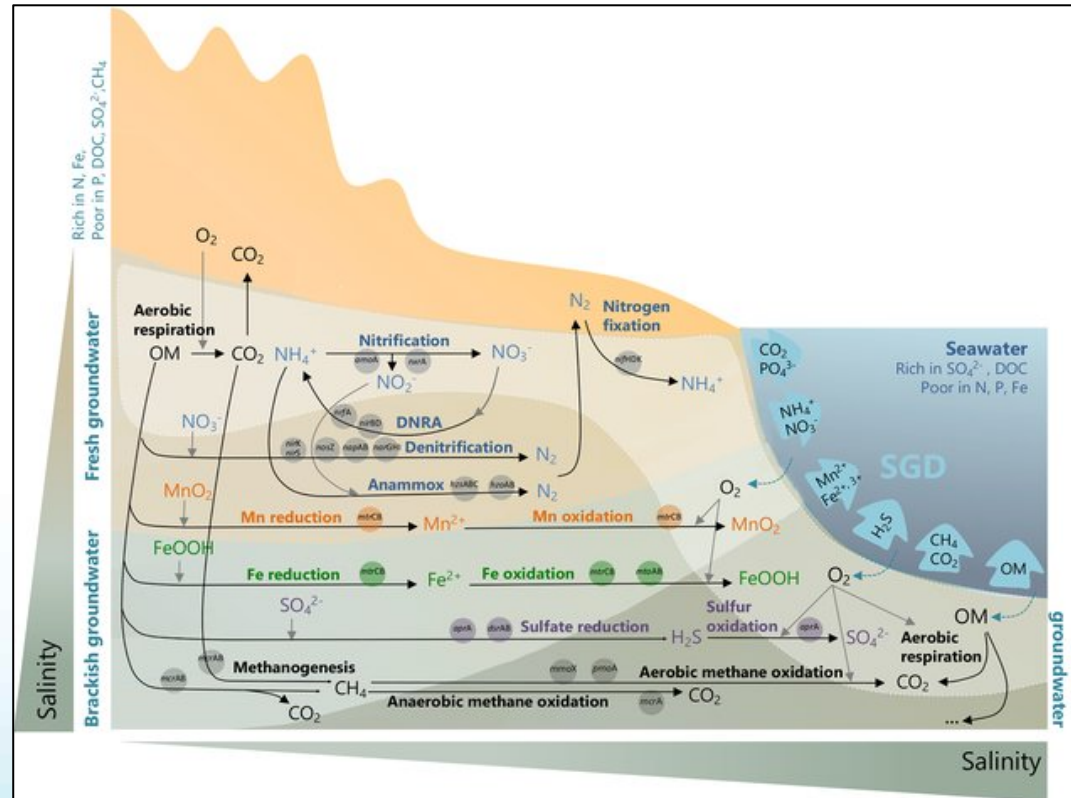
Methanogens

Iron and Manganese Oxidation

Sulfur Oxidation

Fermenters

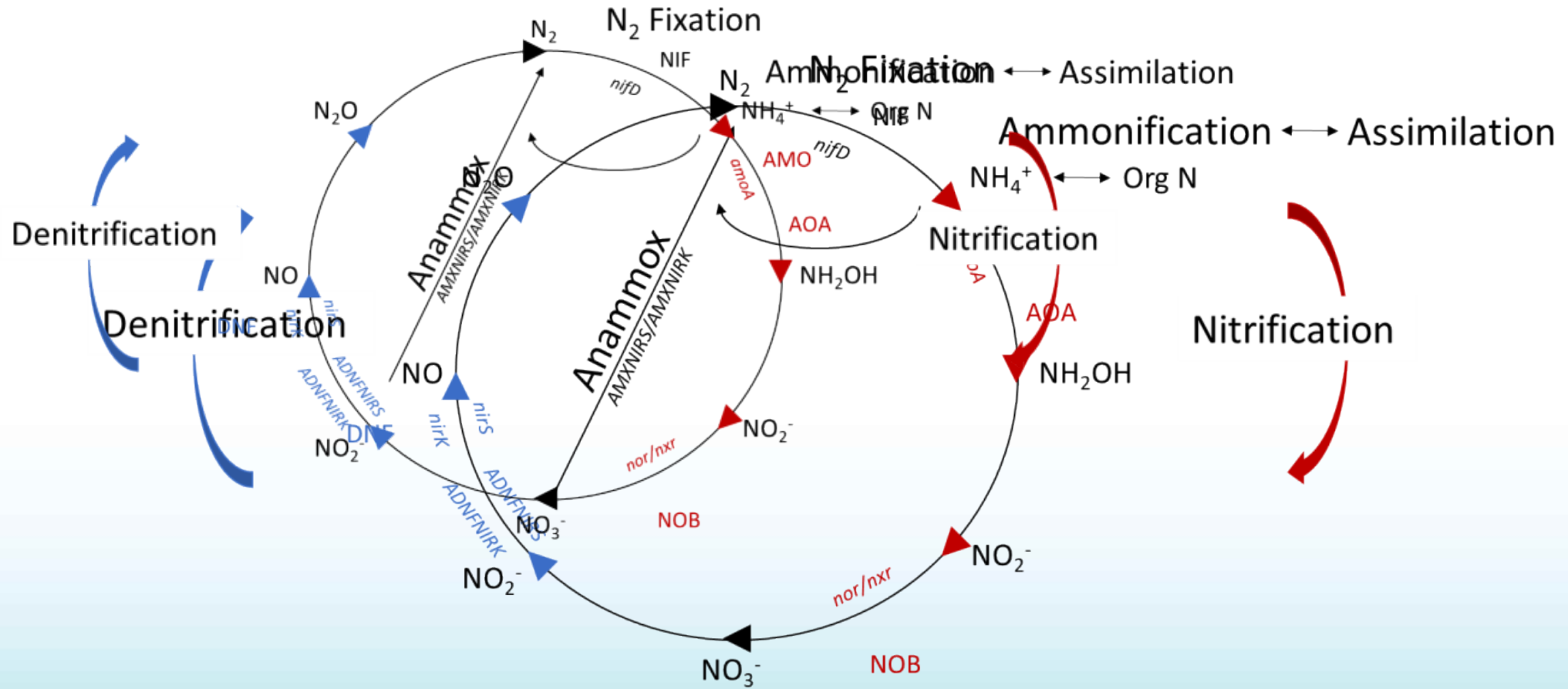
Acetogens



Ruiz-González et al. The microbial dimension of submarine groundwater discharge: Current challenges and future directions. FEMS Microbiology Reviews (2021).



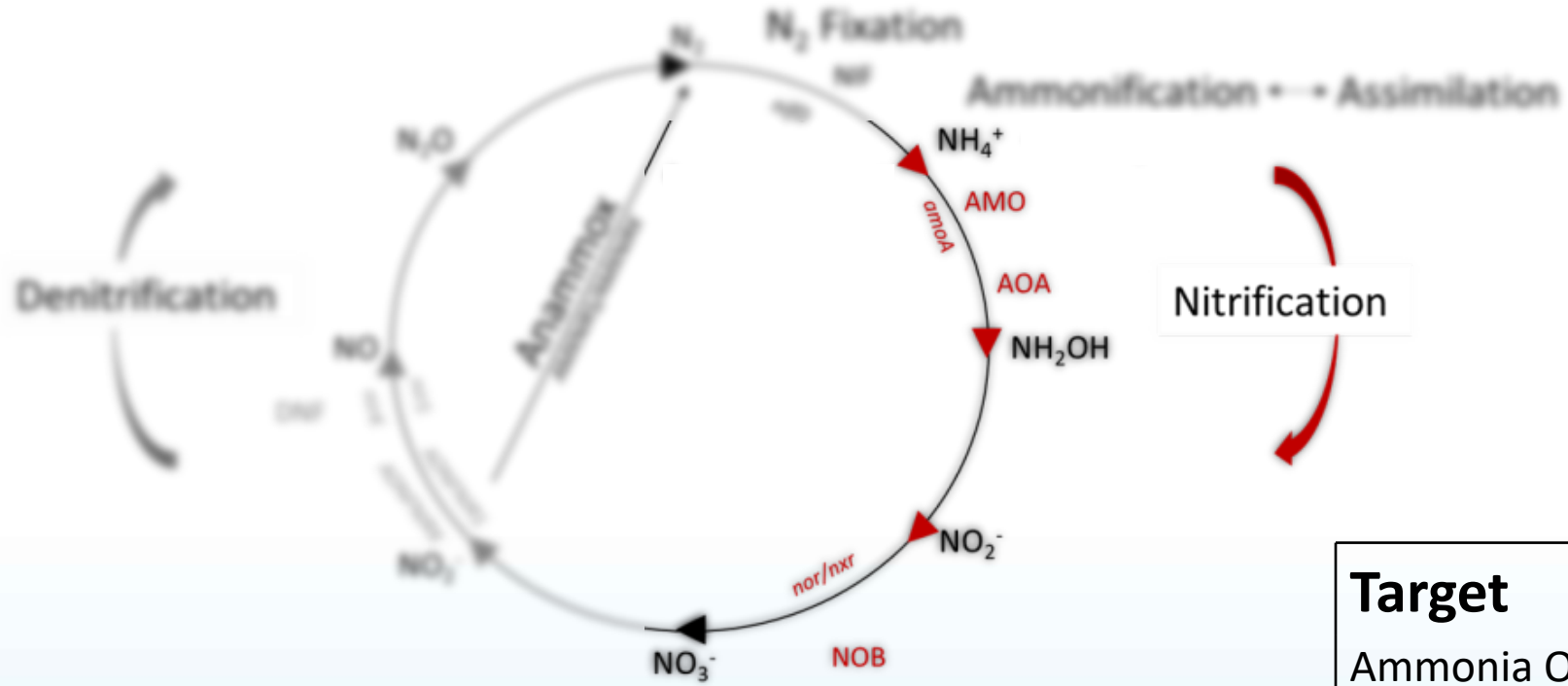
# Nitrogen Cycle Gene Targets







# Nitrogen Cycle Gene Targets

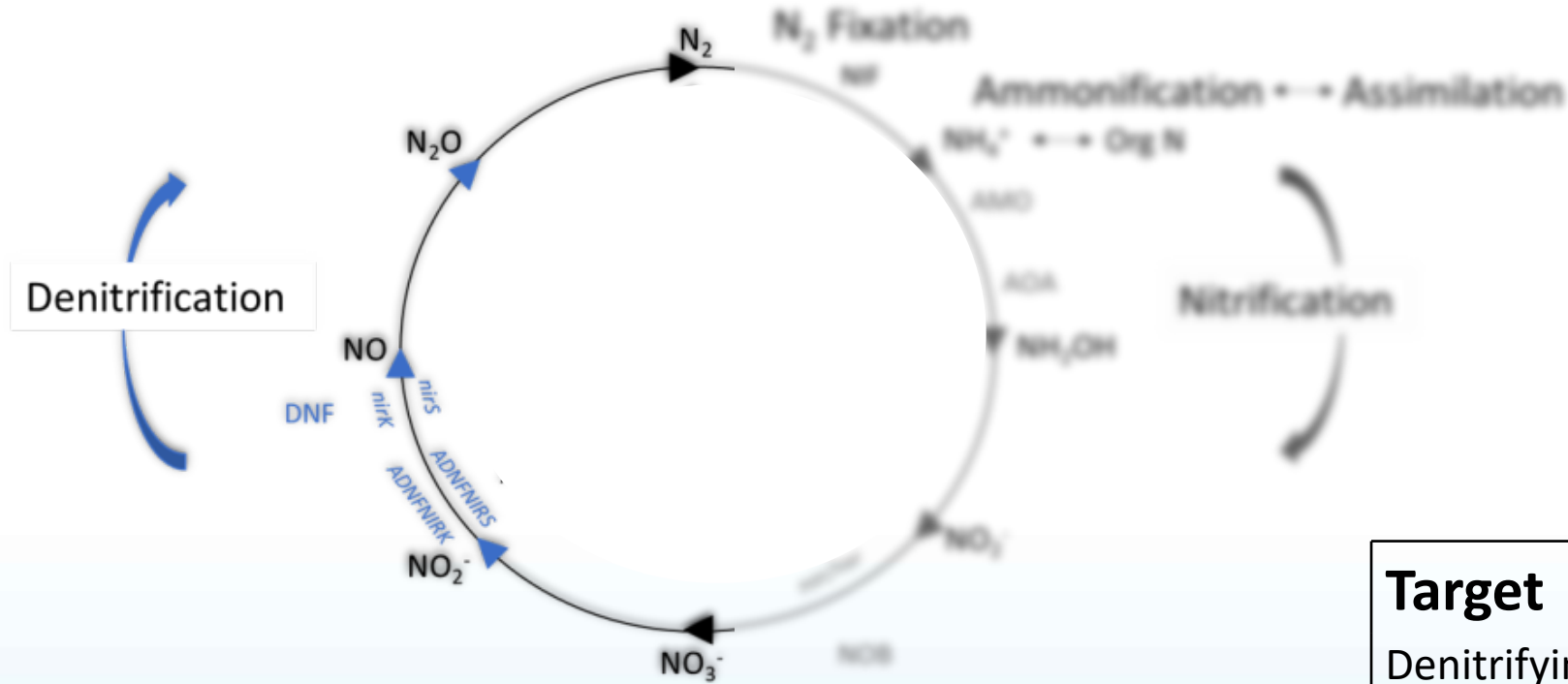


Target	Code
Ammonia Oxidizing Bacteria	<b>AMO</b>
Ammonia Oxidizing Archaea	<b>AOA</b>
Nitrite Oxidizing Bacteria	<b>NOB</b>
Nitrite Oxidizing Bacteria	<b>NOR/NXR</b>





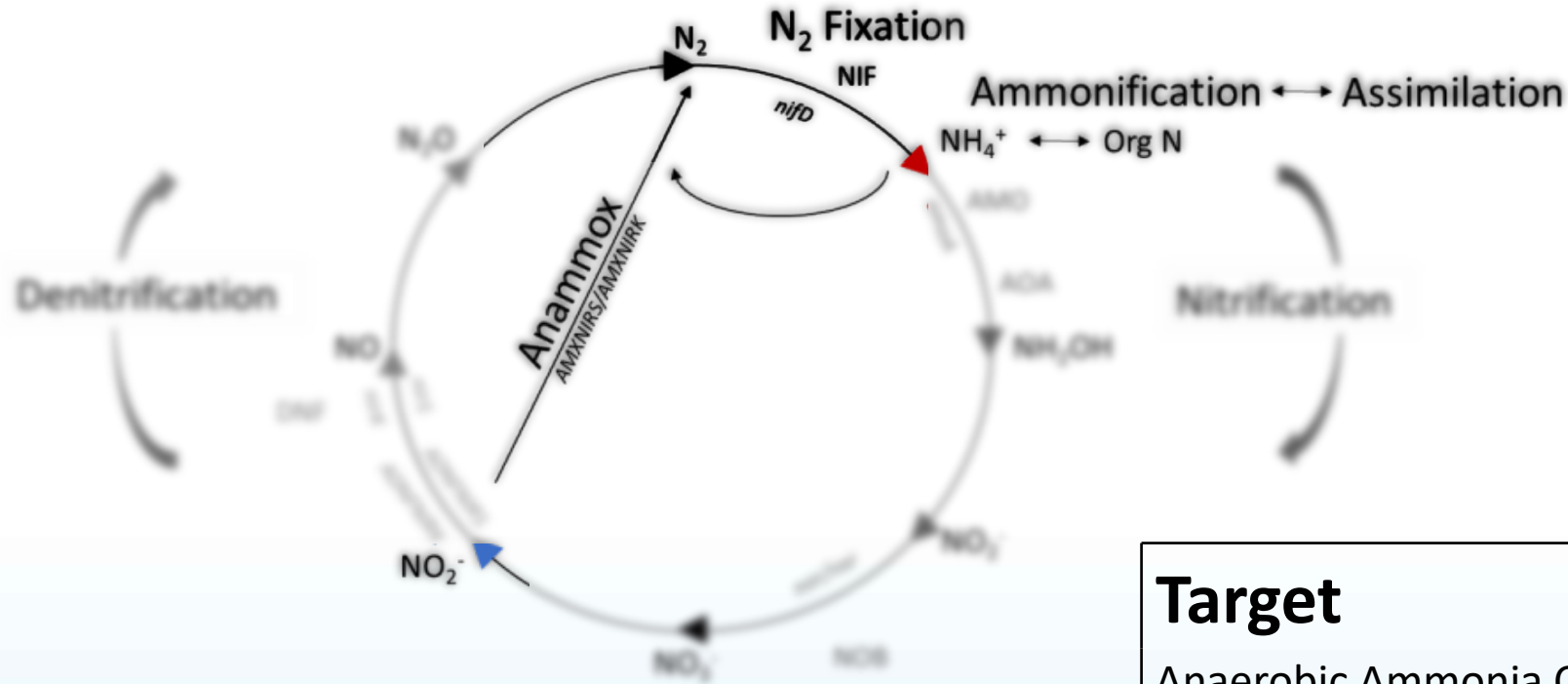
# Nitrogen Cycle Gene Targets



Target	Code
Denitrifying Bacteria	<b>DNF</b>
Archaeal Nitrate Reducers	<b>ADNFNIRK</b>
Archaeal Nitrate Reducers	<b>ADNFNIRS</b>



# Nitrogen Cycle Gene Targets



## Target

Anaerobic Ammonia Oxidizing Bacteria

## Code

**AMXNIRS**

Anaerobic Ammonia Oxidizing Bacteria

**AMXNIRK**

Nitrogen Fixing Bacteria

**NIF**

# NITROGEN CYCLE GENE TARGET APPLICATION

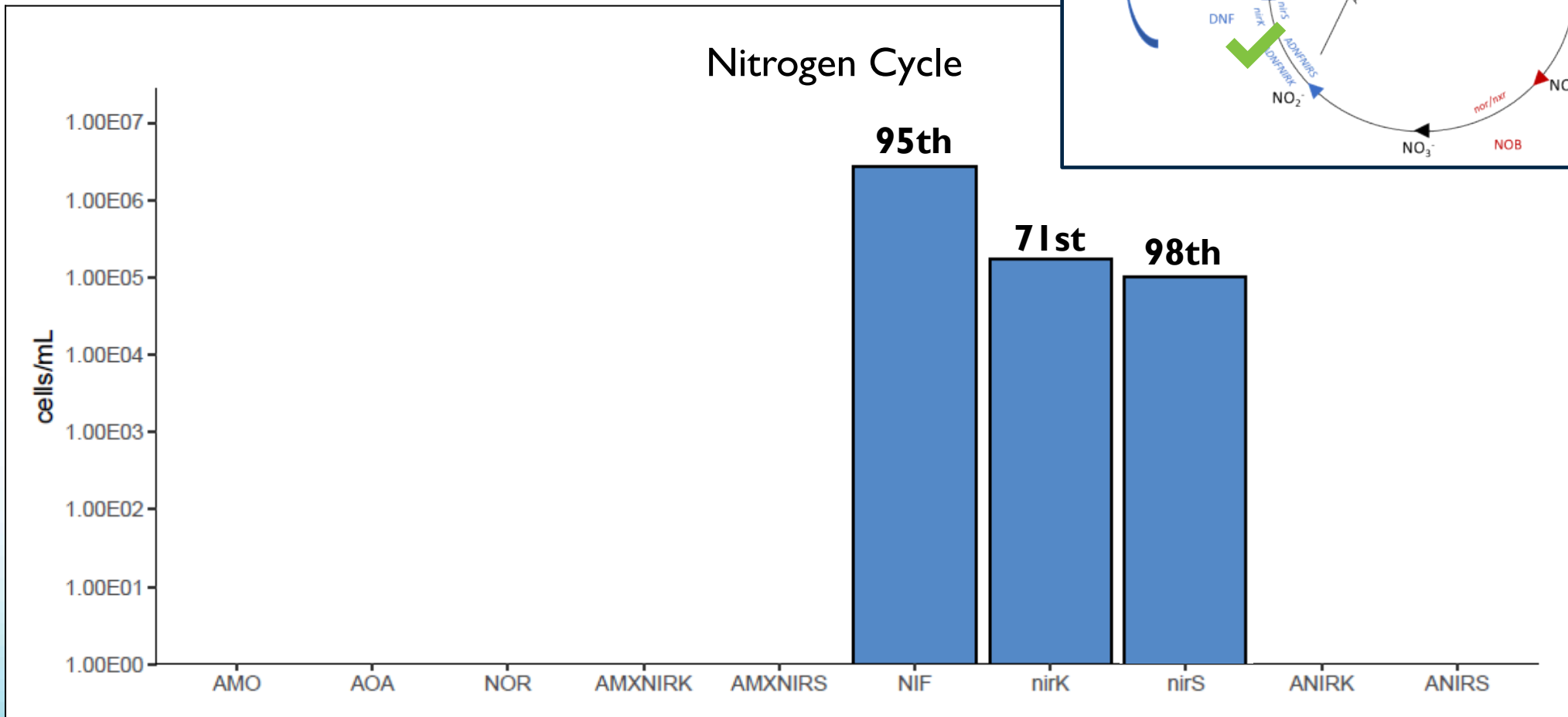
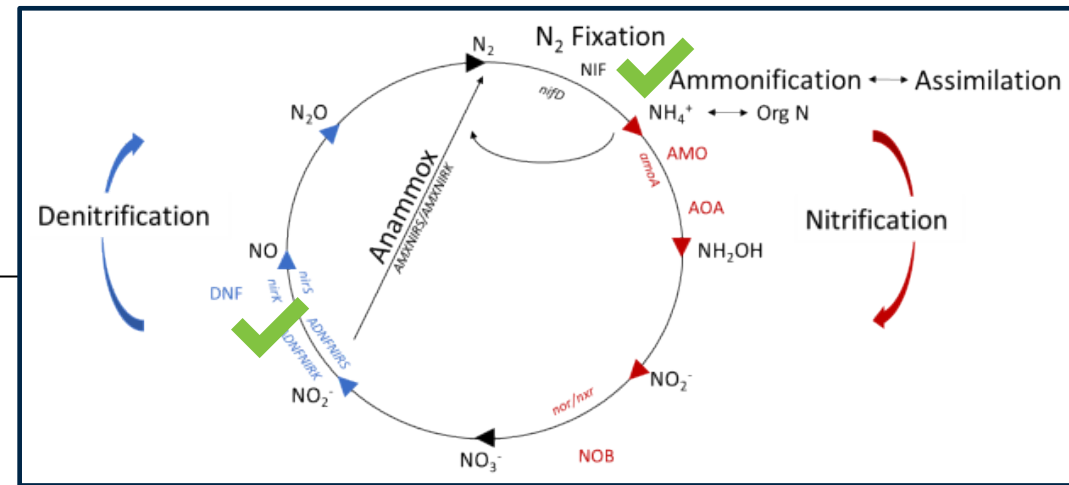
## AGRICULTURAL RUNOFF

- Groundwater samples taken (MW1, MW2) between property and public access
- Nitrate decreasing downgradient
  - $[\text{NO}_3^-] = 5 \text{ mg/L}$  at MW1
  - $[\text{NO}_3^-] = 3 \text{ mg/L}$  at MW2



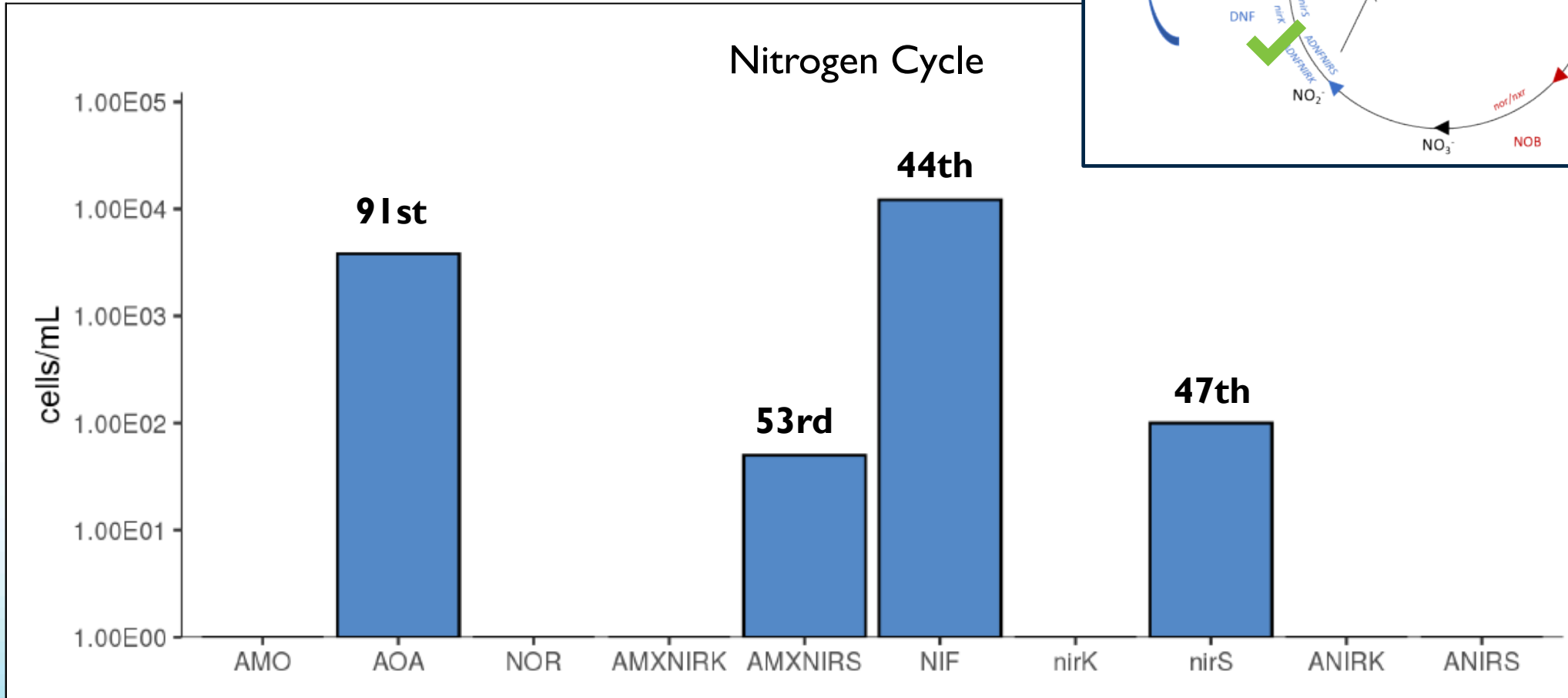
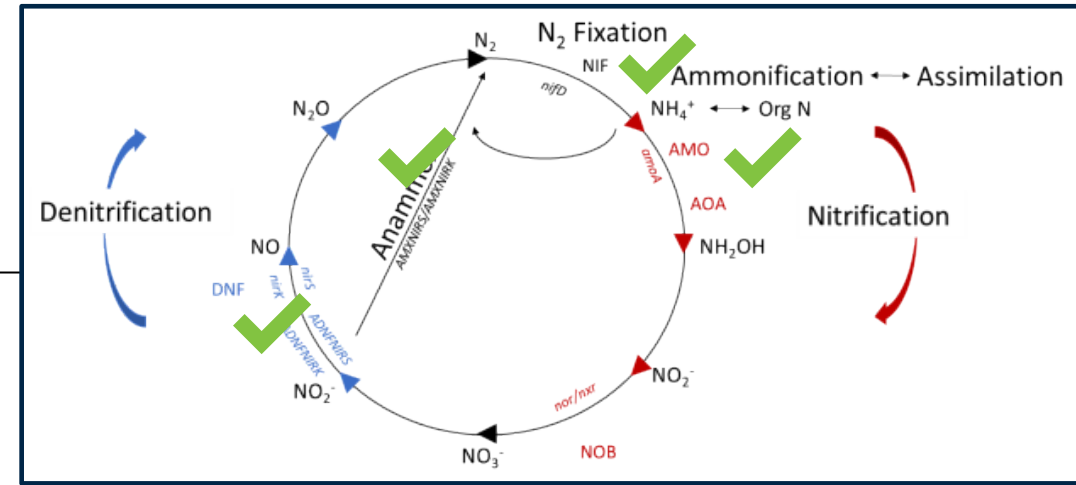


# Nitrogen Cycle Gene Targets – MW1





# Nitrogen Cycle Gene Targets – MW2



The background of the slide is a composite image. On the right side, there is a detailed view of a brass sextant, a navigational instrument used for measuring the angle between objects above the horizon. The sextant is positioned over an old, weathered map with various geographical labels and lines. In the foreground, a thick, braided rope is visible, adding a sense of texture and history to the scene. The overall aesthetic is that of a historical or scientific exploration.

# ADDITIONAL NITROGEN CYCLE GENETARGET APPLICATIONS

- **Agriculture – balancing nutrients**
- **Agriculture – identifying soil health**
- **N<sub>2</sub>O prediction and reduction**



THANK YOU!

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