STERLING
Sterling Environmental Engineering, P.C.

November 17, 2011

Mr. Carl Hoffman, P.E.
Environmental Engineer II
Division of Environmental Remediation
NYSDEC
625 Broadway
Albany, New York 12233-7013

Subject: Town of Ramapo Landfill
2011 Annual Post-Closure Monitoring Report
STERLING File #20010 (Task 200)

Dear Mr. Hoffman,

This report provides groundwater and air quality monitoring results for the 2011 Annual Post-Closure Monitoring (PCM) event conducted for the Town of Ramapo Landfill (Landfill), Rockland County, New York (see Figure 1, Site Location and Figure 2, Property Features). The New York State Department of Environmental Conservation (NYSDEC) approved a variance request on October 27, 2003, reducing the monitoring frequency to annually. The monitoring event is rotated to the next quarter for each year.

Groundwater samples were collected on September 20 and 21, 2011 by Sterling Environmental Engineering, P.C. (STERLING) and analyzed for parameters listed in Table 1. Samples were collected from monitoring wells 1-OS/I, 2-OS, 3-OS/I, 4-OS, 5-OS, 7-OS, 8-OS, 8-I, 8-R, 9-OS, 9-I, 9-R, private water supply wells PW-1 and PW-2, and municipal water supply wells SVWC-93 and SVWC-94. Municipal wells SVWC-95 and SVWC-96 were not sampled for this event because they were out of service for maintenance/repair. Static water level readings were obtained at all of the sampled monitoring wells and at monitoring wells 1-R, 2-R, 3-R, 4-R, 5-R, 6-I, 6-R, 7-I and 7-R. Sample locations are shown on Figure 3.

The 2011 air quality monitoring event was conducted on September 21, 2011. Air monitoring locations are shown on Figure 3 and results are summarized on Table 2.

In addition, the following tasks were conducted by STERLING, as specified in the United States Environmental Protection Agency (USEPA) December 2009 Five-Year Review Report for the Town Landfill:

1. Completed a site inspection of the Landfill cover, surface water drainage and erosion control features on September 21, 2011. An Inspection Checklist and Photograph Log are provided as Appendix A.

2. Discharge volumes for the groundwater/leachate extraction wells located on the downgradient side of the Landfill are summarized in Table 3.

3. Analytical results from 2009 through 2011 for leachate/groundwater pumped from the Landfill extraction wells to the Rockland County Sewer District (RCSD) #1 Publicly Owned Treatment Works (POTW) formerly located at 4 Route 340, Orangeburg, NY, and currently at the Western

24 Wade Road ✦ Latham, New York 12110 ✦ Tel: 518-456-4900 ✦ Fax: 518-456-3532
E-mail: sterling@sterlingenvironmental.com ✦ Web Site: www.sterlingenvironmental.com

Ramapo Treatment Plant in Hillburn, NY, are provided in Appendix B and summarized in Table 4.

4. Evaluated analytical data for shallow monitoring wells to determine if associated cluster wells (intermediate and bedrock wells) should be sampled to evaluate if vertical contamination migration is occurring. Based on this evaluation, samples from monitoring wells 1-R, 2-R, 3-R, 5-I and 5R were collected and analyzed for the Total Analytical List (TAL) Metals for the 2011 PCM event. Analytical results are included in Tables 6 and 7.

Results for the 2011 PCM event are summarized below:

GROUNDWATER FLOW DIRECTIONS

Depth to water measurements from September 20 and September 21, 2011 were used to determine groundwater elevations in the overburden and bedrock aquifers. Groundwater flow direction in the overburden aquifer is to the northwest and southwest, towards Torne Brook and the Ramapo River (see Figure 4). Groundwater flow direction in the bedrock aquifer is more radial, towards the northeast, northwest and southwest (see Figure 5).

GROUNDWATER MONITORING

All samples were analyzed by TestAmerica, Inc. laboratory, located in Amherst, New York, according to the USEPA methodologies and protocols. A copy of the laboratory report, prepared according to NYSDEC Analytical Services Protocol (ASP) Category A reporting requirements, is provided as Appendix C.

Static Water Level, Specific Conductivity, Temperature, pH and Oxidation Reduction Potential (ORP) readings were measured in the field and are presented on Table 5, "Field Parameter Measurements".

The 2011 analytical results are summarized on Tables 6 and 7, "Post-Closure Monitoring Water Quality Results." Historical data for selected parameters are summarized in Tables 8 through 17, with corresponding concentration versus time plots.

A duplicate sample was collected from groundwater well 9-R and is labeled DUP-1.

Analytical results for monitoring well samples are compared with the NYSDEC Division of Water Technical and Operational Guidance Series 1.1.1, Ambient Water Quality Standards and Guidance Values (June 1998) (TOGS 1.1.1). Analytical results for the private and municipal drinking water supply wells are compared with the 10 NYCRR Part 5 MCLs and the USEPA Maximum Contaminant Levels (MCLs) for Primary Drinking Water Regulations. A summary of reported parameter exceedances for sample locations is provided below.

Reported concentrations for the following parameters exceed the applicable water quality standard:

Parameter	Well Location
Antimony	1-OS/I
Arsenic	1-OS/I, 3-OS/I
Chromium	1-OS/I, 1-R, 2-OS, 3-OS/I, 3-R, 4-OS, 5-OS, 5-R, 7-OS, 8-OS, 9-I, 9-OS
Iron	1-OS/I, 1-R, 2-OS, 3-OS/I, 3-R, 4-OS, 5-I, 5-OS, 5-R, 7-OS, 8-I, 8-OS, 8-R, 9-I, 9-OS, 9-R
Lead	1-OS/I
Magnesium	8-R
Manganese	1-OS/I, 1-R, 2-OS, 2-R, 3-OS/I, 3-R, 5-OS, 5-R, 7-OS, 8-I, 8-OS, 8-R, 9-I, 9-R
Nickel	1-OS/I, 1-R, 2-OS, 3-OS/I, 3-R
Sodium	1-OS/I, 1-R, 3-OS/I, 3-R, 4-OS, 8-I, 8-R, 9-R
Thallium	9-I

Reported concentrations for drinking water supply well samples PW-1, PW-2, SVWC-93 and SVWC-94 do not exceed the applicable water standards for all analyzed parameters.

The reporting limit (RL) of 15 ug/L for Antimony for the 3-R and 9-I samples exceeds the groundwater standard of 3 ug/L. In addition, the RLs of 5 ug/L for Benzene and Vinyl Chloride exceed the groundwater standard of 1 ug/L and 2 ug/L, respectively, for all samples. However, there are no reported values higher than the Method Detection Limit (MDL), which is lower than the applicable groundwater standards and the RLs.

CONCENTRATION VERSUS TIME TRENDS

The concentration trends over time for parameters with exceedances reported for this event are presented in plots shown in Tables 8 through 17 and are summarized below:

Antimony (Table 8)

The Antimony level in monitoring well 1-OS/I fluctuates over time, however in general is decreasing.

Arsenic (Table 9)

Arsenic levels in 1-OS/I are increasing slightly over time. This is the first event since June 1999 for 3-OS/I samples where Arsenic is reported at a concentration that exceeds the groundwater standard (53 ug/L versus 25 ug/L (TOGS 1.1.1)).

Chromium (Table 10)

All of the following wells show an increasing trend in Chromium levels over time: 1-OS/I, 1-R, 2-OS, 3-OS/I, 3-R, 4-OS, 5-OS, 5-R, 7-OS, 8-OS, 9-I, 9-OS.

Iron (Table 11)

The following wells show an increasing trend over time: 1-OS/I, 3-OS/I, 3-R, 5-OS, 5-R, 7-OS, 8-I, 9-OS, 9-I, 9-R.

The following wells show a decreasing trend over time: 2-OS, 4-OS, 8-R.

The following wells show no discernible trend over time: 1-R, 5-I, 8-OS

Lead (Table 12)

The Lead concentration in monitoring well 1-OS/I fluctuates, however is generally increasing over time.

Magnesium (Table 13)

The Magnesium concentration in well 8-R is slightly increasing over time.

Manganese (Table 14)

The following wells show an increasing trend over time: 1-OS/I, 1-R, 3-R, 5-OS, 5-R, 7-OS, 8-I, 9-I, 9-R.

The following wells show a decreasing trend over time: 2-OS, 8-OS, 8-R.

The following wells show no discernible trend over time: 2-R, 3-OS/I.

Nickel (Table 15)

Wells 1-OS/I, 1-R, 2-OS, 3-OS/I and 3-R all show an increasing trend over time.

Sodium (Table 16)

The following wells show an increasing trend over time: 1-OS/I, 3-OS/I, 3R, 4-OS, 8-I, 9-R

The following wells show a decreasing trend over time: 1-R, 8-R

While there is no drinking water quality standard for Sodium, the reported concentrations in PW-1, SVWC-93, and SVWC-94 are increasing over time.

Thallium (Table 17)

Well 9-I slightly exceeds the groundwater standard of 0.5 ug/L with a reported concentration of 0.6 ug/L.

AIR QUALITY MONITORING

Air quality monitoring consists of monitoring explosive gas (measured by Lower Explosive Limit, or LEL), Hydrogen Sulfide (H_2S) and Volatile Organic Compounds (VOCs) for the headspace of each monitoring well, the baler building, leachate Manhole A-5, lift stations A-10 and W-20, and breathing

space of the Landfill perimeter at designated locations shown on Figure 3. Air quality monitoring results are summarized in Table 2. LEL and H_2S measurements were obtained with a QRAE Multi gas monitor, and VOC measurements were obtained with a miniRAE 3000 photoionization detector (PID).

The June 2011 air quality monitoring survey for explosive gas, H_2S, and VOCs reports no detected readings above background readings, except for one (1) VOC reading in the baler building at 0.6 parts per million (ppm), which is considered a minor detection. Based on the 2011 air quality monitoring results, the Landfill is in compliance with the requirements of 6 NYCRR 360-2.15(k)(4).

LANDFILL SITE INSPECTION

The Landfill site inspection was conducted by STERLING on September 21, 2011 for the following items: vegetative cover, surface water drainage structures, access road, Landfill cover, gabion retaining walls, fences and gates, slope stability, burrow holes and gas vents. A completed Inspection Checklist is provided in Appendix A.

Vegetative growth is present in the easternmost feeder channel to downchute 4, at the head of downchute 4, the northern section of the drainage ditch along Torne Valley Road and drainage channel 4 (see Figure 6 for surface water drainage locations). Photographs of items noted in the site inspection are provided in Appendix A and photograph locations are shown on Figure 6. STERLING recommends vegetative growth from the noted areas be removed to allow Landfill surface water runoff to drain properly.

One (1) gas vent on the southeast side (see Photograph 9) is bent and needs to be repaired, and one (1) gas vent on the west side of the Landfill (see Photograph 12) is disconnected and needs to be repaired or replaced.

All other inspected Landfill items are in acceptable condition.

EXTRACTION WELL DISCHARGE VOLUMES AND OPERATION PERIODS

As of October 2011, extraction wells W-1, W-3, W-5, W-6 and W-7 are operating and W-2 and W-4 are out of service. The Town has ordered replacements for the transducers, which measure depth to water, for these two (2) wells. Lift Stations A-10 and W-20 are currently operating. Extraction well and lift station locations are provided in Figure 7.

Leachate/groundwater volumes pumped from the Landfill to the RCSD POTW from 1995 to 2011 are summarized in Table 3. The volumes for 1997 and 1998 are estimated because of malfunctioning equipment and therefore no data was collected.

EXTRACTED LEACHATE/GROUNDWATER QUALITY DATA

Until June 2011, leachate and groundwater from the Landfill extraction well network was pumped to the RCSD #1 POTW located at 4 Route 340, Orangeburg, New York. Analytical testing of the Landfill leachate/groundwater occurs on a bi-annual basis from a manhole located upstream of the discharge to the leachate wet well. Analytical results from September 2009 to July 2011 are summarized in Table 4. Reported parameter concentrations are compared with maximum concentration limits set by the RCSD. There are no reported exceedances for any of the listed sampling events.

Starting in June 2011, leachate/groundwater collected by the Landfill extraction wells is pumped to the RCSD #1 Western Ramapo Treatment Plant in Hillburn, New York. Sampling of the discharge from the Landfill is still collected from the same location described above on a bi-annual basis.

CONCLUSIONS / RECOMMENDATIONS

STERLING recommends vegetative growth be removed by the Town from surface water drainage systems noted in the Landfill Site Inspection section to maintain proper surface water discharge from the Landfill cover.

In addition, the two (2) damaged gas vents on the Landfill (see Photograph Log and Figure 6 for locations) should be repaired or replaced.

Air quality measurements for all locations are acceptable and are compliant with 6 NYCRR 360-2.15(k)(4) regulations.

Leachate/groundwater collected from the Landfill and discharged to the RCSD #1 meets the industrial permit requirements for samples collected from August 2009 to July 2011.

As of October 2011, two (2) of the seven (7) extraction wells are out of service (W-2 and W-4). STERLING will notify the NYSDEC and USEPA when extraction wells W-2 and W-4 are back in service.

TAL metal analytical results for samples from bedrock monitoring wells 1-R, 2-R, 3-R, 5-R and deeper overburden well 5-OS indicate downward vertical migration of some metals is occurring into bedrock.

Chromium levels in 1-R, 3-R and 5-R are significantly higher than results for samples collected in April 2003, the last sampling event for these wells. Chromium levels for well 2-R are much lower than 2-OS (2.7 ug/L vs. 1,000 ug/L) which indicates vertical migration of Chromium is not occurring at this location. Potential sources of Chromium impacting the upgradient monitoring well cluster (5-OS, 5-I and 5-R) should be evaluated.

The Sodium level in bedrock well 1-R (23,900 ug/L) is lower than 1-OS/I (101,000 ug/L) however the Sodium concentration in 3-R (59,000 ug/L) is higher than 3-OS/I (57,200 ug/L), therefore downward vertical migration of Sodium may not be a source of contamination in the bedrock aquifer.

General trends indicate Chromium, Iron, Manganese, Nickel and Sodium are increasing for several monitoring wells (see Pages 3 and 4). Analytical results for the drinking water supply well samples for this event indicate there are no reported exceedances of the applicable water quality standards.

Drinking water supply wells PW-1, PW-2, SVWC-93 and SVWC-94 as well as monitoring wells 9-OS, 9-I and 9-R will be sampled on November 29, 2011, which is a quarterly monitoring event.

The next annual sampling event is scheduled for the fourth quarter of 2012. Please contact me should you have any questions or comments.

Very truly yours,

STERLING ENVIRONMENTAL ENGINEERING, P.C.

Elizabeth M. Davis

Elizabeth M. Davis, CPG
Hydrogeologist
liz.davis@sterlingenvironmental.com

EMD/bc
Email Only (NYSDEC)
Attachments (Figures 1-7, Tables 1-17, Appendices A-C)

cc: George Jacob, USEPA
John Olm, NYSDOH*
Edward Dzurinko, Town of Ramapo
Judy Hunderfund, Rockland County DOH*
Kathy Quinn, Rockland County DOH*
Chris Berke, United Water New York *
Tanyo Parashkevov, United Water New York*
John France, Torne Brook Farm **
Rosie Digianni, 20 Torne Brook Road **
Arlene Lapidos, Ramapo Land Co., Inc. *

* letter, figures and Tables 1-7 only.
** letter and Table 7 only.

20010/Reports/2011 Annual Results_ltr.doc