Targeting Watershed Nitrogen Export at the Local Level: The Role of Landscape Sinks

D.Q. Kellogg[1], Arthur J. Gold[1], Suzanne Cox[1], Elizabeth Wentz[2], Kelly Addy[1], John Rozum[3], Peter Groffman[4]

[1] Dept. of Natural Resources Science, University of Rhode Island, Kingston, RI; [2] School of Geographical Science, Arizona State University, Tempe, AZ; [3] CT NEMO Program, University of Connecticut, Haddam, CT; [4] Cary Institute of Ecosystem Studies, Millbrook, NY.

OVERVIEW

One of the major advances in watershed science is the realization that certain areas of the landscape can function as removal sites (i.e. "**sinks**") for water-borne nitrogen (N)[1,2]. These include **riparian zones, streams** and **ponded areas.**

We illustrate the use of N cycling research, spatial data and GIS tools to guide local management of watershed N.

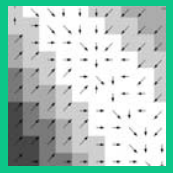
OBJECTIVES AND EXPECTED OUTCOMES

Identify:

- Location of features that relate to high N removal
- Where to target source controls (i.e., BMPs)
- Where to focus riparian and stream protection and restoration efforts

APPROACH

- Recently developed GIS hydrologic analysis tools, e.g., Arc Hydro[3] and the National Hydrography Dataset (NHD)[4], allow relatively easy analyses of flowpath and drainage areas that can link N source areas with potential removal zones.
- Estimate flowpath using flow accumulation grids based on digital elevation models (DEMs).
  Allows:
  - particle tracking from source to outlet
  - resolution of drainage area to any point in landscape.



- Use readily available county scale geospatial data (e.g., SSURGO soils, USGS digital terrain data, Anderson Land Use classifications) to track the pathway and fate of N from source areas through critical hydrologic and geomorphic attributes of riparian zones and stream networks.
- Assess fate of contaminants in sinks encountered along flow path using attribute information e.g., riparian hydric soil width, retention time in streams and reservoirs.
- As improved information emerges on N cycling in sinks, retention factors will be updated.

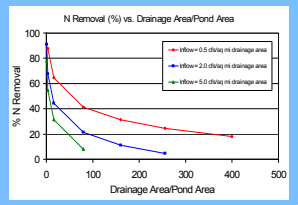
Ponded Areas as N Sinks

Assumptions:

Seitzinger et al. (2002) relate N retention to flow rate and ponded area

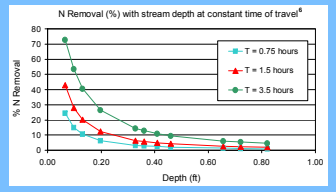
USGS has regionally explicit data relating flow rate to drainage area

In our study area, flow rate = 2.0 ft³/s/mi² of drainage area



Streams as N Sinks

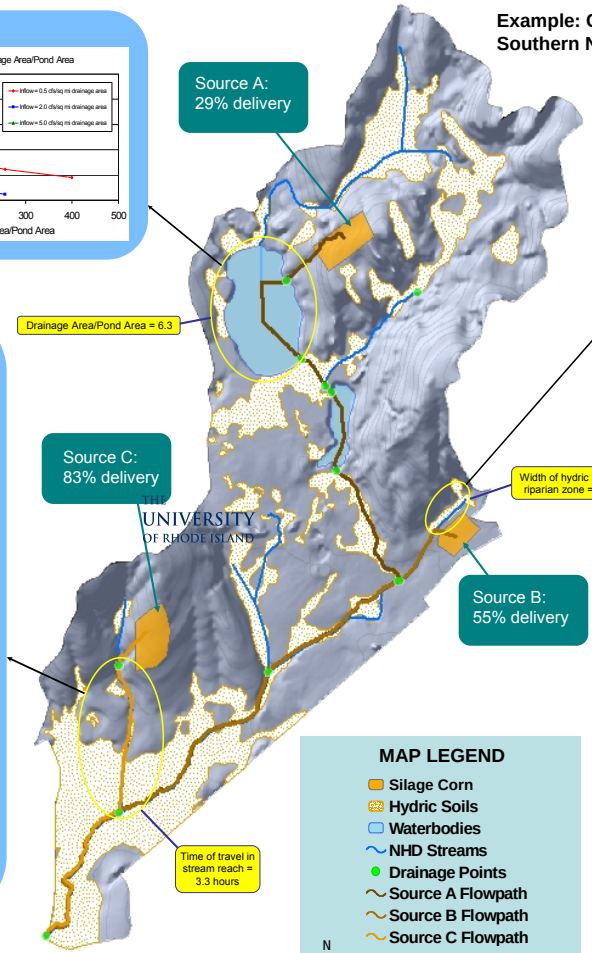
Limited Retention Time Often Generates < 15% Removal



- Summer field reconaissance showed ~ 80% of the 100 first and second order streams surveyed were > 0.16 ft deep. Most N movement occurs during wetter periods when streams would be expected to be even deeper and retention time lower.

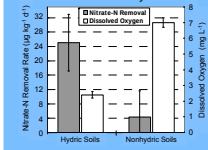
- GIS analysis shows the average length of first and second order streams in RI is 0.8 and 0.6 mi, respectively. Lower order reach retention time often ranges from 0.75 to 3.5 hours.

Example: Chickasheen Watershed, Southern New England (4300 acres)

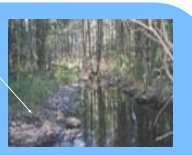


Riparian Zones as N Sinks

Hydric soils support higher denitrification rates than non-hydric soils[7]



Riparian zones with hydric soils



Riparian zone with nonhydric soils

Assigned N retention in riparian zones:

If land use is developed, 0% removal

If soils are non-hydric, 0% removal

If soils are hydric, then[8]

- width < 15 ft, 0% removal
- width is 15 to 50 ft, 40% removal
- width is 50 to 100 ft, 60% removal
- width > 100 ft, 80% removal

Source	Edge of Field Loss lb N/yr	Sink Removal						Total Removal	
		Riparian Zones		Ponded Areas		Stream Reaches			
		lb N/yr	%	lb N/yr	%	lb N/yr	%	lb N/yr	%
A	1850	-	-	1257	68	55	3	1312	71
B	1050	420	40	-	-	50	5	470	45
C	1900	-	-	-	-	323	17	323	17

- indicates sink not present

MAP LEGEND

- Silage Corn
- Hydric Soils
- Waterbodies
- NHD Streams
- Drainage Points
- Source A Flowpath
- Source B Flowpath
- Source C Flowpath

N

0 0.5 1 Miles

CHALLENGES

- **There is a pressing need for research on N retention within ponded areas.**
- **Sources of uncertainty need to be identified to guide decision making and future research.**
- **Testing and assessment is needed to improve the usability of geospatial outputs to provide guidance for local management.**

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PARTNERS

We are working with the Nonpoint Education for Municipal Officials (NEMO) national network and with Natural Resources Conservation Service (NRCS) personnel to introduce this tool to local decision makers and land managers in coastal areas.

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