Relationships Between Land-Use and Water Quality in the Lake George Watershed

Project Components:

In November of 2005, four sub-watersheds were chosen by the research committee for this study based on level of development and conservation within the watershed, accessibility, and availability of discharge data. Nutrient, cation, and anion, loading and retention in these 4 sub-watersheds will be measured. Three of the four watersheds, Northwest Bay Brook (a reference watershed), Finkle Brook (developed watershed at 14% developed), and Indian Brook (a watershed under-development and currently 7% developed) will be intensively sampled, with the fourth watershed (Shelving Rock Brook) being less intensively sampled as an additional reference watershed.

Water samples at Northwest Bay Brook, Finkle Brook, and Indian Brook are taken from 5-6 sites starting at the headwaters and ending near the mouth of each brook. The headwaters of Northwest Bay and Indian Brooks are forked, so both of the forks are being included as sampling sites. Sampling at various points along the elevational gradient will allow us to measure retention within the streams. In addition, collecting data from multiple sampling sites will provide more detailed information on what is occurring throughout the watershed. All of the sites in each stream will be sampled once a month during baseflow (non-storm or snowmelt sampling, i.e. sampling will occur no sooner than 2 days after the last rain event). In addition, samples will be collected for 6-8 storm events during the year, which will include at least 2 storms during 3 seasons: summer (May-Aug), fall (Sept-Nov), and winter (Jan-April). For storm sampling, automated samplers will be used to sample on both the rising and falling limbs of the hydrograph. Finally, snowmelt will also be sampled using the automated samplers to sample across the hydrograph. At Shelving Rock Brook, samples will be collected every 2 weeks during the ice-free season and samples from 2 to 3 storm events will also be collected.

Each sample collected will be analyzed for total nitrogen, nitrate, ammonium, total phosphorus, total dissolved phosphorus, soluble reactive phosphorus, calcium, chloride, sulfate, pH, conductance, temperature, and total suspended solids. This will provide information on the amount and forms of nitrogen and phosphorus, and the cation, anion, and sediment levels in the stream water.

Another project component is to examine how changes in stream water chemistry are reflected in stream and lake food webs. To study this we are examining stream algal dynamics in Northwest Bay, Indian, and Finkle Brooks. Specifically we are examining the biomass of stream periphyton (algae on rocks) in each stream. Also, a series of experiments are being conducted at the mouths of Northwest Bay and Indian and Finkle Brooks to determine whether stream periphyton are nutrient limited in these streams, and if they are, which nutrient (nitrogen or phosphorus) is limiting algal growth. In addition to providing food for stream insects, algae play an important role in nutrient cycling in streams. Therefore these studies will provide valuable information about the factors contributing to nutrient retention and cycling in the streams and food-web dynamics.

Additionally, mapping the location of the gray infrastructure in the sub-watersheds being examined (developed areas) and mapping of the location of sewer and septic systems in the same sub-watersheds will be added to the final analysis of the data collected.

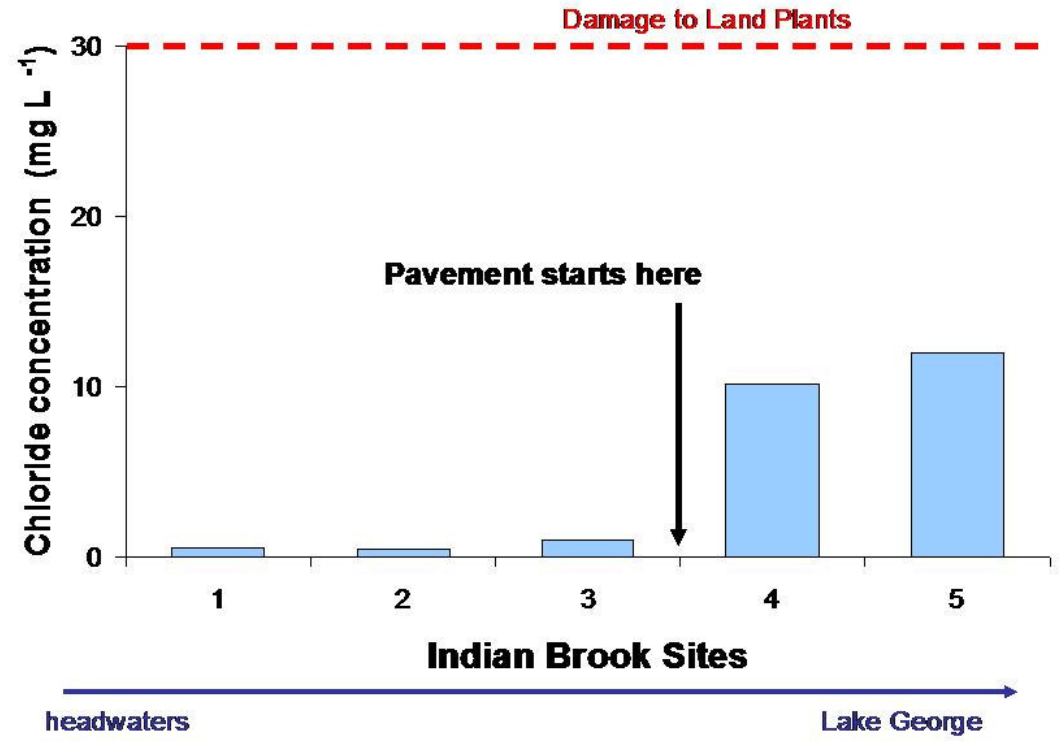
We will also explore the use of a FlowCAM (a state-of-the-art instrument with capabilities of "particle" counting, with simultaneous collection of a photograph of each microscopic "particle") for obtaining a snapshot of the community structure of the stream algae.

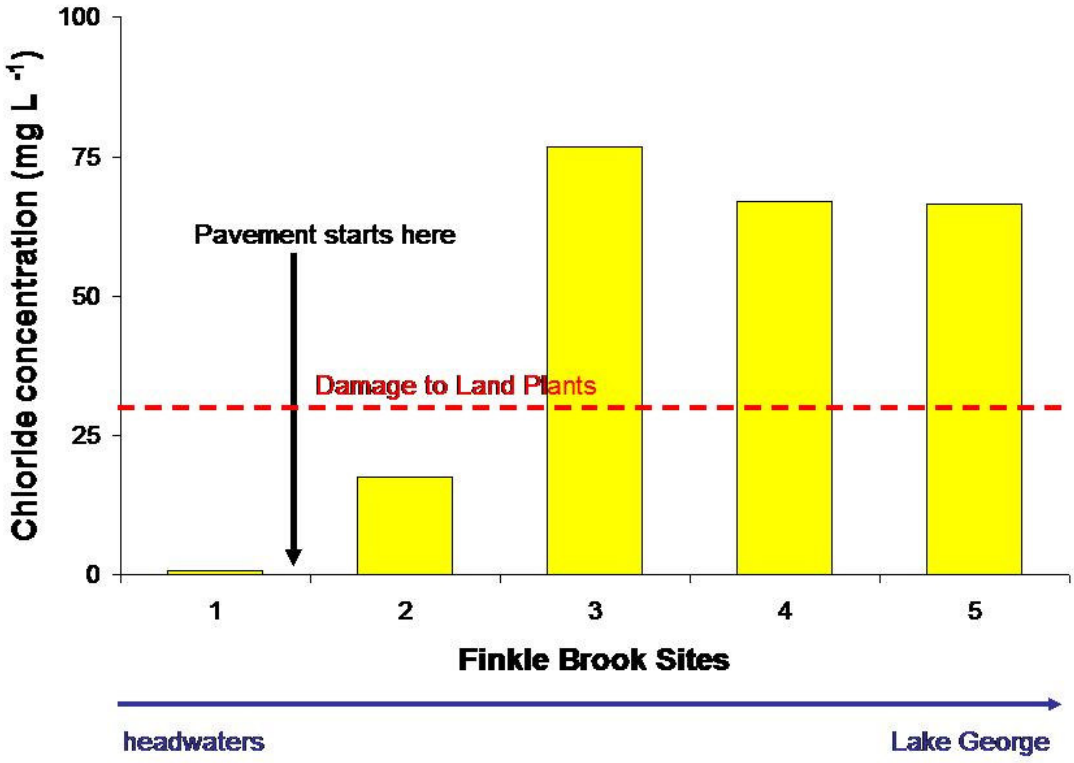
Descriptions of measurements:

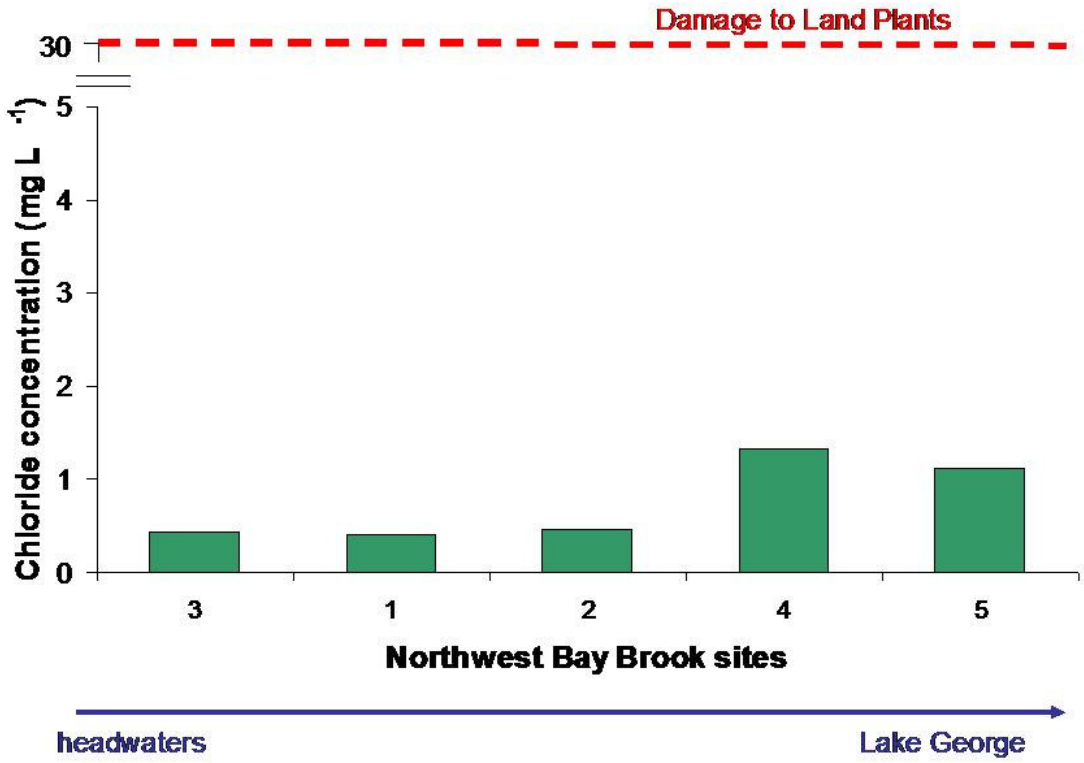
- Total phosphorus – measurements of inorganic and organic phosphorus present in the water column and include phosphorus that is bound to suspended particulates.
- Total dissolved phosphorus – inorganic and organic phosphorus present in the water column but excludes phosphorus bound to particles larger than 0.45 µm.
- Soluble reactive phosphorus – dissolved inorganic phosphorus present in the water column.
- Total nitrogen – inorganic and organic nitrogen present in the water column and includes nitrogen bound to suspended particles.
- Nitrate – inorganic nitrogen in the form NO_3, typically the largest proportion of nitrogen found in developed streams.
- Ammonium – inorganic nitrogen in the form NH_4.
- Total suspended solids – amount of suspended sediments and organic matter in the water column.

Results:

The following graphs depict stream water chloride concentrations in three streams in the Lake George Watershed in October, 2005. Two of the streams (Indian and Finkle Brooks) drain watersheds with paved roads, while all of the sampling sites in the third watershed (Northwest Bay Brook) are upstream of paved roads. Use of road salt for roadway deicing leads to road runoff with high chloride concentrations. Soil chloride concentrations of 30 mg/L have been found to damage terrestrial plants[1]. Freshwater life can be harmed by chronic chloride concentrations of 250 mg/L[1]. Because road salt application occurs during the winter months, we would expect high chloride concentrations in streams draining catchments with paved surfaces during the winter. However, this data shows that elevated chloride concentrations remain throughout the summer and early fall. Note that chloride concentrations become elevated immediately downstream of where pavement begins, providing further evidence that the elevated chloride concentrations are most likely the result of road salt application.


Damage to Land Plants
Chloride concentration (mg L -1)
30
20
10
0
Pavement starts here
1
2
3
4
5
Indian Brook Sites
headwaters
Lake George


Chloride concentration (mg L -1)
100
75
50
25
0
Pavement starts here
Damage to Land Plants
1
2
3
4
5
Finkle Brook Sites
headwaters
Lake George



1. Environment Canada (2001). Priority Substances List Assessment Report for Road Salts.