Report for 2004NY52B: Measuring the effects of wetland and riparian zones on water quality in the urban Patroon Creek Watershed, Albany County, NY.

- Dissertations:
  - Erickson, Elazabeth K, 2004, Road salt application ad its effects on sodium and chloride ion concentrations in an urban stream: Patroon Creek, Albany, NY, MS Thesis, Department of Earth and Atmospheric Sciences, University at Albany, State University of New York, Albany, NY.
- Other Publications:
  - Arnason, J G, 2004, Conference on rising salt concentrations in tribuatries of the Hudson River Estuary, presentation and abstract, Hudson Eiver Environmental Society, Kingston, NY, December 6, 2004.
  - Robinson, G R, 2004, Environmental restoration within the Hudson River Basin, presentation and abstract, Hudson River Environmental Socienty, Hudson, NY, March 22, 2005.

Report Follows

Title: Measuring the effects of wetland and riparian zones on water quality in the urban Patroon Creek Watershed, Albany County, NY

Note: Due to administrative delays, grant funds were not received at the University until February 2005, the end of the original project period. In order to expedite the project, work was carried out during 2004 and early 2005 using a funding advance from the University through an "at-risk" account. The P.I.'s have requested and received a 1-year, no-cost extension on the project and expect to complete it by February 2006. Below, we report preliminary findings and results. We will present a complete report at the termination of the extended project period.

Site description and preliminary survey data

At its western edge, the main body of Six Mile Reservoir (south of the CSXRR line) is fed by two inlet streams (Figure 1). The northern fork begins W of Rapp Rd just south of the tracks and meanders through the Pine Bush Preserve. We believe the source is primarily ground water, with some surface drainage. We have a three year record of water samples from the upstream part of this creek (Site 1, Figure 1), and a shorter record for several sites downstream and along the banks of the northern fork as it widens into the reservoir (sites in yellow, Figure 1).

We have so far traced the southern fork to a culvert that passes under Rapp Rd., across from the entrance to the Albany Sanitary Landfill, adjacent to I-90 (NYS Thruway). This south fork begins to widen approx. 350 m (1100 ft) northeast of the culvert, eventually mixing with the north fork about 700 m further east. USGS maps do not show any inlet, with the south fork drawn as a backwater without any feeding streams. We first followed this southern fork inlet in June 2004, as part of a study of potential road salt accumulation in the Patroon Creek watershed. We have since taken samples every 1-2 months below the culvert and further downstream along the shores of the widening southern fork.

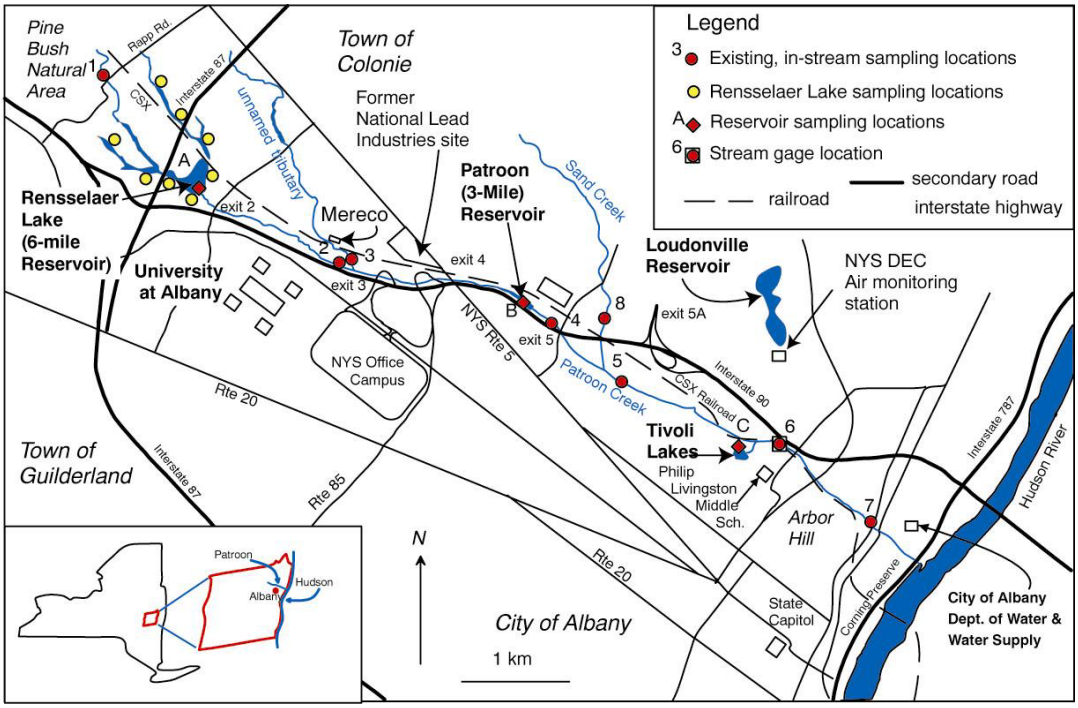

Figure 1. Map of Patroon Creek and Rensselaer Lake showing sampling locations and major features.

Water chemistry

From June 2002 to June 2004, we conducted weekly sampling of Patroon Creek at seven sites for temperature, pH, dissolved oxygen (D.O.), major anion and cation concentrations, and alkalinity under an EPA grant funded through the EMPACT program. We have also developed a high-resolution (2 m) GIS for the reservoir basin, including land cover classes, riparian buffer widths.

In order to develop a longer term water chemistry record, we have continued to collect grab samples on a monthly basis at the same seven sites from July 2004 to the present as part of the current project. In addition to the above parameters, we are now also measuring specific conductivity. Beginning in April 2005, we added an additional sampling site for a total of eight sites. In addition to the periodic sampling, we collected water samples during storm events in January and March 2005. The date, type and number of samples collected from Patroon Creek as part of this project are summarized in Table 1. We are in the process of completing the analysis of existing water samples and compiling the data.

From June 2004 to May 2005, we have been collecting water grab samples and measuring T, pH, D.O., and conductivity periodically at several of 15 different sites in Rensselaer Lake. The date, type and number of samples are summarized in Table 2. We also measured water quality parameters (T, D.O., and pH) and collected samples for major ion chemistry from the water column in the deepest part of the lake (~7.0 m depth). Water column measurements were made in July and December of 2004. These measurements will be compiled together with measurements from April, May, September, and October, taken in previous years in order to more fully characterize the stratification of the reservoir.

Table 1. Summary of measurements and water samples collected along Patroon Creek (sites in red, Figure 1) , July 2004 to May 2005.

Date	*# Anion/Cation samples*	*# Bacteria Samples*	*# Temp, pH, & D.O. measurements*	*# Conductivity measurements*
7/13/04	7	7	7	0
8/10/04	7	7	7	0
10/12/04	7	7	7	0
11/3/04	7	0	7	7
11/9/04	7	7	7	7
12/14/04	7	7	7	7
1/11/05	7	7	7	7
1/26/05*	3	0	3	3
2/8/05	7	7	7	7
3/8/05*	1	0	1	1
3/11/05	7	0	7	7
3/21/05*	3	0	3	3
3/28/05*	5	0	5	5
4/12/05	8	7	8	8
5/10/05	8	7	8	8
Total	91	63	91	70

* Storm Events

Table 2. Summary of measurements and water samples collected at sites along Rensselaer Reservoir (sites in yellow, Figure 1), June 2004 to May 2005.

Date	*# Anion/Cation samples*	*# Bacteria Samples*	*# Temp, pH, & D.O. measurements*	*# Conductivity measurements*
6/3/04	6	0	6	6
6/8/04	3	0	3	3
6/21/04	4	0	4	4
7/14/04	9	0	9	9
7/15/04	5	0	5	5
8/9/04	13	0	13	13
11/18/04	12	0	12	12
2/8/05	13	0	13	13
3/24/05	9	0	9	9
5/19/05	8	0	8	8
total	83	0	83	83

Soil Chemistry

We have collected several dozen soil samples from around the reservoir. These will be characterized through grains size analysis, total carbon content, mineralogy by XRD, and cation/anion exchange capacity.

Principal findings or significant results

In June 2004, we began systematic and periodic water sampling in and around Rensselaer (a.k.a. “6-mile”) Reservoir in order to characterize spatial and seasonal variations in water quality as well as to identify point sources of contaminants. We also collected a suite of soil samples around the reservoir in order to determine soil properties that might influence water quality, such as anion and cation exchange capacity.

Our principal findings to date are as follows:

1. Rensselaer Lake is a eutrophic reservoir with an area of 14.3 ha and a mean depth of 3.35 m. The greatest depth (7.0 m) occurs near the dam at the southeastern corner of the lake (Figure 1). A smaller basin about 4.5 m deep occurs just upstream of the I-87 bridge. During the summer months, the lake is stratified with an oxic epilimnion and anoxic hypolimnion. Chloride ion concentrations are elevated (~250 ppm) in the hypolimnion relative to the epiliminion (~150 ppm). Fall turnover occurs in late September to early October. Following turnover, the bottom waters remain enriched in chloride relative to surface waters, although the gradient is decreased relative to that present during summer stratification. Due to dangerous ice conditions, we were unable to observe winter stratification or spring turnover, if present. Therefore it is unknown if the reservoir is monomictic or dimictic.

2. The source of chloride ion is likely to be from road de-icing salts. Major sources include interstate highways 87 and 90 maintained by the NYS DOT; the Exit -24 toll plaza maintained by the NYS Thruway Authority, and numerous secondary roads and parking lots maintained by the City of Albany, Town of Colonie, and private agencies. Continued application to the watershed could lead to permanent stratification of the reservoir.

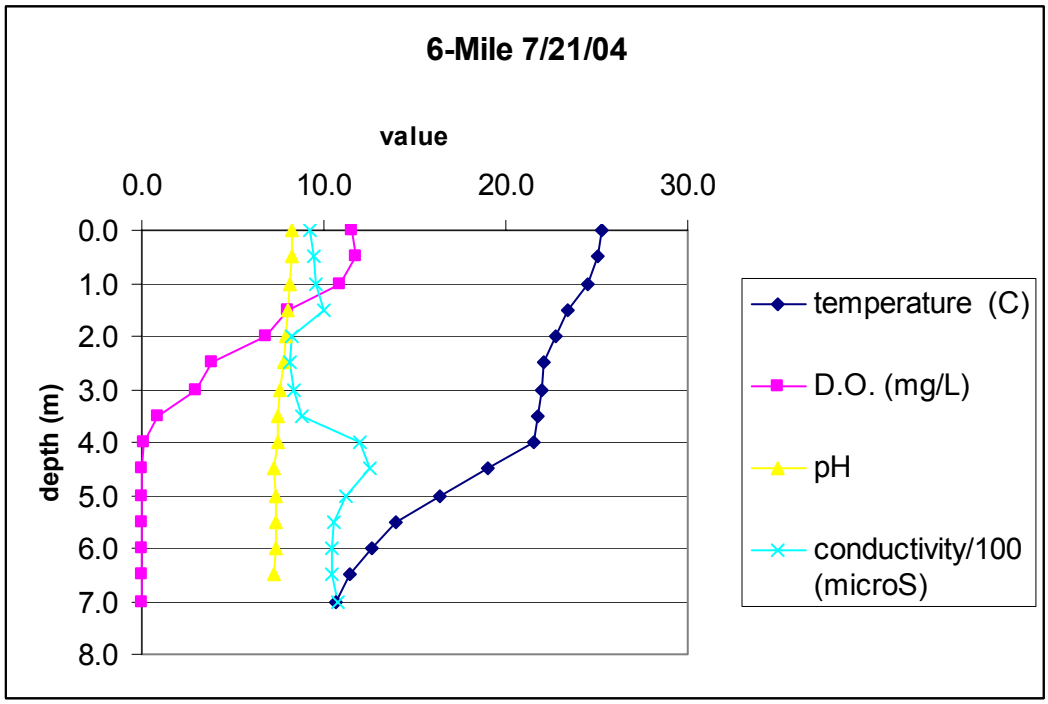

Figure 2. Profile of Rensselaer Lake water column during summer stratification. The thermocline occurs between 4-5.5 m depth. Below 4.0 m, lake waters are anoxic and have higher average conductivity than surface waters.

3. Rensselaer Lake waters are derived from both ground and surface water sources. We have identified three sources in the proximity of the first culvert, (1) apparent groundwater seepage that joins the flow below the culvert, (2) a second large culvert just downstream that appears to run under the north bank, either draining I-90 or

passing under it, and (3) a small culvert (black corrugated drain pipe) that carries water under Rapp Rd. from the vicinity of a trailer park entrance to the south of the main culvert. All four inlets join to feed the 350 m-long creek that leads to the southern reservoir fork. Most of our samples have been taken from a single site that contains a mix from all four water sources. On Feb. 20, 2005, we took separate water samples and field measurements of all four sources. We have not yet analyzed the samples, but field readings are given in Table 3.

Table 3. Field readings from Feb. 20 field sampling. Air temp. was approx. -3 C (27 F). Site numbers are for yellow sites on Figure 1 (not labeled).

Site	Possible source	Water Temp	DO[1]	SC[2]
1.Culvert under Rapp Rd.	groundwater	10.2 C (50.4 F)	0.70	3508
2. Seepage around culvert.	groundwater	10.2 C (50.4 F)	3.8	3629
3. Culvert under I-90	?	6.5 C (43.7 F)	10.6	2427
4. Corrugated pipe	road drainage?	1.4 C (34.5 F)[3]	3.0	1193
5. N fork (APB Preserve)	groundwater	3.9 C (39.0 F)	10.4	570

[1]Dissolved oxygen in mg/l;
[2]specific conductance in µS /cm, adjusted for 25 C.
[3]Surface frozen, water not moving, pipe empty.

Clearly different water sources are contributing. For comparison, site #5 consistently tests out as our cleanest water, with the lowest major ion concentrations, so we use it as a reference site for Pine Bush groundwater. Sites 1 and 2 appear to flow from a very different source, with the warmest water and the highest conductivity. Mean conductivity (SC) for the south fork stream (Site 1) over six months was 1650 µS, and 508 µS for the north fork stream (Site 5). Differences in major ion concentrations are even stronger (Table 4).

Table 4. Major cations (A) and anions (B) comparing upstream sites of the north and south forks of the western part of Six Mile reservoir. All values are in mg/l (approx. ppm). Data are from a single sample, 6/04.

A. Cations

Stream	Sodium	Ammonium	Potassium	Magnesium	Calcium
South fork (Site 1)	384.3	56.9	22.5	29.6	124.3
North fork (Site 5)	41.1	0.7	1.4	11.9	65.2

B. Anions

Stream	Chloride	Nitrate	Phosphate	Sulfate

South fork (Site 1)	649.5	0.1	0.23	25.19
North fork (Site 5)	70.0	1.65	0.27	31.32

The South Fork sample was tested twice in one run of the ion chromatograph, and we took a second sample and tested that on a later run. All three tests gave similar results. North fork values are consistent with a two-year dataset of weekly tests. Therefore, although we need to test our backlog of South Fork water samples from later months (7/04 to current), we do not believe that sample error or technical errors are responsible for the large differences seen in Table 2. In addition, the large discrepancies in field conductivity (Table 1) are borne out by other data and are consistent with the ion concentration differences.

Preliminary interpretation

A preliminary hypothesis is that much of the South Fork inlet derives from groundwater fed by landfill leachate. This will require much more testing, but we have several clues. First, we observed warm water low in oxygen. Second, the extremely high ammonium values (higher than typically reported even for watersheds with heavy agricultural inputs) are very unusual. This together with the near-zero nitrate values indicate an N-rich, anoxic source. A third piece of preliminary evidence is visual. The water is oily and very reddish/orange. Photographs from July 2004 are pasted in the next page.

We plan to continue monitoring and sampling through next summer with support from NYS WRI and USGS, and we have no plans to release data until all tests are run and analyses are thoroughly checked.

Students supported:

A total of three graduate students will be supported during this project. Sean Madden (M.S. Biological Sciences, 2004) was supported during summer 2004. His duties included sampling and laboratory analysis. Chuck Begeal (M.S. student, DEAS) and Dan Capuano (Ph.D student in Biological Sciences) will be supported during summer 2005. Their duties will include water and soil sampling, laboratory analysis, data analysis, and GIS analysis of data.