SODIUM AND CHLORIDE CONTAMINATION IN LOANTAKA BROOK

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Many readers will be familiar with Loantaka Brook as it flows for over two miles through Morris County's Loantaka Brook Reservation, a largely wooded area popular for walking, bicycling and other recreational activities. In spite of this appealing natural setting, the brook is vulnerable to pollution from several types of land use as it flows southward from its origins near the southern outskirts of Morristown, through the Reservation, towards Green Village and the Great Swamp National Wildlife Refuge where it merges with Great Brook. Previous studies[1] have shown that the stream suffers from excessive levels of phosphorus- and nitrogen-bearing nutrients. Over the last few years, GSWA Stream Team staff and volunteers, with the support of Corporate Council members, have sampled the brook regularly at several places to monitor these and other contaminants. One of the striking results of this program has been our finding that, in addition to the high nutrient levels, the water contains unnaturally large amounts of dissolved salt constituents, specifically sodium and chloride. In a portion of the stream, biologically hazardous amounts of chloride, exceeding NJ Surface Water Quality Standards, are consistently found. Here we summarize information gathered over a 3-year period showing the magnitude and year-round nature of the salt contamination problem.

Natural streams undisturbed by human activities normally contain small quantities of dissolved solids since the water feeding them passes through soils and over rocks from which soluble substances like calcium, magnesium, bicarbonate and sulfate can enter the water. In Loantaka Brook we find that these naturally occurring mineral components are augmented by considerable amounts of sodium and chloride. In the northern states and Canada a common source of these contaminants is road salt, used extensively as a deicing agent. The proximity of some sections of the brook to busy roads like Route 124 and South Street, parking lots for apartment complexes, businesses and municipal buildings, and areas of high housing density makes the stream vulnerable to runoff of deicing agents from asphalt and other impervious surfaces.

The widespread rise in salinity in surface water and ground water in northern regions has created growing concern over the future quality of drinking water and the potential negative impact on human health. There are also major ecological consequences of salt pollution of fresh-water streams and wetlands, including impairment of the growth and development of many aquatic plants and animals, with consequent reduction of species diversity. Sodium and chloride both contribute to these undesirable effects. The New

[1] Ten Towns Great Swamp Watershed Management Committee, Great Swamp Water Quality Monitoring Reports, June 2002 and March 2007

Jersey Department of Environmental Protection (NJDEP) currently does not include a numerical criterion for sodium in its Surface Water Quality Standards, but specifies for chloride a "chronic toxicity" standard[2] (meaning a threshold level above which a relatively long exposure to a toxic substance could impact severely on the life of an organism) of 230 milligrams per liter (mg/l). A "human health" standard of 250 mg/l is also specified. This report includes information about the stream's content of both sodium and chloride, but pays particular attention to the chloride results and their relationship to the chronic toxicity standard.

Our water samples are primarily taken under "base-flow" conditions, requiring that on the sampling date there has been no recent precipitation to change the normal water flow pattern. The samples are submitted to a testing laboratory to be analyzed for a variety of chemical species, including sodium and chloride. The charts on page 5 summarize sodium and chloride concentrations measured on samples representing two segments of Loantaka Brook. "Upper Headwaters" refers to the upper reaches of the stream from its sources near the southern edge of Morristown to a point just upstream from the discharge from the Woodland Avenue Wastewater Treatment Plant (WTP). "Lower Headwaters" includes the WTP discharge and the downstream flow from there to the Kitchell Road crossing. Water samples have been drawn each quarter from two or more sites in each of these stream segments. The graphs show data for samples taken near Woodland Avenue (representative of the Upper Headwaters results) and at Kitchell Road (Lower Headwaters).

In the Upper Headwaters segment, chloride levels are 400 mg/l or more in most samples and in all cases are higher than the chronic toxicity criterion of 230 mg/l. In the Lower Headwaters, the chloride content is clearly less, with most values being about 200 mg/l, but it remains undesirably high. There are also several surges in concentration in each of the stream segments. The sodium data for the same set of water samples show a pattern qualitatively similar to that of the chloride data.

In contrast to the high base-flow concentrations in Loantaka Brook, a local stream much less prone to the impact of human activities, Primrose Brook in the Jockey Hollow unit of Morristown National Historical Park, is found by the US Geological Survey to consistently contain less than 10 mg/l of both sodium and chloride.

Except during and after storms, Loantaka Brook is a low-volume, slow-moving stream, especially in the Upper Headwaters; such characteristics mean that any contaminated water entering the stream will not be diluted or flushed downstream as effectively as would occur in a larger, faster-flowing stream. Road salt is used only in winter, but it can be retained in soils, slowly leaching into shallow ground water and seeping into the stream throughout the year. At times of unusually low natural water flow, the reduced amount of dilution can lead to higher-than-normal sodium and chloride concentrations; the November 2007 Upper Headwaters result is probably an example of such an event.

[2] Surface Water Quality Standards, NJDEP, October 2006.

Downstream from the Woodland WTP discharge, the contaminant concentrations are present at reduced but still unacceptable levels, and determining their origin is a little more complex. In the Lower Headwaters, road salt may be only one of several contributors of sodium and chloride to the stream. In addition to sampling the water in the brook, we have measured chloride in the plant effluent and found it to be in the 180 to 250 mg/l range. It seems unlikely that enough deicing agents would infiltrate the wastewater passing through the WTP to account for this. Potential salt sources might include brine flushed from water softeners, laundry detergent, bleaches, and other household cleansing materials passing through the Plant. The discharge from the WTP is added to and mixes with the stream waters. Because under the base-flow sampling conditions the amount of water passing through the WTP is much larger than the flow coming from upstream, the brook for some distance downstream from the plant outlet carries water having chemical content more like the plant effluent than that of the Upper Headwaters. In effect, the plant discharge dilutes the stream with respect to its chloride content; but chloride concentrations in the neighborhood of 200 mg/l remain undesirably high. Any additional chloride entering the stream may cause the total amount to exceed the NJDEP standard, albeit for a limited period. For example, the Lower Headwaters data for February 2005 and February 2007 show such increases, indicating that there was additional road salt contamination at locations downstream from the WTP discharge.

When the quantity of water flowing in the stream is increased during and after rainfall, the concentrations of contaminants may be significantly reduced. The August 2007 sample was intentionally collected during a rainstorm, to obtain a comparison between normal base-flow and storm conditions. The results are therefore not included in the base-flow charts, but are provided in the table at the bottom of page 5. Under the storm conditions, the sodium and chloride concentrations in both stream segments were much lower as a result of dilution by the storm water. In the table, a difference will be noted between results obtained upstream and downstream of Kitchell Pond, which is located immediately north of where the stream passes under Kitchell Road. This difference is attributed, at least in part, to the slow flushing of the pond by the storm water, so that following the onset of rain, the downstream flow continues to carry contaminants stored in the pond for some time.

Storm conditions would not be expected to influence the properties of the WTP effluent, and our storm sampling has confirmed that the sodium and chloride concentrations are similar to their base-flow values. Clearly if the volume of water flowing from the Upper Headwaters during storms is sufficient, it dilutes the WTP effluent, whereas the opposite is the case for normal base-flow conditions, as stated earlier.

In summary, high levels of salt constituents are seen in Loantaka Brook at all our sampled sites under normal base-flow conditions. Road salt runoff from impervious surfaces, and sodium and chloride contained in the WTP plant effluent, are believed to be the principal origins of the contaminants. Our measurements have consistently shown the highest, “chronic toxicity” chloride levels to be in the low-flow-volume Upper Headwaters portion of the stream, sustained by year-round leaching of road salt retained in nearby soils. These unacceptably high levels of contaminants harm aquatic life and

impair the quality of drinking water. We need not sit by and let this continue, however. One of the ways we can all help to reduce the most common contaminants, sodium and chloride, in the surface and ground water in and around our streams is to use alternate winter de-icing materials and practices. For more information, see "Tips You Can Use: De-Icing Ideas for Homeowners" by GSWA Science & Technology Committee Chairperson and Trustee Frank Stillinger in GSWA's newsletter "Across the Watershed", Winter 2008 edition.

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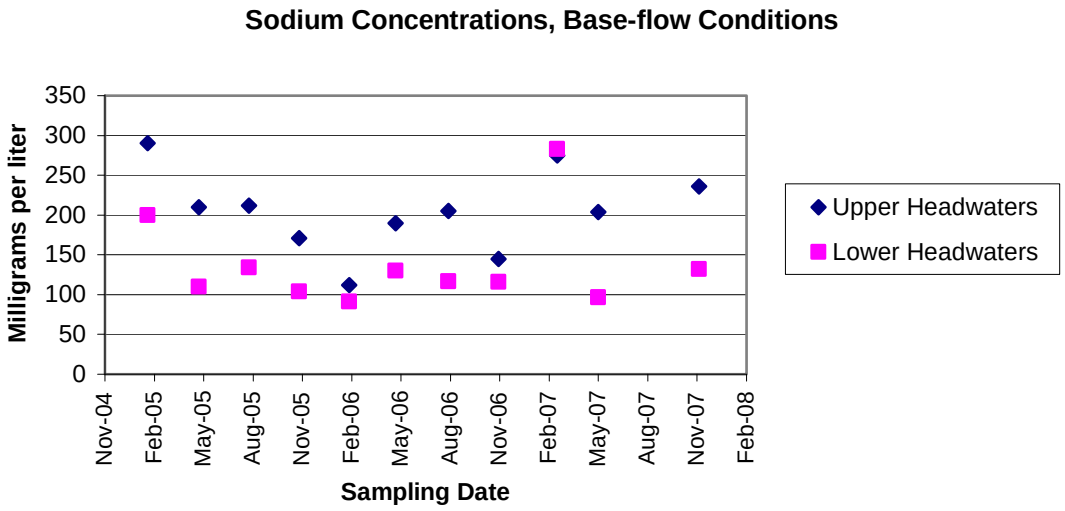
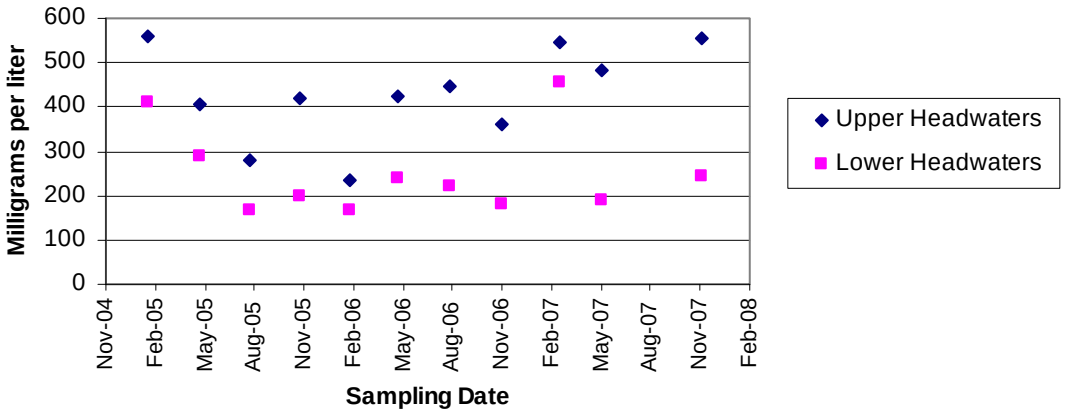
Questions or comments relating to this report may be directed to Kelley Curran at kcurran@greatswamp.org

SODIUM AND CHLORIDE CONCENTATIONS, LOANTAKA BROOK, 2005 - 2007





Storm-flow conditions, August 2007

Sodium	Upper Headwaters	28 mg/l
	Lower Headwaters (above Kitchell Pond)	8 mg/l
	Lower Headwaters (below Kitchell Pond)	74 mg/l
Chloride	Upper Headwaters	57 mg/l
	Lower Headwaters (above Kitchell Pond)	18 mg/l
	Lower Headwaters (below Kitchell Pond)	127 mg/l