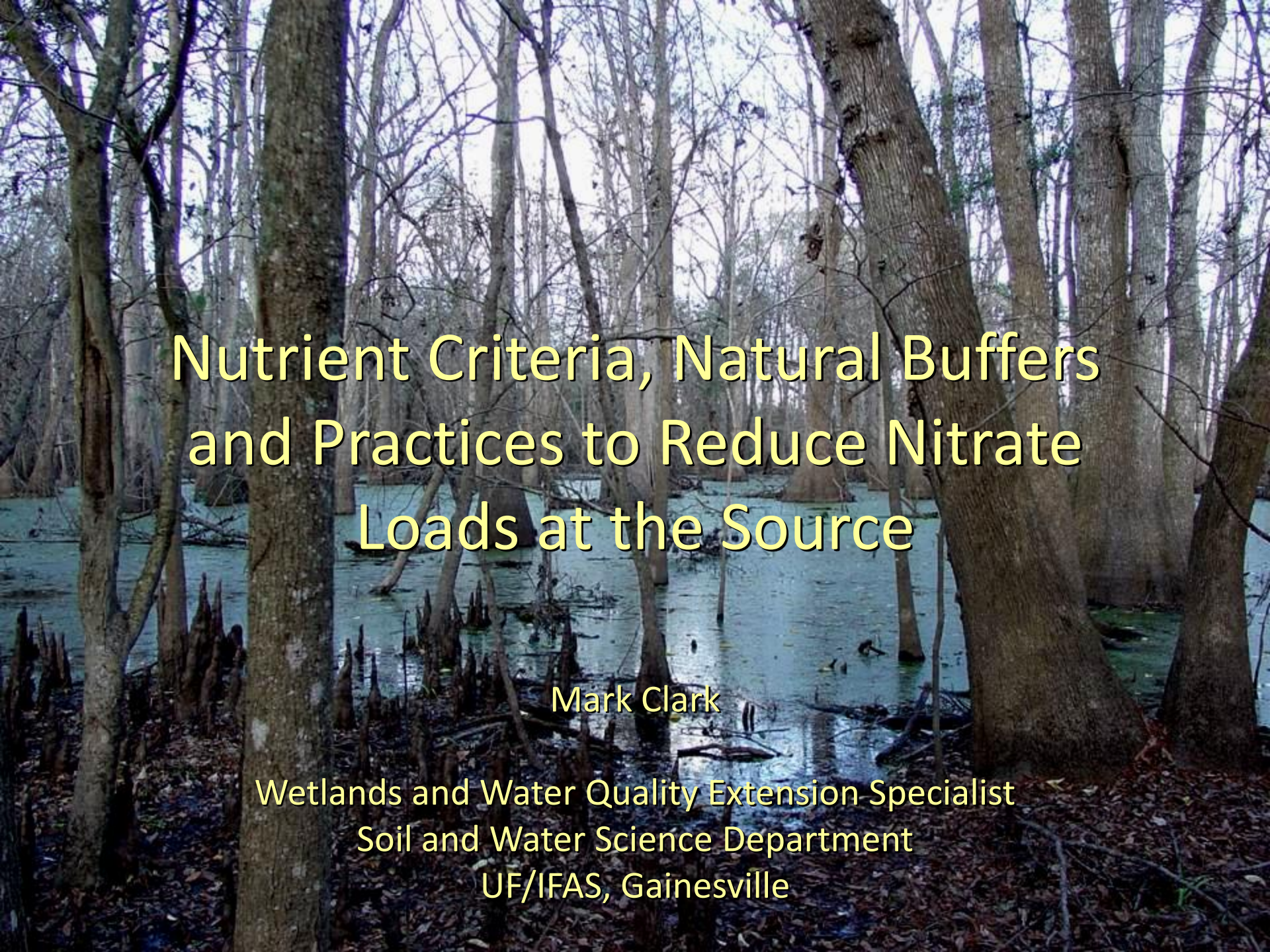


A photograph of a swampy forest, likely a cypress swamp, with tall, thin trees and water in the foreground. The text is overlaid on the image.

Nutrient Criteria, Natural Buffers and Practices to Reduce Nitrate Loads at the Source

Mark Clark

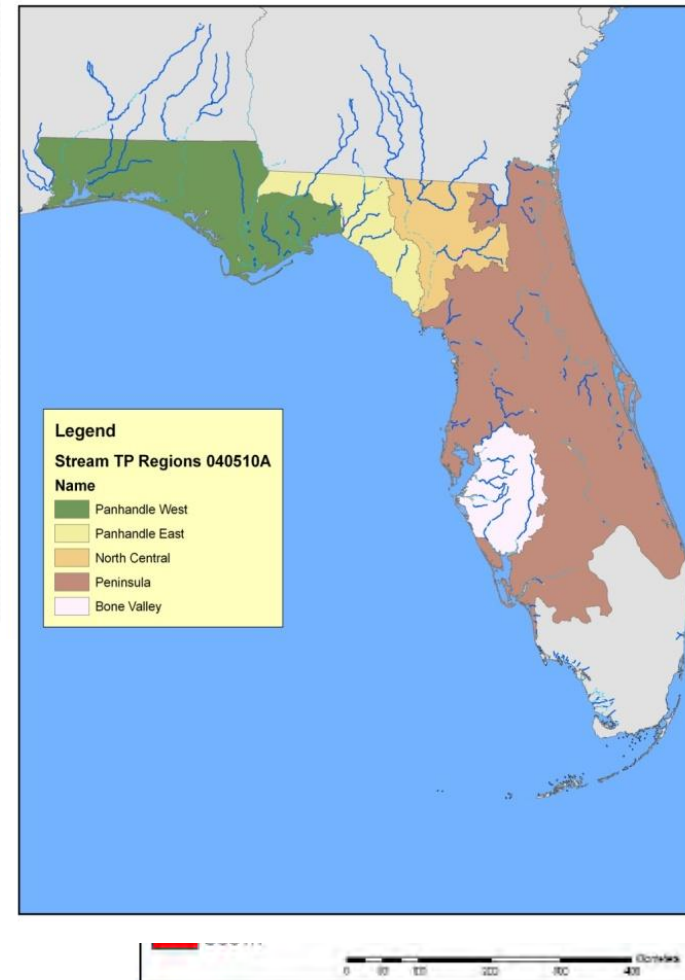
Wetlands and Water Quality Extension Specialist
Soil and Water Science Department
UF/IFAS, Gainesville

Overview

- Numeric nutrient criteria for streams (and spring?)
- Wetland buffers and nitrate reduction in a tributary of the middle Santa Fe River Basin
- Nitrate source controls in a container nursery
 - Fine tuning irrigation
 - Surface runoff interception and treatment
 - Groundwater interception and treatment

EPA's Stream Protection Criteria for Total Nitrogen and Phosphorus

Nutrient Watershed Region (NWR)	Instream Protection Value Criteria	
	TN (mg/L)	TP (mg/L)
Panhandle West	0.67	0.06
Panhandle East	1.03	0.18
West Central	1.65	0.49
Peninsula	1.54	0.12
North Central	1.87	0.30



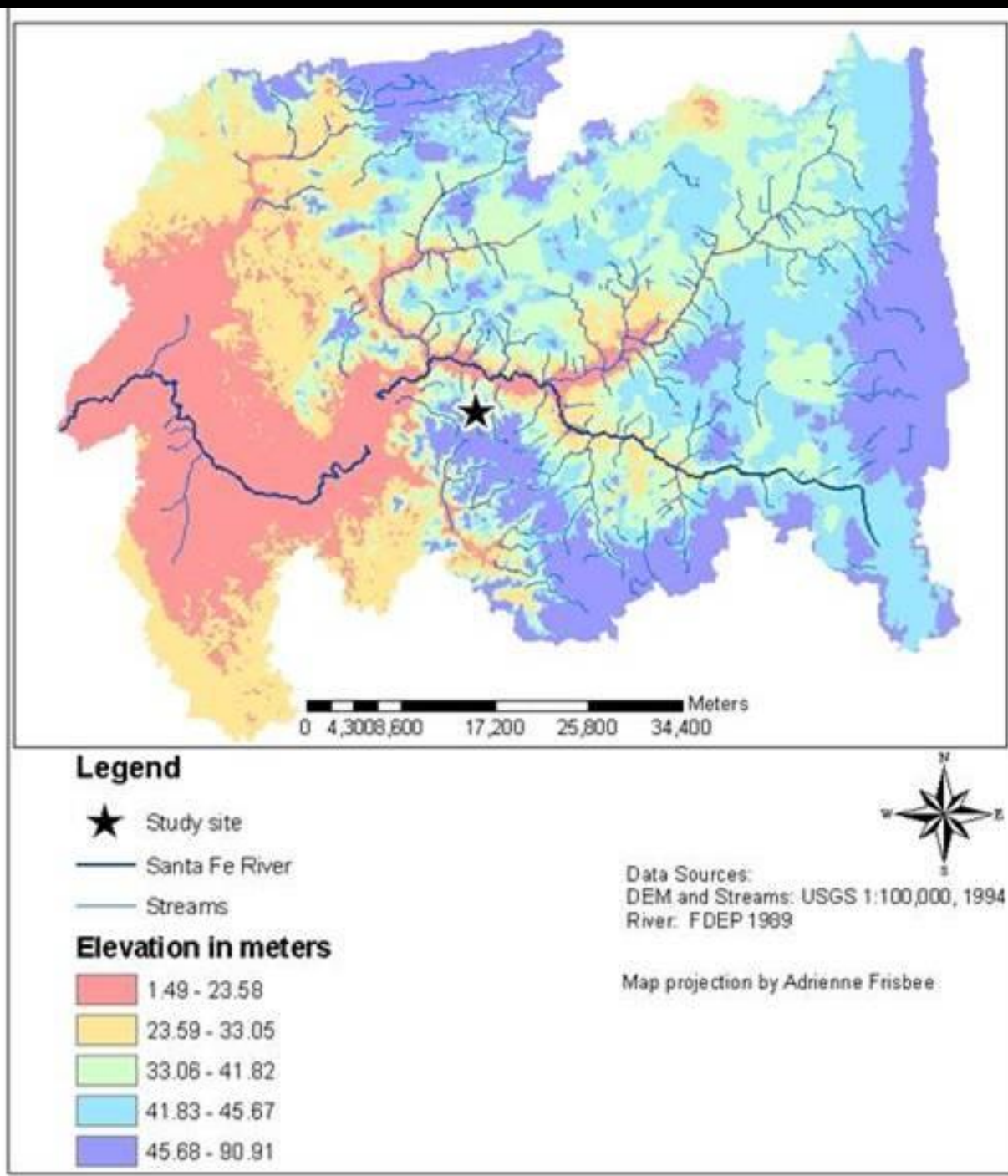
In-stream protection and downstream protection

Criteria for Springs

- Definition
 - “Spring” means a site at which ground water flows through a natural opening in the ground onto the land surface or into a body of surface water
- Rule
 - Establishes nitrate-nitrite criterion of 0.35 mg/L as an annual geometric mean, not to be exceeded more than once in a three year period

Study Site

A tributary in the Middle
Santa Fe River
Watershed



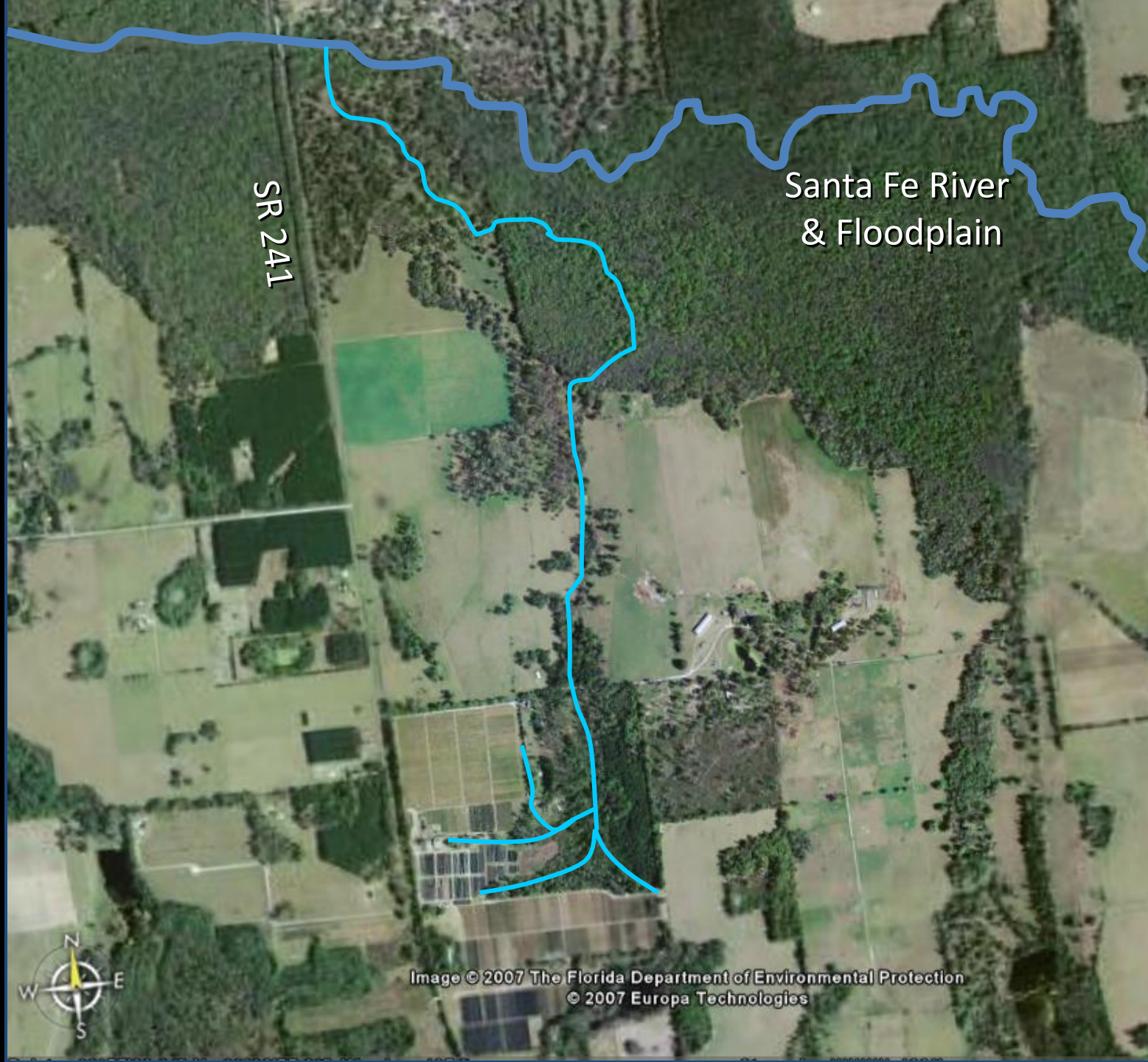
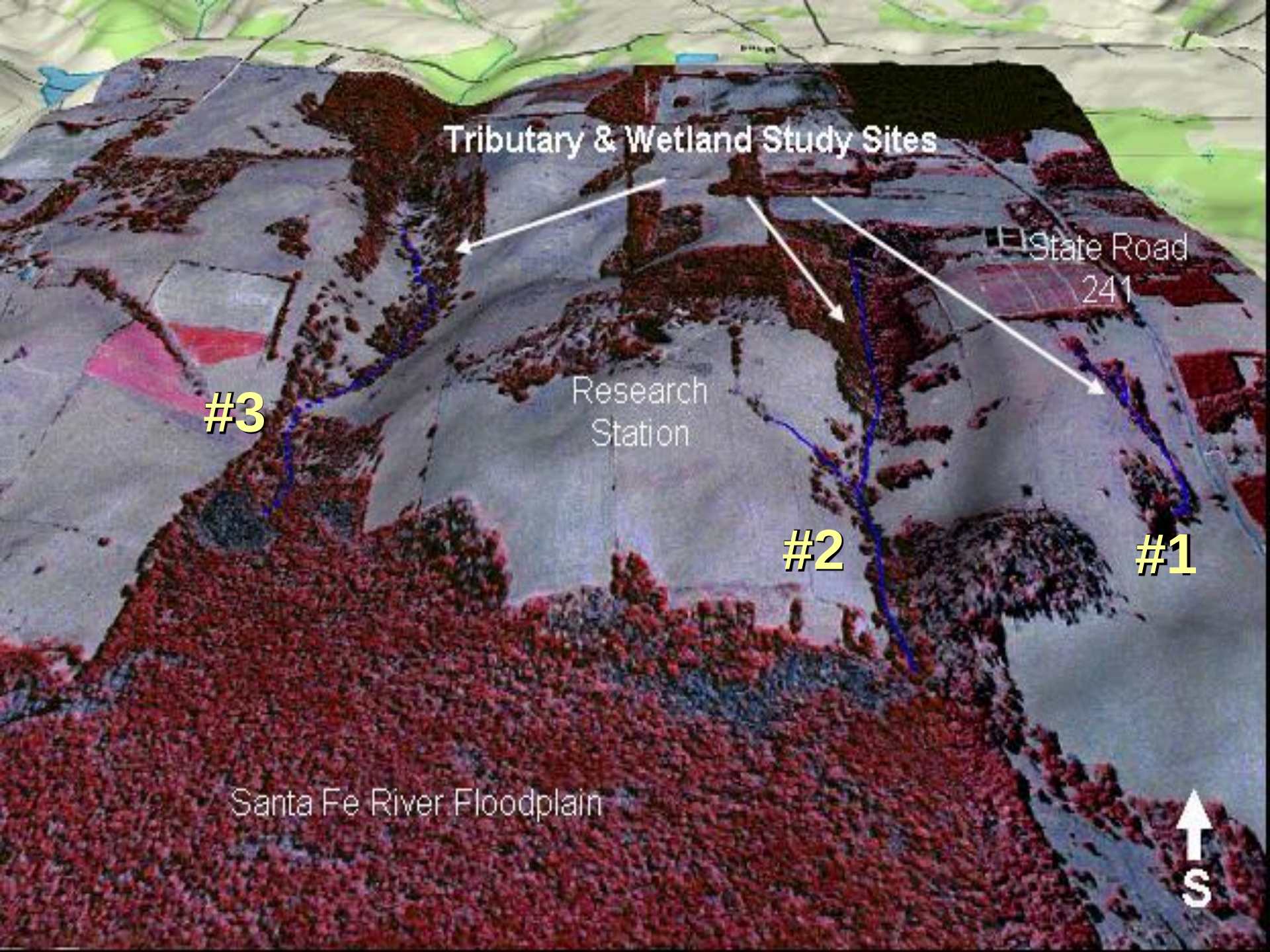


Image © 2007 The Florida Department of Environmental Protection
© 2007 Europa Technologies



Tributary & Wetland Study Sites

State Road
241

Research
Station

#3

#2

#1

Santa Fe River Floodplain



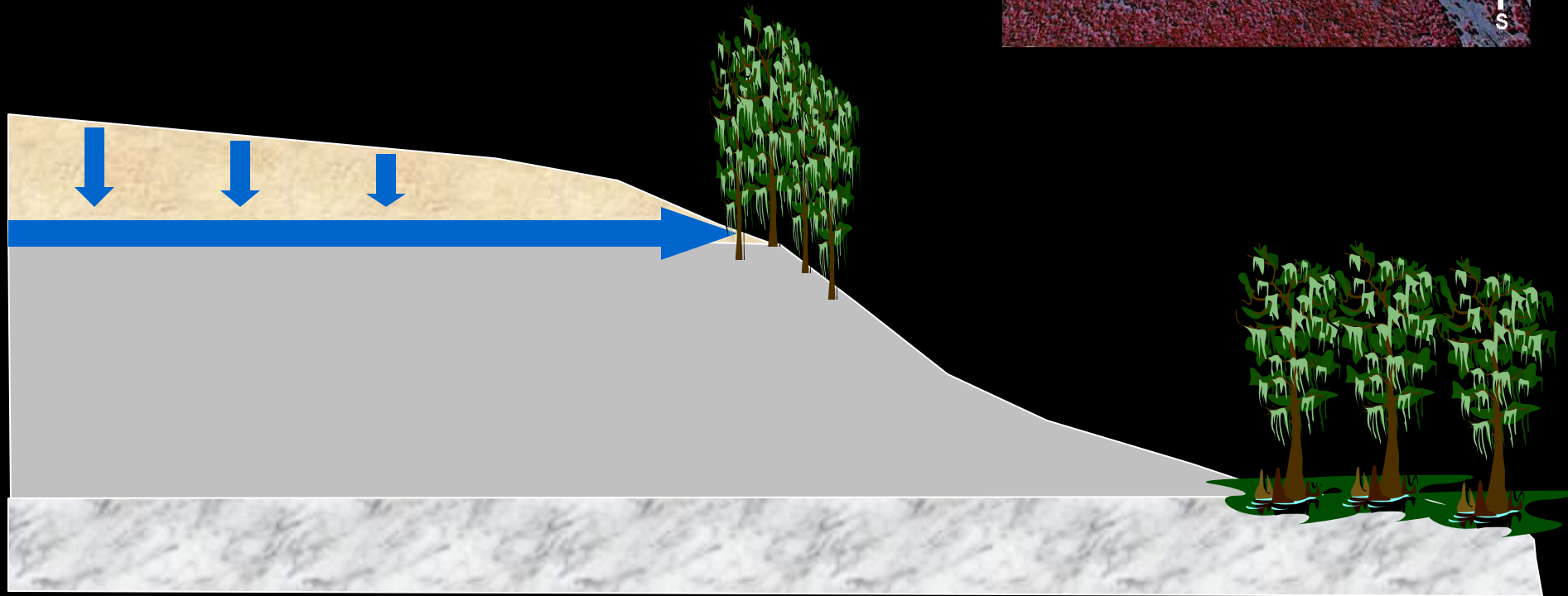
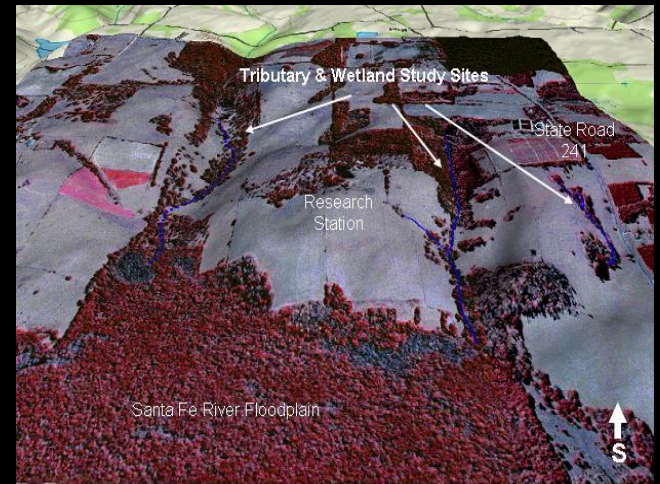
Land Use



Soils and Geology



Geology



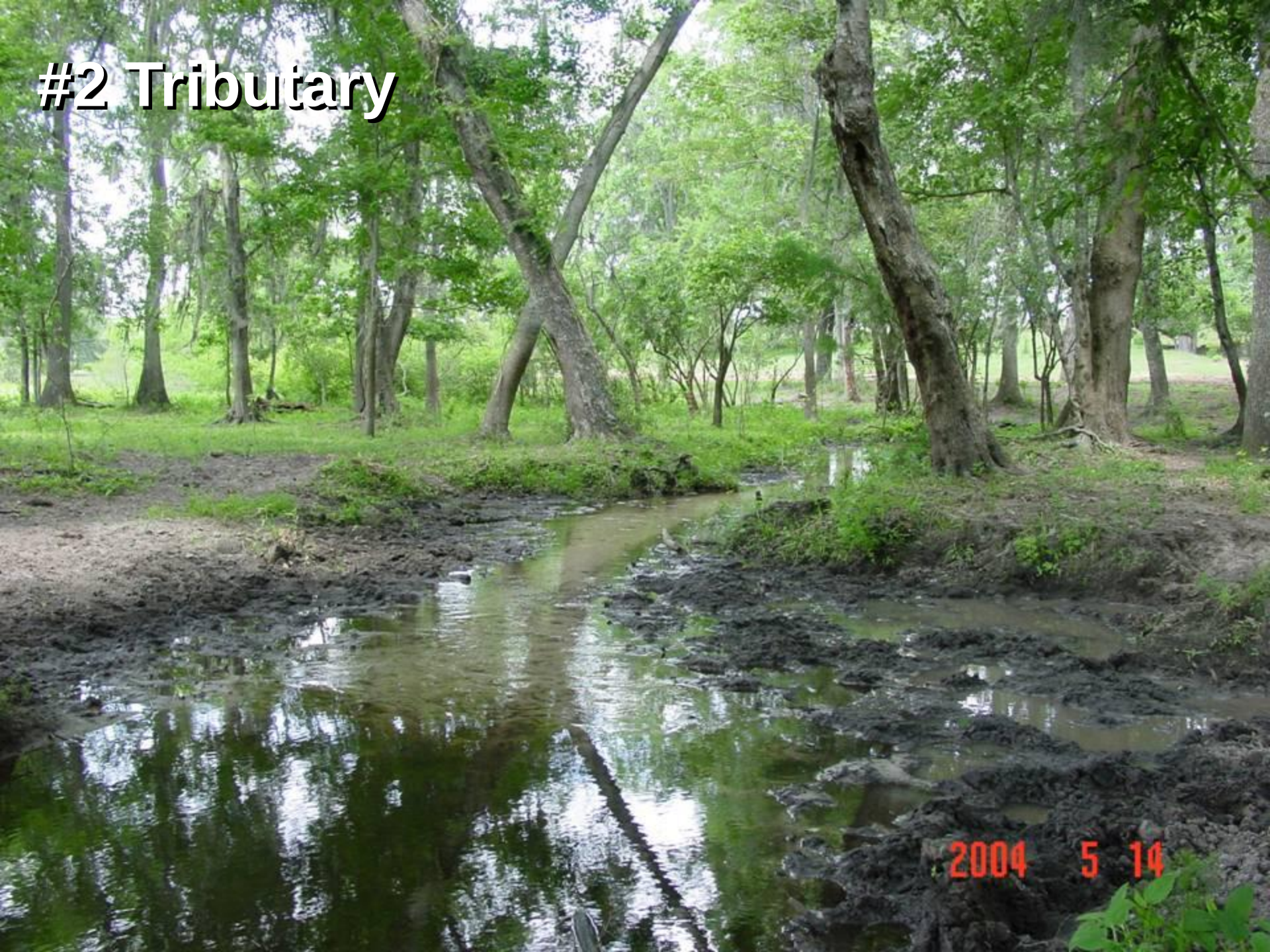
#3 Tributary

2004 5 14

#3 Tributary

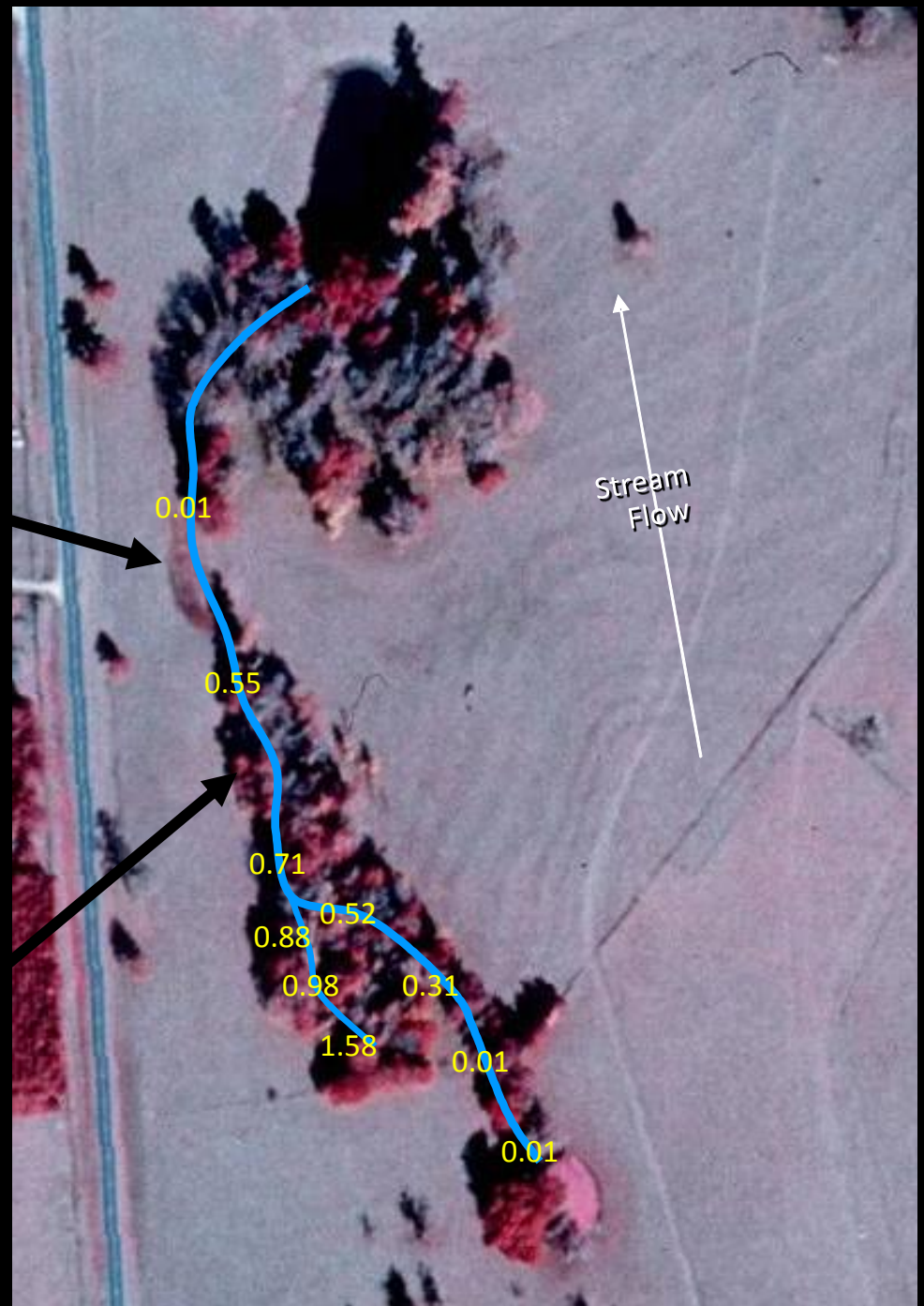


#2 Tributary

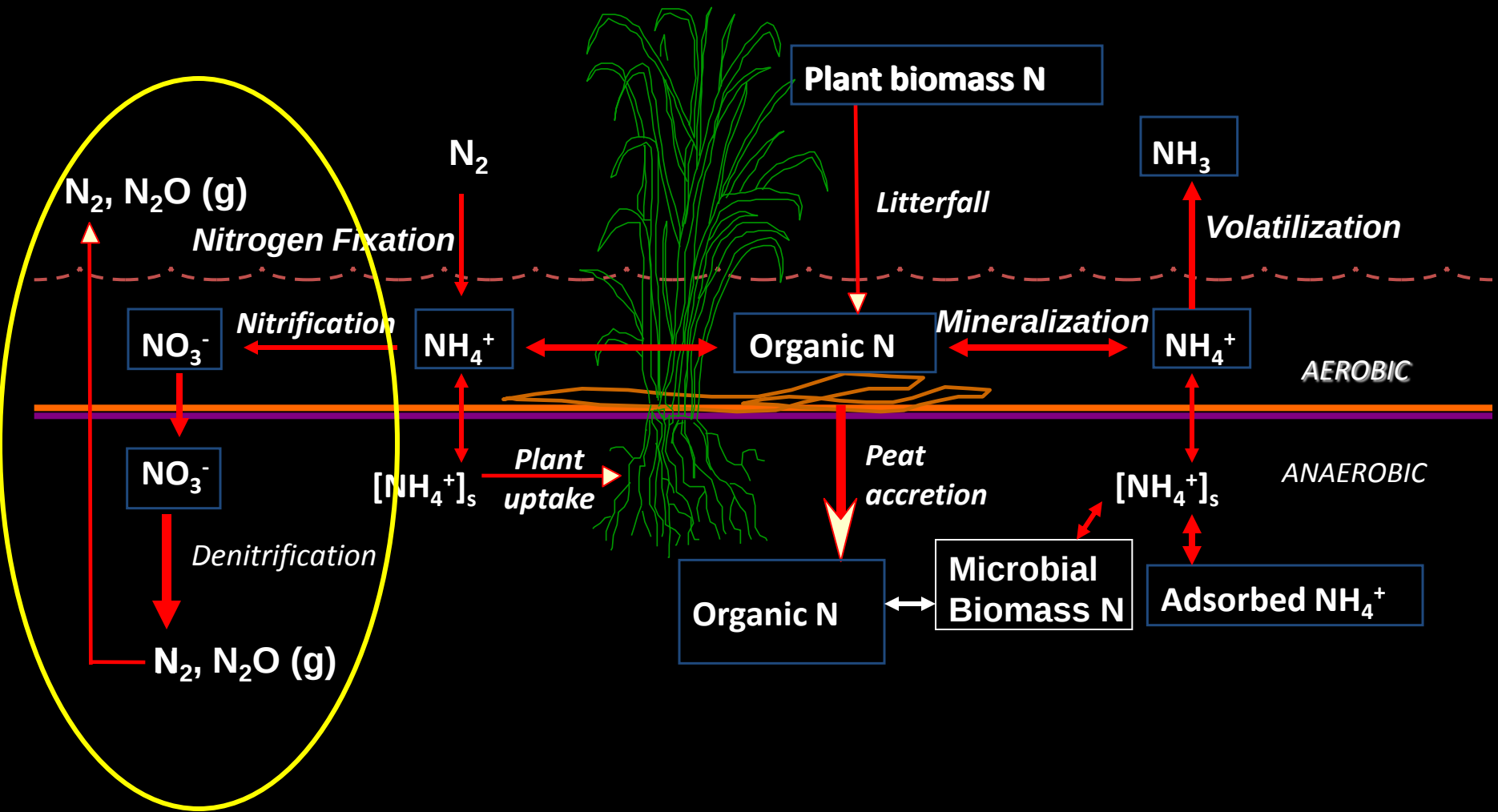


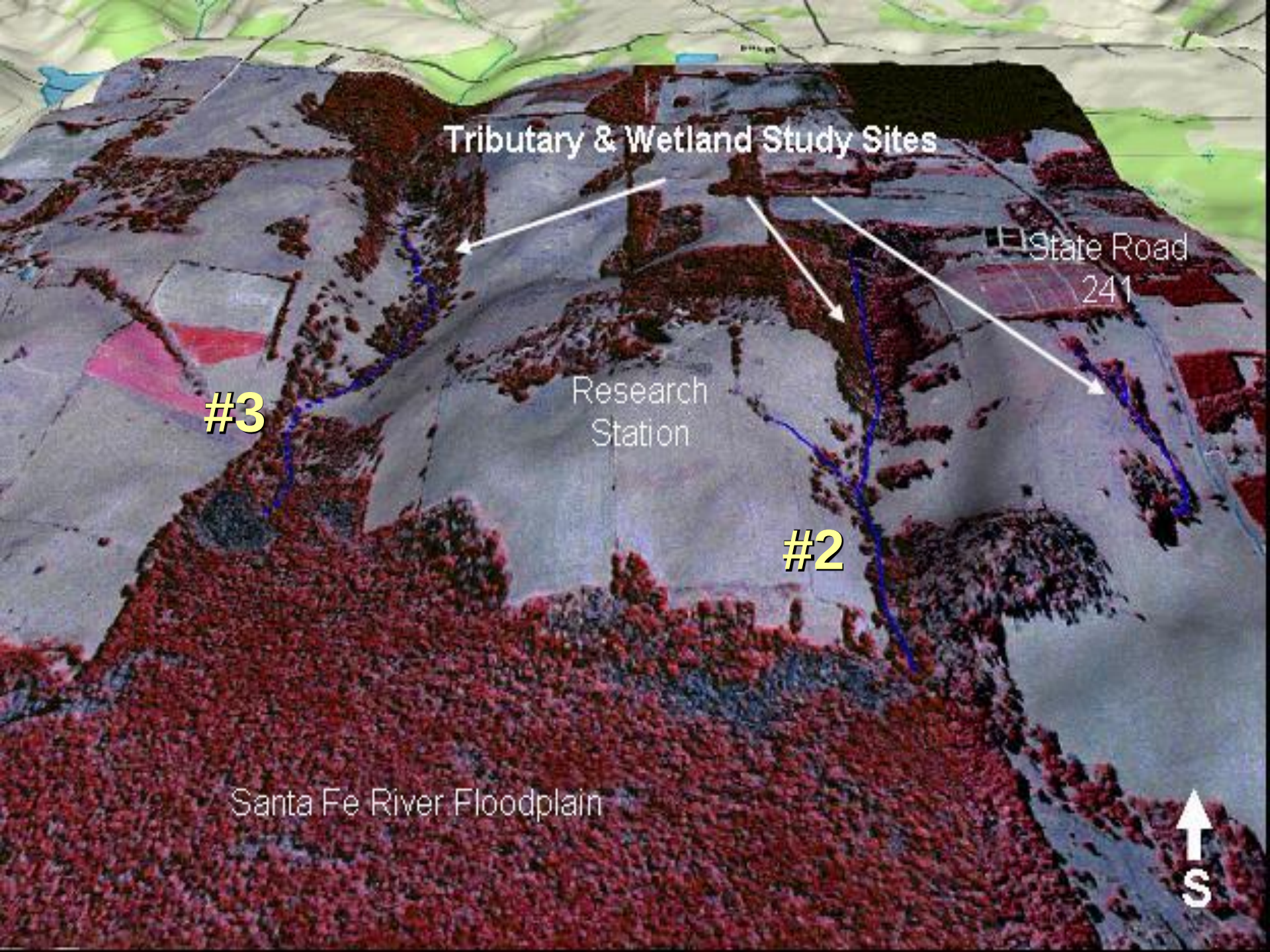
2004 5 14

#1 Tributary



Nitrogen Cycling in Wetlands





Tributary & Wetland Study Sites

State Road
241

Research
Station

#3

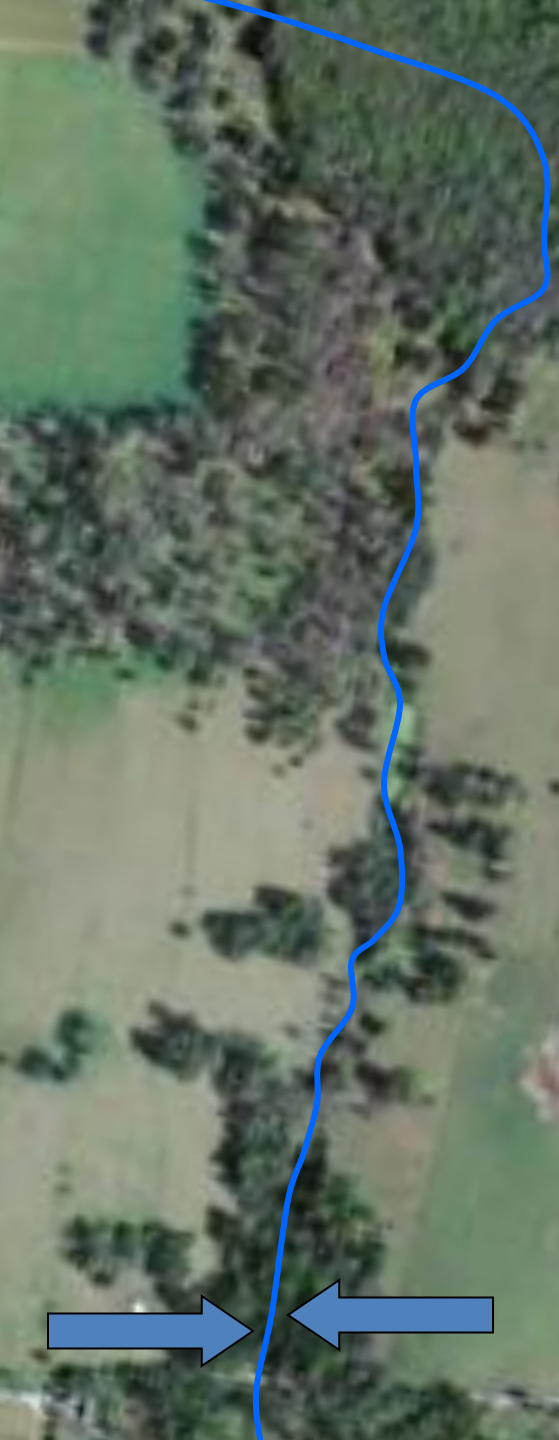
#2

Santa Fe River Floodplain



2005 Average Nitrate Concentration in Tributaries

	Tributary 2			Tributary 3		
	(mg/L)			(mg/L)		
March	5.37	±	0.91	0.014	±	0.007
April	4.56	±	1.72	0.058	±	0.027
May	5.29	±	0.68	0.026	±	0.055
June	4.42	±	0.69	0.030	±	0.028
August	4.03	±	0.70	0.035	±	0.040
September	4.57	±	0.45	0.010	±	0.004
October	5.73	±	0.80	0.017	±	0.006
November	4.88	±	0.89	0.027	±	0.041



Depositional Woody



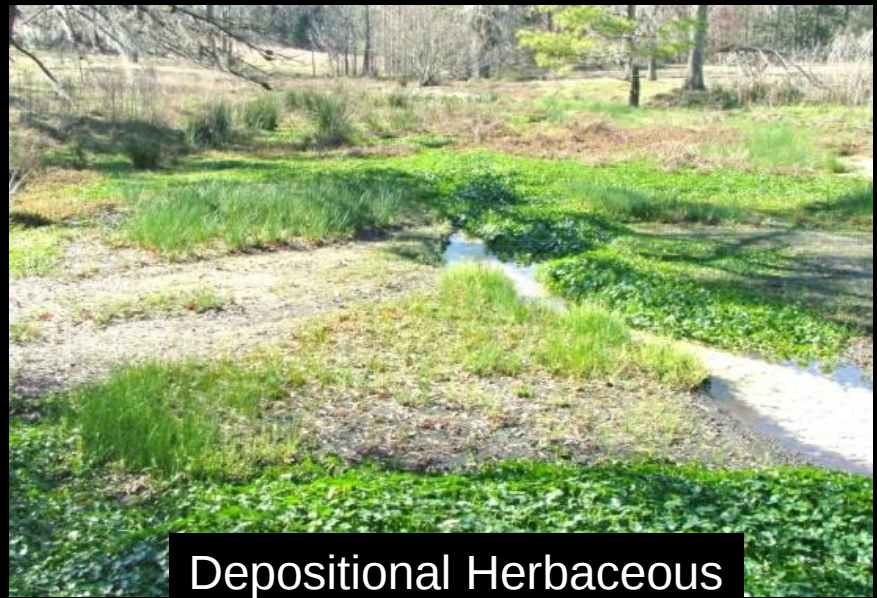
Slightly Incised Woody



Moderately Incised Woody



Deeply Incised Woody



Depositional Herbaceous



Slightly Incised Herbaceous





Santa Fe River
& Floodplain

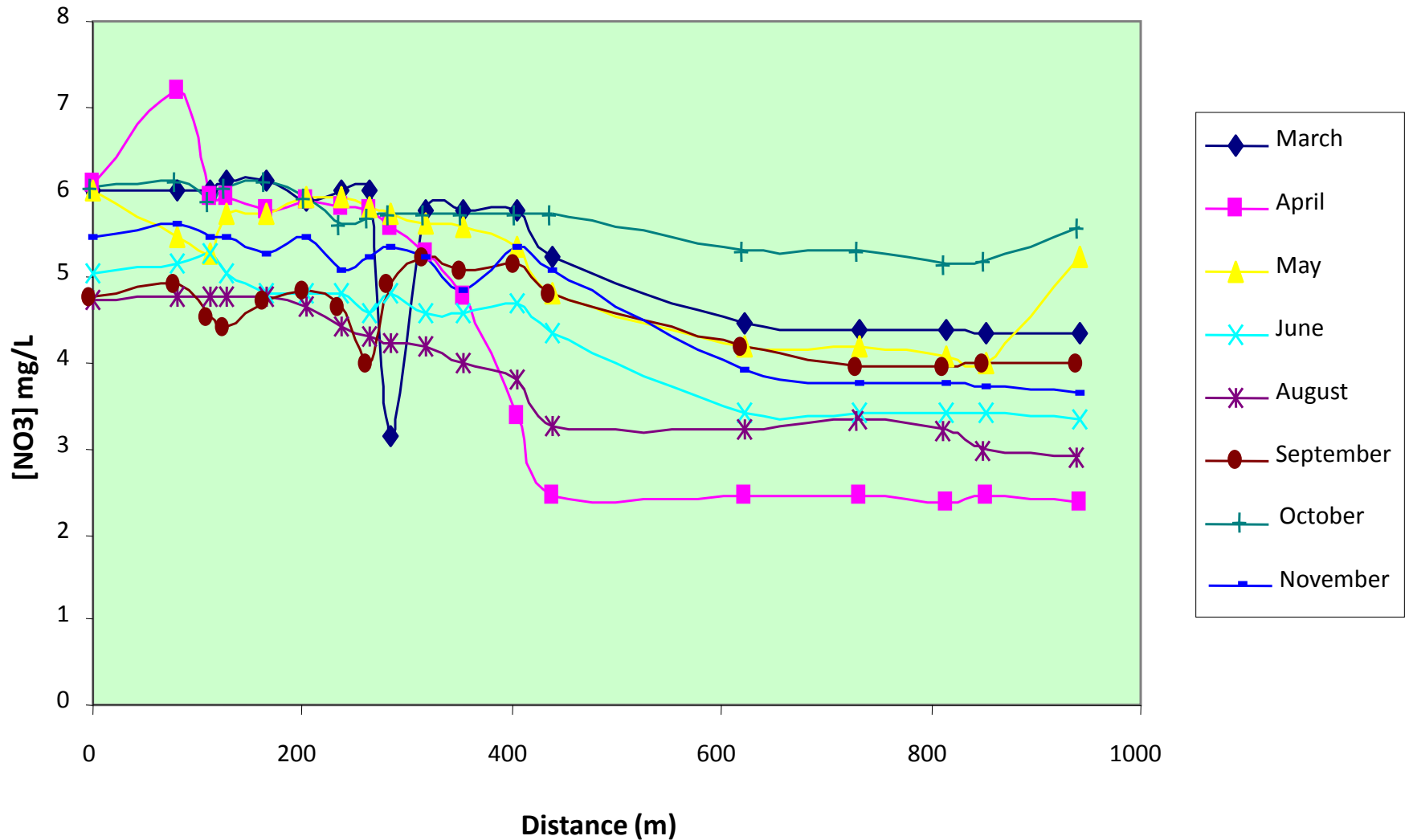
SR 241

Middle Reaches



***What affect does stream reach
characteristics have on nitrate reduction?***

Monthly Nitrate Concentration





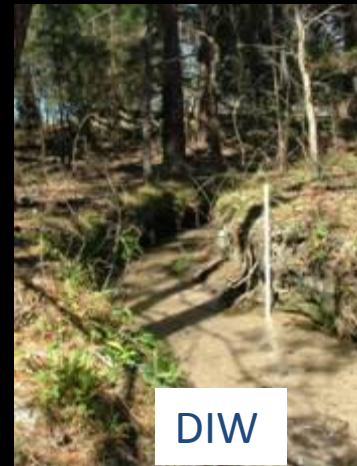
DW



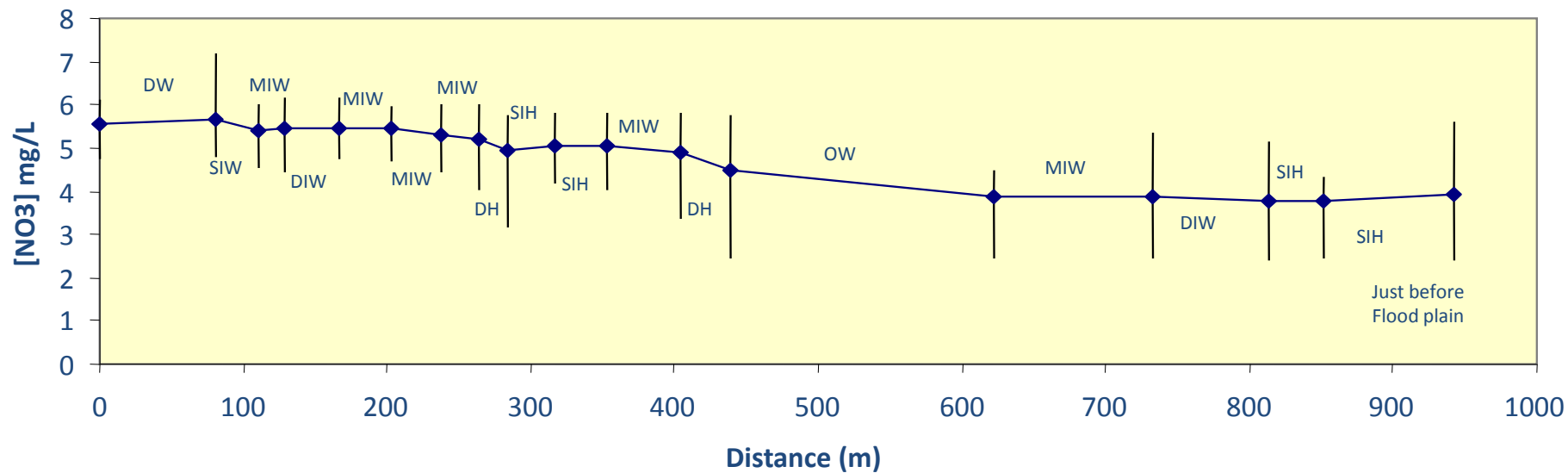
SIW



MIW



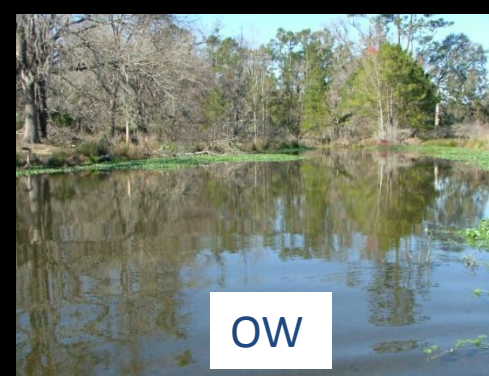
DIW



SIH



DH



OW

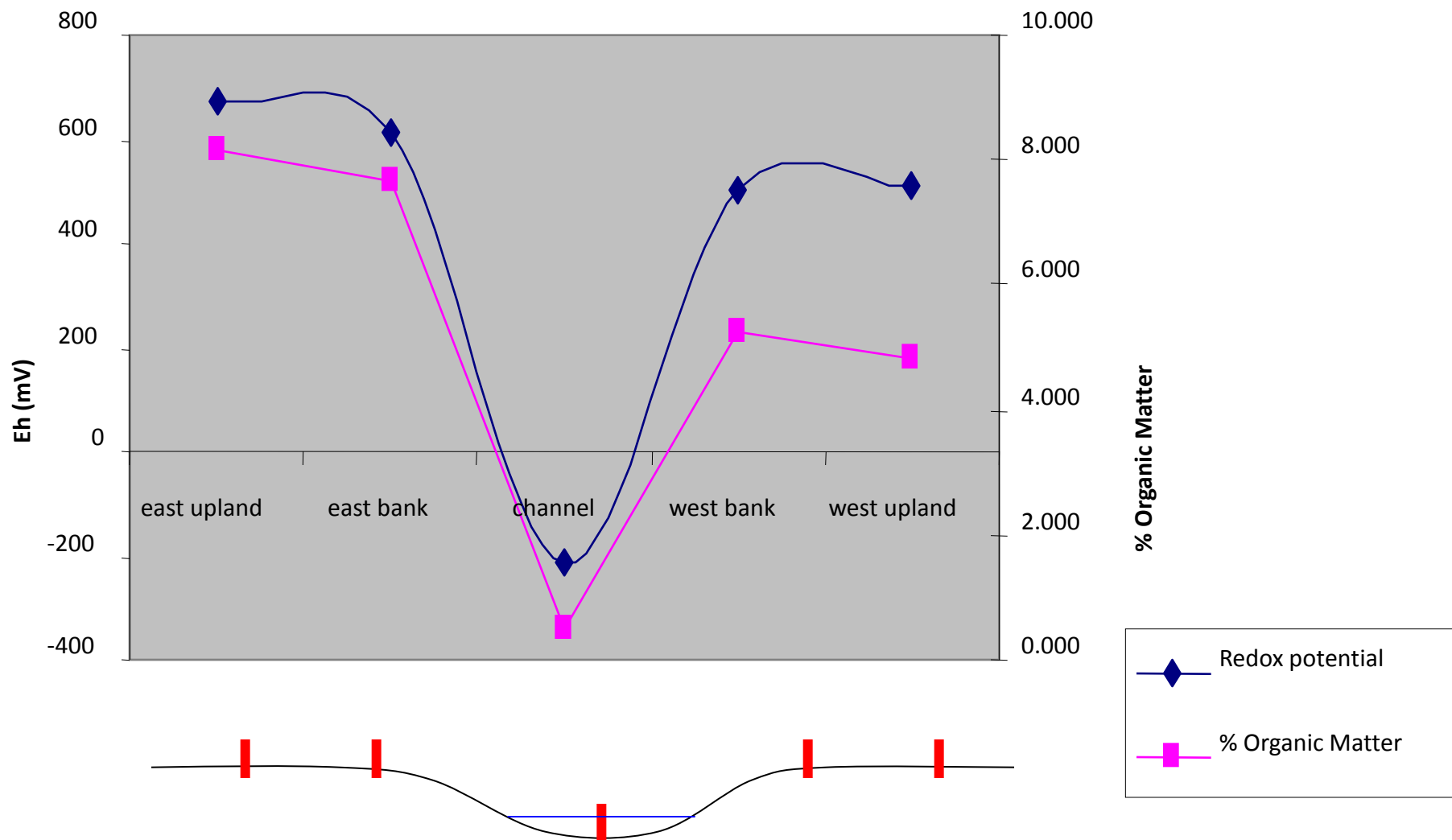
Middle Reaches that Removed the most NO₃⁻

Reach Type	Mean	SD	SL
	% m ⁻¹		
OW	0.27	0.21	a
DH	0.13	0.65	ab
MIH	0.08	0.09	abc
SIW	0.04	0.10	abc
PFP	0.02	0.08	bc
DIH	0.01	0.02	c
FP	0.00	0.14	c
MIW	-0.01	0.36	bc
DIW	-0.04	0.20	bc
SIH	-0.04	0.42	abc

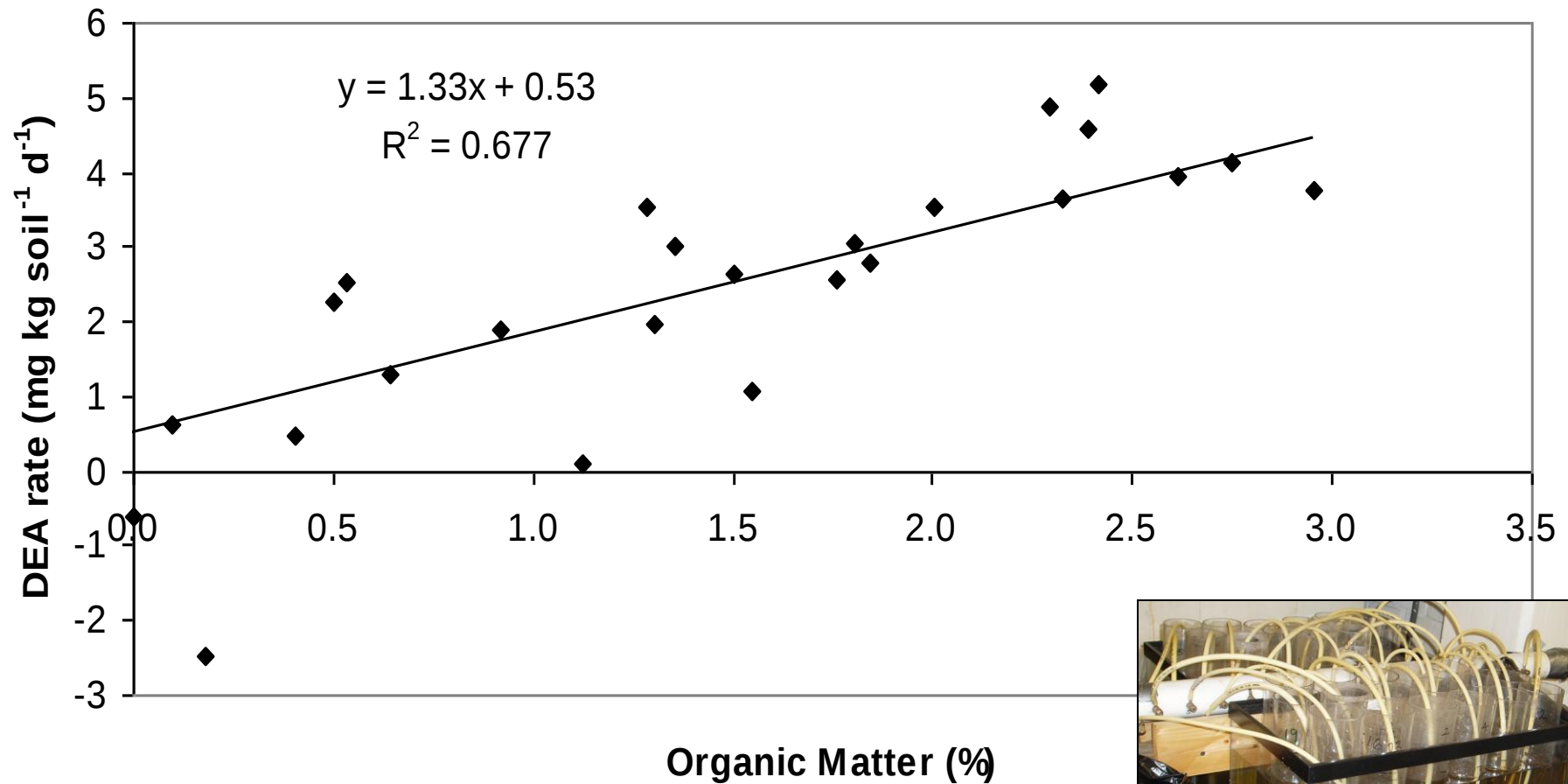


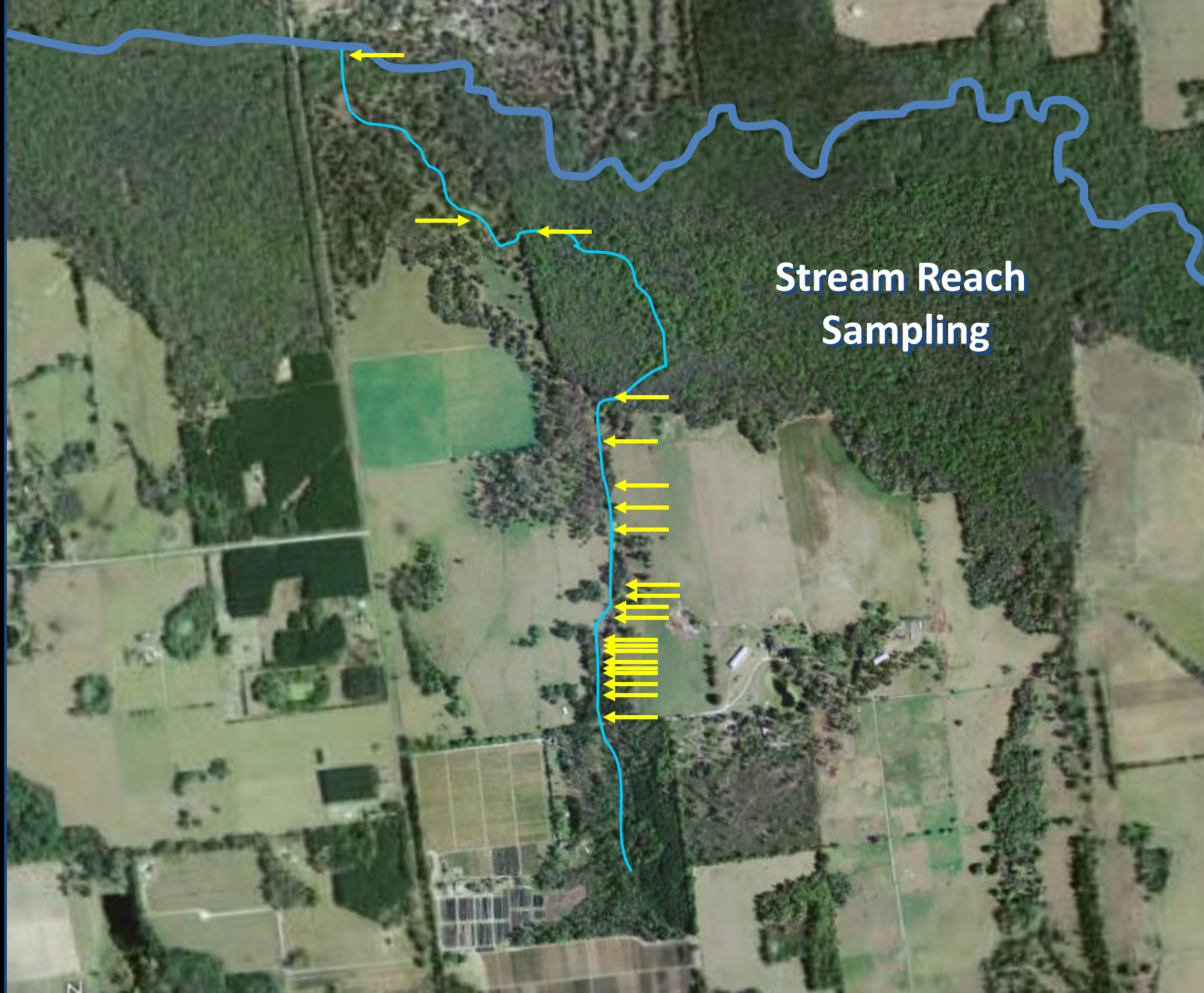
Reach classifications: DW= Depositional Woody, SIW= Slightly Incised Woody, MIW= Moderately Incised Woody, MIH= Moderately Incised Herbaceous, SIH= Slightly Incised Herbaceous, DH= Depositional Herbaceous, OW= Open Water, DIH= Deeply Incised Herbaceous, and FP= Floodplain.

Redox and % Organic Matter Content



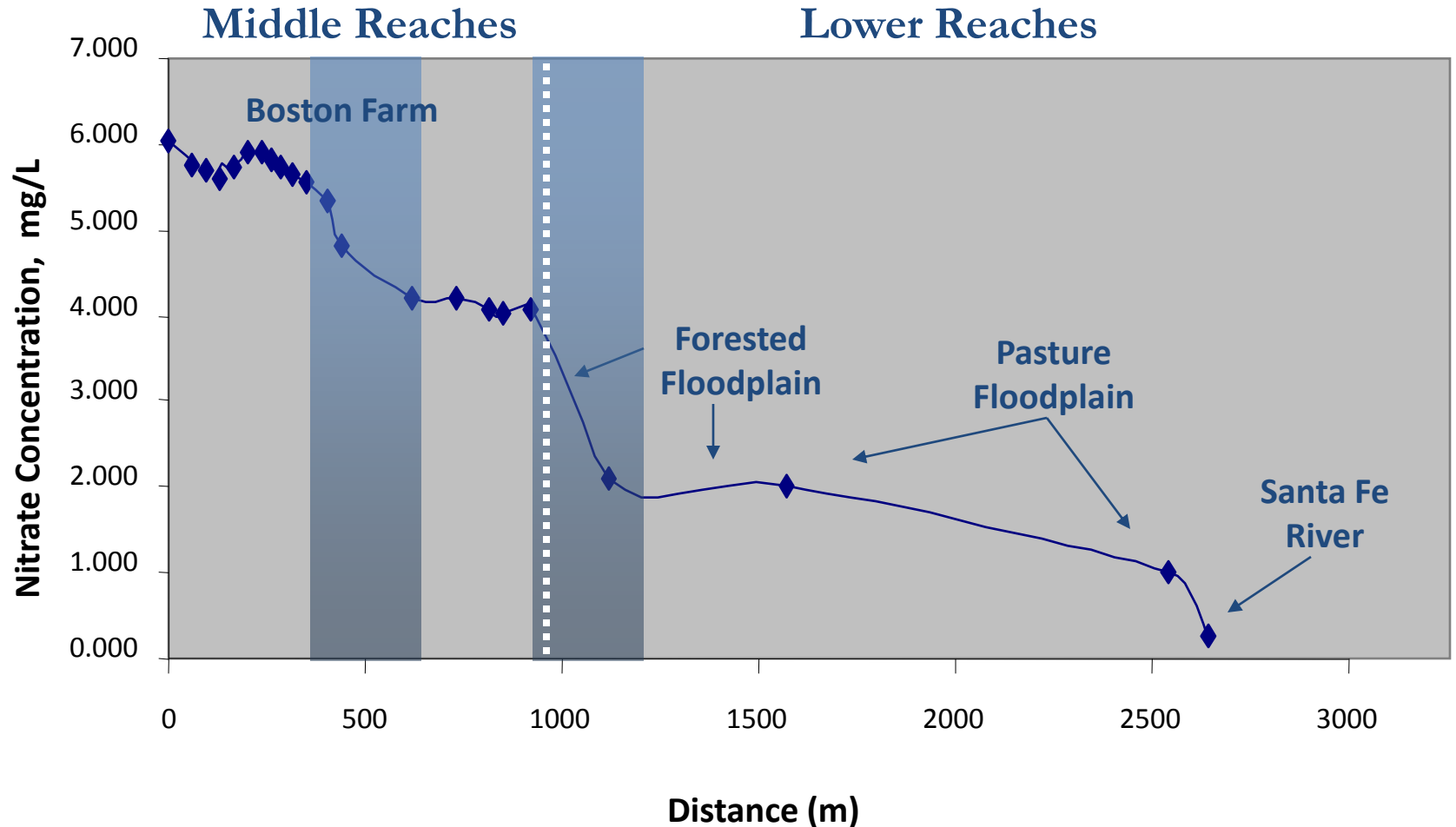
Denitrification Potential vs. Organic Matter Content





**Stream Reach
Sampling**

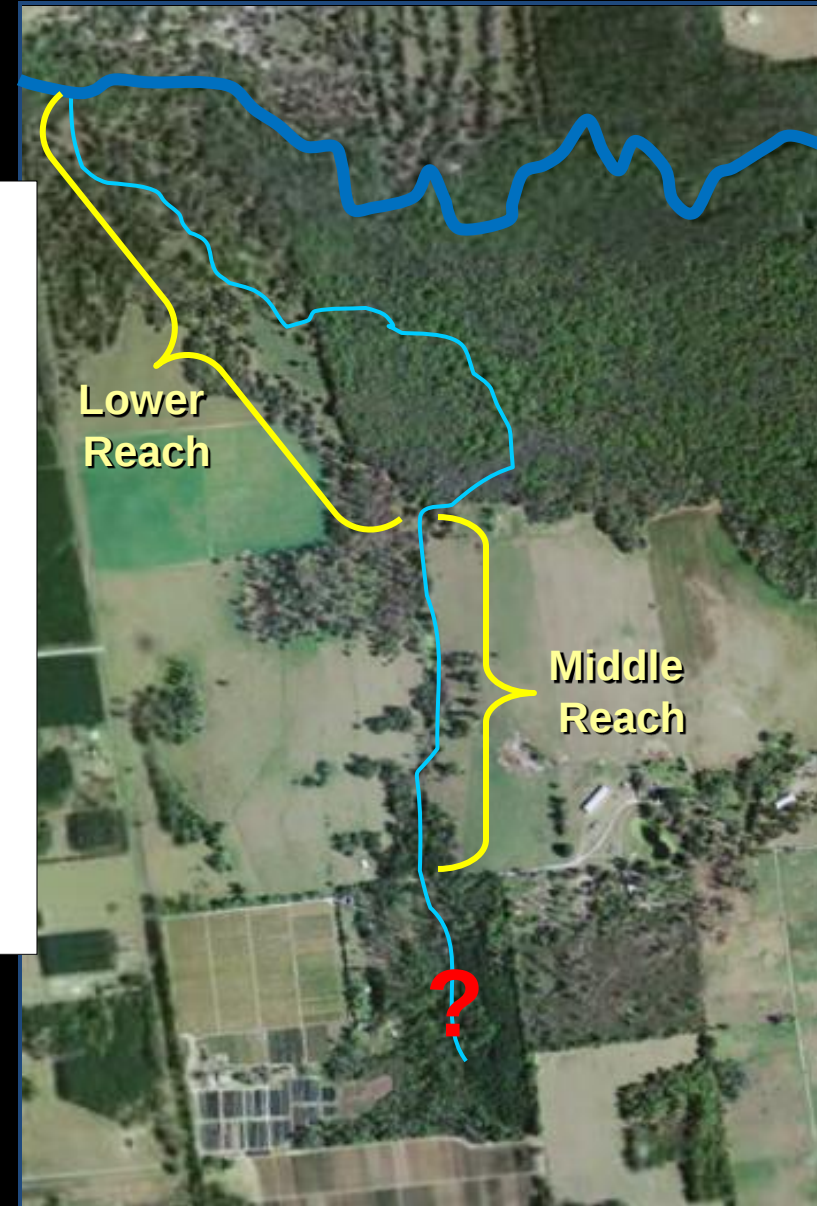
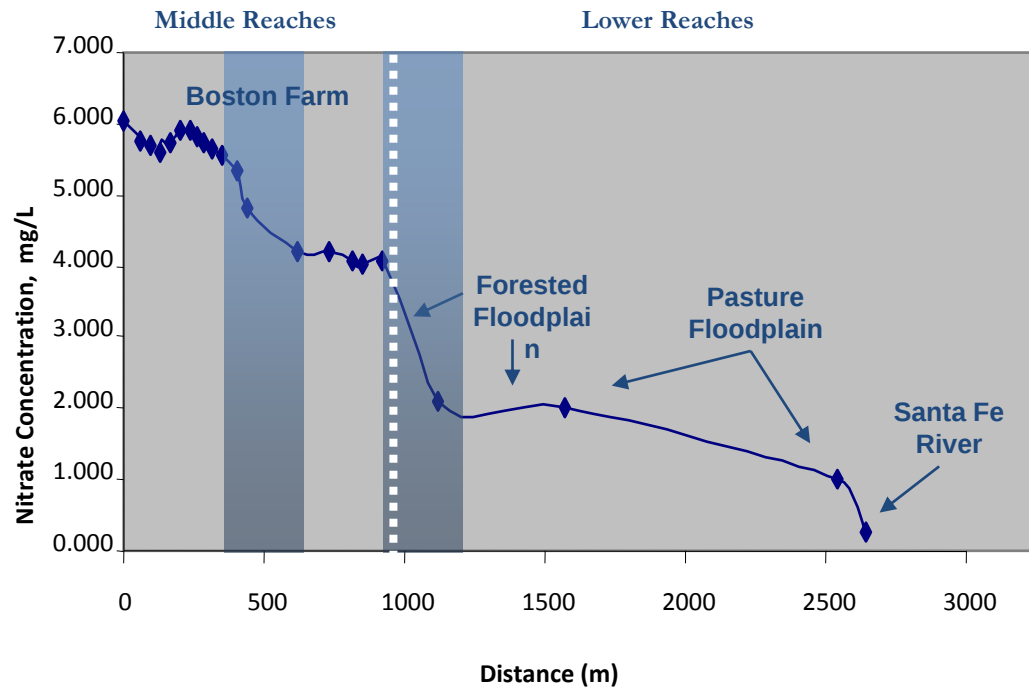
Nitrate Nitrogen Concentration in Middle and Lower Reaches of Tributary 2

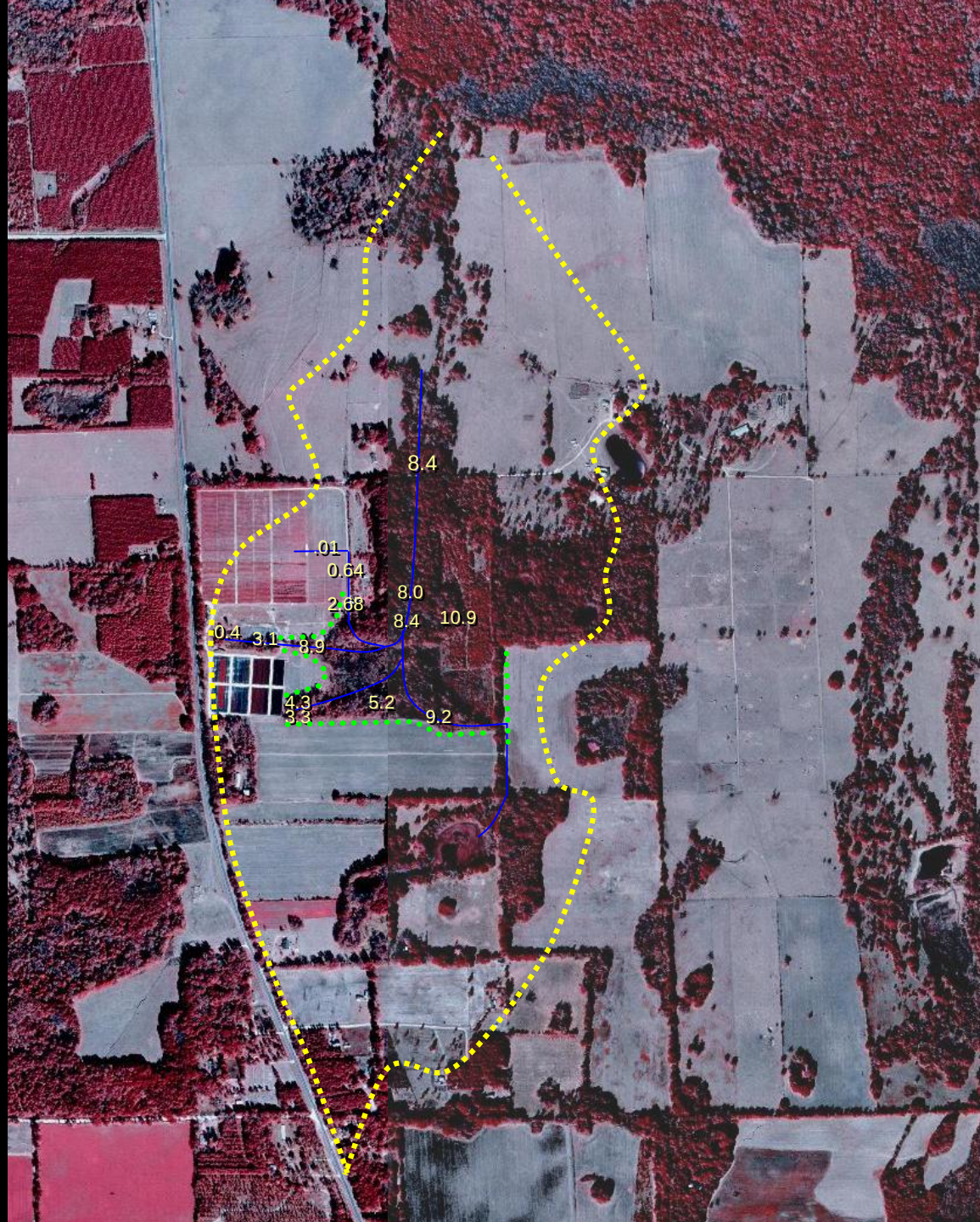






The Rest of the Story





Agricultural BMP's

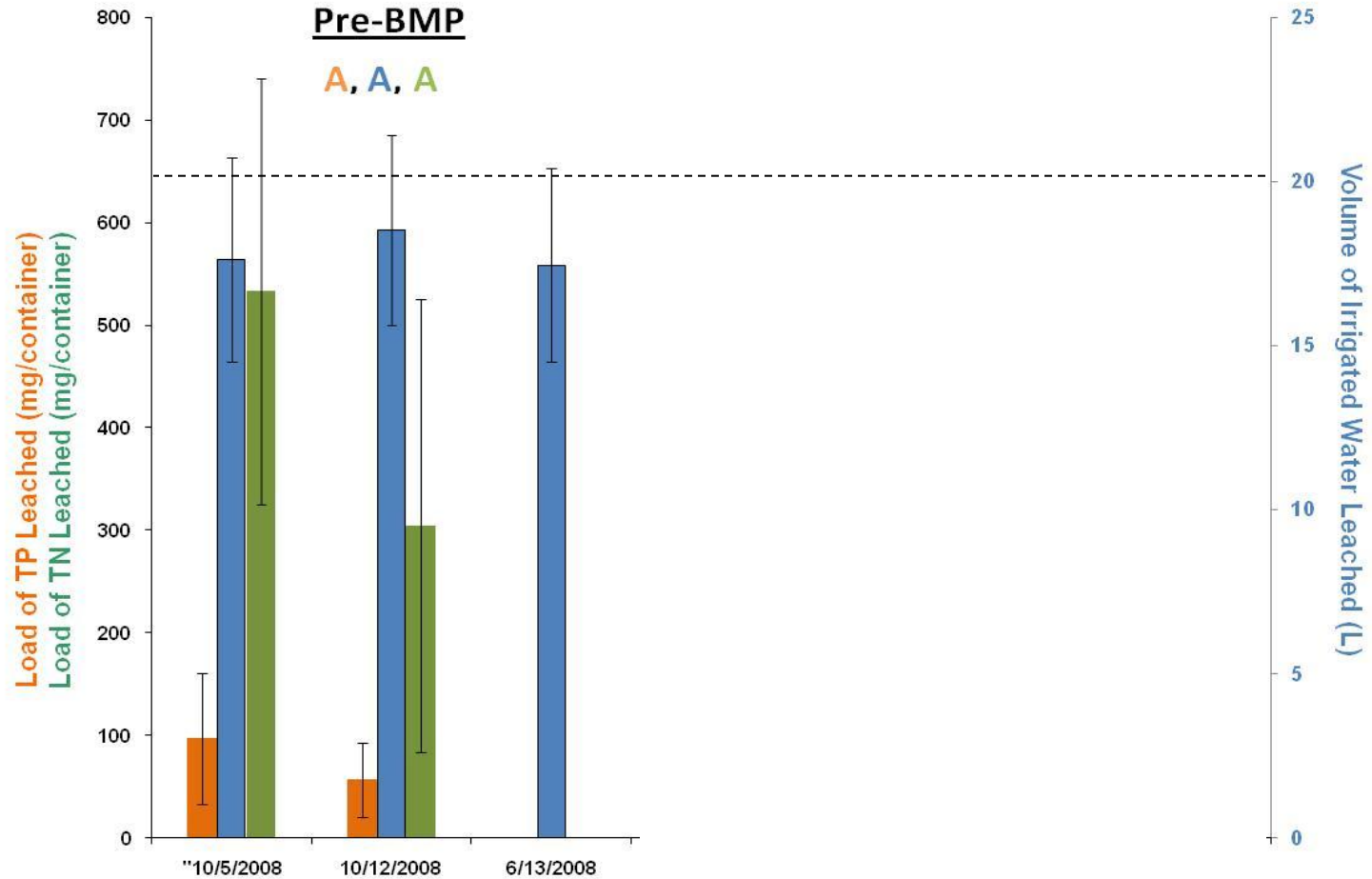
Container Nursery BMP Manual

- By signing Notice of Intent (NOI) and implementing practices, producer is granted a “presumption of compliance” by FDEP
- Presumption of compliance does not guarantee water quality standards are going to be met.
- Limited information on efficacy of practices



“If you can control the water, you
can control the nutrients!”

Container Leaching Study



Irrigation Volume (L)	20.8	19.7	19.7
Ave. Irrigat. Volume (L)		20.1	
Irrigation Duration (min)	30	30	30
Irrigation Frequency/24 Hr	1	1	1

Container Leaching Study



- Daily Pre-BMP Leaching = 2,168,400 L (0.573 MGD)
- Daily Pre-BMP Nitrogen Load = 50.3 kg (20.22 ton/yr)

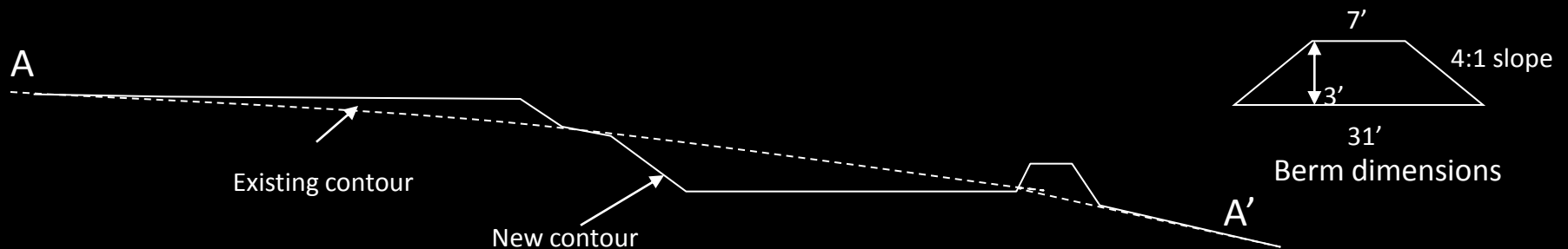
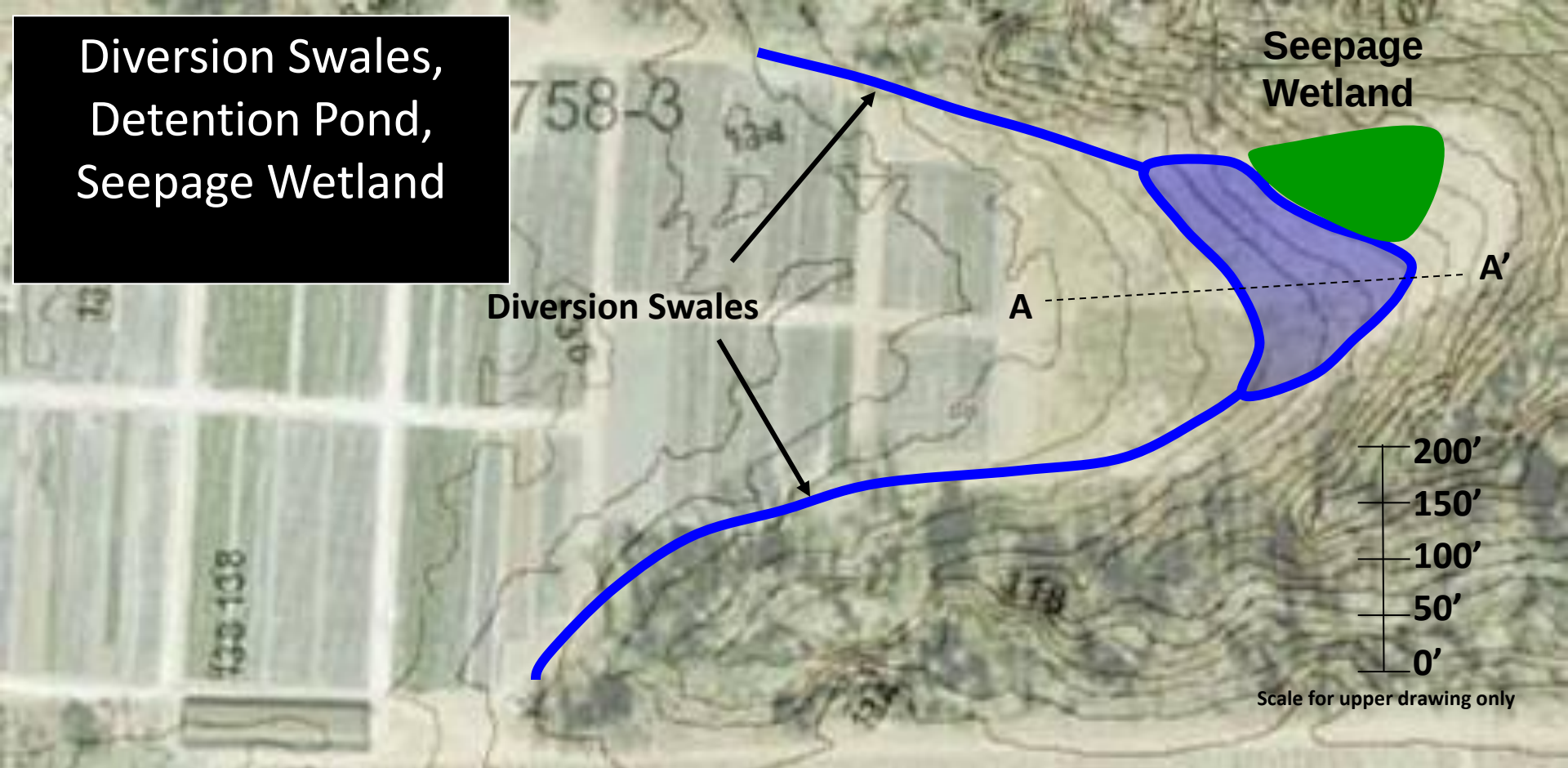


How can we enhance denitrification?



1000'

Diversion Swales, Detention Pond, Seepage Wetland







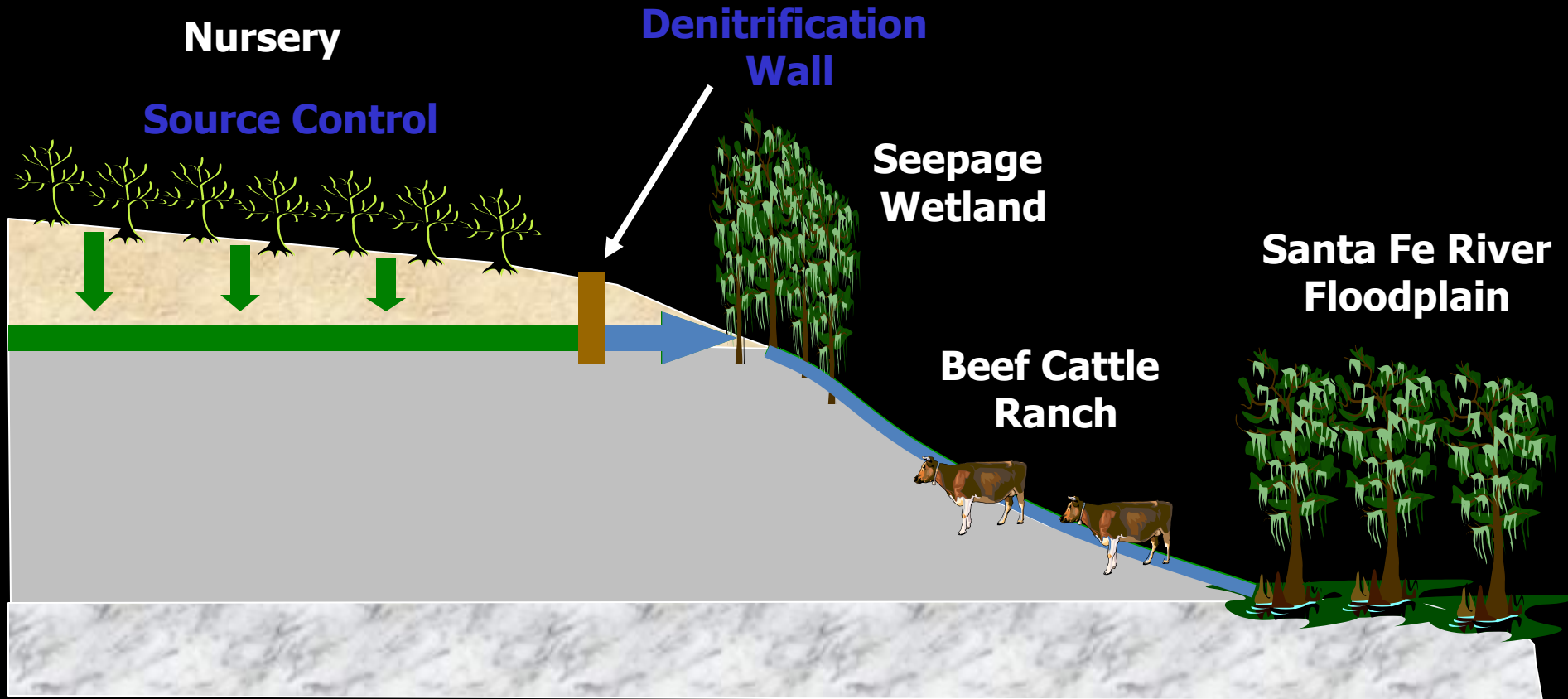








Denitrification Wall

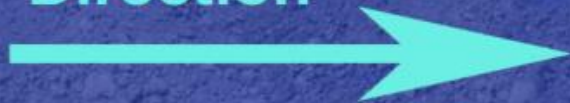




Denitrification Wall



**Groundwater Flow
Direction**



High Nitrate



Low Nitrate

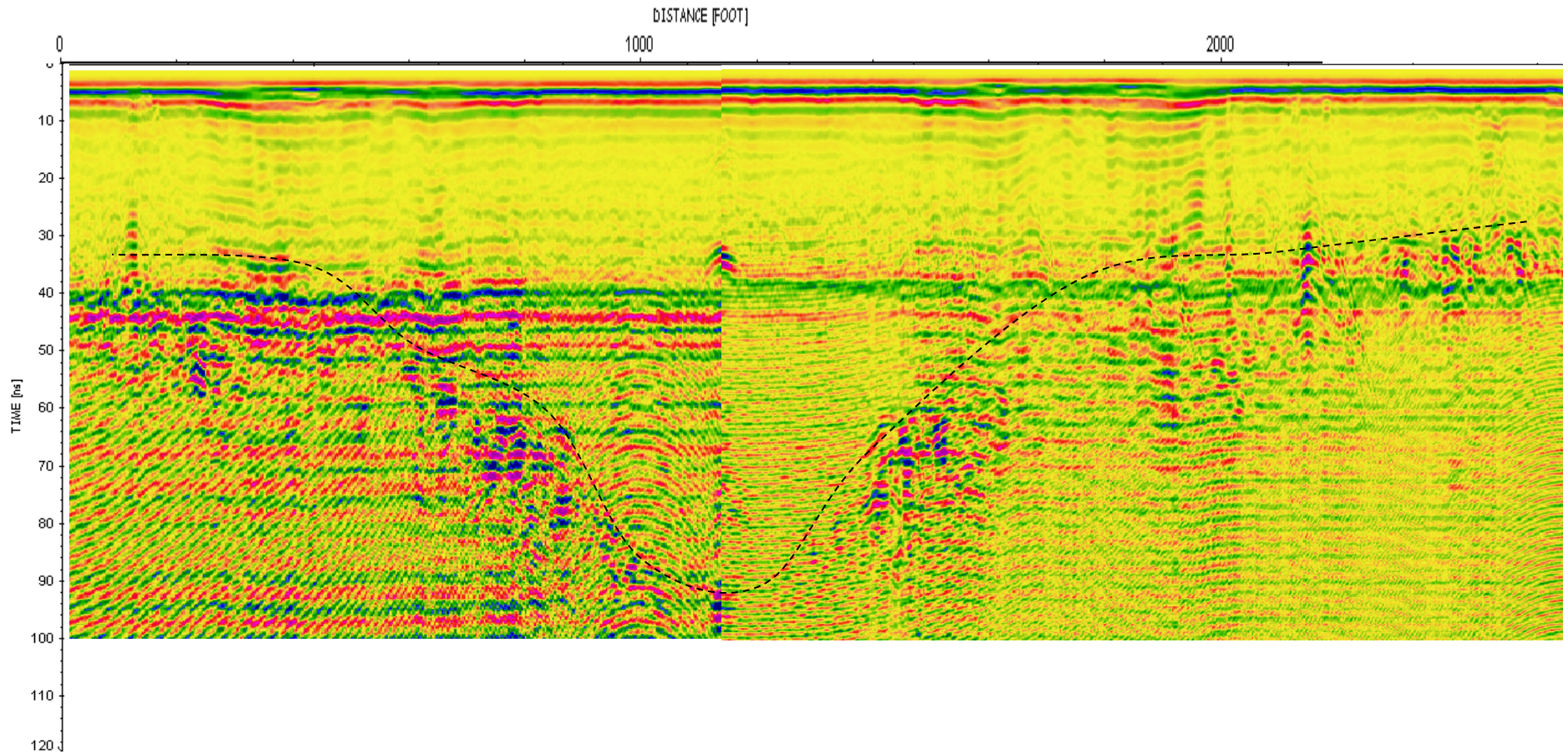
Clay Aquitard



Holly Factory Nursery

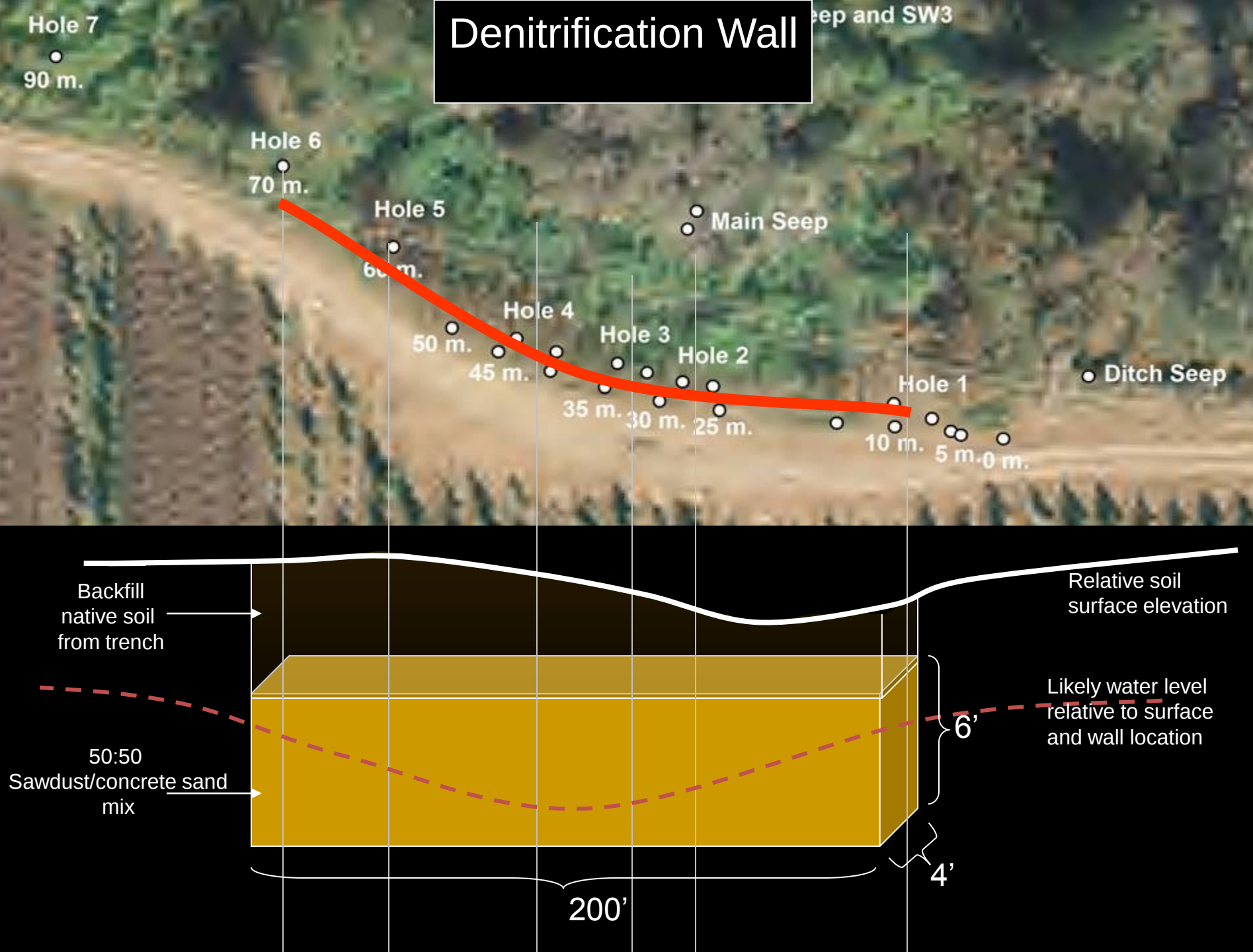
July 24, 2008

File 4074



Going east to west ,
500 MHz, DE @ 12, range 120 ns

Denitrification Wall



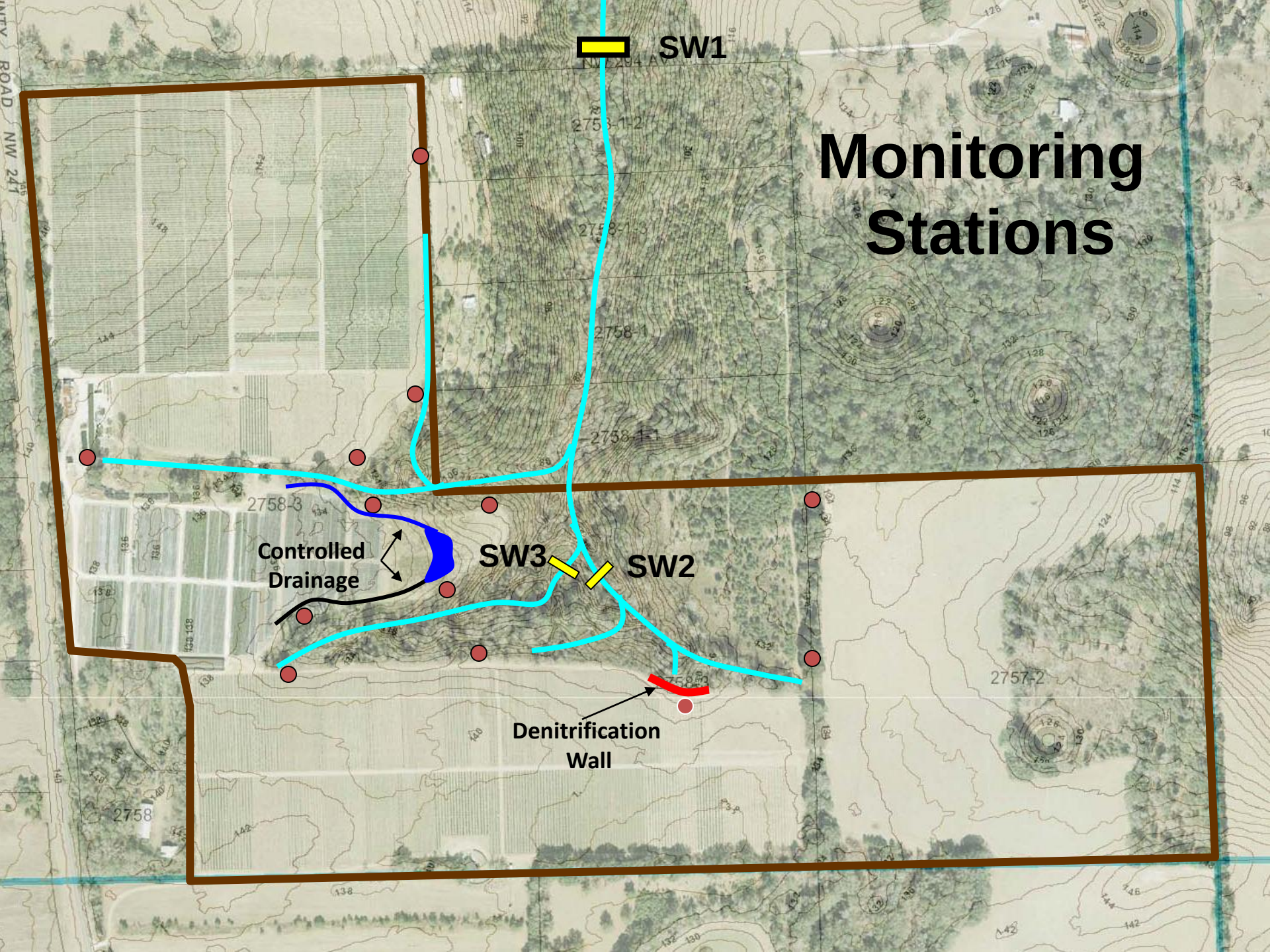












Monitoring Stations

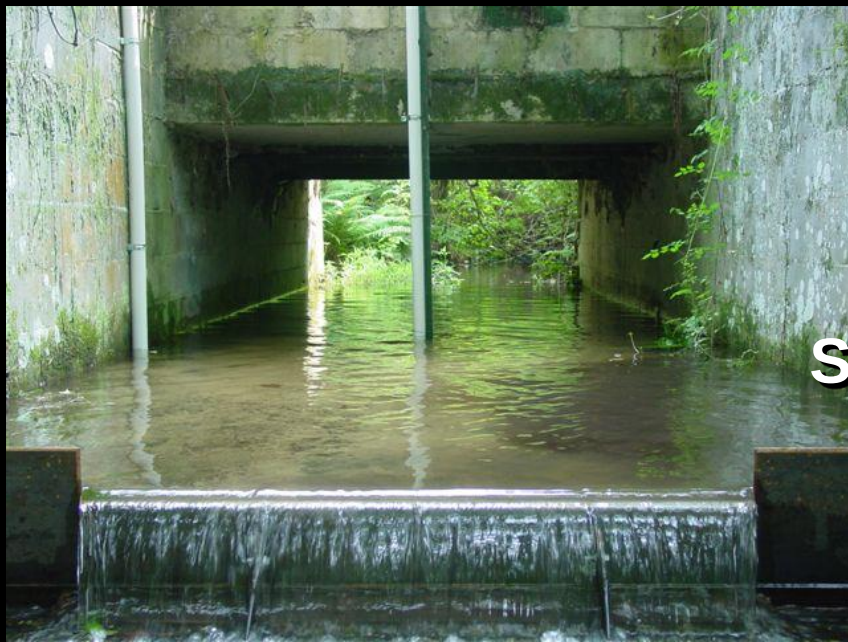
SW1

SW3

SW2

Controlled
Drainage

Denitrification
Wall



SW1

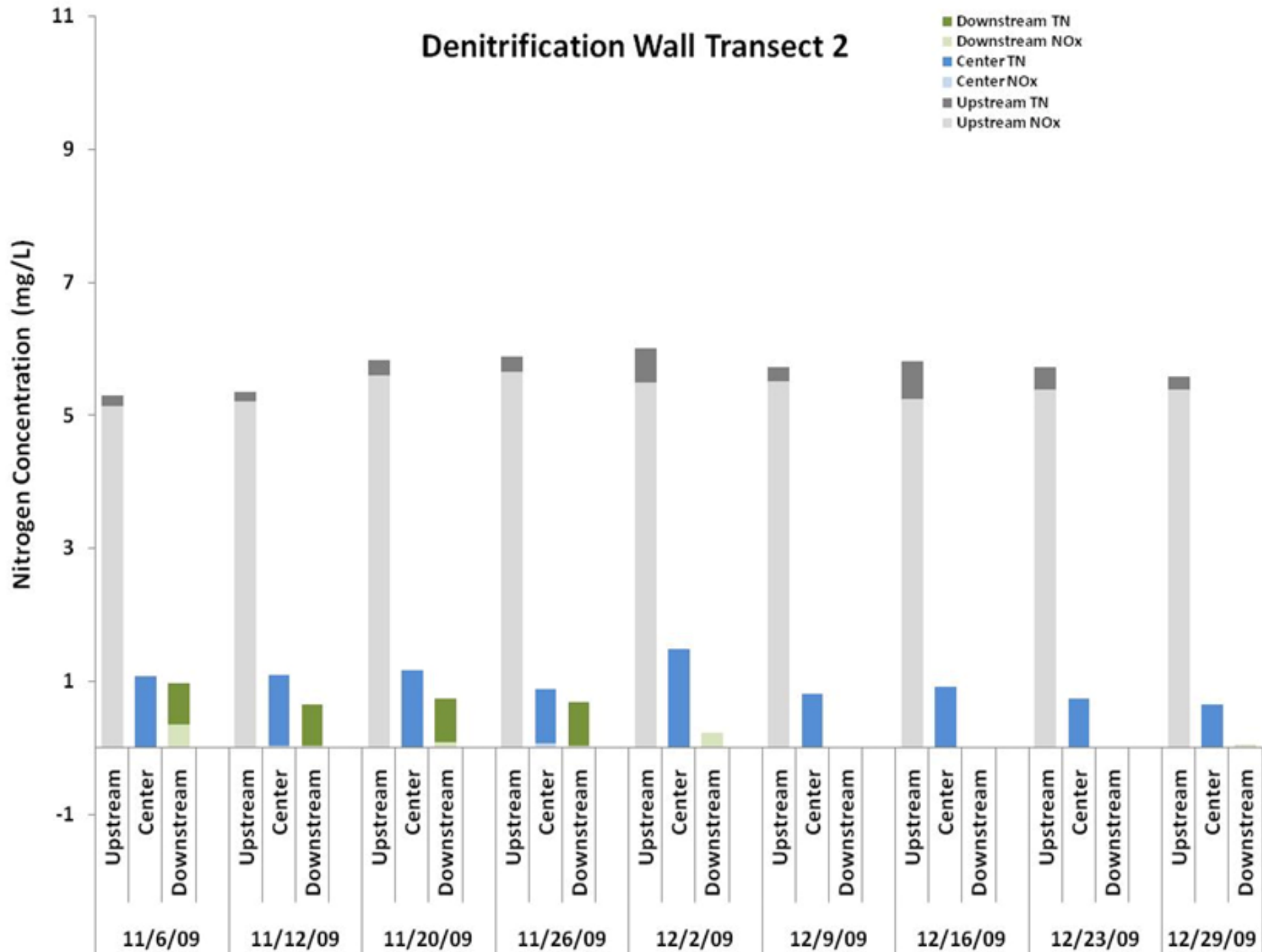


SW3

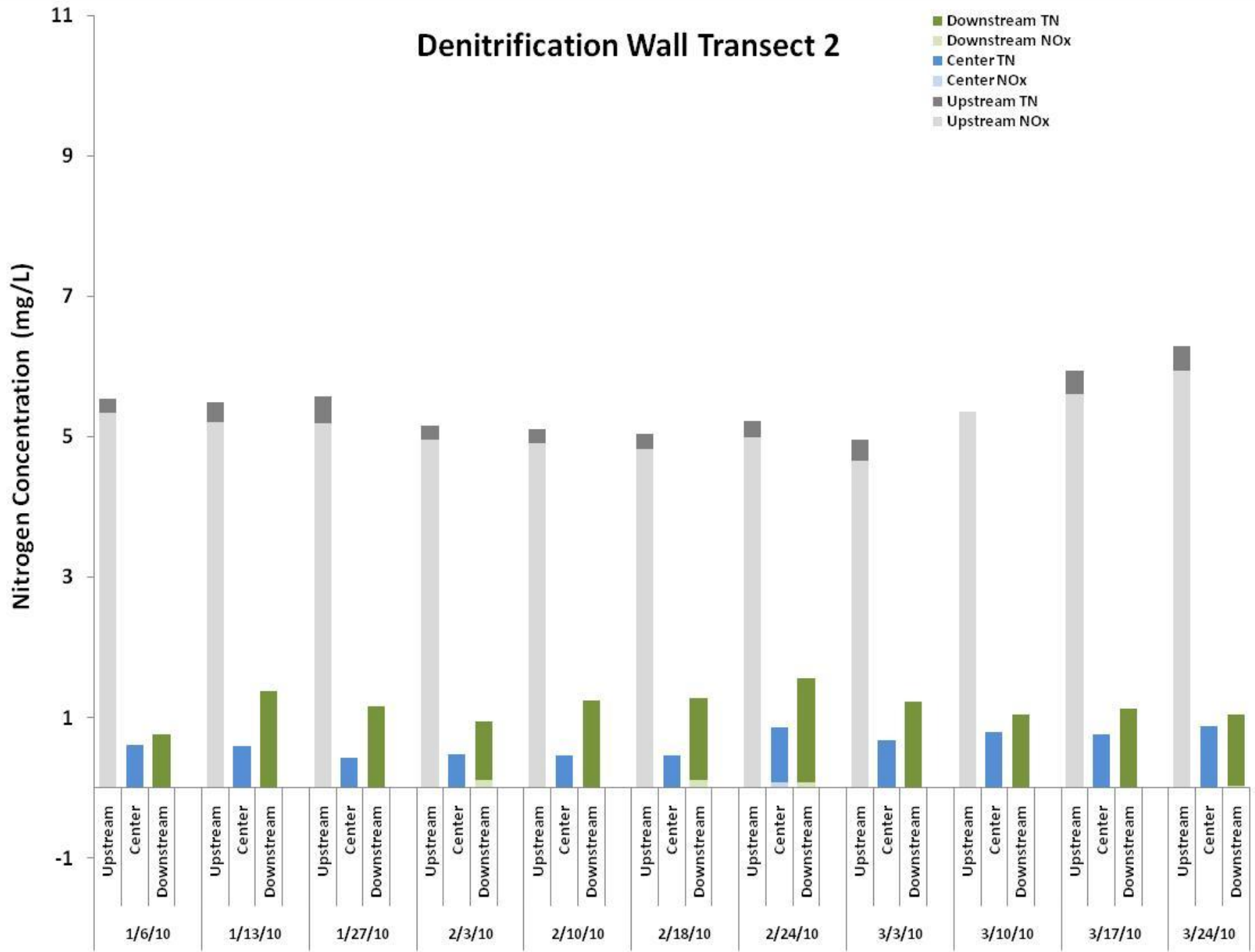


SW2

Denitrification Wall Transect 2

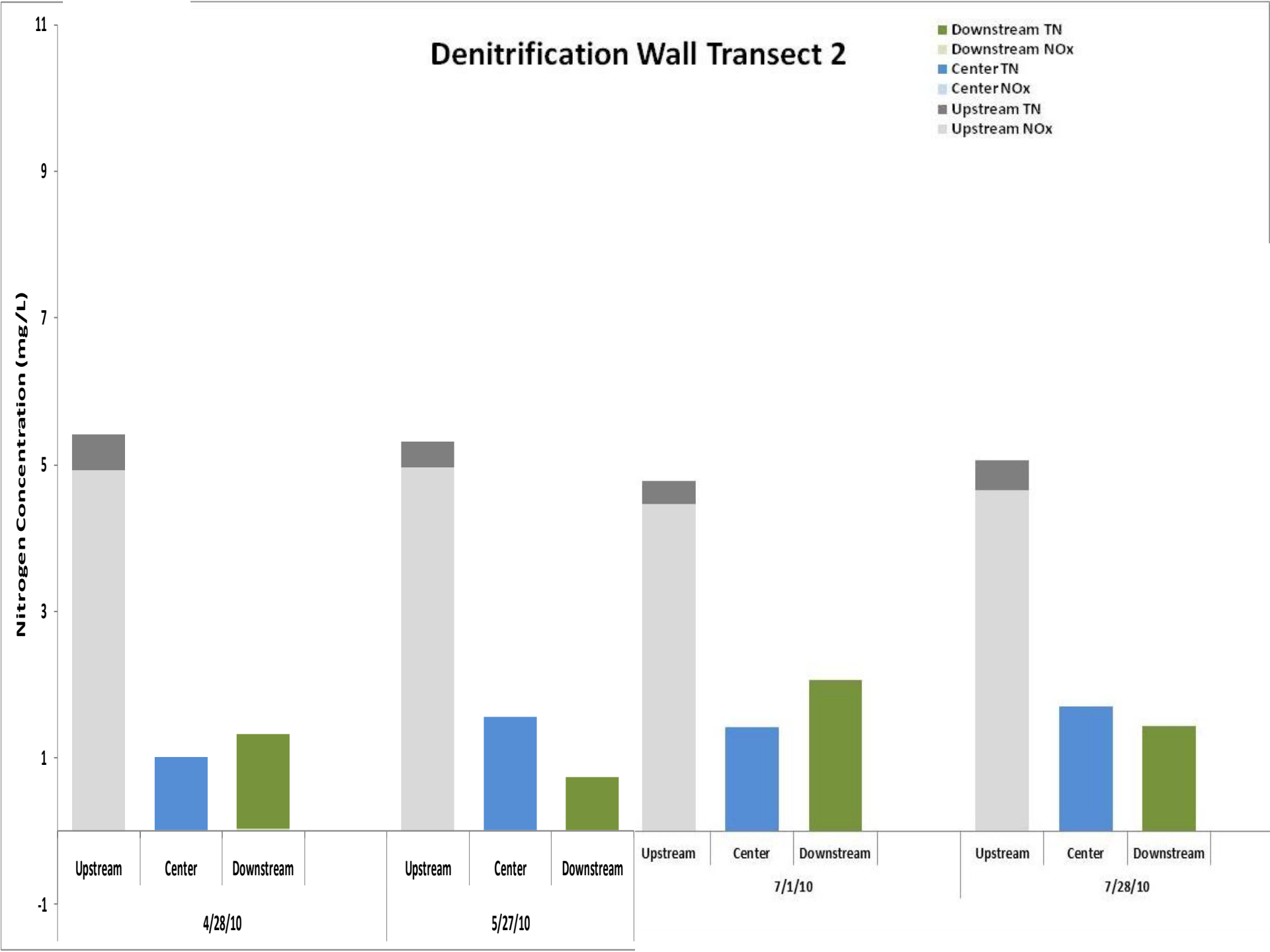


Denitrification Wall Transect 2



Denitrification Wall Transect 2

- Downstream TN
- Downstream NOx
- Center TN
- Center NOx
- Upstream TN
- Upstream NOx



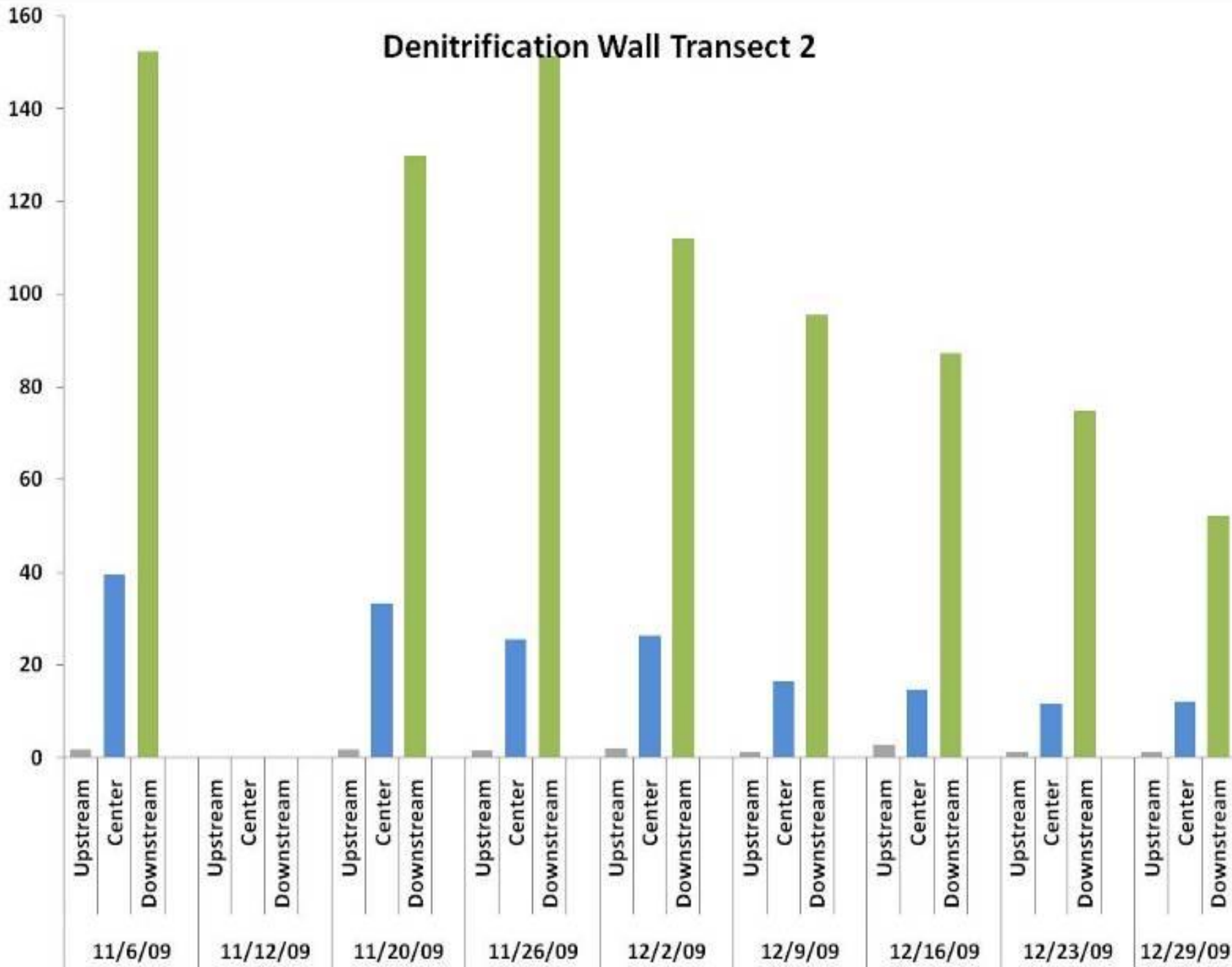


Caution

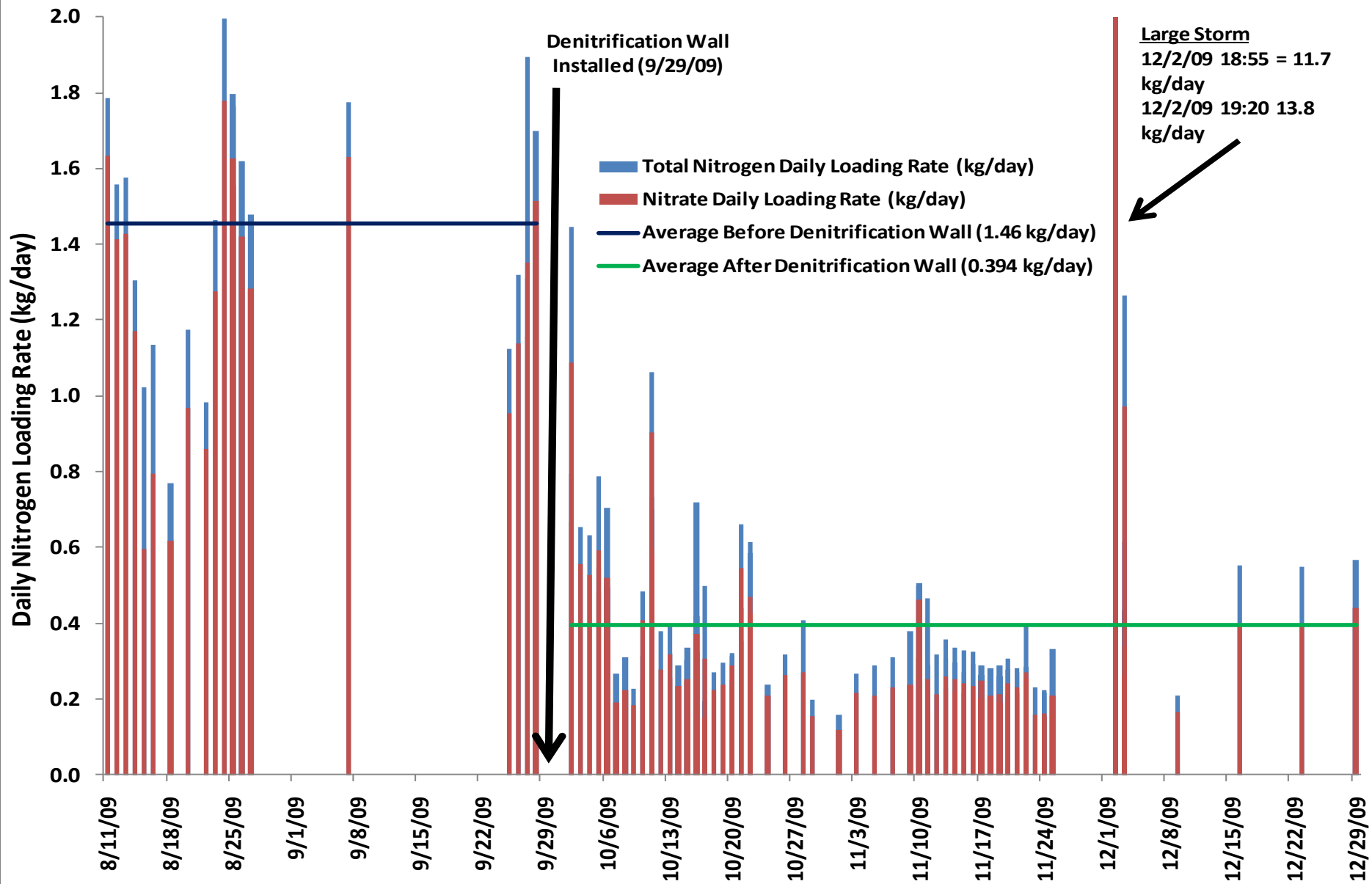


Denitrification Wall Transect 2

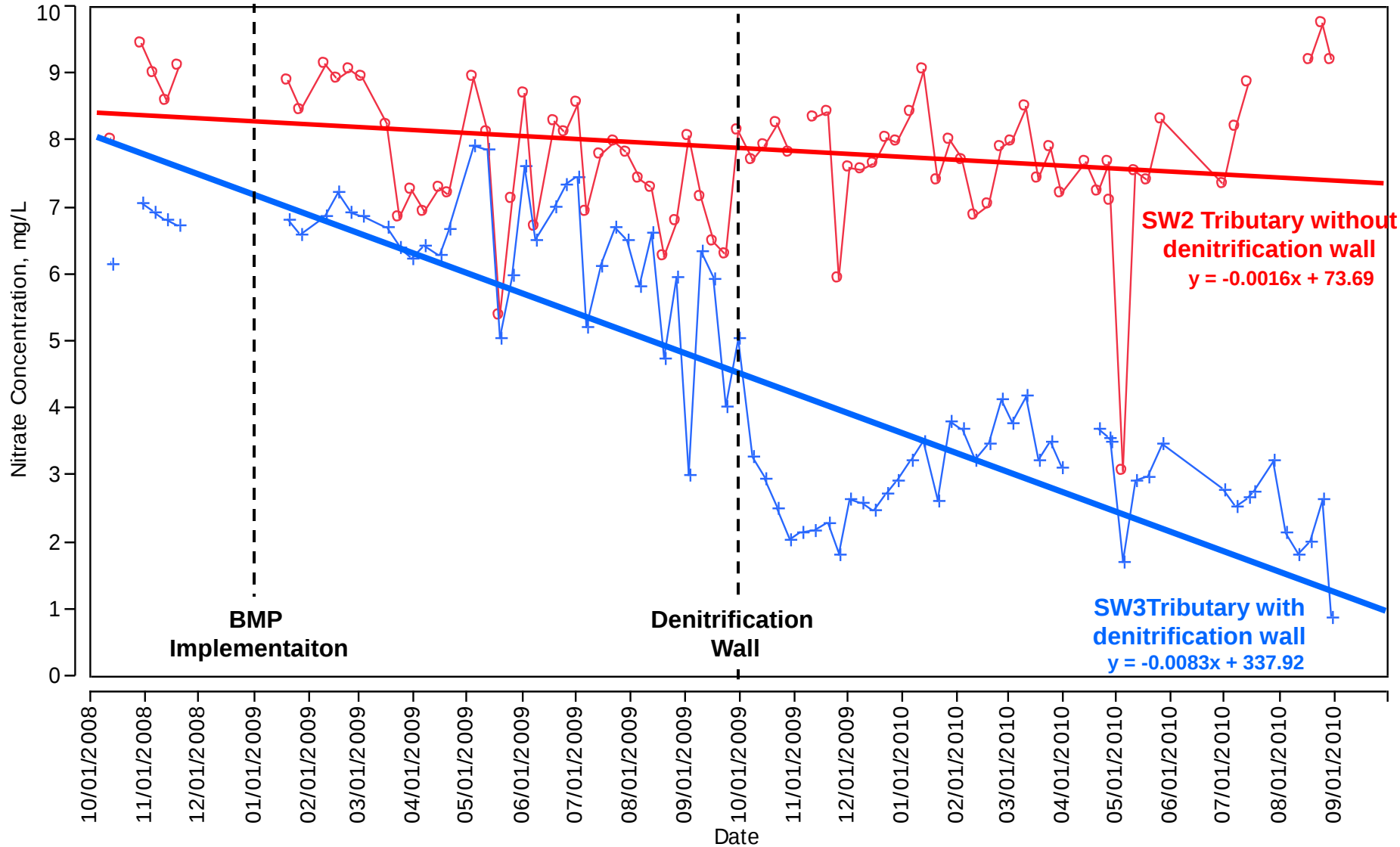
Dissolved Organic Carbon Concentration (mg/L)



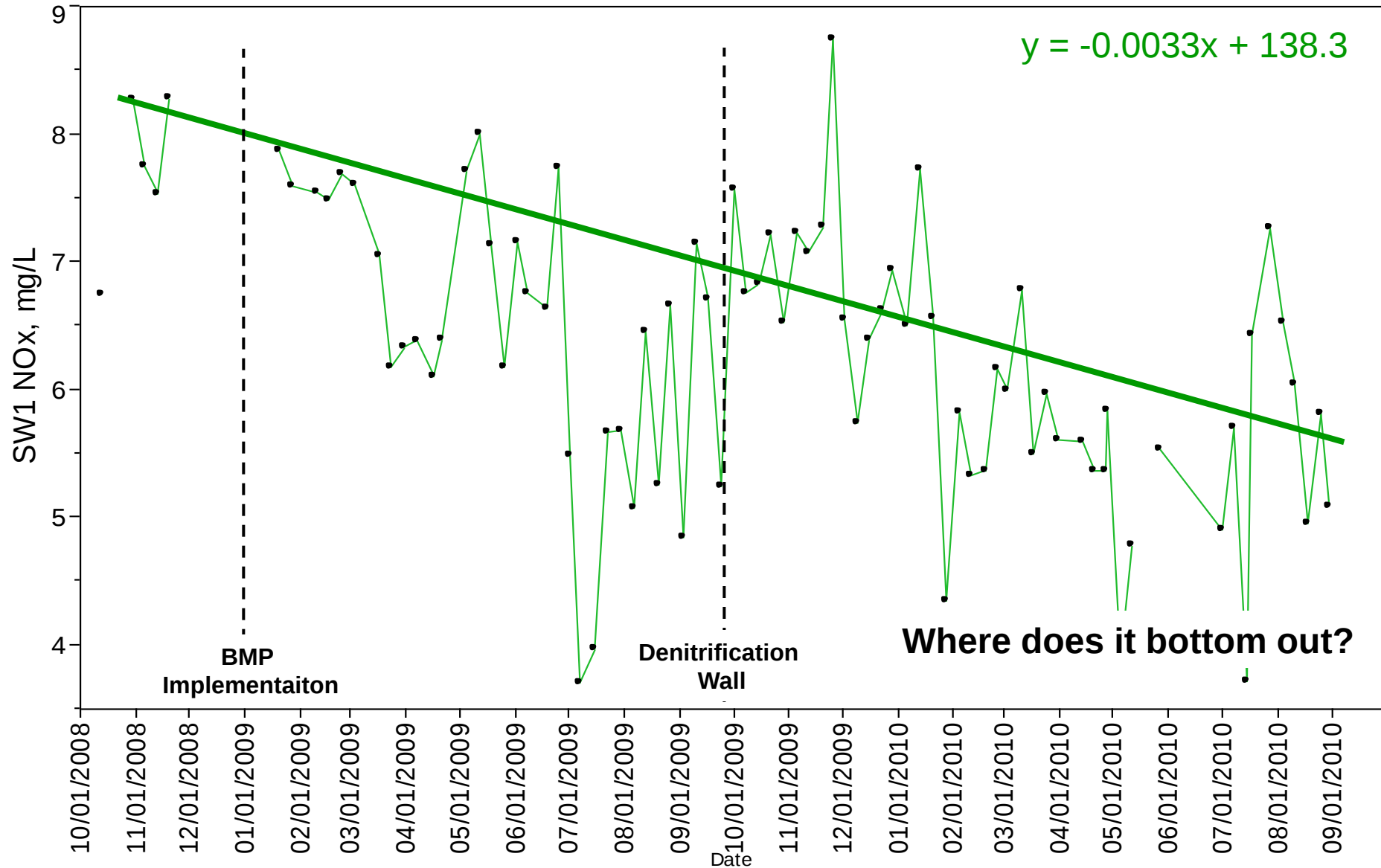
SW3 Nitrogen Loading



Nitrate Concentration at SW2 and SW3



Nitrate Concentration SW1

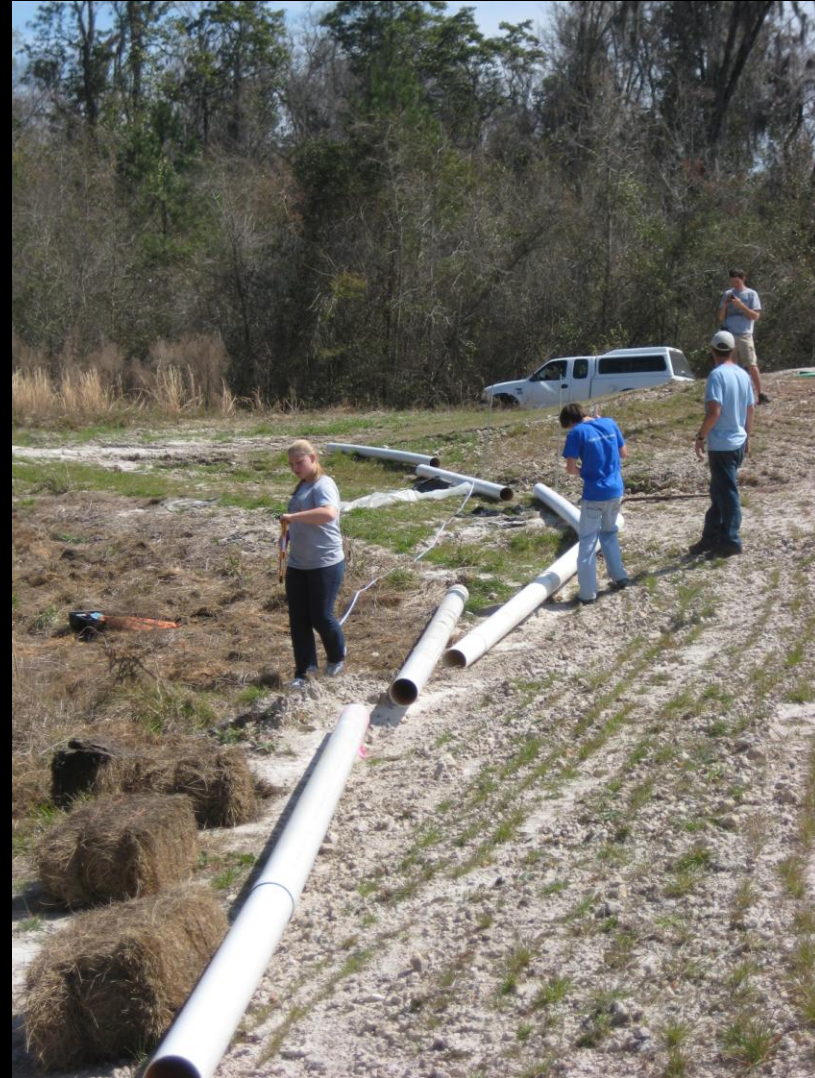


Summary

- Significant nitrate reduction potential in riparian areas with adequate carbon and saturated soils.
- Implementation and optimization of container nursery BMPs can result in significant nitrogen load reductions.
- Additional practices that enhance denitrification can further reduce nitrate nitrogen loads.
- Even with integration of BMP's and enhanced practices it will be very challenging to meet nutrient criteria in upper reaches of streams.

Acknowledgements

- Funding
 - FDEP/USEPA 319 Grant
- Cooperators
 - Holly Factory – Todd Stevens
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 - Adrienne Frisbee (MS)
- OPS
 - Patrick Moran, Ryan Hood, Ryan Tenbroeck, Daniel Mathews
- Student Interns
 - Laura Clark
 - Ilie Tomlin





Questions?

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