

Managing Watershed Nitrogen at the Local Level: Accounting for Riparian Nitrogen Sinks

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riaes

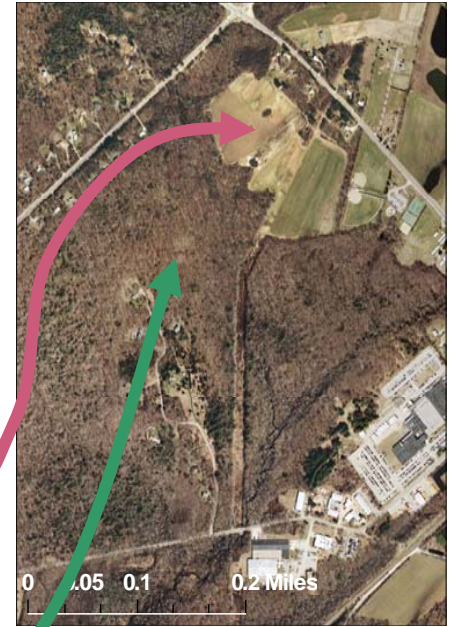
RI Agricultural Experiment Station



Question/Challenges

Can we use our riparian zone research, spatial data and GIS tools to guide local management of watershed N:

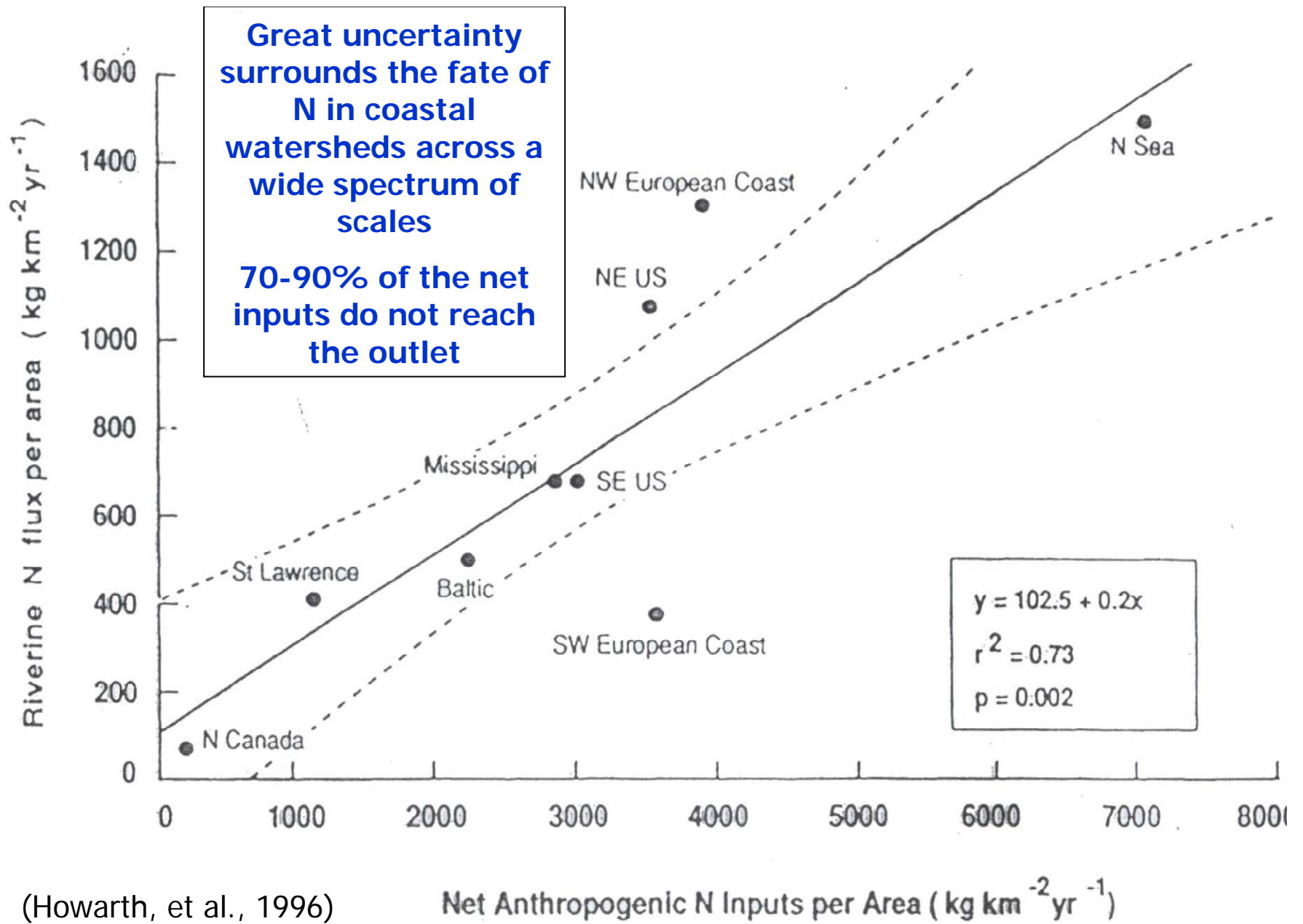
- Where to **target source controls**?
- Where to **focus riparian protection/restoration efforts**?



What landscape features relate to high riparian N removal?

What factors generate uncertainty in our estimates?

Local funding is limited: Can available geospatial data provide guidance for local management?



(Howarth, et al., 1996)

How does watershed N disappear?

Denitrification in watershed sinks accounts for low delivery ratio of N

Seitzinger et al. 2006. Biogeochemistry – Global Estimates



<u>Sink</u>	<u>% Denitrification of Terrestrial N</u>	
	“Best Guess”	Range
Surface Soils	46%	24-65%
Groundwater*	16%	0-51%
Lakes/Reservoirs	11%	7-16%
Rivers	13%	7-13%

** Includes riparian zones; “denitrification depends on proportion of groundwater in contact with riparian zones”*

How to Classify Riparian N Removal?

Long-standing interest in conceptual approaches

- Pinay and DeCamps. 1988.
- Lowrance et al. 1997
- Vidon and Hill. 2004
- Rassam et al., 2008



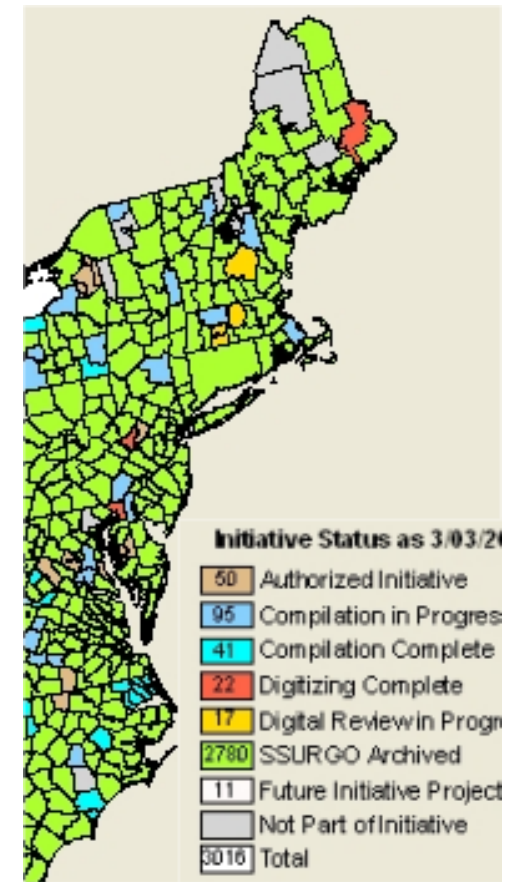
Related Efforts: Buzzards Bay (Howes):

- Local Watershed Mgmt tool assumes 40-60% N removal in all types of lakes and reservoirs – riparian zones ignored

Feedback from Audience: How to incorporate the role of riparian N sinks within comprehensive local watershed management?

Available High Resolution Spatial Data

- Nat'l Wetland Inventory: 1:24,000
- SSURGO County Scale Digital soil surveys: 1:15,840
 - Soil wetness (hydric soils)
 - Geomorphology
- Land use
 - 1995 Anderson Level III (1:24,000)
- Topography & hydrography (1:5,000 to 1:24,000)
 - Flow patterns, watershed boundaries
 - Stream Networks



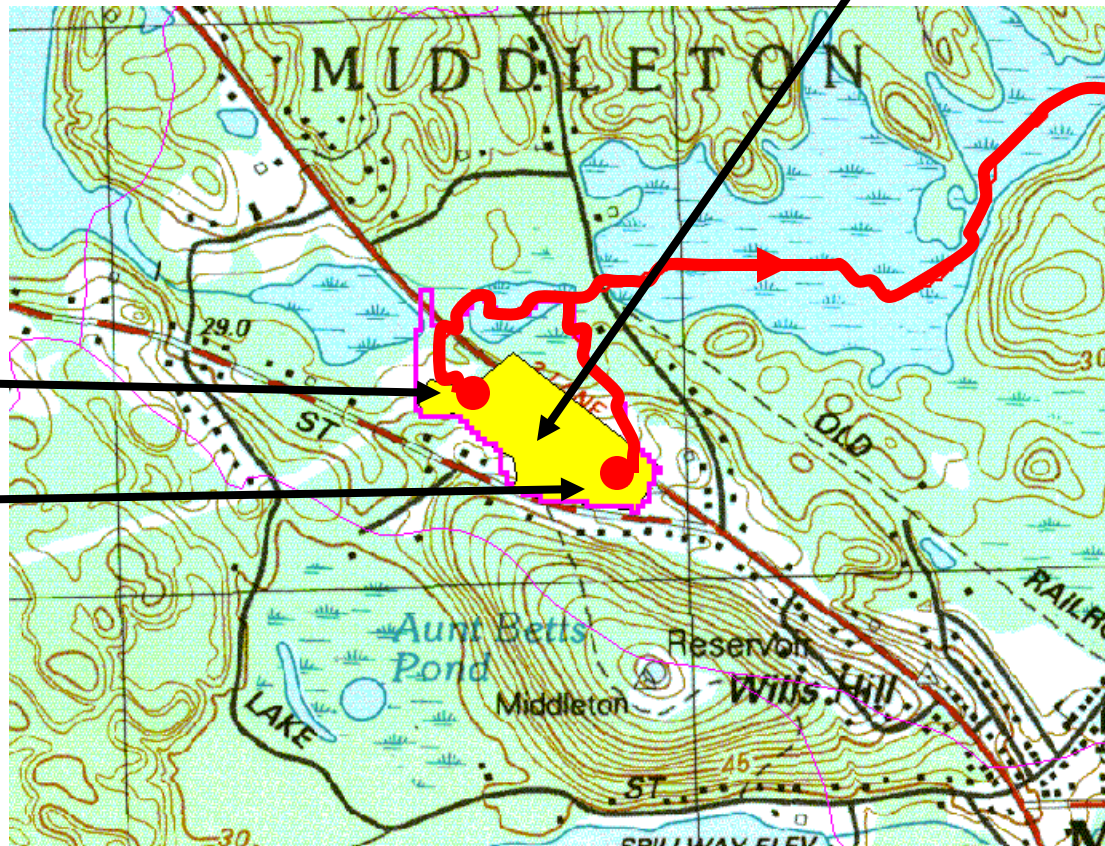
SSURGO
Status:
NE U.S.
March 2007

Recent GIS tools link source areas to riparian zones and other watershed sinks

USGS Watershed Analyst
Analyst
Raindrop Tracker
generates flowpaths
from source areas
(1:24,000 Topography)

Origin of
Raindrops

Agricultural field



Proposed spatial data for classifying riparian N sinks in New England

Removal Factors

- Hydric soil status
- Geomorphology
- Land use/land cover
 - forest, shrubs, hayland = High
 - lawns = Low

Uncertainty Factors

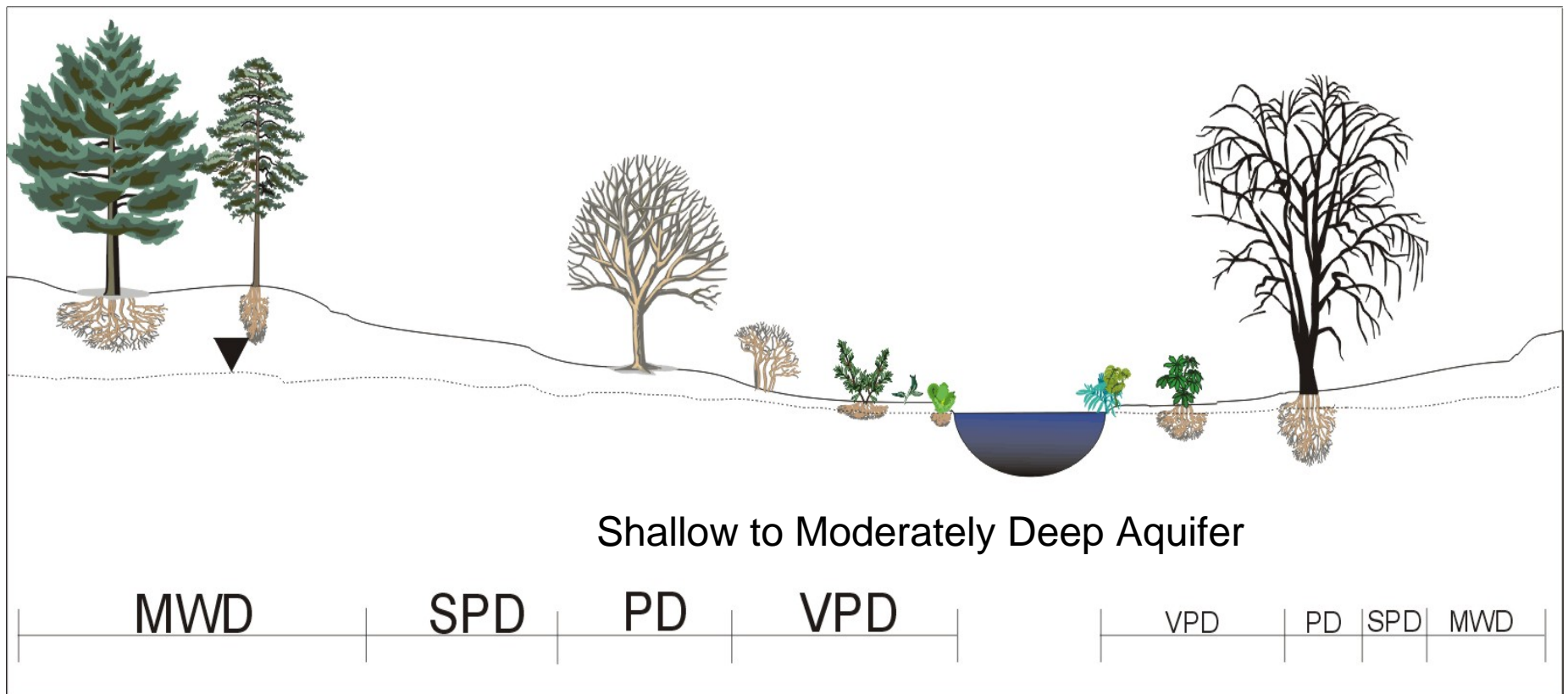
- Source area distance to riparian zone
- Depth of aquifer (from geomorphology and stream order)
- Irregularity of riparian buffer length



High Nitrate Removal Setting

Nitrate removal >50-70% in low order streams w/hydric outwash and alluvial soils

Groundwater denitrification & C deposits found up to 3 m depth near streams

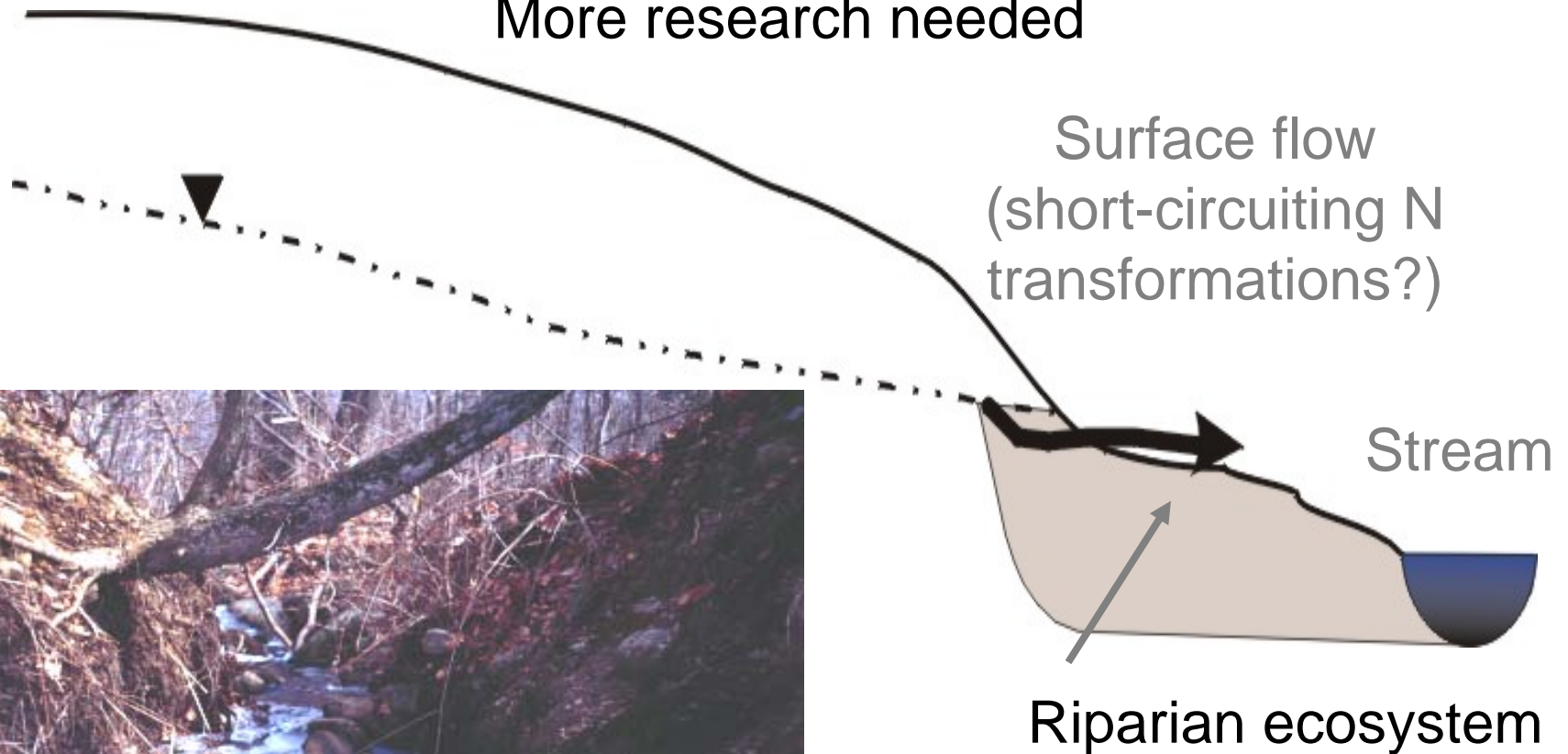


Moderate Nitrate Removal

Hydric Soils with glacial Till (10-30% Removal)

Seeps found at 29/34 hydric till sites

More research needed

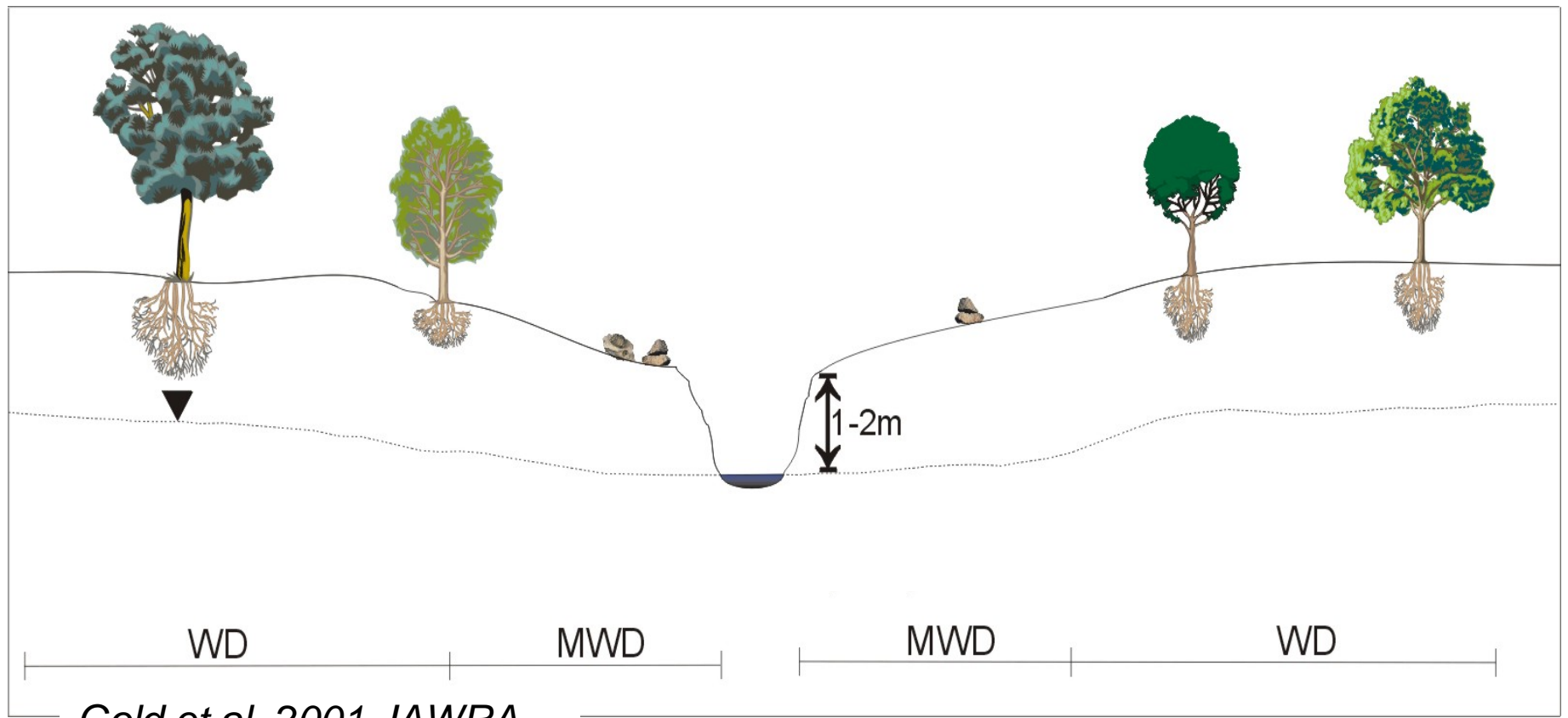


Rosenblatt et al., 2001; JEQ

Negligible Nitrate Removal Setting

Incised Stream Channels and No Hydric Soils

Nitrate removal <5%



Gold et al. 2001 JAWRA.

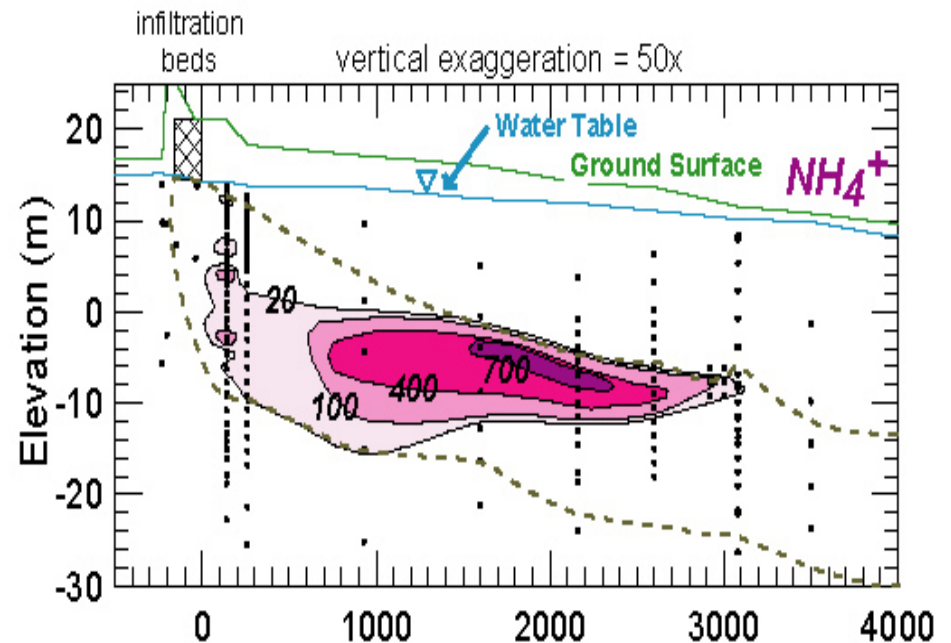
Uncertainties linking N sources to riparian zones: Aquifer depth and distance

Assume *HIGH*
uncertainty if:

- *aquifer depth > 5 m*
(Outwash on higher order stream)

AND

- *N source is > 200 m away?*



Source: Bohlke et al. 2006

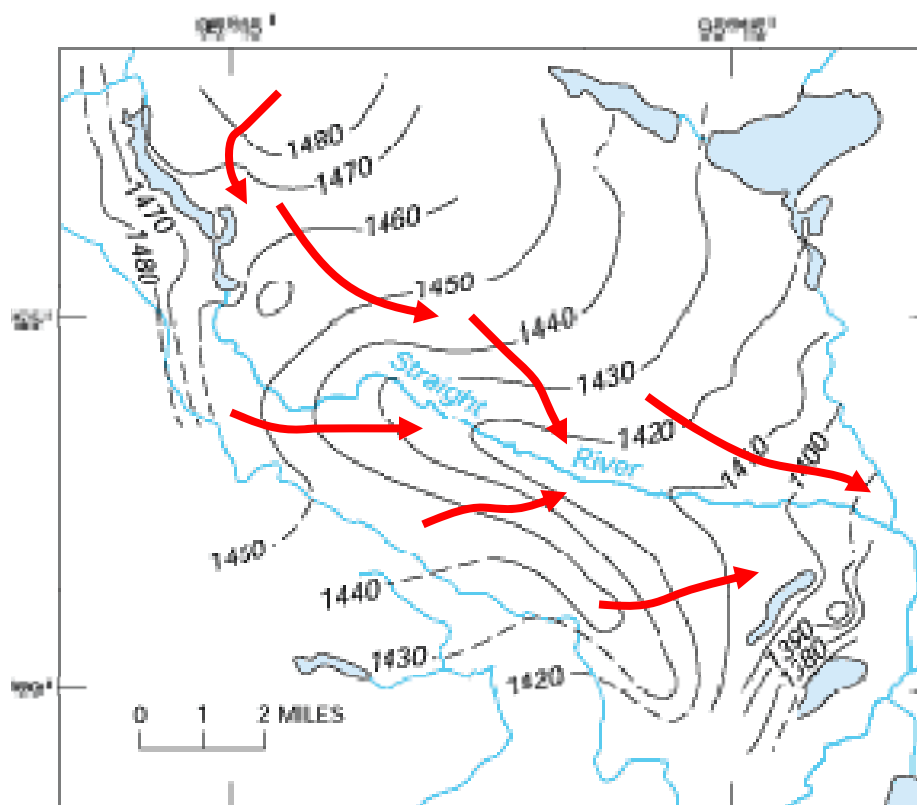
Uncertainties in linking N sources to riparian zones

Emerge with distance from source areas to riparian zones
and extent of buffer length along reach

Groundwater flow paths are
not always perpendicular
shoreline

With intermittent riparian
buffer zones N enriched
groundwater may bypass
removal zones

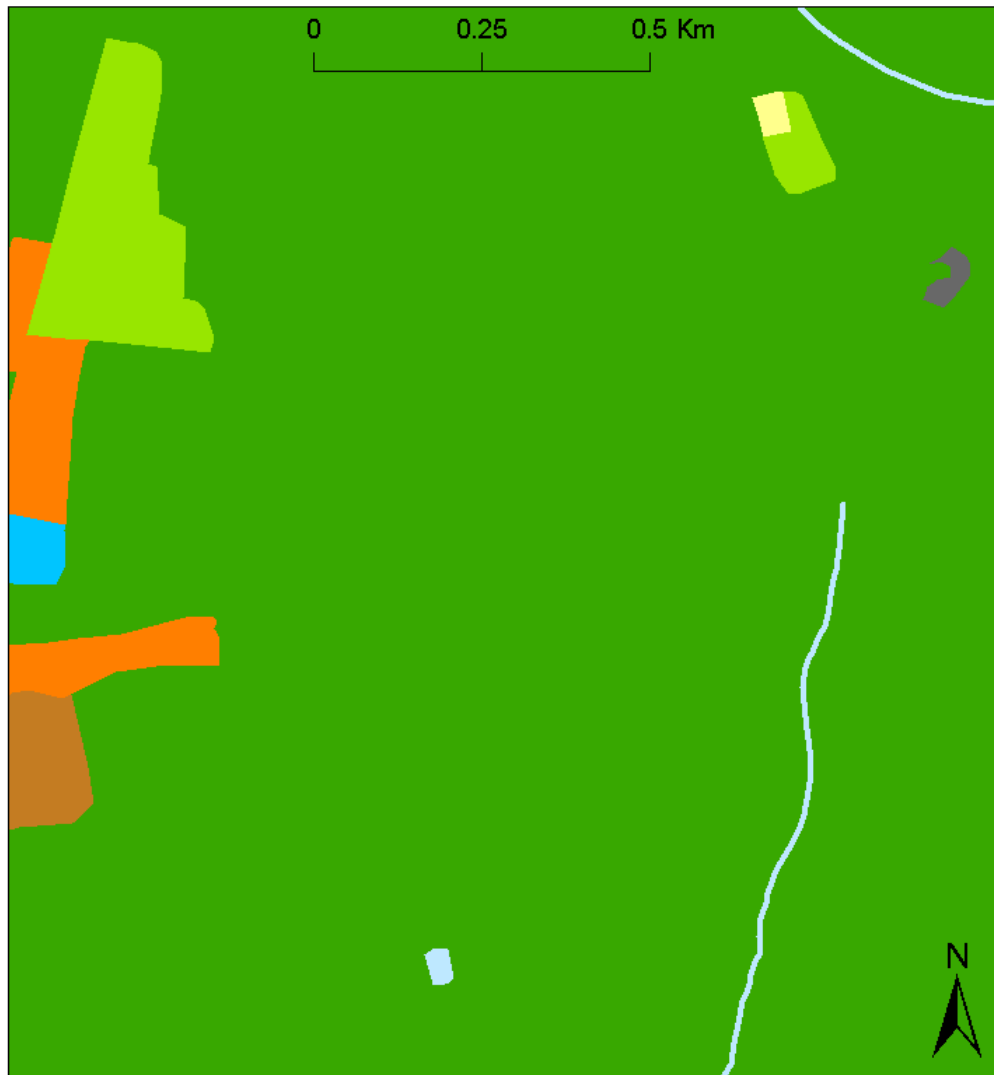
Assume high uncertainty if:
source is > 200 m from a
riparian zone with variable
features












- Stream
- Groundwater equipotential lines
- Groundwater flow path

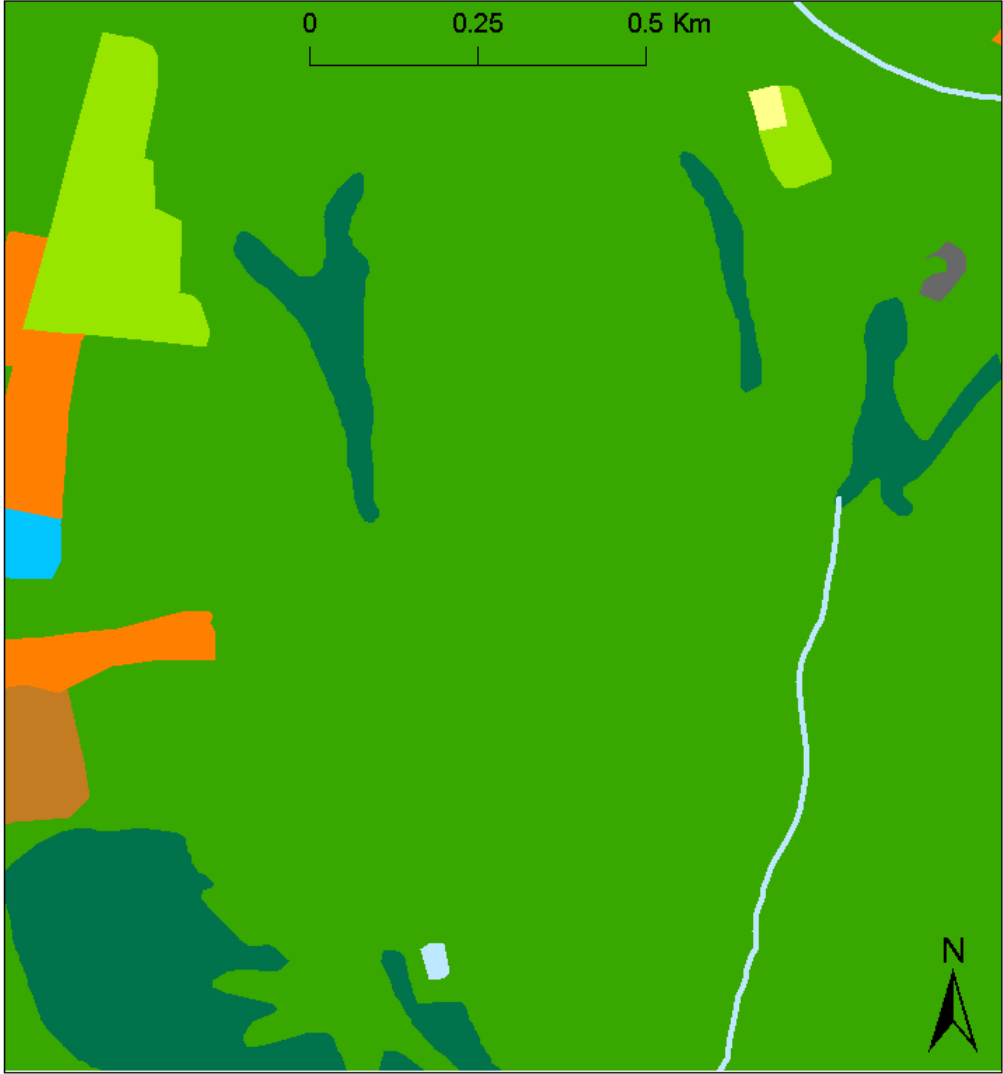
Scale/type of spatial data can mask or display pathways and sinks










(data: Kingston Quad-RI)



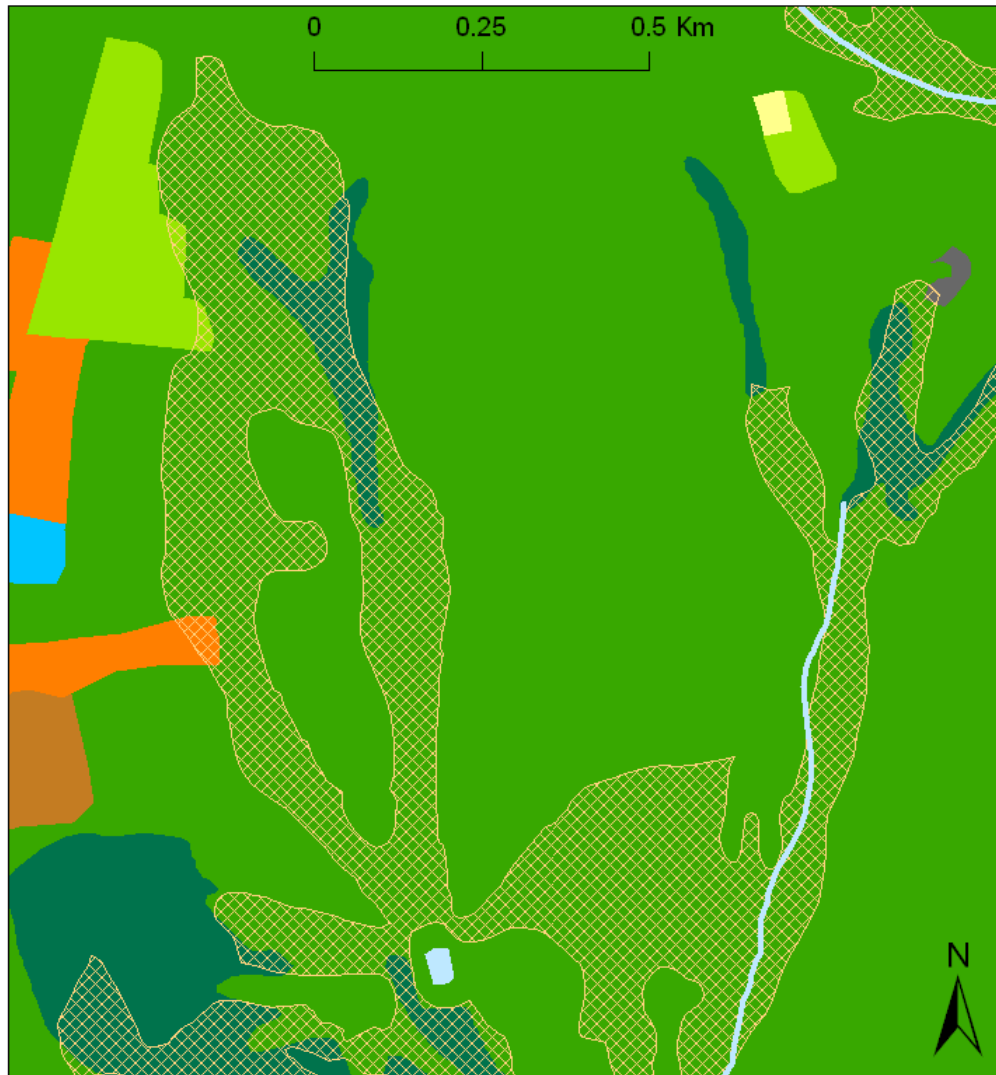
-  Streams (1:24,000)
-  Ponds (1:24,000)
-  Forest / Open Space
-  Agriculture
-  Residential (low density)
-  Residential (med density)
-  Res. (med high density)
-  Institutional
-  Gravel pits












National Wetland Inventory (1:24,000) displays potential sinks



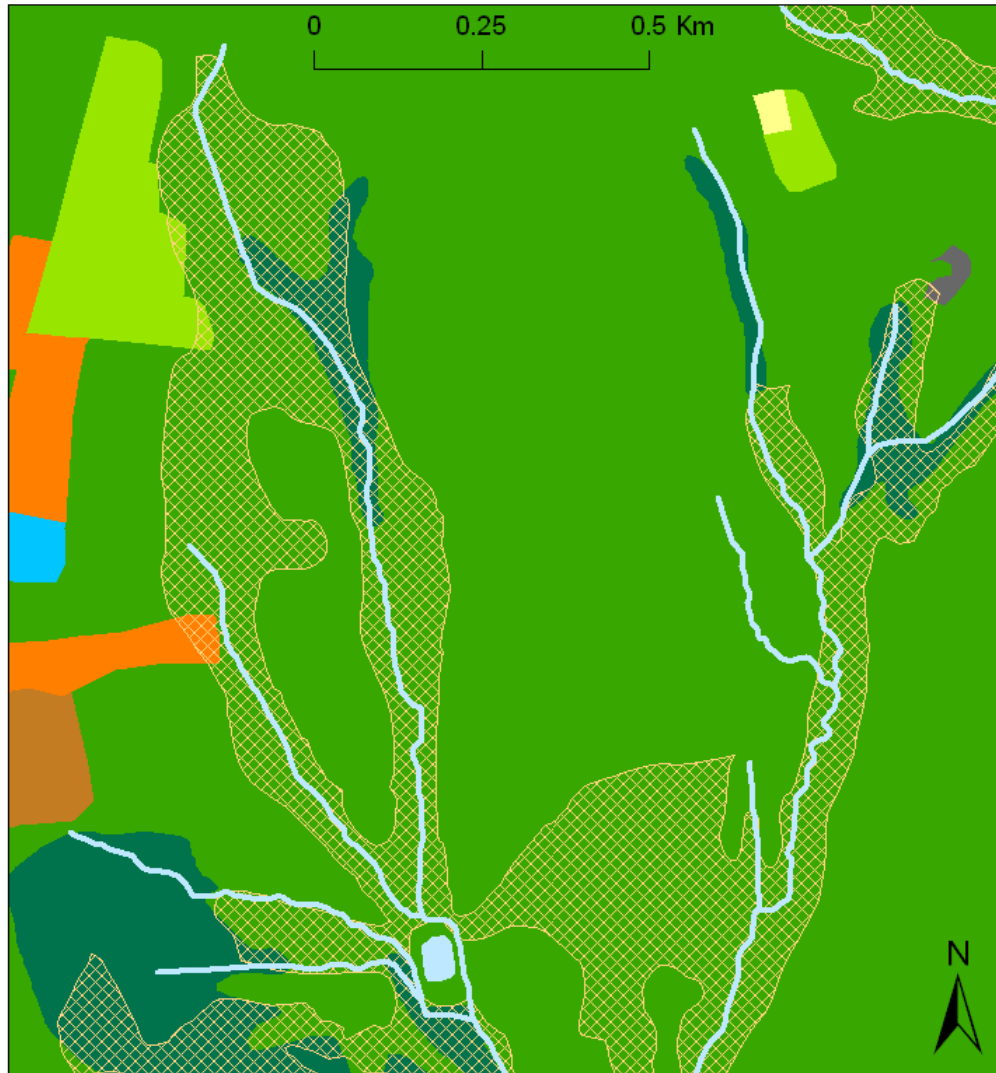
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-  **NWI Wetlands (1:24K)**












SSURGO Hydric Soils suggest wetlands and zero order streams connect source to stream



-  Streams (1:24,000)
-  Ponds (1:24,000)
-  Forest / Open Space
-  Agriculture
-  Residential (low density)
-  Residential (med density)
-  Res. (med high density)
-  Institutional
-  Gravel pits
-  NWI Wetlands
-  **Hydric Soils (SSURGO)**
(1:15,840)

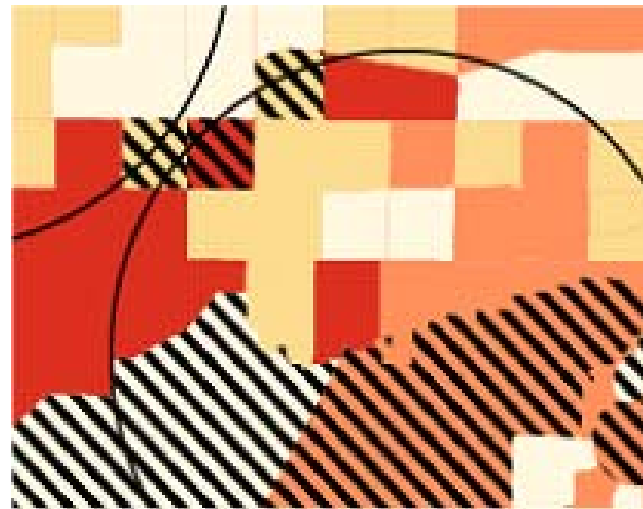
High resolution stream data and hydric soils display an active biogeochemical landscape



-  Streams (1:5,000)
-  Ponds (1:5,000)
-  Forest / Open Space
-  Agriculture
-  Residential (low density)
-  Residential (med density)
-  Res. (med high density)
-  Institutional
-  Gravel pits
-  NWI Wetlands
-  Hydric Soils (SSURGO) (1:15,840)

Goal: Geospatial Approach That Displays Removal & Uncertainty of N Source Locations

Suggestions?
Comments?



Suggestions?
Comments?

