

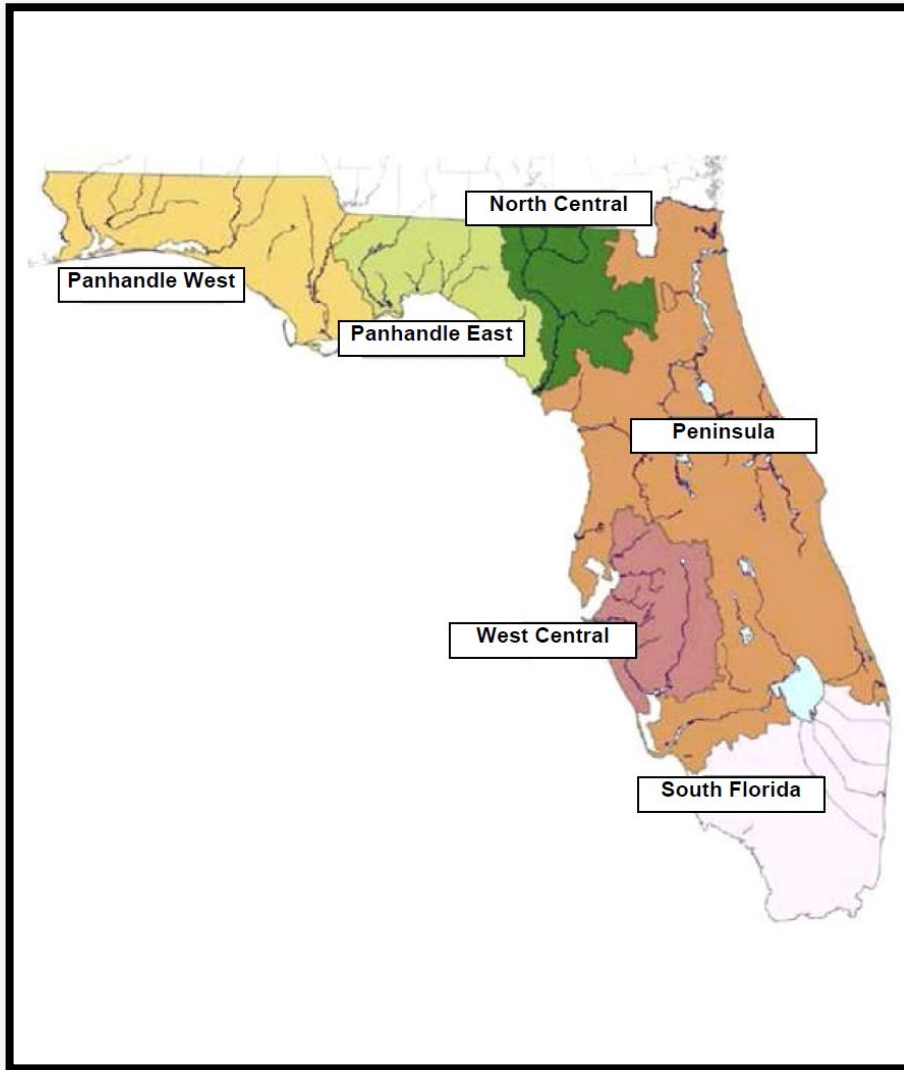
Introduction : Stephen M. Suaau, P.E.

- Resident of Sarasota County for nearly 40-years
- Nearly 40-years of experience in water management in southwest Florida
- Former Sarasota County Stormwater Utility Director
- Most of Career in private sector as small business owner
- Clients include Palmer Ranch, Lakewood Ranch, West River Villages, City of Holmes Beach, Peace River Manasota Regional Water Supply Authority, Gulf Coast Community Foundation, Conservation Foundation of Southwest Florida
- Oversaw original floodplain models and maps for Sarasota County, City of Venice, and City of Sarasota
- Oversaw the development of watershed restoration projects such as the “Celery Fields” and “Dona Bay”
- Technical Advisor and Co-Author of ***Community Playbook for Clean Waterways***

Context:

- State of Florida : Narrative and Numeric Nutrient Standards
- City of Venice Strategic Plan for Fiscal Year Ending September 30, 2023 (*Maintain pristine beaches and gulf waters – continue to pursue innovative strategies to mitigate pollution and improve water quality by ... eliminating the known causes of pollution*)
- City of Venice Draft Land Development Regulations

State of Florida – Nutrient Criteria



West Central Region Numeric Nutrient Criteria for Freshwater Streams:

Total Nitrogen = 1.65 mg/L

Total Phosphorus = 0.49 mg/L

Peninsula Region Numeric Nutrient Criteria for Freshwater Streams:

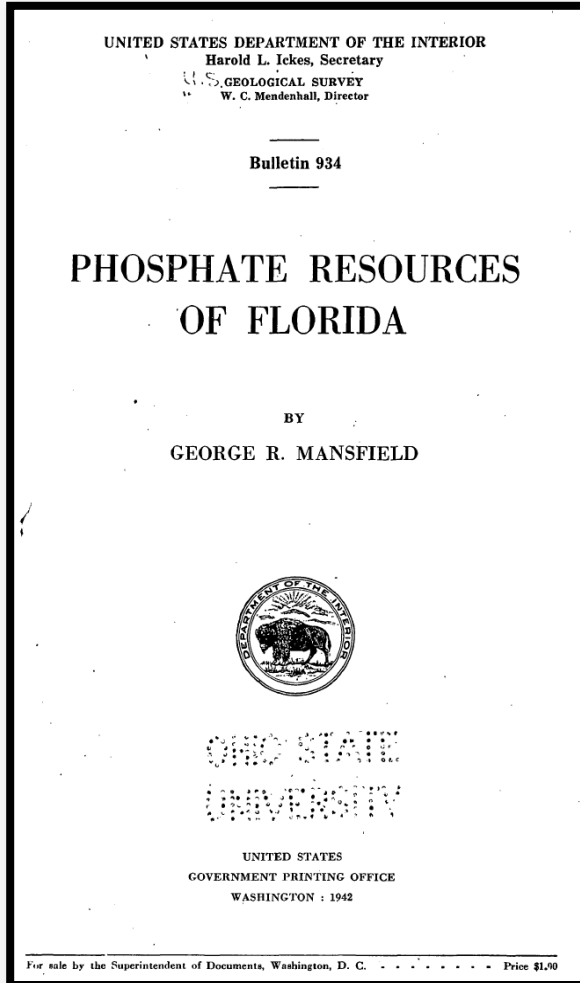
Total Nitrogen = 1.54 mg/L

Total Phosphorus = 0.12 mg/L

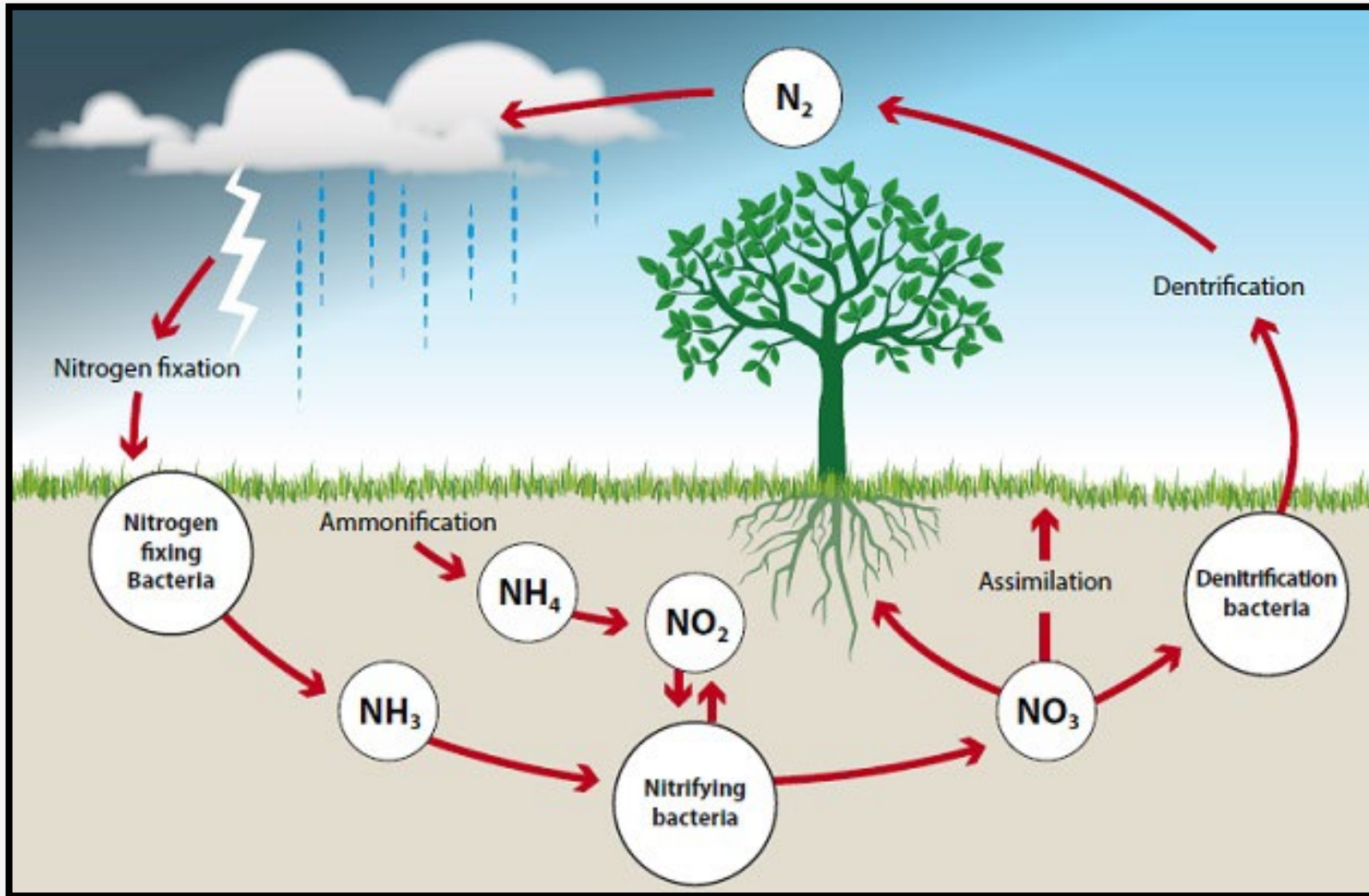
Narrative Numeric Criteria:

*The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter. Man-induced nutrient enrichment (total nitrogen or total phosphorus) shall be considered degradation in relation to the provisions of Rules 62-302.300, 62-302.700, and 62-4.242, F.A.C. **In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.***

Phosphorus & Geology

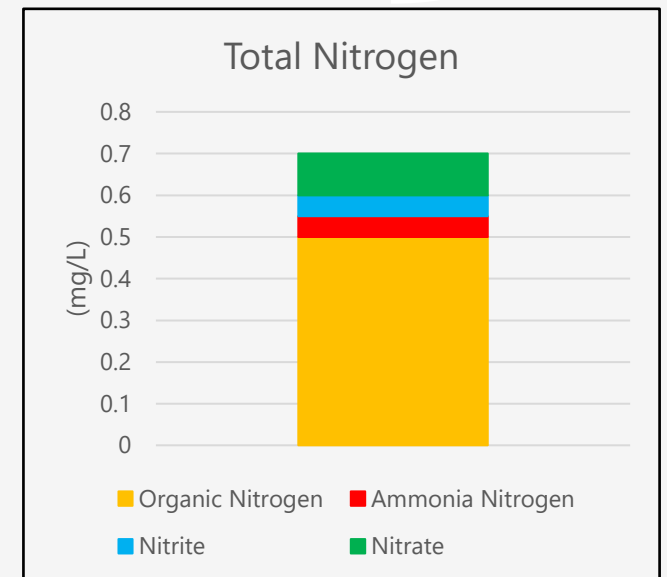


Nitrogen & the Nitrogen Cycle



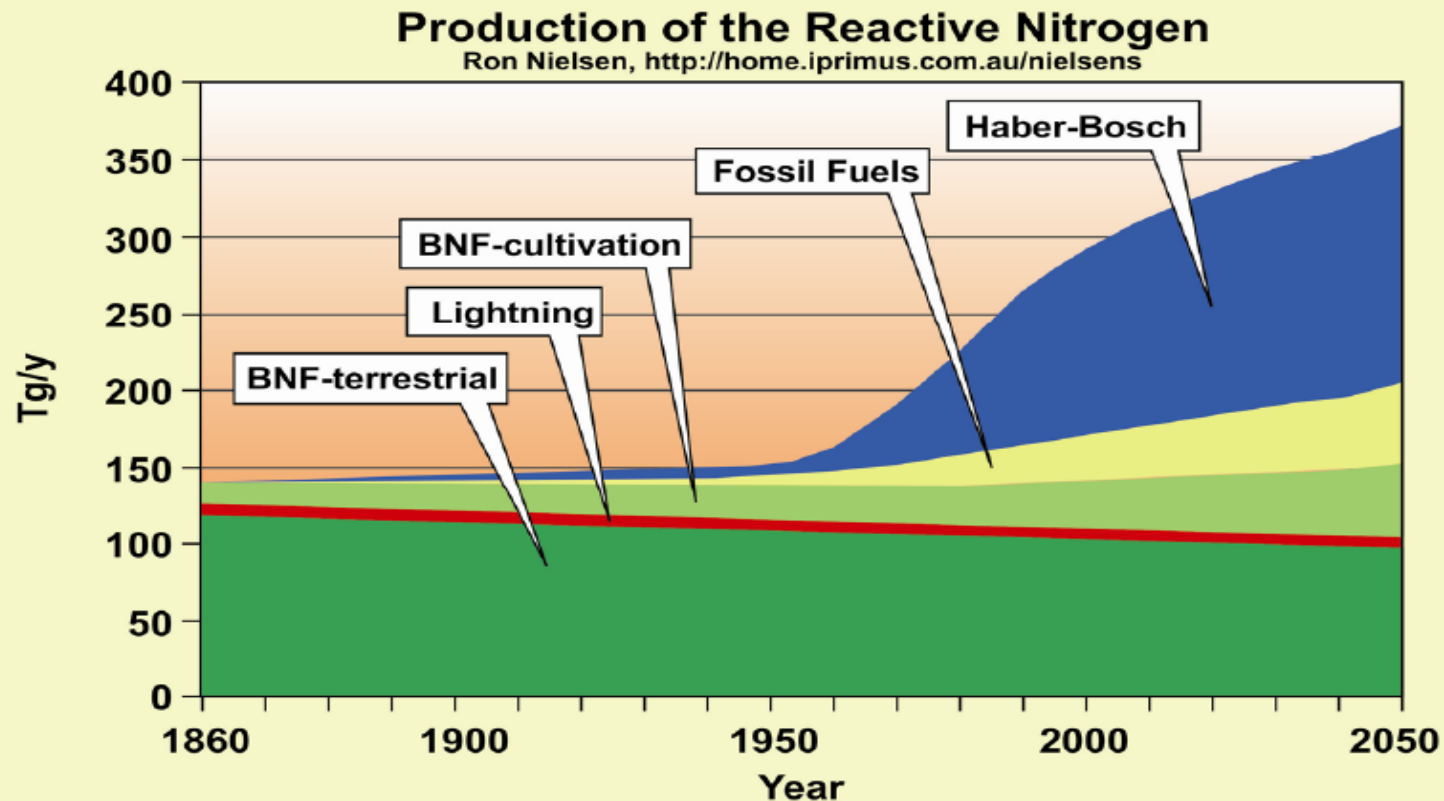
Nitrogen Like Water,
Nitrogen can exist as a gas,
liquid, or solid

And like the water
hydrologic cycle, there is a
natural nitrogen cycle



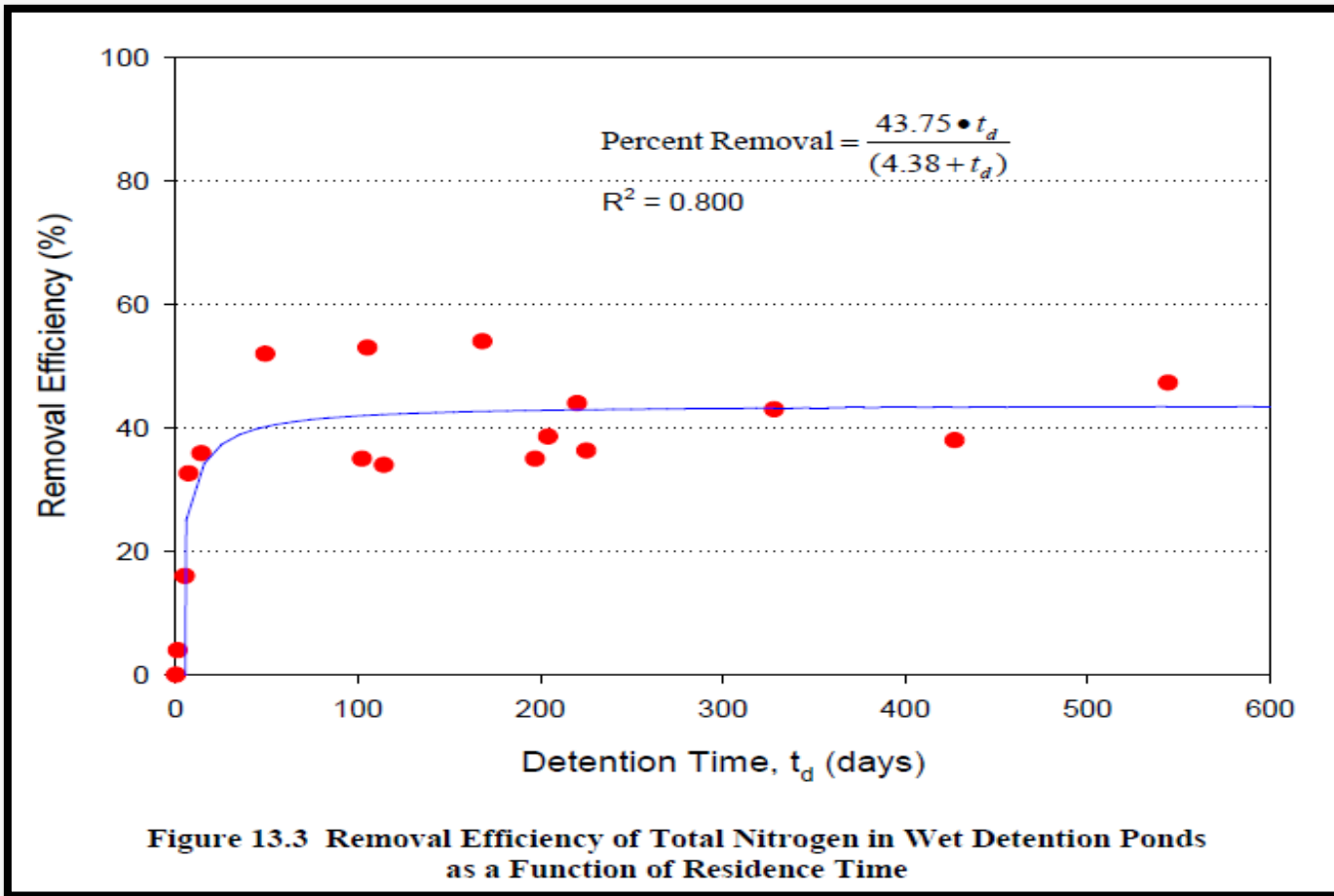
The Green Revolution : Haber-Bosch

Globally, these “new” reactive N sources are increasing rapidly!



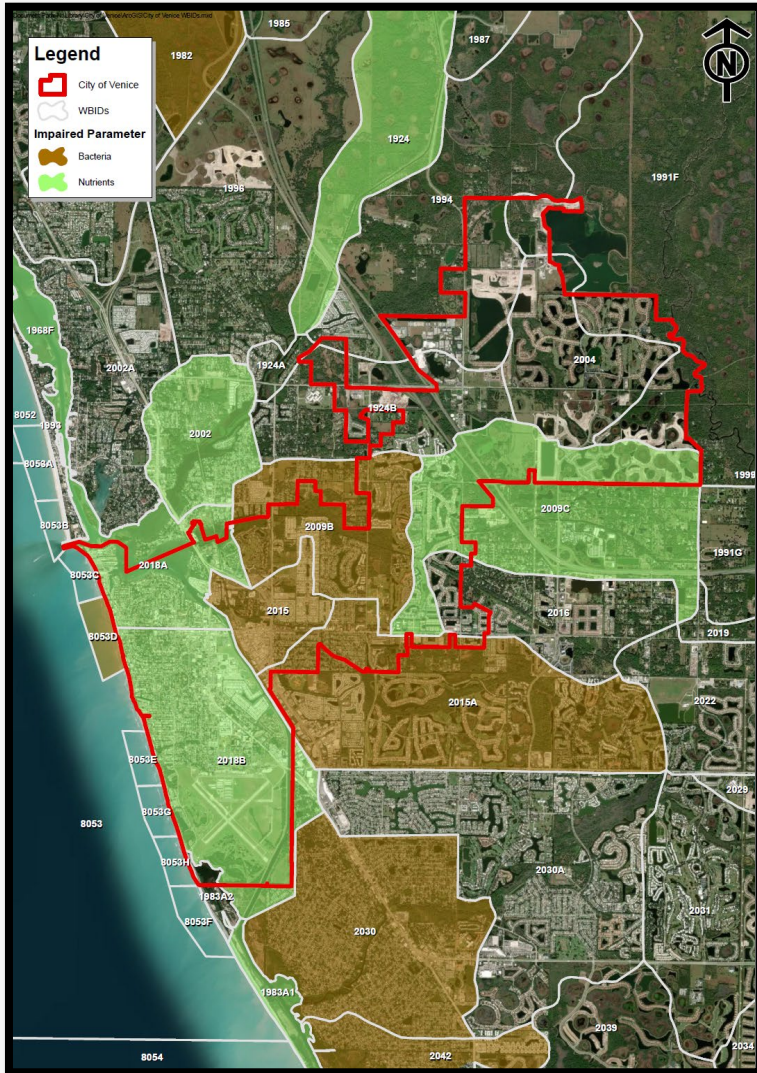
Source: Nielsen, 2005; Galloway, et. al., 2004

Water Quality Trends



Since 1995, the Florida recognized nutrient levels were increasing in natural waterways causing them to be impaired and that stormwater systems (i.e. ponds) were not as effective as presumed in reducing nitrogen and embarked on a decade long process to update the stormwater treatment criteria to better reduce nutrients.

Water Quality Trends



The List of Waters Impaired (primarily nutrients) continues to grow.

Nitrogen in many of our Bays has been trending upward over the past 2 decades resulting in:

- increasing seagrass loss
- macro algae
- harmful algae blooms
- manatee fatalities

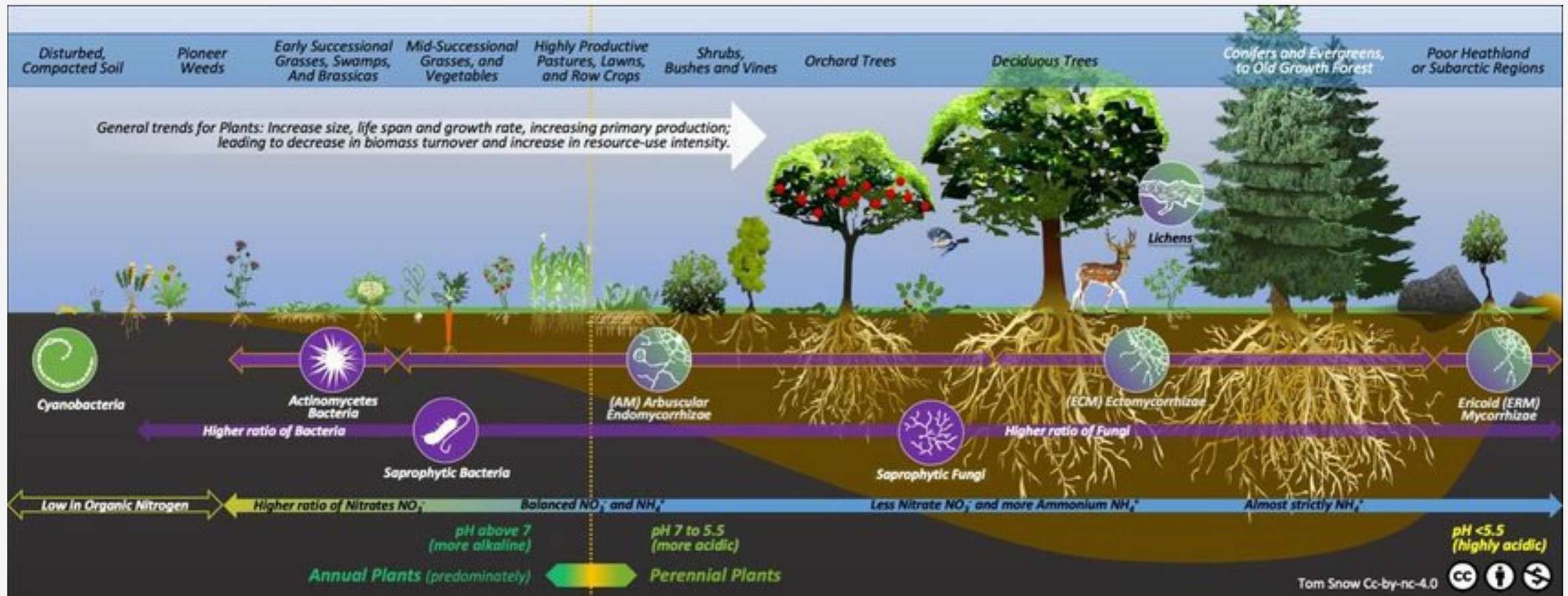
Potential Land-Based Sources of Nitrate from Human Activity

1. Non-AWT municipal reclaimed wastewater
2. Municipal biosolids
3. On-site wastewater treatment and disposal systems (OWTDS) effluent
4. Chemical Fertilizer
5. Is there anything we are missing?



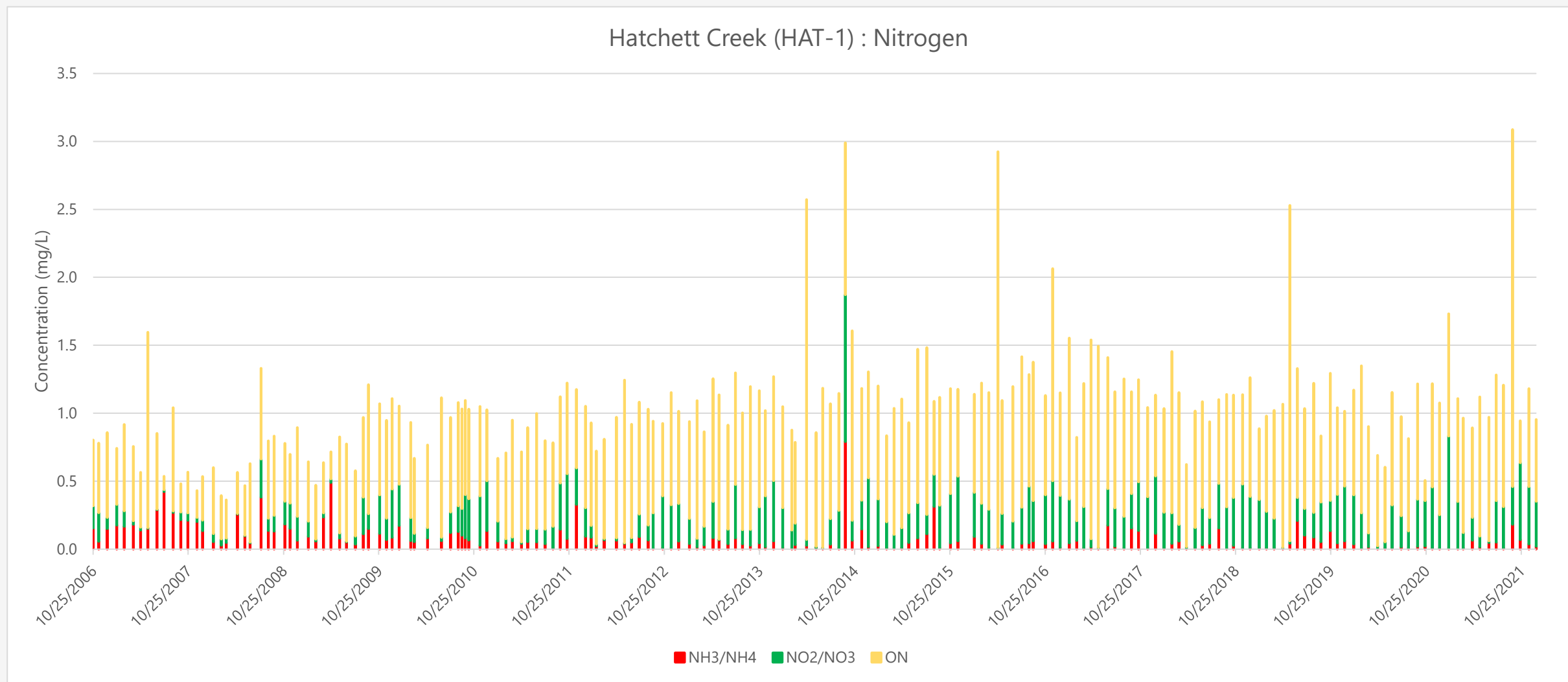
Urban Landscape Changes : Reverse Succession

Fungi dominated to Bacteria dominate : Aerobic to Anaerobic : Ammonium Nitrogen to Nitrate Nitrogen



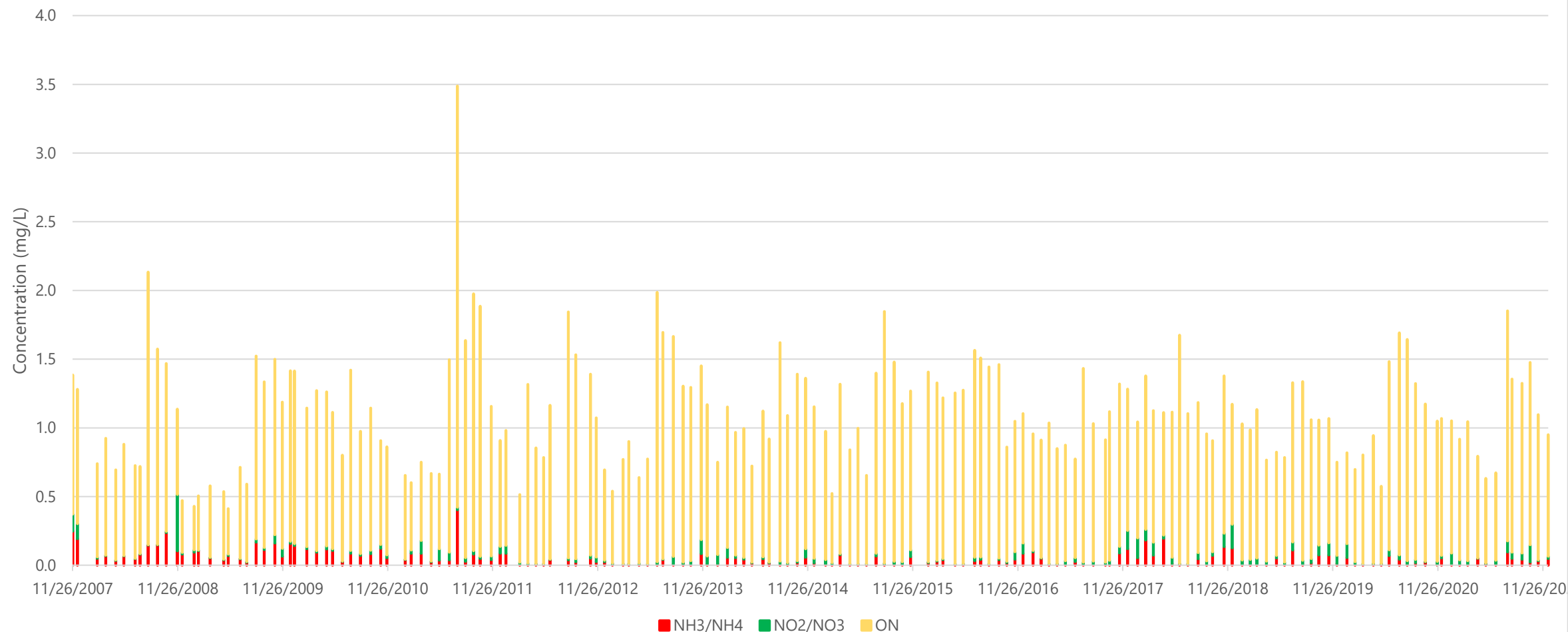
Some prominent variations through ecological succession, inspired by 'Plant Succession' illustration in Ingham and Rollins (2011, p. 30; Snow, 2020).

Hatchett Creek (HAT-1) Dissolved Inorganic Nitrogen – 27%



Deer Prairie Creek (DPS) Dissolved Inorganic Nitrogen – 7%

Deer Prairie Creek (DPS) : Nitrogen



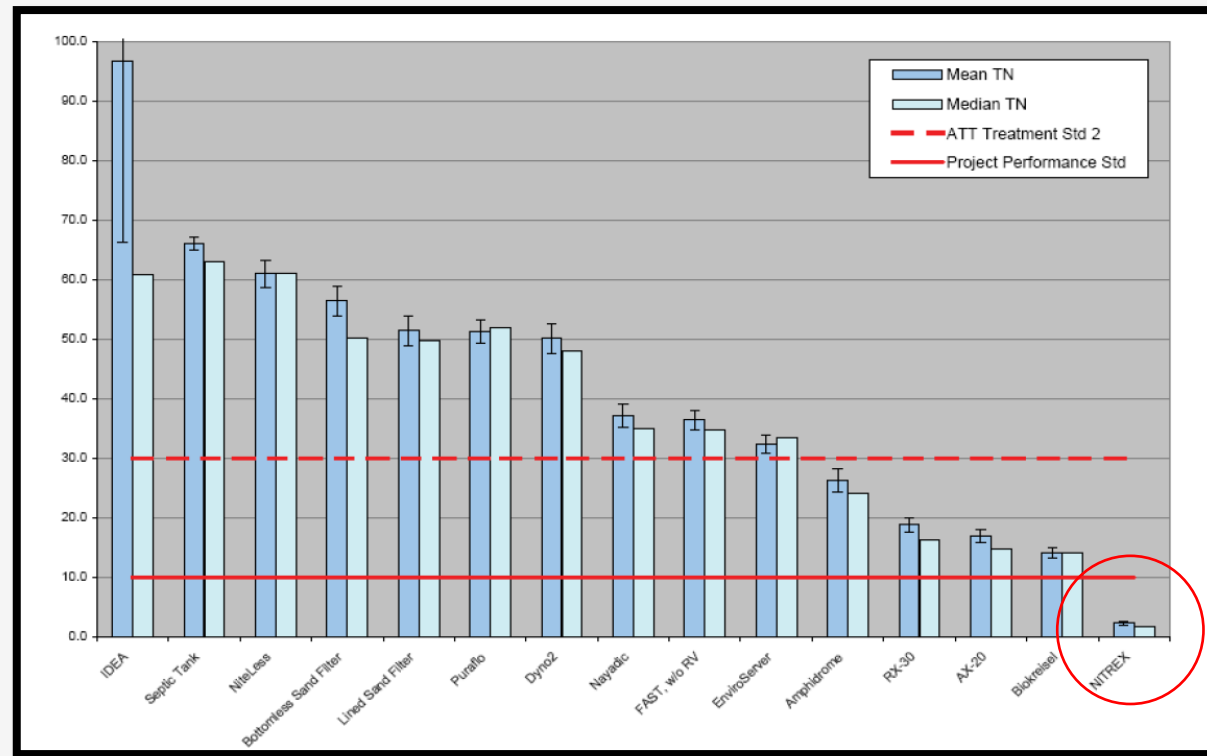
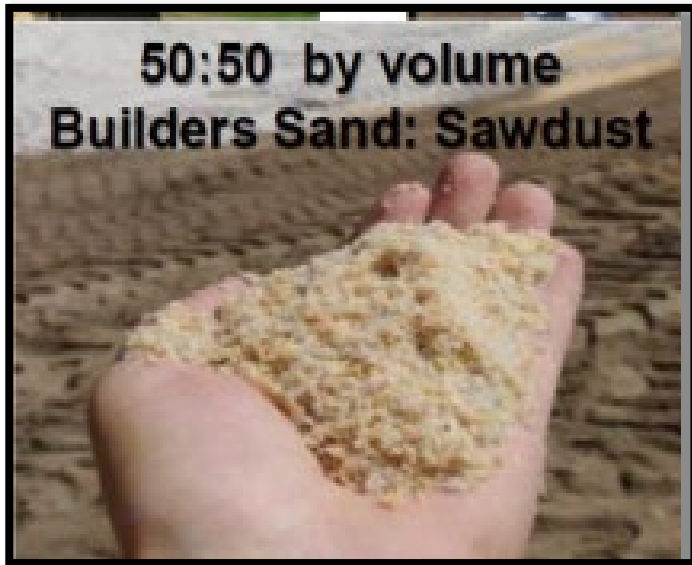
Can indigenous Soil Biology be salvaged & beneficially reused?



Organic Carbon : Passive Nutrient Reduction Media



Placed in an anaerobic environment, wood chips or sawdust are carbon sources that act as a host for the natural bacteria that facilitates denitrification

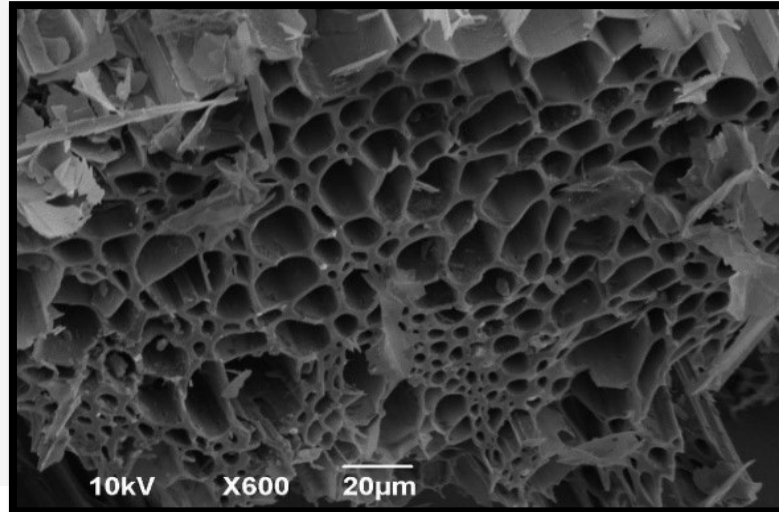


Organic Carbon : Passive Nutrient Reduction Media

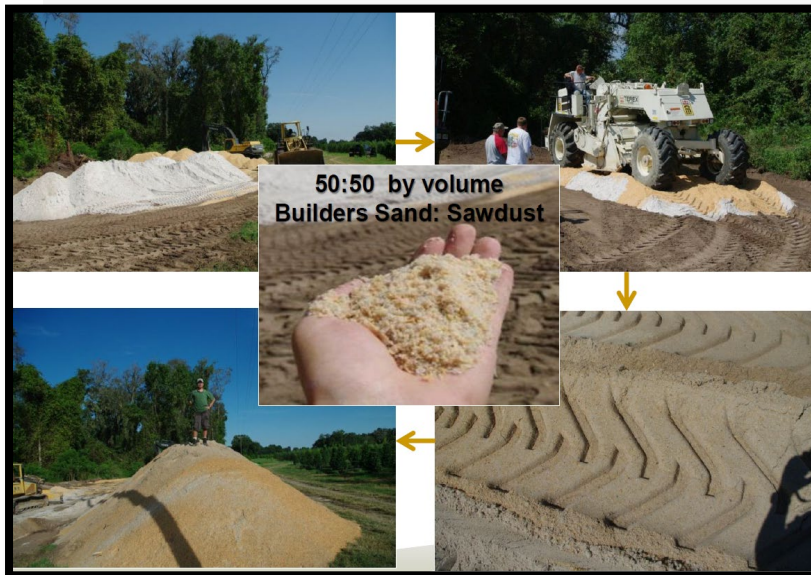
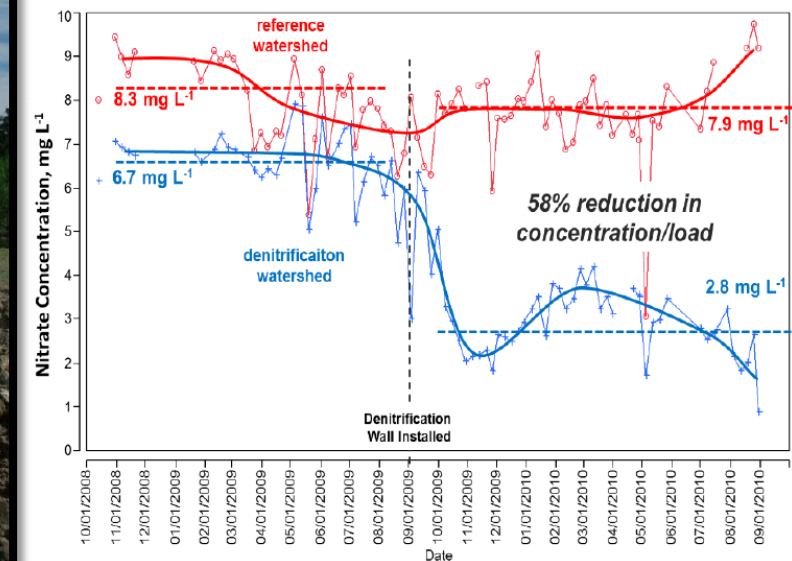
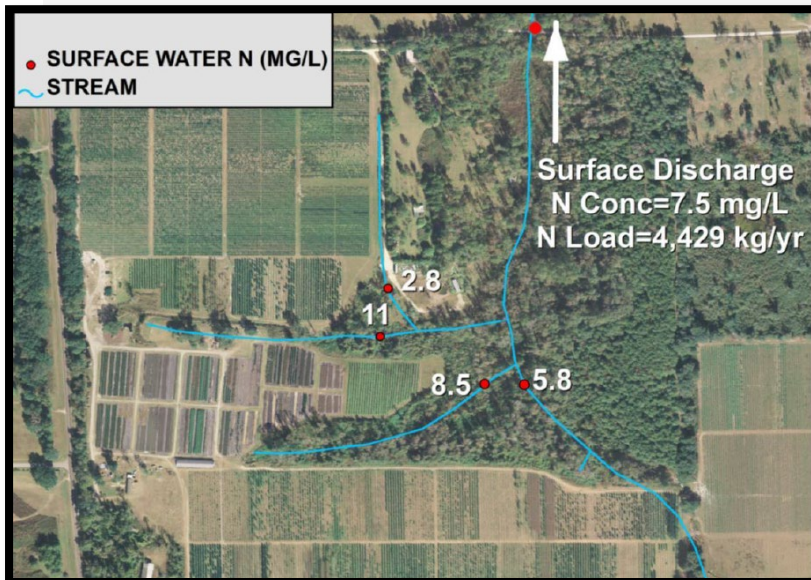


Biochar is produced by heating organic material with limited or no oxygen.

The resulting media is stable carbon/charcoal that can be used as a soil amendment and MAY BE effective in capturing phosphorus and denitrification.



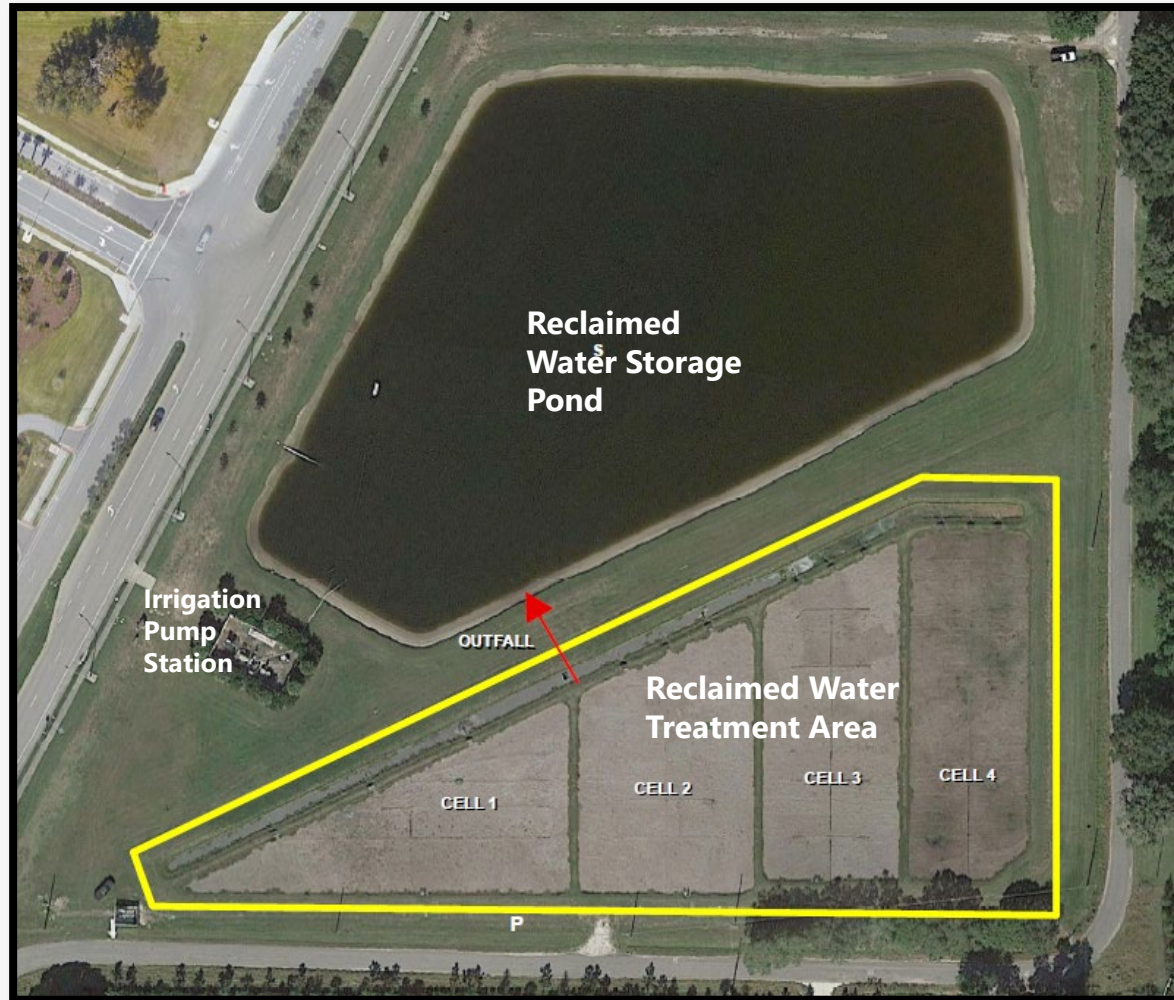
Organic Carbon : Passive Nutrient Reduction Media



- Groundwater intercepted = 84,000 L d⁻¹ at 5-9 mg L⁻¹ Nitrate-N
- Nitrate-N removal rate = 3.2 ± 1.9 g N m⁻³ d⁻¹
- Conservative longevity of wall = 15 years
- Amortized cost per kilogram of Nitrate-N removed = \$0.79 (\$0.36/lb)

Lakewood Ranch – Braden River Utilities (BRU)

Passive Nutrient Reduction Pilot Project



BRU, with cooperative funding assistance from SWFWMD as implemented a passive nutrient reduction pilot project with the objective of reducing nitrogen and phosphorus concentrations in up to 1 mgd of Manatee County's reclaimed water to meet AWT standards using various organic carbon medias.

- 99% reduction in NITRATE concentrations at system outfalls
- **\$42.25/LB Nitrate Reduced/Year (\$2.11/LB Nitrate Reduced IF 20-year life)**

Palmer Ranch - Prestancia

Subsurface Denitrification System (9/20 - 9/21)



- On 9/15/20, two subsurface denitrification systems (SDS), consisting of 6 cubic yards (162 cubic feet) each of Nitrex™ media were installed at the bottom of the 2.36 acre reclaimed wastewater storage pond.
- The SDS consists of gabion baskets filled with Nitrex™ and an internal perforated PVC pipe system. A 4,400 gph rated pump is included to cycle the pond water through each of the SDS. Together, the rated capacity of the circulation pumps is 211,200 gallons per day. Conservatively assuming a pond depth of 8 feet, the pond recycling time is estimated as 29 days or approximately 1 month.
- 74% reduction in NITRATE concentrations
- **\$17.03/LB TN Reduced/Year (\$0.85/LB TN Reduced IF 20-year life)**

Gaging Cost-Effectiveness for Investments in Nutrient Reduction

Comparison of Nutrient Reduction Costs between Stormwater BMPs and AWT Facilities

Briefing Paper Prepared by the Florida Stormwater Association

Comparative Life Cycle Costs of Nutrient Removal for Stormwater BMPs & Wastewater AWT Projects in Florida							
Treatment Type Average Nutrient Removal	Total Nitrogen	Total Phosphorus	TN		TP		Number of Projects
			Min	Max	Min	Max	
Stormwater - Cost/lb	\$268	\$1,052	\$9	\$1,259	\$56	\$6,925	20
Wastewater (AWT) - Cost/lb	\$26	\$124	\$11	\$71	\$86	\$186	5

Florida Stormwater Association, October 2017

July 2019

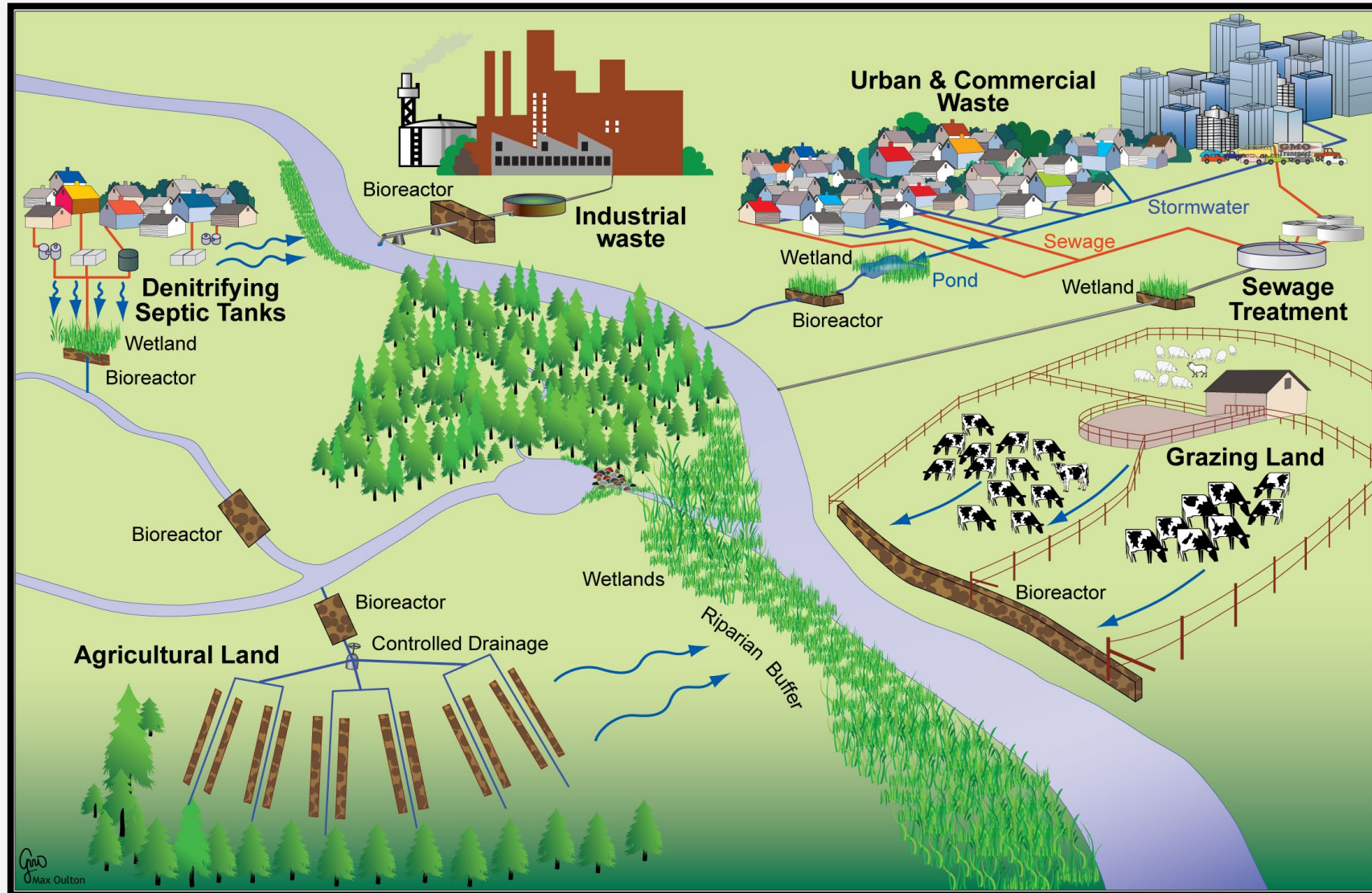
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

CFI Process Overview

METRICS FOR RANKING COST EFFECTIVENESS

Water Quality Projects (cost/lb of pollutant removed)			
Project Type	High	Medium	Low
Total Nitrogen (cost/lb)	<\$176	≥\$176 ≤ \$475	>\$475
Total Phosphorus (cost/lb)	<\$1498	≥\$1498 ≤ \$4152	>\$4152
Septic Conversion Total Nitrogen (cost/lb)	<\$100	≥\$100 ≤ \$176	>\$176

Broad Applications of Passive Nutrient Reduction Systems



LDR Recommendations

SECTION 2.10.A

Low Impact Development (LID) and Regenerative practices, including but not limited to shallow bioretention, pervious pavements, stormwater harvesting, green roof stormwater treatment systems, rainwater harvesting, and detention with biofiltration, and beneficial reuse of indigenous soil biology and organic carbon shall be considered as a stormwater approach that requires a suite of hydrologic controls throughout a site and integrates a series of treatments to replicate natural functions of the predevelopment landscape.

SECTION 2.10.C

Provisions for slope erosion including but not limited to installation of riprap, other materials to minimize bank erosion; and The use of aquatic plants evenly distributed around the entire stormwater pond perimeter.

General Recommendations

- ✓ Excess Nitrate reduction should be a top management priority
- ✓ Encourage Community Composting and Re-building of Soil Biology
- ✓ Cost/benefit (\$/Pound of Nitrate Reduced) should be considered to inform investment of public funds
- ✓ Review water quality data collected to inform decisions
- ✓ Continue to lead the way in the reduction of excess nitrate

Thank You

Acknowledgements:

- Braden River Utilities/Lakewood Ranch
- Southwest Florida Water Management District
- Prestancia Property Owners Association
- Soil Food Web
- Sarasota Water Atlas
- Pio Lombardo
- Big Earth Supply
- CarbonXT
- C & M Roadbuilders