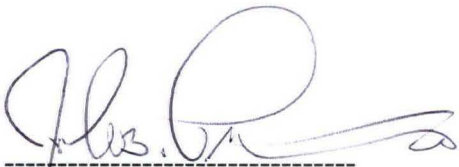


**FOURTH FIVE-YEAR REVIEW REPORT FOR
SAYREVILLE LANDFILL SUPERFUND SITE
MIDDLESEX COUNTY, NEW JERSEY**



Prepared by

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Date

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LIST OF ABBREVIATIONS & ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
CEA	Classification Exemption Area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIC	Community Involvement Coordinator
CFR	Code of Federal Regulations
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Difference+
FYR	Five-Year Review
GWQS	Groundwater Quality Standards
ICs	Institutional Controls
IRIS	Integrated Risk Information System
MCLs	Maximum Contaminant Level
MW	Monitoring Well
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NJDEP	New Jersey Department of Environmental Protection
NJDEPE	New Jersey Department of Environmental Protection and Energy
NJWQS	New Jersey Water Quality Standards
NPL	National Priorities List
OU	Operable Unit
O&M	Operation and Maintenance
PRP	Potentially Responsible Party
RAO	Remedial Action Objectives
ROD	Record of Decision
RP	Responsible Party
RPM	Remedial Project Manager
SVOCs	Semi-Volatile Organic Compounds
TBC	To be considered
UU/UE	Unlimited Use/Unrestricted Use
VOCs	Volatile Organic Compounds

I. INTRODUCTION

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP) (40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the fourth FYR for the Sayreville Landfill Superfund Site (Site). The triggering action for this statutory review is the date of the third FYR, February 28, 2012. The FYR has been prepared due to the fact that hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of two operable units (OUs) which will be addressed in this FYR. The OU1 remedy addresses control of contamination within the landfill which includes drum removal, the cap, gas management, fencing and deed restrictions. The OU2 remedy is “No Action” for sediments and surface water, and “No Action with Monitoring” for groundwater.

The Sayreville Landfill Superfund Site Five-Year Review was led by Diane Salkie of the US EPA. Other EPA participants included Kathryn Flynn (hydrogeologist), Marian Olsen (human health risk assessor), Mindy Pensak (ecological risk assessor) and Pat Seppi (community involvement coordinator). Non-EPA participants were Gwen Zervas from New Jersey Department of Environmental Protection (NJDEP) and Dominick DeAngelis of Integral Consulting Inc. representing the responsible parties. The review began on 5/25/2016.

Site Background

The 30 acre Sayreville Landfill Superfund Site is located in a moderately industrial section of the Borough of Sayreville in Middlesex County, New Jersey. Several small industries surround the Site to the north, east and south. The South River, which flows north, is a major tributary to the Raritan River and forms the western border of the Site. It is designated as a salt water estuary in the vicinity of the Site. The river waters adjacent to the Site are designated for both primary and secondary contact recreations. Pond Creek forms a portion of the Site boundary to the north and northwest, and Duck Creek on the south and southwest. These waters are classified by the NJDEP as fresh water Non-Trout. The Site is partially located within the tidal wetlands of the river with drainage swales along the western part of the property.

Of the 30 acres of land, approximately 20 acres were used for wastefill and contain buried wastes. The wastefill area rises above the natural grade by approximately 8-10 feet and is covered with low-lying vegetation and marsh grasses and is bordered by small surface streams. The eastern section of the Site, near Jernee Mill Road, contains clusters of hardwood trees. The nearest residential developments are located 1/2 mile to the north and 1/4 mile to the west across the South River.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Sayreville Landfill		
EPA ID: NJD980505754		
Region: 2	State: NJ	City/County: Borough of Sayreville, Middlesex County
SITE STATUS		
NPL Status: Deleted		
Multiple OUs? Yes	Has the site achieved construction completion? Yes	
REVIEW STATUS		
Lead agency: State <i>[If "Other Federal Agency", enter Agency name]:</i>		
Author name (Federal or State Project Manager): Diane Salkie		
Author affiliation: EPA		
Review period: 5/25/2016 - 1/24/2017		
Date of site inspection: 6/8/2016		
Type of review: Statutory		
Review number: 4		
Triggering action date: 2/28/2012		
Due date (five years after triggering action date): 2/28/2017		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

In April 1981, the New Jersey Division of Criminal Justice performed a magnetometer survey on a portion of the landfill alleged to contain buried hazardous waste materials. Based on the survey results, an estimated 30 drums were excavated from the western peninsula of the wastefill area. Analytical results from the drums detected various hazardous compounds, including pentachlorophenol, para-ethyl toluene, chloroform, methyl bromide, as well as pesticides and acids.

Groundwater was found to be contaminated with volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals and pesticides. To control the emissions, 22 passive vents were

installed within the landfill. In 1999, 13 soil gas monitoring probes were installed around the perimeter of the landfill. Since its installation, methane has been consistently elevated in soil gas probe P-6A located at the edge of the Site in the wetlands area. Surface water samples from Duck and Pond Creeks were found to be contaminated with lead, cadmium and ammonia above the fresh water New Jersey Water Quality Standards (NJWQS). Sediment samples from Duck and Pond Creeks and the South River revealed metals and 4,4'-DDD (Dichlorodiphenyldichloroethane) above the criteria.

The results of a Baseline Human Health Risk Assessment indicated that there was risk from dermal direct contact with pesticides for industrial workers from exposure to dieldrin; unacceptable risks were also found for future on-site residents ingesting shallow groundwater. In groundwater, the risk was from consumption of metals such as arsenic, aluminum, iron, cadmium, lead, magnesium, chromium (total), nickel and thallium as well as VOCs and SVOCs including: chloroethane, benzene, methylene chloride, 1,2-dichloroethane and chlorobenzene. An Ecological Assessment indicated that the surface water and sediment contaminants were identified at concentrations in exceedance of screening values. However, the results of the assessment indicated that it could not be determined that the Site is the source of contaminants identified in Duck Creek, Pond Creek and the South River due to the presence of many industries both upstream and downstream of the Site.

Response Actions

On September 28, 1990, EPA issued a Record of Decision (ROD) with the following remedial action objectives (RAOs): prevent direct contact with landfill soils and buried drums and minimize surface water runoff which contributes to landfill erosion; minimize migration of soil and drum content contaminants into groundwater, surrounding surface waters and stream sediments; and identify potential releases of contaminants to groundwater, surface waters and sediments. The ROD selected a final remedial action plan for the landfill operable unit 1 (OU1), which included:

- fencing of the Site to restrict access and the establishment of deed restrictions;
- capping of the wastefill with an NJDEP Solid Waste Cap to prevent infiltration and any potential releases of hazardous waste to groundwater and surface waters;
- construction of an access road and storm water and passive gas management systems;
- removal and off-site thermal treatment of buried drums containing hazardous wastes;
- constructing passive gas collection and surface runoff control systems at the landfill;
- intensive groundwater, surface waters, stream sediments and air sampling and monitoring; and
- the installation of additional groundwater monitoring wells within the deep Farrington aquifer

On June 30, 1997, EPA issued an Explanation of Significant Differences (ESD) which modified the original cleanup selected in the 1990 ROD. The ESD documented that EPA and NJDEP, after further review of the circumstances surrounding the Site, including additional monitoring data, determined that installation of an additional deep well into the Farrington Sand aquifer was not necessary.

On September 23, 1998, the NJDEP, in consultation with EPA, issued a ROD for off-site sediments, surface water, and groundwater (OU2). This ROD selected as the remedy, "No Further Action" for surface water and sediments, and "No Further Action with Monitoring" for groundwater. The major components of the selected remedy included:

- monitoring of the wells surrounding the landfill to verify the effectiveness of the landfill cap to ensure that the landfill is not contaminating the ground water;
- implementation of a Deed Notice to prevent any intrusive activities into the landfill cap; and
- implementation of a Classification Exception Area (CEA) for the shallow aquifer in the vicinity of the Site.

Status of Implementation

The final remedial design for OU1 was approved in February 1996. Actual on-site construction began on June 30, 1997, and was substantially completed by July 1998. A preliminary closeout report was issued by EPA on September 28, 1998. O'Brien and Gere Engineers certified final construction completion in June 1999 and EPA approved the remedial action report on September 30, 1999. The remedial action report contains detailed information on the construction of the remedy for OU1.

Fencing was installed extending several hundred feet along Jernee Mill Road in both directions from the entrance gate. At both ends, the fence then turns westward towards the South River and proceeds approximately halfway to the river, preventing access to the landfill from other than wetlands areas. "No Trespassing" signs have also been posted around the perimeter of the landfill.

In March 2003, O'Brien and Gere Engineers provided the NJDEP with information that was placed in the State's CEA database, which identifies what areas of the Site have groundwater contamination in excess of NJWQS. The CEA was established by NJDEP on June 14, 2007. A deed notice for the landfill property was signed by the Borough of Sayreville on July 26, 2010 and was recorded by Middlesex County on August 10, 2010.

Specific to the OU2 groundwater monitoring requirement, selected wells were chosen in each unit to be monitored on a semi-annual (twice a year) basis for a five-year period, from 1999 until 2004, then on an annual basis from 2005 to 2010. From 2008–2010, a review of groundwater data and on-site gas monitoring data was performed and a revision to the operation and maintenance (O&M) plan was submitted to NJDEP. In 2011, EPA and NJDEP approved a revision to the 2009 O&M plan which altered conducting annual groundwater sampling and to a sampling frequency of once every five years from a select number of monitoring wells. Annual reports for inspections and gas monitoring continue to be a Site requirement.

In 2011, EPA, with the concurrence of NJDEP, determined that all appropriate fund-financed responses under CERCLA have been implemented, other than operation, maintenance, monitoring and FYRs, and no further action by responsible parties is appropriate. The Notice of Intent to Delete was published in the Federal Register on August 15, 2011 and the Site was deleted from the National Priorities List on September 29, 2011.

Institutional Control (IC) Summary

Table 1: Summary of Planned and/or Implemented ICs

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Soil	Yes	Yes	Landfill cap	Restrict damage to landfill cap	Deed Notice August 10, 2010
Groundwater	Yes	Yes	Landfill	Restrict installation of groundwater wells and groundwater use	CEA June 14, 2007

Systems Operations/Operation & Maintenance

In 2011, based on the latest groundwater report, EPA and NJDEP approved the 2009 revised O&M Plan with the following modifications to the sampling and analysis plan: 1) A reduction in the groundwater monitoring frequency to one round per five years. 2) Monitoring of the deep water bearing zone (monitoring well (MW)-1D, MW-14, and MW-15) was discontinued since it is not part of the CEA, and investigations and monitoring have demonstrated that no contamination related to the landfill has impacted the deep water zone. 3) SVOCs were not detected in the groundwater and were removed from the list of target analytes. 4) Based on the CEA constituents and recent analytical results, the list of target organic analytes has been reduced to the following VOCs: benzene, chlorobenzene and chloroethane. 5) Based on the CEA constituents and recent analytical results, the list of target inorganic analytes was reduced to the following: arsenic, chromium, lead, nickel and thallium since all other detected inorganic constituents (iron, manganese, and sodium) that exceed the NJGWQS reflect regional background conditions. 6) A low-flow purging and sampling methodology in general conformance with the NJDEP Field Sampling Procedures Manual (2005) should continue to be used to obtain a more accurate representation of actual groundwater quality in the monitored water bearing zones. The latest groundwater data was presented in the CME Associates, groundwater monitoring report, dated March 2016.

Biannually, the landfill gas is monitored from four probes, GMP-6A, GMP-6, GMP-7 and GMP-8 for concentrations of methane (% lower explosive limit (LEL)), carbon dioxide and oxygen and reported in annual O&M inspection and monitoring reports. Site inspections are performed quarterly, with the findings recorded in the inspection and maintenance logs. The contractor generally cuts the grass twice a year, and performs any necessary repairs to the liners and/or the soil gas monitoring probes. Damage to the surface soil above the cap is also inspected and repaired as necessary. The contractor is also responsible for maintaining the integrity of the fence.

Potential Site impacts from climate change have been assessed, and the performance of the remedy is currently not at risk due to the expected effects of climate change in the region and near the Site.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the last FYR as well as the recommendations from the last FYR and the current status of those recommendations.

Table 2: Protectiveness Determinations/Statements from the 2012 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Protective	The remedy at OU1 is protective of human health and the environment because wastes have been consolidated and capped. A deed restriction and a CEA prevent unacceptable use of landfill and associated groundwater.
2	Protective	The remedy at OU2 protects human health and the environment because groundwater concentrations downgradient of the landfill have attenuated below Federal and State groundwater standards and a CEA prevents use of groundwater in the vicinity of the landfill.
Sitewide	Protective	There are no exposure pathways that could result in unacceptable risks and none are expected as long as the Site use does not change and the engineered and access controls currently in place continue to be properly operated, monitored, and maintained. The implemented actions (OU-1 and OU-2) taken at the Sayreville Landfill Superfund Site protect human health and the environment.

The 2012 FYR report did not identify any issue or recommend any action at the Site needed to protect public health and/or the environment that is not addressed by the remedy selected in the Site decision documents.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

On November 14, 2016, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies at 38 Superfund sites in New York and New Jersey, including the Sayreville Landfill Site. The announcement can be found at the following web address:

https://www.epa.gov/sites/production/files/2016-11/documents/five_year_reviews_fy2017_final.pdf.

In addition to this notification, efforts will be made to reach out to local public officials to inform them of the results. The EPA Community Involvement Coordinator (CIC) for the Site, Pat Seppi, arranged for a notice to be posted on the township website, as well as the EPA website,

<https://www.epa.gov/superfund/sayreville-landfill> . This notice indicated that a FYR would be conducted at the Sayreville Landfill Site to ensure that the Site is protective of human health and the environment. Once the FYR is completed, the results will be made available at the following repository: Sayreville Public Free Library at 1050 Washington Road, Parlin, New Jersey 08859. In addition, the final report will be posted on the following website,

<https://www.epa.gov/superfund/sayreville-landfill>.

Data Review

Groundwater Data Review

Since the previous FYR, groundwater monitoring wells were sampled once in December 2015. The analytes were limited to arsenic, chromium, lead, nickel, sodium, thallium, benzene, chlorobenzene, and chloroethane. The applicable or relevant and appropriate requirements (ARARs) for the groundwater at the Site are the EPA Safe Drinking Water Act Maximum Contaminant Levels (MCLs) and NJGWQSs. The ARARs for all analytes measured in 2015 are the NJGWQS.

Monitoring wells MW-8, MW-11, and P-5 are located within the landfill boundary and screened in the perched water-bearing zone. Groundwater flows to the southeast in the perched water zone. The 2015 sampling results demonstrate that chromium, nickel and thallium are either non-detect or below the standard in the three wells. Arsenic was measured above the standard at MW-11 and lead was above the standard at MW-8. Benzene and chlorobenzene have decreased significantly since their maximum concentrations at these wells, but benzene remains above the standard at all three perched wells and chlorobenzene is elevated above the standard at P-5. Chloroethane exceeded the ARAR at MW-8 and P-5. Sodium has increased at MW-8 since 2010, from 31,000 micro grams per liter ($\mu\text{g/L}$) to 242,000 $\mu\text{g/L}$ which is closer to levels found in the other two perched wells: MW-11 at 181,000 $\mu\text{g/L}$ and P-5 at 159,000 $\mu\text{g/L}$. However, this Site is located in a tidal, salt water estuary environment and sodium is not a contaminant of concern. See Table 3.

In the shallow aquifer, wells P-1, MW-3, MW-5S and MW-6S have also shown declining concentrations of contaminants. All organic compounds were found to be below the NJGWQS and MCLs. Metals have declined at all of these wells from their maximum concentrations, but have been stable since 2010. In 2015, arsenic was above the standard at MW-5S and MW-6S, but not detected at MW-3 and P-1. Lead only exceeded the standard at P-1. Chromium, nickel, and thallium were below their standards at all wells. According to the OU1 ROD, the shallow aquifer appears to be in hydraulic communication with the salt water of the South River, therefore all shallow wells demonstrate elevated sodium concentrations. See Table 4.

The general trend of groundwater data at the Site is that metals and VOCs are declining or stable, except for chloroethane at MW-8 located within the landfill.

Landfill Gas Monitoring

As stated earlier in the report, since its installation in 1999, sampling port at vent P-6A has contained elevated methane levels. A forensic evaluation of methane gas was conducted and concluded that the detected concentrations of methane in samples collected from soil gas probe P-6A and landfill vent LV-15, in conjunction with presence of some trace non-methanogenic volatile chemicals, are consistent with a biogenically-derived gas. They suggest that the most likely source of methane is from historical landfill activities in that area of the landfill.

In the 2015 annual landfill gas monitoring, in order to evaluate the extent of methane emissions from probe 6A, three additional, temporary gas probes were installed and sampled 25 feet from probe 6A in each lateral direction. This report indicates that methane is still at 100% LEL and 25.7% methane in gas probe 6A, but was found to be 0 in all other probes, including the three new temporary probes. As can be seen on Table 5, gas probe 6A has still shows methane, however, the percent levels have been

declining. The sampling indicated that the high methane levels are confined to the vent P-6A area and this probe and its trends will continue to be sampled and analyzed.

Site Inspection

The inspection of the Site was conducted on 6/8/2016. In attendance from the regulatory agencies were the EPA Remedial Project Manager (RPM), Diane Salkie, NJDEP case manager, Gwen Zervas, EPA hydrogeologist, Kathryn Flynn. In attendance from the responsible parties were Dom DeAngelis, the project Administrator for Responsible Party (RP) Site Committee, Rainer Domalski, the RP for Rutgers Organics Corp., Wayne Kronowski, Chief Financial Officer, Borough of Sayreville, Tim Gillen of CME Associates, the O&M consultant and Behram Turan, CME Associates, the LSRP consultant. The purpose of the inspection was to assess the protectiveness of the remedy.

During the FYR process, interviews were conducted to document any perceived problems or successes with the remedy that has been implemented to date. The results of these interviews are summarized below.

During the June 08, 2016 Site visit, EPA and NJDEP discussed the current Site conditions and future redevelopment with the responsible party's contractor, Dominick DeAngelis of Integral Consulting Inc. In addition, the monitoring wells were located and inspected. It was found that the wells were difficult to locate, missing locks and the outer casing of one well, MW 5S, was damaged. It was agreed during the inspection, that the consultants would mark out the well locations, lock each of them and repair the damaged casing. On August 08, 2016, photo-documentation was provided by the consultant showing each well marked out, locked and repaired. EPA and NJDEP found this repair to satisfactorily address the issue.

EPA and NJDEP also discussed the status of redevelopment of the Site by Middlesex Energy Center, LLC (Middlesex Energy). There is currently a proposal by Middlesex Energy to construct a natural gas fueled electric generating plant on a part of the Site property. The plant would be constructed on property located in between the landfill cap and Jernee Mill Road. Therefore, the construction would not impact the cap aside from 3 acres of land that would hold an access road. An application for major sanitary landfill disruption was approved by EPA and NJDEP for this parcel of land. During the interview and walk through, the areas where construction would occur were located and discussed.

V. TECHNICAL ASSESSMENT

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

The 1990 OU1 ROD RAOs called for interrupting direct contact with the landfill soils and buried drums and minimizing surface water runoff that contributes to landfill erosion; minimizing of migration of soil and drum content contaminants into groundwater surrounding surface waters and stream sediments; and identifying potential releases of contaminants to groundwater, surface waters and sediments. The subsequent 1998 ROD called for no action ROD with monitoring for the groundwater in the vicinity of the landfill and no further action for the surface water and sediments in the vicinity of the landfill.

The OU1 remedial construction activities included placement of a 25-acre composite cap system and installation of a passive landfill gas venting system. Fencing was installed extending several hundred

feet along Jernee Mill Road in both directions from the entrance gate. The fencing and cap are still in place and in good condition. The landfill gas is monitored annually for concentrations of methane, carbon dioxide and oxygen and levels, with the exception of probe P-6A, continue to be below LEL and health based levels. Elevated levels in probe P-6A are localized and lines of evidence indicate they are a function of past landfill activities. This probe will continue to be monitored and evaluated for methane trends and any indicators of changed Site conditions.

The OU2 groundwater remedy for “No Further Action with Monitoring” began on a semi-annual basis from August 1999 to August 2004 and on an annual basis from August 2004 to November 2007 to evaluate the effectiveness of the remedy. Currently the groundwater is monitored every five years. A CEA for the shallow water bearing zones and a fact sheet was issued on June 14, 2007, listing arsenic, chromium, sodium, and nickel for metals, and benzene and chlorobenzene for VOCs, as the applicable CEA constituents. The combination of declining concentrations, establishment of the cap and the CEA have interrupted potential exposures to the groundwater at the Site.

In accordance with the September 28, 1990 OU1 ROD supplemented by the September 23, 1998 OU2 ROD, the Borough of Sayreville, the property owner, agreed to subject a portion of the property to certain statutory and regulatory requirements which impose restrictions upon the use and reuse of the property and to provide notice to subsequent owners, lessees and operators of the restrictions and the monitoring, maintenance, and certification requirements. A deed notice was signed by the Borough of Sayreville on July 26, 2010 and was recorded by Middlesex County on August 10, 2010.

The selected remedy for OU2 is functioning as intended by the 1998 ROD. Monitoring is performed every five years at selected perched and shallow groundwater wells. All site-related contamination remains localized within the landfill footprint.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

There have been no changes in the physical conditions of the Site since the last FYR that would change the protectiveness of the remedy. The landfill cap is maintained and serves as a barrier to potential exposures. Exposures to the Site are limited based on location within an industrial area, fencing over a portion of the Site to limit or prevent access, and signage. The ongoing procedures of inspecting the fence for damage and making repairs as appropriate continue to limit access to the Site.

Soil and groundwater use at the Site are not expected to change during the next five years and are consistent with the risk assessments used to support the decision e.g., industrial land use, and future off-site residential land use. During this FYR, it was noted that redevelopment of the property is under consideration. In the event that this redevelopment continues, future changes in the use of the property will be conducted in a manner that is protective and this change will be addressed in the next FYR.

Changes in Standards and TBCs

Groundwater monitoring data is evaluated against EPA and NJDEP for a subset of organic and inorganic contaminants. The EPA and NJDEP MCLs have not changed and remain protective.

Changes in Toxicity and Other Contaminant Characteristics

The toxicity values for one COC, thallium was updated since the last five years through the Provisional Peer-Reviewed Toxicity Value program at EPA. Other chemicals are being updated through the Integrated Risk Information System (IRIS), EPA's consensus toxicity system (e.g., arsenic, manganese, chromium valence state +6m nickel and cadmium) and will be considered in the next FYR. These changes in toxicity value for thallium do not affect the protectiveness of the remedy.

Changes in Risk Assessment Methods

There have been no changes in EPA's guidance for conducting Superfund risk assessments since the last FYR. Soil vapor intrusion was qualitatively evaluated based on groundwater concentrations. Although the vapor intrusion guidance was updated, the update does not change the overall conclusions from the previous FYR that if current landfill access controls, zoning and future deed restrictions change, analysis of vapor intrusion will be necessary based on the methane identified above.

Changes in Exposure Pathways

Since the last FYR exposure assumptions were updated with the release of the 2014 OSWER Directive # 9200.1-120. Updates included changes in exposure assumptions for bodyweight for the adult, skin surface area for the adult and child drinking water ingestion rate for the young child, and others. These changes do not change the conclusions of the risk assessment or the protectiveness of the remedy. Overall, based on the past remedial actions and ongoing monitoring at the Site, the remedy remains protective under the industrial scenario.

Although the ecological risk assessment screening and toxicity values used to support the 1990 and 1998 RODs may not necessarily reflect the current process, the landfill cap will eliminate any potential risk from surface soil contaminants to terrestrial receptors and will prevent infiltration and or releases to groundwater and surface water. While the ecological risk assessment conducted in 1989 identified surface water and sediment contaminants at concentrations in exceedance of screening values, it could not be determined that the Site was the source of contamination due to the presence of industries both upstream and downstream of the Site. Subsequent sampling of the surface water and sediment during the pre-design phase 1996 supported the risk assessment findings and remedy selected for the Site. Consequently, the exposure assumptions remain appropriate and thus the remedy remains protective of ecological resources.

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

No

VI. ISSUES/RECOMMENDATIONS

There are no issues/recommendations associated with the OU1 or OU2 remedies.

OTHER FINDINGS

The following are recommendations that were identified during the FYR, but do not affect current and/or future protectiveness:

- Groundwater elevations and contouring should be included in future groundwater monitoring reports to verify groundwater flow direction.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)		
<i>Operable Unit:</i> OU1	<i>Protectiveness Determination:</i> Protective	<i>Planned Addendum Completion Date:</i> Click here to enter a date
<i>Protectiveness Statement:</i> The remedy at OU1 is protective of human health and the environment.		
<i>Operable Unit:</i> OU2	<i>Protectiveness Determination:</i> Protective	<i>Planned Addendum Completion Date:</i> Click here to enter a date
<i>Protectiveness Statement:</i> The remedy at OU2 is protective of human health and the environment.		

Sitewide Protectiveness Statement	
<i>Protectiveness Determination:</i> Protective	<i>Planned Addendum Completion Date:</i> Click here to enter a date
<i>Protectiveness Statement:</i> The remedy for Sayreville Landfill is protective of human health and the environment.	

VIII. NEXT REVIEW

The next five-year review report for the Sayreville Landfill Superfund Site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

Consulting and Municipal Engineers. 2016. *Inspection and Monitoring Report Sayreville Landfill III*, Borough of Sayreville, Middlesex County, New Jersey, NJDEP PI No 134979. March

Consulting and Municipal Engineers. 2016. *Groundwater Monitoring Report Sayreville Landfill III*, Borough of Sayreville, Middlesex County, New Jersey, NJDEP PI No 134979. March

Consulting and Municipal Engineers. 2016. *Monitoring Well Repair Report*. August

TABLE 3: PEAK AND FIVE YEAR GROUNDWATER RESULT SUMMARY FOR PERCHED WELLS (µg/L)

Perched Water Bearing Zone	GWQS	MCLs	MW-8				MW-11				P-5			
			1986-2010	2007	2010	2015	1986-2010	2007	2010	2015	1993-2010	2007	2010	2015
Aluminum*	200	200**	2030	91	ND		830	100	ND		46,200	380	100	
Antimony	6	6	119	ND	ND		220	ND	ND		21.1	ND	ND	
^Arsenic	3	10	4.1	ND	ND	ND	5.9	ND	ND	5.90	20	ND	ND	ND
Barium	6000	2000	420	420	360		1400	860	1000		6600	660	580	
Beryllium	1	4	5	ND	ND		9	ND	ND		3.8	ND	ND	
Cadmium	4	5	6	ND	ND		7	ND	ND		4.1	ND	ND	
^Chromium	70	100	98	3.3	ND	3.93	36	3.6	ND	4.97	109	5	ND	4.38
Iron*	300	300**	180,000	86,000	55,000		154,700	54,000	39,000		292,000	39,000	30,000	
^Lead	5	15	8.9	ND	ND	5.09	7.4	ND	ND	1.75	100	5.9	6.7	3.15
Manganese*	50	50**	4000	390	270		896	140	130		1190	170	140	
^Nickel	100	---	64	7.1	ND	ND	82	14	ND	10.6	145	33	29	35.6
^Sodium*	50,000	---	48,300	17,000	31,000	242,000	140,000	130,000	140,000	181,000	200,000	200,000	190,000	159,000
^Thallium	2	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
^Chloroethane	5***	---	280	135	120	432	150	5.4	2.7	3.59	6600	44	33	20.1
^Benzene	1	5	10	5.2	5.6	2.68	170	32.2	10	3.74	13	6.76	9	7.16
^Chlorobenzene	50	100	34	28.2	27	15.6	31	27.1	20	16.5	66.2	47.9	52	54.2
Methylene chloride	3	5	15	0.38	ND		14	ND	ND		120	0.34	ND	
Toluene	600	1000	51	0.2	ND		140	ND	ND		1.5	ND	ND	
Ethylbenzene	700	700	46	0.28	ND		200	ND	ND		2.1	ND	ND	
Xylenes (Total)	1000	10,000	510	9.38	9.5		580	3.04	ND		80	0.36	ND	

GWQS- NJDEP Ground Water Quality Standards, July 2010; *** Interim Ground Water Quality Criteria

MCLs – National Primary Drinking Water Regulations, May 2009; ** National Secondary Drinking Water Regulations

* Aluminum, iron, manganese and sodium reflect regional background conditions and are not thought to be site-related.

Highlighted results are above the ARARs.

^ - Indicates compounds and analytes that are included in the updated O&M plan.

TABLE 4: PEAK AND FIVE YEAR GROUNDWATER SUMMARY FOR SHALLOW WELLS (µg/L)

Shallow Water Bearing Zone	GWQS	MCLs	MW-3				MW-5S				MW-6S			
			1986-2010	2007	2010	2015	1986-2010	2007	2010	2015	1986-2010	2007	2010	2015
Aluminum*	200	200**	800	160	320		914	ND	ND		300	210	ND	
Antimony	6	6	13.8	ND	ND		231	2.8	ND		203	2.8	ND	
^Arsenic	3	10	1.8	ND	ND	ND	47	5.6	31	28.4	13	ND	3.6	3.84
Barium	6000	2000	100	43	56		188	52	77		130	26	110	
Beryllium	1	4	0.2	ND	ND		13	ND	ND		10	ND	ND	
Cadmium	4	5	0.7	ND	ND		4	ND	2.7		19	ND	ND	
^Chromium	70	100	436	23	ND	3.70	390	27	ND	4.77	40	6	ND	3.05
Iron*	300	300**	5918	320	1100		195,000	46,000	87,000		227,000	36,000	110,000	
^Lead	5	15	24	ND	ND	1.15	6	ND	ND	1.69	2.3	ND	ND	1.56
Manganese*	50	50**	500	330	500		1500	990	480		530	62	210	
^Nickel	100	---	156	9.5	ND	4.37	490	49	ND	1.30	134	3.8	ND	ND
^Sodium*	50,000	---	93,000	67,000	93,000	158,000	2,000,000	1,700,000	1,600,000	1,610,000	480,000	54,000	320,000	287,000
^Thallium	2	2	4.5	ND	ND	ND	12	12	ND	ND	9.8	ND	ND	ND
^Chloroethane	5***	---	0.12	ND	ND	ND	ND	ND	ND	ND	10	ND	ND	1.12
^Benzene	1	5	0.15	ND	ND	ND	ND	ND	ND	ND	0.13	ND	ND	ND
^Chlorobenzene	50	100	ND	ND	ND	ND	ND	ND	ND	ND	0.66	ND	ND	ND
Methylene chloride	3	5	4.3	ND	ND		13	ND	ND		12	ND	ND	
Toluene	600	1000	0.64	ND	ND		0.31	ND	ND		0.36	ND	ND	
Ethylbenzene	700	700	ND	ND	ND		ND	ND	ND		ND	ND	ND	
Xylenes (Total)	1000	10,000	0.23	ND	ND		0.49	ND	ND		0.66	ND	ND	

GWQS- NJDEP Ground Water Quality Standards, July 2010; *** Interim Ground Water Quality Criteria

MCLs – National Primary Drinking Water Regulations, May 2009; ** National Secondary Drinking Water Regulations

* Aluminum, iron, manganese and sodium reflect regional background conditions and are not thought to be site-related

Highlighted results are above the ARARs.

^ - Indicates compounds and analytes that are included in the updated O&M plan.

TABLE 4: PEAK AND FIVE YEAR GROUNDWATER SUMMARY FOR SHALLOW WELLS (µg/L) (Continued)						
Shallow Water Bearing Zone	GWQS	MCLs	P-1			
			1993-2010	2007	2010	2015
Aluminum*	200	200**	30,000	900	320	
Antimony	6	6	14.9	3.1	ND	
^Arsenic	3	10	30	4.3	ND	ND
Barium	6000	2000	1900	1200	50	
Beryllium	1	4	2	ND	ND	
Cadmium	4	5	5.5	ND	ND	
^Chromium	70	100	70	ND	ND	ND
Iron*	300	300**	170,000	69,000	31,000	
^Lead	5	15	180	7.4	ND	16.4
Manganese*	50	50**	680	300	520	
^Nickel	100	---	40	2	ND	2.72
^Sodium*	50,000	---	57,100	24,000	540,000	443,000
^Thallium	2	2	7.8	ND	ND	ND
^Chloroethane	5***	---	0.67	0.26	ND	ND
^Benzene	1	5	15	0.21	1.3	ND
^Chlorobenzene	50	100	3.7	3.5	1.4	0.823
Methylene chloride	3	5	3	0.1	ND	
Toluene	600	1000	0.32	0.12	1.7	
Ethylbenzene	700	700	ND	ND	ND	
Xylenes (Total)	1000	10,000	1.2	0.82	ND	

GWQS- NJDEP Ground Water Quality Standards, July 2010; *** Interim Ground Water Quality Criteria

MCLs – National Primary Drinking Water Regulations, May 2009; ** National Secondary Drinking Water Regulations

* Aluminum, iron, manganese and sodium reflect regional background conditions and are not thought to be site-related

Highlighted results are above the ARARs.

^ - Indicates compounds and analytes that are included in the updated O&M plan.

TABLE 5: Percent Methane Levels in Landfill Gas Probes										
Probe Number	06/19/03	Peak 2003-2007	02/05/08	5/28/08	08/06/08	11/09/08	12/30/10	01/11/13	12/11/13	12/10/15
1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
2	9.3	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
3	28	0.3	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
4	15.6	0.2	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
5	9.7	22.1	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
6	0.3	1.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.0
6A	3.4	96.2	80.1	74.2	49	78.6	91	46.2	24.9	25.7
7	0.0	0.2	0.1	0.0	0.0	0.0	0.0	NS	NS	0.0
8	3.4	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.5	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS

NS- Not sampled, probe is no longer part of monitoring program.

FIGURE 1 Site Map

