

NONPOINT SOURCES OF PERCHLORATE TO SUFFOLK COUNTY, NY, GROUNDWATER

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ABSTRACT

Perchlorate poses a threat to drinking water quality due to its high mobility and potential health effects. Perchlorate concentrations were measured in a few possible nonpoint sources in urban areas. We detected perchlorate in rain water, soil water influenced by fertilizer, sewage and road runoff. Soil water influenced by organic fertilizer measured the highest concentrations, with an average of 76.38 ppb ClO_4 , and concentrations reaching 600 ppb at times. Although the other sources had considerably lower concentrations they were, at times, above the state action level of 5 ppb ClO_4 , with sewage septic tank/cesspool systems measuring an average value of 4.08 ± 4.97 ppb ClO_4 and road runoff concentrations at 2.20 ± 3.74 ppb ClO_4 . Rain water measured an average value of 0.197 ± 0.445 ppb ClO_4 .

INTRODUCTION

Perchlorate is known to inhibit iodide uptake of the thyroid gland (NRC, 2005). This is of particular concern for sensitive populations such as young children, pregnant women and those with iodide deficiencies. After perchlorate was placed on the Environmental Protection Agency (EPA) contaminant candidate list in 1998 it has been the focus of much research and debate. Although no national standard has been determined the EPA has recommended levels as low as 1 ppb ClO_4 . A large proportion of the initial contamination findings have been associated with military defense sites, as perchlorate is an excellent oxidizer and is used in rocket propellant. When a known point source could not account for perchlorate contamination the culprit was past or present use of Chilean nitrate fertilizer. Yet recently, perchlorate is noted in groundwater not known to be influenced by these sources (Motzer, 2001). In desert regions natural perchlorate, which formed in the atmosphere, can concentrate and account for the concentrations found in places such as the High Plains in Texas (Dasgupta et al., 2005), but in areas with larger rain fall, such as Long Island, nonpoint sources must be evaluated.

METHODS

- Rainwater samples were collected monthly in addition to soil water samples from lysimeters installed at 100 cm below turfgrass sites which we fertilized with organic fertilizer, chemical fertilizer or no fertilizer.
- Fifteen sewage samples from cesspools were acquired from Suffolk County Public Works.
- Road runoff samples were sampled from catch basins at two sites in the Town of Brookhaven. In addition two recharge basins, both with standing water, were sampled at one of the two sites. The samples were acquired after four rain events during April, 2006.
- Perchlorate concentrations were detected using an Ion Chromatograph coupled with a dual mass spectrometer (Aribi and Sakuma, 2005). Detection limit was 0.1 ppb for most samples and 5 ppt for rain water samples.

RESULTS

We measured concentrations of sewage from fifteen septic tank/cesspool systems at 4.08 ± 4.97 ppb ClO_4 and road runoff concentrations at 2.20 ± 3.74 ppb ClO_4 (Figure 1). Household bleach has between 90-400 ppb ClO_4 (with perchlorate content increasing with age of storage) and is likely the major source of perchlorate to household sewage. The only known source of perchlorate to road runoff samples are road flares, which is why we choose two areas of high traffic accidents. However it is not clear at this time if road flares could account for the total amount of perchlorate measured in our study area.

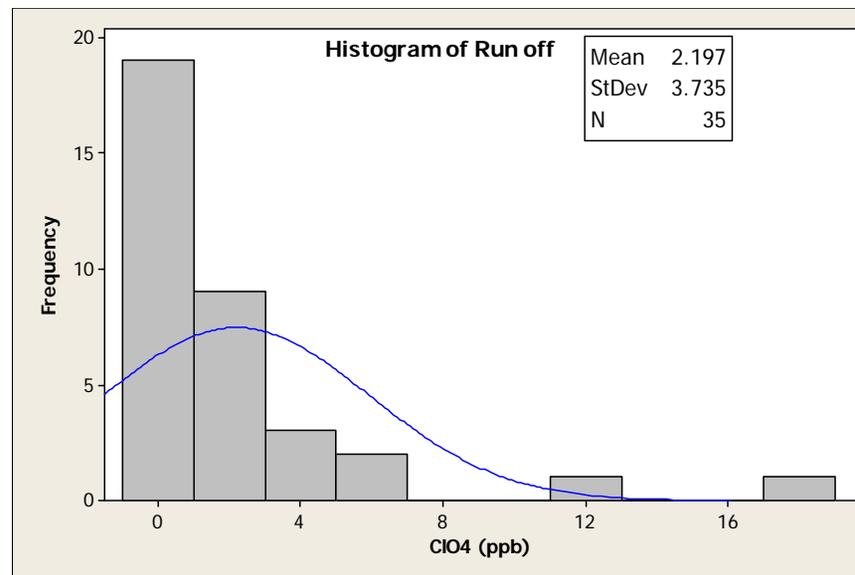
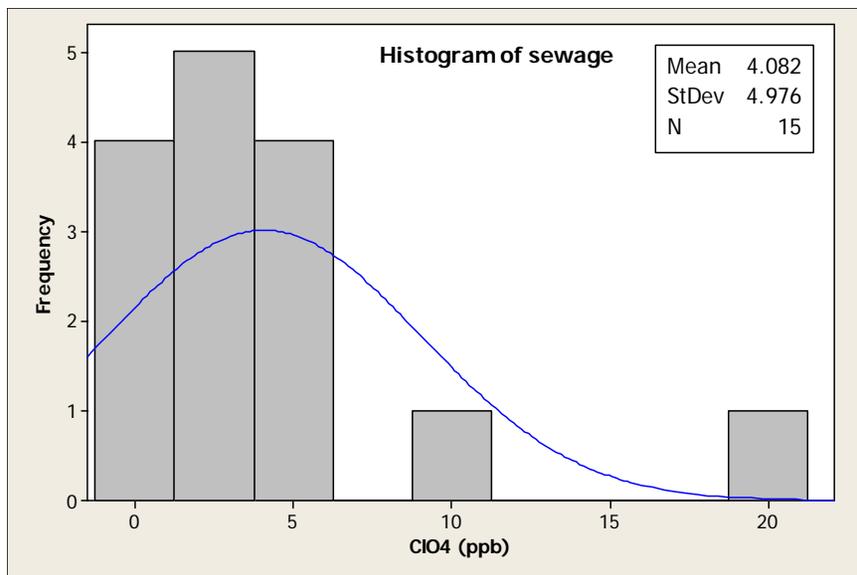


Figure 1. Histograms of Sewage and Road Run off.

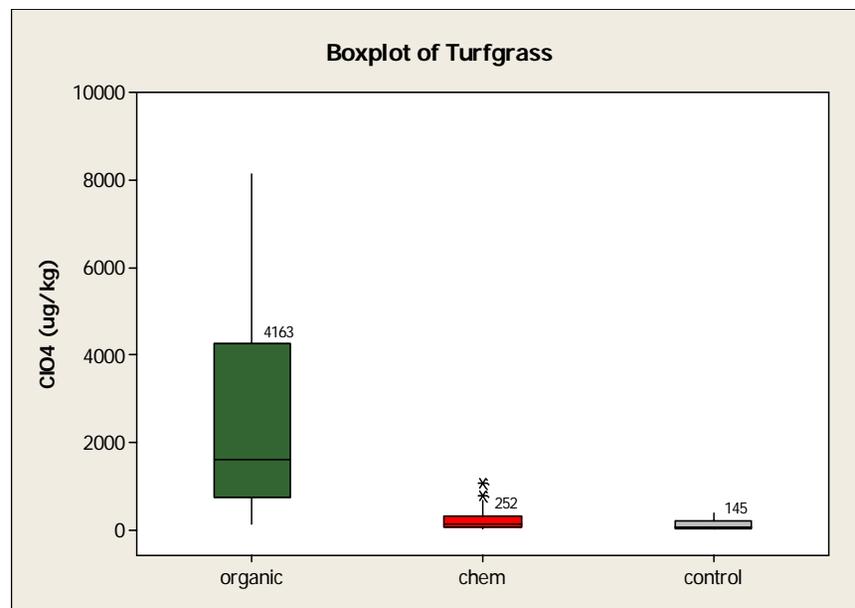
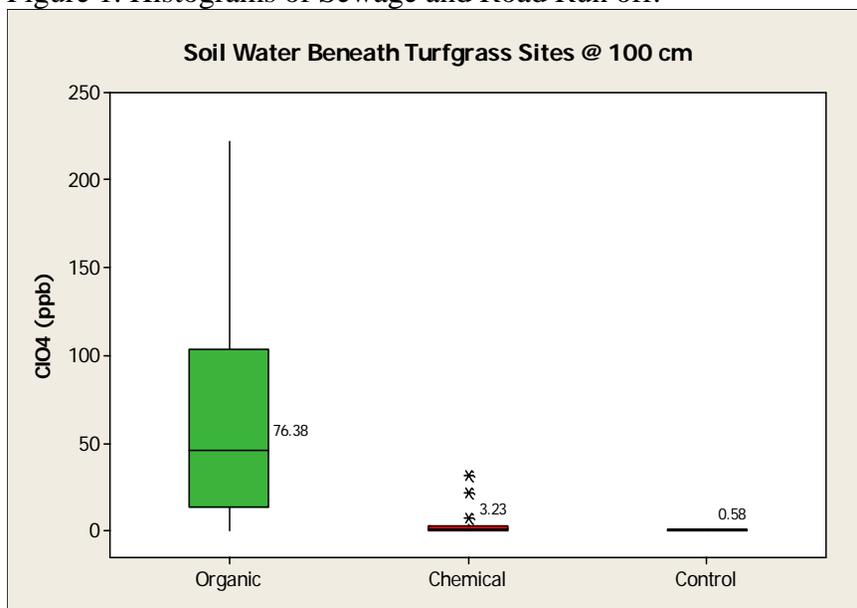


Figure 2. Box plot of soil water and turfgrass concentrations.

Soil water concentrations were the highest measured in this study (Figure 2), specifically soil water collected at 100 cm beneath sites that were fertilizer with an organic fertilizer. We collected samples from April 2006 through January 2007 at five sites in Suffolk County, NY. Fertilizer was applied, once, in May at 5lbs per 1000 ft². The fertilizer had 9 ppm ClO₄. We hypothesize that perchlorate is being stored in the turfgrass (Figure 2) and in the upper layers of the soil profile (Figure 3) and later being released into the profile. A one time fertilizer event can not account for the concentrations of perchlorate measured in the soil water.

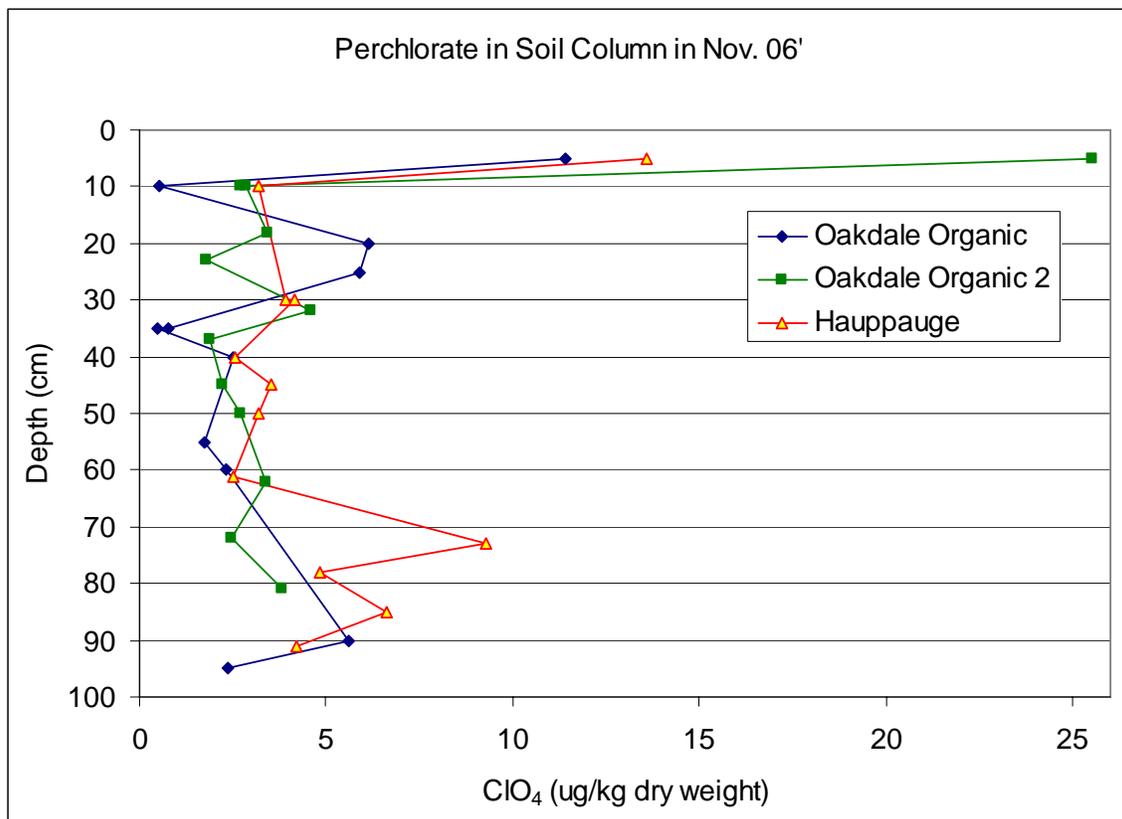


Figure 3. Soil profile of perchlorate content.

Nonpoint sources of perchlorate are prevalent and need further evaluation to understand their impact on groundwater quality

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