MEMORANDUM

To: Groundwater Advisory Council
From: H. Bokuniewicz
Re: Minutes of the Meeting of 20 December 2004
Date: December 21, 2004

PRESENT	**REGRETS**
M. Alarcon	N. Bartilucci
H. Bokuniewicz	R. Liebe
B. Brownawell	R. Mazza
C. Clapp	B. Nemickas
J. K. Cochran	G. Proios
G. Hanson	S. Robbins
S. Jones	K. Roberts
L. Koppelman	K. Willis
J. Milazzo	
D. Paquette	
W. Spitz	

1. The minutes of the last meeting were mailed out. Because attendance was reduced due to the weather, corrections, if any, will be taken up at the next meeting on January 18.

2. Chris Clapp has joined us to work on the Groundwater Clearinghouse. (Angie quit after a few weeks to take a better paying job with a consulting firm). We are looking into the use of ARCIMS which is software to allow web-site access to GIS files. A draft MOU is being reviewed and we hope to finalize it early in the New Year.

3. The summary of 2004 activity was distributed (attached). We are pleased to announce that the NY section of AWWA has joined us as a co-sponsor of the Guerrera Award for graduate research. The Water Authority will also be dedicating a new pump house (across from the Westhampton Train Station) to Gus Guerrera in the spring. At this site, too, they will be doing some experiments in the use of native vegetation.

4. Three of the Institute faculty was present to discuss research directions. Kirk Cochran reviewed some of the work done with geochemical tracers last year. In particular, Janet Reimer completed her master's research dating groundwater using the tritium-helium, carbon-14 and freons. Tritium was enriched in the atmosphere by atomic weapons' tests 50 years ago. Tritium has a half-life of 12 years but its decay can be traced by helium-3. Freons are artificial compounds that were used as refrigerants and propellants. They dissolve in rain and enter the aquifer with recharge. There is some question concerning their reactivity with aquifer materials but, because their concentration has varied in time, they provide a good signal for

dating. Carbon-14 was also enriched in the atmosphere by bomb testing. Its presence in groundwater comes from the fixation of atmospheric CO_2 in the upper soil layers by decomposing organic matter. The dating was done in collaboration with other laboratories; Carbon-14 was done at the Woods Hole Oceanographic Institute, freons at Lamont-Doherty Earth Observatory of Columbia and the tritium-helium at the University of Miami. The resolution of these techniques depends on the age but it usually is within 10 years. Because of the mixing of waters of different ages in supply wells, the average age, provided geochemically, can constrain the mixture of water from different travel-times in the capture zone as defined, for example, by the SWAP modeling.

Geochemical tracers are also being used to study submarine groundwater discharge and the interaction of groundwater with surface waters. Direct measurements with chambers on the sea floor can give you the discharge at a single point but the tracers have the ability to average the total discharge over large areas. Naturally-occurring, radioactive radium is being used because it is concentrated in groundwater. It is a product of the Uranium-thorium decay series. Uranium occurs naturally in the minerals of the aquifer material. The radium, being soluble, is leached out of the soil into groundwater. Four isotopes are used. Radium-228 and radium-226 have half-lives of 6 years and 1600 years respectively but radium-224 and radium-223 are short-lived with half-lives of four days and eleven days respectively so they label water newly released from the aquifer. We have just acquired a new system to measure these short-lived isotopes. Aaron Beck, a graduate student has applied it, preliminarily, in Jamaica Bay. Elevated radium levels are seen in the bay, decreasing with distance offshore, indicating a significant groundwater source. In this case, changes in the groundwater seepage may be contributing to marsh loss in the bay. Marsh loss is also a concern in other locations in Long Island.

The technique is also relevant to considerations of nutrient loading via groundwater seepage. We had discussed in an earlier meeting the possible implications for plans to use the recharge of sewage to groundwater in order to avoid increasing direct discharges of nitrogen into Long Island Sound. The approach may also be applicable to contamination problems in the North Fork, if, for example, surface contamination plumes leak to coastal waters before contaminating deeper sections of the aquifer.

Bruce Brownawell discussed research being done on contamination by personal care products (PCPs). His lab has recently developed new methods enabling the measurements of hormones, and their more soluble conjugates, in groundwater. This is being used to study the lifetime of these compounds in groundwater. Initial data indicates that these compounds are degraded by bacteria within minutes after passing through a septic system, so they do not appear to pose any problems for groundwater.

Studies at the Woodhaven Nursing Home were able to detect several compounds from the septic systems in near-field, groundwater plumes. Caffeine, and its methylated conjugate, paraxanthine, show good mobility due to low absorption and persistence over at least several months. Antibiotics and compounds like Prozac were also detected in near-field plumes. Questions remain about their removal due to adsorption and the rates of degradation. At another site on Cape Cod, plumes of such compounds were detected at depths of 16 feet below the water table and about 20 feet down-gradient but most are degraded in the presence of oxygen in very short times

by microbial oxidation. Questions remain concerning the possible existence of other redox stresses that might influence the distance that anaerobic plumes can migrate.

Work on PCPs and pharmaceuticals is also being done in Jamaica Bay to further study the processes that remove these compounds in water. Possible tracers of sewage include cotinine, a metabolite of nicotine, and paraxanthine, a metabolite of caffeine. Caffeine degrades over a few days by microbial activity and the rates of degradation of metabolites are being determined. In the course of this research some unknown contaminants were detected, one of which has a fairly strong signal, and work is being done to identify it.

A proposal for funding further work, on determining the controls on plume spreading, is being developed for NSF. We are also interested in funding additional sites on Long Island that might have fairly consistent inputs. The Selden Sanitary District has a leaching field but the active elements are rotated over the year which makes it difficult to monitor.

Gil Hanson discussed research on determining sources of contamination by chemical and isotopic signatures. Work has focused on nitrogen but we have been discussing possible applications to perchlorate. (The USGS is planning to use isotopic signatures as a method to identify perchlorate specifically from Chilean fertilizer). Dr. Hanson's research group is both identifying tracers and developing models. Recently, the extent of denitrification is being explored. Previous results so far suggest that there's little denitrification in the groundwater. (If this is the case, recharging sewage to groundwater may not reduce the nitrogen load to coastal waters like Long Island Sound, but merely lengthen the travel-time). The lysimeter work, however, found low concentrations (3ppm) of nitrate below the root zone. These levels are not much above rainwater (1ppm) suggesting that denitrification occurs in the soil. In the groundwater, oxygen levels in supply wells seem to be high (10ppm). Eh values calculated based on nitrate ammonium concentrations in groundwater suggest that denitrification may be occurring in the aquifer. Nitrogen/Argon has a distinctive signature in the atmosphere and may be useful in sorting this out in groundwater.

The use of multiple, inorganic tracers show promise for distinguishing sources. Rainwater, soil water and sewage can be discriminated by their chemical signature. The use of conservative elements, most anions, have little interaction with aquifer material so that their distribution can be described by simple mixing. Others are non-conservative so that sorption-desorption and degradation need to be considered. Jennie Munster is now looking into the use of Chloride, Bromide, Iodide and Boron (all conservative tracers). These can be measured at ppb levels with high (1%) precision.

Modeling cations in contaminated plumes is underway. The results are independent of scale which means that one calculation can have multiple applications. The extent of interaction depends on the number of pore volumes through a plume rather than the size of the plume. The model results compare well with experimental data and show that a sewage plume first causes a release of cations in the distinctive ratio of concentrations unique to the aquifer material. Only when this source is exhausted does the sewage signature appear.

5. Perchlorate is an important issue. At one supply well in East Northport a nitrate removal system was installed but perchlorate has now been detected and it is is not removed by treatment. The EPA has a risk level of 0.5ppb and may impose a standard of 1ppb. There is also an old fertilizer facility in Cutchoge that could be a point source of perchlorate. In the coming year we hope to cooperate with a national, USGS of perchlorate sources perhaps on the North Fork.

6. Pesticides were briefly discussed. Atrazine is the world's most widely used and has been shown to have ecological effects as an endocrine disrupter in amphibian populations in the Midwest. Of course, the Suffolk County Department of Health Services has been proactively investigating pesticide contamination on Long Island. Perhaps an update of those results would be useful.

7. Our next meeting is scheduled for TUESDAY (18 January, the day after Martin Luther King Day) 9:30 – 11 AM at the offices of Dvirka and Bartilucci in Woodbury.

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