# Third Five-Year Review Report

# Ramapo Landfill Superfund Site

## Rockland County
## Town of Ramapo, New York

## Prepared by

## U.S. Environmental Protection Agency
## Region 2
## New York, New York

## December 2009

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| Acronyms Used in this Document | |
|---|---|
| ARAR | Applicable or Relevant and Appropriate Requirements |
| COPC | Contaminants of Potential Concern |
| ESD | Explanation of Significant Differences |
| EPA | United States Environmental Protection Agency |
| HI | Hazard Index |
| mg/kg | milligrams per kilogram |
| MCL | Maximum Contaminant Level |
| NPL | National Priorities List |
| NYSDEC | New York State Department of Environmental Conservation |
| O&M | operation and maintenance |
| PRP | potentially responsible party |
| RD | Remedial Design |
| RI/FS | Remedial Investigation/ Feasibility Study |
| ROD | Record of Decision |
| RPM | Remedial Project Manager |
| µg/l | micrograms per liter |
| VOC | volatile organic compound |
| WQSGV | NYSDEC Water Quality Standards and Guidance Values |

## Executive Summary

This is the third five-year review for the Ramapo Landfill Superfund site, located in the Town of Ramapo, Rockland County, New York. During the review period, contamination was detected in a sentinel well for three consecutive sampling events and was detected in private and public supply wells and institutional controls are not currently implemented. It is believed that the increases in groundwater contaminant concentrations in the sentinel well and in the private and public supply wells may be attributable to the operational problems of two of the extraction wells. Now that these wells have been properly operating for over two years, the wells should be sampled quarterly for a year to ensure a downward trend. In addition, the private and public water supply wells need to be resampled, additional monitoring wells need to be installed and sampled, the capture zone needs to be evaluated, and the groundwater extraction system needs to be optimized. If the results of the water supply resampling effort indicate that that they are contaminated, the alternate water supply contingency remedy called for in the Record of Decision and institutional controls may need to be implemented. It is anticipated that once the noted recommendations and follow-up actions are completed, the remedy will be protective of public health and the environment, at which time a report addendum containing a protectiveness statement will be issued. A protectiveness determination for this site cannot be made until the noted additional information is obtained. It is expected that a report addendum containing a protectiveness statement will be issued within eighteen months of the date of this report.

# Five-Year Review Summary Form

## SITE IDENTIFICATION

**Site name** *(from WasteLAN)*: Ramapo Landfill Superfund Site

**EPA ID** *(from WasteLAN)*: NYD000511493

**Region:** 2 | **State:** NY | **City/County:** Town of Ramapo/Rockland County

## SITE STATUS

**NPL status:** ■ Final ☐ Deleted ☐ Other (specify)

**Remediation status** (choose all that apply): ☐ Under Construction ☐ Operating ■ Complete

**Multiple OUs?** ☐ YES ■ NO | **Construction completion date:** 09/27/1997

**Has site been put into reuse?** ■ YES ☐ NO ☐ N/A

## REVIEW STATUS

**Lead agency:** ☐ EPA ■ State ☐ Tribe ☐ Other Federal Agency _____

**Author name: George Jacob**

**Author title: RPM** | **Author affiliation: USEPA**

**Review period:**** 12/2004 to 12/2009

**Date(s) of site inspection:** 10/06/2009

**Type of review:** ☐ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion ☐ Policy ■ Statutory

**Review number:** ☐ 1 (first) ☐ 2 (second) ■ 3 (third) ☐ Other (specify)_____

**Triggering action:**
☐ Actual RA Onsite Construction at OU # __ ☐ Actual RA Start at OU#
☐ Construction Completion ■ Previous Five-Year Review Report
☐ Other (specify)

**Triggering action date** *(from WasteLAN)*: 12/23/2004

**Due date** *(five years after triggering action date)*: 12/23/2009

**Does the report include recommendation(s) and follow-up action(s)?** ■ yes ☐no
**Is human exposure under control?** ■ yes ☐ no
**Is contaminated groundwater under control?** ■yes ☐ no ☐ not yet determined
**Is the remedy protective of the environment?** ■yes ☐ no ☐ not yet determined

**Acres in use or available for use:** **restricted:** 60 **unrestricted: 0**

** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

**Five-Year Review Summary Form, cont'd.**

*Other Comments on Operation, Maintenance, Monitoring, and Institutional Controls*

This site has ongoing operation, maintenance, and monitoring activities as part of the selected remedy. As was anticipated by the decision documents, these activities are subject to routine modification and adjustment.

*Issues, Recommendations, and Follow-Up Actions*

Groundwater contaminant concentrations have increased in some monitoring wells and fluctuated in other wells. The current monitoring well network does not allow for an adequate determination of a groundwater capture zone or give early warning regarding potential contaminant migration to downgradient drinking water wells. In addition, the performance of the groundwater extraction system is difficult to evaluate given the lack of information and that two of the extraction wells had experienced operational difficulties and a third is undergoing troubleshooting to identify and correct operational problems. Also, because the laboratory's detection limits for antimony and thallium were often greater than the state standard, it is unknown whether these constituents are present in the wells, and if present, whether the levels are protective.

It is believed that increases in groundwater contaminant concentrations in the sentinel well over the past several years and in the water supply wells may be attributable to the operational problems of two of the extraction wells. Now that these wells have been properly operating for over two years, the wells should be sampled quarterly over the next year to ensure a downward trend. Contaminant concentrations and flow rates for the groundwater extraction wells need to be reported on a routine basis. In addition, the groundwater extraction system needs to be optimized in order to keep the wells functioning to the fullest capacity and to ensure that contaminants are not migrating. Additional groundwater well clusters located downgradient of monitoring wells along the landfill boundary that exceed Maximum Contaminant Levels are necessary in order to determine the extent of groundwater contamination and aid in determining the area of influence of the groundwater extraction system. Also, a conceptual or analytical model of the site groundwater contaminants needs to be developed.

Immediate resampling of the private and public water supply wells needs to occur and an alternative analytical method for antimony and thallium needs to be employed for this and all subsequent sample analyses. More frequent sampling needs to be performed for the private and public water supply wells. If, based upon the results of the resampling effort and using lower laboratory detection limits, it is determined that these wells are contaminated, the alternate water supply contingency remedy called for in the Record of Decision may need to be implemented and the Town would need to implement institutional controls to restrict the use of off-property groundwater.

Notwithstanding the fact that EPA and the Town have communicated since the last five-year review relative to drafting language for a restrictive covenant, institutional controls prohibiting the installation of groundwater wells and to protect the integrity of the cap are still not in place. A restrictive covenant should be drafted and filed.

*Protectiveness Statement*

A protectiveness determination for this site cannot be made until additional information is obtained. It is expected that a report addendum containing a protectiveness statement will be issued within eighteen months of the date of this report.

# FIVE-YEAR REVIEW REPORT

## I. INTRODUCTION

This is the third five-year review for the Ramapo Landfill Superfund site, located in the Town of Ramapo, Rockland County, New York. This five-year review was conducted by United States Environmental Protection Agency (EPA) Remedial Project Manager (RPM) George Jacob. The review was conducted pursuant to Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, 42 U.S.C. §9601 *et seq.* and 40 CFR 300.430(F)(4)(ii) and in accordance with the Comprehensive Five-Year Review Guidance, OSWER Directive 9355.7-03B-P (June 2001). The purpose of five-year reviews is to ensure that implemented remedies protect public health and the environment and that they function as intended by the site decision documents. This report will become part of the site file.

A five-year review is required at this site due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

In accordance with Section 1.3.3 of the five-year review guidance, a subsequent statutory five-year review is triggered by the signing date of the previous five-year review report. The previous five-year review was signed on December 23, 2004.

Based upon this five-year review, it has been determined that a protectiveness determination for this site cannot be made until additional information is obtained. It is expected that a report addendum containing a protectiveness statement will be issued within eighteen months of the date of this report.

## II. SITE CHRONOLOGY

Table 1 (attached) summarize the site-related events from discovery to construction completion.

## III. BACKGROUND

### Site Location

The Ramapo Landfill site is located in the Town of Ramapo, Rockland County, New York, about 35 miles northwest of New York City and 1 mile northeast of the Village of Hillburn, New York. The site is situated at the western base of the Ramapo Mountains off Torne Valley Road east of the New York State Thruway, Route 17, and Route 59.

### Physical Characteristics

The landfill is situated on a 96-acre tract. Approximately 60 acres of the site (the landfill portion) are covered with fill material. The landfill portion of the site is mounded into two major lobes (northern and southern), and slopes steeply toward the west with grades ranging from less

than one percent to greater than 30 percent. Both landfill lobes consist of mixed refuse. Substances reportedly disposed of in the landfill include industrial sludge and other wastes reportedly from a pharmaceutical company, sewage sludge, municipal refuse, asbestos, construction and demolition debris, yard debris, paint sludge (presumably from an automotive plant), and liquid wastes reportedly from a paper company.

Utility corridors lie on three sides of the site, high voltage power transmission lines to the east and west, and a high pressure gas line to the south. A power substation is located just north of the site.

The main surface waters in the vicinity of the site are the Ramapo River, Torne Brook, and Candle Brook. The Ramapo River, located approximately 300 feet from the southwest corner of the site, is a New York State Department of Environmental Conservation (NYSDEC) Class "A" water, which may be used as a source of water supply for drinking, culinary, or food-processing purposes. Torne Brook, which flows near the western boundary of the site, and Candle Brook, a tributary of Torne Brook, are NYSDEC Class "B" waters, suitable for primary contact recreation and any other use, except as a source of water supply for drinking, culinary, or food-processing purposes.

The United States Geological Survey has identified an area of less than ten acres near the headwaters of Candle Brook as a wetland.

**Site Geology/Hydrogeology**

The site is underlain by a sequence of glacially derived unconsolidated sediments that overly bedrock, which is comprised of granitic and biotite gneiss. The bedrock geology is structurally complex with numerous fault systems in the area. A fracture trace analysis identified a number of lineaments in the vicinity of the site, the most obvious one being the Ramapo fault (approximately 1.25 miles southeast of the site), which strikes northeast and dips steeply southeast. Two other lineaments observed within the immediate area of the landfill include one that lies adjacent to the west side of the landfill and trends northeast. This lineament may represent faulting or other subsurface structures controlling deflections in Torne Brook. The second lineament trends east-west and appears to cross the central portion of the landfill.

The shallow aquifer is comprised of permeable sediments consisting of a grey to brown, very loose to loose sand or sandy gravel with some silt with a hydraulic conductivity on the order of $1 \times 10^{-4}$ cm/sec and a medium-dense to very dense silty sand or gravelly sand with abundant bolders and cobbles with hydraulic conductivity values ranging from $5.1 \times 10^{-5}$ to $1.4 \times 10^{-4}$ cm/sec. Below these sand units is a thin weathered rock zone ranging in thickness from a few inches to nearly five feet with hydraulic conductivity values ranging from $4 \times 10^{-5}$ to $1.5 \times 10^{-3}$ cm/sec. Underlying the weathered rock zone is a granitic and biotite gneiss bedrock aquifer. In some locations, highly fractured zones were found within the bedrock suggesting faulting. Hydraulic conductivity values for the bedrock aquifer ranged from $8.9 \times 10^{-5}$ to $1 \times 10^{-2}$ cm/sec.

Past investigations found that shallow groundwater generally flows toward Torne Brook and the Ramapo River with Torne Brook acting as the discharge area for the water table aquifer and that groundwater in the bedrock aquifer likely flows beneath Torne Brook. Vertical flow measurements indicated that groundwater generally flows downward.

## Land and Resource Use

The Town subdivided the property north of the limit of waste and sold it to the Rockland County Solid Waste Management Authority in August 1998. The Rockland County Solid Waste Management Authority currently operates a garbage transfer facility at this location.

A pistol range utilized by the Town of Ramapo Police Department since May 1997 is located in the northeastern area of the site. Immediately adjacent to it (south of the pistol range), the Rockland County Solid Waste Management Authority constructed a leaf composting facility in 2007.

Groundwater is withdrawn from the area south and west of the site for residential use. Ten water supply wells, operated by the Spring Valley Water Supply Company and serving a population of over 200,000, are located along the Ramapo River both upstream and downstream of the site. Four of these wells are located within 1,600 feet of the landfill; the nearest being 750 feet from the landfill. The closest private well is located approximately 450 feet west of the site on the west bank of the Ramapo River at the Torne Brook Estate, a residential apartment complex of 25 units. A 2-unit apartment building maintains a well about 1,200 feet from the landfill.

## History of Contamination

Prior to landfill operations in the 1950s and 1960s, portions of the site were excavated as a source of gravel. In 1971, the Rockland County Department of Health granted a permit to the Town of Ramapo for the operation of the sanitary landfill. At that time, the site was owned by the Ramapo Land Company and the contract-operator was the Torne Mountain Sand and Gravel Co., Inc.

In 1976, a contract was awarded to Carmine Franco of Sorgine Construction Services of New York, Inc., for the operation and maintenance of the landfill. The contract was terminated by the Town of Ramapo in 1979, when the Town began operating the landfill directly. Municipal waste was accepted in the landfill until 1984. The Town of Ramapo continued to accept construction and demolition debris at the landfill until 1989.

A leachate collection system was constructed along the downgradient edge of the landfill from 1984 to 1985. The collected leachate was conveyed to a wastewater treatment pond in the site's southwest corner. After aeration and settling in the pond, the water was discharged to the Ramapo River. Beginning in November 1990, the collected leachate was discharged to the Village of Suffern Wastewater Treatment Plant via a 7,900-foot sewer line.

## Initial Response

In September 1983, the Ramapo Landfill site was placed on the Superfund National Priorities List. From June 1980 through October 1986, NYSDEC and the Town of Ramapo entered into three Orders on Consent related to phasing out the operation of the landfill, determining the extent of leachate movement and the feasibility of leachate collection, and constructing a surface-water and groundwater-diversion system, leachate-collection system, and a system capable of transporting or treating the collected leachate.

On February 1, 1988, the Town entered into its fourth and current Order on Consent (Index No. W3-0083-8707) with NYSDEC. This Order required that a remedial investigation and feasibility study (RI/FS) be performed for the site and that the design and construction of the remedy that was to be ultimately selected be undertaken. The Town also received a Title 3, Environmental Bond Act grant to assist it in performing the remedial activities called for by the Order.

**Basis for Taking Action**

The results of the RI revealed that volatile organic compounds (VOCs) were detected in three waste sample (landfill material and paint sludge) locations, ranging from 0.002 milligrams per kilogram (mg/kg) to 110 mg/kg; VOCs were not detected in any of the surface soil samples. Semi-volatile compounds, including polycyclic aromatic hydrocarbons, were detected in waste samples and surface soil samples at concentrations ranging from 0.042 mg/kg to 16 mg/kg. Antimony, barium, beryllium, cadmium, calcium, chromium, copper, lead, selenium, and zinc were detected in surface soil and waste samples at concentrations exceeding background by an order of magnitude. NYSDEC Water Quality Standards and Guidance Values (T.O.G.S. 1.1.1) (WQSGV) and/or EPA Maximum Contaminant Levels (MCLs)[1] were exceeded for arsenic, chromium, iron, lead, magnesium, manganese, mercury, sodium, benzene, chlorobenzene, and di-n-octyl phthalate in on-site groundwater monitoring wells. No federal or state drinking water standards were exceeded in groundwater samples collected from the nearby public or private water supply wells during the RI.

The baseline human health risk assessment identified five potential exposure pathways by which the public may be exposed to contaminant releases at the site under current and future land-use conditions. These pathways included ingestion of soil, dermal contact with soil, inhalation of vapors from the landfill, ingestion of groundwater, and inhalation of vapors during showering. Under the current land-use scenario, five potential receptors were identified, namely, adult and child (ages 6-11) trespassers, adult and child residents living downgradient and off-site, and employees (workers) at the landfill. Under the future land-use scenario, three receptors were identified, namely adult and child (ages 0-6) residents living on-site, and workers.

The hazard index (HI) is obtained by adding the hazard quotients for all compounds across all media. A hazard index greater than 1 indicates that the potential exists for noncarcinogenic health effects to occur as a result of site-related exposures. Under current land-use conditions, the total site HI exceeded one for workers and child trespassers. Under future land-use conditions, the HIs exceeded 1 for all scenarios evaluated. The primary chemical contributors to noncarcinogenic health risks were xylenes (total) and chlorobenzene for inhalation of vapors from the landfill, and manganese and arsenic for ingestion of groundwater.

For known or suspected carcinogens, EPA considers excess upper bound individual lifetime cancer risks of between $10^{-4}$ to $10^{-6}$ to be acceptable. This level indicates that an individual has not greater than a one in ten thousand to one in a million chance of developing cancer as a result

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[1] WQSGVs and MCLs are the highest level of contaminant that is allowed in drinking water. They are promulgated standards that apply to public water systems and are intended to protect human health by limiting the levels of contaminants in drinking water.

of site-related exposure to a carcinogen over a 70-year period under specific exposure conditions at the Site. Under current land-use conditions, the risk characterization showed that cancer risks for all receptors evaluated (*i.e.*, adults, children, and workers) were less than or within the acceptable cancer risk range of $10^{-4}$ to $10^{-6}$. Under future land-use conditions, cancer risks for children and workers were within the acceptable range. However, the sum of future cancer risks for all exposure pathways assessed for adults ($2 \times 10^{-4}$) were marginally outside the range. Arsenic and benzene were the chemicals responsible for the highest carcinogenic risks from groundwater ingestion and inhalation of vapors, respectively.

Based upon the sample results and the baseline human health risk assessment, the following remedial action objectives were established: 1) prevent inhalation of vapors from the landfill; 2) prevent human and animal contact with contaminated soil from the landfill surface; 3) prevent erosion of contaminated surface soil through surface-water runoff; 4) minimize the infiltration of rainfall or snow melt into the landfill, thus reducing the quantity of water percolating through the landfill materials and leaching out contaminants; and 5) reduce the movement and toxicity of the contaminated landfill leachate into groundwater, and subsequent down gradient migration of contaminants.

Surface water samples were collected from Torne Brook, the Ramapo River near the confluence of Torne Brook, a drainage swale on an adjacent property, and two leachate seeps emanating from the landfill. At all surface water locations that were sampled, New York State surface water standards were exceeded for one or more of the following contaminants: vinyl chloride, antimony, arsenic, iron, manganese, mercury, nickel, zinc, ammonia, sulfide, copper, and lead. The highest frequency of the detections above the standards occurred near the confluence of Torne Brook and the Ramapo River, where water from the on-site leachate holding pond was being discharged to the Ramapo River. Three semi-volatile compounds were detected in a sediment sample collected in Torne Brook at concentrations below NYSDEC sediment cleanup criteria. Inorganic compounds detected in sediments which exceeded background concentrations by at least an order of magnitude included antimony, calcium, manganese, and thallium.

## IV. REMEDIAL ACTIONS

### Remedy Selection

Based upon the results of the RI/FS, in March 1992, EPA signed a Record of Decision (ROD) for the site, calling for, among other things:

- Installation of a cap on the top of the landfill using a multimedia system, including layers of fill material, a gas-venting system and an impermeable membrane. The landfill side slopes would be capped using a multimedia system without an impermeable membrane if confirmatory studies demonstrated that this approach met the remedial action objectives. Should the confirmatory studies indicate that the overall remedy's effectiveness would be significantly reduced by not including an impermeable barrier in the multimedia cap on the side slopes, then an impermeable barrier was to be included in the cap on some or all of the side slopes of the landfill;

- Installation of groundwater extraction wells to supplement the existing leachate collection system;

- Installation of a perimeter drain around the sections of the cap containing the impermeable membrane to collect and divert surface water runoff;

- Collection and diversion of leachate seeps to the existing leachate collection system;

- Conveyance of the collected leachate and contaminated groundwater via the sewer system to a local wastewater treatment facility;

- Imposition of property deed restrictions which would include measures to prevent the installation of drinking water wells at the site, and restrict activities which could affect the integrity of the cap;

- Performance of a maintenance and sampling program upon completion of closure activities. The monitoring program will provide data to evaluate the effectiveness of the remedial effort. Additional monitoring points would be established as needed to detect any future movement of site contaminants toward drinking water sources off-site;

- Development of a contingency plan for rapid implementation of additional measures to protect nearby residents and users of groundwater if those measures are determined to be necessary.

**Remedy Implementation**

The Town of Ramapo retained URS Consultants, Inc. of Buffalo, New York to conduct the remedial design (RD), solicit and obtain bids for the landfill closure, and provide construction administration and resident engineering.

As was noted above, the ROD stated that an impermeable barrier would be placed on the landfill's side slopes if confirmatory studies indicated that the remedy's overall effectiveness would be significantly enhanced. The confirmatory studies indicated that the exclusion of an impermeable barrier from the landfill cap on the side slopes would result in increased infiltration of rainfall through the cap. This would cause the generation of greater quantities of contaminated groundwater, which would result in greater operational costs to collect and treat a larger volume of contaminated groundwater and leachate. In addition, it was determined that either a thicker soil cover or an impermeable barrier would be needed on the side slopes to provide adequate control of landfill gases. The impermeable barrier was found to be the less costly of the two options. Therefore, based upon the results of the confirmatory studies, it was concluded that a cap with an impermeable barrier on the landfill's side slopes would be more protective and more cost-effective than a cap without an impermeable barrier on the side slopes.

An Explanation of Significant Differences (ESD) was issued in November 26, 1997 to document these findings.

The RD, which was prepared by URS Greiner Inc., was approved by NYSDEC in 1992. The RD not only included the plans and specifications for the construction of the landfill cap and expanding the leachate collection system, but also included a preliminary design (contingency plan) for the connection of nearby residents to the Pothat Water Company water line should groundwater monitoring data indicate that groundwater standards are being contravened.

A construction contract was awarded to Geo-Con Inc. in 1993. Construction of the site remedy began on December 26, 1994 and was substantially completed on May 30, 1997.

The construction effort involved the construction of a landfill cap (a gas venting layer, a textured 40-mil high density polyethylene geomembrane liner, a 12-inch barrier protection layer, and a 6-inch topsoil layer) and the expansion of the existing leachate collection system to enhance its recovery of contaminated groundwater.

**Institutional Controls Implementation**

The ROD called for the imposition of property deed restrictions to prevent the installation of drinking water wells at the site and restrict activities which could affect the integrity of the cap. Since the site property is municipally-owned, NYSDEC has not required the Town to obtain a property deed restriction. Instead, NYSDEC has advised the Town that in the event that there is to be a change in the ownership/operation of the property, the Town should prepare appropriate language for restrictions to be incorporated into the deed. Nonetheless, NYSDEC and EPA agree that institutional controls need to be implemented at the present time.

**Operation, Maintenance and Monitoring**

An Operation and Maintenance Manual, covering post-landfill cap construction inspection and maintenance procedures, was submitted and approved by NYSDEC as part of the RD. During the first year following the landfill cap construction, the site was inspected quarterly and following heavy storm events. For the subsequent years, the site has been inspected on a quarterly basis as follows:

- The site is inspected for debris, litter and/or waste.
- The landfill cap is inspected for vegetation loss due to erosion or poor grass growth. Annual ground inspections at the beginning of each summer also note the status of woody plant species on the landfill surface and side slopes.
- The landfill cap is inspected for settlement, ponding, and animal borrows.
- The gas venting pipes are inspected for damage.
- The site access gate and fence are inspected for operational locks and vandalism.

- The culverts, drainage ditches, and settlement gauges are inspected for sediment buildup or erosion.

- The groundwater monitoring wells are inspected for operational locks, damage, and vandalism.

The monitoring program originally called for the sampling of the groundwater monitoring wells and drinking water wells on a triannual schedule. In 2003, due to the relative stability of the sampling results, the groundwater and drinking water well monitoring frequency was changed to every five quarters (annual monitoring rotated to occur in a different quarter each year to consider potential seasonal effects).

More frequent sampling (*i.e.,* quarterly) needs to be performed for the private and public water supply wells based on past MCL exceedances and given their close proximity to the landfill.

The annual O&M report that is submitted by the Performing Party includes a summary of the findings of the above-noted inspection along with a certification that remedy-related operation and management is being performed.

The Town[2] indicated that during the past two five-year review periods, it discovered that two of the extraction wells had operational difficulties. Fine sediments periodically clogged the impellers of two of the extraction wells, which required periodic removal of the pumps and either cleaning the impellers or replacing the pump. The pumps would run properly for a while, but eventually, the impellers would become clogged again. Realizing that a more permanent solution was needed, in 2005, the Town solicited proposals to develop specifications for the redevelopment of the wells and installing finer screens. The work was performed in July 2007. According to the Town, the wells have been fully operational since that time.

A pump in another extraction well began experiencing an electrical signal problem in September 2009. The Town has indicated that it is currently troubleshooting the instrumentation and controls and expects to restore its operation shortly.

The inspections, maintenance, sampling, monitoring, data evaluation and reporting costs are approximately $135,000 on an annual basis; these costs are broken down in Table 2 (attached).

## V. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The previous five-year review, which was completed in December 2004, noted that since the laboratory's detection limit for antimony was greater than the state standard of 3 micrograms per liter (µg/l), it was unknown whether antimony was present at unacceptable levels in the drinking water wells. The five-year review recommended that additional groundwater samples be collected and analyzed using a lower laboratory detection limit for antimony. Follow up actions

[2] Source: Ted Dzurinko, Director, Town of Ramapo Department of Public Works, via e-mail on December 3, 8, 9, and 10, 2009.

would be taken should it be determined that the drinking water standard for antimony was exceeded were identified.

Due to the concern about potential human health exposure from groundwater contamination, a site-wide protectiveness determination could not be made in the 2004 five-year review.

In May 2005, all of the drinking water wells were resampled and a lower laboratory detection limit (0.4 µg/l) was used. Antimony was not detected in any of the samples. The results of this effort were documented in a Five-Year Review Addendum in August 2005. The Five-Year Review Addendum also made a site-wide protectiveness determination (*i.e.,* the remedy protects human health and the environment).

The 2004 five-year review also recommended that additional monitoring wells be installed and a conceptual or analytical model of the site groundwater contaminants be developed. A workplan for the installation of the additional monitoring wells and the development of a conceptual model of the site groundwater contaminants was approved by NYSDEC and EPA in 2006. The well installation was not, however, performed due to the Town's inability to obtain access to a property. The Town recently purchased this property. It is anticipated that the well installation will be performed in summer 2010. Since these recommendations from the 2004 five-year review were not addressed, they will be listed as recommendations in this report.

## VI. FIVE-YEAR REVIEW PROCESS

### Administrative Components

The five-year review team consisted of George Jacob (RPM), Diana Cutt (Hydrogeologist), Julie McPherson (Human Health Risk Assessor), and Mindy Pensak (Ecological Risk Assessor, Biological Technical Assistance Group).

### Community Involvement

The EPA Community Involvement Coordinator for the Ramapo Landfill site, Cecilia Echols, published a notice in the *Journal Newspaper,* a local newspaper, on August 23, 2009, notifying the community of the initiation of the five-year review process. The notice indicated that EPA would be conducting a five-year review of the site to ensure that the site is protective of public health and the environment and that the implemented components of the remedy are functioning as designed. It was also indicated that once the five-year review is completed, the results will be made available in the local site repository. In addition, the notice included the RPM's address and telephone number for questions related to the five-year review process or the Ramapo Landfill site.

### Document Review

The documents, data, and information which were reviewed in completing the five-year review are summarized in Table 3 (attached).

## Data Review

During the review period, groundwater samples were collected in June 2005, September 2006, October 2007, and March 2009. Only inorganics were detected above MCLs.

Typically, one of the measures of the success of a groundwater containment remedy is based upon the analysis of groundwater elevations demonstrating consistent plume capture over time. The current monitoring well network does not, however, allow for a determination of a groundwater capture zone (additional monitoring wells are needed). In the absence of adequate groundwater elevation data, the second line of evidence in demonstrating the success of the groundwater containment remedy would be decreasing contaminant concentrations in groundwater over time. Data collected during the review period shows MCL exceedances for chromium, antimony, arsenic, thallium, and nickel. While contaminant concentrations in some monitoring wells fluctuated above and below the MCL over time with no distinct pattern, contaminant concentrations in several monitoring wells showed an increase over time. The most noteworthy increase in contamination was in the sentinel cluster well, which is located approximately 300 feet downgradient from the landfill (and approximately 150 feet upgradient of the Torne Brook Estate well). The chromium concentrations in this well had been consistently below the MCL of 50 µg/l for many years. In September 2006, the chromium concentration in the well screened in the shallow aquifer (MW-9OS) increased to 55 µg/l. This was followed by an increase to 330 µg/l in October 2007; in March 2009, the chromium concentration decreased to 300 µg/l. In October 2007, chromium was detected in the intermediate well (MW-9I) at a concentration that also exceeded the MCL. In addition, in September 2006, an exceedance of the MCL for thallium (0.5 µg/l) was observed in one of the two private drinking water wells at a concentration of 8.8 µg/l and the MCL for aluminum (50 µg/l) was slightly exceeded in both private drinking water wells at concentrations of 76 and 67 µg/l and two of the public water supply wells (SVWC-93 and SVWC-94 at concentrations of 63 and 56 µg/l, respectively). For the subsequent sampling events, the laboratory detection limits for aluminum, arsenic, antimony, and thallium for samples from the two private drinking water wells and the public water supply wells often exceeded their respective MCL, thereby making it difficult to determine if groundwater in this area has been impacted by the landfill.

The vertical extent of the groundwater contamination has not been confirmed since only two of the deeper bedrock wells were sampled during the review period (sampling of the other deeper wells was, apparently, discontinued after October 2003 since the contaminant concentrations were below the detection limits, although the detection limits for antimony exceeded the MCL in these wells).

## Five-Year Review Site Inspection

A site inspection related to this five-year review was conducted on October 6, 2009. Those in attendance included George Jacob, Diana Cutt and Julie McPherson of EPA, Jim Schreyer and Janet Brown of NYSDEC, and Ted Dzurinko, Director, Town of Ramapo Department of Public Works. During the inspection, it was observed that the cap and vegetative cover are intact and in good condition, the fence is intact and in good repair, and the monitoring wells are in good condition and are properly locked. It was also observed that the berm associated with the shooting range was not covered by a roof to prevent its erosion and increased lead mobility and that expended bullet casings were present and accumulating on the ground.

**Interviews**

In e-mail exchanges in early December 2009, Ted Dzurinko provided replies to EPA inquiries requesting updated information and clarifications related to the operation and maintenance of the groundwater monitoring and extraction system.

**Institutional Controls Verification**

Since the site property is municipally-owned, NYSDEC has not required the Town to obtain a property deed restriction. Instead, NYSDEC has advised the Town that in the event that there is to be a change in the ownership/operation of the property, the Town should prepare appropriate language for restrictions to be incorporated into the deed. Nonetheless, NYSDEC and EPA agree that institutional controls need to be implemented at the present time.

**Other Comments on Operation, Maintenance, Monitoring, and Institutional Controls**

Table 4 (attached) summarizes several observations and offers suggestions to resolve the issues.

## VII. TECHNICAL ASSESSMENT

***Question A: Is the remedy functioning as intended by the decision documents?***

The ROD, as modified by the ESD, called for, among other things, the installation of a cap with an impermeable barrier and groundwater and leachate collection and treatment. The purpose of the response action was to reduce the risk to human health and the environment due to contaminants leaching from the landfill mound. The capping of the landfill was to minimize the infiltration of rainfall and snowmelt into the landfill, thereby reducing the potential for contaminants leaching from the landfill and negatively impacting the wetlands habitat and groundwater quality. Capping was to also prevent direct contact exposure to contaminated soils. Extracting and treating the contaminated groundwater was to contain the groundwater contamination within the boundary of the landfill to ensure that groundwater beyond the boundary meets Applicable or Relevant and Appropriate Requirements (ARARs) for groundwater.

From an ecological perspective, the remedial actions that have taken place at the site have eliminated potential exposure of ecological receptors to contaminated surface water, sediment, and surface soil, which is one of the goals of the decision documents. Therefore, the remedial actions are functioning as intended for the ecological interests at the site.

The success of the groundwater extraction system in containing the contamination as intended by the decision documents is difficult to determine at this time. Typically, the success of a groundwater containment remedy is measured by the analysis of groundwater elevations demonstrating consistent plume capture over time, decreasing concentrations in groundwater over time, and data from groundwater extraction wells demonstrating that the wells are consistently operational and are extracting contaminated groundwater.

The monitoring well network is comprised of well clusters aligned in a general northeast to southwest direction along the west side of the landfill, generally parallel to the groundwater

extraction wells. With the exception of one well cluster, there are no wells radiating from the landfill that would aid in the determination of a capture zone.

There are insufficient monitoring wells to obtain adequate groundwater elevation data. In the absence of adequate groundwater elevation data, the second line of evidence in demonstrating the success of the groundwater containment remedy would be decreasing contaminant concentrations in groundwater over time. Data collected during the review period shows MCL exceedances for chromium, antimony, arsenic, thallium, and nickel. While contaminant concentrations in some monitoring wells fluctuated above and below the MCL over time with no distinct pattern, contaminant concentrations in several monitoring wells showed an increase over time. The most noteworthy increase in contamination was in the sentinel cluster well, which is located approximately 300 feet downgradient from the landfill (and approximately 150 feet upgradient of the Torne Brook Estate well). The chromium concentrations in this well had been consistently below the MCL of 50 µg/l for many years. In September 2006, the chromium concentration in the well screened in the shallow aquifer (MW-9OS) increased to 55 µg/l. This was followed by an increase to 330 µg/l in October 2007; in March 2009, the chromium concentration decreased to 300 µg/l. In October 2007, chromium was detected in the intermediate well (MW-9I) at a concentration that also exceeded the MCL. In addition, in September 2006, an exceedance of the MCL for thallium (0.5 µg/l) was observed in one of the two private drinking water wells at a concentration of 8.8 µg/l and the MCL for aluminum (50 µg/l) was slightly exceeded in both private drinking water wells at concentrations of 76 and 67 µg/l and two of the public water supply wells (SVWC-93 and SVWC-94 at concentrations of 63 and 56 µg/l, respectively). For the subsequent sampling events, the laboratory detection limits for aluminum, arsenic, antimony, and thallium for samples from the two private drinking water wells and the public water supply wells often exceeded their respective MCL, thereby making it difficult to determine if groundwater in this area has been impacted by the landfill.

The vertical extent of the groundwater contamination has not been confirmed, since only two of the deeper bedrock wells were sampled during the review period (sampling of the other deeper wells was, apparently, discontinued after October 2003 since the contaminant concentrations were below the detection limits, although the detection limits for antimony exceeded the MCL in these wells).

During the review period, no data was submitted for the groundwater extraction wells. According to the Town of Ramapo Department of Public Works, two of the extraction wells had not operated continuously due to low groundwater levels and at times had been out of service due to clogging of the impeller and electrical power problems; the wells have, however, been fully operational since they were redeveloped and finer screens were installed in 2007. Additionally, the volume of groundwater/leachate or contaminant concentrations from the system effluent are apparently not recorded from the individual extraction wells. The lack of performance data from the groundwater extraction system makes it difficult to determine its effectiveness.

Due to the proximity of the extraction wells that have experienced operational problems to the sentinel well, which is now contaminated, it appears likely that the operational problems are the

cause of the increases in groundwater contaminant concentrations in the sentinel well and in the drinking water wells.

The ROD called for the imposition of property deed restrictions to prevent the installation of drinking water wells at the site and restrict activities which could affect the integrity of the cap. While the site property is municipally-owned, there are no current plans to further develop it, and it is fenced, a restrictive covenant preventing activities that would disturb the cap and prohibit the installation of drinking water wells need to be drafted and filed.

***Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?***

The majority of the exposure pathways and the receptor populations identified in the 1991 Baseline Human Health Risk Assessment are still valid. Although specific parameters and toxicity values may have changed, the risk assessment process that was used is still consistent with current practices and the remedial action objectives remain valid and will ensure protection of human health and the environment.

The toxicity values for several contaminants of potential concern (COPCs) have changed since the RI. In order to account for changes in toxicity values since the RI, the maximum detected concentrations of COPCs in monitoring wells during the review period were compared to their respective MCLs. The MCL is the highest level of contaminant that is allowed in drinking water. MCLs are promulgated standards that apply to public water systems and are intended to protect human health by limiting the levels of contaminants in drinking water. Aluminum, antimony, arsenic, chromium, iron, lead, manganese, and thallium were identified as exceeding their respective MCL in at least one on-site monitoring well.

While the vapor intrusion exposure pathway was not evaluated in the original risk assessment, it should be noted that since VOCs have not been detected above screening criteria in the downgradient wells, it is not anticipated that vapor intrusion is an issue at this site.

While institutional controls are not currently in place, since the site property is municipally-owned, it is not anticipated that groundwater use on-site is likely to occur in the short-term.

The remedial action objectives established in the ROD are still valid.

***Question C: Has any other information come to light that could call into question the protectiveness of the remedy?***

During the review period, contamination was detected in a sentinel well above MCLs for three consecutive sampling events and was also detected in private and public water supply wells; in addition institutional controls are not currently implemented. It is believed that the increases in groundwater contaminant concentrations in the sentinel well and in the drinking water wells may be attributable to the operational problems that had been experienced at two of the extraction wells. Now that these wells have been properly operating for over two years, the wells should be sampled quarterly for a year to ensure a downward trend most recently observed in the wells continues. In addition, the private and public water supply wells need to be resampled,

additional monitoring wells need to be installed and sampled, the capture zone needs to be evaluated, and the groundwater extraction system needs to be optimized.

**Technical Assessment Summary**

Based upon the results of the five-year review, it has been concluded that:

- the cap and vegetative cover are intact and in good condition;
- the fence around the cap within the site is intact and in good repair;
- the monitoring wells are in good condition and are properly locked;
- the berm associated with the shooting range was not covered by a roof to prevent its erosion and increased lead mobility and expended bullet casings were present and accumulating on the ground;
- it is not clear whether or not the on-site groundwater extraction system is preventing contaminant migration from the landfill;
- during the review period, monitoring of downgradient drinking water wells was not able to substantiate that the water meets water quality standards or whether or not downgradient groundwater is impacted by site contaminants;
- the lack of performance data from the groundwater extraction system makes it difficult to determine its effectiveness; and
- there are no restrictions on the installation of wells downgradient of the site

A portion of the site is currently being utilized as a shooting range by the Ramapo Police Department. The shooting range was constructed so that the ammunition fired would enter a berm constructed for the purposes of the shooting range. In accordance with best management practices of outdoor shooting ranges, berms should be covered by a roof to prevent erosion of the berm and increased lead mobility. During the five-year review site inspection, it was observed that a roof was not present and expended bullet casings were present and accumulating on the ground. Potential human exposure to lead exists at the site through various exposure pathways as a result of the lack of good management practices at the shooting range. The primary exposure of lead to humans as a result of shooting range activities is through incidental ingestion of lead contaminated soil. An additional exposure pathway that individuals may be exposed to lead from shooting range activities is by lead bullets or lead particles moving via storm water runoff into the downgradient surface water areas (Torne Brook, Ramapo River and the adjacent wetland). The Torne Brook and Ramapo River are used for recreational purposes, which include swimming and fishing. Dissolved lead may also migrate through soils and leach into the groundwater. However, since an impermeable cap is placed on the landfill, it is expected that any lead on the surface of the landfill would not infiltrate the cap, but rather move via storm water runoff into the downgradient surface water areas. Human health, as well as ecological

risks at the site, could potentially increase due to the activities conducted at this shooting range facility. Waterfowl, such as the Canadian geese observed on the landfill during the site visit are highly susceptible to lead ingestion. These animals often ingest shots, mistaken it for food, which may lead to increased mortality. In addition, the lead could pose a potential risk to humans, since Canadian geese are migratory and are hunted. This potential contributing source of lead contamination at the landfill may be attributable to the shooting range activities. It is recommended that the shooting range be properly maintained and best management practices be implemented to ensure that activities conducted at the shooting range do not impact human health and the environment.

## VIII. ISSUES, RECOMMENDATIONS, AND FOLLOW-UP ACTIONS

Table 5 (attached) identifies concerns related to contamination detected in a sentinel well and the possibility that contamination is present in private and public water supply wells and contains recommendations and follow-up actions which should ensure long-term protectiveness.

## IX. PROTECTIVENESS STATEMENT

A protectiveness determination for this site cannot be made until additional information is obtained. It is expected that a report addendum containing a protectiveness statement will be issued within eighteen months of the date of this report.

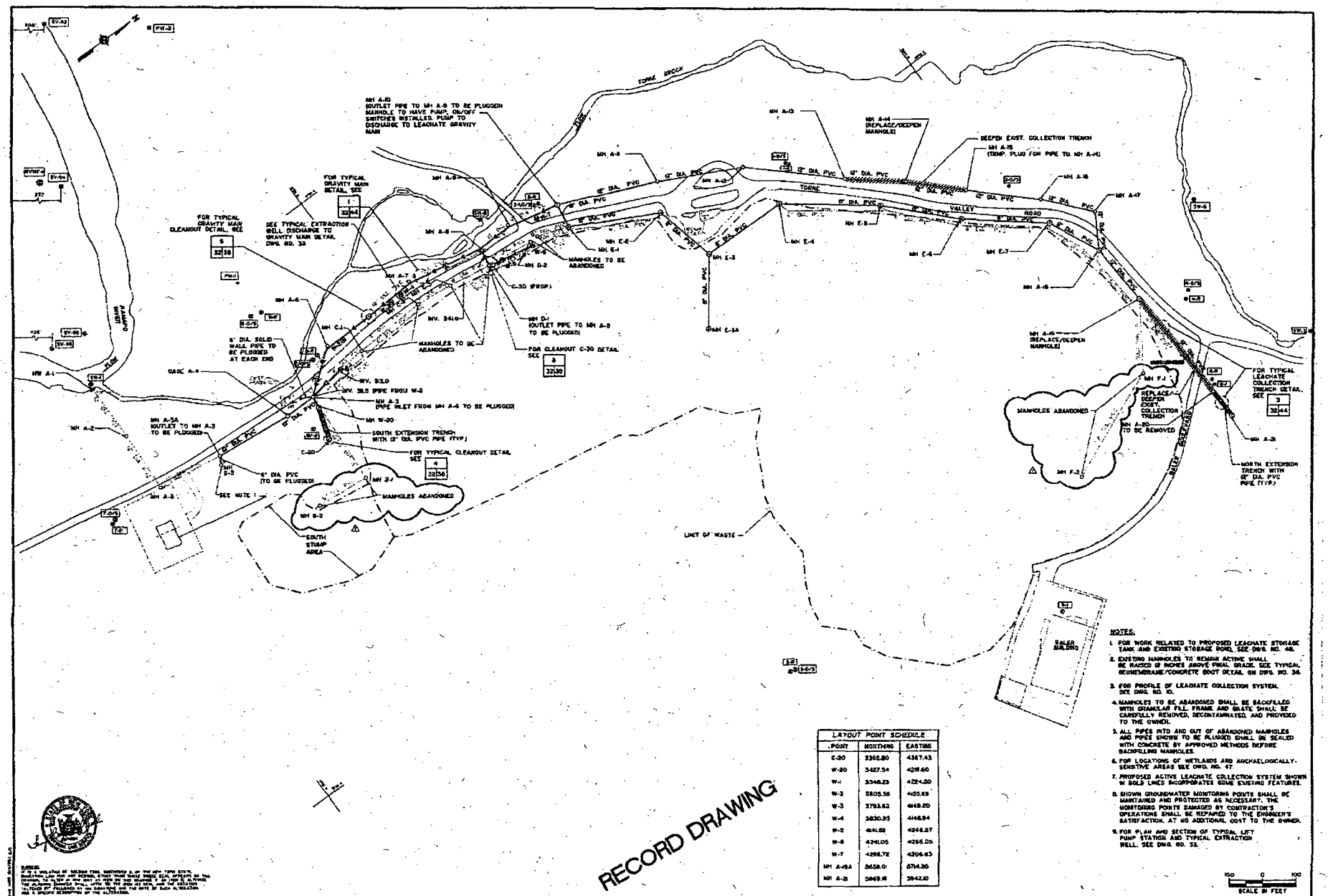
## X. NEXT REVIEW

Since hazardous substances, pollutants or contaminants remain at the Ramapo Landfill site which do not allow for unlimited use or unrestricted exposure, in accordance with 40 CFR 300.430 (f) (4) (ii), the remedial action for the site shall be reviewed no less often than every five years. EPA will conduct another five-year review within five years of the date of this five-year review.

Approved:

Walter E. Mugdan, Director
Emergency and Remedial Response Division

12/22/09
Date




RECORD DRAWING

| LAYOUT POINT SCHEDULE | | |
|---|---|---|
| POINT | NORTHING | EASTING |
| C-30 | 3398.80 | 4387.43 |
| W-20 | 3427.54 | 4281.60 |
| W-1 | 3548.23 | 4224.50 |
| W-2 | 3805.56 | 4103.69 |
| W-3 | 3793.62 | 4149.20 |
| W-4 | 3830.93 | 4148.94 |
| W-5 | 4141.88 | 4246.57 |
| W-6 | 4241.05 | 4266.05 |
| W-7 | 4298.72 | 4304.63 |
| MH A-9A | 3658.01 | 4114.30 |
| MH A-2A | 3969.18 | 3942.10 |

NOTES:

1. FOR WORK RELATED TO PROPOSED LEACHATE STORAGE TANK AND EXISTING STORAGE POND, SEE DWG. NO. 48.
2. EXISTING MANHOLES TO REMAIN ACTIVE SHALL BE RAISED 12 INCHES ABOVE FINAL GRADE. SEE TYPICAL REINFORCEMENT/CONCRETE BOOT DETAIL ON DWG. NO. 34.
3. FOR PROFILE OF LEACHATE COLLECTION SYSTEM, SEE DWG. NO. 10.
4. MANHOLES TO BE ABANDONED SHALL BE BACKFILLED WITH GRANULAR FILL. FRAME AND GRATE SHALL BE CAREFULLY REMOVED, DECONTAMINATED, AND PROVIDED TO THE OWNER.
5. ALL PIPES INTO AND OUT OF ABANDONED MANHOLES AND PIPES SHOWN TO BE PLUGGED SHALL BE SEALED WITH CONCRETE BY APPROVED METHODS BEFORE BACKFILLING MANHOLES.
6. FOR LOCATIONS OF WETLANDS AND ARCHAEOLOGICALLY-SENSITIVE AREAS SEE DWG. NO. 47.
7. PROPOSED ACTIVE LEACHATE COLLECTION SYSTEM SHOWN W SOLID LINES INCORPORATES SOME EXISTING FEATURES.
8. SHOWN GROUNDWATER MONITORING POINTS SHALL BE MAINTAINED AND PROTECTED AS NECESSARY. THE MONITORING POINTS DAMAGED BY CONTRACTOR'S OPERATIONS SHALL BE REPAIRED TO THE ENGINEER'S SATISFACTION, AT NO ADDITIONAL COST TO THE OWNER.
9. FOR PLAN AND SECTION OF TYPICAL LIFT PUMP STATION AND TYPICAL EXTRACTION WELL, SEE DWG. NO. 33.

SCALE IN FEET

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| NO. | DATE | DESCRIPTION | NO. | DATE | DESCRIPTION |
| 1 | 8/96 | RECORD DRAWING | | | |

DESIGNED BY: M.O.
DRAWN BY: P.S.L.
CHECKED BY: A.M.M.
PROJ. ENGR.: A.A.L.

URS Consultants, Inc.
CONSULTING ENGINEERS
BUFFALO NEW YORK

JOB No. 35344

RAMAPO LANDFILL
TOWN OF RAMAPO NEW YORK

# FIGURE 1

MODIFICATIONS TO LEACHATE COLLECTION SYSTEM PLAN

Scale: 1"=100' Date: JUNE 96 DWG. NO. 32

| Table 1: Chronology of Site Events | |
|---|---|
| **Event** | **Date(s)** |
| Commencement of operation of the landfill | 1950 |
| NYSDEC and Town of Ramapo enter into three Orders on Consent related to phasing out operation of the landfill, determining extent of leachate movement and feasibility of leachate collection, and constructing a surface-water and groundwater-diversion system, leachate-collection system, and system capable of transporting or treating the collected leachate | 1980-1986 |
| Site placed on National Priorities List | 1983 |
| Town enters into fourth Order on Consent under which a remedial investigation and feasibility study is performed | 1988 |
| Record of Decision | 1992 |
| Remedial Design | 1992-1994 |
| Remedial Action | 1994-1997 |
| Explanation of Significant Differences | 1997 |
| First Five-Year Review conducted | 1999 |
| Preliminary Site Close-Out Report. | 2002 |
| Second Five-Year Review conducted | 2004 |
| Five-Year Review Addendum | 2005 |

| **Table 2: Annual Operation, Maintenance, and Monitoring Costs** | |
|---|---|
| **Activity** | **Cost per Year** |
| Sampling and analysis (quarterly)/data evaluation and reporting | $35,000 |
| Site inspection/maintenance | $100,000 |
| *Total estimated cost* | *$135,000* |

| Table 3: Documents, Data, and Information Reviewed in Completing the Five-Year Review | |
|---|---|
| **Document Title, Author** | **Submittal Date** |
| Record of Decision, EPA | 1992 |
| Explanation of Significant Differences, EPA | 1997 |
| Remedial Investigation/Feasibility Study, URS Consultants, Inc. | 1991 |
| Design Analysis Report, URS Greener, Inc. | 1994 |
| Preliminary Close-Out Report, EPA | 1997 |
| Operation and Maintenance Monitoring Manual, URS Greener, Inc. | 1998 |
| Construction Monitoring Report Ramapo Landfill Remediation, URS Greiner, Inc. | 1998 |
| First Five-Year Review Report, EPA | 1999 |
| Second Five-Year Review Report, EPA | 2004 |
| Five-Year Review Report Addendum, EPA | 2005 |
| Post-Closure Annual Groundwater Quality Monitoring Letter Reports, Sterling Environmental Engineering | 2004-2009 |
| EPA guidance for conducting five-year reviews and other guidance and regulations to determine if any new Applicable or Relevant and Appropriate Requirements relating to the protectiveness of the remedy have been developed since EPA issued the ROD. | |

| Table 4: Other Comments on Operation, Maintenance, Monitoring, and Institutional Controls | |
|---|---|
| **Comment** | **Suggestion** |
| In accordance with best management practices of outdoor shooting ranges, berms should be covered by a roof to prevent erosion of the berm and increased lead mobility. During the five-year review site inspection, it was observed that a roof was not present and expended bullet casings were present and accumulating on the ground. | The berm should be covered with a roof. |
| The operation and maintenance (O&M) reports are not complete. The data that is missing includes information about the groundwater and leachate extraction systems, groundwater flow contour maps, and data tables that include EPA Maximum Contaminant Levels (MCLs). | The O&M reports need to be modified to include information about the groundwater and leachate extraction systems, groundwater flow contour maps, and data tables that include EPA MCLs. |
| The drinking water wells are not currently monitored for the New York State Part V drinking water parameters. | The drinking water wells should be monitored for the New York State Part V drinking water parameters. |
| A Site Management Plan does not exist. | A Site Management Plan with an updated long-term monitoring plan (including a revised sampling frequency if extraction wells are down longer than 60 days) and a new section on institutional controls should be prepared. |
| New York State now requires annual certifications that institutional controls that are required by RODs are in place and that remedy-related O&M is being performed and is effective. On an annual basis, the site is inspected to determine whether any intrusive activities have been performed. The annual O&M report that is currently submitted by the Performing Party includes a summary of the findings of the inspection along with a certification that remedy-related O&M is being performed. | Once the required institutional controls are put into place, on an annual basis, the annual O&M report should include a certification that the institutional controls are in place. |

**Table 5: Recommendations and Follow-Up Actions**

| Issue | Recommendations and Follow-Up Actions | Party Responsible | Oversight Agency | Milestone Date | Affects Protectiveness (Y/N) | |
|---|---|---|---|---|---|---|
| | | | | | Current | Future |
| The current monitoring well network does not allow for a determination of a groundwater capture zone nor does it give early warning regarding potential contaminant migration to downgradient drinking water wells. | Additional monitoring wells need to be installed and sampled and a conceptual or analytical model of the site groundwater contaminants needs to be developed. Additional well clusters located downgradient of monitoring wells along the landfill boundary that exceed Maximum Contaminant Levels (MCLs) are necessary in order to determine the extent of groundwater contamination and aid in determining the area of influence of the groundwater extraction system. | PRP | NYSDEC | 12/10 | Y | Y |
| The performance of the groundwater extraction system is difficult to evaluate given the lack of information. | Contaminant concentrations and flow rates for the groundwater extraction wells need to be reported to the Agencies on a routine basis. | PRP | NYSDEC | 12/10 | N | Y |
| It is believed that increases in groundwater contaminant concentrations in the sentinel well and in the water supply wells over the past several years may be attributable to the operational problems of the pumps in two of the extraction wells. | Now that these extraction wells have been properly operating for over two years, the wells should be sampled quarterly over the next year to ensure a downward trend. In the future, any operational problems should be reported to the Agencies and should be addressed in a timely manner in order to keep the wells functioning to the fullest capacity. | PRP | NYSDEC | 12/10 | N | Y |
| The pump in a third extraction well is currently experiencing electrical problems. Troubleshooting is currently underway. | Troubleshooting should continue and appropriate corrective action should be taken to ensure that the extraction well operates effectively. | PRP | NYSDEC | 12/09 | N | Y |
| The laboratory's detection limit for antimony and thallium is greater than the standard in | Immediate resampling of the private and public water supply wells needs to occur | PRP | NYSDEC | 1/10 | N | Y |

**Table 5: Recommendations and Follow-Up Actions**

| Issue | Recommendations and Follow-Up Actions | Party Responsible | Oversight Agency | Milestone Date | Affects Protectiveness (Y/N) | |
|---|---|---|---|---|---|---|
| | | | | | Current | Future |
| many sampling events for several of the wells, including the private drinking water and municipal water supply wells. Therefore, it is unknown if levels of these constituents that are present in any of the drinking water wells exceed drinking water standards. | and an alternative analytical method for antimony and thallium needs to be employed for this and all subsequent sample analyses. This new method should have a method detection limit that is below the MCLs for these parameters. More frequent sampling (*i.e.,* quarterly) needs to be performed for the drinking water wells based on past MCL exceedances and given their close proximity to the landfill. Any exceedances of drinking water standards observed in these wells needs to be reported to the Agencies immediately. | | | | | |
| If it is determined that the level of antimony and/or thallium detected in the downgradient drinking water wells exceed drinking water standards, appropriate actions need to be taken. | The alternate water supply contingency remedy may need to be implemented and institutional controls to restrict the withdrawal or use of off-site groundwater may be required. | PRP | NYSDEC | 12/10 | N | Y |
| Groundwater contaminant concentrations have increased in some monitoring wells, including the most downgradient wells (MW-9OS and MW-9I), and fluctuated in other wells. Also, the vertical extent of the groundwater contamination has not been confirmed, since only two of the deeper bedrock wells were sampled during the review period. | An evaluation of potential causes of increases in groundwater contaminant concentrations needs to be performed. It is possible that extraction wells cycling or not properly operating are the cause of the increasing concentrations. In all locations where the MCLs are exceeded in shallow wells, the intermediate and bedrock wells must be sampled to determine if contaminants are migrating vertically (not all intermediate or bedrock wells are currently being sampled). Sampling of bedrock wells should be | PRP | NYSDEC | 12/10 | Y | Y |

**Table 5: Recommendations and Follow-Up Actions**

| Issue | Recommendations and Follow-Up Actions | Party Responsible | Oversight Agency | Milestone Date | Affects Protectiveness (Y/N) | |
|---|---|---|---|---|---|---|
| | | | | | Current | Future |
| | incorporated into the operation and maintenance plan. An additional well cluster must be considered downgradient of monitoring well cluster MW-9 to determine the extent of contamination. | | | | | |
| Notwithstanding the fact that EPA and the Town have communicated since the last five-year review relative to drafting language for a restrictive covenant, institutional controls prohibiting the installation of groundwater wells and to protect the integrity of the cap are still not in place. | A restrictive covenant should be drafted and filed. | PRP | NYSDEC | 12/10 | N | Y |