Chemistry of a Sewage Plume from a Domestic Cesspool

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Introduction

This is a study of the chemistry of a sewage plume from a residential cess pool in Southaven, Long Island (Fig. 1). The site is south of Montauk highway and about 200 meters west of Carmans River (Fig. 2 and 3). Geologically the site is in a large abandoned valley that was probably a tunnel valley that developed under the glacier that formed the Ronkonkoma moraine. The Carmans River is now reoccupying one of the tributaries in the valley.

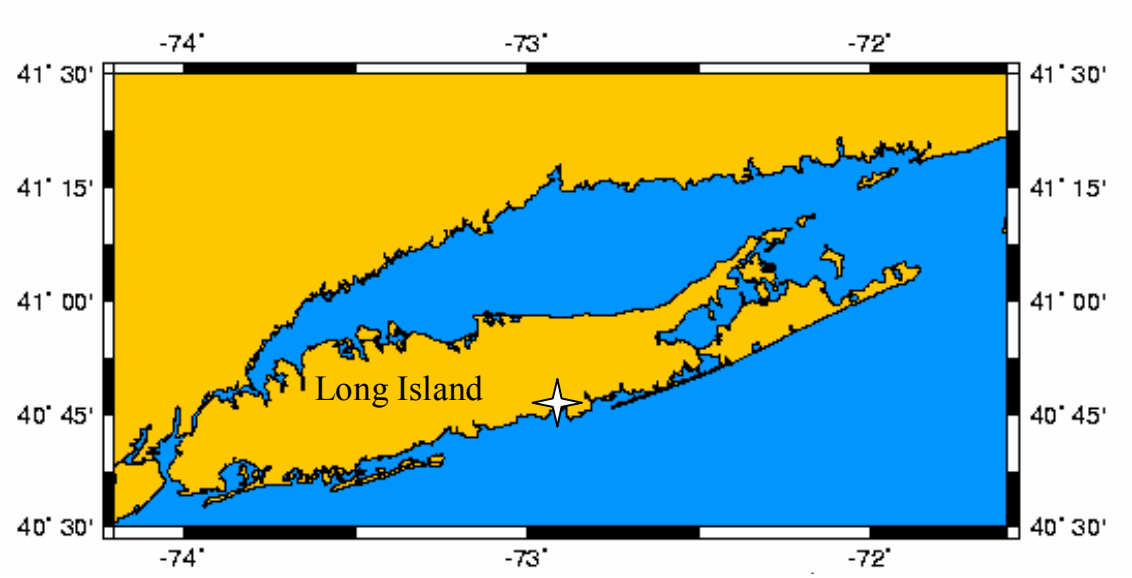

Fig. 1 Star shows location of site on Long Island, New York.

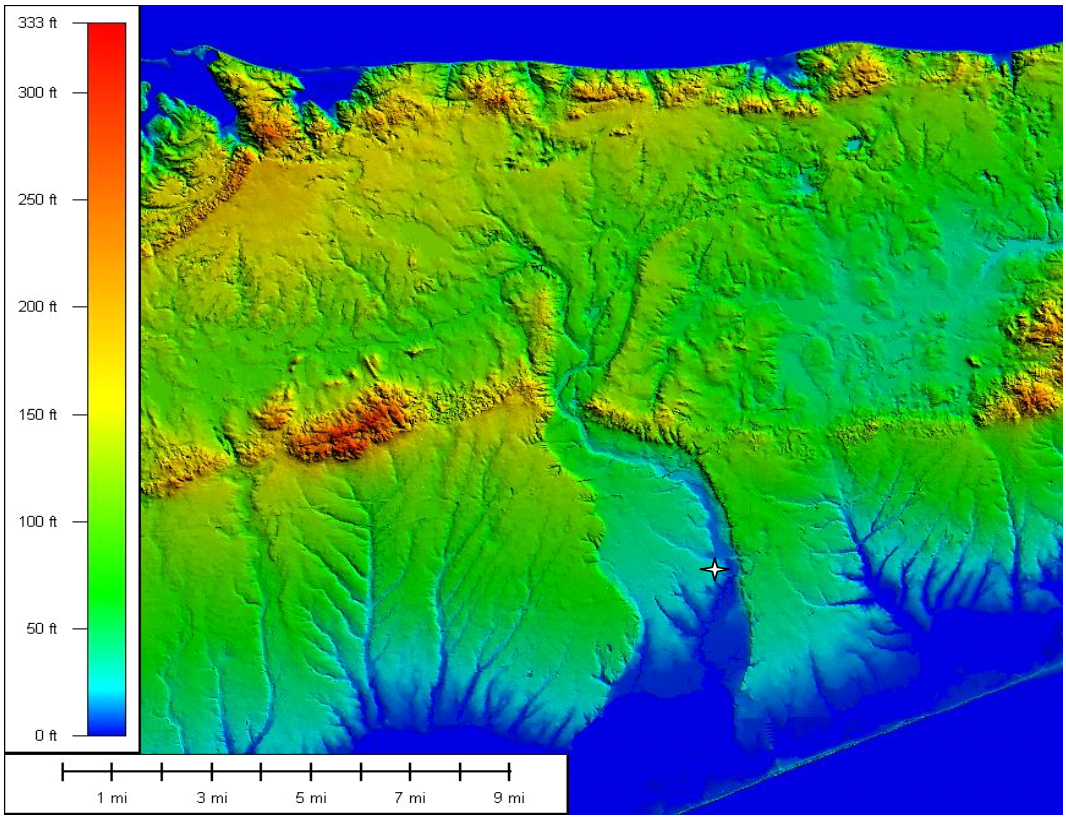

Fig. 2 Shows location of site on Digital Elevation Model of central Long Island. The site is near the Carmans River in the large tunnel valley.

Fig.3 The site is located north of Montauk Highway and west of Carmans river.

The occupants of the house are three senior adults who spend most of each day in the house The sewage treatment occurs only in a cesspool. There is no septic tank. The ground water table is about 12 ft below the surface. Nine sampling wells were installed down gradient from the cesspool along the ground water flow direction and one was installed up gradient (Fig. 4). The waste water is from laundry, kitchen, bathroom and toilet. The lawn is not fertilized or irrigated. The water supply is from a shallow well (24 ft. deep).

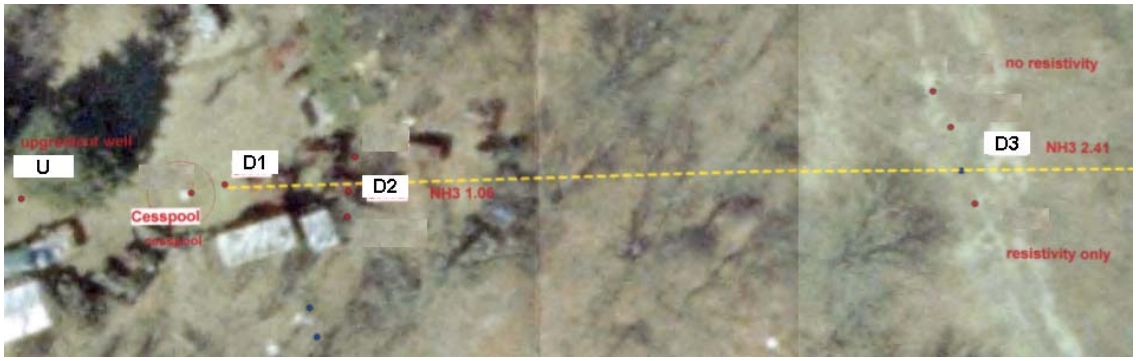

Fig. 4 Location of the site and positions of installed wells.

Results:

Four soil samples were collected parallel to the ground water flow direction: one from up gradient of the cesspool and three down gradient. The grain size distribution for these samples shows a typical well-sorted, medium sand typical of river sand (Fig. 5). The Hazen approximation gives an estimated hydraulic conductivity as 47~70m/day. Taking the hydraulic gradient at this site as 0.003, the groundwater flow velocity is around 0.14~0.25 m/day.

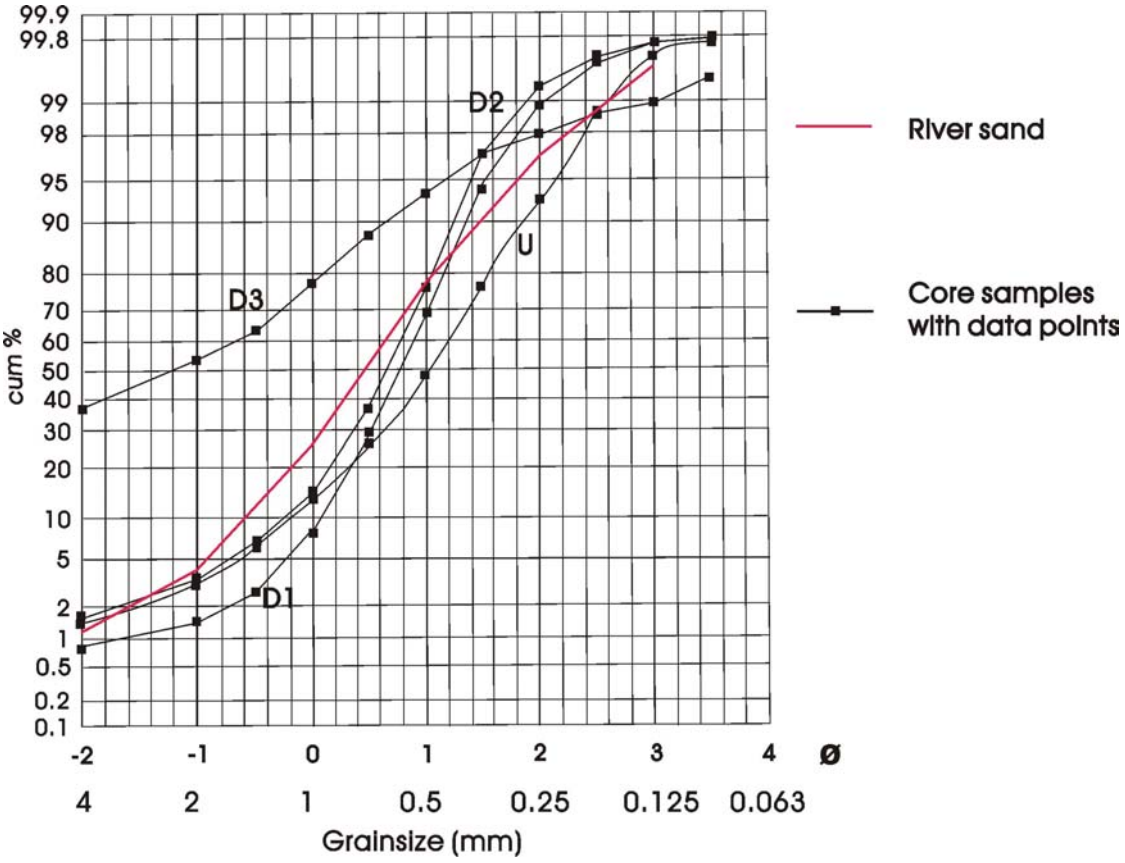

Fig. 5 Grain size distribution analysis of core samples compared with typical river sand. (River sand data is from Richard C. Selley. 2000)

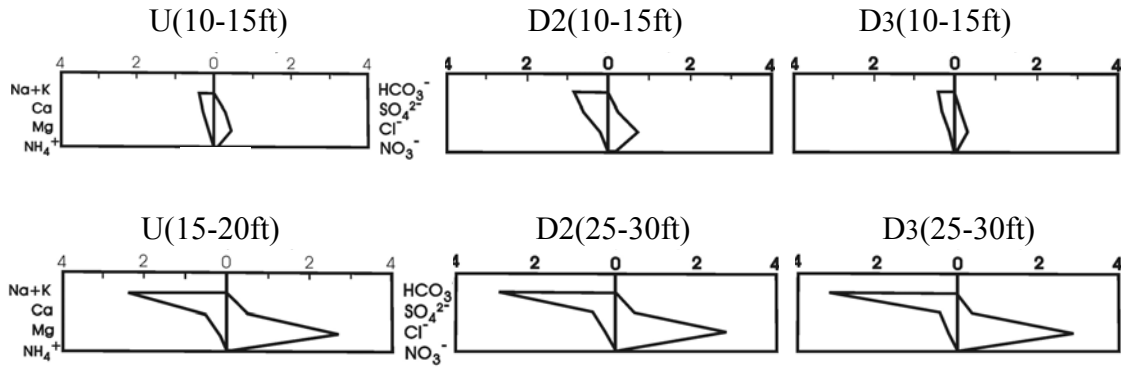

Fig.6 Stiff diagrams showing two distinct plumes on this site. One is in shallow depth (10-15ft) with high Ca; the other is in deep depth (15-30ft) with high Na and Cl.

Major cations and anions were analyzed by Suffolk County Department of Health Services for water samples at three depths (10 to 15 feet, 20 to 25 feet and 25 to 30 feet) in most of the wells. Stiff diagrams were used to discriminate plume characteristics (Fig.6). Two distinct plume types were identified. One was in the shallow ground water about 10-15 ft below surface with a high proportion of Ca; the other plume is deeper, from 20-30 ft below surface and is characterized by high Na and Cl concentration. The total CEC of the soil samples ranges from 0.9 to 2.4 meq/100g with extremely high Ca concentration (Fig.7) compared with CEC data for sands from Cathedral Pine County park (Sonya Boguslavsky, 2000), We suggest that lime may have been stored or scattered over the site when it was a duck farm. The Ca in

the shallower ground water plume is from Ca on the soil. The mole ratio of Na/Cl of 0.98 to 1.06 from the deeper 20-30 ft suggests that its source is road salt (Fig.8). Considering this particular site is only about 200 meters south of the Montauk highway (about 200m), it is proposed that the deep ground water is a road salt plume.

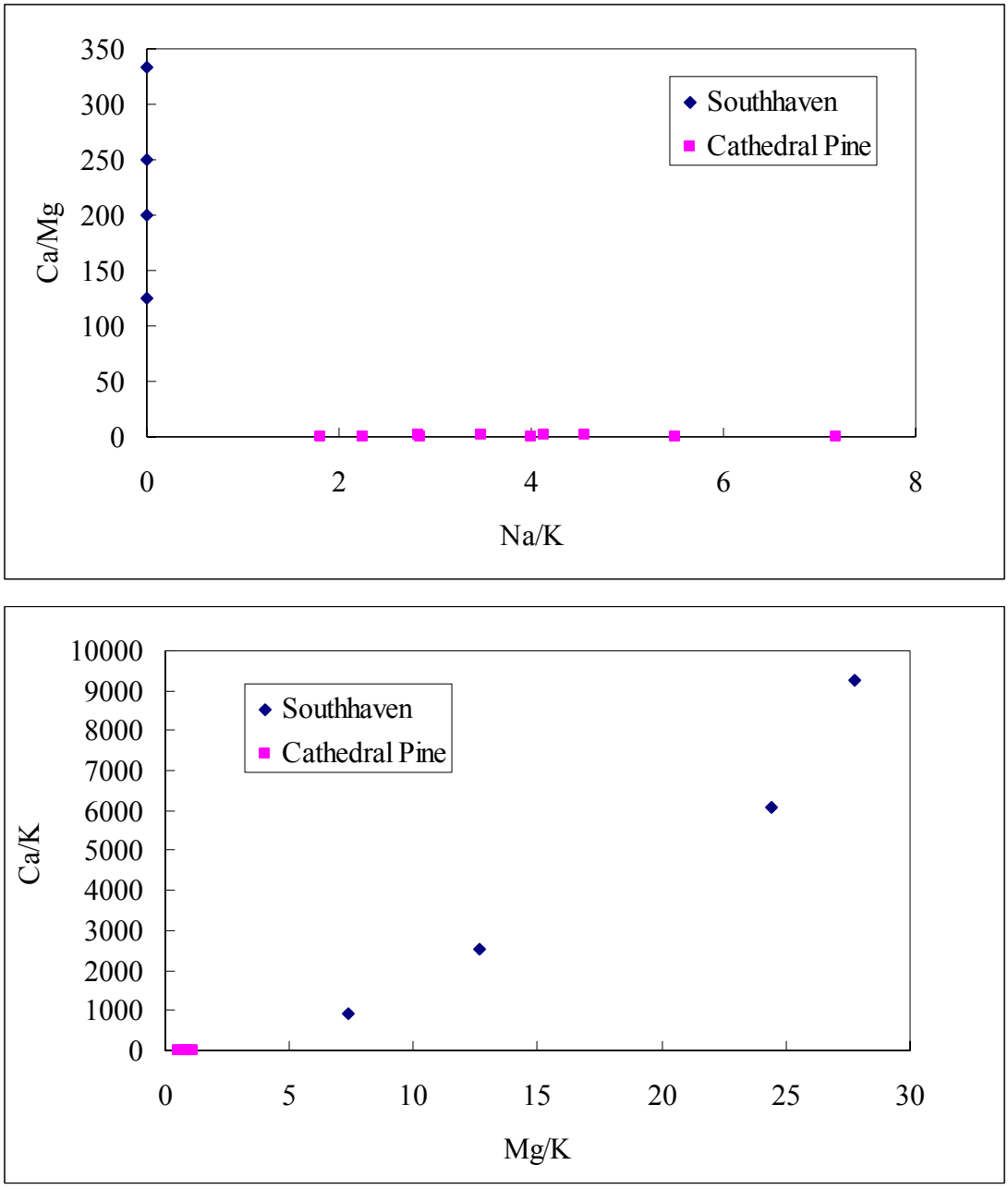

Fig.7 CEC results for core samples compared with Cathedral pine county park (Sonya Boguslavsky, 2000). Na concentrations of all the samples are non-detectable.

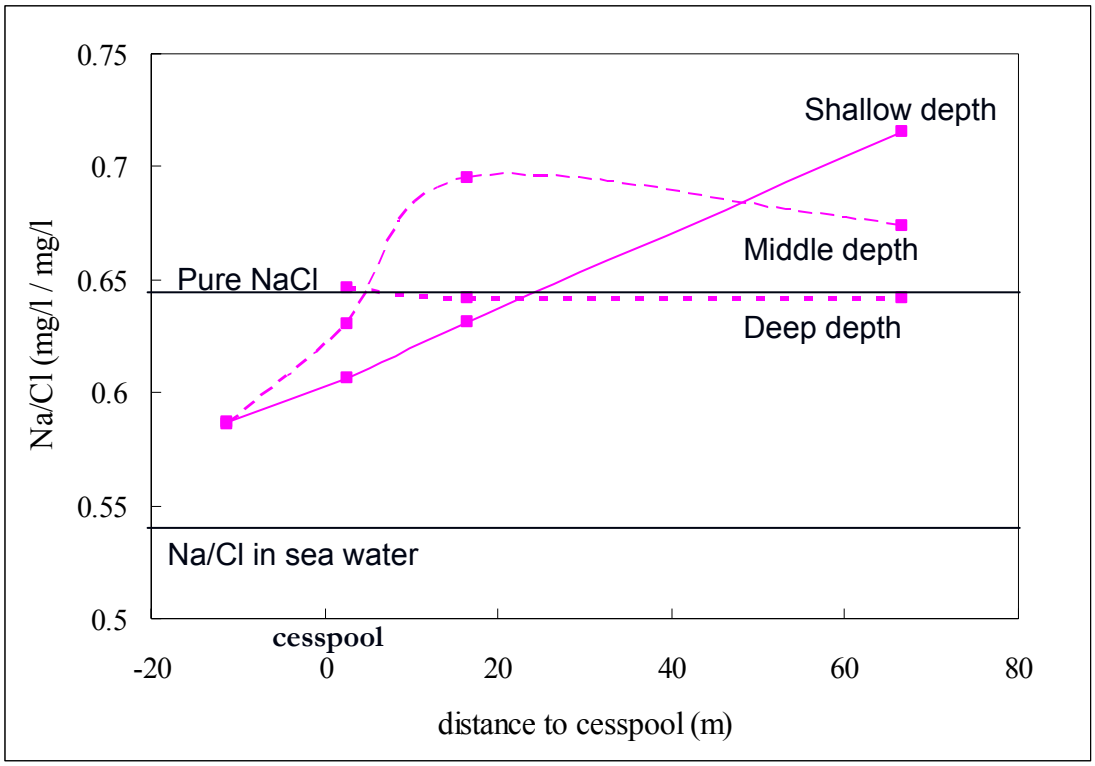

Fig.8 Na vs. Cl concentration in different depth compared with pure NaCl (~0.647) and NaCl concentration in seawater (~0.539).

Summary:
Two distinct plumes were found at this site with sewage plume on top of deeper road salt plume. High concentration of E.Coli was found in the up gradient well. Based on these data, we are suspicious that the water table at this area is so flat that the waste water is no transported down gradient effectively. Highest concentration of NH3 appeared in the down gradient well which is furthermost to the cesspool. Denitrification is proposed but further study is needed to prove this proposition.

Reference:

1. Sonya Boguslavsky. 2000. **Organic Sorption and Cation Exchange Capacity of Glacial Sand, Long Island** . M.S. Thesis. State University of New York At Stony Brook.
2. Richard C. Selley. 2000. Applied Sedimentology (second edition). Academic Press.