



FIVE-YEAR REVIEW REPORT
WARWICK LANDFILL SUPERFUND SITE
TOWN OF WARWICK, ORANGE COUNTY, NEW YORK



Prepared by:
U.S. Environmental Protection Agency
Region II
New York, New York

August 2011

EXECUTIVE SUMMARY

This is the third five-year review for the Warwick Landfill Superfund site (Site), located in the Village of Greenwood Lake, Town of Warwick, Orange County, New York. The remedy for the Site included the installation of a landfill cap, in accordance with the New York State 6 NYCRR Part 360 closure requirements for solid waste landfills. The cap also includes landfill gas vents throughout the landfill mound. The operations, maintenance and monitoring activities include groundwater, surface water and sediment sampling, as well as annual Site inspections, to ensure that the cap and cover, as well as the fence around the landfill, remain intact. There is currently a permanent easement registered on the Site property to prevent any future use of the landfill, including preventing any installation of groundwater wells on the landfill.

Based upon a review of the Site documents, sampling data and the Site inspection, the U.S. Environmental Protection Agency concludes that the remedy implemented at the Site currently protects human health and the environment; because, the landfill cap reduces leachate generation, and groundwater monitoring does not indicate contaminated groundwater is migrating from the landfill. However, in order for the remedy to be protective in the long-term, the residential wells screened in the bedrock that are downgradient of the landfill should be sampled to ensure residents are not being exposed to Site contaminants.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name (from WasteLAN): Warwick Landfill		
EPA ID (from WasteLAN): NYD980506679		
Region: 2	State: NY	City/County: Town of Warwick/Orange
SITE STATUS		
NPL status: <input type="checkbox"/> Final <input checked="" type="checkbox"/> Deleted <input type="checkbox"/> Other (specify)		
Remediation status (choose all that apply): <input type="checkbox"/> Under Construction <input checked="" type="checkbox"/> Constructed <input checked="" type="checkbox"/> Operating		
Multiple OUs?* <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Construction completion date: 09/28/1998	
Has site been put into reuse? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> N/A (Site involves fenced landfill cap including environmental easement with no future development.)		
REVIEW STATUS		
Lead agency: <input checked="" type="checkbox"/> EPA <input type="checkbox"/> State <input type="checkbox"/> Tribe <input type="checkbox"/> Other Federal Agency		
Author name: Damian Duda		
Author title: Remedial Project Manager	Author affiliation: EPA	
Review period:** 08/31/2006 to 08/31/2011		
Date(s) of site inspection: May 2, 2011		
Type of review: <input checked="" type="checkbox"/> Post-SARA <input type="checkbox"/> Pre-SARA <input type="checkbox"/> NPL-Removal only <input type="checkbox"/> Non-NPL Remedial Action Site <input type="checkbox"/> NPL State/Tribe-lead <input type="checkbox"/> Regional Discretion		
Review number: <input type="checkbox"/> 1 (first) <input type="checkbox"/> 2 (second) <input checked="" type="checkbox"/> 3 (third) <input type="checkbox"/> Other (specify)		
Triggering action: <input type="checkbox"/> Actual RA Onsite Construction at OU # _____ <input type="checkbox"/> Actual RA Start at OU# _____ <input type="checkbox"/> Construction Completion <input checked="" type="checkbox"/> Previous Five-Year Review Report <input type="checkbox"/> Other (specify)		
Triggering action date (from WasteLAN): 08/31/2011		
Does the report include recommendation(s) and follow-up action(s)? <input checked="" type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> not yet determined		
Is the site protective of public health? <input checked="" type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> not yet determined		
Is the remedy protective of the environment? <input checked="" type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> not yet determined		

* ["OU" refers to operable unit.]

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

Five-Year Review Summary Form (continued)

Issues, Recommendations and Follow-Up Actions

Table 6 includes suggestions for improving, modifying and/or adjusting the O&M activities that do not affect the protectiveness of the remedy.

Table 7 presents recommendations and follow-up actions which could result in modifications to the current Site monitoring program, including the sampling of downgradient residential wells.

Protectiveness Statement

The remedy implemented at the Site currently protects human health and the environment; because, the landfill cap reduces leachate generation and groundwater monitoring does not indicate contaminated groundwater is migrating from the landfill. However, in order for the remedy to be protective in the long-term, the downgradient residential wells screened in the bedrock aquifer should be sampled in order to ensure residents are not being exposed to site contaminants.

ACRONYMS USED IN THIS DOCUMENT

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	Contaminant of potential concern
EPA	United States Environmental Protection Agency
MCL	Maximum contaminant level
µg/l	Micrograms per liter
mg/kg	Milligrams per kilogram
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OU	Operable Unit
O&M	Operations and Maintenance
PAHs	Polycyclic aromatic hydrocarbons
PRP	Potentially Responsible Party
ROD	Record of Decision
RI/FS	Remedial Investigation/Feasibility Study
RPM	Remedial Project Manager
SAMP	Sampling, Analysis and Monitoring Plan
SVOC	Semi-volatile organic compound
VOC	Volatile organic compound
WAG	Warwick Administrative Group

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U.S. Environmental Protection Agency
Region II
Emergency and Remedial Response Division
Five-Year Review
Warwick Landfill Superfund Site
Town of Warwick, Orange County, New York

I. **INTRODUCTION**

This is the third five-year review (FYR) for the Warwick Landfill Superfund site (Site), located in the Village of Greenwood Lake, Town of Warwick, Orange County, New York (see Figure 1). The selected remedies for the Site were addressed under two separate operable units. Operable Unit One (OU-1) was the implementation of the landfill cap remedy, and Operable Unit Two (OU-2) was the no further action for the groundwater. This review was conducted by Damian Duda, the U.S. Environmental Protection Agency (EPA) Region II Remedial Project Manager (RPM) for the Site. This FYR was conducted, pursuant to Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, 42 U.S.C. §9601 *et seq.* and 40 CFR(f)(4)(ii). The FYR was completed, in accordance with the Comprehensive Five-Year Review Guidance, OSWER Directives 9355.7-02B-P (June 2001). The purpose of a FYR is to ensure that the implemented remedies protect human health and the environment and that they function as intended by the Site decision documents. This report will become part of the Administrative Record for this Site.

A statutory review is required at this Site because hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure. This review covers the period from August 2006 to August 2011. The trigger for this FYR is the date the last FYR was signed.

The lead agency for this Site is EPA Region II.

II. **SITE CHRONOLOGY**

Chronology of Site Events

Table 1 summarizes the chronology of events for the Site.

Table 1: Chronology of Site Events	
Event	Date
NYSDEC denies Grace Disposal permit to continue operation of the Warwick Landfill	September 1979
Phase I and II Preliminary Investigation Warwick Landfill	1983 and 1985
Warwick Landfill added to the National Priorities List (NPL)	March 1989
Remedial Investigation/Feasibility Study (RI/FS) Report (Operable Unit One (OU-1))	February 1991
EPA issued first Record of Decision (Operable Unit - One (OU-1))	June 1991
Unilateral Administrative Order No. II CERCLA-20203 For Remedial Design/Remedial Action, USEPA, Warwick Landfill Superfund Site.	February 1992
EPA Administrative Order on Consent No. II CERCLA-20214 for RI/FS for Groundwater, USEPA, Warwick Landfill Superfund Site	September 1992
RI/FS Report issued (Operable Unit - Two (OU-2))	April 1995
Final Design Report issued (OU-1)	May 1995
Amendment to Administrative Order No. II CERCLA-20214 for the Risk Assessment, USEPA, Warwick Landfill Superfund Site	May 1995
EPA issued second Record of Decision (OU-2)	September 1995
Landfill Cap Construction Began (bid award)	June 1996
Substantial Completion of Warwick Landfill Cap	August 1998
Final Inspection of Warwick Landfill Cap and Demobilization	September 1998
Preliminary Close Out Report (EPA Construction Completion)	September 1998
Final Close Out Report	July 2000
Operations and Maintenance (O&M) Manual issued	August 2000
Initial O&M Sampling, Analysis and Monitoring Plan Report	December 2000
First Five-Year Review Report Issued by EPA	August 2001
Deletion from NPL	July 6, 2001
Filing of Easement with Orange County Clerk's Office	January 6, 2003
Second Five-Year Review Site Inspection	April 27, 2006
Second Five-Year Report Issued by EPA	August 2006
Third Five-Year Review Site Inspection	May 2011

I. SITE BACKGROUND

Site Location and Physical Description

The Warwick Landfill site (Site) is located approximately one and one-half miles northeast of the Village of Greenwood Lake in the Town of Warwick, Orange County, New York and is approximately three-quarters of a mile north of State Route #17A and fronts Penaluna Road on its western boundary between Old Tuxedo Road and Old Dutch Hollow Road. The landfill mound transects a small valley and occupies approximately 19 acres of a former 26-acre leasehold area. Contiguous to the landfill mound are two wetland areas: an emergent marsh/scrub-shrub wetland, approximately nine acres in size, in the southeast, and a smaller, palustrine, forested scrub-shrub, deciduous wetland, approximately three to four acres in size, to the northwest. Upland habitats surround both wetlands. This leasehold is a portion of a 64-acre parcel of property.

Site Geology and Hydrogeology

Two aquifers exist beneath the Site. The overburden aquifer is an unstratified drift deposit consisting of a mixture of clay, silt, sand, gravel and boulders which widely range in size, shape, and permeability. The bedrock aquifer generally consists of moderately fractured quartz-plagioclase gneiss, hornblende-feldspar gneiss and amphibolite.

The Site hydrogeology is complex. In the overburden, the downgradient flow is southeasterly, southwesterly and northwesterly from the landfill; this stems primarily from the geometry of the aquifer formation and the configuration of the landfill itself. The actual discharge of the overburden aquifer to adjacent wetlands and streams, however, occurs mainly in the northwesterly and southeasterly directions. As groundwater moves in the southwesterly direction, it meets a till layer which acts as a dam and forces it along the front to the northwest or the southeast, hence, to the adjacent wetlands and streams. For the shallow bedrock, the groundwater flow is, generally, in the southwesterly direction.

The hydrogeologic conditions indicate that areas northeast and northwest of the landfill proper are upgradient of the landfill proper. Downgradient locations can generally be defined as south and southwest of the landfill.

A summary of the hydrogeologic conditions for the Site follows:

- The landfill is situated in a groundwater discharge environment, *i.e.*, perched leachate and lower leachate primarily flows to North Brook and South Brook and their associated wetlands.
- Shallow bedrock groundwater moves from the residential area, located northeast of the landfill, towards the landfill.
- Low hydraulic conductivity in the bedrock indicates limited hydraulic connection between the shallow bedrock groundwater and the deep bedrock groundwater.
- The hydraulic properties, *i.e.*, hydraulic heads and lower hydraulic conductivity, of the shallow bedrock minimize the movement of leachate to the north and northeast.

- The bedrock beneath the Site will tend to limit the vertical movement of leachate, because of its low vertical hydraulic conductivity. Groundwater flow at depth is also limited.
- Northeast of the landfill, the natural hydrogeologic conditions show potential for downgradient groundwater flow in the shallow bedrock aquifer; and, combined with the construction techniques of deep residential wells in that area (typically 300 feet or more), conditions may exist for some downward vertical migration of shallow groundwater.

An unnamed intermittent stream drains the small wetlands area on the northwest side of the Site and flows north into a creek, *i.e.*, North Brook, which ultimately flows westward and then southward into Greenwood Lake. Another stream, located on the landfill's southeast side, flows southward into the larger wetlands area which is drained by an unnamed perennial stream, *i.e.*, South Brook, designated a Class "A" water body by the New York State Department of Environmental Conservation (NYSDEC) which flows south and west into Greenwood Lake. The wetlands and streams draining the Site area do not support fishing or other recreational activities. However, they are a suitable habitat for small aquatic wildlife, such as frogs and turtles.

Land and Resource Use

The Village of Greenwood Lake is a semi-rural residential community located approximately fifty miles northwest of New York City. Total population of the Village of Greenwood Lake is estimated to be 3,400. The Town of Warwick has a population of approximately 33,000.

The area surrounding the Site is generally wooded with clusters of residential homes, all of which utilize private wells as their source of drinking water. One residential property is located adjacent to the Site on the western side, and additional residential properties are located directly across Penaluna Road from the landfill.

History of Contamination

The Site was owned and farmed by the Penaluna family from 1898 to the mid-1950s, when the Town of Warwick leased the property from the Penaluna family and utilized it as a refuse disposal area. The facility accepted waste from the Town of Warwick, which includes the Villages of Florida, Warwick and Greenwood Lake, and other surrounding towns in Orange County. Some industrial wastes containing hazardous substances were disposed of during this time. The Town of Warwick operated the landfill until 1977.

From 1977-1980, the landfill was operated by Grace Disposal, Inc.; evidence indicated that the majority of the disposal of materials containing hazardous substances occurred during this time. In 1979, in response to concerns of local citizens who had reported observations of suspicious dumping activities at the landfill, EPA and NYSDEC collected and analyzed two leachate samples from the Site. The results indicated the presence of heavy metals, phenols and various volatile organic compounds (VOCs), some of which exceeded the Federal and state drinking water standards. After transfer of the property from the Penalunas to Orange County, as a result of non-payment of taxes, the property was ultimately transferred in 1987 to the current owner, L & B Developers, Inc.

Initial Response

In March 1985, a preliminary assessment/site inspection, including a field investigation, was performed by NYSDEC. The information generated was utilized to prepare a Hazard Ranking System (HRS) assessment of the Site. Based upon the HRS score, the Site was proposed for inclusion on EPA's National Priorities List (NPL) of uncontrolled hazardous waste sites in 1985 and was added to the NPL in March 1989.

From September 1989 until November 1990 during the initial Remedial Investigation (RI) phase of the project, residential well sampling was conducted by EPA and the New York State Department of Health (NYSDOH). The data results indicated levels of VOC-contamination above Federal and state drinking water standards. As a result, NYSDOH and NYSDEC fitted those affected households with granular activated carbon units. These units were subsequently turned over to the homeowners for their continued use. The RI and Feasibility Study (FS) were completed in February 1991.

Basis for Taking Action

On December 28, 1988, EPA sent special notice letters to a number of potentially responsible parties (PRPs) at the Site. None of the PRPs offered to implement the RI/FS; therefore, EPA contracted with Ebasco Services, Inc. to perform the RI/FS, using Superfund monies.

In June 1991, EPA issued a Record of Decision (ROD) which called for the construction of a landfill cap. The ROD selected remedy is described in more detail below under Remedy Selection.

On February 28, 1992 and April 9, 1993, EPA issued Unilateral Administrative Orders (UAOs) to a select group of the PRPs, i.e., Ford, Georgia Pacific, Reichold Chemicals, IBM, Town of Warwick and Union Carbide, which organized into the Warwick Administrative Group (WAG) to perform the remedial design (RD) and remedial action (RA) work for OU-1. The WAG enlisted the services of Arcadis Geraghty and Miller, Inc. (Arcadis) as its engineering contractor to perform the RD work.

On September 28, 1992, EPA entered into an Administrative Order on Consent (AOC) with certain members of the WAG to perform the supplemental groundwater investigation for OU-2. The WAG also retained Arcadis to conduct this effort.

RI activities under both OU-1 and OU-2 included the following: installation of landfill piezometers, monitoring wells and borings; groundwater monitoring well and residential well sampling; landfill seep surveying and mapping; off-site seeps and surface water bench marking; leachate sampling; wetlands, surface water and sediment sampling; landfill gas and ambient air sampling; and, residential septic tank sampling.

In June 1993 and April 1994, additional sampling for VOCs, semi-volatile organic compounds (SVOCs) and metals in water, sediments and landfill leachate was conducted. Contaminant levels were generally within state standards.

In December 1993, leachate samples were collected from the landfill piezometers. Except for several pesticides (alpha-chlordane, gamma-chlordane, 4,4'-DDE and 4,4-DDT), the levels detected were within state surface water standards.

In December 1993 and August/September 1994, groundwater sampling (upgradient and downgradient) was conducted at on-site and off-site monitoring wells. Various VOCs were detected above the Federal and state standards in seven monitoring wells during the two rounds of sampling. With the exception of a few isolated, low-level detections of benzene and chloromethane, VOC-contamination was not found in downgradient wells above Federal and state drinking water standards. Some inorganic compounds, including chromium, nickel and lead, were detected at or above Federal and state drinking water standards in both upgradient and downgradient monitoring wells. Chromium and nickel were found to be naturally occurring in the formations.

In September 1994, 11 residential septic systems northeast of the landfill were sampled. The maximum concentrations of VOCs detected in the residential septic tank systems included substantial levels of 1,1-dichloroethane (DCA), toluene and chlorobenzene. In some cases, the same VOCs were also found in the nearby residential wells, indicating that the septic systems presented a potential source of contamination to the domestic drinking water wells in this area.

Also, during September 1994, as required by the OU-1 ROD, a separate residential well sampling program was initiated. Most residences within a quarter-mile radius of the Site were sampled for VOCs and inorganics. Three sampling events were undertaken: September 1994, May and November 1995. Some low-level VOC-contamination, present in some upgradient residential wells, was determined to be related to privately-owned septic systems in the area and not landfill-related. Lead was also detected above the Federal action level in some upgradient residential wells; the presence of lead here was determined to be attributable to household plumbing sources.

Based on the RI for OU-1, the potential for direct human exposure as well as the potential for further contaminant migration to groundwater or surface water existed at the site. At the time of the RI, there were no permanent controls in place to prevent contaminant migration. In addition, the environmental assessment evaluated potential exposure routes of the site contamination to terrestrial wildlife and aquatic life. However, because of the low concentrations of contaminants detected, lack of potential bioaccumulation, absence of fishing or other recreational activity, the assessment was not quantified.

The RI for OU-2 concluded that, since most of the contaminants detected above Federal and/or state standards were isolated occurrences, no groundwater plumes could be delineated for organic or inorganic contaminants and as a result, there was no unacceptable risk.

II. REMEDIAL ACTIONS

Remedy Selection

The June 1991 ROD addressed the primary threats posed by the Site by controlling the source of contamination and provided an interim measure to ensure that area residents have a potable water supply. The Remedial Action Objectives (RAOs) were:

- Minimize the infiltration of rainfall and snow melt into the landfill, which will reduce the quantity of water percolating through the landfill materials and leaching out contaminants;
- Eliminate the risk to area resident associated with contaminated groundwater ingestion and exposure;
- Minimize any further contamination of the wetlands and drainage channels which feed into Greenwood Lake; and,
- Reduce the movement and toxicity of the contaminated landfill leachate, thereby reducing the downward migration of contaminants.

The major components of the selected remedy included:

- Construction of an approximate 22-acre multi-layer cap consistent with New York Part 360 Solid Waste Landfill closure requirements;
- Regrading and compaction of the landfill mound to provide a stable foundation for the placement of the cap prior to its construction;
- Construction of a gas venting system following the testing and characterization of landfill gas emissions;
- Performance of air monitoring prior to, during, and following construction at the site, to ensure that air emissions resulting from the cap construction meet applicable or relevant and appropriate requirements;
- Installation of groundwater monitoring wells within the landfill mound to observe effect of groundwater flow patterns through the saturated portion of the landfill and to monitor the movement of contaminants beneath the landfill;
- Quarterly groundwater monitoring program using existing groundwater monitoring wells and newly installed wells within the mound;
- Construction of fencing around the perimeter of the 25-acre leasehold;
- Recommendations that ordinances be established or restrictions imposed on the deed to ensure that future use of the site property will maintain the integrity of the cap;
- Implementation of a residential well sampling program of area residential wells;
- As an interim measure, fitting and maintenance of granular activated carbon units on residential wells where contaminant levels found exceed either Federal or state maximum contaminant levels (MCLs) or on those residential wells which are threatened by potential contamination in exceedance of MCLs based on the results of the residential well sampling program and the OU2 investigation. The units will be maintained until the decision on a final groundwater remedy is evaluated under OU2; and,
- Evaluate and delineation of the northwestern and southeastern wetlands and the drainage channels flowing through the wetlands adjacent to the landfill.

In addition to the landfill closure activities selected for OU-1, the selected response action in the ROD ensured that, until a decision on a final groundwater remedy was made in OU-2, the area residents were protected from drinking contaminated groundwater by the installation of point-of-use treatment systems on the residential wells. In addition, a full evaluation of the two adjacent wetlands would be performed prior to remediation activities to determine any measures which would be necessary to mitigate potential negative impacts to the wetlands.

Based on the findings of the OU-2 RI performed at the Site, EPA and NYSDEC determined that Site-related groundwater contamination is very limited in extent, was not found to be the probable source of contamination in wells located northeast of the Site and did not pose any significant risk to human health and the environment. The implementation of an environmental monitoring program to include sampling of the groundwater, ambient air, surface water, sediments and landfill gas would further ensure that the OU-1 and OU-2 remedies remain protective of human health and the environment.

In September 1995, EPA issued a ROD for OU-2, which specified that no further action was necessary regarding the Site groundwater.

Remedial Action Implementation

The Town of Warwick performed the remedial action, pursuant to the February 28, 1992 UAO, as discussed above. The landfill system, *i.e.*, the landfill cap, was designed to prevent surface water infiltration into the landfill, thereby, reducing leachate production and the subsequent migration of contaminants in the groundwater.

The elements of the cap construction include the following:

- Relocation of waste from outside the landfill footprint;
- Regrading and relocation of waste within the footprint of the landfill;
- Covering the waste with a minimum of one-foot cover material;
- Construction of a gas venting layer, consisting of geotextile, gas venting piping, passive gas venting wells and a layer of gas venting sand;
- Construction of a cap, consisting of placement of 60-mil textured membrane, a geo-composite layer, two feet of protective and vegetative material, six inches of topsoil and the establishment of a vegetative cover on the topsoil; and,
- Construction of permanent surface water controls.

The remedy has been constructed in accordance with the 1991 OU-1 ROD and the approved Final Design Report plans and specifications, with modifications as shown in the as-built documentation. The Remedial Action Report was approved on May 11, 1999.

Institutional Controls Implementation

The June 1991 ROD called for recommendations that ordinances be established or restrictions imposed on the deed to ensure that future use of the Site property will maintain the integrity of the

cap. In January 2003, restrictions on the deed of the landfill were obtained through the filing of an environmental protection easement and declaration of restrictive covenants (Easement) by the property owner with the Orange County Clerk's office. The Easement was granted by the property owner to members of the WAG and requires, inter alia, that the cap area not be developed residentially, that groundwater not be extracted from the property and that any plans for future development of the cap area be provided to EPA for review and approval. The Easement is now part of the property record and runs with the land, ensuring compliance by any future owners of the property.

Over the past few years, the Town of Warwick Planning Board has instituted protocols requiring certain construction techniques, reports and well testing for subdivision lots within 2000 feet of the landfill. The Town of Warwick now requires that prospective purchasers are placed on notice that the potential subdivision is located within the immediate vicinity of the landfill. In addition, a residence site plan application requires the following: 1) installation of a vapor intrusion protection system; 2) the installation of a deep bedrock well, grouted to a minimum of 20 feet into the bedrock; 3) potable well sampling analysis for metals, VOCs and SVOCs by the Orange County Department of Health (OCDH); and, 4) a recommendation for the installation of a point-of-entry treatment system if contaminants exceed the NYSDOH Part 5, Subpart 5-1 maximum contaminant levels (MCLs) for drinking water. In addition, the Town of Warwick Well Testing procedures outline pump test and analytical testing requirements, including general water quality and other parameters on a case-by-case basis, if the property is located near areas of potential concern, including landfills, gas stations, hazardous waste sites or other areas of potential concern.

Operations, Maintenance and Monitoring

Under the February 1992 and April 1993 UAOs for RD/RA, the WAG (PRPs) was required to develop a Site Operations and Maintenance (O&M) Manual and perform O&M in conformance with that O&M Manual, the OU-1 ROD and other requirements of the UAO. The O&M Manual established the requirements for inspections, maintenance, repair, if necessary, and monitoring, including sampling and analysis of a variety of parameters and media, of the landfill closure system at the Site. The O&M Manual, including the Sampling, Analysis and Monitoring Plan (SAMP), presents a complete system of activities that provides assurances that the landfill closure system is operating, in accordance with the remedial design and construction performance objectives. Arcadis, the WAG engineer, is currently implementing the O&M activities, including sampling and Site inspections, with EPA and NYSDEC oversight, as needed. Arcadis prepares the O&M SAMP reports and the O&M Site Inspection reports and distributes them to EPA and NYSDEC.

In 2006, NYSDEC issued a letter modifying some of the O&M requirements as set forth in the original O&M Plan. These modifications were implemented during the July 2006 O&M sampling event [transmitted in December 2006 after the release of the 2006 FYR]. These modifications included the following:

- A minimum of 50% of the monitoring wells (representative of the Site) should be sampled during each sampling event, including at least one upgradient well.
- All monitoring wells should be sampled at least once every third monitoring event (*i.e.*, every 45 months)
- The location, depth, contaminant and pumping test data for any new residential wells installed within a quarter mile of the perimeter of the landfill should be included in the Five-Quarter O&M SAMP.
- Site inspections should be performed at least quarterly during the warmer seasons, *i.e.*, Spring, Summer and Fall, to prevent animals and roots of woody plants from penetrating the landfill cap.
- Neither pesticides nor herbicides should be used during the quarterly inspections.
- An inspection report (identifying the quarterly inspection results) should be submitted annually.

The annual O&M Site inspections include 1) performing general Site maintenance to maintain the vegetative layer, including reseeded, fertilizing and/or grass cutting (depending on Site conditions, one third of the landfill's vegetative cover should be mowed on annual basis), as necessary; 2) evaluating the integrity of the remedial measures that have been implemented, namely the landfill cover system and its various components, *i.e.*, vegetative and synthetic barrier layers, surface water control systems (drainage swales), the passive gas venting systems (gas vents) and, Site security (fence, gate and locks); 3) evaluating the monitoring program components, including the monitoring wells and piezometers and the surface water and sediment sampling locations; and, 4) performing any repair and/or maintenance work, associated with all of the above-discussed components of the landfill cover system and monitoring network. When identified, any repair and/or maintenance work deemed necessary is completed by the WAG inspection personnel. In addition to the annual inspections, supplemental inspections may be conducted at other times, such as during the O&M five-quarter sampling events.

During the annual O&M Site inspections, the Site inspection form, as prescribed in the O&M Manual, is used to evaluate the various components of the selected remedy. Also, when necessary, a maintenance/repair form is completed to identify any necessary actions to be taken; this form includes the dates when the problem was identified and when the repair/maintenance was made. Grass-mowing, reseeded and/or fertilizing activities are identified as maintenance activities. The O&M Inspection Reports also include photographs taken during the time of the O&M Site inspections.

The monitoring program at the Site includes investigation of 1) the current hydrogeology, including taking water level measurements at piezometers within the landfill mound, 2) the current groundwater by sampling the 13 monitoring wells at upgradient and downgradient locations, 3) the current surface water at two locations adjacent to the landfill and two downstream of the landfill and 4) the current sediments at two locations adjacent to the landfill and two downstream of the landfill.

The regular O&M monitoring of the groundwater, surface water and sediment conditions began shortly after the Site's final inspection on September 1998. Sampling for these parameters has

been performed regularly from December 1998 through May 2010. These events have been documented in the associated O&M SAMP reports. Since the last FYR, four O&M SAMPs were prepared (July 2006, October 2007, November 2008 and May 2010) and two Inspection Reports (September 2008, December 2009). The July 2006 and the October 2007 O&M SAMPs included the annual Site Inspection information.

III. PROGRESS SINCE LAST FIVE-YEAR REVIEW

The five-quarter O&M sampling and the annual Site inspections have been conducted according to the schedule, as revised by NYSDEC's 2006 letter. EPA has reviewed the O&M SAMP and Site Inspection reports during the period since the last FYR.

The 2006 FYR concluded that the remedy at the Site was implemented in accordance with the requirements of the two RODs and was protective of human health and the environment. In that FYR, EPA discussed the change in land use near the landfill where home sites were being located downgradient, adjacent to and across the road from the landfill. Potable water is supplied by individual domestic wells. These new drinking water wells were being installed and tested at the time of their installation. The 2006 FYR discussion indicated that Site contaminants could have an impact on the water quality in these new residential wells, especially if the homeowners are pumping substantial amounts of bedrock groundwater on a regular basis. The 2006 FYR recommended that EPA and the PRPs (WAG) request, from the Town of Warwick, the permitting requirements for the wells, review those domestic well permits and review the O&M plan to evaluate whether the installation of additional monitoring wells was necessary.

As reflected in the 2006 FYR, the Agencies had some concern about the quality of the drinking water in new residential wells at homes constructed near the Site, particularly those downgradient of the landfill. Arcadis contacted the Town of Warwick and obtained information about new residential well installation near the Site. In February 2008, Tectonic Engineering (the Engineer for the Town of Warwick) provided Arcadis data on some new properties on Penaluna Road which showed levels within Federal and state standards. Furthermore, in June 2011, Arcadis completed a review of the Town of Warwick Health Department's well-drilling records and sampling results and provided this information to EPA. The permit reviews showed that the Town accepted the protocols for the well-drilling, as well as the sampling results from the newly drilled wells. Arcadis will further examine the O&M monitoring program to determine if it is sufficient to monitor Site contaminants, especially considering the new residential development in the area.

As discussed under the Institutional Controls (ICs) section above, the Town of Warwick Planning Board instituted protocols requiring certain construction techniques, reports and well testing for subdivision lots within 2000 feet of the landfill. These protocols apply to all new residential drinking water wells that may be constructed downgradient of the landfill and should ensure that any new domestic well is properly installed, sampled and approved for residential use.

IV. THE FIVE-YEAR REVIEW PROCESS

Five-Year Review Team

The FYR team consisted of Damian Duda (RPM), Grant Anderson (hydrogeologist), Julie McPherson (human health risk assessor), Rebecca Ofrane-Hughes (human health risk assessor), Mindy Pensak (ecological risk assessor), Steve Ferreira (environmental scientist), Sal Badalamenti (supervisor) and Carol Berns (Site attorney).

Community Notification and Involvement

The EPA Community Involvement Coordinator for the Warwick Landfill site, Ms. Cecilia Echols, arranged for a public notice to be published in a local newspaper, Times Herald-Record on Thursday, January 6, 2011. The public notice announced that EPA was conducting the third FYR for the Site. To date, there have been no inquiries from the public about this FYR.

Document Review

The relevant documents and reports which were reviewed during the FYR process are identified in Table 2.

Data Review

The O&M SAMP reports, including the Site inspection reports, evaluate the effectiveness of the landfill cap through the monitoring of groundwater, surface water and sediments. If the O&M data indicate that either groundwater quality in the overburden and/or bedrock aquifers or surface water quality in the adjacent wetlands is not being restored to acceptable levels by reduced leachate generation, further actions would be taken. Since the construction of the landfill cap, 13 years of on-Site and off-Site groundwater, surface water and sediments data have been generated.

Since the completion of the remedial action activities and the final inspection, the Site conditions have remained relatively stable. There has been some minor evidence of trespassing, but these episodes do not affect the landfill cap remedy nor the O&M activities. The fence which surrounds the majority of the Site is intact and in good condition; the monitoring wells installed within and around the Site are functional; and, the passive gas vents are operational.

Groundwater Quality

Pre-construction hydrogeologic conditions are similar to post-construction conditions. Groundwater elevation monitoring results for the May 2010 sampling event indicates negligible variation from the previous five-quarter sampling events. Overall, the general direction of groundwater flow in both the overburden and bedrock aquifers has not changed. Therefore, the monitoring well network and surface-water and sediment locations identified in the O&M Manual remain suitable for the O&M SAMP.

The May 2010 SAMP report showed maps of the overburden and bedrock aquifers. In the overburden, groundwater flows radially towards North Brook and South Brook. In the bedrock aquifer, the map showed a deep groundwater flow direction from the residential wells along Penaluna Road toward the landfill (west to east). However, after reassessing the water level data, EPA determined that the deep groundwater for this portion of the area (west side of Penaluna Road) shows a directional flow from east to west. This reassessment shows that those residential wells that are installed in the deep bedrock aquifer to the southwest of the landfill are directly downgradient from the landfill.

In general, for all sampling events, groundwater quality has remained fairly consistent over the years with some moderate improvement for some VOCs and some metals.

During the past five years, VOC concentrations in the monitoring wells have generally dropped and were rarely detected in samples from downgradient monitoring wells. In MW-11S (2010 sampling event), benzene was shown at 1.8 µg/l, just over the state standard of 1 µg/l. In MW-10S (November 2008 sampling event), 1,1,1-TCA was shown at 5.7 µg/l, just above the state standard of 5 µg/l. Both monitoring wells are upgradient of the landfill.

During the past five years, antimony, chromium and nickel were detected at concentrations greater than state standards in both upgradient and downgradient wells. The highest concentrations of antimony were detected in downgradient wells: WL-8D at 6 µg/l, MW-13 at 17.4 µg/l and MW-14 at 5.7 µg/l and upgradient well: MW-10S at 9.5 µg/l. The highest concentrations of chromium were detected in downgradient wells: WL-6D at 196 µg/l; WL-8D at 191 µg/l and MW-14 at 1300 µg/l and upgradient well: MW-10S at 2070 µg/l. The highest concentrations of nickel were detected in downgradient well: WL-4D at 715 µg/l and upgradient well: MW-10S at 266 µg/l. Historically, the OU-2 RI showed that antimony, chromium and nickel were detected in samples from background monitoring wells, not part of the O&M SAMP well network, and naturally occurring in the formations. The groundwater conditions have been relatively stable since monitoring began during the OU-2 RI.

Monitoring well MW-10S is located upgradient of the Site and downgradient of a residential neighborhood in the overburden. Historically, some VOCs (1,1-DCE, 1,1-DCA and 1,1,1-TCA), detected in MW-10S, were above state standards; however, the VOC trend is now downward with 1,1-DCE and 1,1-DCE concentrations currently below MCLs and 1,1,1-TCA concentrations near the MCL. The OU-2 RI determined that residential septic systems were a cause of VOC contamination in the overburden aquifer which, in turn, affected residential wells in this neighborhood. Table 3 compares the maximum detected concentration of Contaminants of Potential Concern (COPCs) in the various monitoring wells.

Twelve new potable well locations were found within 2,000 feet of the limits of the landfill. Five of these residences are located southwest of the landfill and have domestic wells installed downgradient of the landfill. All wells were tested for total coliform and *e. coli* and successfully met drinking water standards. Furthermore, a domestic well search yielded five residential wells (four of which are downgradient of the landfill) which were sampled for additional parameters, including VOCs, SVOCs and metals. In all wells, VOCs showed non-detect with the exception of 1) toluene detected at 0.297 and 0.5 micrograms per liter (µg/l), 2) chloroform detected at 5.1 µg/l

and 3) carbon disulfide detected at 0.9 µg/l. Toluene has been historically non-detect in the bedrock monitoring wells located downgradient of the landfill, including monitoring wells WL-4D, WL-6D, MW-13 and MW-14. With respect to metals, the majority were found to be non-detect, including chromium and nickel which, as discussed above, were found in upgradient and downgradient monitoring wells.

SVOCs were non-detect except for bis (2-ethylhexyl) phthalate detected at 0.7 µg/l. The lab report stated that sample contamination could occur during sample bottle filling.

Surface Water and Sediments

Surface water and sediments sampling indicates little change in existing conditions. Pesticides were not detected in any adjacent or downstream surface water samples collected during the last five years, as reported in the November 2008 SAMP. Historically, pesticides were reported infrequently and at very low concentrations (0.51 to 11 parts per trillion). In the adjacent surface water locations, PAHs were detected in the sediments at very low levels in SD-G location and, except for benzo(k)flouranthene at 0.035 mg/kg, non-detect in the SD-H location. In the downstream surface water locations, PAHs were detected in the sediments at very low levels in the SD-E locations and, except for benzo(a)anthracene at 0.012 mg/kg, anthracene at 0.01 mg/kg and flouranthene at 0.014 mg/kg, non-detect in the SD-B location and are consistent with the RD SAMP investigation data (see Table 4).

The surface water showed non-detects for all pesticides.

O&M Site Inspections

As a result of annual, as well as supplemental, O&M inspections conducted during April/July/October 2006, April/July/October 2007, May/July/September/November 2008, May/July/October 2009, and O&M sampling events conducted in July 2006, October 2007, November 2008 and May 2010. Some maintenance and repair activities were performed, including fence repair, removal of various dead tree trunks and branches from the landfill cover and replacement of ventilators for passive methane ventilators.

Site Inspection and Interviews

As part of the FYR process, EPA conducted a Site inspection on May 2, 2011. Represented at the inspection were EPA, NYSDEC, NYSDOH and the WAG contractors, Arcadis and Waste Management, Inc. The following representatives were present: EPA: Damian Duda (RPM), Steve Ferreira (Environmental Scientist), Julie McPherson and Rebecca Hughes (Risk Assessors), Mindy Pensack (BTAG coordinator), Grant Anderson, (Hydrogeologist) and Carol Berns (Site Attorney); NYSDEC: Robin Hackett (Project Manager); NYSDOH: Renata Ockenby (Project Manager); Arcadis: Mike Klechkowski (Project Manager); and, Waste Management, Inc.: Mark Snyder (Project Manager).

During the Site inspection, including a walk around the landfill cap in and around the drainage swales, no problems or irregularities were identified with respect to the ongoing O&M of the landfill cap remedy. Some distressed trees were observed that should be removed; these were removed shortly after the Site inspection by Arcadis. The group also assessed residential development near the Site. No interviews were taken during this inspection. All residential homes in the area receive drinking water from private domestic wells.

V. TECHNICAL ASSESSMENT

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

Yes.

The 1991 ROD selected remedy consisted of the following components: construction of a landfill cap and associated gas venting, in compliance with NYS 360 closure requirements for solid waste landfills; implementation of groundwater, residential well, surface water and sediments monitoring programs; an ongoing maintenance program; installation of perimeter fencing; and, securing institutional controls. A second ROD, issued in 1995, determined that no further action was required for the groundwater contamination beyond the remedy selected in 1991. The landfill continues to eliminate the exposure pathway to Site-related contaminants via the soil exposure pathway. The media sampling data indicate that the landfill cap is working to reduce contamination migrating from the landfill.

The landfill cap construction was completed in September 1998, reducing the potential for contaminants to leach from the landfill and eliminating the exposure pathway of receptors being in direct contact with landfill contaminants. The landfill cap is currently being maintained by Arcadis (PRPs/WAG) and is functioning as intended.

Arcadis inspects and assesses the integrity of the cap, as well as the fence, on an annual basis. At the present time, the landfill cap and fencing are in good shape, the vegetative cover is intact and flourishing, and site maintenance and security is sufficient. Numerous types of wildlife cross through or reside in the vegetative cover, such as deer, quail, migrating birds, various rodents, even bear. In addition, a select group of monitoring wells and surface water and sediment locations are monitored to assess the migration of any Site-related contaminants.

The groundwater monitoring and landfill cap maintenance programs were implemented as part of the O&M phase of the remedial action, and the final O&M Manual was issued by Arcadis in August 2000. O&M sampling and monitoring has continued at the Site. As discussed previously, the sampling frequency was reduced over the past five years as reflected in NYSDEC's 2006 modification.

With respect to ICs, an environmental protection easement and declaration of restrictive covenants (Easement) by the property owner is filed with the Orange County Clerk's office. The Easement restricts residential development and groundwater extraction on the landfill and requires EPA review and approval of any and all future development plans for the landfill cap area.

The Town of Warwick Planning Board instituted protocols requiring specific construction techniques, reports and well testing (pump test and analytical testing) for subdivision lots (residential) within 2000 feet of the landfill. A residence site plan now requires the installation of a vapor intrusion protection system, a deep bedrock well, grouted to a minimum of 20 feet; a potable well sampling analysis by the OCDH for metals, VOCs, SVOCs; and, general water quality parameters, as well as a recommendation for the installation of a point-of-entry treatment system if contaminants exceed MCLs.

As discussed above, EPA determined that the groundwater flow in the bedrock aquifer moves in the direction of the new homes across Penaluna Road from the landfill. These homes have private wells screened in the deep bedrock aquifer. At the present time, a review of the limited residential groundwater data secured from the Town of Warwick does not show any Site-related contaminant impacts to these downgradient residential wells installed from September 2005 through May 2008. In addition, as discussed above, historical groundwater sampling downgradient does not show Site-related contamination in the bedrock aquifer.

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

Yes, the majority of the exposure pathways and the receptor populations identified in the 1995 Baseline Human Health Risk Assessment (BHHRA) and ecological assessment remain valid.

Land use assumptions, exposure assumptions and pathways, cleanup levels and remedial action objectives considered in the decision documents remain valid. However, land use immediately downgradient of the landfill boundary has changed. Although specific parameters may have changed since the time the risk assessment was completed, the process that was used remains valid and not expected to affect the remedy.

Generally, VOCs have not been detected above the state standards during the past five years at the majority of monitoring wells in the overburden and bedrock aquifer. Historically, 1,1,1-TCA has been detected in MW-10S but is now demonstrating a decreasing trend in concentrations. The most recent sampling event showed 1,1,1-TCA near state standards. Historically, 1,1,1-TCA has also been detected in MW-10I sporadically and continues to hover around the state standard. Benzene has not been detected historically at the Site and was detected in MW-11S. The groundwater flow in this area suggests that benzene is not a landfill contaminant but rather a contaminant from an upgradient source. Previous investigations have identified potential septic system waste contamination migrating from the homes. Several metals detected in the unfiltered groundwater samples exceeded their respective state standards; however, nickel was the only metal that was detected in filtered samples above the state standard in the past five years. Although nickel was detected above the state standard, the concentrations are below EPA's Hazard Index of 1.

Soil vapor intrusion (SVI) is evaluated when soils and/or groundwater are known or suspected to contain VOCs. Increased development in the area has raised the potential concern for vapor

intrusion into homes. The maximum detected concentration of VOCs identified in the last five year review did not exceed their respective vapor intrusion screening criteria. Within the past five years, one well (MW-11S) had a slight exceedance of benzene over the 10^{-6} vapor intrusion screening level (see Table 5). As stated previously, the benzene concentrations are, most likely, associated with upgradient sources. Since the landfill proper does not have any buildings on-site, the vapor intrusion pathway is incomplete; however, the Town of Warwick requires that for all residences within 2000 feet of the landfill, a vapor intrusion protection system be installed during construction. As a result, this requirement should alleviate any potential issue with respect to potential vapor intrusion in new residential properties. With respect to the sampling (at the time of installation) of the new downgradient residential wells (installed at depths from 200 to 400 feet), most of the recent VOC groundwater data were non-detect.

With respect to the ecological assessment, the exposure pathways and receptor populations identified in both the OU-1 and OU-2 ROD are appropriate, although the study conducted was qualitative. The results of the sediment and surface water sample data indicate that concentrations identified are not associated with risk to ecological receptors.

The wetlands and streams draining the Site area do not support fishing or other recreational activities. However, they are a suitable habitat for small aquatic wildlife, such as frogs and turtles. The Site inspections reveal no signs of distressed conditions in the wetlands.

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

According to NYSDEC's 2006 letter, the O&M sampling schedule was reduced so that some monitoring wells are sampled only once every third monitoring event, equating to once about every 45 months. Since the 2006 FYR, all monitoring wells, identified as part of the O&M SAMP, have been sampled at least three times. Also, the Town of Warwick's mandatory testing of domestic wells is conducted only once, prior to owner occupancy. The groundwater flow from the landfill in the deeper bedrock aquifer is southwest, in the direction of some of the new residential homes, all with domestic drinking water wells. As a result of these residential wells being installed into the deeper bedrock aquifer and of the continued pumping rates these wells may exert on said aquifer, EPA recommends that the current O&M sampling regimen be reviewed for sampling frequency and that the downgradient private residential wells be sampled for COPCs, consistent with the O&M SAMP. Any private well testing would also be consistent with the 1991 ROD residential well sampling program.

The 2006 NYSDEC letter also reduced the frequency of surface water and sediment sampling, resulting in only one data point for this FYR. EPA recommends that surface water and sediment sampling be continued, providing at least two sampling events in the next 45 months for the current COPCs.

The May 2, 2011 Site inspection indicated that the Site maintenance and security are sufficient.

VI. ISSUES, RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Table 6 includes suggestions for improving, modifying and/or adjusting the O&M activities that do not affect the protectiveness of the remedy.

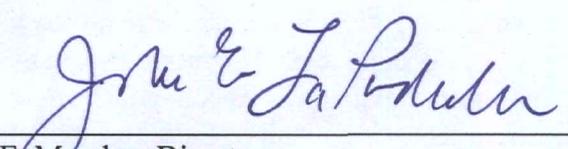
Table 7 presents recommendations and follow-up actions which could result in modifications to the current Site monitoring program, including the monitoring of downgradient residential wells.

VII. PROTECTIVENESS STATEMENT

The remedy implemented at the Site currently protects human health and the environment; because, the landfill cap reduces leachate generation and groundwater monitoring does not indicate contaminated groundwater is migrating from the landfill. However, in order for the remedy to be protective in the long-term, the downgradient residential wells screened in the bedrock aquifer should be sampled in order to ensure residents are not being exposed to site contaminants.

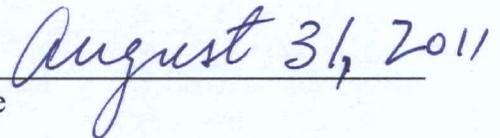
VIII. NEXT FIVE-YEAR REVIEW

The next FYR for the Warwick Landfill site should be completed within five years of the signature date below.

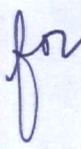


Walter E. Mugdan, Director
Emergency and Remedial Response Division

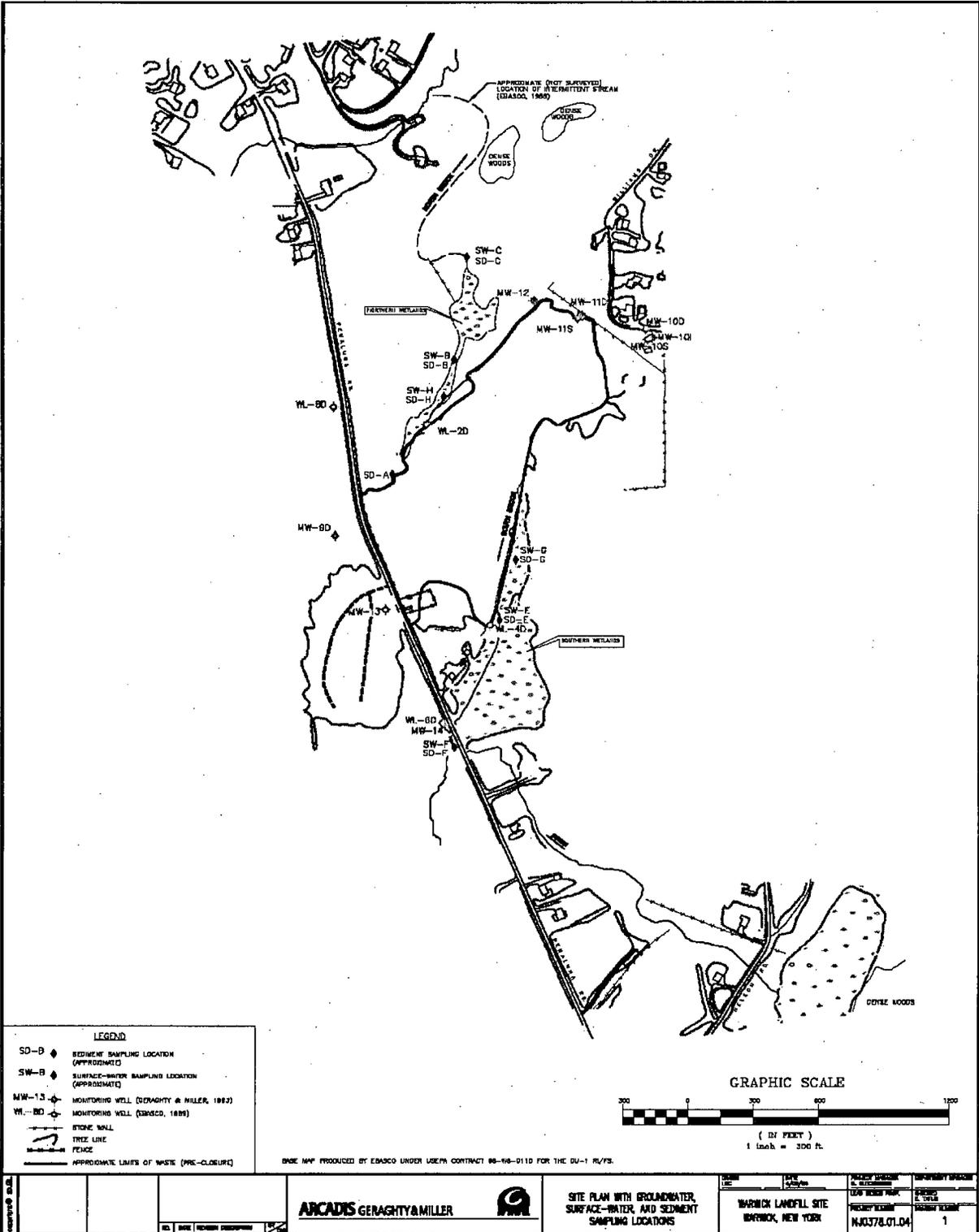
Date



August 31, 2011

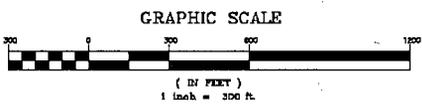


FIGURES



DATE: 02/19/04
 DRAWN BY: J. J. GIBSON
 CHECKED BY: J. J. GIBSON
 APPROVED BY: J. J. GIBSON
 PROJECT: WARWICK LANDFILL SITE

LEGEND	
SD-B	SEDIMENT SAMPLING LOCATION (APPROXIMATE)
SW-B	SURFACE-WATER SAMPLING LOCATION (APPROXIMATE)
MW-13	MONITORING WELL (GERAGHTY & MILLER, 1992)
WL-80	MONITORING WELL (GIBSON, 1999)
	STONE WALL
	TREE LINE
	FENCE
	APPROXIMATE LINES OF WASTE (PRE-CLOSURE)



THIS MAP PRODUCED BY EBASCO UNDER USEPA CONTRACT #6-98-0110 FOR THE DU-1 RL/FS.

		SITE PLAN WITH GROUNDWATER, SURFACE-WATER, AND SEDIMENT SAMPLING LOCATIONS		WARWICK LANDFILL SITE WARWICK, NEW YORK		DATE: 02/19/04 DRAWN BY: J. J. GIBSON CHECKED BY: J. J. GIBSON APPROVED BY: J. J. GIBSON		SHEET NO. 1 OF 1	
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TABLES

TABLE 2
Documents, Data and Information Reviewed in Completing the Five-Year Review

<u>Document Title, Author</u>	<u>Date</u>
Comprehensive Five-Year Review Guidance, EPA	June 2001
Remedial Investigation/Feasibility Study Report, Ebasco Services, Inc. (EPA)	February 1991
Record of Decision for Operable Unit One, EPA,	June 27, 1991
Remedial Investigation Report, Operable Unit Two, Geraghty & Miller, Inc.	April 1995
Record of Decision for Operable Unit Two, EPA	September 29, 1995
Superfund Preliminary Close-Out Report, EPA	September 28, 1998
Operations and Maintenance Manual, Arcadis Geraghty & Miller	February 2000
O&M SAMP Five-Quarter Report (December 2000), Arcadis	January 2001
O&M SAMP Five-Quarter Report (April 2002), Arcadis	January 2003
O&M Inspection Report (May 2001; July and October 2002; June 2003), Arcadis	November 2003
O&M SAMP Five-Quarter Report (November 2003), Arcadis	May 2004
O&M SAMP Five-Quarter Report (April 2004), Arcadis	October 2004
O&M Inspection Report (May 2004; October 2004), Arcadis	December 2004
O&M Inspection Report (October, November 2005 and April 2006), Arcadis	August 2006
O&M SAMP Five-Quarter Report (July 2006) and Site Inspections (April, July and October 2006), Arcadis	December 2006
O&M SAMP Five-Quarter Report (October 2007) and Site Inspections (April, July and October 2007), Arcadis	May 2008
O&M Inspection Report (May, July, September and November 2008)	December 2008
O&M SAMP Five-Quarter Report (November 2008), Arcadis	June 2009
O&M Inspection Report (May, July and October 2009), Arcadis	December 2009
O&M SAMP Five-Quarter Report (May 2010), Arcadis	December 2010

TABLE 3 - Comparison of Maximum Detected Concentrations of COPCs detected in Site Monitoring Wells with Respect to Human Health Risk-Based Screening Criteria (Preliminary Remediation Goals), Primary Drinking Water Standards (Maximum Contaminant Levels) and New York State Department of Environmental Conservation Water Quality Regulations (NYSDEC WQR)

Contaminant of Potential Concern (COPC)	Max. Detected Conc. (µg/l)	Region 9 Preliminary Remediation Goal (µg/l)	Primary Drinking Water Standard - MCL (µg/l)	NYSDEC WQR (µg/l)	MW Location	Date
1,1-DCE	4.4	340 (nc)	7	5	10I	2008
1,1-DCA	2	810 (nc)	None	5	10S 10I	2006 2008
PCE	0.96	0.1 (c)	5	5	MW-12	2008
Chlorobenzene	1.2	110 (nc)	100	5	MW-11S	2008
Benzene	1.8	0.35 (c)	5	1	MW-11S	2007
1,1,1-TCA	6	3200 (nc)	200	5	MW-10S	2006
Toluene	0.24	720 (nc)	1000	5	MW-10D	2010
Antimony	17.4	15 (nc)	6	3	MW-13	2006
Arsenic	8.8	0.045 (c)	10	25	WL-2D	2010
Barium	84	2600 (nc)	2000	1000	WL-2D	2010
Chromium	2070	110 (c)	100	50	MW-10S	2008
Lead	4.4	None	15	25	WL-8D	2008
Nickel	715	730 (nc)	None	100	6D	2008

Footnotes:

- (c): Value is based on a Cancer endpoint
(nc): Value is based on a Non-cancer endpoint

Sources:

- Region 9 PRGs are human health risk based screening criteria and are equivalent to a cancer risk of 1×10^{-6} or a Hazard Index of 1. Refer to: <http://www.epa.gov/Region9/waste/sfund/prg/index.htm>
- National Drinking Water Standards (MCLs) are legally enforceable standards that apply to public water systems. Refer to: <http://www.epa.gov/cgi-bin/epaprintonly.cgi>
- New York State Department of Environmental Conservation Water Quality Regulations (NYSDEC WQR) are the ARARs established in the ROD. Refer to: <http://www.dec.state.ny.us/website/regs/part703.html>

TABLE 4 - Comparison of Maximum Detected Concentrations of COPCs in Sediments With Respect to Screening Criteria (Region 9 Preliminary Remediation Goals - Residential)

COPC	Max. Detected Conc. (mg/kg)	Region 9 PRG - Residential (mg/kg)	Location	Date
Benzo(a)pyrene	0.059J	0.062 (c)	SD-E	2008
Pyrene	0.059J	2300 (nc)	SD-E	2008
Indeno(1,2,3-cd)pyrene	0.030J	0.62 (c)	SD-E	2008
Fluoranthene	0.1J	2300 (nc)	SD-E	2008
Chrysene	0.051J	62 (c)	SD-E	2008
Dibenzo(a,h)anthracene	0.0J	0.062 (c)	SD-G	2008
Benzo(a)anthracene	0.052J	0.62 (c)	SD-E	2008
Anthracene	0.01J	22000 (nc)	SD-B	2008
Benzo(b)fluoranthene	0.051J	0.62 (c)	SD-E	2008
Benzo(k)fluoranthene	0.032J	6.2 (c)	SD-E	2008
DDT	0.006J	1.7 (c)	SD-G	2008
4,4-DDE	0.0098J	1.7 (c)	SD-G	2008

Footnotes:

- (c): Value is based on a Cancer endpoint
- (nc): Value is based on a Non-cancer endpoint
- J: Estimated value

Source:

Region 9 PRGs are human health risk based screening criteria and are equivalent to a cancer risk of 1×10^{-6} or a hazard index of 1.
Refer to: <http://www.epa.gov/Region9/waste/sfund/prg/index.htm>

TABLE 5 - Comparison of Maximum Detected Concentrations of COPCs in Monitoring Wells With Respect to Vapor Intrusion Screening Criteria

COPC	Maximum Detected Concentration (µg/l)	Vapor Intrusion Screening Value (µg/l)	Vapor Intrusion Screening Value (µg/l)
		Cancer Risk = $1 * 10^{-6}$ Non-cancer hazard = 0.1	Cancer Risk = $1 * 10^{-4}$ Non-cancer hazard = 1
Chloroethane	0.27	2800 (nc)	28000 (nc)
1,1-DCE	4.4	19 (nc)	190 (nc)
1,1-DCA	2	220 (nc)	2200 (nc)
2-Butanone	5	44000 (nc)	440000 (nc)
PCE	0.96	110 (c)	1.1 (c)
Chlorobenzene	0.1	39 (nc)	390 (nc)
Benzene	1.8	1.4 (c)	140 (c)
1,1,1-TCA	6	310 (nc)	3100 (nc)
Toluene	1	150 (nc)	1500 (nc)

Footnotes:

(c): Value is based on a Cancer endpoint

(nc): Value is based on a Non-cancer endpoint

Source:

Vapor Intrusion Screening Values are used for screening purposes. Refer to: <http://www.epa.gov/correctiveaction/eis/vapor.htm>

TABLE 6: Other Comments on Operations, Maintenance, Monitoring and Institutional Controls

<u>Comment</u>	<u>Suggestions</u>
<p>The May 2010 O&M SAMP Report includes maps of the overburden and bedrock aquifers which need to be recontoured to correct data plotting errors. With respect to the bedrock aquifer, recontouring now shows that the deep groundwater flow is from east to west indicating that the new bedrock-drilled domestic wells are directly downgradient from the landfill.</p>	<p>Notify PRP to recontour the two aquifer maps, according to the groundwater elevation data collected.</p>
<p>During the May 2011 Site Inspection, numerous dead trees were observed around the western side of the fence which could impact the integrity of the fence.</p>	<p>The PRP's contractor removed these trees in July 2011.</p>

TABLE 7: Issues, Recommendations and Follow-Up Actions

<u>Issue</u>	<u>Recommendations and Follow-Up Actions</u>	<u>Party Responsible</u>	<u>Over-sight Agency</u>	<u>Milestone Date</u>	<u>Affects Protectiveness (Y/N)</u>	
					<u>Current</u>	<u>Future</u>
New residential development is observed in the Site area. Home sites are located adjacent to and across Penaluna Road from the landfill. Domestic wells are the only drinking water source and are being installed in the deep bedrock and tested after installation. Site contaminants may have an impact on the water quality in these new wells, especially if the homeowners pump substantial amounts of groundwater on a regular basis.	During the next five-quarter O&M monitoring event, require the sampling of the residential wells downgradient of the landfill for Site constituents to ensure that the drinking water from these wells remains potable.	PRP	EPA	June 30, 2012	N	Y