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VIA EMAIL

December 13, 2012

Ms. Mandy Yau
Environmental Engineer
New York State Department of Environmental Conservation
Division of Environmental Remediation
Region 2
47-40 21st Street
Long Island City, New York 11101-5407

Re: Proposed Natural Attenuation Monitoring
Coral Island Shopping Center, Staten Island
Brownfield Cleanup Program Site #C243033

Dear Ms. Yau:

The following presents an assessment of the potential for natural attenuation and a proposed long-term groundwater monitoring plan for the Coral Island Shopping Center located at 1650 Richmond Avenue, Staten Island, New York (the "Site"). This information was prepared in response to a New York State Department of Environmental Conservation ("NYSDEC") letter to Roux Associates, Inc. ("Roux Associates") dated August 21, 2012 and a September 11, 2012 meeting between Roux Associates and NYSDEC. As will be discussed in greater detail below, Roux Associates is proposing two groundwater monitoring events a year for an expected duration of approximately 17 years.

Background

Roux Associates and NYSDEC have been negotiating a long-term groundwater monitoring plan for the Site, as required by the Site Management Plan ("SMP"). Multiple rounds of groundwater sampling have been conducted since the approval of the SMP in support of various proposals. The latest data collected was submitted to NYSDEC in January 2012. That submittal included a summary of groundwater analytical and groundwater flow data collected on or around October 26, 2011 (the "Fall 2011" sampling event). The Fall 2011 data was reported as being consistent with expectations and Roux Associates concluded that residual contamination would continue to degrade under existing subsurface conditions.

NYSDEC responded to Roux Associate's January 2012 letter in the August 21, 2012 letter indicating that:

1. "Based on dissolved oxygen levels in groundwater, anaerobic degradation is most likely at an end. Dissolved contaminants will not continue to degrade under existing subsurface conditions..."; and

2. "Monitored natural attenuation may be an acceptable alternative to additional treatment; however, data must be presented to justify that natural attenuation exists and will continue to occur."

The following responds to those concerns.

Biogeochemistry
Evaluating the current dissolved oxygen levels by themselves would suggest that anaerobic degradation is most likely at an end. However, oxidation reduction potential ("ORP") measurements and the detection of ethane and ethene in the most recent sampling event support the position that natural attenuation exists and should continue to occur.

NYSDEC has indicated on several occasions their concern that the biogeochemical environment of the subsurface was only favorable for anaerobic degradation because of the enhanced reductive dechlorination ("ERD") remediation in 2007, and that the life cycle of the electron donor used in that remediation (molasses) has ended. Roux Associates agrees that the life cycle of the molasses has ended, however we also believe that anaerobic conditions still exist at the Site, and existed at the Site prior to the ERD remediation.

This belief is supported primarily by negative ORP measured in groundwater during the Fall 2011 sampling event at one or more monitoring wells in clusters MW-101, MW-103, MW-107, MW-112, MW-113, MW-205, MW-206, and MW-207 (Table 1). It is believed that these are natural conditions as compared to lingering effects of the ERD remediation as many of the Fall 2011 ORP measurements are similar to ORP measurements from pre-remediation sampling conducted in 2007 (clusters MW-101, MW-103, MW-113, MW-205, and MW-206) (Table 1). To further support this position, the ORP in monitoring well MW-203D was -91 millisiemens per centimeter in the Fall 2011 sampling event (Table 1). As monitoring well MW-203D is located outside of any treatment zone this data further supports that anaerobic conditions do exist at the Site today (Figure 1).

In addition to ORP measurements, the Fall 2011 groundwater analytical results include concentrations of ethene and ethane in nine monitoring wells (MW-101D, MW-101S, MW-112D, MW-113D, MW-113S, MW-205D, MW-205S, MW-206D, and MW-207D) (Table 1). The continued presence of these dechlorination byproducts is considered to be another indicator that natural attenuation via anaerobic degradation exists at the Site today and can continue to occur.

Proposed Groundwater Sampling Plan
As Roux Associates believes natural attenuation via anaerobic degradation exists at the Site, we are proposing a monitored natural attenuation as an alternative to additional groundwater treatment. The primary components of that plan include a specific network of monitoring wells, sampling frequency, and a sampling duration.

Monitoring Well Network and Frequency
NYSDEC's August 21, 2012 letter also indicated that the frequency and network of monitoring wells must be taken into consideration when selecting the long-term approach. The monitoring well network and frequency proposed below is intended to be an appropriate effort that provides

two sampling events a year, with one of those sampling events being limited to a single day of fieldwork.

Evaluating concentrations of PCE and its degradation byproducts (contaminants of concern "COCs") in all samples collected during the Fall 2011 sampling event, 11 of 23 samples had at least one individual COC detected above NYSDEC Ambient Water Quality Standards and Guidance Values ("AWQSGVs"). Five of those samples had concentrations of total COCs that were less than 100 parts per billion ("ppb"). The following scope of work is proposed for long term groundwater monitoring:

- Semiannual Sampling: Groundwater samples will be collected from four monitoring wells: MW-101S, MW-107D, MW-112D, and MW-205D in the spring and fall of each year. These monitoring wells were selected for semiannual sampling based on the most current sampling data and/or their location within the assumed contaminant plume as described in the embedded table below. Field parameters including dissolved oxygen, oxidation reduction potential, pH, temperature, and specific conductance will be recorded and groundwater samples will be analyzed for volatile organic compounds only.

Proposed Semiannual Sampling			
Monitoring Well	**Total COCs* (ppb)**	**Sampling Frequency**	**Sampling Rational**
101S	174	Spring/Fall	Former Source Area
107D	980	Spring/Fall	Total concentration of COCs
112D	110	Spring/Fall	Near current extent of COC plume
205D	1,003	Spring/Fall	Total concentration of COCs

* Collected during the Fall 2012 sampling event

- Annual Sampling: In addition to the four monitoring wells listed above, groundwater samples will be collected from an additional seven monitoring wells in the fall of each year. These monitoring wells provide a more comprehensive understanding of the entire Site and were selected for annual sampling based on the most current sampling data and/or their location within the assumed contaminant plume as described in the embedded table below. Field parameters including dissolved oxygen, oxidation reduction potential, pH, temperature, and specific conductance will be recorded and groundwater samples will be analyzed for volatile organic compounds only.

Proposed Annual Sampling			
Monitoring Well	**Total COCs* (ppb)**	**Sampling Frequency**	**Sampling Rational**
101D	0	Fall	Former Source Area
103D	102	Fall	Relatively low concentration of Total COCs

Proposed Annual Sampling			
Monitoring Well	**Total COCs* (ppb)**	**Sampling Frequency**	**Sampling Rational**
108D	0	Fall	Upgradient
113D	65	Fall	Relatively low concentration of Total COCs
203D	0	Fall	Downgradient sentinel well
206D	130	Fall	Relatively low concentration of Total COCs
207D	21.3	Fall	Relatively low concentration of Total COCs

* Collected during the Fall 2012 sampling event

- Water Level Measurement: Water level measurements will be collected from all monitoring wells at the Site during each semiannual and annual sampling event.

It should be noted that three monitoring wells with at least one COC exceeding AWQSGVs were excluded from the proposed sampling program (MW-113S, MW-107S, and MW-205S). These wells were excluded as they have relatively low concentrations of COCs and the other well in the cluster is being sampled.

Excluded Monitoring Wells			
Monitoring Well	**Total COCs* (ppb)**	**Sampling Frequency**	**Rational**
113S	39.1	Excluded	Low concentrations, other well in cluster sampled
107S	9.5	Excluded	Low concentrations, other well in cluster sampled
205S	3.9	Excluded	Low concentrations, other well in cluster sampled

* Collected during the Fall 2012 Sampling Event

Sampling Duration

In order to develop bulk attenuation rates and degradation time frames, data from one or more monitoring wells in clusters MW-101, MW-103, MW-112, MW-113, MW-205, MW-206, and MW-207 were used to develop first order attenuation rate constants ("k") for each COC. These wells were selected as they had detections of these parameters as initial concentrations on or around June 30, 2008 (the "Summer 2008" sampling event) and/or a final concentration in the Fall 2011 sampling event (Table 2). Initial and final data were analyzed using an exponential

regression (regression analysis) to calculate an attenuation rate constant for each parameter in each well, which were then averaged (Table 3).

The averages of all attenuation rates for each parameter were used with the current maximum Site-wide concentrations of those parameters (initial value) and the AWQSGVs (final value) to calculate degradation rates. The results from the regression analysis show that the constituents have an average rate constant corresponding to approximately 3 to 6 years for PCE and trichloroethene ("TCE"), respectively and approximately 13 years to 17 years for cis-1,2 dichloroethene ("cis–1,2 DCE") and vinyl chloride ("VC"), respectively (Table 3). As VC appears to be the limiting factor for natural attenuation across the Site, the calculated degradation rate of 17 years for that COC has been assumed as the sampling duration.

Summary

Roux Associates believes that natural attenuation via anaerobic degradation exists at the Site and will continue. We are therefore proposing monitored natural attenuation that includes two sampling events per year. One semiannual event includes four monitoring wells selected primarily due to the current concentrations of total COCs. A second annual event includes an additional seven monitoring wells that provides a more comprehensive understanding of the entire Site. Average attenuation rates were calculated for each COC using data from across the Site. These values were then used to calculate degradation rates with the longest rate being 17 years for VC. This has been assumed as the sampling duration.

The natural attenuation component of the Monitoring Plan will be evaluated on an annual basis as part of the Periodic Review Report as required by the SMP and Roux Associates may make recommendations to change the plan based on that evaluation. If you have any questions or require additional information, please contact me by email at mroux@rouxinc.com or by telephone at 631-232-2600.

Sincerely,

ROUX ASSOCIATES, INC.

Michael Roux
Principal Hydrogeologist

cc: Jane O'Connell, NYSDEC
Christopher Magee, NYSDEC
Wendy Marsh, Hancock Estabrook